



VSE Project Number:

REFERENCE:

Ground Mount Solar Array Foundation Installation

To Whom It May Concern:

Per your request, we have reviewed the proposed ground mount solar array installation at the above referenced site. The purpose of our review was to determine the adequacy of the proposed ground screw foundations (interaction of screw with soil only, capacity of screw by others) for the ground mount solar array installation. Design of all other structural components of the ground mount system is beyond the scope of this letter and is the responsibility of others.

Based upon our review the ground screw foundations are adequate when installed as described in this letter and the plans stamped by our office.

Design Parameters

Code: National Building Code - 2019 Alberta Edition (2015 NBC)

Importance Category: Low

Terrain: Open

1/50 Hourly Wind Pressure: 0.43 kPa

1/50 Ground Snow Load: 1.6 kPa

1/50 Associated Rain Load: 0.1 kPa

Ground Mount Geometry

See plans stamped by our office.

Ground Mount Foundation

Ground screws, designed by others. Min. (1) screw shall be tested for, and deflections limited to, the values listed below. We recommend sacrificial screws be used for the testing. We also recommend the sacrificial tests be performed prior to fabrication of the rest of the ground mount. The tests will determine the final ground screw design and/or column spacing so fabrication can be finalized. Testing values for 30,45,60 tilts.

- 1651 lbs uplift (Includes 1.5 Factor of Safety); Deflection shall be limited to 1/2"
- 1730 lbs lateral (Includes 2.0 Factor of Safety); Deflection shall be limited to 1 " This test load shall be applied at a point on the pile 4'-8" above the ground

The following test limits and guidelines shall be employed for testing.

- The load tests must be performed by a qualified contractor
- A test is considered to have failed if deflection limits are exceeded prior to reaching test loads
- In the event of a failed test, one of the following options may be followed:
 - a. See manufacturer recommendations to increase ground screw capacity
 - b. Contact the Vector Structural Engineering, LLC to determine if the spacing between columns needs to be reduced

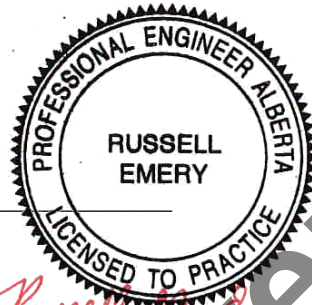


Limitations

All components of the ground mounted solar array 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, racking or foundations. Please note that a representative of Vector Structural Engineering has not physically observed site conditions.

VECTOR STRUCTURAL ENGINEERING, LLC

AB Firm License: 14521



Russell Emery, P.Eng

AB License: 257430 - Expires: 08/31/2024

Project Engineer

Enclosures

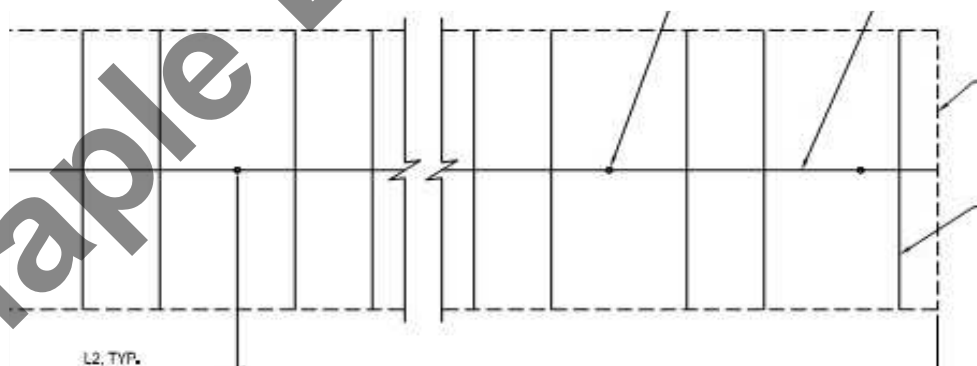
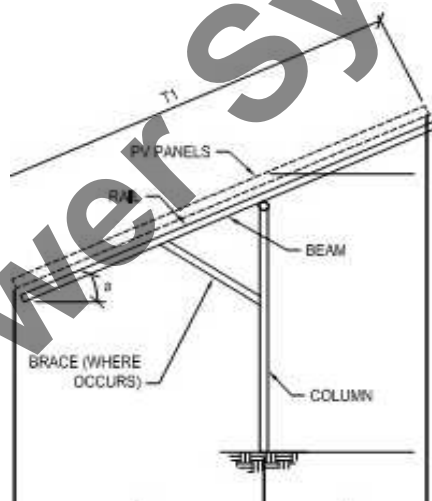
Russell M. Emery
ID # 257430
2023-12-20

Maple Leaf Power Systems

PROJECT:

Mount Geometry

Panel Orientation:	Portrait
Panel Width (short dimension) [in]:	45
Panel Length (long dimension) [in]:	89
No. of Panels in Transverse Direction:	1
No. of Panels in Longitudinal Direction:	4
Transverse Length Along Slope (T1) [ft]:	7.4
Projected Transverse Length (T2) [ft]:	6.4
Longitudinal Length (L1) [ft]:	15.1
No. of Columns in Tranverse Direction:	1
Transverse Overhang (T4) [ft]:	3.2
Transverse Overhang (T5) [ft]:	3.2
No. of Columns in Longitudinal Direction:	3
Longitudinal Column Spacing (L2) [ft]:	5.9
Longitudinal Overhang (L3) [ft]:	1.6
Panel Slope from Horizontal (a) [°]:	30
Transverse Ground Slope [°]:	0
Longitudinal Ground Slope [°]:	0
Leading Edge Height [ft]:	2.3
Min. Array Height at Column(H) [ft]:	4.1
Max. Array Height at Column (H) [ft]:	4.1
Trailing Edge Height [ft]:	6.0





PROJECT:

30° Tilt

DEAD LOADS

Panel & Rail Weight [psf]:	3.0
Tributary Area per Column [ft ²]:	43.7
Weight per Column [lbs]:	131.1

Beam Weight [plf]:	2.7
Tributary Length per Column [ft]:	5.9
Weight per Column [lbs]:	16.1

Brace Weight [plf]:	NA
Tributary Length per Column [ft]:	
Weight per Column [lbs]:	

Column Weight [plf]:	2.7
Max. Column Height [ft]:	4.1
Min. Column Height [ft]:	4.1
Max. Column Weight [lbs]:	11.2
Min. Column Weight [lbs]:	11.2

Max. Total Weight Per Column [lbs]:	158.4	(1.0 Dead)
Min. Total Weight per Column [lbs]:	158.4	(1.0 Dead)

Maple Leaf Power Systems



PROJECT:

30° Tilt

SNOW LOADS

Design Snow Load, S [psf]: (1.0 Snow)

Tributary Area per Column [ft²]:

Snow Load per Column [lbs]: (1.0 Snow)

Maple Leaf Power Systems



PROJECT:

30° Tilt

WIND PRESSURES

Calculations per:	ASCE 7-10	
Design Wind Speed, V [mph]:	105	
Risk Category:	I	(Table 1.5-1)
Exposure Category:	C	(Section 26.7)
Elevation [ft]:	2178.5	
Ground Elevation Factor, K_e :		(Not applicable)
α :	9.5	(Table 26.9.1)
z_g [ft]:	900	(Table 26.9.1)
Velocity Pressure Exposure Coefficient, K_h :	0.85	(Table 27.3-1)
Topographic Factor, K_{ht} :	1.0	(Section 26.8)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, GC_{pi} :	0.00	(Figure 26.11-1)
Velocity Pressure, q_h [psf]:	20.37	(Equation 27.3-1)
Gust Effect Factor, G:	0.85	(Section 26.9.1)
Panel Slope [degrees]:	30.0	
Wind Flow:	Clear	
Roof Configuration:	Monoslope	

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.4-4

Clear Wind Flow	C_{NW}	C_{NL}
Case 1 ($\gamma = 0^\circ$, Load Case A)	-1.8	-1.8
Case 2 ($\gamma = 0^\circ$, Load Case B)	-2.5	-0.5
Case 3 ($\gamma = 180^\circ$, Load Case A)	2.1	2.1
Case 4 ($\gamma = 180^\circ$, Load Case B)	2.6	1.0

Design Wind Pressures per Equation 27.4-3 [psf]

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ($\gamma = 0^\circ$, Load Case A)	-31.2	-31.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-43.3	-8.7
Case 3 ($\gamma = 180^\circ$, Load Case A)	36.4	36.4
Case 4 ($\gamma = 180^\circ$, Load Case B)	45.0	17.3
Case 5 ($\gamma = 0^\circ$, 16 psf Min. Horiz.)	-16.0	-16.0
Case 6 ($\gamma = 180^\circ$, 16 psf Min. Horiz.)	16.0	16.0



PROJECT:

30° Tilt

COLUMN WIND LOADS

Column Tributary Area

Panel Slope [degrees]:	30.0
Trib. Along Slope [ft ²):	43.7
Projected Vert. Trib. [ft ²):	21.9
Projected Horiz. Trib. [ft ²):	37.9
Min. Column Height [ft]:	4.1

Wind Loads from Transverse Pressures (1.0 Wind)

	Vertical [lbs]	Horizontal [lbs]	Moment [ft-lbs]
Case 1:	-1179	-681	2803
Case 2:	-983	-567	3736
Case 3:	1376	794	-3270
Case 4:	1179	681	-1683
Case 5:		-350	1439
Case 6:		350	-1439
Max:	1376	794	3736
Min:	-1179	-681	-3270

Maple Leaf Power Systems



PROJECT:

30° Tilt

COLUMN REACTIONS (ASD)

Summary of Loads per Column

Dead Loads

1.0 Max. Dead:

Down [lbs]

0.6 Min. Dead:

Down [lbs]

Snow Loads

1.0 Snow:

Down [lbs]

Wind Loads

0.6 Wind:

Down [lbs]

Uplift [lbs]

Shear [lbs]

Moment [lb-ft]

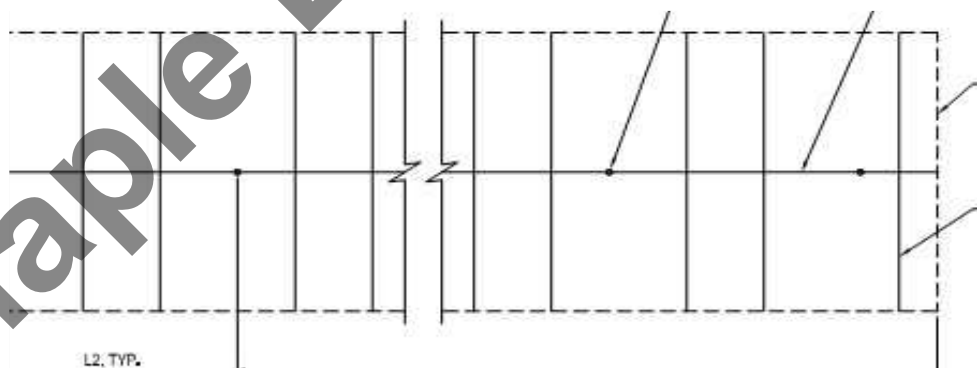
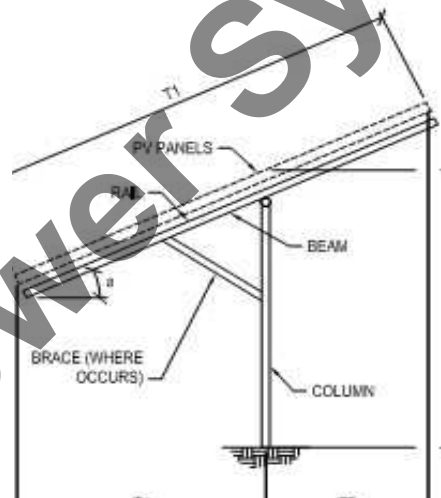
Reactions by Load Combination per Column

Load Combination	Column Reactions			
	Down [lbs]	Uplift [lbs]	Shear [lbs]	Moment [lb-ft]
1.0 Dead	158	0	0	0
1.0 Dead + 1.0 Snow	1028	0	0	0
1.0 Dead + 0.6 Wind	984	549	477	2241
1.0 Dead + 0.75 Snow + 0.45 Wind	1430	0	357	1681
0.6 Dead + 0.6 Wind	921	613	477	2241
Maximum Design Reactions	1430	613	477	2241

PROJECT:

Mount Geometry

Panel Orientation:	Portrait
Panel Width (short dimension) [in]:	45
Panel Length (long dimension) [in]:	89
No. of Panels in Transverse Direction:	1
No. of Panels in Longitudinal Direction:	4
Transverse Length Along Slope (T1) [ft]:	7.4
Projected Transverse Length (T2) [ft]:	5.2
Longitudinal Length (L1) [ft]:	15.1
No. of Columns in Tranverse Direction:	1
Transverse Overhang (T4) [ft]:	2.6
Transverse Overhang (T5) [ft]:	2.6
No. of Columns in Longitudinal Direction:	3
Longitudinal Column Spacing (L2) [ft]:	5.9
Longitudinal Overhang (L3) [ft]:	1.6
Panel Slope from Horizontal (a) [°]:	45
Transverse Ground Slope [°]:	0
Longitudinal Ground Slope [°]:	0
Leading Edge Height [ft]:	1.5
Min. Array Height at Column(H) [ft]:	4.1
Max. Array Height at Column (H) [ft]:	4.1
Trailing Edge Height [ft]:	6.7



Note: All images are for illustration purposes only, and does not necessarily match the proposed installation



PROJECT:

45° Tilt

DEAD LOADS

Panel & Rail Weight [psf]:	3.0
Tributary Area per Column [ft ²]:	43.7
Weight per Column [lbs]:	131.1

Beam Weight [plf]:	2.7
Tributary Length per Column [ft]:	5.9
Weight per Column [lbs]:	16.1

Brace Weight [plf]:	NA
Tributary Length per Column [ft]:	
Weight per Column [lbs]:	

Column Weight [plf]:	2.7
Max. Column Height [ft]:	4.1
Min. Column Height [ft]:	4.1
Max. Column Weight [lbs]:	11.2
Min. Column Weight [lbs]:	11.2

Max. Total Weight Per Column [lbs]:	158.4	(1.0 Dead)
Min. Total Weight per Column [lbs]:	158.4	(1.0 Dead)

Maple Leaf Power Systems



PROJECT:

45° Tilt

SNOW LOADS

Design Snow Load, S [psf]: (1.0 Snow)

Tributary Area per Column [ft²]:

Snow Load per Column [lbs]: (1.0 Snow)

Maple Leaf Power Systems



PROJECT:

45° Tilt

DEAD LOADS

Panel & Rail Weight [psf]:	3.0
Tributary Area per Column [ft ²]:	43.7
Weight per Column [lbs]:	131.1

Beam Weight [plf]:	2.7
Tributary Length per Column [ft]:	5.9
Weight per Column [lbs]:	16.1

Brace Weight [plf]:	NA
Tributary Length per Column [ft]:	
Weight per Column [lbs]:	

Column Weight [plf]:	2.7
Max. Column Height [ft]:	4.1
Min. Column Height [ft]:	4.1
Max. Column Weight [lbs]:	11.2
Min. Column Weight [lbs]:	11.2

Max. Total Weight Per Column [lbs]:	158.4	(1.0 Dead)
Min. Total Weight per Column [lbs]:	158.4	(1.0 Dead)

Maple Leaf Power Systems



PROJECT:

45° Tilt

SNOW LOADS

Design Snow Load, S [psf]: (1.0 Snow)

Tributary Area per Column [ft²]:

Snow Load per Column [lbs]: (1.0 Snow)

Maple Leaf Power Systems



PROJECT:

45° Tilt

WIND PRESSURES

Calculations per:	ASCE 7-10	
Design Wind Speed, V [mph]:	105	
Risk Category:	I	(Table 1.5-1)
Exposure Category:	C	(Section 26.7)
Elevation [ft]:	2178.5	
Ground Elevation Factor, K_e :		(Not applicable)
α :	9.5	(Table 26.9.1)
z_g [ft]:	900	(Table 26.9.1)
Velocity Pressure Exposure Coefficient, K_h :	0.85	(Table 27.3-1)
Topographic Factor, K_{ht} :	1.0	(Section 26.8)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, GC_{pi} :	0.00	(Figure 26.11-1)
Velocity Pressure, q_h [psf]:	20.37	(Equation 27.3-1)
Gust Effect Factor, G:	0.85	(Section 26.9.1)
Panel Slope [degrees]:	45.0	
Wind Flow:	Clear	
Roof Configuration:	Monoslope	

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.4-4

Clear Wind Flow	C_{NW}	C_{NL}
Case 1 ($\gamma = 0^\circ$, Load Case A)	-1.6	-1.8
Case 2 ($\gamma = 0^\circ$, Load Case B)	-2.3	-0.7
Case 3 ($\gamma = 180^\circ$, Load Case A)	2.2	2.2
Case 4 ($\gamma = 180^\circ$, Load Case B)	2.6	1.4

Design Wind Pressures per Equation 27.4-3 [psf]

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ($\gamma = 0^\circ$, Load Case A)	-27.7	-31.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-39.8	-12.1
Case 3 ($\gamma = 180^\circ$, Load Case A)	38.1	38.1
Case 4 ($\gamma = 180^\circ$, Load Case B)	45.0	24.2
Case 5 ($\gamma = 0^\circ$, 16 psf Min. Horiz.)	-16.0	-16.0
Case 6 ($\gamma = 180^\circ$, 16 psf Min. Horiz.)	16.0	16.0



PROJECT:

45° Tilt

COLUMN WIND LOADS

Column Tributary Area

Panel Slope [degrees]:	45.0
Trib. Along Slope [ft ²]:	43.7
Projected Vert. Trib. [ft ²]:	30.9
Projected Horiz. Trib. [ft ²]:	30.9
Min. Column Height [ft]:	4.1

Wind Loads from Transverse Pressures (1.0 Wind)

	Vertical [lbs]	Horizontal [lbs]	Moment [ft-lbs]
Case 1:	-909	-909	3604
Case 2:	-802	-802	4423
Case 3:	1177	1177	-4845
Case 4:	1070	1070	-3565
Case 5:		-494	2036
Case 6:		494	-2036
Max:	1177	1177	4423
Min:	-909	-909	-4845

Maple Leaf Power Systems



PROJECT:

45° Tilt

COLUMN REACTIONS (ASD)

Summary of Loads per Column

Dead Loads

1.0 Max. Dead:

Down [lbs]

0.6 Min. Dead:

Down [lbs]

Snow Loads

1.0 Snow:

Down [lbs]

Wind Loads

0.6 Wind:

Down [lbs]

Uplift [lbs]

Shear [lbs]

Moment [lb-ft]

Reactions by Load Combination per Column

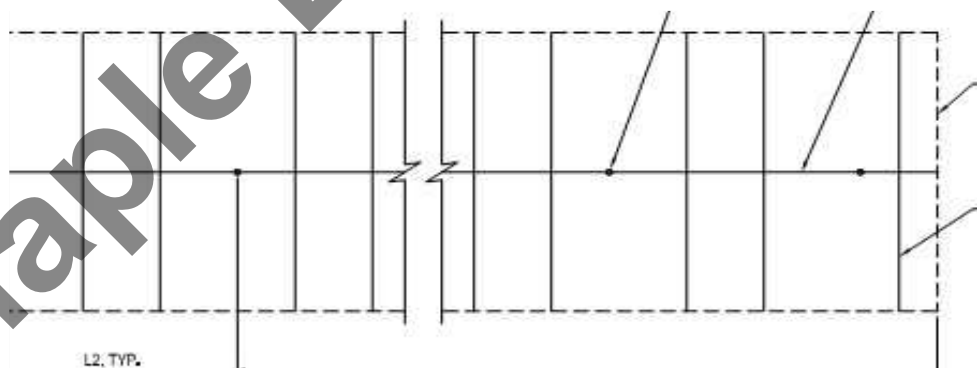
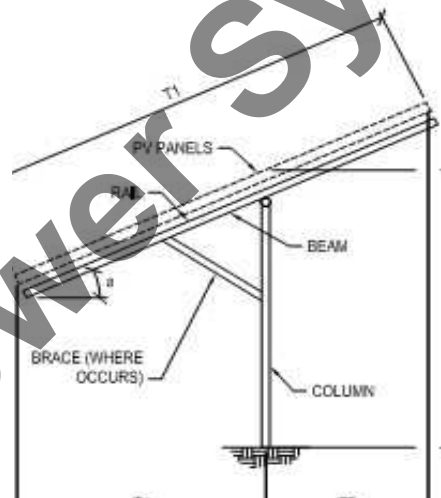
Load Combination	Column Reactions			
	Down [lbs]	Uplift [lbs]	Shear [lbs]	Moment [lb-ft]
1.0 Dead	158	0	0	0
1.0 Dead + 1.0 Snow	623	0	0	0
1.0 Dead + 0.6 Wind	865	387	706	2907
1.0 Dead + 0.75 Snow + 0.45 Wind	1036	86	530	2180
0.6 Dead + 0.6 Wind	801	451	706	2907
Maximum Design Reactions	1036	451	706	2907

PROJECT:

60° Tilt

Mount Geometry

Panel Orientation:	Portrait
Panel Width (short dimension) [in]:	45
Panel Length (long dimension) [in]:	89
No. of Panels in Transverse Direction:	1
No. of Panels in Longitudinal Direction:	4
Transverse Length Along Slope (T1) [ft]:	7.4
Projected Transverse Length (T2) [ft]:	3.7
Longitudinal Length (L1) [ft]:	15.1
No. of Columns in Tranverse Direction:	1
Transverse Overhang (T4) [ft]:	1.9
Transverse Overhang (T5) [ft]:	1.9
No. of Columns in Longitudinal Direction:	3
Longitudinal Column Spacing (L2) [ft]:	5.9
Longitudinal Overhang (L3) [ft]:	1.6
Panel Slope from Horizontal (a) [°]:	60
Transverse Ground Slope [°]:	0
Longitudinal Ground Slope [°]:	0
Leading Edge Height [ft]:	0.9
Min. Array Height at Column(H) [ft]:	4.1
Max. Array Height at Column (H) [ft]:	4.1
Trailing Edge Height [ft]:	7.3



Note: All images are for illustration purposes only, and does not necessarily match the proposed installation



60° Tilt

PROJECT:

DEAD LOADS

Panel & Rail Weight [psf]:	3.0
Tributary Area per Column [ft ²]:	43.7
Weight per Column [lbs]:	131.1

Beam Weight [plf]:	2.7
Tributary Length per Column [ft]:	5.9
Weight per Column [lbs]:	16.1

Brace Weight [plf]:	NA
Tributary Length per Column [ft]:	
Weight per Column [lbs]:	

Column Weight [plf]:	2.7
Max. Column Height [ft]:	4.1
Min. Column Height [ft]:	4.1
Max. Column Weight [lbs]:	11.2
Min. Column Weight [lbs]:	11.2

Max. Total Weight Per Column [lbs]:	158.4	(1.0 Dead)
Min. Total Weight per Column [lbs]:	158.4	(1.0 Dead)

Maple Leaf Power Systems



PROJECT:

60° Tilt

SNOW LOADS

Design Snow Load, S [psf]: (1.0 Snow)

Tributary Area per Column [ft²]:

Snow Load per Column [lbs]: (1.0 Snow)

Maple Leaf Power Systems



60° Tilt

PROJECT:

WIND PRESSURES

Calculations per:	ASCE 7-10	
Design Wind Speed, V [mph]:	105	
Risk Category:	I	(Table 1.5-1)
Exposure Category:	C	(Section 26.7)
Elevation [ft]:	2178.5	
Ground Elevation Factor, K_e :		(Not applicable)
α :	9.5	(Table 26.9.1)
z_g [ft]:	900	(Table 26.9.1)
Velocity Pressure Exposure Coefficient, K_h :	0.85	(Table 27.3-1)
Topographic Factor, K_{ht} :	1.0	(Section 26.8)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, GC_{pi} :	0.00	(Figure 26.11-1)
Velocity Pressure, q_h [psf]:	20.37	(Equation 27.3-1)
Gust Effect Factor, G:	0.85	(Section 26.9.1)
Panel Slope [degrees]:	60.0	
Wind Flow:	Clear	
Roof Configuration:	Monoslope	

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.4-4

Clear Wind Flow	C_{NW}	C_{NL}
Case 1 ($\gamma = 0^\circ$, Load Case A)	-1.6	-1.8
Case 2 ($\gamma = 0^\circ$, Load Case B)	-2.3	-0.7
Case 3 ($\gamma = 180^\circ$, Load Case A)	2.2	2.2
Case 4 ($\gamma = 180^\circ$, Load Case B)	2.6	1.4

Design Wind Pressures per Equation 27.4-3 [psf]

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ($\gamma = 0^\circ$, Load Case A)	-27.7	-31.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-39.8	-12.1
Case 3 ($\gamma = 180^\circ$, Load Case A)	38.1	38.1
Case 4 ($\gamma = 180^\circ$, Load Case B)	45.0	24.2
Case 5 ($\gamma = 0^\circ$, 16 psf Min. Horiz.)	-16.0	-16.0
Case 6 ($\gamma = 180^\circ$, 16 psf Min. Horiz.)	16.0	16.0



PROJECT:

60° Tilt

COLUMN WIND LOADS

Column Tributary Area

Panel Slope [degrees]:	60.0
Trib. Along Slope [ft ²):	43.7
Projected Vert. Trib. [ft ²):	37.9
Projected Horiz. Trib. [ft ²):	21.9
Min. Column Height [ft]:	4.1

Wind Loads from Transverse Pressures (1.0 Wind)

	Vertical [lbs]	Horizontal [lbs]	Moment [ft-lbs]
Case 1:	-643	-1114	4445
Case 2:	-567	-983	5166
Case 3:	832	1441	-5934
Case 4:	757	1310	-4555
Case 5:		-606	2493
Case 6:		606	-2493
Max:	832	1441	5166
Min:	-643	-1114	-5934

Maple Leaf Power Systems



PROJECT:

60° Tilt

COLUMN REACTIONS (ASD)

Summary of Loads per Column

Dead Loads

1.0 Max. Dead:

Down [lbs]

0.6 Min. Dead:

Down [lbs]

Snow Loads

1.0 Snow:

Down [lbs]

Wind Loads

0.6 Wind:

Down [lbs]

Uplift [lbs]

Shear [lbs]

Moment [lb-ft]

Reactions by Load Combination per Column

Load Combination	Column Reactions			
	Down [lbs]	Uplift [lbs]	Shear [lbs]	Moment [lb-ft]
1.0 Dead	158	0	0	0
1.0 Dead + 1.0 Snow	314	0	0	0
1.0 Dead + 0.6 Wind	658	227	865	3560
1.0 Dead + 0.75 Snow + 0.45 Wind	649	437	649	2670
0.6 Dead + 0.6 Wind	594	291	865	3560
Maximum Design Reactions	658	437	865	3560