Date: 09/27/2023

Job Number: 15485

Prepared for : Renewable Energy Design Group, 90 Beechwood Dr Lewisville, North Carolina 27023

Project.: Roneil Swaby , 402 New Castle Ln, Spring Lake, NC, 28390

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. The verification of such info is the responsibility of others. After review, I certify that the roof structure has sufficient structural capacity for the applied PV loads. All PV mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

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Exp.: 12/31/2024
Date Certified and
Signed: 09/27/2023

Solar Module Details

Module Type	Hanwha
Module Quantity	14
Module Model Number	400 watt

Design Criteria

Code: 2018 North Carolina Residential Code ASCE 7-16

Live Load (psf)	20
Ult Wind Speed (mph)	125
Exposure Cat	C
Ground Snow (psf)	25

Structure Geometry

Eave Height, he (ft)	15 to 20ft
Pitch of main roof (deg)	33.69
Building Length, L (ft)	65
Building Width, B (ft)	45
Roof Area (Module Area) ft2	2925.00
Standoff(i.e., Roof Mount) Spacing Feet	4`

NOTE: attachments should be installed in a staggered configuratiion to properly destributor loading.

Roof Properties

Roof Geometry type	Gable Roof
Roof Type	Truss
Roof Pitch (deg)	33.69

Roofing Type	Comp Shingles
Sheathing Type	1/2" OSB Board
Wood species	No. 2, Douglas Fir-Larch
Wood Fb (psf)	900
Wood Fv (psf)	180
Wood E (psf)	1600000
Purlin C/C Spacing (in)	12
Rafter C/C. Spacing (in.)	24

Purlin

Section Thickness, b (in.)	2
Section Depth, d (in.)	4

Rafter

Section Thickness, b (in.)	2
Section Depth, d (in.)	4
Maximum Rafter Span (ft)	7

Factors

Cd(wind)	1.60
Cd(Snow)	1.60
CLS	1.15
CM	1
Ct	1
CL	0.75
CF	1.5
Cfu	1
Cv	1
Cr	1
M allowable_wind	413.44
M allowable_snow	297.16

Dead Load(psf)

Comp Shingles	3.00 psf
1/2" OSB Board	2.00 psf
Insulation	2.00 psf
Total Roof 1DL	7 psf
No. 2, Douglas Fir-Larch	31.00 lb/ft^3
Solar Panel DL	3.00 psf

	Roof 1
Roof_Dist_DL	7.00 psf
M_Roof_Dist_DL	2699.04
Def_Roof_Dist_DL	1.61
PV_uni_Dist_DL	3.00 psf
M_PV_uni_Dist_DL	10.54
Def_PV_uni_Dist_DL	0.01
Total_Uni_DL	11.00 psf
M_Total_DL	2709.58
Def_Total_DL	1.61

Snow Load(psf)

Ground Snow Load, pg	25
Importance Factor, Ic	1
Thermal Factor, Ct	1
Exposure Factor, Ce	1
Flat roof snow, pF	25
Slope Factor, Cs	1

Sloped Row Snow, ps	25

Uni_Dist_S	25.00
M_uni_Dist_s	153.13
Def_uni_Dist_S	0.09

Wind Load

Ultimate Wind Speed	125
Directionality Factor,kd	0.85
Topographic factor	1.00
Velocity pressure exposure factor,kz	0.88
Ground Elevation Factor,ke	-0.55
Side Wall Width	45
Median Roof Height	-35.57
Velocity pressure,qz	29.92

External Pressure Up,GCp_1	-0.0524
External Pressure Up,GCp_2	-0.6
External Pressure Up,GCp_3	-0.9
External Pressure Down,GCp	0.3738

Design Pressure Up,p_1	-1.31
Design Pressure Up,p_2	-15.01
Design Pressure Up,p_3	-22.51
Design Pressure Up,p	9.35

Uni_Dist_W_up	-22.51
M_uni_Dist_W_up	-137.87
Def_uni_Dist_W_up	-0.08
Uni_Dist_W_down	9.35

M_uni_Dist_W_down	57.27
Def_uni_Dist_W_down	0.03

Lag Screw Uplift Check (ASD)

5/16" Lag Screw Withdrawl value	205.00 lb/in
Lag Screw Penetration	2.50 in
Roof1 0.6D+0.6W(up z1)	1849.986 > 512.5
Roof1 0.6D+0.6W(up z2)	1841.766 > 512.5

Framing Check (ASD):

Roof1 uni 1.0D+0.6W	2743.94 > 413.44
Lag Screw Penetration	2850.20 > 413.44
Roof1 0.6D+0.6W(up z1)	2862.71 > 297.16
Roof1 0.6D+0.6W(up z2)	1543.03 > 413.44

Seismic Check:

Wood	5.00 psf
2x4 Studs @ 16"	2.00 psf
Gypsum	3.00 psf
Misc(insulatioon,etc)	2.00 psf
Total wall DL	12.00 psf
Total Wall Area (Approx)	2415.00 ft^2
Total Wall W	28980 lbs
Total Roof DL	7.50 psf
Total Roof Area (Approx)	1297.74 ft^2
Total Roof W	9733.05 lbs

PV Panel W	3.00 psf	
Area of panel	280.00 ft^2	
Total Roof W	636.93 lbs	
% increase=(Wadditional)/Wexisting	1.76%	**OK**

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

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 Engineerinc 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. Prior to the commencement of work, the contractor shall verify the existing roof and framing conditions. Notify Engineerinc and the engineer of record of any Discrepancies prior to starting construction. Prior to the commencement of work, the contractor shall inspect framing for any damage such as water damage, cracked framing, etc. and notify the E.O.R. if any issues are found.These plans/calculations are stamped for structural code compliance of the roof framing supporting the proposed PV installation reference only. These plans/calculations are not stamped for water leakage. PV modules, racking, and attachment components must follow manufacturer guidelines and requirements.