

03/06/2024

Powur PBC



Subject: Structural Certification for Installation of Residential Solar

Job: Karla Yesenia Clavel

Project Address: 36 Athens Court, Cameron, NC, 28326

Attn.: To Whom It May Concern

Observation of the condition of the existing framing system was performed by an audit team of Powur PBC.

After review of the field observation data, structural capacity calculations were performed in accordance with applicable building codes to determine adequacy of the existing roof framing supporting the proposed panel layout. Please see full Structural Calculations report for details regarding calculations performed and limits of scope of work and liability. The design criteria and structural adequacy are summarized below:

Design Criteria

Code: NCSBC 2018, IBC 2015, ASCE 7-10

Ult Wind Speed: 117.0 mph

Ground Snow: 10.0 psf

Min Snow Roof: N/A

Current Renewables Engineering Inc.
Professional Engineer
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Summaries:

Check 1: Shingle roofing supported by 2x2 Truss @ 24 in. OC spacing. The roof is sloped at approximately 14 degrees and has a max beam span of 5.0 ft between supports. Roof is adequate to support the imposed loads. Therefore, no structural upgrades are required.

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The following calculations are for the structural engineering design of the photovoltaic panels and are valid only for the structural info referenced in the stamped plan set. I certify that the roof structure has sufficient structural capacity for the applied PV loads. All mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

Design Criteria

Code: NCSBC 2018, IBC 2015, ASCE 7-10

Live Load: 20 psf

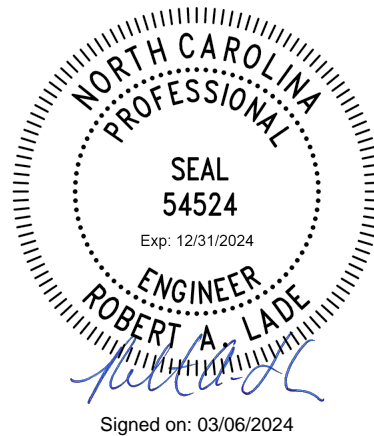
Ult Wind Speed: 117.0 mph

Exposure Cat: C

Ground Snow: 10.0 psf

Min Snow Roof: N/A

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Roof Properties:

	Check 1
Roof Type:	Shingle
Roof Pitch (deg):	14
Mean Roof Height (ft):	13.00
Attachment Trib Width (ft):	3.25
Attachment Spacing (ft):	4.00
Framing Type:	Truss
Framing Size:	2x2
Framing OC Spacing (in):	24.00
Section Thickness, b (in):	1.50
Section Depth, d (in):	1.50
Section Modulus, S _x (in ³):	0.562
Moment of Inertia, I _x (in ⁴):	0.422
Unsupported Span (ft):	5.00
Upper Chord Length (ft):	12.00
Deflection Limit D+L (in):	2.400
Deflection Limit S or W (in):	1.600
Framing Upgrade:	No
Sister Size:	N/A
Wood Species:	DF
Wood F _b (psi):	900.00
Wood F _v (psi):	180.00
Wood E (psi):	1,600,000.00
C _D (Wind):	1.60
C _D (Snow):	1.15
C _{LS} :	1.00
C _M = C _t = C _L = C _i :	1.00
C _F :	1.50
C _{fu} :	1.00
C _r :	1.15
F' _b Wind (psi):	2,484.00
F' _b Snow (psi):	1,785.37
F' _v Wind (psi):	288.00
F' _v Snow (psi):	207.00
Moment Allowable Wind (lb-ft):	116.44
Moment Allowable Snow (lb-ft):	83.69
V Allowable Wind (lbs):	432.00
V Allowable Snow (lbs):	310.50
E' (psi):	1,600,000

Load Calculations:**Dead Load Calculations:**

	Check 1
Panel Dead Load (psf):	3.00
Roofing Weight (psf):	3.00
Decking Weight (psf):	2.00
Framing Weight (psf):	0.26
Misc. Additional Weight (psf):	1.00
Existing Dead Load (psf):	6.26
Total Dead Load (psf):	9.26

Wind Load Calculations:

	Check 1
Ultimate Wind Speed (mph):	117.00
Directionality Factor, kd:	0.85
Topographic Factor, kzt:	1.00
Velocity Press Exp Factor, kz:	0.85
Velocity Pressure, qz (psf):	25.29
External Pressure Up, GCp ₁ :	-0.87
External Pressure Up, GCp ₂ :	-1.55
External Pressure Up, GCp ₃ :	-2.42
External Pressure Down, GCp:	0.44
Design Pressure Up, p ₁ :	-22.00
Design Pressure Up, p ₂ :	-39.18
Design Pressure Up, p ₃ :	-61.18
Design Pressure Down, p (psf):	16.00

Snow Load Calculations:

	Check 1
Ground Snow Load, pg (psf):	10.00
Min Flat Snow, pf_min (psf):	0.00
Min Sloped Snow, ps_min (psf):	0.00
Snow Importance Factor, Ic:	1.00
Exposure Factor, Ce:	0.90
Thermal Factor, Ct:	1.10
Flat Roof Snow, pf (psf):	6.93
Slope Factor, Cs:	0.93
Sloped Roof Snow, ps (psf):	6.47

Hardware Checks:

Attachment Check:

	Check 1
Attachment Type:	Deck Mount
Allowable Up Force (lbs):	210.00
Allowable Down Force (lbs):	210.00
Allowable Side Force (lbs):	115.00
Applied Uplift Force (lbs):	-125.69
Uplift DCR:	0.599
Applied Down Force (lbs):	179.99
Down DCR:	0.857
Applied Lateral Force (lbs):	29.78
Lateral DCR:	0.259

Roof Framing Checks:**Force Checks****LC1: D+S**

	<u>Check 1</u>
Applied Moment (lb-ft):	87.4
Applied Shear (lbs):	94.8
Allowable Moment (lb-ft):	83.7
Allowable Shear (lbs):	310.5
Moment DCR:	1.044
Shear DCR:	0.305

LC2: D+0.6W

	<u>Check 1</u>
Applied Moment (lb-ft):	104.8
Applied Shear (lbs):	113.7
Allowable Moment (lb-ft):	116.4
Allowable Shear (lbs):	432.0
Moment DCR:	0.900
Shear DCR:	0.263

LC3: D+0.75(S+0.6W)

	<u>Check 1</u>
Applied Moment (lb-ft):	118.4
Applied Shear (lbs):	128.5
Allowable Moment (lb-ft):	116.4
Allowable Shear (lbs):	432.0
Moment DCR:	1.017
Shear DCR:	0.297

LC4: 0.6D+0.6W

	<u>Check 1</u>
Applied Moment (lb-ft):	84.2
Applied Shear (lbs):	91.4
Allowable Moment (lb-ft):	116.4
Allowable Shear (lbs):	432.0
Moment DCR:	0.723
Shear DCR:	0.211

Deflection Checks (Service Level):**LC1: D+L****Check 1**

Deflection (in.):	0.784
Deflection Limit (in.):	2.400
Deflection DCR:	0.327

LC2: S**Check 1**

Deflection (in.):	0.129
Deflection Limit (in.):	1.600
Deflection DCR:	0.080

LC3: W (Down)**Check 1**

Deflection (in.):	0.134
Deflection Limit (in.):	1.600
Deflection DCR:	0.084

LC4: W (Up)**Check 1**

Deflection (in.):	0.184
Deflection Limit (in.):	1.600
Deflection DCR:	0.115

Seismic Check:

Existing Weight:

Wall Weight (psf):	17.00
Tributary Wall Area (ft ²):	880.00
Total Wall Weight (lbs):	14,960.00
Roof Weight (psf):	6.26
Roof Area (ft ²):	1,740.00
Total Roof Weight (lbs):	10,888.59
Total Existing Weight (lbs):	25,848.59

Additional PV Weight:

PV Panel Weight (lbs):	64.35
Number of Panels:	19
Total Additional PV Weight (lbs):	1,222.65

Weight Increase:

$(\text{Existing W} + \text{Additional W}) \div (\text{Existing W}) = 104.73\%$

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

Limits of Scope of Work and Liability:

Existing structure is assumed to have been designed and constructed following appropriate codes at time of erection, and assumed to have appropriate permits. The calculations produced are only for the roof framing supporting the proposed PV installation referenced in the stamped planset and were completed according to generally recognized structural analysis standards and procedures, professional engineering and design experience, opinions and judgements. Existing deficiencies which are unknown or were not observable during time of inspection are not included in this scope of work. All PV modules, racking, and mounting equipment shall be designed and installed per manufacturer's approved installation specifications. The Engineer of Record and the engineering consulting firm assume no responsibility for misuse or improper installation. This analysis is not stamped for water leakage. Framing was determined based on information in provided plans and/or photos, along with engineering judgement. Prior to commencement of work, the contractor shall verify the framing sizes, spacings, and spans noted in the stamped plans, calculations, and cert letter (where applicable) and notify the Engineer of Record of any discrepancies prior to starting construction. Contractor shall also verify that there is no damaged framing that was not addressed in stamped plans, calculations, and cert letter (where applicable) and notify the Engineer of Record of any concerns prior to starting construction.