

1/15/2023

**RE: Structural Certification for Installation of Residential Solar
JENNIFER IVEY:165 NATURES WAY, DUNN, NC 28334**

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 Asphalt Shingle roofing over roof plywood supported by 2X4 Trusses at 24 inches. The slope of the roof was approximated to be 30 degrees. The maximum allowable chord span is 8 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

<u>Code</u>	2018 North Carolina Building Code/IBC 2015		
<u>Risk category</u>		II	<u>Wind Load</u> (component and Cladding)
<u>Roof Dead Load</u>	Dr	10 psf	V(ult) 120 mph
<u>PV Dead Load</u>	DPV	3 psf	Exposure B
<u>Roof Live Load</u>	Lr	20 psf	
<u>Ground Snow</u>	S	10 psf	

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

Sincerely,



Signed 1/15/2023

Structural Letter for PV Installation

Date: 1/15/2023
Job Address: **165 NATURES WAY
DUNN, NC 28334**
Job Name: **JENNIFER IVEY**
Job Number: **230115JI**

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.

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Engineering Calculations Summary

<u>Code</u>	2015 International Building Code (ASCE 7-10)	
<u>Risk category</u>		II
<u>Roof Dead Load</u>	Dr	10 psf
<u>PV Dead Load</u>	DPV	3 psf
<u>Roof Live Load</u>	Lr	20 psf
<u>Ground Snow</u>	S	10 psf
<u>Wind Load</u>	(component and Cladding)	
	V (Ult)	120 mph
	Exposure	B

References

2 NDS for Wood Construction

Sincerely,



Signed 1/15/2023

Wind Load Cont.

Risk Category =	II	ASCE 7-10 Table 1.5-1
Wind Speed (3s gust), V =	120 mph	ASCE 7-10 Figure 26.5-1A
Roughness =	B	ASCE 7-10 Sec 26.7.2
Exposure =	B	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	ASCE 7-10 Figure 30.5-1
a =	4.40 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=	-18.1	-21.8	-21.8	Figure 30.5-1
$P_{net} = 0.6 \times \lambda \times K_{ZT} \times P_{net30}$ =	10.86	13.08	13.08	Equation 30.5-1
Downpressure (0.6W)	Zone 1 (psf)	Zone 2 (psf)	Zone 3 (psf)	
Pnet30=	19.8	19.8	19.8	Figure 30.5-1
$P_{net} = 0.6 \times \lambda \times K_{ZT} \times P_{net30}$ =	11.88	11.88	11.88	Equation 30.5-1

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

Connection Check

Attachment max. spacing=	4 ft	
5/16" Lag Screw Withdrawal Value=	266 lbs/in	Table 12.2A - NDS
Lag Screw Penetration	2.5 in	DFL Assumed
Prying Coefficient	1.4 in	
Allowable Capacity=	760	

Zone	Trib Width	Area (ft)	Uplift (lbs)	Down (lbs)
1	4	11.0	99.7	163.7
2	4	11.0	124.1	163.7
3	4	11.0	124.1	163.7
		Max=	124.1	< 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 sheathing or other material does not count.

Vertical Load Resisting System Design

Roof Framing

Trusses

Snow Load Fully Exposed

$p_g =$	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 =	8 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

$P_{net} + P_{pv}\cos(\theta) + P_{DL} =$	49.8 plf	
Max Moment, $M_u =$	245 lb-ft	Conservatively
Pv max Shear	163.7 lbs	
Max Shear, $V_u = wL/2 + P_v$ Point Load =	268 lbs	

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

$0.75(P_{net} + P_s) + P_{pv}\cos(\theta) + P_{DL} =$	55 plf	
$M_{down} =$	271 lb-ft	
Mallowable = $S_x \times F_b'$ (wind) =	634 lb-ft	> 271 lb-ft OK

Load Case: DL+S

$P_s + P_{pv}\cos(\theta) + P_{DL} =$	41 plf	
$M_{down} =$	203 lb-ft	
Mallowable = $S_x \times F_b'$ (wind) =	456 lb-ft	> 203 lb-ft OK

Max Shear, $V_u = wL/2 + P_v$ Point Load = 268 lbs

Member Capacity

DF-L No.2

2X4	Design Value	C_L	C_F	C_i	C_r	K_F	ϕ	λ	Adjusted Value
$F_b =$	900 psi	1.0	1.5	1.0	1.15	2.54	0.85	0.8	1553 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, $d =$ 3.5 in

Width, $b =$ 1.5 in

Cross-Sectional Area, $A =$ 5.25 in²

Moment of Inertia, $I_{xx} =$ 5.35938 in⁴

Section Modulus, $S_{xx} =$ 3.0625 in³

Allowable Moment, $M_{all} = F_b' S_{xx} =$ 396.2 lb-ft

$DCR = M_u / M_{all} =$ 0.40 < 1

Satisfactory

Allowable Shear, $V_{all} = 2/3 F_v' A =$ 630.0 lb

$DCR = V_u / V_{all} =$ 0.42 < 1

Satisfactory

Siesmic Loads Check

Roof Dead Load	10 psf
% or Roof with Pv	32.2%
Dpv and Racking	3 psf
Averarage Total Dead Load	11.0 psf
Increase in Dead Load	6.4% 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 - JENNIFER IVEY. 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.