Current Renewables Engineering

08-31-2023

Palmetto Solar

997 Morrison Dr, Ste 200, Charleston, SC 29403

Attn.: To Whom It May Concern

re job: Mikale Bohlmann

207 Barnsley Rd, Angier, NC 27501, USA

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: 2018 NCSBC, IBC 2018, ASCE 7-16,
Live Load: 20 psf
Ult Wind Speed: 117 mph
Exposure Cat: C
Ground Snow: 20 psf
Min Snow Roof: N/A

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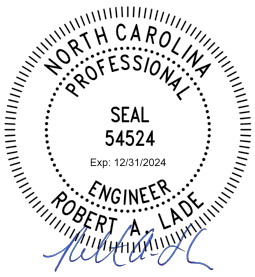

Current Renewables Engineering Inc.
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Roof Properties:

	Roof 1
Roof Type =	Shingle
Roof Pitch (deg) =	27.0
Mean Root Height (ft) =	13.0
Attachment Trib Width (ft) =	3.3
Attachment Spacing (ft) =	4.0
Framing Type =	Rafter
Framing Size =	2x4
Framing OC Spacing (in.) =	24.0
Section Thickness, b (in) =	1.5
Section Depth, d (in) =	3.5
Section Modulus, Sx (in^3) =	3.062
Moment of Inertia, Ix (in) =	5.359
Unsupported Span (ft) =	9.5
Upper Chord Length (ft) =	20.0
Deflection Limit D+L (in) =	4.0
Deflection Limit S or W (in) =	2.667
Framing Upgrade =	No
Sister Size =	NA
Wood Species =	DF
Wood Fb (psi) =	900.0
Wood Fv (psi) =	180.0
Wood E (psi) =	1600000.0
C_D (wind) =	1.6
C_d (snow) =	1.15
C_{LS} =	1.0
$C_M = C_t = C_L = C_i$ =	1.0
C_F =	1.5
C_{fu} =	1.0
C_r =	1.15
F'b wind (psi) =	2484.0
F'b snow (psi) =	1785.37
F'v wind (psi) =	288.0
F'v snow (psi) =	207.0
M allowable wind (lb-ft) =	633.94
M allowable snow (lb-ft) =	455.64
V allowable wind (lbs) =	1008.0
V allowable snow (lbs) =	724.5
E' (psi) =	1600000.0

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Load Calculation:

Dead Load Calculations:

	Roof 1
Panels Dead Load (psf) =	3.0
Roofing Weight (psf) =	3.0
Decking Weight (psf) =	2.0
Framing Weight (psf) =	0.602
Misc. Additional Weight (psf) =	1.0
Existing Dead Load (psf) =	6.602
Total Dead Load (psf) =	9.602

Wind Load Calculations:

Ultimate Wind Speed (mph) =	117.441
Directionality Factor, kd =	0.85
Topographic Factor, kzt =	1.0
Velocity Press Exp Factor, kz =	0.849
Velocity Pressure, qz (psf) =	25.477
External Pressure Up, GCp_1 =	-1.5
External Pressure Up, GCp_2 =	-2.167
External Pressure Up, GCp_3 =	-2.453
External Pressure Down, GCp =	0.465
Design Pressure Up, p_1 (psf) =	-26.369
Design Pressure Up, p_2 (psf) =	-38.098
Design Pressure Up, p_3 (psf) =	-43.122
Design Pressure Down, p (psf) =	16.0

Snow Load Calculations:

Ground Snow Load, pg (psf) =	20.0
Min Flat Snow, pf_min (psf) =	0.0
Sloped Snow, ps_min (psf) =	0.0
Snow Importance Factor, Ic =	1.0
Exposure Factor, Ce =	0.9
Thermal Factor, Ct =	1.1
Flat Roof Snow, pf (psf) =	13.86
Slope Factor, Cs =	1.0
Sloped Roof Snow, ps (psf) =	13.86

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Lag Screw Checks:

	Roof 1
Ref. Withdrawal Value, W (lb/in) =	266.0
(C_m = C_t = C_{eg} = 1.0) CD =	1.6
Adjusted Withdrawal Value, W' (lb/in) =	425.6
Lag Penetration, p (in.) =	2.5
Allowable Withdrawal Force, W'p (lbs) =	1064.0
Applied Uplift Force (lbs) =	-159.455
Uplift DCR =	0.15
Ref. Lateral Value, Z (lbs) =	266.0
(C_m = C_t = C_Δ = C_{eg} = 1.0) CD =	1.15
Adjusted Lateral Value, Z' (lbs) =	310.5
Applied Lateral Force (lbs) =	101.036
Angle of Resultant Force, α (deg) =	1.006
Adjusted Interaction Lateral Value, Z'α (lbs) =	627.654
Lateral DCR =	0.161

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Roof Framing Checks:

Force Checks:

LC1: D+S

	Roof 1
Applied Moment (lb-ft) =	439.0
Applied Shear (lbs) =	267.0
Allowable Moment (lb-ft) =	456.0
Allowable Shear (lbs) =	724.0
Moment DCR =	0.964
Shear DCR =	0.369

LC2: D+0.6W

Applied Moment (lb-ft) =	360.0
Applied Shear (lbs) =	219.0
Allowable Moment (lb-ft) =	634.0
Allowable Shear (lbs) =	1008.0
Moment DCR =	0.567
Shear DCR =	0.217

LC3: D+0.75(S+0.6W)

Applied Moment (lb-ft) =	509.0
Applied Shear (lbs) =	310.0
Allowable Moment (lb-ft) =	634.0
Allowable Shear (lbs) =	1008.0
Moment DCR =	0.803
Shear DCR =	0.307

LC4: 0.6D+0.6W

Applied Moment (lb-ft) =	288.0
Applied Shear (lbs) =	175.0
Allowable Moment (lb-ft) =	634.0
Allowable Shear (lbs) =	1008.0
Moment DCR =	0.454
Shear DCR =	0.174

Deflection Checks (Service Level):

LC1: D+L

Deflection (in.) =	0.803
Deflection Limit (in.) =	4.0
Deflection DCR =	0.201

LC2: S

Deflection (in.) =	0.303
Deflection Limit (in.) =	2.667
Deflection DCR =	0.114

LC3: W (Down)

Deflection (in.) =	0.147
Deflection Limit (in.) =	2.667
Deflection DCR =	0.055

LC4: W (Up)

Deflection (in.) =	0.242
Deflection Limit (in.) =	2.667
Deflection DCR =	0.091

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Seismic Check:

Existing Weight:

Wall Weight (psf) =	17.0
Tributary Wall Area (ft^2) =	880.0
Total Wall Weight (lbs) =	14960.0
Roof Weight (psf) =	6.602
Roof Area (ft^2) =	1920.0
Total Roof Weight (lbs) =	12675.0
Total Existing Weight (lbs) =	27635.0

Total Additional PV Weight (lbs) = 1158.3

Weight Increase:

(Existing W + Additional W)/(Existing W) = 1.042

The increase in 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:

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 judgments. Existing deficiencies which are unknown or were not observable during time of inspection are not included in this scope of work. This analysis is not stamped for water leakage. 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.