



Project Number: U2716-092-191

December 28, 2020

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

**REFERENCE: Sunmodo Sunturf Ground Mount A2  
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, 2015 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 7-05)
- Design wind speed for occupancy category I structures: 115 mph
- Wind Importance Factor: 0.77
- Wind exposure: C
- Ground snow load: 30 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	2860	1.5	4290
LATERAL	1790	2	3580

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. The SunModo SunTurf Footings have been designed for most normal soil types located in Illinois and the safety factors associated allow for variance within soil samples. However, this report does not cover all soil samples and therefore independent soils testing may need to 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.

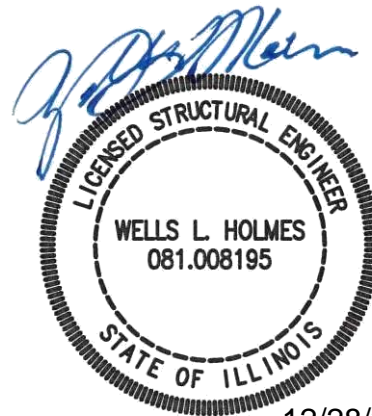
Very truly yours,

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Wells Holmes, P.E.  
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Project Engineer

Enclosures

WLH/stb



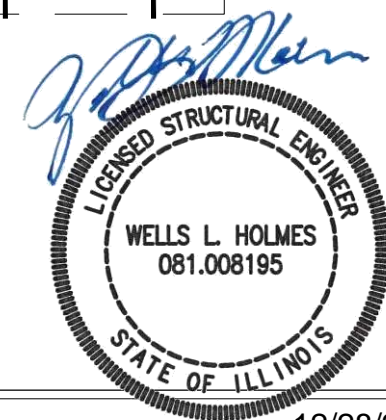
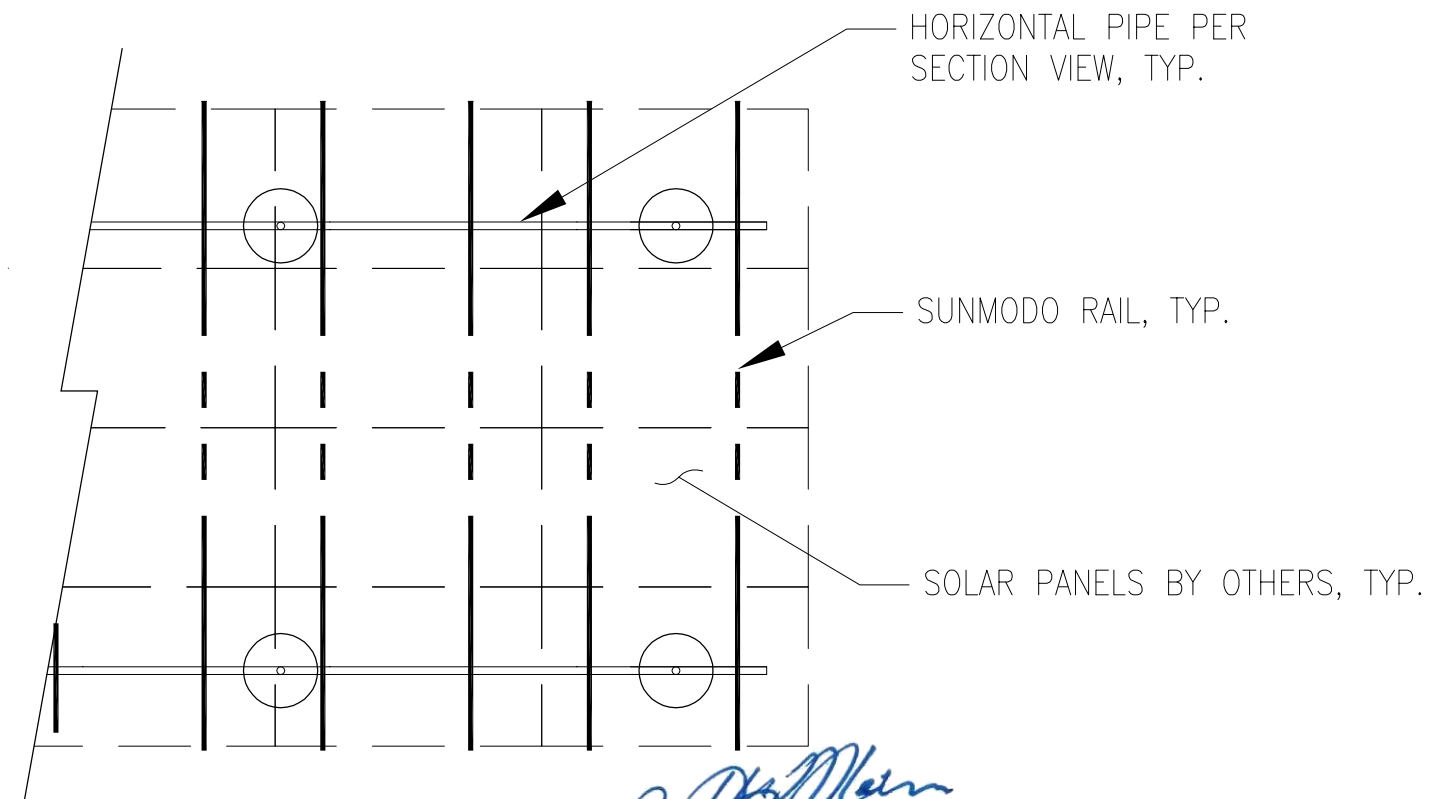
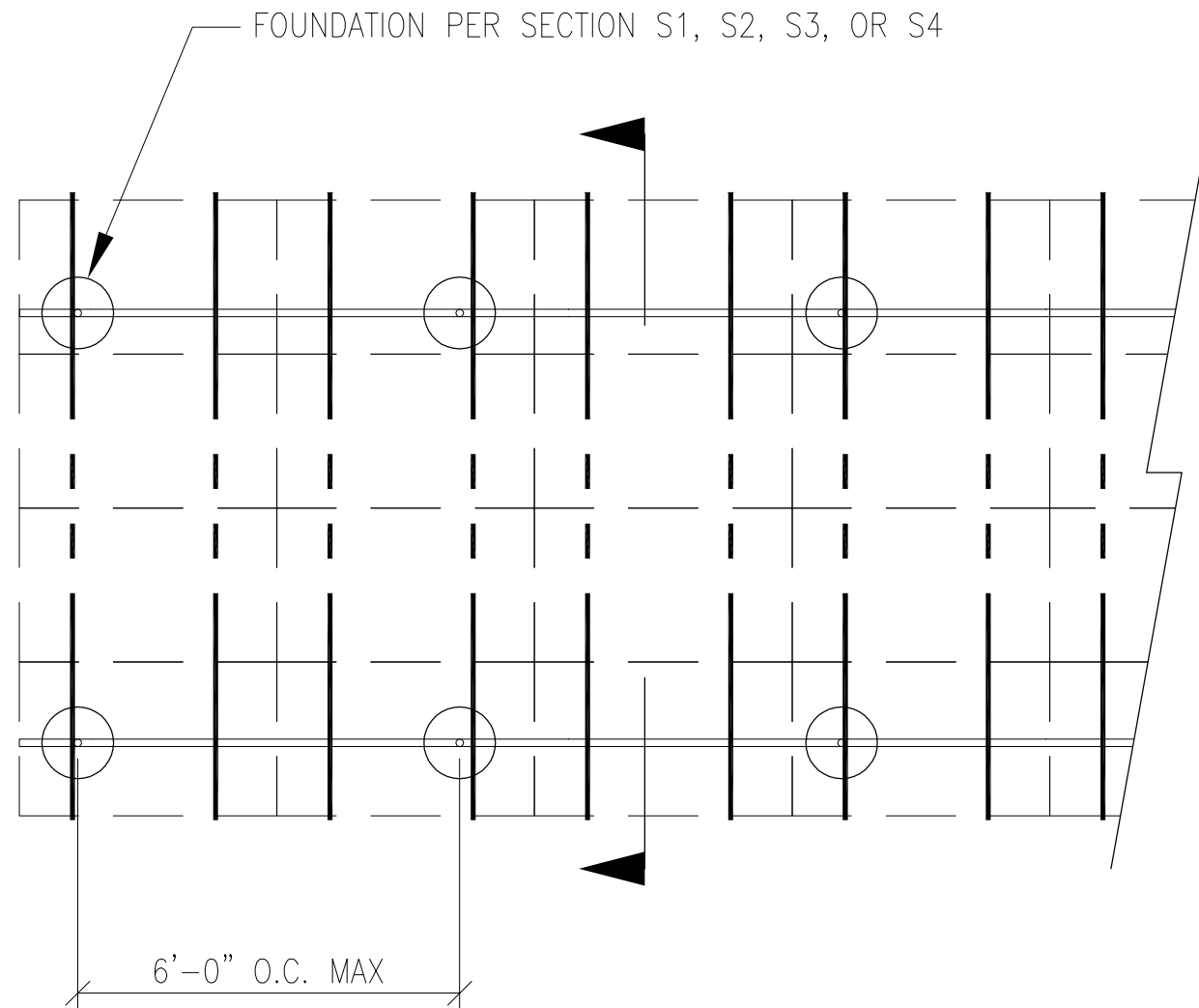
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JOB NO. U2716-092-191  
 PROJECT SUNMODO SUNTURF GROUND MOUNTS A2  
 SUBJECT ALL OPTIONS

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



**PV ARRAY PLAN**

N.T.S.

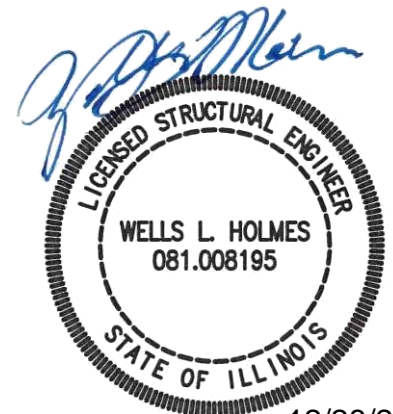
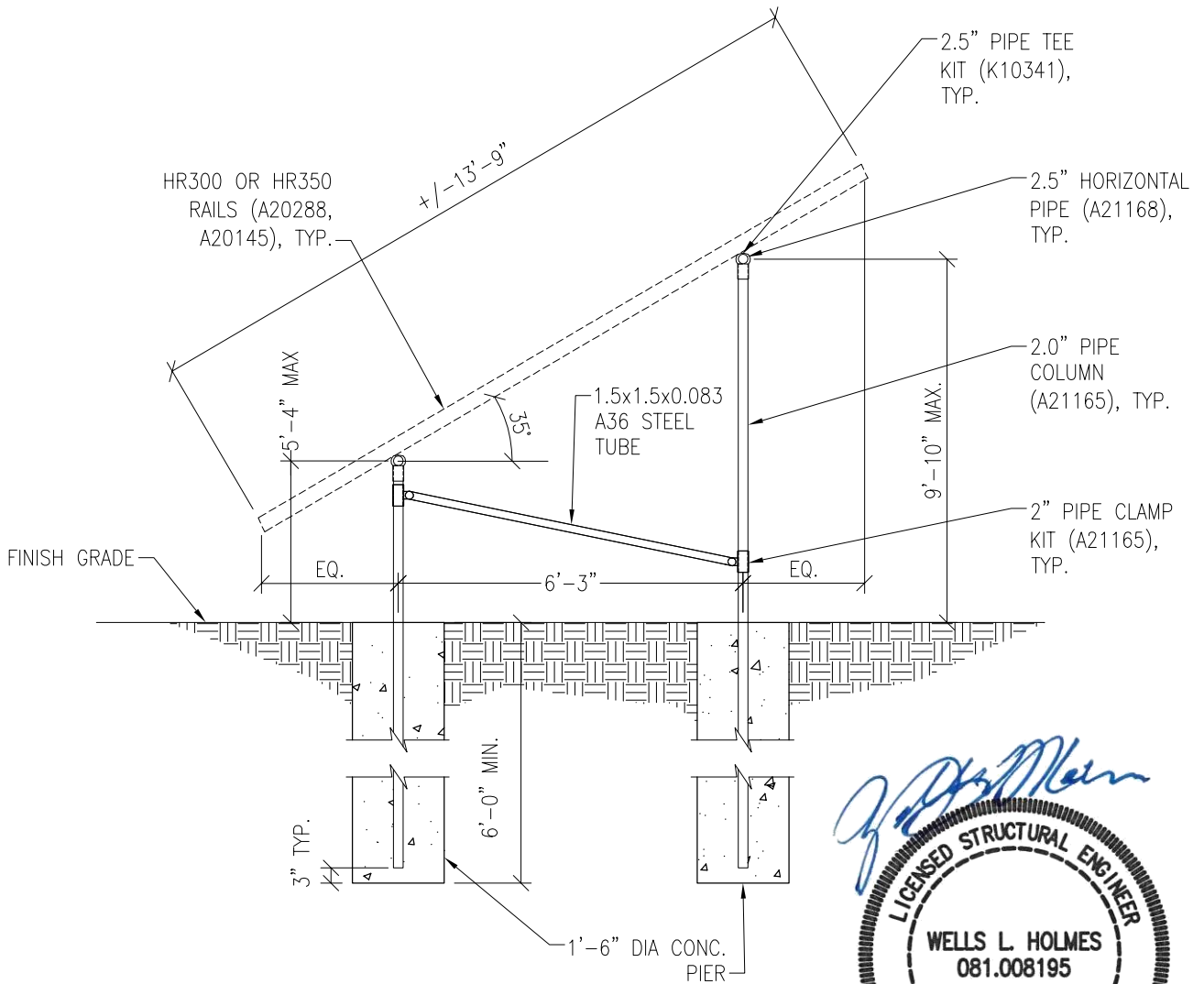
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**P1**

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A2

SUBJECT DRILLED PIER OPTION



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**PV ARRAY SECTION**

N.T.S.

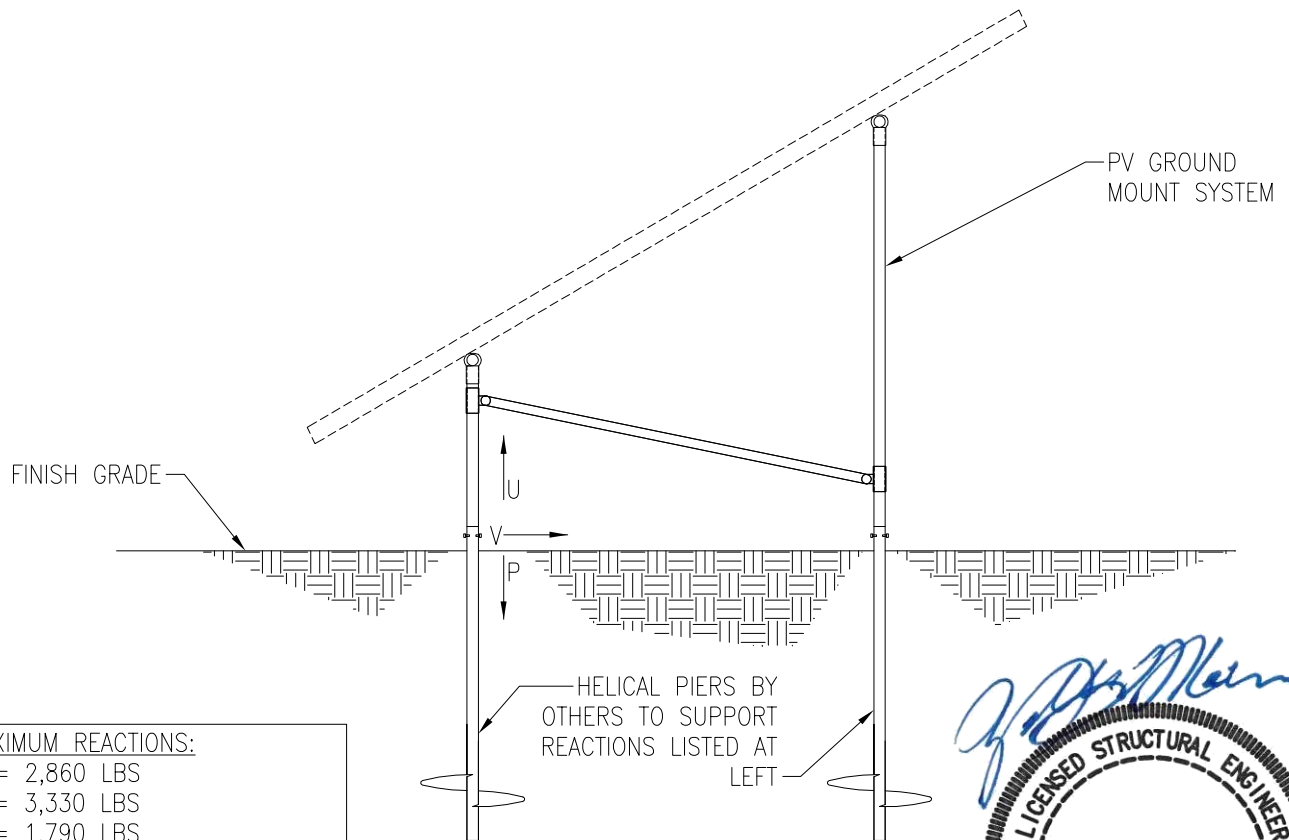
**S1**

PROJECT SUNMODO SUNTURF GROUND MOUNTS A2

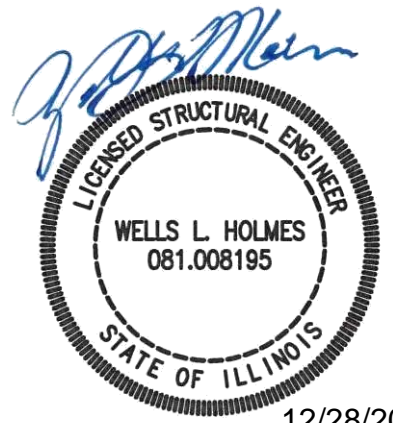
SUBJECT HELICAL PIER OPTION

**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 = 2,860 LBS  
 P = 3,330 LBS  
 V = 1,790 LBS



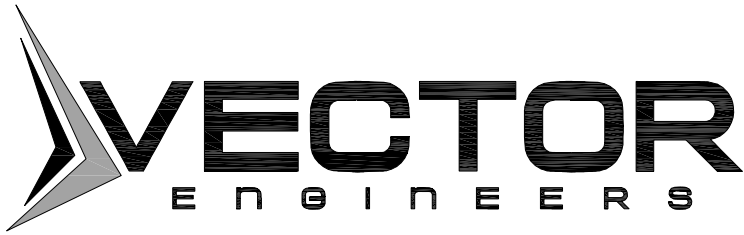
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**PV ARRAY SECTION**

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**S2**



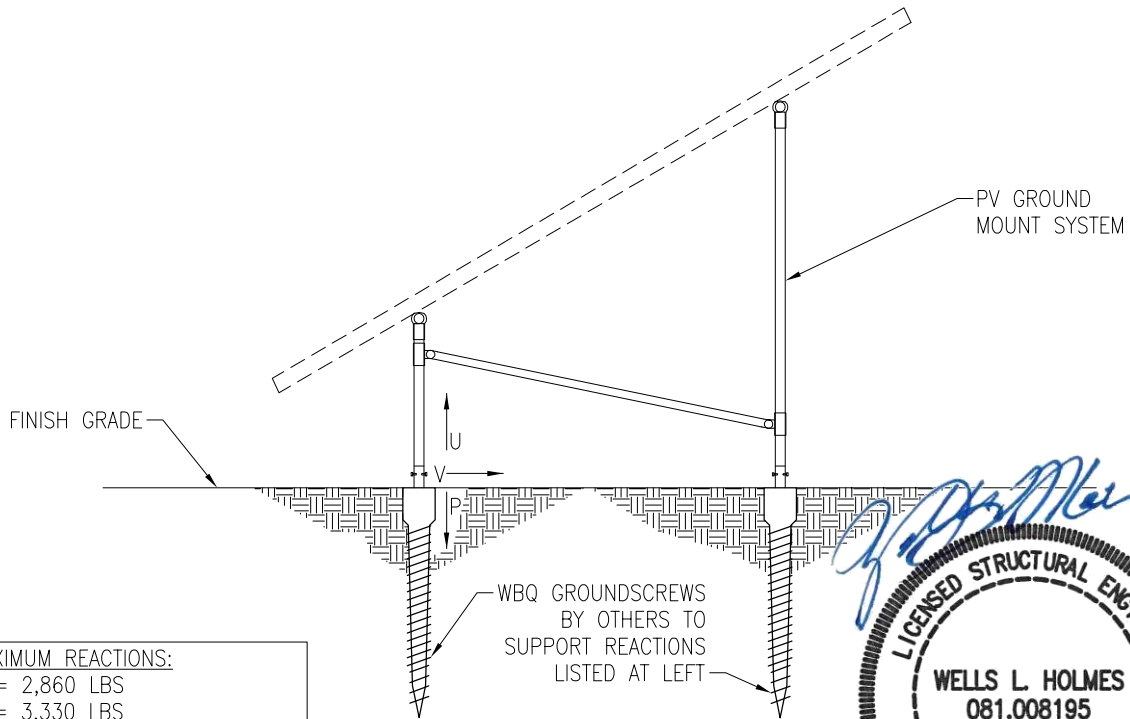
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PROJECT SUNMODO SUNTURF GROUND MOUNTS A2

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 = 2,860 LBS  
 P = 3,330 LBS  
 V = 1,790 LBS



**PV ARRAY SECTION** License Expires: 11-30-2022 **S3**  
 N.T.S.



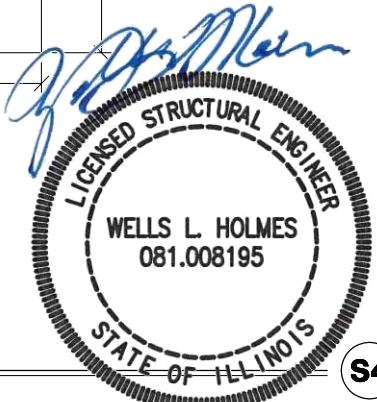
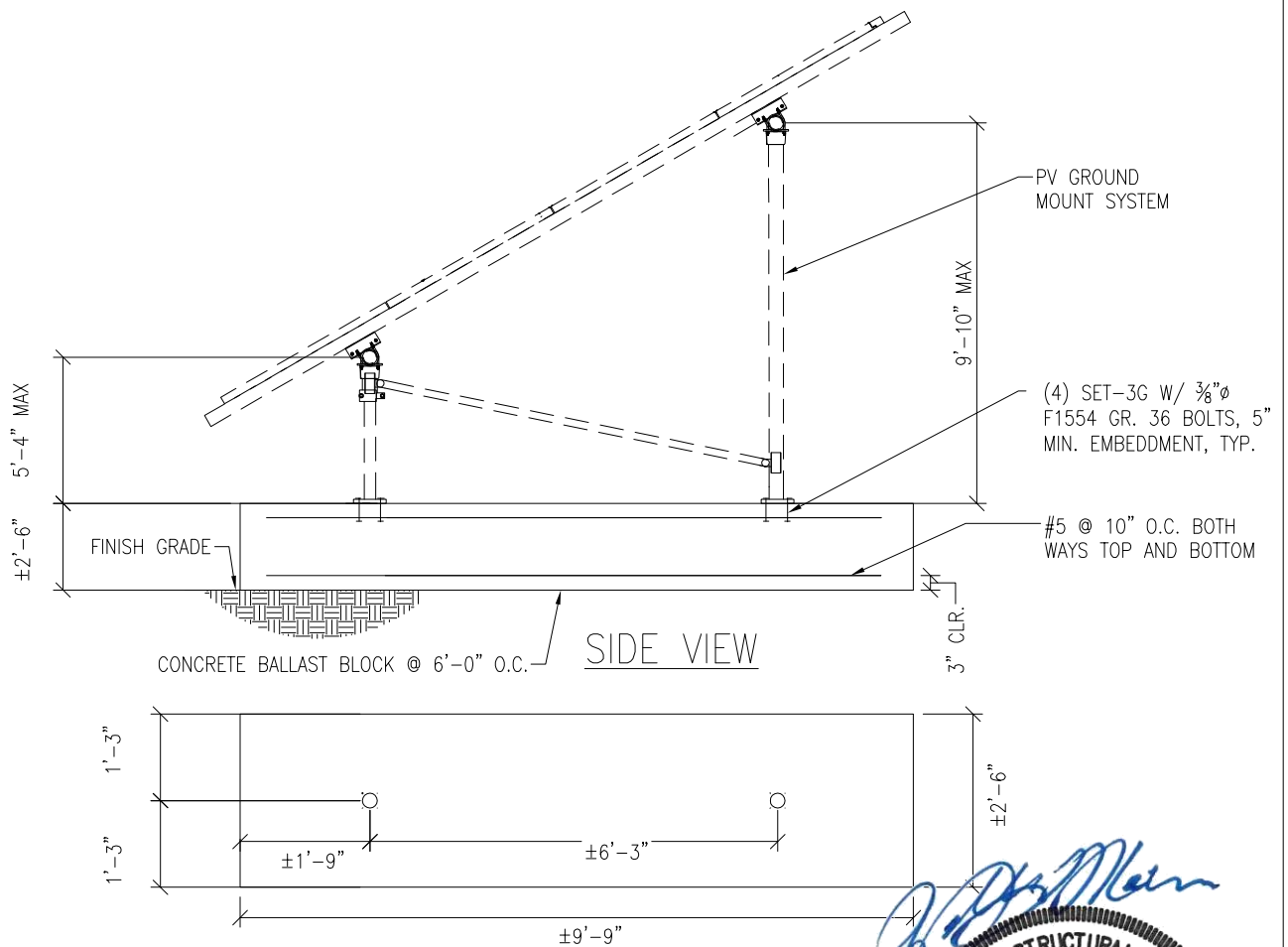
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PROJECT SUNMOD0 SUNTURF GROUND MOUNTS A2

SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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**PV ARRAY SECTION**

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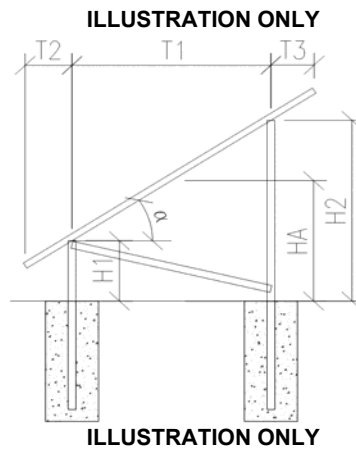
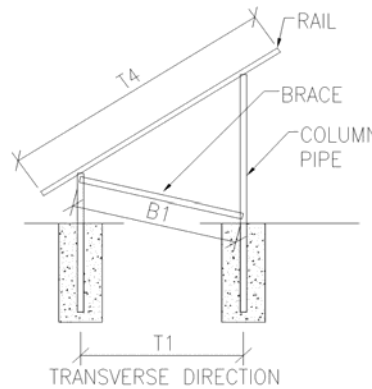
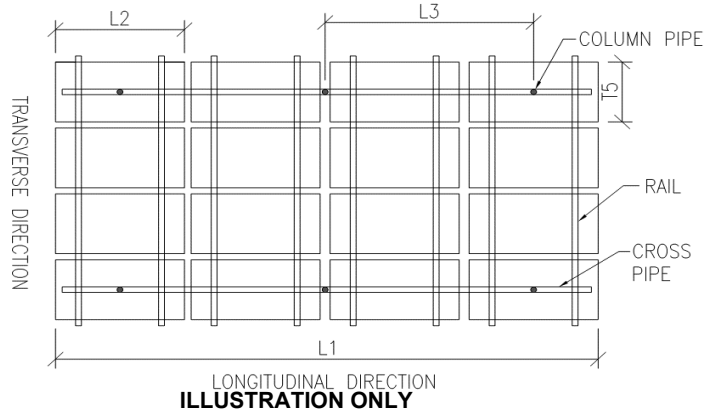
12/28/2020

PROJECT: A2 – Sunmodo Sunturf GM

SUBJECT: Dead Load

**Design Weight:**

Individual Panel Weight [lb]:	50.7
Panel Transverse Length (T5) [in]:	41.5
Panel Transverse Length (T5) [ft]:	3.5
Panel Longitudinal Length (L2) [in]:	81.4
Panel Longitudinal Length (L2) [ft]:	6.8
Individual Panel Area [ft <sup>2</sup> ]:	23.5
Individual Panel Weight [psf]:	2.2
# of Panels in Transverse Direction:	4
Approximate Transverse Length (T4) [ft]:	13.8
# of Panels in Longitudinal Direction:	12
Approximate Longitudinal Length (L1) [ft]:	81.4
Transverse Column Spacing (T1) [ft]:	6.3
Longitudinal Column Spacing (L3) [ft]:	6.0
# of Columns in Longitudinal Direction:	14
# of Columns in Transverse Direction:	2
Total Number of Columns:	28
Panel Slope from Horizontal (a) [°]:	35.0
Short Column Height (H1) [ft]:	5.4
Approximate Tall Column Height (H2) [ft]:	9.8
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]:	6.0
Tributary Area per Column [ft <sup>2</sup> ]:	41.5
Rail Weight [plf]:	1.0
Transverse Rail Weight per Column [lb]:	13.8
Longitudinal Rail Weight per Column [lb]:	21.9
Tall Column Weight [lb]:	35.8
Panel Weight per Column [lb]:	89.7
Rail Weight per Column [lb]:	13.8
Cross Pipe Weight per Column [lb]:	21.9
Brace Weight per Column [lb]:	16.4
<b>Total Weight per Column (1.0 D) [lb]:</b>	<b>177.7</b>



**Assumptions:**

- T2 = T3



JOB NO.: U2716-091-191

DESIGNED: STB

DATE: 07/25/19

PROJECT: A2 – Sunmodo Sunturf GM

SUBJECT: Snow Load

**SNOW LOAD (S):**

ASCE 7 Standard:	05	
Panel Slope from Horizontal [°]:	35.0	
Snow Ground Load, $p_g$ [psf]:	30.0	(Section 7.2)
Terrain Category:	C	(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)
Occupancy Category:	I	(Table 1-1)
Importance Factor, $I_s$ :	0.8	(Table 7-4)
Flat Roof Snow Load, $p_f$ [psf]:	18	(Equation 7-1)
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]:	12	(Equation 7-2)
Design Snow Load, S [psf]:	12	
Tributary Transverse Length [ft]:	5.7	
Tributary Longitudinal Length [ft]:	6	
Tributary Area per Column [ft <sup>2</sup> ]:	34.0	
<b>Snow Load per Column (1.0 S) [lb]:</b>	<b>392.5</b>	



PROJECT: A2 – Sunmodo Sunturf GM

SUBJECT: Wind Pressure

**Design Wind Load:**

ASCE 7 Standard:	05	
Basic Wind Speed, V [mph]:	115	
Occupancy Category:	I	
Importance, I <sub>w</sub> :	0.77	
Exposure Category	C	(Section 6.5.6.3)
Velocity Pressure Exposure Coefficient, K <sub>z</sub> :	0.85	(Table 6-3)
Topographic Factor, K <sub>zt</sub> :	1.0	(Section 6.5.7.2)
Wind Directionality Factor, K <sub>d</sub> :	0.85	(Table 6-4)
Internal Pressure Coefficient, GC <sub>pi</sub> :	0.00	(Figure 6-5)
Velocity Pressure, q <sub>h</sub> [psf]:	18.8	(Equation 6-15)
Gust Effect Factor, G:	0.85	(Section 6.5.8)
Panel Slope [degrees]:	35.0	

Net Pressure Coefficients (C<sub>N</sub>) per: (Figure 6-18A)

Clear Wind Flow	C <sub>NW</sub>	C <sub>NL</sub>
Case 1 (γ = 0°, Load Case A)	-1.80	-1.80
Case 2 (γ = 0°, Load Case B)	-2.43	-0.57
Case 3 (γ = 180°, Load Case A)	2.10	2.17
Case 4 (γ = 180°, Load Case B)	2.67	1.07

Design Wind Pressures (p) [psf] per: (Equation 6-25)

Clear Wind Flow	q <sub>h</sub> GC <sub>NW</sub>	q <sub>h</sub> GC <sub>NL</sub>
Case 1 (γ = 0°, Load Case A)	-28.8	-28.8
Case 2 (γ = 0°, Load Case B)	-39.0	-9.1
Case 3 (γ = 180°, Load Case A)	33.6	34.7
Case 4 (γ = 180°, Load Case B)	42.7	17.1

Wind Pressure on Each Side of Panels [psf]

Clear Wind Flow	Short Col. Pressure	Long Col. Pressure
Case 1 (γ = 0°, Load Case A)	-28.8	-28.8
Case 2 (γ = 0°, Load Case B)	-9.1	-39.0
Case 3 (γ = 180°, Load Case A)	33.6	34.7
Case 4 (γ = 180°, Load Case B)	42.7	17.1



JOB NO.: U2716-091-191

PROJECT: A2 – Sunmodo Sunturf GM

SUBJECT: Open Building Wind Loads

### Design Wind Load Per ASCE 7-05

$$p = q_h G C_n$$

Velocity Pressure Exposure Coefficient, $K_{zt}$ :	0.85	(Table 6-3)
Topographic Factor, $K_{ht}$ :	1.0	(Section 6.5.7.2)
Wind Directionality Factor, $K_d$ :	0.85	(Table 6-4)
Ultimate Wind Speed, $V$ [mph]:	115	

Velocity Pressure, $q_h$ [psf]:	18.8	(Equation 6-15)
Gust Effect Factor, $G$ :	0.85	(Section 6.5.8)

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

Force Coefficient,  $C_N$ :

Horizontal Distance from Winward Edge	Roof angle	Load Case	Obstructed Wind Flow
			CN
<= h	35	A	-0.8
		B	0.8
> h, <= 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
<= h	35	A	-12.8
		B	12.8
> h, <= 2h	35	A	-9.6
		B	8.0
> 2h	35	A	-4.8
		B	4.8



JOB NO.: U2716-092-191

DESIGNED: STB

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# Foundation Option 1: Drilled Concrete Pier



JOB NO.: U2716-091-191  
DATE: 07/25/19

DESIGNED: STB

PROJECT: A2 – Sunmodo Sunturf GM

**Drilled Pier Design**

**Design Loads:**

Max. Shear, V [k]:	1.8	Max. Down, P <sub>d</sub> [k]:	3.3
Max. Moment, M [k-ft]:	0.0	Max. Uplift, P <sub>u</sub> [k]:	2.9

**Pier Properties:**

Pier Diameter, b [ft]:	1.5	Volume of Concrete [ft <sup>3</sup> ]:	11
Min. Pier Diameter, b <sub>min</sub> (opt'l) [ft]:		Volume of Concrete [yd <sup>3</sup> ]:	0.4
Top of Pier Elevation [ft]:	0.00	Weight of Concrete [k]:	1.6
Pier Depth, d [ft]:	6.0		
Min. Pier Depth, d <sub>min</sub> (opt'l) [ft]:			
Max. Pier Depth, d <sub>max</sub> (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]: 7.1 **Bearing capacity OK.**

**Check Uplift:**

Uplift Capacity [k]: 8.5 **Uplift capacity OK.**

**Check Lateral Bearing:**

Applied Lateral Force, P [lb]:	1,790	
Point of Application, h [ft]:	0.0	
S <sub>1_max</sub> [psf]:		
S <sub>1</sub> [psf]:	600	
A = 2.34*P/(S <sub>1</sub> b):	4.65	
Required Pier Depth, d <sub>reqd</sub> [ft]:	4.7	<b>Lateral bearing capacity OK.</b>

# Foundation Option 2: Helical Pier

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

Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2860	1.5	4290
LATERAL	1790	2	3580

# 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	2860	1.5	4290
LATERAL	1790	2	3580

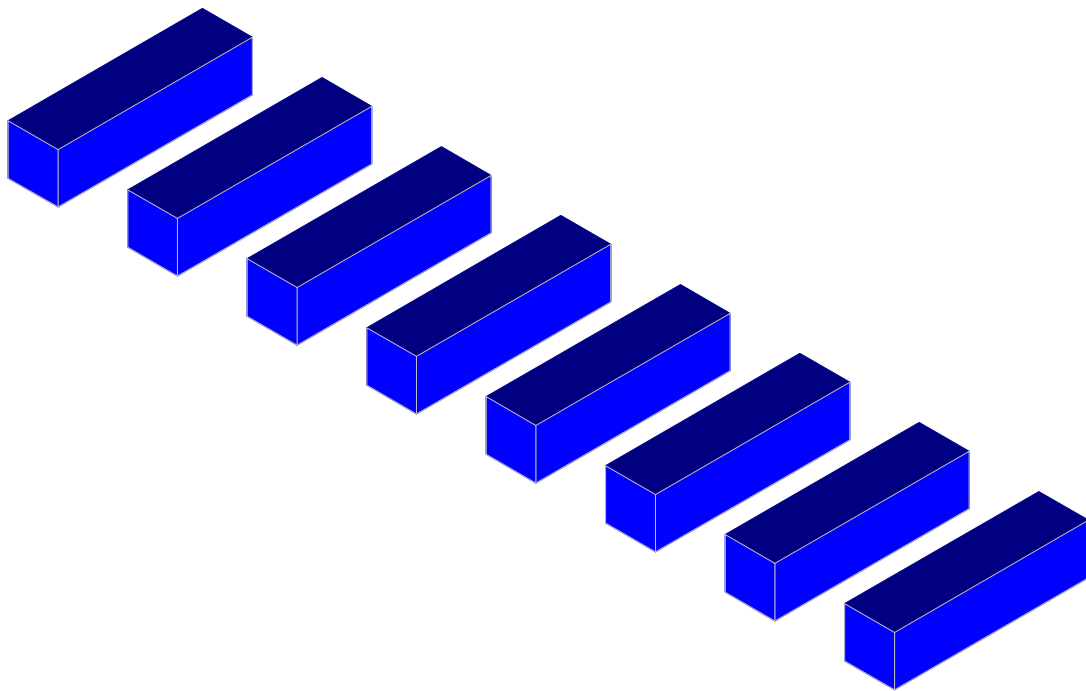


JOB NO.: U2716-092-191

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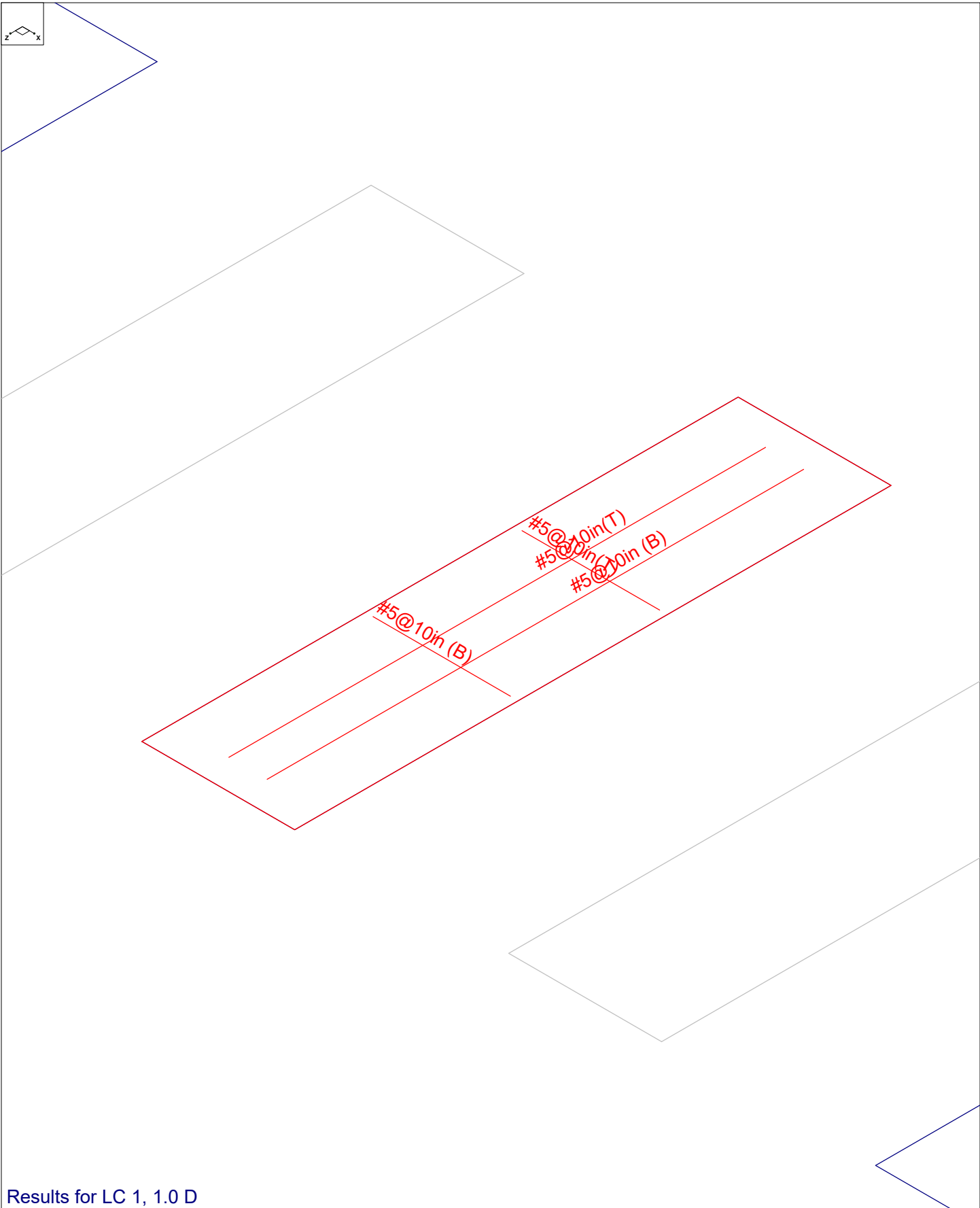
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# Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 14
STB		June 7, 2019 at 2:48 PM
U2716.092.181		New England A2 v3.r3d



Results for LC 1, 1.0 D

Vector Structural Engineeri...	Ground Mount	SK - 13
STB		June 7, 2019 at 2:48 PM
U2716.092.181		New England A2 v3.r3d



**(Global) Model Settings**

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	100
Mesh Size (in)	12
Max Iterations	10
Merge Tolerance (in)	.12
Solver	Sparse Accelerated
Coefficient of Friction	.3
No. of Shear Regions	4
Shear Region Spacing Increment (in)	4
Min 1 Bar Dia Spacing for Beams?	No
Optimize footings for OTM / Sliding?	Yes
Parame Beta Factor	.65
Pile Safety Factor	3
Concrete Stress Block	Rectangular
Concrete Rebar Set	ASTM A615
Concrete Code	ACI 318-08
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	10	10	10	10	1	Optimize

**Soil Definitions**

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

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

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	-5.057
2	R3D_N1	Y	199.943
3	R3D_N2	X	1.172
4	R3D_N2	Y	185.719
5	R3D_N132	Y	186.504
6	R3D_N133	Y	189.419
7	R3D_N109	Y	175.671
8	R3D_N110A	Y	187.284
9	R3D_N121	Y	188.126





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

	Label	Direction	Magnitude[lb.lb-ft]
22	R3D_N122	X	4
23	R3D_N122	Y	1199.009
24	R3D_N122	Z	-117.054
25	R3D_N133B	X	-5.431
26	R3D_N133B	Y	-2905.756
27	R3D_N133B	Z	1308.525
28	R3D_N134B	X	1.319
29	R3D_N134B	Y	1213.433
30	R3D_N134B	Z	-117.491
31	R3D_N151	Y	-2927.874
32	R3D_N151	Z	1307.688
33	R3D_N152	X	-5.432
34	R3D_N152	Y	1204.716
35	R3D_N152	Z	-117.062
36	R3D_N157A_1	X	-3.571
37	R3D_N157A_1	Y	-2738.405
38	R3D_N157A_1	Z	1276.527
39	R3D_N158A_1	X	-5.448
40	R3D_N158A_1	Y	1174.82
41	R3D_N158A_1	Z	-115.677
42	R3D_N157A	X	-45.44
43	R3D_N157A	Y	-2962.195
44	R3D_N157A	Z	1296.053
45	R3D_N158A	X	4.889
46	R3D_N158A	Y	1190.661
47	R3D_N158A	Z	-116.147

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

	Label	Direction	Magnitude[lb.lb-ft]
1	R3D_N1	X	-62.521
2	R3D_N1	Y	3119.117
3	R3D_N1	Z	-1739.621
4	R3D_N2	X	6.615
5	R3D_N2	Y	-743
6	R3D_N2	Z	156.961
7	R3D_N132	X	2.753
8	R3D_N132	Y	3063.081
9	R3D_N132	Z	-1782.319
10	R3D_N133	X	3.885
11	R3D_N133	Y	-750.45
12	R3D_N133	Z	160.018
13	R3D_N109	X	2.844
14	R3D_N109	Y	2912.64
15	R3D_N109	Z	-1771.432
16	R3D_N110A	X	-5.246
17	R3D_N110A	Y	-754.99
18	R3D_N110A	Z	158.808
19	R3D_N121	X	6.583
20	R3D_N121	Y	3075.653
21	R3D_N121	Z	-1777.162
22	R3D_N122	Y	-737.996
23	R3D_N122	Z	159.564
24	R3D_N133B	X	4.939
25	R3D_N133B	Y	3060.47
26	R3D_N133B	Z	-1781.907
27	R3D_N134B	X	1.232









### Load Combinations

Label	Solve	Service	A...	SF	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...	Cat..	Fa...
1	1.0 D	Yes	Yes	1.5	DL	1																						
2	1.0 D + 1....	Yes	Yes	1.5	DL	1	RLL	1																				
3	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL1	1																		
4	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL2	1																		
5	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL3	1																		
6	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL4	1																		
7	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL5	1																		
8	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL6	1																		
9	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL1	.75																		
10	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL2	.75																		
11	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL3	.75																		
12	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL4	.75																		
13	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL5	.75																		
14	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL6	.75																		
15	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL1	1																		
16	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL2	1																		
17	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL3	1																		
18	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL4	1																		
19	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL5	1																		
20	0.6 D + 0....	Yes	Yes		DL	.6	RLL		OL6	1																		
21																												
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	.8																		
25	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL2	.8																		
26	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL3	.8																		
27	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL4	.8																		
28	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL5	.8																		
29	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL6	.8																		
30	1.2D+1.6...	Yes			DL	1.2	RLL	.5	OL1	1.6																		
31	1.2D-1.6...	Yes			DL	1.2	RLL	.5	OL2	1.6																		
32	1.2D+1.6...	Yes			DL	1.2	RLL	.5	OL3	1.6																		
33	1.2D-1.6...	Yes			DL	1.2	RLL	.5	OL4	1.6																		
34	1.2D+1.6...	Yes			DL	1.2	RLL	.5	OL5	1.6																		
35	1.2D-1.6...	Yes			DL	1.2	RLL	.5	OL6	1.6																		
36	.9D+1.6Wx	Yes			DL	.9			OL1	1.6																		
37	.9D-1.6Wx	Yes			DL	.9			OL2	1.6																		
38	.9D+1.6Wz	Yes			DL	.9			OL3	1.6																		
39	.9D-1.6Wz	Yes			DL	.9			OL4	1.6																		
40	.9D+1.6W...	Yes			DL	.9			OL5	1.6																		
41	.9D-1.6W90	Yes			DL	.9			OL6	1.6																		

### Design Strips

Label	Rebar Angle from PI...	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	25		
3 OL1	46		
4 OL2	47		
5 OL3	46		
6 OL4	45		
7 OL5	43		



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 Designer : STB  
 Job Number : U2716.092.181  
 Model Name : Ground Mount

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**Load Categories (Continued)**

	Category	Point Loads	Line Loads	Area Loads
8	OL6	40		

**Strip Reinforcing**

	Label	UC Top	LC	Top Bars	Governing ...	UC Bot	LC	Bot B...	Gover...	UC Shear	LC	Governing ...
1	DS1	.011	32	#5@10in	DS1-X26	.031	37	#5@1...	DS1-...	.042	37	DS1-X15
2	DS2	.002	39	#5@10in	DS2-X26	.003	32	#5@1...	DS2-...	.005	32	DS2-X37

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

	LC	Slab	Angle[deg]	Mo-xx[lb-ft]	Ms-xx[lb-ft]	Mo-zz[lb-ft]	Ms-zz[lb-ft]	Ms-xx/Mo-xx	Ms-zz/Mo-zz
1	1	S1	0	0	44910.993	0	11536.731	9.999+	9.999+
2	1	S2	0	0	44881.038	0	11498.635	9.999+	9.999+
3	1	S3	0	0	44921.574	0	11517.132	9.999+	9.999+
4	1	S4	0	0	44915.991	0	11514.511	9.999+	9.999+
5	1	S5	0	0	44917.078	0	11514.845	9.999+	9.999+
6	1	S6	0	0	44926.8	0	11517.676	9.999+	9.999+
7	1	S7	0	0	44868.617	0	11499.911	9.999+	9.999+
8	1	S8	0	0	44917.688	0	11525.483	9.999+	9.999+
9	2	S1	0	0	48947.866	0	12582.669	9.999+	9.999+
10	2	S2	0	0	48900.025	0	12469.481	9.999+	9.999+
11	2	S3	0	0	49034.637	0	12531.761	9.999+	9.999+
12	2	S4	0	0	49017.363	0	12523.678	9.999+	9.999+
13	2	S5	0	0	49021.671	0	12531.06	9.999+	9.999+
14	2	S6	0	0	49055.74	0	12544.095	9.999+	9.999+
15	2	S7	0	0	48847.852	0	12474.325	9.999+	9.999+
16	2	S8	0	0	48944.91	0	12539.061	9.999+	9.999+
17	3	S1	0	23119.554	44999.906	2615.933	11536.731	1.946	4.41
18	3	S2	0	21795.086	44808.468	2279.053	11498.635	2.056	5.045
19	3	S3	0	22913.005	44912.209	2474.848	11517.132	1.96	4.654
20	3	S4	0	22802.835	44897.347	2445.337	11514.511	1.969	4.709
21	3	S5	0	22821.401	44898.867	2449.095	11514.845	1.967	4.702
22	3	S6	0	22952.443	44911.227	2470.112	11517.676	1.957	4.663
23	3	S7	0	21721.578	44830.845	2313.171	11499.911	2.064	4.971
24	3	S8	0	23097.125	45010.25	2548.541	11532.923	1.949	4.525
25	4	S1	0	24608.394	44999.906	2402.847	11536.731	1.829	4.801
26	4	S2	0	22757.872	44808.468	1920.849	11498.635	1.969	5.986
27	4	S3	0	24253.996	44912.209	2163.818	11517.132	1.852	5.323
28	4	S4	0	24100.162	44897.347	2125.685	11514.511	1.863	5.417
29	4	S5	0	24123.195	44898.867	2135.809	11514.845	1.861	5.391
30	4	S6	0	24291.339	44911.227	2167.527	11517.676	1.849	5.314
31	4	S7	0	22753.46	44830.845	1977.027	11499.911	1.97	5.817
32	4	S8	0	24563.708	45010.25	2315.798	11532.923	1.832	4.98
33	5	S1	0	4442.203	44910.993	0	14646.643	9.999+	9.999+
34	5	S2	0	4974.367	44881.038	0	14201.704	9.022	9.999+
35	5	S3	0	4565.583	44921.574	0	14422.747	9.839	9.999+
36	5	S4	0	4704.347	44915.991	0	14386.323	9.548	9.999+
37	5	S5	0	4698.967	44917.078	0	14389.04	9.559	9.999+
38	5	S6	0	4592.39	44926.8	0	14434.151	9.783	9.999+
39	5	S7	0	4655.596	44868.617	0	14209.417	9.638	9.999+
40	5	S8	0	4518.372	44917.688	0	14410.313	9.941	9.999+
41	6	S1	0	19463.121	44999.906	2528.889	11536.731	2.312	4.562
42	6	S2	0	18725.497	44808.468	2351.442	11498.635	2.393	4.89
43	6	S3	0	19404.436	44912.209	2484.163	11517.132	2.315	4.636
44	6	S4	0	19343	44897.347	2467.108	11514.511	2.321	4.667
45	6	S5	0	19355.829	44898.867	2465.028	11514.845	2.32	4.671
46	6	S6	0	19441.605	44911.227	2474.695	11517.676	2.31	4.654
47	6	S7	0	18600.402	44830.845	2360.249	11499.911	2.41	4.872



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

LC	Slab	Angle[deg]	Mo-xx[lb-ft]	Ms-xx[lb-ft]	Mo-zz[lb-ft]	Ms-zz[lb-ft]	Ms-xx/Mo-xx	Ms-zz/Mo-zz	
48	6	S8	0	19462.058	45010.25	2485.269	11532.923	2.313	4.641
49	7	S1	0	1535.902	44910.993	0	12646.998	9.999+	9.999+
50	7	S2	0	1526.823	44881.038	0	12361.671	9.999+	9.999+
51	7	S3	0	1003.747	44921.574	0	12223.152	9.999+	9.999+
52	7	S4	0	692.221	44915.991	0	11889.132	9.999+	9.999+
53	7	S5	0	606.749	44917.078	0	11925.406	9.999+	9.999+
54	7	S6	0	625.061	44926.8	0	11928.231	9.999+	9.999+
55	7	S7	0	647.861	44868.617	0	11870.889	9.999+	9.999+
56	7	S8	0	627.554	44917.688	0	11931.606	9.999+	9.999+
57	8	S1	0	9924.506	44999.906	1117.573	11536.731	4.534	9.999+
58	8	S2	0	7131.443	44808.468	745.24	11498.635	6.283	9.999+
59	8	S3	0	6480.723	44912.209	699.859	11517.132	6.93	9.999+
60	8	S4	0	6717.759	44897.347	721.383	11514.511	6.683	9.999+
61	8	S5	0	6846.288	44898.867	729.083	11514.845	6.558	9.999+
62	8	S6	0	6848.36	44911.227	735.932	11517.676	6.558	9.999+
63	8	S7	0	6464.891	44830.845	684.476	11499.911	6.935	9.999+
64	8	S8	0	6965.54	45010.25	767.994	11532.923	6.462	9.999+
65	9	S1	0	17339.666	47944.678	1961.949	12321.185	2.765	6.28
66	9	S2	0	16346.314	47473.686	1709.289	12226.769	2.904	7.153
67	9	S3	0	17184.754	47807.254	1856.136	12289.451	2.782	6.621
68	9	S4	0	17102.126	47760.351	1834.003	12280.462	2.793	6.696
69	9	S5	0	17116.051	47765.289	1836.821	12277.006	2.791	6.684
70	9	S6	0	17214.332	47803.94	1852.584	12283.607	2.777	6.631
71	9	S7	0	16291.183	47546.747	1734.878	12230.721	2.919	7.05
72	9	S8	0	17322.843	47961.568	1911.406	12303.951	2.769	6.437
73	10	S1	0	18456.295	47944.678	1802.135	12321.185	2.598	6.837
74	10	S2	0	17068.404	47473.686	1440.637	12226.769	2.781	8.487
75	10	S3	0	18190.497	47807.254	1622.864	12289.451	2.628	7.573
76	10	S4	0	18075.121	47760.351	1594.264	12280.462	2.642	7.703
77	10	S5	0	18092.396	47765.289	1601.856	12277.006	2.64	7.664
78	10	S6	0	18218.504	47803.94	1625.645	12283.607	2.624	7.556
79	10	S7	0	17065.095	47546.747	1482.77	12230.721	2.786	8.249
80	10	S8	0	18422.781	47961.568	1736.849	12303.951	2.603	7.084
81	11	S1	0	3331.652	47938.648	0	14653.619	9.999+	9.999+
82	11	S2	0	3730.775	47895.278	0	14254.071	9.999+	9.999+
83	11	S3	0	3424.187	48006.371	0	14457.315	9.999+	9.999+
84	11	S4	0	3528.26	47992.02	0	14425.245	9.999+	9.999+
85	11	S5	0	3524.225	47995.522	0	14432.652	9.999+	9.999+
86	11	S6	0	3444.293	48023.505	0	14474.847	9.999+	9.999+
87	11	S7	0	3491.697	47853.043	0	14262.851	9.999+	9.999+
88	11	S8	0	3388.779	47938.104	0	14449.289	9.999+	9.999+
89	12	S1	0	14597.341	47944.678	1896.666	12321.185	3.284	6.496
90	12	S2	0	14044.123	47473.686	1763.582	12226.769	3.38	6.933
91	12	S3	0	14553.327	47807.254	1863.122	12289.451	3.285	6.596
92	12	S4	0	14507.25	47760.351	1850.331	12280.462	3.292	6.637
93	12	S5	0	14516.872	47765.289	1848.771	12277.006	3.29	6.641
94	12	S6	0	14581.204	47803.94	1856.021	12283.607	3.278	6.618
95	12	S7	0	13950.301	47546.747	1770.187	12230.721	3.408	6.909
96	12	S8	0	14596.543	47961.568	1863.952	12303.951	3.286	6.601
97	13	S1	0	1151.926	47938.648	0	13153.885	9.999+	9.999+
98	13	S2	0	1145.117	47895.278	0	12874.046	9.999+	9.999+
99	13	S3	0	752.81	48006.371	0	12807.619	9.999+	9.999+
100	13	S4	0	519.166	47992.02	0	12552.352	9.999+	9.999+
101	13	S5	0	455.062	47995.522	0	12584.927	9.999+	9.999+
102	13	S6	0	468.796	48023.505	0	12595.406	9.999+	9.999+
103	13	S7	0	485.896	47853.043	0	12508.955	9.999+	9.999+
104	13	S8	0	470.665	47938.104	0	12590.259	9.999+	9.999+





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

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
1	1	S1	0	3.885	2766.484	0	2766.484	9.999+	9.999+
2	1	S2	0	0	2759.672	0	2759.672	9.999+	9.999+
3	1	S3	0	0	2764.112	0	2764.112	9.999+	9.999+
4	1	S4	0	0	2763.483	0	2763.483	9.999+	9.999+
5	1	S5	0	0	2763.563	0	2763.563	9.999+	9.999+
6	1	S6	0	0	2764.242	0	2764.242	9.999+	9.999+
7	1	S7	0	0	2759.979	0	2759.979	9.999+	9.999+
8	1	S8	0	1.488	2767.009	0	2767.009	9.999+	9.999+
9	2	S1	0	13.89	3011.507	0	3011.507	9.999+	9.999+
10	2	S2	0	0	2992.675	0	2992.675	9.999+	9.999+
11	2	S3	0	3.026	3009.438	0	3009.438	9.999+	9.999+
12	2	S4	0	2.42	3007.135	0	3007.135	9.999+	9.999+
13	2	S5	0	0	3007.454	0	3007.454	9.999+	9.999+
14	2	S6	0	1.035	3009.962	0	3009.962	9.999+	9.999+
15	2	S7	0	0	2993.838	0	2993.838	9.999+	9.999+
16	2	S8	0	4.38	3012.003	0	3012.003	9.999+	9.999+
17	3	S1	0	42.425	2166.447	1333.21	2166.447	9.999+	1.625
18	3	S2	0	1.949	2213.869	1358.458	2213.869	9.999+	1.63
19	3	S3	0	5.467	2173.428	1362.702	2173.428	9.999+	1.595
20	3	S4	0	5.212	2179.729	1366.253	2179.729	9.999+	1.595
21	3	S5	0	5.529	2179.097	1366.586	2179.097	9.999+	1.595
22	3	S6	0	2.658	2173.01	1367.674	2173.01	9.999+	1.589
23	3	S7	0	5.78	2208.286	1333.225	2208.286	9.999+	1.656
24	3	S8	0	22.161	2169.549	1353.634	2169.549	9.999+	1.603
25	4	S1	0	61.779	2229.2	1161.94	2229.2	9.999+	1.919
26	4	S2	0	4.104	2301.131	1183.707	2301.131	9.999+	1.944
27	4	S3	0	3.281	2246.764	1185.685	2246.764	9.999+	1.895
28	4	S4	0	4.112	2255.786	1191.034	2255.786	9.999+	1.894
29	4	S5	0	6.84	2255.073	1191.552	2255.073	9.999+	1.893
30	4	S6	0	5.432	2247.295	1190.626	2247.295	9.999+	1.887
31	4	S7	0	9.019	2290.903	1160.849	2290.903	9.999+	1.973
32	4	S8	0	39.064	2235.548	1179.906	2235.548	9.999+	1.895
33	5	S1	0	59.791	3479.32	1582.661	3479.32	9.999+	2.198
34	5	S2	0	2.402	3406.967	1612.624	3406.967	9.999+	2.113
35	5	S3	0	6.583	3465.409	1617.599	3465.409	9.999+	2.142
36	5	S4	0	6.172	3456.42	1621.897	3456.42	9.999+	2.131
37	5	S5	0	6.638	3457.352	1622.301	3457.352	9.999+	2.131
38	5	S6	0	3.27	3466.158	1623.524	3466.158	9.999+	2.135
39	5	S7	0	7.008	3414.465	1582.638	3414.465	9.999+	2.157
40	5	S8	0	30.296	3476.653	1606.913	3476.653	9.999+	2.164
41	6	S1	0	21.084	2174.532	1342.505	2174.532	9.999+	1.62
42	6	S2	0	.096	2195.384	1368.133	2195.384	9.999+	1.605
43	6	S3	0	5.962	2171.49	1373.88	2171.49	9.999+	1.581
44	6	S4	0	5.617	2174.747	1375.526	2174.747	9.999+	1.581
45	6	S5	0	3.837	2174.258	1375.666	2174.258	9.999+	1.581
46	6	S6	0	0	2170.315	1378.366	2170.315	9.999+	1.575
47	6	S7	0	1.44	2194.383	1343.466	2194.383	9.999+	1.633
48	6	S8	0	5.253	2174.589	1362.931	2174.589	9.999+	1.596
49	7	S1	0	18.592	3024.124	579.036	3024.124	9.999+	5.223
50	7	S2	0	.019	2966.79	515.832	2966.79	9.999+	5.751
51	7	S3	0	6.027	2937.173	389.637	2937.173	9.999+	7.538
52	7	S4	0	1.788	2852.319	216.454	2852.319	9.999+	9.999+
53	7	S5	0	1.024	2862.712	227.507	2862.712	9.999+	9.999+
54	7	S6	0	0	2862.775	227.745	2862.775	9.999+	9.999+
55	7	S7	0	1.12	2849.685	222.177	2849.685	9.999+	9.999+
56	7	S8	0	8.49	2868.679	225.698	2868.679	9.999+	9.999+
57	8	S1	0	12.051	2507.829	578.708	2507.829	9.999+	4.333



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

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
58	8	S2	0	1.48	2581.703	448.143	2581.703	9.999+	5.761
59	8	S3	0	1.758	2597.2	383.302	2597.2	9.999+	6.776
60	8	S4	0	1.352	2591.162	401.432	2591.162	9.999+	6.455
61	8	S5	0	0	2588.583	410.282	2588.583	9.999+	6.309
62	8	S6	0	0	2587.619	407.817	2587.619	9.999+	6.345
63	8	S7	0	1.039	2596.328	398.005	2596.328	9.999+	6.523
64	8	S8	0	6.739	2587.626	404.45	2587.626	9.999+	6.398
65	9	S1	0	23.344	2500.223	999.907	2500.223	9.999+	2.5
66	9	S2	0	1.462	2525.072	1018.843	2525.072	9.999+	2.478
67	9	S3	0	1.831	2505.094	1022.026	2505.094	9.999+	2.451
68	9	S4	0	2.094	2508.407	1024.69	2508.407	9.999+	2.448
69	9	S5	0	4.147	2508.132	1024.939	2508.132	9.999+	2.447
70	9	S6	0	2.77	2505.108	1025.755	2505.108	9.999+	2.442
71	9	S7	0	4.335	2521.603	999.919	2521.603	9.999+	2.522
72	9	S8	0	14.08	2502.659	1015.226	2502.659	9.999+	2.465
73	10	S1	0	37.859	2547.288	871.455	2547.288	9.999+	2.923
74	10	S2	0	3.078	2590.519	887.78	2590.519	9.999+	2.918
75	10	S3	0	.191	2560.096	889.264	2560.096	9.999+	2.879
76	10	S4	0	1.269	2565.449	893.275	2565.449	9.999+	2.872
77	10	S5	0	5.13	2565.114	893.664	2565.114	9.999+	2.87
78	10	S6	0	4.851	2560.821	892.97	2560.821	9.999+	2.868
79	10	S7	0	6.764	2583.567	870.637	2583.567	9.999+	2.967
80	10	S8	0	26.757	2552.159	884.929	2552.159	9.999+	2.884
81	11	S1	0	53.318	3484.878	1186.995	3484.878	9.999+	2.936
82	11	S2	0	1.802	3419.896	1209.468	3419.896	9.999+	2.828
83	11	S3	0	7.206	3474.079	1213.199	3474.079	9.999+	2.864
84	11	S4	0	6.444	3465.925	1216.423	3465.925	9.999+	2.849
85	11	S5	0	4.978	3466.823	1216.726	3466.823	9.999+	2.849
86	11	S6	0	1.676	3474.969	1217.643	3474.969	9.999+	2.854
87	11	S7	0	5.256	3426.238	1186.978	3426.238	9.999+	2.887
88	11	S8	0	25.263	3482.987	1205.185	3482.987	9.999+	2.89
89	12	S1	0	7.338	2506.287	1006.879	2506.287	9.999+	2.489
90	12	S2	0	.072	2511.208	1026.1	2511.208	9.999+	2.447
91	12	S3	0	2.202	2503.64	1030.41	2503.64	9.999+	2.43
92	12	S4	0	2.398	2504.67	1031.644	2504.67	9.999+	2.428
93	12	S5	0	2.878	2504.503	1031.749	2504.503	9.999+	2.427
94	12	S6	0	.777	2503.087	1033.775	2503.087	9.999+	2.421
95	12	S7	0	1.08	2511.176	1007.599	2511.176	9.999+	2.492
96	12	S8	0	1.399	2506.439	1022.199	2506.439	9.999+	2.452
97	13	S1	0	22.419	3143.481	434.277	3143.481	9.999+	7.238
98	13	S2	0	.014	3089.763	386.874	3089.763	9.999+	7.986
99	13	S3	0	6.79	3077.902	292.228	3077.902	9.999+	9.999+
100	13	S4	0	.474	3012.849	162.34	3012.849	9.999+	9.999+
101	13	S5	0	.768	3020.843	170.63	3020.843	9.999+	9.999+
102	13	S6	0	.777	3022.432	170.809	3022.432	9.999+	9.999+
103	13	S7	0	.84	3002.653	166.633	3002.653	9.999+	9.999+
104	13	S8	0	8.908	3027.007	169.274	3027.007	9.999+	9.999+
105	14	S1	0	.563	2756.259	434.031	2756.259	9.999+	6.35
106	14	S2	0	1.11	2800.948	336.107	2800.948	9.999+	8.333
107	14	S3	0	.951	2822.923	287.476	2822.923	9.999+	9.82
108	14	S4	0	.801	2816.981	301.074	2816.981	9.999+	9.356
109	14	S5	0	0	2815.246	307.712	2815.246	9.999+	9.149
110	14	S6	0	.777	2816.064	305.862	2816.064	9.999+	9.207
111	14	S7	0	.779	2812.635	298.504	2812.635	9.999+	9.422
112	14	S8	0	2.513	2816.217	303.337	2816.217	9.999+	9.284
113	15	S1	0	43.979	1059.853	1333.21	1059.853	9.999+	.795
114	15	S2	0	1.949	1110	1358.458	1110	9.999+	.817



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 Designer : STB  
 Job Number : U2716.092.181  
 Model Name : Ground Mount

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

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
115	15	S3	0	5.467	1067.784	1362.702	1067.784	9.999+	.784
116	15	S4	0	5.212	1074.336	1366.253	1074.336	9.999+	.786
117	15	S5	0	5.529	1073.672	1366.586	1073.672	9.999+	.786
118	15	S6	0	2.658	1067.313	1367.674	1067.313	9.999+	.78
119	15	S7	0	5.78	1104.294	1333.225	1104.294	9.999+	.828
120	15	S8	0	22.757	1062.745	1353.634	1062.745	9.999+	.785
121	16	S1	0	63.333	1122.606	1161.94	1122.606	9.999+	.966
122	16	S2	0	4.104	1197.262	1183.707	1197.262	9.999+	1.011
123	16	S3	0	3.281	1141.119	1185.685	1141.119	9.999+	.962
124	16	S4	0	4.112	1150.393	1191.034	1150.393	9.999+	.966
125	16	S5	0	6.84	1149.647	1191.552	1149.647	9.999+	.965
126	16	S6	0	5.432	1141.598	1190.626	1141.598	9.999+	.959
127	16	S7	0	9.019	1186.912	1160.849	1186.912	9.999+	1.022
128	16	S8	0	39.659	1128.745	1179.906	1128.745	9.999+	.957
129	17	S1	0	58.237	2372.726	1582.661	2372.726	9.999+	1.499
130	17	S2	0	2.402	2303.098	1612.624	2303.098	9.999+	1.428
131	17	S3	0	6.583	2359.764	1617.599	2359.764	9.999+	1.459
132	17	S4	0	6.172	2351.027	1621.897	2351.027	9.999+	1.45
133	17	S5	0	6.638	2351.927	1622.301	2351.927	9.999+	1.45
134	17	S6	0	3.27	2360.461	1623.524	2360.461	9.999+	1.454
135	17	S7	0	7.008	2310.473	1582.638	2310.473	9.999+	1.46
136	17	S8	0	29.701	2369.849	1606.913	2369.849	9.999+	1.475
137	18	S1	0	22.638	1067.939	1342.505	1067.939	9.999+	.795
138	18	S2	0	.096	1091.515	1368.133	1091.515	9.999+	.798
139	18	S3	0	5.962	1065.845	1373.88	1065.845	9.999+	.776
140	18	S4	0	5.617	1069.354	1375.526	1069.354	9.999+	.777
141	18	S5	0	3.837	1068.833	1375.666	1068.833	9.999+	.777
142	18	S6	0	0	1064.619	1378.366	1064.619	9.999+	.772
143	18	S7	0	1.44	1090.392	1343.466	1090.392	9.999+	.812
144	18	S8	0	5.848	1067.785	1362.931	1067.785	9.999+	.783
145	19	S1	0	17.038	1917.531	579.036	1917.531	9.999+	3.312
146	19	S2	0	.019	1862.921	515.832	1862.921	9.999+	3.611
147	19	S3	0	6.027	1831.528	389.637	1831.528	9.999+	4.701
148	19	S4	0	1.788	1746.926	216.454	1746.926	9.999+	8.071
149	19	S5	0	1.024	1757.287	227.507	1757.287	9.999+	7.724
150	19	S6	0	0	1757.079	227.745	1757.079	9.999+	7.715
151	19	S7	0	1.12	1745.694	222.177	1745.694	9.999+	7.857
152	19	S8	0	7.895	1761.876	225.698	1761.876	9.999+	7.806
153	20	S1	0	13.605	1401.235	578.708	1401.235	9.999+	2.421
154	20	S2	0	1.48	1477.834	448.143	1477.834	9.999+	3.298
155	20	S3	0	1.758	1491.555	383.302	1491.555	9.999+	3.891
156	20	S4	0	1.352	1485.769	401.432	1485.769	9.999+	3.701
157	20	S5	0	0	1483.158	410.282	1483.158	9.999+	3.615
158	20	S6	0	0	1481.922	407.817	1481.922	9.999+	3.634
159	20	S7	0	1.039	1492.336	398.005	1492.336	9.999+	3.75
160	20	S8	0	7.334	1480.823	404.45	1480.823	9.999+	3.661

**Envelope Slab Soil Pressures**

	Label	UC	LC	Soil Pressure[psf]	Allowable Bearing[psf]	Point
1	S1	.517	5	775.75	1500	N226
2	S2	.499	5	748.8	1500	N233
3	S3	.513	5	768.881	1500	N240
4	S4	.512	5	767.341	1500	N247
5	S5	.512	5	767.658	1500	N254
6	S6	.513	5	769.453	1500	N261
7	S7	.498	5	747.117	1500	N268



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***Envelope Slab Soil Pressures (Continued)***

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	Label	UC	LC	Soil Pressure[psf]	Allowable Bearing[psf]	Point
8	S8	.516	5	774.531	1500	N275



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Address:			
Phone:			
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 318-05  
Units: Imperial units

**Anchor Information:**

Anchor type: Bonded anchor  
Material: F1554 Grade 36  
Diameter (inch): 0.375  
Effective Embedment depth,  $h_{ef}$  (inch): 5.000  
Code report: ICC-ES ESR-4057  
Anchor category: -  
Anchor ductility: Yes  
 $h_{min}$  (inch): 6.25  
 $c_{ac}$  (inch): 9.16  
 $C_{min}$  (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  
Yield stress: 34084 psi

**Profile type/size:** Pipe1-1/2STD

**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 9.2

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]: 4780

$V_{uax}$  [lb]: 230

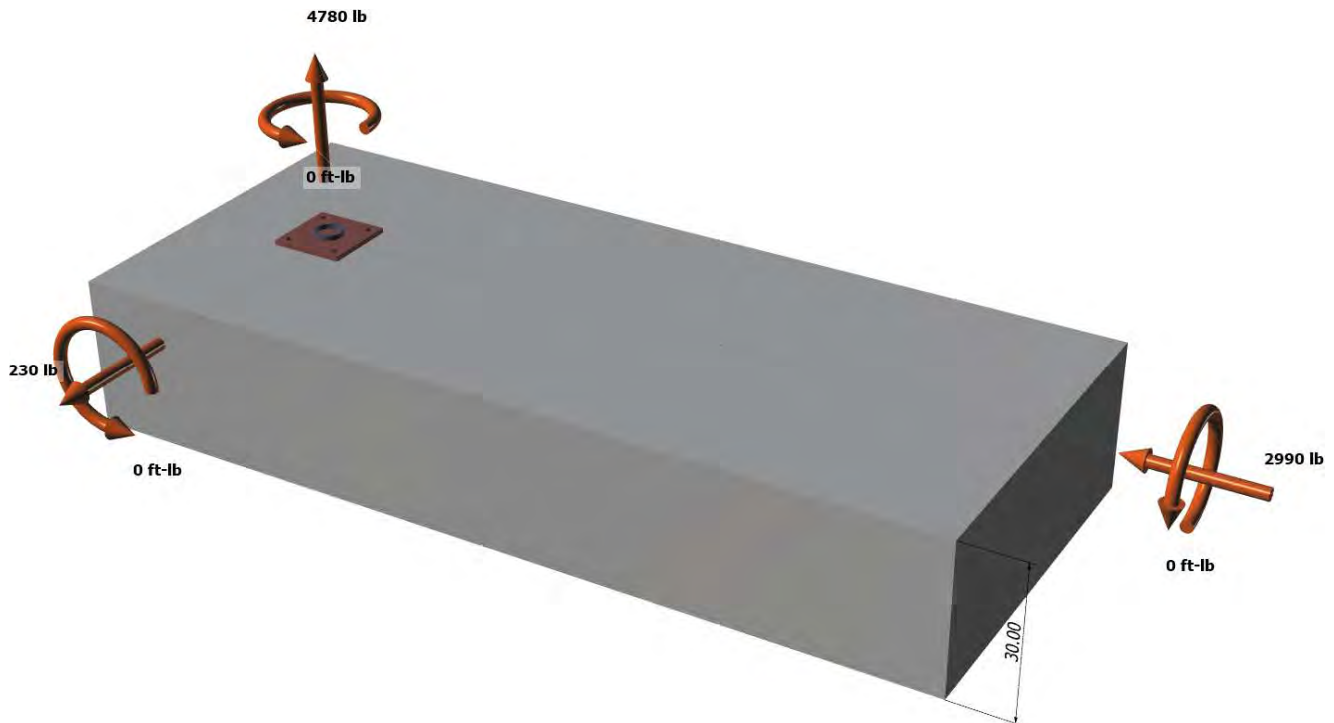
$V_{uay}$  [lb]: -2990

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

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

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

<Figure 1>





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<Figure 2>





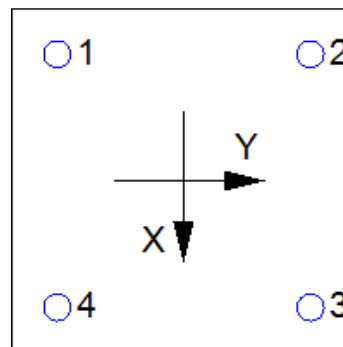
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### 3. Resulting Anchor Forces

Anchor	Tension load, N <sub>ua</sub> (lb)	Shear load x, V <sub>uax</sub> (lb)	Shear load y, V <sub>uay</sub> (lb)	Shear load combined, $\sqrt{(V_{uax})^2 + (V_{uay})^2}$ (lb)
1	1195.0	57.5	-747.5	749.7
2	1195.0	57.5	-747.5	749.7
3	1195.0	57.5	-747.5	749.7
4	1195.0	57.5	-747.5	749.7
Sum	4780.0	230.0	-2990.0	2998.8

Maximum concrete compression strain (%): 0.00  
 Maximum concrete compression stress (psi): 0  
 Resultant tension force (lb): 4780  
 Resultant compression force (lb): 0  
 Eccentricity of resultant tension forces in x-axis, e'<sub>Nx</sub> (inch): 0.00  
 Eccentricity of resultant tension forces in y-axis, e'<sub>Ny</sub> (inch): 0.00  
 Eccentricity of resultant shear forces in x-axis, e'<sub>Vx</sub> (inch): 0.00  
 Eccentricity of resultant shear forces in y-axis, e'<sub>Vy</sub> (inch): 0.00

<Figure 3>



### 4. Steel Strength of Anchor in Tension (Sec. D.5.1)

N <sub>sa</sub> (lb)	φ	φN <sub>sa</sub> (lb)
4525	0.75	3394

### 5. Concrete Breakout Strength of Anchor in Tension (Sec. D.5.2)

$$N_b = k_c \lambda \sqrt{f_c} h_{ef}^{1.5} \text{ (Eq. D-7)}$$

k <sub>c</sub>	λ	f <sub>c</sub> (psi)	h <sub>ef</sub> (in)	N <sub>b</sub> (lb)
17.0	1.00	2500	5.000	9503

$$\phi N_{cbg} = \phi (A_{Nc} / A_{Nco}) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \text{ (Sec. D.4.1 \& Eq. D-5)}$$

A <sub>Nc</sub> (in <sup>2</sup> )	A <sub>Nco</sub> (in <sup>2</sup> )	c <sub>a,min</sub> (in)	ψ <sub>ec,N</sub>	ψ <sub>ed,N</sub>	ψ <sub>c,N</sub>	ψ <sub>cp,N</sub>	N <sub>b</sub> (lb)	φ	φN <sub>cbg</sub> (lb)
337.63	225.00	7.25	1.000	0.990	1.00	1.000	9503	0.65	9176

### 6. Adhesive Strength of Anchor in Tension (AC308 Sec. 3.3)

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

τ <sub>k,cr</sub> (psi)	f <sub>short-term</sub>	K <sub>sat</sub>	f <sub>c</sub> (psi)	n	τ <sub>k,cr</sub> (psi)
1346	1.00	1.00	2500	0.24	1346

$$N_{a0} = \tau_{k,cr} \pi d_a h_{ef} \text{ (Eq. D-16f)}$$

τ <sub>k,cr</sub> (psi)	d <sub>a</sub> (in)	h <sub>ef</sub> (in)	N <sub>a0</sub> (lb)
1346	0.38	5.000	7929

$$\phi N_{ag} = \phi (A_{Na} / A_{Na0}) \psi_{ed,Na} \psi_{g,Na} \psi_{ec,Na} \psi_{p,Na} N_{a0} \text{ (Sec. D.4.1 \& Eq. D-16b)}$$

A <sub>Na</sub> (in <sup>2</sup> )	A <sub>Na0</sub> (in <sup>2</sup> )	ψ <sub>ed,Na</sub>	ψ <sub>g,Na</sub>	ψ <sub>ec,Na</sub>	ψ <sub>p,Na</sub>	N <sub>a0</sub> (lb)	φ	φN <sub>ag</sub> (lb)
161.83	85.03	1.000	1.091	1.000	1.000	7929	0.55	9057

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. D.6.1)**

$V_{sa}$ (lb)	$\phi_{grout}$	$\phi$	$\phi_{grout}\phi V_{sa}$ (lb)
2715	1.0	0.65	1765

**9. Concrete Breakout Strength of Anchor in Shear (Sec. D.6.2)**

**Shear perpendicular to edge in x-direction:**

$$V_{bx} = 7(l_e / d_a)^{0.2} \sqrt{d_a \lambda} \sqrt{f_c c_{a1}^{1.5}} \text{ (Eq. D-24)}$$

$l_e$ (in)	$d_a$ (in)	$\lambda$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{bx}$ (lb)
3.00	0.375	1.00	2500	13.75	16564

$$\phi V_{cbgx} = \phi (A_{Vc} / A_{Vco}) \psi_{ec,v} \psi_{ed,v} \psi_{c,v} \psi_{h,v} V_{bx} \text{ (Sec. D.4.1 \& Eq. D-22)}$$

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	$V_{bx}$ (lb)	$\phi$	$\phi V_{cbgx}$ (lb)
647.11	850.78	1.000	0.805	1.000	1.000	16564	0.70	7103

**Shear perpendicular to edge in y-direction:**

$$V_{by} = 7(l_e / d_a)^{0.2} \sqrt{d_a \lambda} \sqrt{f_c c_{a1}^{1.5}} \text{ (Eq. D-24)}$$

$l_e$ (in)	$d_a$ (in)	$\lambda$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{by}$ (lb)
3.00	0.375	1.00	2500	10.75	11450

$$\phi V_{cbgy} = \phi (A_{Vc} / A_{Vco}) \psi_{ec,v} \psi_{ed,v} \psi_{c,v} \psi_{h,v} V_{by} \text{ (Sec. D.4.1 \& Eq. D-22)}$$

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	$V_{by}$ (lb)	$\phi$	$\phi V_{cbgy}$ (lb)
387.00	520.03	1.000	0.891	1.000	1.000	11450	0.70	5313

**Shear parallel to edge in x-direction:**

$$V_{by} = 7(l_e / d_a)^{0.2} \sqrt{d_a \lambda} \sqrt{f_c c_{a1}^{1.5}} \text{ (Eq. D-24)}$$

$l_e$ (in)	$d_a$ (in)	$\lambda$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{by}$ (lb)
3.00	0.375	1.00	2500	7.25	6342

$$\phi V_{cbgx} = \phi (2)(A_{Vc} / A_{Vco}) \psi_{ec,v} \psi_{ed,v} \psi_{c,v} \psi_{h,v} V_{by} \text{ (Sec. D.4.1, D.6.2.1(c) \& Eq. D-22)}$$

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	$V_{by}$ (lb)	$\phi$	$\phi V_{cbgx}$ (lb)
261.00	236.53	1.000	1.000	1.000	1.000	6342	0.70	9797

**Shear parallel to edge in y-direction:**

$$V_{bx} = 7(l_e / d_a)^{0.2} \sqrt{d_a \lambda} \sqrt{f_c c_{a1}^{1.5}} \text{ (Eq. D-24)}$$

$l_e$ (in)	$d_a$ (in)	$\lambda$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{bx}$ (lb)
3.00	0.375	1.00	2500	10.25	10661

$$\phi V_{cbgy} = \phi (2)(A_{Vc} / A_{Vco}) \psi_{ec,v} \psi_{ed,v} \psi_{c,v} \psi_{h,v} V_{bx} \text{ (Sec. D.4.1, D.6.2.1(c) \& Eq. D-22)}$$

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	$V_{bx}$ (lb)	$\phi$	$\phi V_{cbgy}$ (lb)
401.67	472.78	1.000	1.000	1.000	1.000	10661	0.70	12680

**10. Concrete Pryout Strength of Anchor in Shear (Sec. D.6.3)**

$$\phi V_{cp} = \phi \min \{ K_{cp} N_{ag}; K_{cp} N_{cbg} \} = \phi \min \{ K_{cp} (A_{Na} / A_{Na0}) \psi_{ed,Na} \psi_{g,Na} \psi_{ec,Na} \psi_{p,Na} N_{a0}; K_{cp} (A_{Nc} / A_{Nco}) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \} \text{ (Eq. D-30b)}$$

$K_{cp}$	$A_{Na}$ (in <sup>2</sup> )	$A_{Na0}$ (in <sup>2</sup> )	$\psi_{ed,Na}$	$\psi_{g,Na}$	$\psi_{ec,Na}$	$\psi_{p,Na}$	$N_{a0}$ (lb)	$N_a$ (lb)
2.0	161.83	85.03	1.000	1.091	1.000	1.000	7929	16468

$A_{Nc}$ (in <sup>2</sup> )	$A_{Nco}$ (in <sup>2</sup> )	$\psi_{ec,N}$	$\psi_{ed,N}$	$\psi_{c,N}$	$\psi_{cp,N}$	$N_b$ (lb)	$N_{cb}$ (lb)	$\phi$
337.63	225.00	1.000	0.990	1.000	1.000	9503	14118	0.70

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



Company:		Date:	5/14/2018
Engineer:		Page:	6/6
Project:			
Address:			
Phone:			
E-mail:			

$\phi V_{cpq}$  (lb)  
19765

## 11. Results

### Interaction of Tensile and Shear Forces (Sec. RD.7)

Tension	Factored Load, $N_{ua}$ (lb)	Design Strength, $\phi N_n$ (lb)	Ratio	Status	
Steel	1195	3394	0.35	Pass	
Concrete breakout	4780	9176	0.52	Pass	
<b>Adhesive</b>	<b>4780</b>	<b>9057</b>	<b>0.53</b>	<b>Pass (Governs)</b>	
Shear	Factored Load, $V_{ua}$ (lb)	Design Strength, $\phi V_n$ (lb)	Ratio	Status	
Steel	750	1765	0.42	Pass	
T Concrete breakout x+	230	7103	0.03	Pass	
T Concrete breakout y-	2990	5313	0.56	Pass	
Concrete breakout y-	115	9797	0.01	Pass	
Concrete breakout x-	1495	12680	0.12	Pass	
<b>Concrete breakout, combined</b>	<b>-</b>	<b>-</b>	<b>0.56</b>	<b>Pass (Governs)</b>	
Pryout	2999	19765	0.15	Pass	
Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. RD.7	0.34	0.38	72.9%	1.0	Pass

**SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef = 5.000 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.

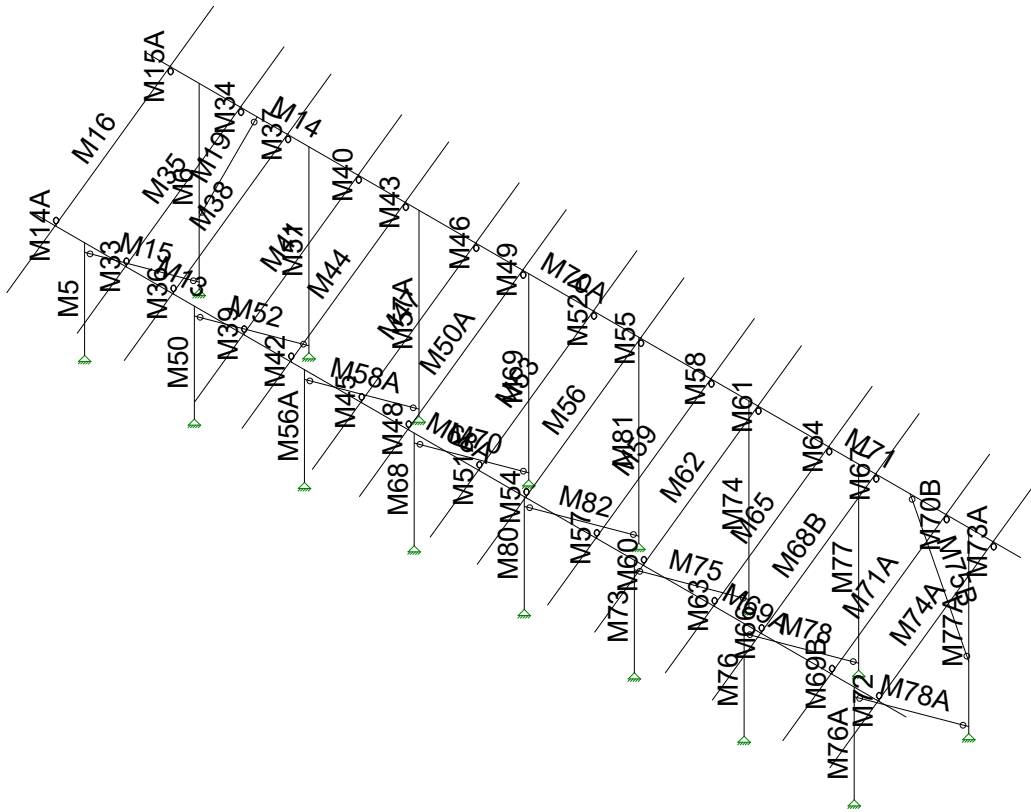


JOB NO.: U2716-093-191

DESIGNED: STB

---

# Framing Analysis



Envelope Only Solution

Vector Structural Engineeri...

STB

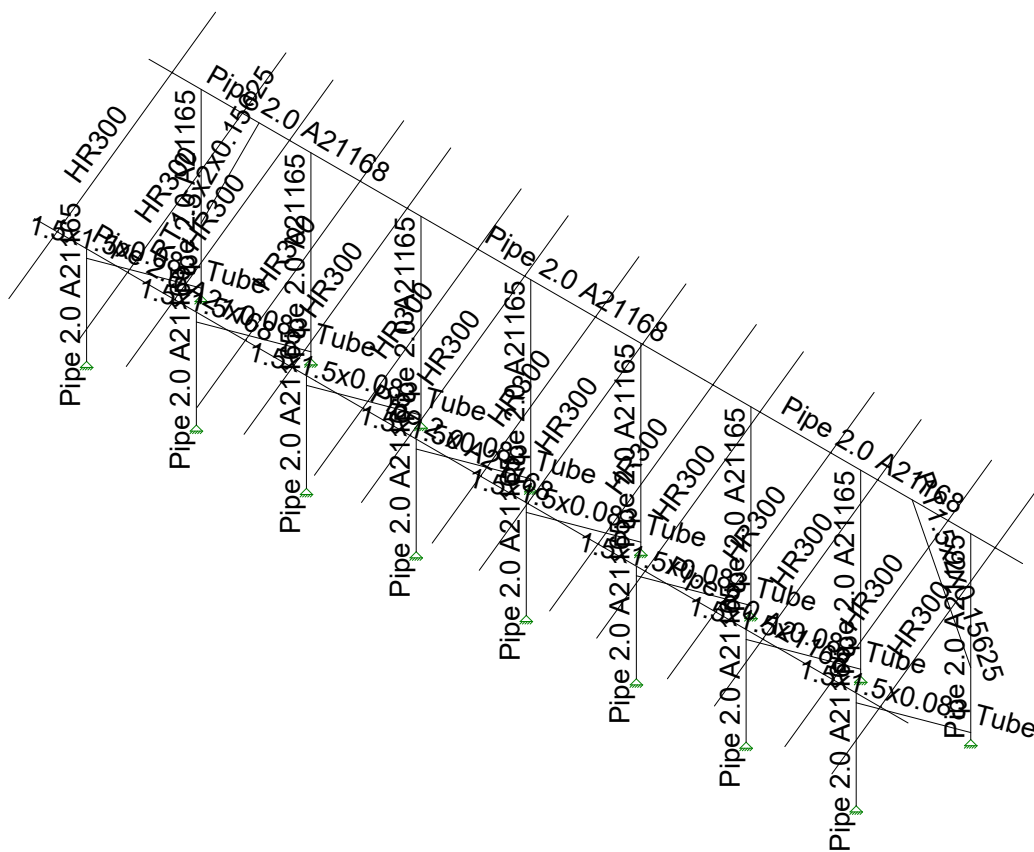
U2716.092.191

Ground Mount

SK - 3

June 7, 2019 at 2:43 PM

New England A2 v3.r3d



Vector Structural Engineeri...

STB

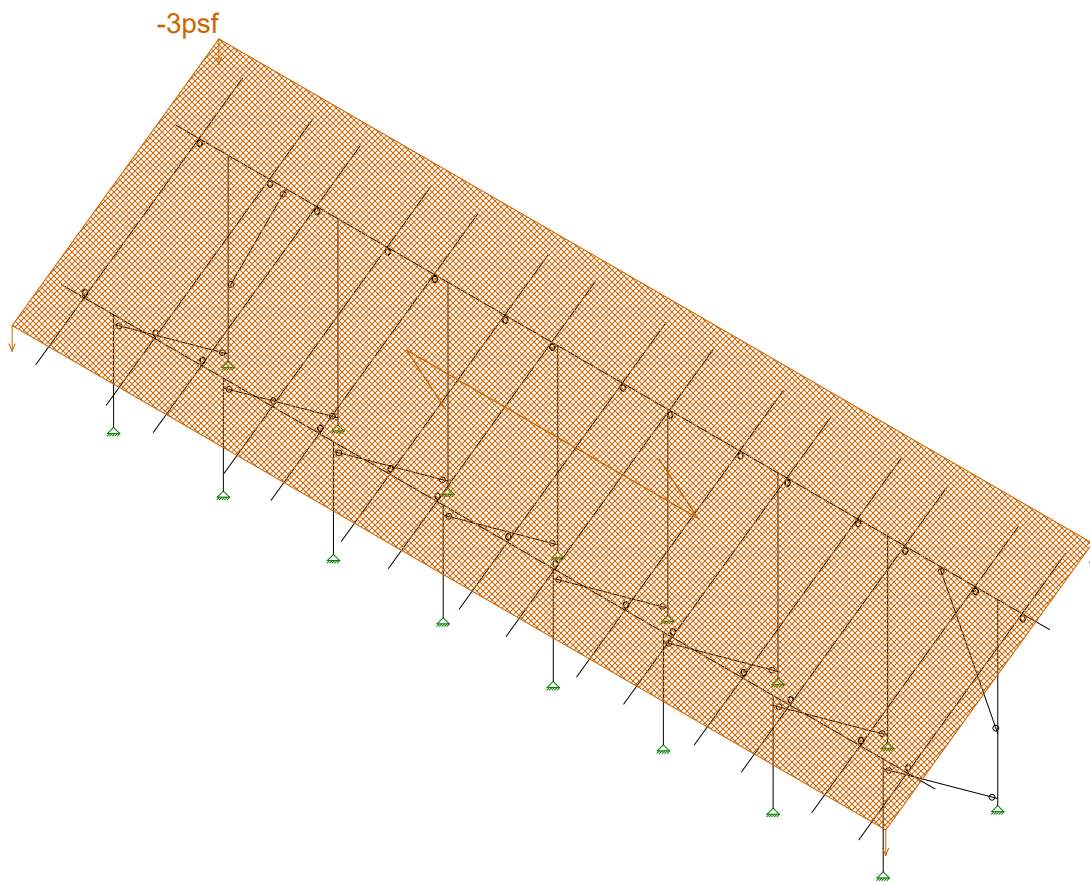
U2716.092.191

Ground Mount

SK - 7

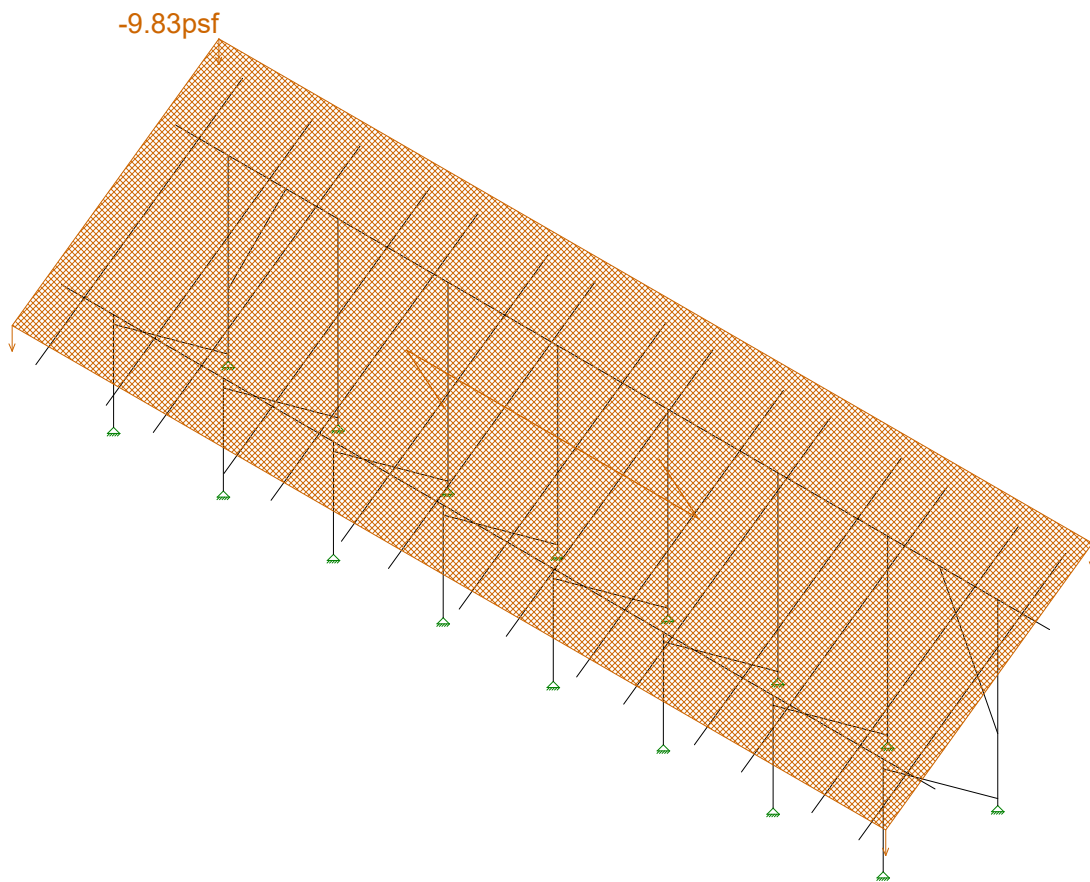
July 25, 2019 at 1:28 PM

New England A2 v3.r3d



Loads: BLC 2, Solar Panel Weight  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 5
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d



Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri..

STB

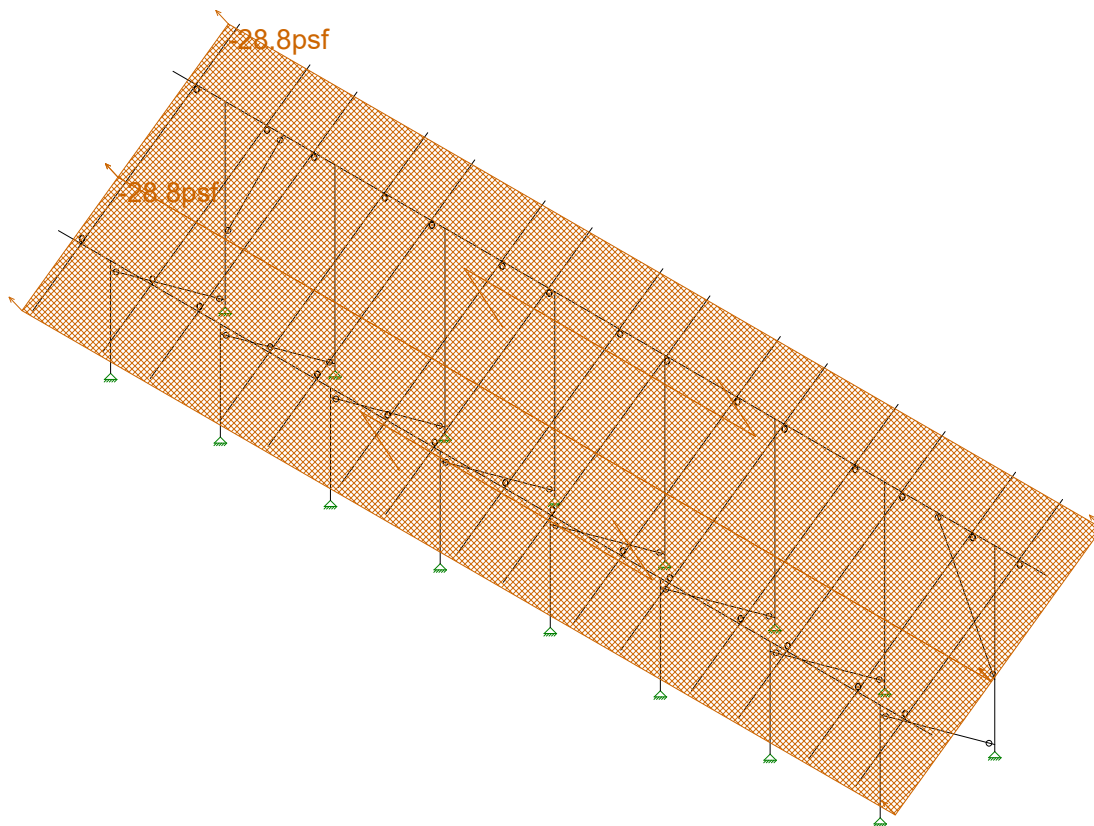
U2716.092.191

Ground Mount

SK - 2

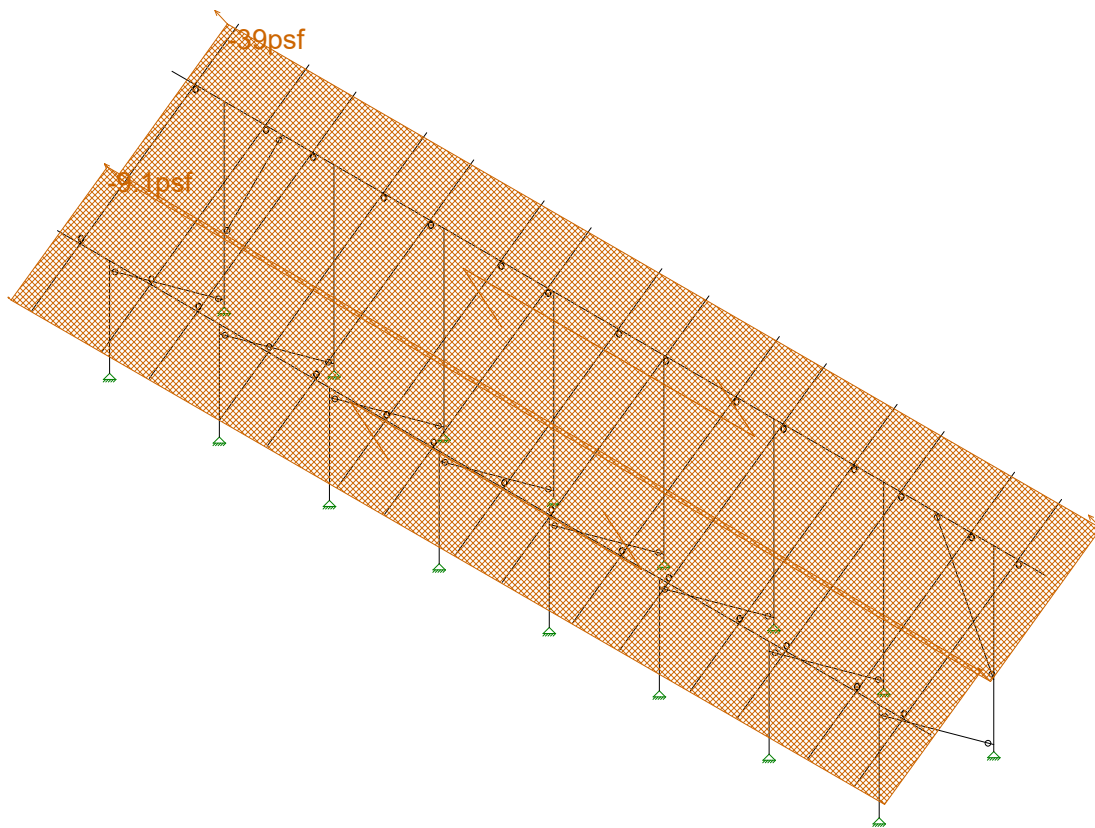
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New England A2 v3.r3d



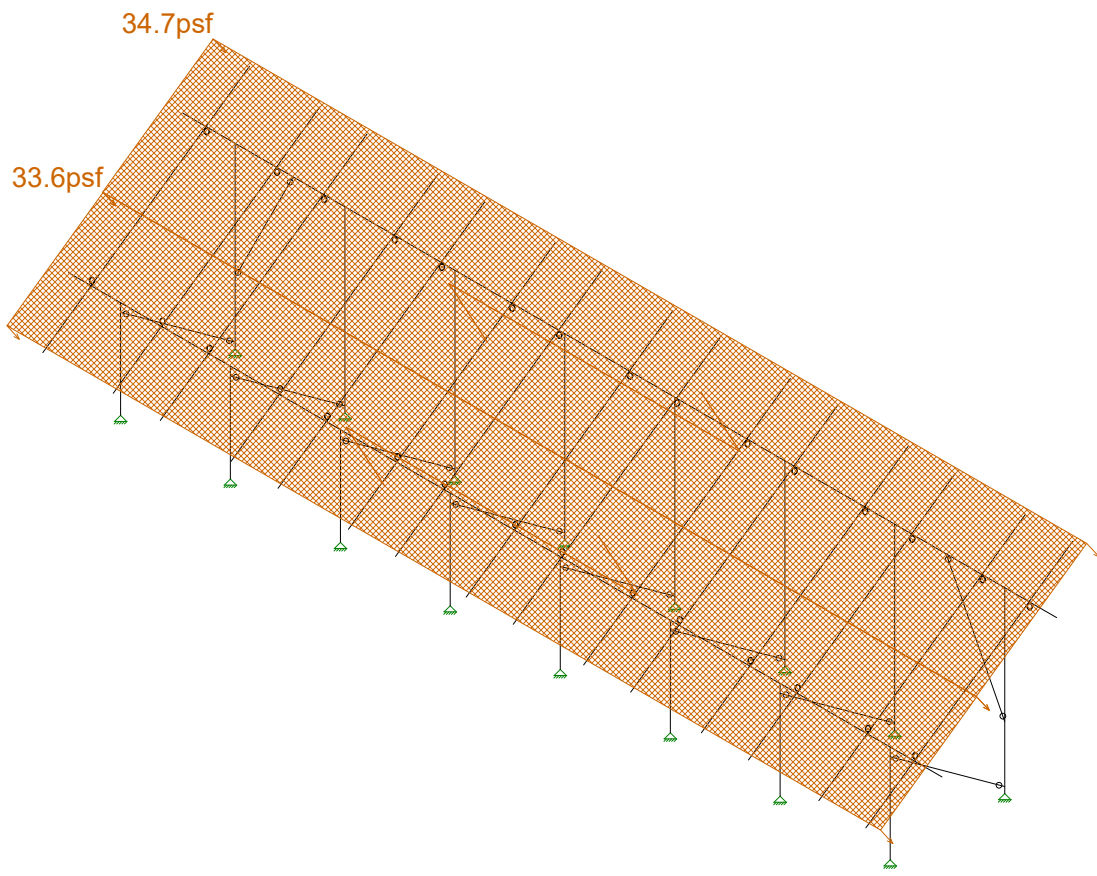
Loads: BLC 4, Wind A 0 deg  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 7
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d



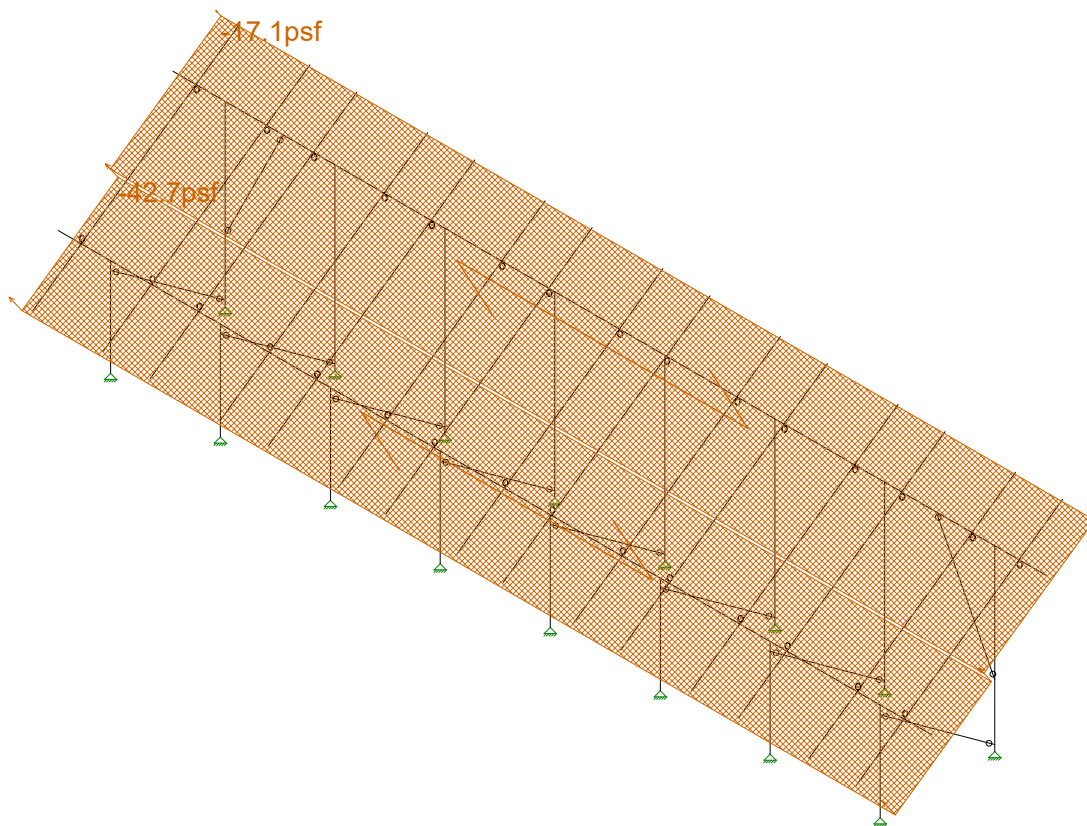
Loads: BLC 5, Wind B 0 deg  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 8
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d



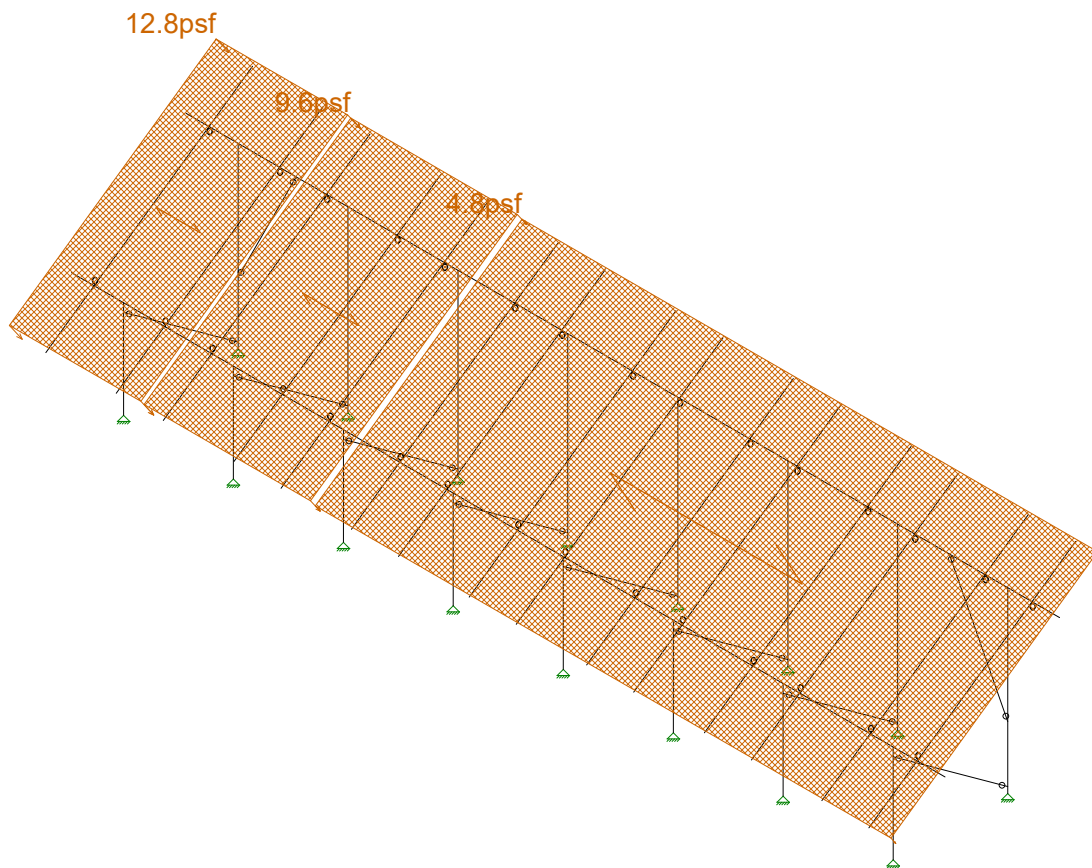
Loads: BLC 6, Wind A 180 deg  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 9
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d



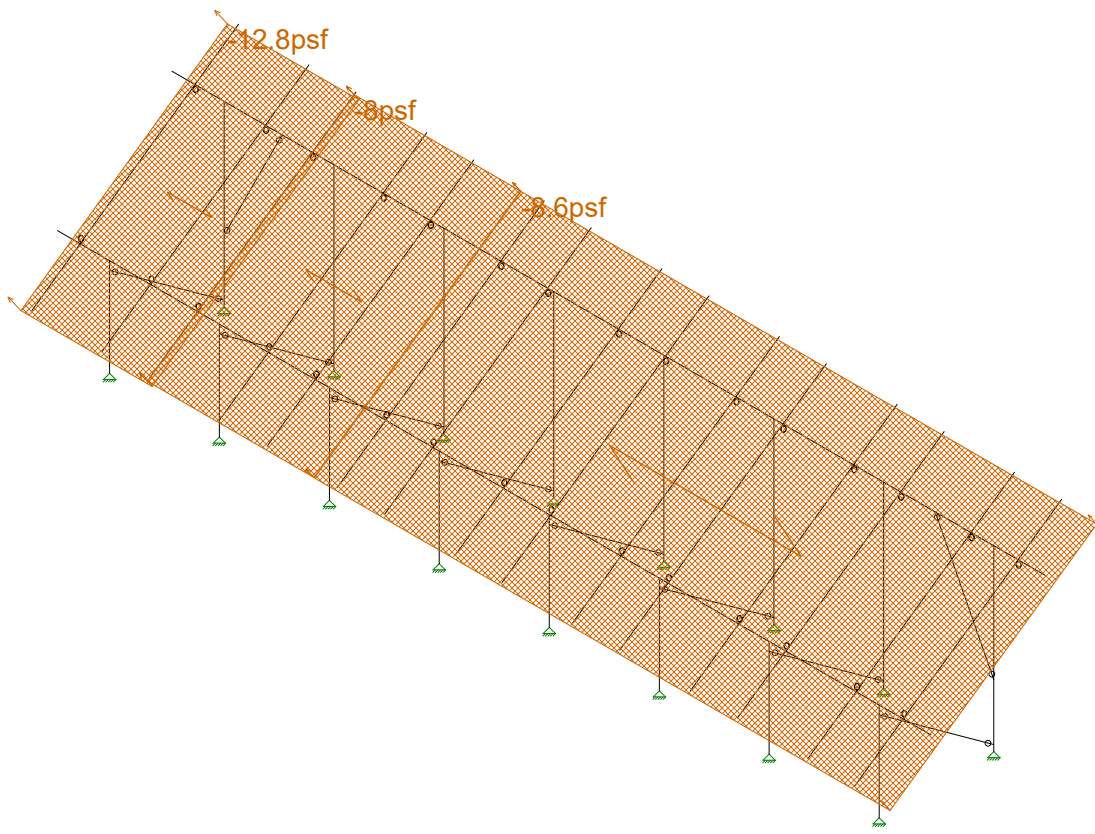
Loads: BLC 7, Wind B 180 deg  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 10
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d



Loads: BLC 8, Wind A 90  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 11
STB		June 7, 2019 at 2:43 PM
U2716.092.191		New England A2 v3.r3d

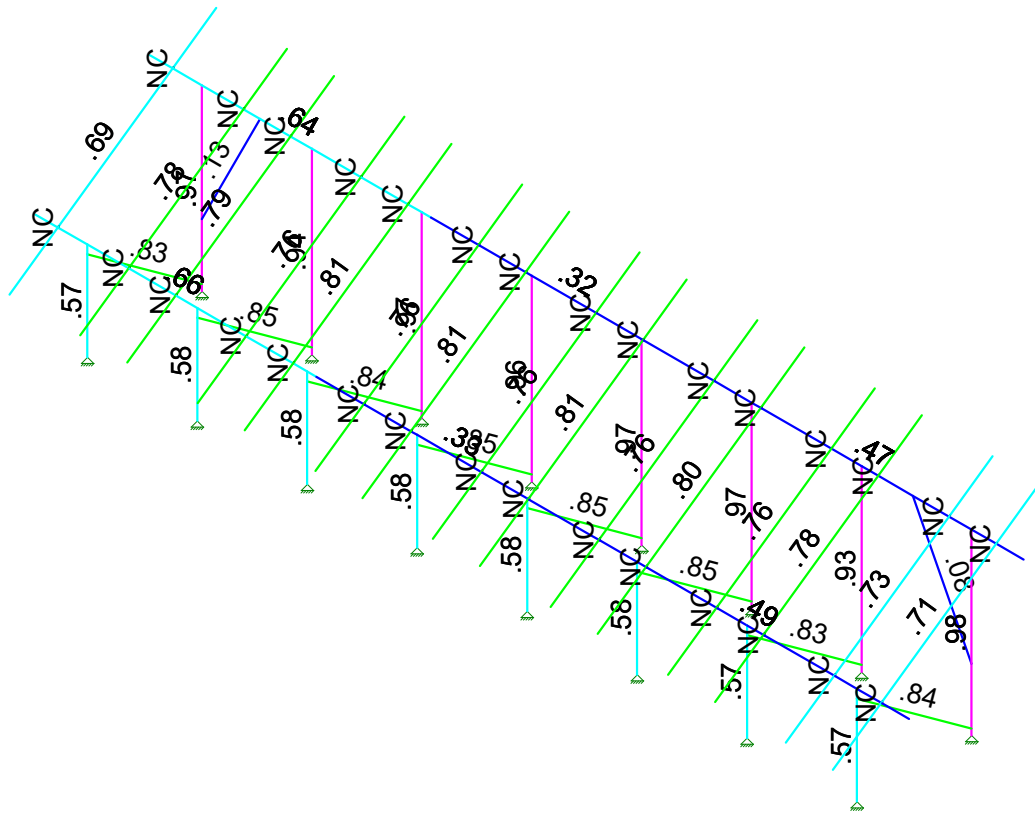


Loads: BLC 9, Wind B 90  
Envelope Only Solution

Vector Structural Engineeri..	Ground Mount	SK - 12
STB		June 7, 2019 at 2:44 PM
U2716.092.191		New England A2 v3.r3d



Code Check (Enr)	
Black	No Calc
Red	> 1.0
Yellow	.60-1.0
Green	.75-.90
Cyan	.50-.75
Blue	0-.50

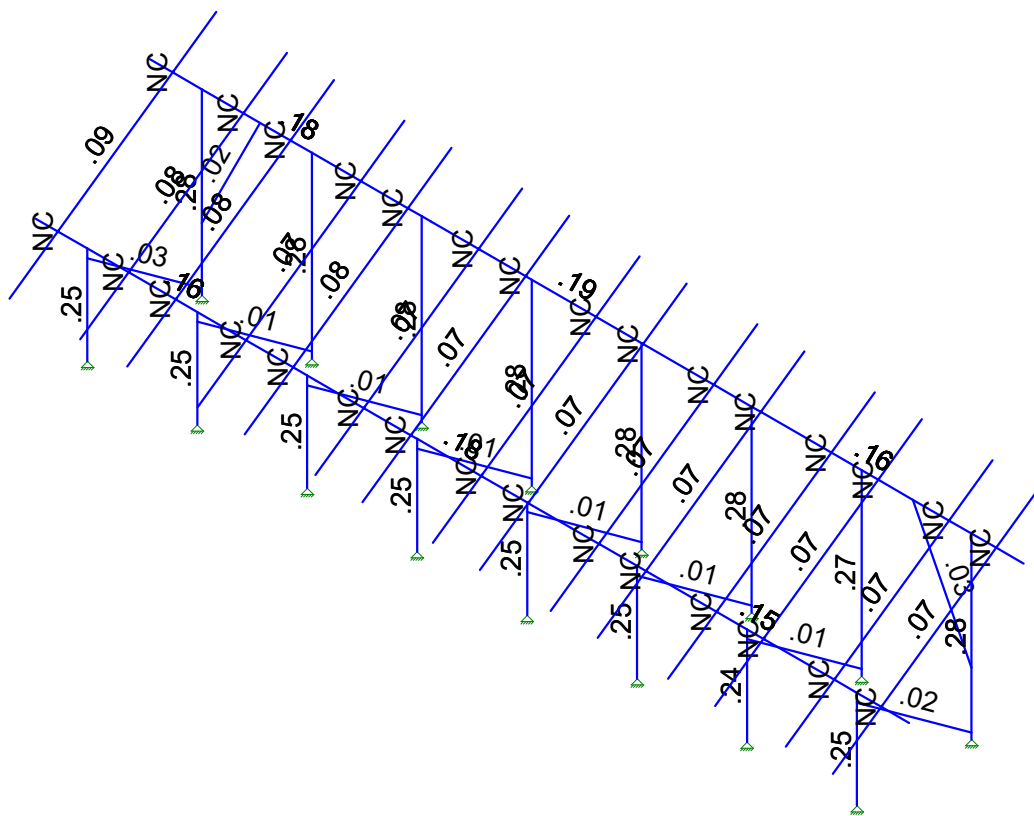


Member Code Checks Displayed (Enveloped)  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 5
STB		July 25, 2019 at 1:27 PM
U2716.092.191		New England A2 v3.r3d



Shear Check  
(Enr)  
No Calc  
> 1.0  
40-1.0  
75-50  
50-75  
0-.50



Member Shear Checks Displayed (Enveloped)  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 6
STB		July 25, 2019 at 1:27 PM
U2716.092.191		New England A2 v3.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 13th(360-05): ASD
Adjust Stiffness?	Yes(Iterative)
RISACONNECTION CODE	AISC 13th(360-05): ASD
Cold Formed Steel Code	AISI S100-07: ASD
Wood Code	AWC NDS-15: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-08
Masonry Code	ACI 530-08: ASD
Aluminum Code	AA ADM1-05: ASD - Building AISC 14th(360-10): ASD

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 7-10
Seismic Base Elevation (in)	15600
Add Base Weight?	Yes
Ct X	.02
Ct Z	.02
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	3
R Z	3
Ct Exp. X	.75
Ct Exp. Z	.75
SD1	1
SDS	1
S1	1
TL (sec)	5
Risk Cat	I or II
Drift Cat	Other
Om Z	1
Om X	1
Cd Z	4
Cd X	4
Rho Z	1
Rho X	1

**Hot Rolled Steel Properties**

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

**Aluminum Properties**

	Label	E [ksi]	G [ksi]	Nu	Therm (...Density[... Table 3.3	kt	Ftu[psi]	Fty[psi]	Fcy[psi]	Fsu[psi]	Ct
1	3003-H14	10100	3787.5	.33	1.3 172.8 Table 3.3-3	1	19000	16000	13000	12000	141
2	6061-T6	10100	3787.5	.33	1.3 172.8 Table 3.3-4	1	38000	35000	35000	24000	141
3	6063-T5	10100	3787.5	.33	1.3 172.8 Table 3.3-4	1	22000	16000	16000	13000	141
4	6063-T6	10100	3787.5	.33	1.3 172.8 Table 3.3-4	1	30000	25000	25000	19000	141
5	5052-H34	10200	3787.5	.33	1.3 172.8 Table 3.3-3	1	34000	26000	24000	20000	141
6	6061-T6 W	10100	3787.5	.33	1.3 172.8 Table 3.3-3	1	24000	15000	15000	15000	141
7	6005-T5	10100	3787.5	.33	1.3 172.8 Table 3.3-3	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 2.0 A21168	Beam	Wide Flange	A572 Gr.50	Typical	.947	.907	.907	1.814
3	Diagonal Brace	1.5x1.5x0.083 ...	HBrace	SquareTube	A36 Gr.36	Typical	.47	.158	.158	.236









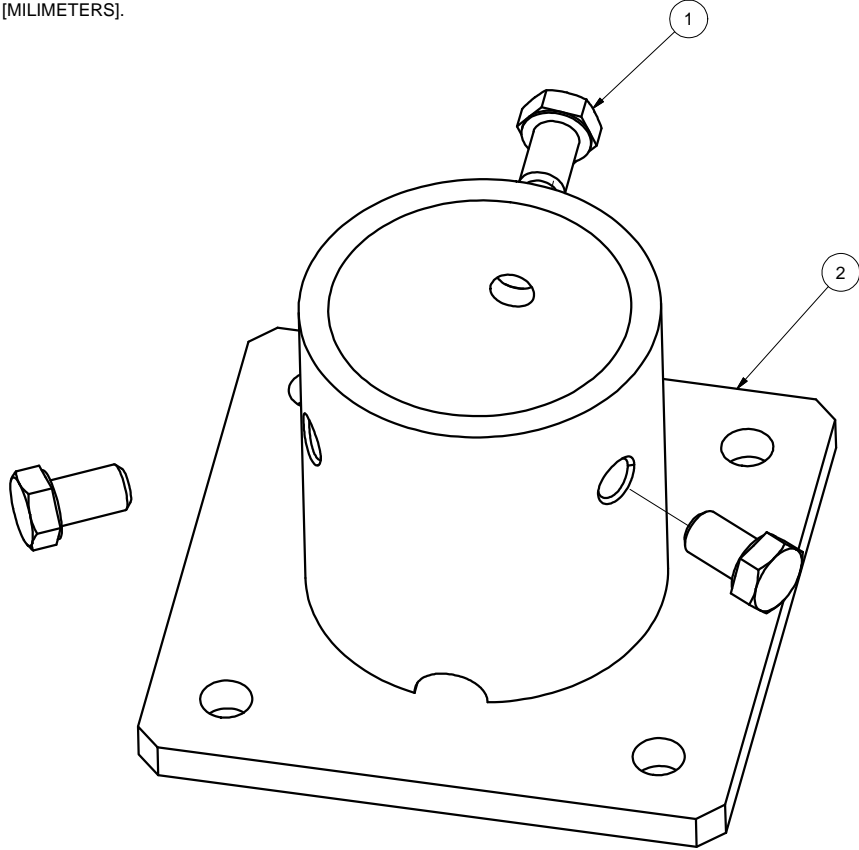
Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.092.191  
 Model Name : Ground Mount

July 25, 2019  
 1:28 PM  
 Checked By: \_\_\_\_\_

**Envelope AA ADM1-05: ASD - Building Aluminum Code Checks**

Member	Shape	Code	Loc[in]	LC	Shear	Loc[in]	Dir	LC	Fc [psi]	Ft [psi]	Fb y-y	Fb z-z	Fs y-y	Fs z-z	Cb	Cmy	Cmz	Eqn	
1	M19	RT1.5x2...	.129	52.207	5	.024	84.947	y	5	2325.7	19487	21212	20972	12246	12246	1	.6	.6	4.1.1-3
2	M16	HR300	.686	39.586	18	.088	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
3	M35	HR300	.777	39.586	18	.076	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
4	M38	HR300	.792	39.586	18	.078	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
5	M41	HR300	.764	37.865	18	.072	130	y	16	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
6	M44	HR300	.808	39.586	18	.079	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
7	M47	HR300	.764	37.865	18	.070	39.586	y	5	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
8	M50A	HR300	.813	39.586	18	.073	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
9	M53	HR300	.764	37.865	18	.068	39.586	y	5	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
10	M56	HR300	.810	39.586	18	.068	39.586	y	5	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
11	M59	HR300	.764	37.865	18	.070	130	y	16	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
12	M62	HR300	.799	39.586	18	.073	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
13	M65	HR300	.764	37.865	18	.073	130	y	16	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
14	M68B	HR300	.780	39.586	18	.072	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
15	M71A	HR300	.728	39.586	18	.072	130	y	16	4493.9	19487	19667	21212	12246	12246	1	.6	.6	4.1.1-3
16	M74A	HR300	.712	37.865	18	.070	130	y	16	4493.9	19487	19487	19487	12246	12246	1	.6	.6	4.1.2-1
17	M75B	RT1.5x2...	.083	52.276	5	.026	0	y	5	2319.5	19487	21212	20970	12246	12246	1	.6	.6	4.1.1-3

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



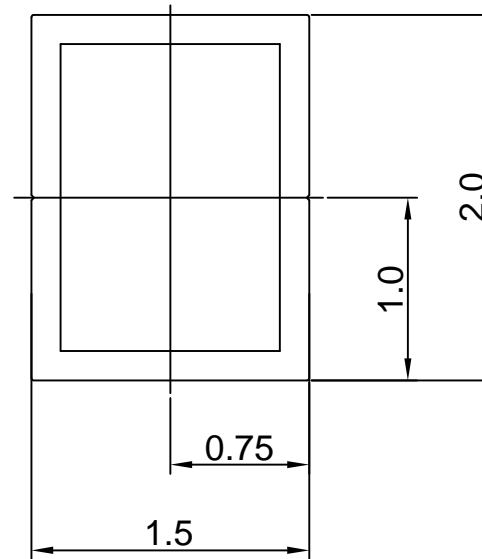
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REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

2	A21120-001	2" PIPE BASE	1
1	B15018-011	HEX CAP SCREW 3/8-16 X 5/8	3
ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<b>Sunmodo Corp.</b> 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661	
Tolerances		TITLE	
X.XXX ±0.01 [0.25mm]		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. MATERAIL: ALUMINUM 6005-T5.  
FINISH: CLEAR ANODIZED 10  $\mu$ m THICK.
3. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.



## Section properties:

Weight: 1.156 lbs/ft

Area: 0.992 in<sup>2</sup>

Perimeter: 12.601 in

Bounding Box: X: -1.000,1.000

Y: -0.750, 0.750

Centroid:(0.000,0.000)

Moments of Inertia(in<sup>4</sup>): I<sub>x</sub>=0.506,I<sub>y</sub>=0.322

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

Radii of Gyration: X: 0.714, Y: 0.570

MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS			
All Dimensions in inches [millimeters]			
Tolerances			
X.XXX ± 0.01 [0.25mm]		Break all sharp edges	
X.XX ± 0.02 [0.50mm]		.010-.020 unless	
X.X ± 0.039 [1.0mm]		otherwise specified.	
Unless otherwise specd			
DRAWN BY	DATE		
zcg	03/12/2014		
CHECKED BY		B	DRAWING NUMBER
			A20164
APPROVALS		SCALE:	NONE
		SHEET	1 of 1

**Sunmodo Corp.**

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

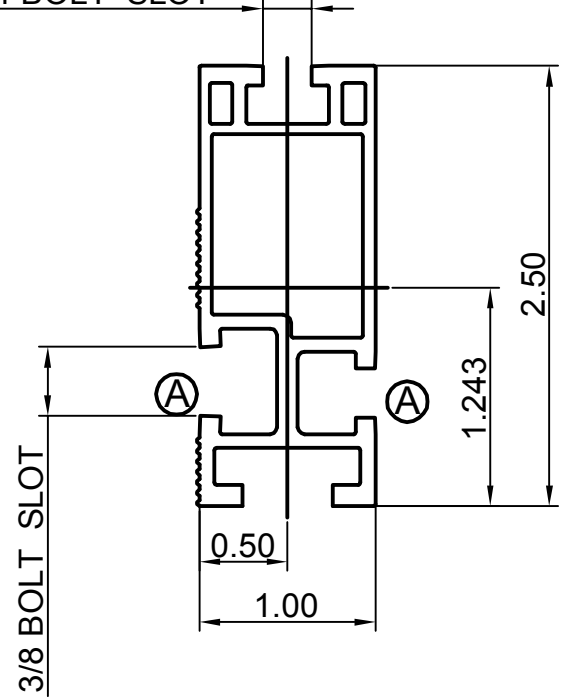
TITLE  
1.5X2 AL TUBE BRACE EXTRUSION

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

NOTES: UNLESS OTHERWISE SPECIFIED

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

2X 1/4 BOLT SLOT



### Section properties:

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

Centroid:(0.000,0.000)  
 Moments of Inertia(in<sup>4</sup>): I<sub>x</sub>=0.486,I<sub>y</sub>=0.095  
 Section modulus in bending(in<sup>3</sup>): W<sub>x</sub>=0.387,W<sub>y</sub>=0.190  
 Radii of Gyration: X: 0.820, Y: 0.363

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	02/21/2013	
CHECKED BY		
APPROVALS		

<b>Sunmodo Corp.</b>	
1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
TITLE HELIO STANDARD RAIL	
DRAWING NUMBER	A20144
SCALE:	NONE
SHEET	1 of 1

4

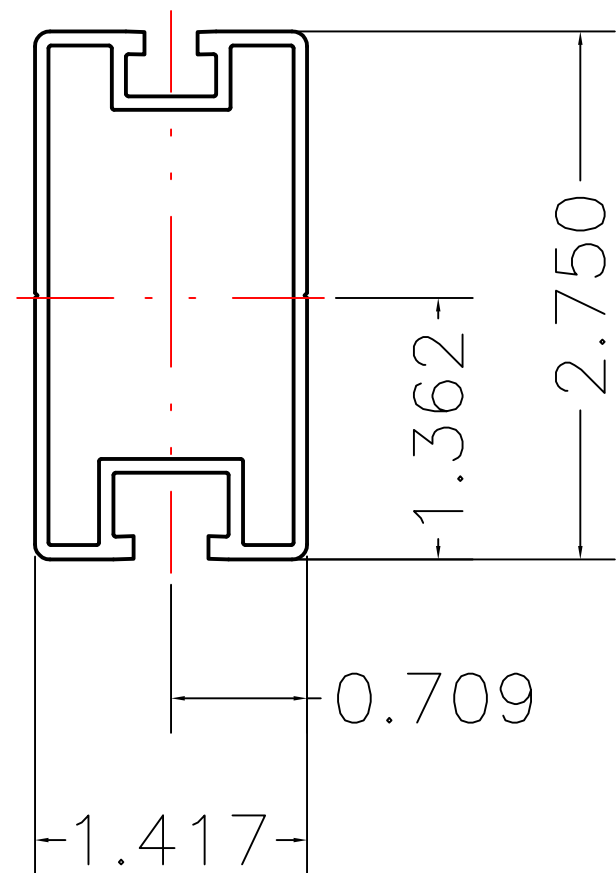
3

2

1

NOTES: UNLESS OTHERWISE SPECIFIED

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



### Section properties:

Weight: 0.862 lbs/ft  
 Area: 0.736 in<sup>2</sup>  
 Perimeter: 19.824 in  
 Bounding Box: X: -0.709,0.709  
                   Y: -1.362,1.388  
 Centroid:(0.000,0.000)  
 Moments of Inertia(in<sup>4</sup>): I<sub>x</sub>=0.727,I<sub>y</sub>=0.214  
 Section modulus in bending(in<sup>3</sup>): W<sub>x</sub>=0.524,W<sub>y</sub>=0.302  
 Radii of Gyration: X: 994, Y: 0.539

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

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

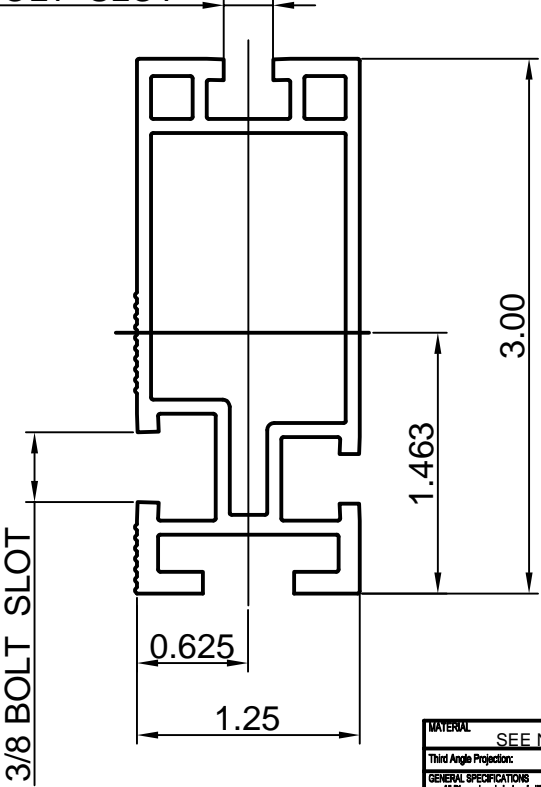
THIS DRAWING IS CONFIDENTIAL PROPERTY OF SUNMODO AND ITS CONTENTS MAY NOT BE DISCLOSED WITHOUT THE PRIOR WRITTEN CONSENT OF SUNMODO CORP.

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

NOTES: UNLESS OTHERWISE SPECIFIED

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

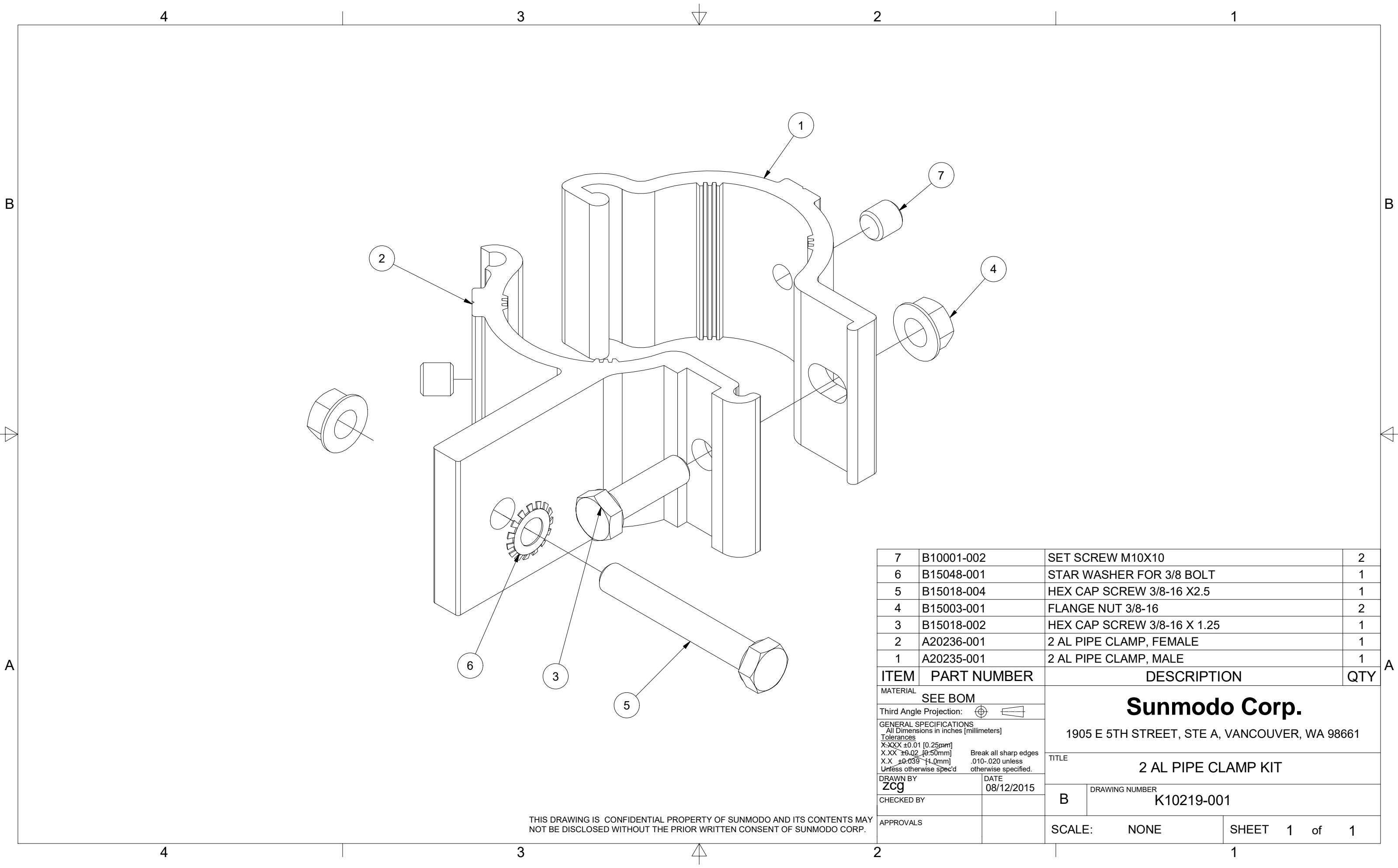
2X 1/4 BOLT SLOT



**Section properties:**

Weight: 1.151 lbs/ft  
 Area: 0.980 in<sup>2</sup>  
 Perimeter: 22.104 in  
 Bounding Box: X: -0.625,0.625  
                   Y: -1.463,1.537  
 Centroid:(0.000,0.000)  
 Moments of Inertia(in<sup>4</sup>): Ix=1.047,Iy=0.207  
 Section modulus in bending(in<sup>3</sup>): Wx=0.681,Wy=0.331  
 Radii of Gyration: X: 1.034, Y: 0.460

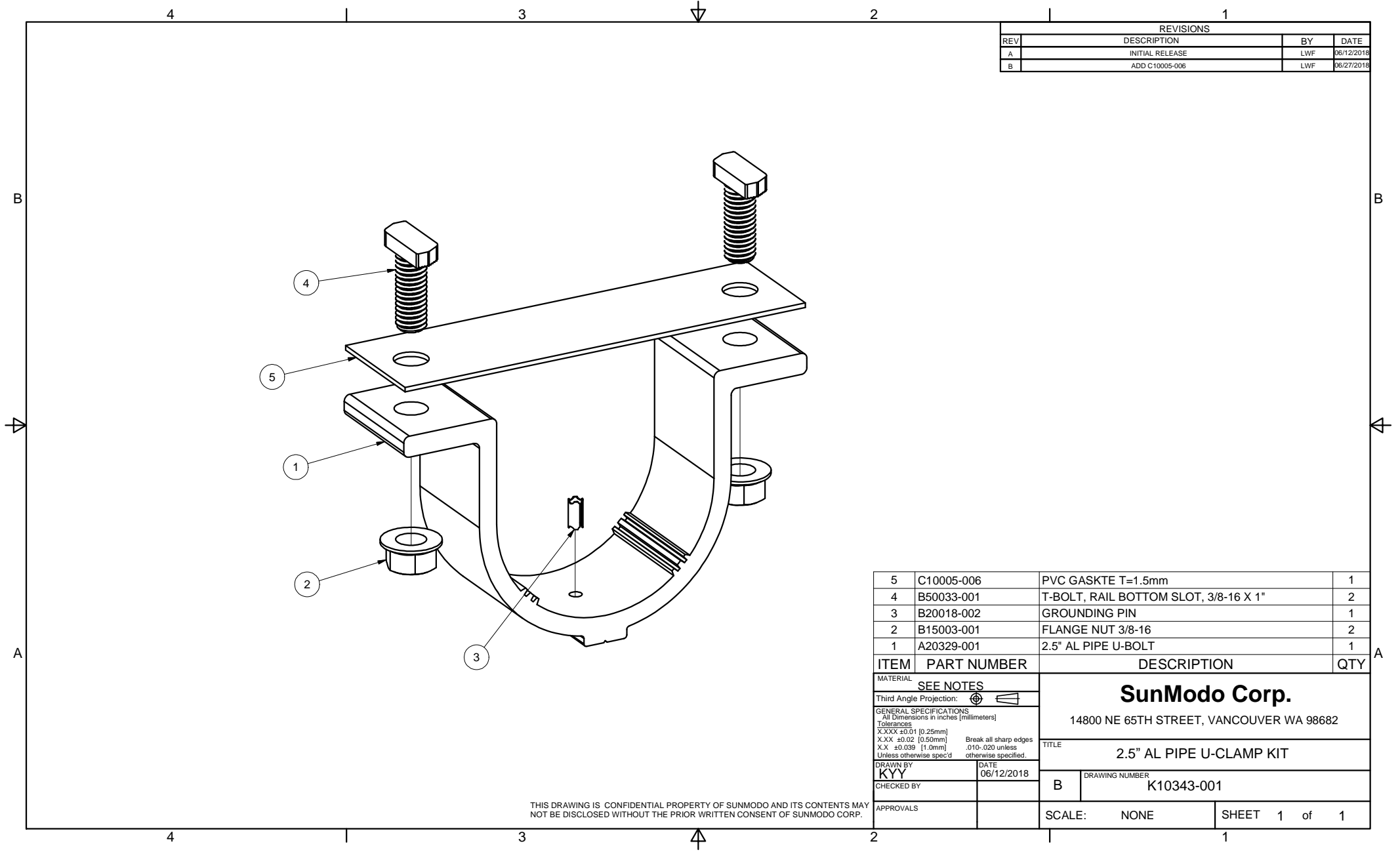
MATERIAL		SEE NOTES	
Third Angle Projection			
GENERAL SPECIFICATIONS			
All Dimensions in Inches [millimeters]			
Tolerances			
XXX ±0.01 (0.25mm)			
XX ±0.02 (0.50mm)			
X ±0.03 (1.0mm)			
Unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2015	
CHECKED BY		DATE	
APPROVALS		DATE	
Sunmodo Corp.		1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
TITLE		HELIO HEAVY RAIL	
DRAWING NUMBER		A20145	
SCALE:		NONE	
SHEET		1 of 1	



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

ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE BOM	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches (millimeters)			
Tolerances			
X.XXX ±0.01 [0.25mm]		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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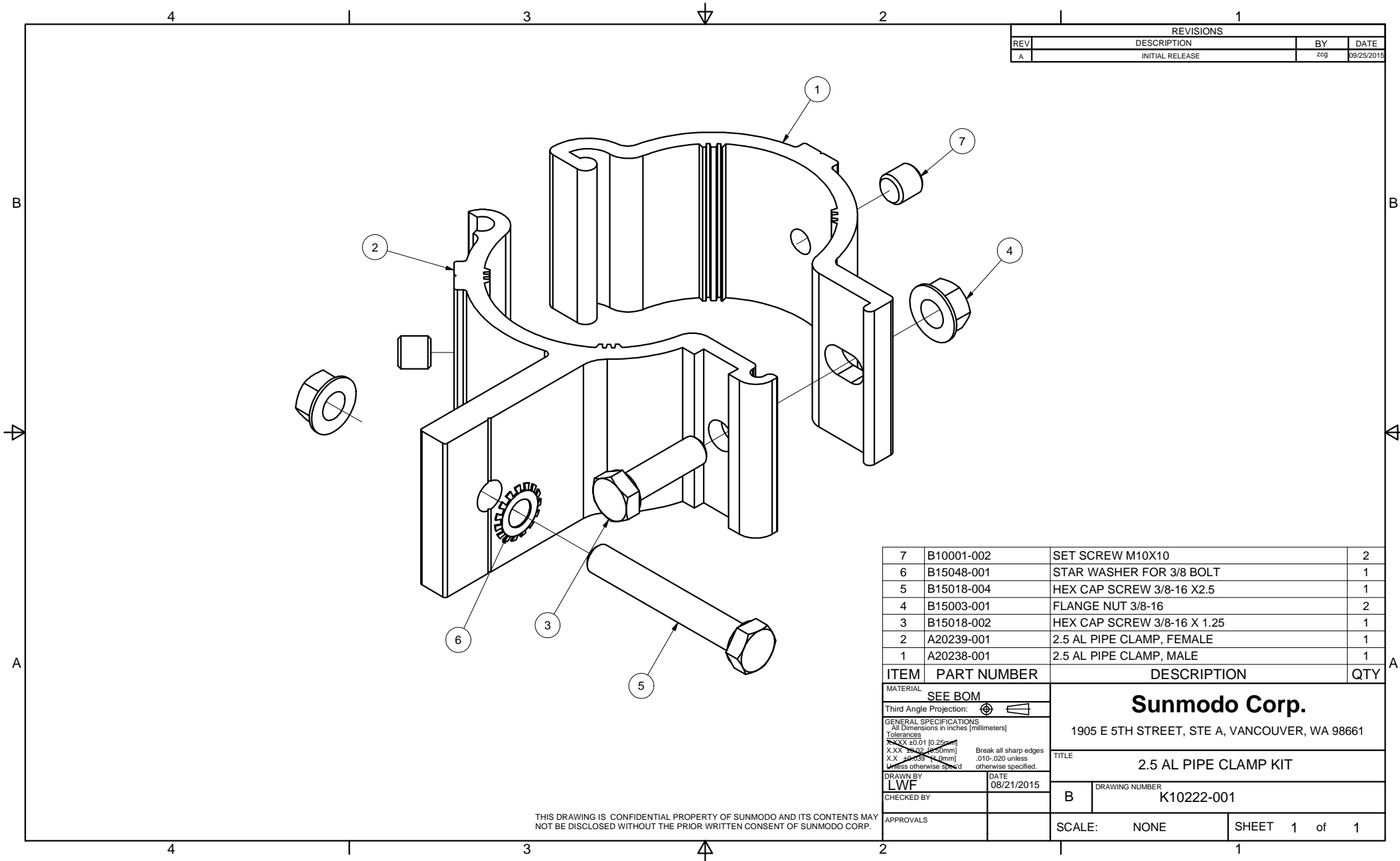


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	06/27/2018

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		<b>SEE NOTES</b>	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<p><b>SunModo Corp.</b> 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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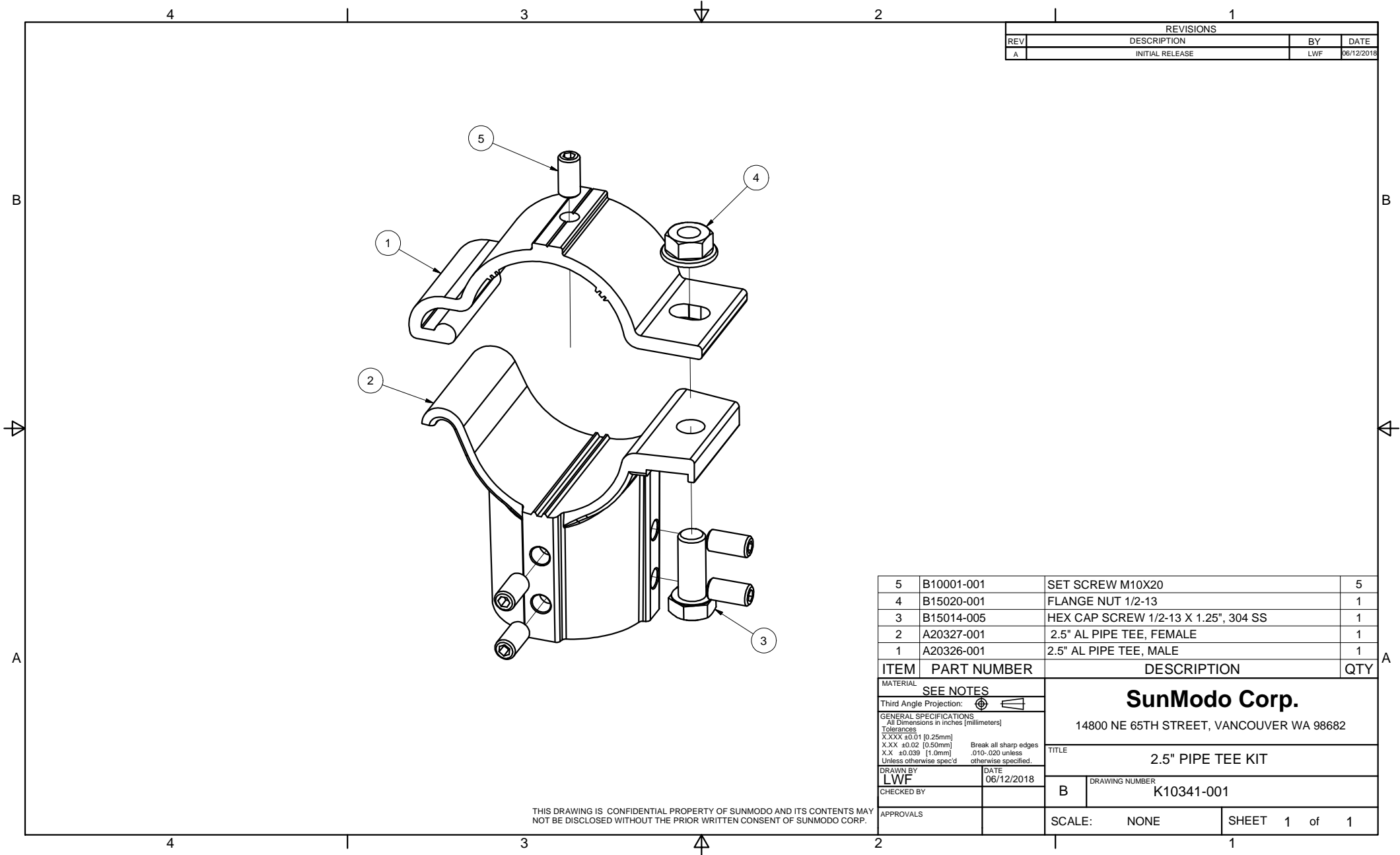


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	zcg	09/25/2015

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		<b>SEE BOM</b>	
Third Angle Projection:			
<b>GENERAL SPECIFICATIONS</b> All Dimensions in inches [millimeters] <b>Tolerances</b> X.XX ±0.01 [0.25mm] X.X ±0.02 [0.5mm] 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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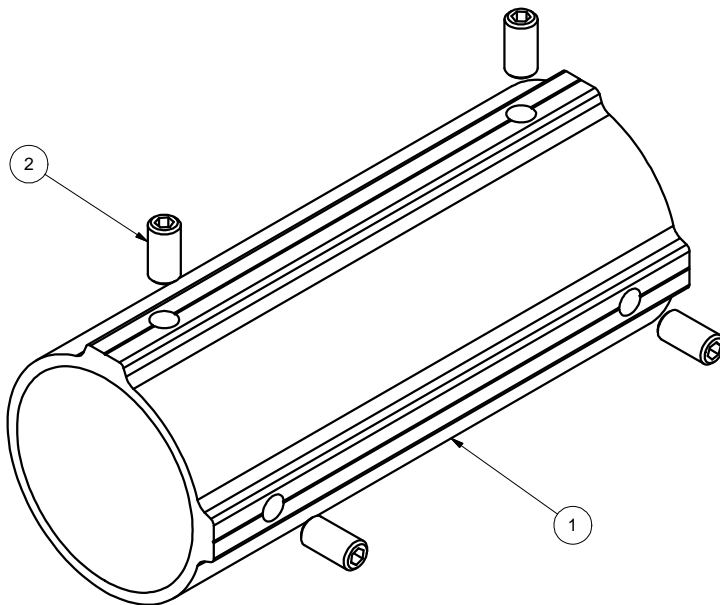
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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

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

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



2	B10001-001	SET SCREW M10X20	4
1	A20328-001	2.5" PIPE SPLICE	1
ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<b>SunModo Corp.</b> 14800 NE 65TH STREET, VANCOUVER WA 98682	
All Dimensions in inches [millimeters] Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd		Break all sharp edges .010-.020 unless otherwise specified.	
DRAWN BY		TITLE	
LWF		2.5" PIPE SPLICE KIT	
DATE		DRAWING NUMBER	
06/12/2018		B K10342-001	
CHECKED BY		SCALE: NONE	
APPROVALS		SHEET 1 of 1	

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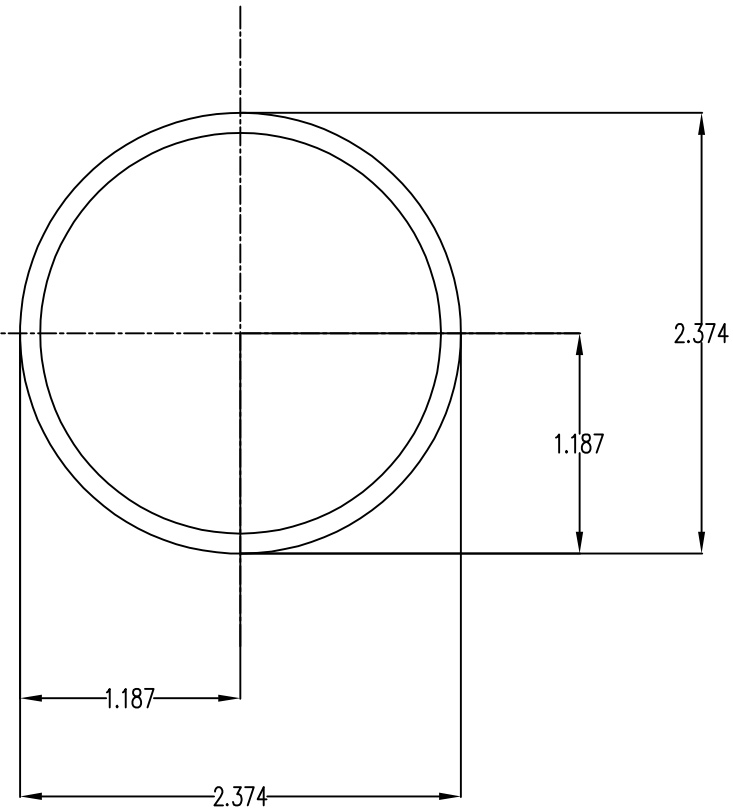
NOTES: UNLESS OTHERWISE SPECIFIED

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

MINIMUM 50 KSI YIELD STRESS.

4. BREAK ALL BURRS AND SHARP EDGES.

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



## Section properties:

Weight: 2.641 lbs/ft

Area: 0.776 in<sup>2</sup>

Perimeter: 14.238 in

Bounding Box: X: -1.187,1.187

Y: -1.187,1.187

Centroid:(0.000,0.000)

Moments of Inertia(in<sup>4</sup>): I<sub>x</sub>=0.499,I<sub>y</sub>=0.499

Section modulus in bending(in<sup>3</sup>): W<sub>x</sub>=0.420,W<sub>y</sub>=0.420

Radii of Gyration: X: 0.802, Y: 0.802

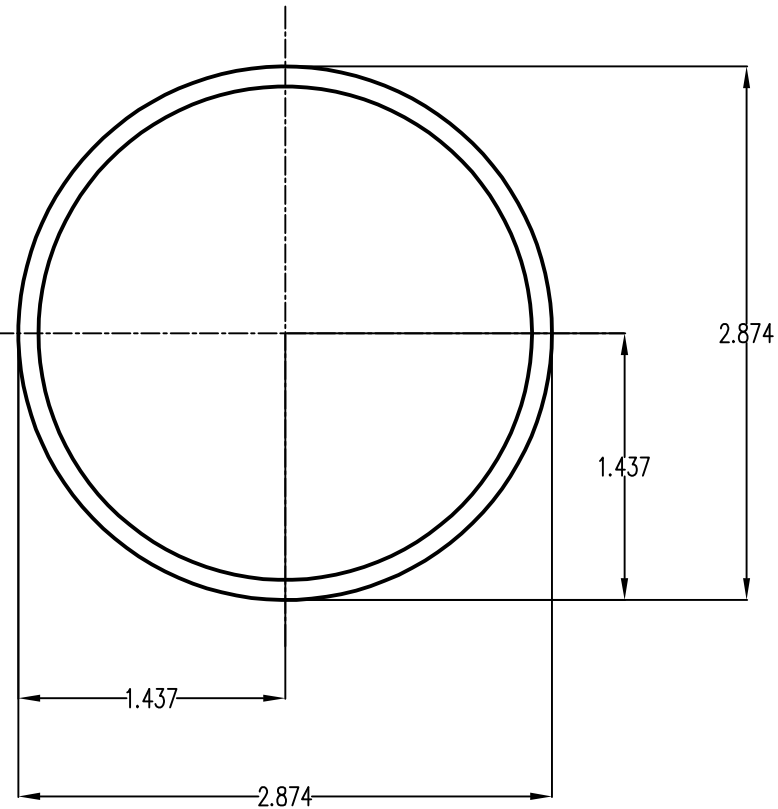
MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE,L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (0.25mm)					
XX ±0.02 (0.50mm)					
X ±0.050 (1.27mm)					
Unless otherwise specified					
DRAWN BY		DATE		DRAWING NUMBER	
LWF		04/03/2019		A21165	
CHECKED BY				B	
APPROVALS				SCALE: NONE	
				SHEET 1 of 1	

NOTES: UNLESS OTHERWISE SPECIFIED

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

MINIMUM 50 KSI YIELD STRESS.

4. BREAK ALL BURRS AND SHARP EDGES.
5. ALL WELDING MUST BE IN COMPLIANCE WITH AWS CODE D1;1.



### Section properties:

Weight: 3.201 lbs/ft

Area: 0.941 in<sup>2</sup>

Perimeter: 17.378 in

Bounding Box: X: -1.437,1.437

Y: -1.437,1.437

Centroid:(0.000,0.000)

Moments of Inertia(in<sup>4</sup>): Ix=0.901,Iy=0.901

Section modulus in bending(in<sup>3</sup>): Wx=0.627,Wy=0.627

Radii of Gyration: X: 0.979, Y: 0.979

MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS All Dimensions in Inches (millimeters)				TITLE	
Tolerances XXX ±0.01 (0.25mm) XX ±0.02 (0.50mm) X ±0.030 (1.0mm) Unless otherwise specified				PIPE, HSS, 2.875" OD X 12 GAUGE,L=XXX	
DRAWN BY LWF		DATE 04/03/2019		DRAWING NUMBER A21168	
CHECKED BY				B	
APPROVALS				SCALE: NONE SHEET 1 of 1	