PV Letters

June 07, 2023

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

Subject: Proposed Solar Panel Installation
Rhonda Bradford Residence, 1968 Tingen Rd, Broadway, NC
DC System Size: 7.505 kW DC
PV Letters Job #004-0236

To Whom it May Concern,

I have reviewed information, provided by you or your office, 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 my review and analysis of the given information, and in accordance with governing building codes, it is my professional opinion that the existing structure is permitted to remain unaltered for the proposed solar installation.

Design Parameter Summary

Governing Building Code: 2018 North Carolina Residential Code
Risk Category: II
Wind Exposure: C
Design Wind Speed: 120 mph (per city/county requirements)
Ground Snow Load: 10 psf (per ASCE 7-16)

Roof Information

Roof Structure: 2x4 Manufactured Trusses @ 24" O.C.
Roofing Material: Asphalt Shingles (1 layer)
Roof Slope: 23 degrees

Roof Connection Details

Lag Screws: (2) #14 Self-Drilling Screw with a minimum penetration depth of 2" at 72" O.C. max
Stagger attachments to avoid overloading any individual rafter.
Note: Required embedment length excludes the tapered tip of the screw, and embedment into sheathing.

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%, the stresses in the members are not increased by more than 5%, and so per section 806.2 of the 2018 International Existing Building Code (IEBC), 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 section 806.2 of the adopted 2018 IEBC, 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 7-16. 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 IronRidge QuickMount HUG at a maximum spacing of 72" along the rail with a maximum rail cantilever of 29". The max attachment spacing, rail span and cantilever is valid in all roof zones (1, 2, and 3).

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 your office with respect to the foregoing. The undersigned has not inspected the structure for defects, although we have reviewed the information provided by your office, including pictures where applicable.

Electrical design is 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@plvetters.com.

Sincerely,
Trevor A. Jones, P.E.

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Standard Loading Comparison

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

	Without Solar	With Solar	
Dead Load			
Asphalt Shingles	3	3	psf
1/2" Plywood	1	1	psf
Framing	4	4	psf
Insulation	1	1	psf
1/2" Gypsum Ceiling	2	2	psf
M,E, & Misc	1.5	1.5	psf
Solar Panel	0	3	psf
Total Dead Load	12.5	15.5	psf
Snow Load			
Ground Snow Load, P_g	10		psf
Exposure Factor, C_e	1		
Thermal Factor, C_t	1.1		
Importance Factor, I_s	1		
Flat Roof Snow Load	8		Eqn. 7.3-1 or jurisdiction min.
Slope	23		degrees
Unobstructed Slippery Surface?	No	No	
Slope Factor, C_s	1.00	1.00	
Sloped Roof Snow Load	7.7	7.7	psf
Live Load			
Roof Live Load	20	0	psf
Load Combination			
D + Lr	32.5	15.5	psf
D + S	20.2	23.2	psf
Max. Load	32.5	23.2	psf
% of original		**71%**	

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.

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Lag Screw Calculation (per ASCE 7-16)

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	38	in	(1/2 panel length)
Roof Angle	23	degrees	
Roof Layout	Gable		
Wind Speed	120	mph	
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	26.2	psf	
Prying Coefficient	1		

Zones:	1, 2e	2n, 2r, 3r	3e	
GC_p (max)	1.50	2.20	2.50	
Exposed Panels? (γ_E = 1.5)	No	No	No	
Spacing parallel to rail, in	72	72	72	
Effective Wind Area on each con., ft^2	18.8	18.8	18.8	
Pressure Equalization Factor, γ_a	0.69	0.69	0.69	
Uplift Force	27.2	39.8	45.2	psf
Max. Uplift Force / Connection (0.6 WL)	305.9	448.1	509.4	lbs
Solar Dead Load (0.6 DL)	33.8	33.8	33.8	lbs
Max. Uplift Force (0.6 WL - 0.6 DL)	**272.1**	**414.4**	**475.6**	**lbs**

Connection Capacity

Attachment FTG	QuickMount HUG	
Attachment location	Framing	
Fastener Type	Lag Screw	
Fastener Diameter (in)	0.25	
Embedment Length (in), min	2	
Lumber Species & Grade	SPF #2 (Assumed)	
Nominal Withdrawal Capacity W (lbs)	346	NDS 12.2-1
# of Screws	2	
Load Duration Factor Cd	1.6	
Screw Adj. Withdrawal Cap. W' (lbs)	**1109**	
Attachment FTG Strength (lbs) with Cd	**1606**	per ftg cert.

Max applied load, lbs	476
Max allowable load, lbs	1109

Compare Adjusted Withdrawal Capacity to ASD Factored Demand

Zones:	1, 2e	2n, 2r, 3r	3e
	O.K.	O.K.	O.K.

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