VSE Project Number: U3573.3125.201

November 25, 2020

SunPro Solar
ATTENTION: Dean Scott
22171 MCH Road
Mandeville, LA 70471

REFERENCE: Glenda Curry Residence (PROJ-22688): 219 Birch Avenue, Spring Lake, NC 28390
Solar Array Installation

To Whom It May Concern:

Per your request, Cameron Alworth, a representative of Vector Structural Engineering, LLC performed a site visit at the address above on November 24, 2020. The purpose of the visit was to observe the existing framing and determine the adequacy of the existing structure to support the proposed installation of solar panels on the roof.

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation.

Design Parameters

Code: North Carolina Building Code, 2018 Edition (2015 IBC)
Risk Category: II
Design wind speed: 118 mph (3-sec gust) per ASCE 7-10
Wind exposure category: C
Ground snow load: 10 psf

Existing Roof Structure

Roof 1: composite shingles over 2x4 manufactured trusses @ 24" O.C. with a roof slope of 34°
Roof 2: composite shingles over 2x4 manufactured trusses @ 24" O.C. with a roof slope of 43°

Connection to Roof

Mounting connection: (1) 5/16" lag screw w/ min. 2.5" embedment into framing at max. 48" o.c. along rails
(2) rails per row of panels, evenly spaced; panel length perpendicular to the rails not to exceed 67 in

Conclusions

Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation. In the area of the solar array, other live loads will not be present or will be greatly reduced (2018 NCBC, Section 1607.12.5). The gravity loads and; thus, the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 807.4 of the 2018 NCEBC (2015 IEBC) are met and the structure is permitted to remain unaltered.

The solar array will be flush-mounted (no more than 6" above the roof surface) and parallel to the roof surface. Thus, we conclude that any additional wind loading on the structure related to the addition of the proposed solar array is negligible. The attached calculations verify the capacity of the connections of the solar array to the existing roof against wind (uplift), the governing load case. Because the increase in lateral forces is less than 10%, this addition meets the requirements of the exception in Section 807.5 of the 2018 NCEBC (2015 IEBC). Thus the existing lateral force resisting system is permitted to remain unaltered.

Limitations

Installation of the solar panels must be performed in accordance with manufacturer recommendations. All work performed must be in accordance with accepted industry-wide methods and applicable safety standards. The contractor must notify Vector Structural Engineering, LLC should any damage, deterioration or discrepancies between the as-built condition of the structure and the condition described in this letter be found. Connections to existing roof framing must be staggered, except at array ends, so as not to overload any existing structural member. The use of solar panel support span tables provided by others is allowed only where the building type, site conditions, site-specific design parameters, and solar panel configuration match the description of the span tables. The design of the solar panel racking (mounts, rails, etc.) and electrical engineering is the responsibility of others. Waterproofing around the roof penetrations is the responsibility of others. Vector Structural Engineering assumes no responsibility for improper installation of the solar array.

VECTOR STRUCTURAL ENGINEERING, LLC
NC Firm License: COA #P-0742

NORTH CAROLINA PROFESSIONAL SEAL 049893 ENGINEER JACOB S. PROCTOR

11/25/2020

Jacob Proctor, P.E.
NC License: 049893 - Expires: 12/31/2020
Project Engineer

Enclosures

JSP/lic

PROJECT: Glenda Curry Residence

Components and Cladding Wind Calculations

Label: Solar Panel Array

Note: Calculations per ASCE 7-10

SITE-SPECIFIC WIND PARAMETERS:

Basic Wind Speed [mph]:	118
Exposure Category:	C
Risk Category:	II

Notes:

ADDITIONAL INPUT & CALCULATIONS:

Height of Roof, h [ft]:	25	(Approximate)
Comp/Cladding Location:	Gable Roofs 27° < θ ≤ 45°	
Enclosure Classification:	Enclosed Buildings	
Zone 1 GC_p:	1.0	Figure 30.4-2C (enter negative pressure coefficients)
Zone 2 GC_p:	1.2	
Zone 3 GC_p:	1.2	
α:	9.5	Table 26.9-1
z_g [ft]:	900	Table 26.9-1
K_h:	0.95	Table 30.3-1
K_{zt}:	1	Equation 26.8-1
K_d:	0.85	Table 26.6-1
Velocity Pressure, q_h [psf]:	28.6	Equation 30.3-1
GC_{pi}:	0	Table 26.11-1

PRESSURES:

$$p = q_h\left[\left(GC_p\right) - \left(GC_{pi}\right)\right]$$ Equation 30.9-1

Zone 1, p [psf]:	28.6	psf (1.0 W, Interior Zones, beyond 'a' from roof edge)
Zone 2, p [psf]:	34.4	psf (1.0 W, End Zones, within 'a' from roof edge)
Zone 3, p [psf]:	34.4	psf (1.0 W, Corner Zones, within 'a' from roof corner)
		(a= 3 ft)

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SUBJECT: CONNECTION

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Calculate Uplift Forces on Connection

	Pressure (0.6 Dead -0.6 Wind) (psf)	Max Connection Spacing[1] (ft)	Max Trib. Area[2] (ft^2)	Max Uplift Force (lbs)
Zone 1	17.2	4.0	11.2	168
Zone 2	20.6	4.0	11.2	206
Zone 3	20.6	4.0	11.2	206

Calculate Connection Capacity

Lag Screw Size [in]:	5/16	
C_d:	1.6	NDS Table 2.3.2
Embedment[3] [in]:	2.5	
Grade:	SPF (G = 0.42)	
Nominal Capacity [lbs/in]:	205	NDS Table 12.2A
Number of Screws:	1	
Prying Coefficient:	1.4	
Total Capacity [lbs]:	586	

Determine Result

Maximum Demand [lbs]:	206
Lag Screw Capacity [lbs]:	586

Result: **Capacity > Demand, Connection is adequate.**

Notes

1. 'Max Connection Spacing' is the spacing between connections along the rails.
2. 'Max Trib Area' is the product of the 'Max Connection Spacing' and 1/2 the panel width/height perpendicular to the rails. (2) rails per row of panels. Length of panels perpendicular to the rails shall not exceed 67".
3. Embedment is measured from the top of the framing member to the beginning of the tapered tip of the lag screw. Embedment in sheathing or other material is not effective. The length of the tapered tip is not part of the embedment length.

VECTOR ENGINEERS

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SUBJECT: GRAVITY LOADS

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CALCULATE ESTIMATED GRAVITY LOADS

Roof Pitch: 8.1 :12

ROOF DEAD LOAD (D)	Design material weight [psf]	Increase due to pitch	Material weight [psf]
Composite Shingles	2.4	1.21	2.0
1/2" Plywood	1.2	1.21	1.0
Framing	3.0		3.0
Insulation	0.5		0.5
1/2" Gypsum Clg.	2.4	1.21	2.0
M, E & Misc	1.5		1.5
Total Original Roof DL	11.0		
PV Array DL	3.6	1.21	3

ROOF LIVE LOAD (Lr)

Existing Design Roof Live Load [psf]	20	ASCE 7-10, Table 4-1
Roof Live Load With PV Array [psf]	0	2018 NCBC, Section 1607.12.5

SNOW LOAD (S):	Existing	w/ Solar Array	
Roof Slope [x:12]:	8.1	8.1	
Roof Slope [°]:	34	34	
Snow Ground Load, p_g [psf]:	10	10	ASCE 7-10, Section 7.2
Terrain Category:	C	C	ASCE 7-10, Table 7-2
Exposure of Roof:	Fully Exposed	Fully Exposed	ASCE 7-10, Table 7-2
Exposure Factor, C_e:	0.9	0.9	ASCE 7-10, Table 7-2
Thermal Factor, C_t:	1.1	1.1	ASCE 7-10, Table 7-3
Risk Category:	II	II	ASCE 7-10, Table 1.5-1
Importance Factor, I_s:	1.0	1.0	ASCE 7-10, Table 1.5-2
Flat Roof Snow Load, p_f [psf]:	7	7	ASCE 7-10, Equation 7.3-1
Minimum Roof Snow Load, p_m [psf]:	0	0	ASCE 7-10, Section 7.3.4
Unobstructed Slippery Surface?	No	No	ASCE 7-10, Section 7.4
Slope Factor Figure:	Figure 7-2b	Figure 7-2b	ASCE 7-10, Section 7.4
Roof Slope Factor, C_s:	1.00	1.00	ASCE 7-10, Figure 7-2
Sloped Roof Snow Load, p_s [psf]:	7	7	ASCE 7-10, Equation 7.4-1
Design Snow Load, S [psf]:	7	7	

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SUBJECT: LOAD COMPARISON

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Summary of Loads

	Existing	With PV Array
D [psf]	11	15
Lr [psf]	20	0
S [psf]	7	7

Maximum Gravity Loads:

	Existing	With PV Array	
(D + Lr) / Cd [psf]	25	16	ASCE 7-10, Section 2.4.1
(D + S) / Cd [psf]	16	19	ASCE 7-10, Section 2.4.1

(Cd = Load Duration Factor = 0.9 for D, 1.15 for S, and 1.25 for Lr)

Maximum Gravity Load [psf]:	25	19

Ratio Proposed Loading to Current Loading: **76%** **OK**

The gravity loads and; thus, the stresses of the structural elements, in the area of the solar array are either decreased or increased by no more than 5%. Therefore, the requirements of Section 807.4 of the 2018 NCEBC (2015 IEBC) are met and the structure is permitted to remain unaltered.