



# PV Letters

Contractor Name: Top Tier Solar Solutions  
Contractor Address: 1530 Center Park Dr #2911, Charlotte, NC 28217

October 22, 2024

Subject: Proposed Solar Panel Installation  
Michael Hill Residence 1371 Cane Mill Rd, Coats, NC  
DC System Size: 10.920 kW  
PV Letters Job #004-14438

To Whom it May Concern,

We have reviewed information, provided by our client, related to the proposed solar panel installation at the above-referenced address. The purpose of the review was to determine if the existing roof is structurally adequate for the proposed installation. Based on our review and analysis of the given information, and in accordance with governing building codes, I certify that the capacity of the structural roof framing that directly supports the additional gravity loading due to the solar panel supports and modules had been reviewed and determined to meet or exceed the requirements in accordance with the Design Criteria.

## **Design Parameter Summary**

Governing Building Code: 2018 North Carolina Residential Code  
Risk Category: II  
Wind Exposure: C  
Design Wind Speed: 120 mph  
Ground Snow Load: 15 psf

## **Roof Information**

Roof Structure: 2x6 Rafters @ 24" O.C. (assumed)  
Roofing Material: Corrugated Metal (1 layer)  
Roof Slope: 20, 33 degrees

## **Roof Connection Details**

S-5! ProteaBracket to existing metal roof, at 48" O.C. max  
*Note: Required installation of 25%/75% between Framing and Decking Mounts.*

## **Engineering Analysis**

The proposed installation - including weight of panels, racking, mounts, and inverters where applicable - will be approximately 3 psf. In the areas where panels are installed, roof live loads will not be present. The reduction of roof live load is adequate to fully or partially compensate for the addition of the panel installation. Because the member forces in the area of the solar panels are not increased by more than 5%, and so per provisions in the adopted building codes, the structure need not be altered for gravity loading.

The proposed installation will be 6" max. above the roof surface (flush mounted) and parallel to the roof surface. Therefore, any increase in wind loading on the building structure from the solar panel installation is expected to be negligible. Wind is the governing lateral load case. Because the increase in lateral loading is not increased by more than 10%, per provisions in the adopted building codes, the structure need not be altered for lateral loading.

Wind uplift on the panels has been calculated in accordance with the relevant provisions of ASCE 7-10. This loading has been used to verify the adequacy of the connection specified above. Connection locations should be in accordance with design drawings.

IronRidge XR10 rails will support the modules and will fasten to the roof structure with S-5! ProteaBracket along the rail.

## **Conclusion**

The roof structure need not be altered for either gravity loading (including snow) or lateral loading (including wind). Therefore, the existing structure is permitted to remain unaltered. Connections to the roof must be made per the "Roof Connection Details" section above. Copies of all relevant calculations are enclosed.

**Limitations and Disclaimers**

The opinion expressed in this letter is made in reliance on the following assumptions: the existing structure is in good condition; the existing structure is free from defects in design or workmanship; and the existing structure was code-compliant at the time of its design and construction. These assumptions have not been independently verified, and we have relied on representations made by our client with respect to the foregoing. The undersigned has not inspected the structure for defects, although we have reviewed the information provided by our client, including pictures where applicable.

Electrical design is excluded from this analysis. Waterproofing is the sole responsibility of the installer and is also excluded from this analysis. Solar panels must be installed per manufacturer specifications. Structural design and analysis of the adequacy of solar panels, racks, mounts, and other components is performed by each component's respective manufacturer; the undersigned makes no statement of opinion regarding such components. This letter and the opinions expressed herein are rendered solely for the benefit of the permitting authority (city or county building department) and your office, and may not be utilized or relied on by any other party.

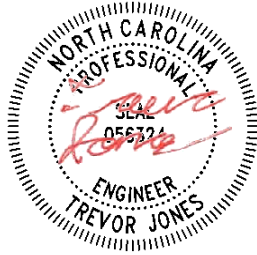
If you have any questions or concerns, please contact me at (208)-994-1680, or email me directly at Trevor@pvletters.com.

Sincerely,



Trevor A. Jones, P.E.

10/22/2024





# PV Letters

## Standard Loading Comparison (Roof 1)

This calculation justifies the additional solar load by comparing existing to proposed gravity loads in the location of the solar panels.

	<u>Without Solar</u>	<u>With Solar</u>	
<b>Dead Load</b>			
Corrugated Metal	3	3	psf
1/4" Plywood	1	1	psf
Framing	2	2	psf
Insulation	--	--	psf
1/2" Gypsum Ceiling	--	--	psf
M,E, & Misc	--	--	psf
Solar Panel	0	3	psf
<b>Total Dead Load</b>	<b>6</b>	<b>9</b>	<b>psf</b>
<b>Snow Load</b>			
Ground Snow Load, $P_g$	15		psf
Exposure Factor, $C_e$	1.00		
Thermal Factor, $C_t$	1.1		
Importance Factor, $I_s$	1		
Flat Roof Snow Load	12		ASCE 7 Eqn. 7.3-1 or jurisdiction min.
Slope	33		degrees
Unobstructed Slippery Surface?	Yes	Yes	
Slope Factor, $C_s$	0.62	0.62	
<b>Sloped Roof Snow Load</b>	<b>7.1</b>	<b>7.1</b>	<b>psf</b>
<b>Live Load</b>			
Roof Live Load	20	0	psf
<b>Load Combination</b>			
D + L <sub>r</sub>	26.0	9.0	psf
D + S	13.1	16.1	psf
<b>Max. Load</b>	<b>26.0</b>	<b>16.1</b>	<b>psf</b>
% of original		<b>62%</b>	

**Result:**

**Because the total forces are decreased, per the relevant code provisions stated in the body of the letter, the existing roof structure is permitted to remain unaltered.**



# PV Letters

## Bracket Connection Calculation (per ASCE 7-10) (Roof 1)

This calculation justifies the connection of the solar panels to existing roof members, by showing the connection capacity is equal to or greater than the uplift force demands.

### Connection Demand

Spacing perpendicular to rail, in	40
Roof Angle, degrees	33
Roof Layout	Hip
Wind Speed, mph	120
Exposure Coefficient, $K_z$	0.85
Topographic Factor, $K_{zt}$	1.00
Directionality Factor, $K_d$	0.85
Elevation Factor, $K_e$	0.99
Velocity Pressure $q_z$ , psf	26.3
Prying Coefficient	1

### Zones:

	<u>1</u>	<u>2</u>	<u>3</u>
Spacing parallel to rail, in	48	48	48
$GC_p$ (max)	1.00	2.00	2.00
Exposed Panels? ( $\gamma_E = 1.5$ )	No	No	No
Effective Wind Area on each con., ft <sup>2</sup>	13.2	13.2	13.2
Pressure Equalization Factor, $\gamma_a$	0.75	0.75	0.75
Uplift Force, psf	19.8	39.6	39.6
Max. Uplift Force / Connection (0.6 WL), lbs	156.5	313.1	313.1
Solar Dead Load (0.6 DL). Lbs	23.7	23.7	23.7
Max. Uplift Force (0.6 WL - 0.6 DL), lbs	<b>132.8</b>	<b>289.4</b>	<b>289.4</b>

### Connection Capacity

Connection Type	S-5! ProteaBracket
Ultimate Capacity, lbs	817
Factor of Safety	2.00
Total Capacity, lbs	<b>408.5</b>

### Compare ASD Factored Demand to Capacity

Demand, lbs	289.4
Capacity, lbs	408.5

### **Result**

**Capacity exceeds demands. Therefore, connection passes.**



# PV Letters

## Standard Loading Comparison (Roof 2)

This calculation justifies the additional solar load by comparing existing to proposed gravity loads in the location of the solar panels.

	<u>Without Solar</u>	<u>With Solar</u>	
<b>Dead Load</b>			
Corrugated Metal	3	3	psf
1/4" Plywood	1	1	psf
Framing	2	2	psf
Insulation	--	--	psf
1/2" Gypsum Ceiling	--	--	psf
M,E, & Misc	--	--	psf
Solar Panel	0	3	psf
<b>Total Dead Load</b>	<b>6</b>	<b>9</b>	<b>psf</b>
<b>Snow Load</b>			
Ground Snow Load, $P_g$	15		psf
Exposure Factor, $C_e$	1.00		
Thermal Factor, $C_t$	1.1		
Importance Factor, $I_s$	1		
Flat Roof Snow Load	12		ASCE 7 Eqn. 7.3-1 or jurisdiction min.
Slope	20		degrees
Unobstructed Slippery Surface?	Yes	Yes	
Slope Factor, $C_s$	0.83	0.83	
<b>Sloped Roof Snow Load</b>	<b>9.6</b>	<b>9.6</b>	<b>psf</b>
<b>Live Load</b>			
Roof Live Load	20	0	psf
<b>Load Combination</b>			
D + L <sub>r</sub>	26.0	9.0	psf
D + S	15.6	18.6	psf
<b>Max. Load</b>	<b>26.0</b>	<b>18.6</b>	<b>psf</b>
% of original		<b>72%</b>	

**Result:**

**Because the total forces are decreased, per the relevant code provisions stated in the body of the letter, the existing roof structure is permitted to remain unaltered.**



# PV Letters

## Bracket Connection Calculation (per ASCE 7-10) (Roof 2)

This calculation justifies the connection of the solar panels to existing roof members, by showing the connection capacity is equal to or greater than the uplift force demands.

### Connection Demand

Spacing perpendicular to rail, in	40
Roof Angle, degrees	20
Roof Layout	Hip
Wind Speed, mph	120
Exposure Coefficient, $K_z$	0.85
Topographic Factor, $K_{zt}$	1.00
Directionality Factor, $K_d$	0.85
Elevation Factor, $K_e$	0.99
Velocity Pressure $q_z$ , psf	26.3
Prying Coefficient	1

### Zones:

	<u>1</u>	<u>2</u>	<u>3</u>
Spacing parallel to rail, in	48	48	48
$GC_p$ (max)	0.90	2.20	2.60
Exposed Panels? ( $\gamma_E = 1.5$ )	No	No	No
Effective Wind Area on each con., ft <sup>2</sup>	13.2	13.2	13.2
Pressure Equalization Factor, $\gamma_a$	0.75	0.75	0.75
Uplift Force, psf	17.8	43.6	51.5
Max. Uplift Force / Connection (0.6 WL), lbs	140.9	344.4	407.0
Solar Dead Load (0.6 DL). Lbs	23.7	23.7	23.7
Max. Uplift Force (0.6 WL - 0.6 DL), lbs	<b>117.2</b>	<b>320.7</b>	<b>383.3</b>

### Connection Capacity

Connection Type	S-5! ProteaBracket
Ultimate Capacity, lbs	817
Factor of Safety	2.00
Total Capacity, lbs	<b>408.5</b>

### Compare ASD Factored Demand to Capacity

Demand, lbs	383.3
Capacity, lbs	408.5

### **Result**

**Capacity exceeds demands. Therefore, connection passes.**