11/19/2024

RE: Structural Certification for Installation of Residential Solar
   GEORGE WILLIAMS RESIDENCE:66 QUAIL HOLLOW, CAMERON, NC 28326

Attn: To Whom It May Concern

This Letter is for the existing roof framing which supports the new PV modules as well as the attachment of the PV system to existing roof framing. From the field observation report, the roof is made of Composite shingle roofing over roof plywood supported by 2X6 Rafters at 24 inches. The slope of the roof was approximated to be 30 degrees. The maximum allowable chord span is 10 feet between supports.

After review of the field observation data and based on our structural capacity calculation, **the existing roof framing has been determined to be adequate to support the imposed loads without structural upgrades.** Contractor shall verify that existing framing is consistent with the described above before install. Should they find any discrepancies, a written approval from SEOR is mandatory before proceeding with install. Capacity calculations were done in accordance with applicable building codes.

Design Criteria

Code	2018 North Carolina Building Code/IBC 2015					
Risk category			II	Wind Load	(component and Cladding)	
Roof Dead Load	Dr		10 psf		V(ult)	139 mph
PV Dead Load	DPV		3 psf		Exposure	C
Roof Live Load	Lr		20 psf			
Ground Snow	S		10 psf			

If you have any questions on the above, please do not hesitate to call.

Sincerely,

NORTH CAROLINA
PROFESSIONAL
SEAL
048371
VINCENT MWUMVANEZA
ENGINEER

Signed   11/19/2024

Structural Letter for PV Installation

Date: 11/19/2024
Job Address: **66 QUAIL HOLLOW**
CAMERON, NC 28326
Job Name: **GEORGE WILLIAMS RESIDENCE**
Job Number: **241119GWR**

Scope of Work

This Letter is for the existing roof framing which supports the new PV modules as well as the attachment of the PV system to existing roof framing. All PV mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

Table of Content

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Engineering Calculations Summary

Code	2015 International Building Code (ASCE 7-10)		
Risk category		II	
Roof Dead Load	Dr	10	psf
PV Dead Load	DPV	3	psf
Roof Live Load	Lr	20	psf
Ground Snow	S	10	psf
Wind Load	(component and Cladding)		
	V (Ult)	139	mph
	Exposure	C	

References

2 NDS for Wood Construction

Sincerely,

Signed   11/19/2024

Wind Load Cont.

Risk Category =	II	ASCE 7-10 Table 1.5-1
Wind Speed (3s gust), V =	**139** mph	**ASCE 7-10 Figure 26.5-1A**
Roughness =	C	**ASCE 7-10 Sec 26.7.2**
Exposure =	C	**ASCE 7-10 Sec 26.7.3**
Topographic Factor, K_{ZT} =	1.00	ASCE 7-10 Sec 26.8.2
Pitch =	30.0 Degrees	
Adjustment Factor, λ =	1.35	ASCE 7-10 Figure 30.5-1
a =	5.60 ft	ASCE 7-10 Figure 30.5-1

Where a: 10% of least horizontal dimension or 0.4h, whichever is smaller, but not less than 4% of least horizontal dimension or 3ft (0.9m)

Uplift (0.6W)	Zone 1 (psf)	Zone 2 (psf)	Zone 3 (psf)	
Pnet30=	-24.3	-29.2	-29.2	Figure 30.5-1
Pnet = 0.6 x λ x KZT x Pnet30)=	19.67	23.69	23.69	Equation 30.5-1
Downpressure (0.6W)	Zone 1 (psf)	Zone 2 (psf)	Zone 3 (psf)	
Pnet30=	26.6	26.6	26.6	Figure 30.5-1
Pnet = 0.6 x λ x KZT x Pnet30)=	21.52	21.52	21.52	Equation 30.5-1

Rafter Attachments: 0.6D+0.6W (CD=1.6)

Connection Check

Attachement max. spacing=	4 ft	
Quick Mount HUG=	760 lbs	Manufacturer Test

Allowable Capacity=	760	

Zone	Trib Width	Area (ft)	Uplift (lbs)	Down (lbs)	
1	4	11.0	196.6	269.7	
2	4	11.0	240.8	269.7	
3	4	11.0	240.8	269.7	
		Max=	240.8	<	760

CONNECTION IS OK

1. Pv seismic dead weight is negligible to result in significant seismic uplift, therefore the wind uplift governs
2. Embedment is measured from the top of the framing member to the tapered tip of a lag screw. Embedment in sheading or other material does not count.

Vertical Load Resisting System Design

Roof Framing   Rafters

Snow Load Fully Exposed

$pg =$	10	psf	ASCE 7-10 , Section 7.2	$p_f =$	7 psf
$C_e =$	0.9		ASCE 7-10 , Table 7-2	$p_{fmin.} =$	10.0 psf
$C_t =$	1.1		ASCE 7-10 , Table 7-3	$p_s =$	10 psf 16.0 plf
$I_s =$	1.0		ASCE 7-10 , Table 1.5-1		

Max Length, L =   **10** ft   (Beam maximum Allowable Horizontal Span)

Tributary Width, W_T =   **24** in

$Dr =$ **10** psf   20 plf

$PvDL =$ 3 psf   6 plf

Load Case: DL+0.6W

$Pnet + P_{pv}\cos(\theta) + P_{DL} =$ 69.0 plf

Max Moment, $M_u =$ 767 lb-ft   Conservatively

Pv max Shear   269.7 lbs

Max Shear, $V_u = wL/2 + Pv$ Point Load =   400 lbs

Load Case: DL+0.75(0.6W+S)

$0.75(Pnet + Ps) + P_{pv}\cos(\theta) + P_{DL} =$ 69 plf

$M_{down} =$ 772 lb-ft

Mallowable = Sx x Fb' (wind) =   1357 lb-ft   >   772 lb-ft   **OK**

Load Case: DL+S

$Ps + P_{pv}\cos(\theta) + P_{DL} =$ 41 plf

$M_{down} =$ 458 lb-ft

Mallowable = Sx x Fb' (wind) =   975 lb-ft   >   458 lb-ft   **OK**

Max Shear, $V_u = wL/2 + Pv$ Point Load =   400 lbs

Member Capacity

DF-L No.2

2X6	Design Value	C_L	C_F	C_i	C_r	K_F	ϕ	λ	Adjusted Value
$F_b =$	900 psi	1.0	1.3	1.0	1.15	2.54	0.85	0.8	1346 psi
$F_v =$	180 psi	N/A	N/A	1.0	N/A	2.88	0.75	0.8	180 psi
$E =$	1600000 psi	N/A	N/A	1.0	N/A	N/A	N/A	N/A	1600000 psi
$E_{min} =$	580000 psi	N/A	N/A	1.0	N/A	1.76	0.85	N/A	580000 psi

Depth, d =   5.5 in

Width, b =   1.5 in

Cross-Sectonal Area, A =   8.25 in^2

Moment of Inertia, $I_{xx} =$ 20.7969 in^4

Section Modulus, $S_{xx} =$ 7.5625 in^3

Allowable Moment, $M_{all} = F_b'S_{xx} =$ 847.9 lb-ft   DCR=$M_u/M_{all} =$ 0.52 < 1   **Satisfactory**

Allowable Shear, $V_{all} = 2/3F_v'A =$ 990.0 lb   DCR=$V_u/V_{all} =$ 0.40 < 1   **Satisfactory**

Siesmic Loads Check

Roof Dead Load	10 psf
% or Roof with Pv	7.6%
Dpv and Racking	3 psf
Averarage Total Dead Load	10.2 psf
Increase in Dead Load	1.5% **OK**

The increase in seismic Dead weight as a result of the solar system is less than 10% of the existing structure and therefore no further seismic analysis is required.

Limits of Scope of Work and Liability

We have based our structural capacity determination on information in pictures and a drawing set titled PV plans - GEORGE WILLIAMS RESIDENCE. The analysis was according to applicable building codes, professional engineering and design experience, opinions and judgments. The calculations produced for this structure's assessment are only for the proposed solar panel installation referenced in the stamped plan set and were made according to generally recognized structural analysis standards and procedures.