

1/21/2025

CAROLINA CONNECTIONS 422 HUFFMAN MILL ROAD, SUITE 105 BURLINGTON, NC 27215

Attn.: To Whom It May Concern

re job: MARK CIOLEK RESIDENCE

15 PAPER BIRCH WAY,

FUQUAY VARINA, NC 27526

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 proposed 26 PV modules.

All mounting equipment shall be designed and installed per manufacturer's approved installation specifications.

Design Criteria:

Code: 2018 NC Building Code

ASCE 7-10

Live Load: 20 psf Ult Wind Speed: 116 mph

Exposure Cat: B

Ground Snow: 15 psf Min Roof Snow: NA

AHZ Consulting Engineers Inc. Professional Engineer projects@ahzengineers.com



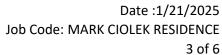


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Roof Properties:

	Roof 1							
Roof Type =	Shingle							
Roof Pitch (deg) =	28							
Mean Roof Height (ft) =	23							
Attachment Trib Width (ft) =	2.75							
Attachment Spacing (ft) =	4							
Framing Type =	Truss							
Framing Size =	2x4							
Framing OC Spacing (in.) =	24							
Section Thickness, b (in.) =	1.5							
Section Depth, d (in.) =	3.5							
Section Modulus, Sx (in.^3) =	3.1							
Moment of Inertia, lx (in.^4) =	5.4							
Framing Span (ft) =	8							
Deflection Limit D+L (in.) =	1.6							
Deflection Limit S or W (in.) =	1.07							
Attachments Pattern =	Fully Staggered							
Framing Upgrade =	Adequate							
Sister Size =	NA							
Wood Species =	DF #2							
Wood Fb (psi) =	900							
Wood Fv (psi) =	180							
Wood E (psi) =	1600000							
C _D (Wind) =	1.6							
C_D (Snow) =	1.15							
$C_{LS} =$	1.15							
$C_{M} = C_{t} = C_{L} = C_{i} =$	1.0							
C _F =	1.5							
C _{fu} =	1.00							
$C_r =$	1.15							
F'b_wind (psi) =	2857							
F'b_snow (psi) =	2053							
F'v_wind (psi) =	288							
F'v_snow (psi) =	207							
M allowable wind (lb-ft) =	729							
M_allowable_snow (lb-ft) =	524							
V_allowable_wind (lbs) =	1008							
V_allowable_snow (lbs) =	725							

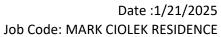




E' (psi) = 1600000

Load Calculation:

Dead Load Calculations:		
Panels Dead Load (psf) =	3.0	
	Roof 1	
Roofing Weight (psf) =	3.0	
Decking Weight (psf) =	2.0	
Framing Weight (psf) =	0.6	
Misc. Additional Weight (psf) =	1.0	
Existing Dead Load (psf) =	6.6	
Total Dead Load (psf) =	9.6	
Snow Load Coloulations		
Snow Load Calculations:	1 5	
Ground Snow Load, pg (psf) =	15 NA	
Min Flat Snow, pf_min (psf) =	NA NA	
Min Sloped Snow, ps_min (psf) =	1.0	
Snow Importance Factor, Ic =	0.9	
Exposure Factor, Ce =	Roof 1	
 Thermal Factor, Ct =	1.2	
Flat Roof Snow, pf (psf) =	11.34	
Slope Factore, Cs =	1.00	
Sloped Roof Snow, ps (psf) =	1.00	
Sloped Root Silow, ps (psi) -	11	
Wind Load Calculations:		
Ultimate Wind Speed (mph) =	116	
Directionality Factor, kd =	0.85	
Topographic Factor, kzt =	1.0	
	Roof 1	
Velocity Press Exp Factor, kz =	0.70	
Solar Equalization Factor, γa =	1.00	
External Pressure Up, GCp_1 =	-0.95	
External Pressure Up, GCp_2 =	-1.15	
External Pressure Up, GCp_3 =	-1.15	
External Pressure Down, GCp =	0.85	
Design Pressure Up, p_1 (psf) =	-19.5	
Design Pressure Up, p_2 (psf) =	-23.6	
Design Pressure Up, p_3 (psf) =	-23.6	
Design Pressure Down, p (psf) =	17.4	



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Hardware Checks:

Attachment Checks:

	Roof 1
Attachment Type =	QM HUG
Allowable Up Force (lbs) =	1000
	2000
Allowable Side Force (lbs) =	240
Applied Uplift Force (lbs) =	-111
Uplift DCR =	0.11
Applied Down Force (lbs) =	198
Down DCR =	0.10
Applied Lateral Force (lbs) =	74
Lateral DCR =	0.31

Roof Framing Checks:

Force Checks:

	Roof 1
LC1: D+S	
Applied Moment (lb-ft) =	223
Applied Shear (lbs) =	168
Allowable Moment (lb-ft) =	524
Allowable Shear (lbs) =	725
Moment DCR =	0.43
Shear DCR =	0.23
LC2: D+0.6W	
Applied Moment (lb-ft) =	214
Applied Shear (lbs) =	161
Allowable Moment (lb-ft) =	729
Allowable Shear (lbs) =	1008
Moment DCR =	0.29
Shear DCR =	0.16
LC3: D+0.75(S+0.6W)	
Applied Moment (lb-ft) =	277
Applied Shear (lbs) =	208
Allowable Moment (lb-ft) =	729
Allowable Shear (lbs) =	1008
Moment DCR =	0.38
Shear DCR =	0.21
LC4: 0.6D+0.6W	



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Applied Moment (lb-ft) = 63 Applied Shear (lbs) = 47 Allowable Moment (lb-ft) = 729 Allowable Shear (lbs) = 1008 0.09 Moment DCR = Shear DCR = 0.05

<u>Deflection Checks (Service Level):</u>

		Roof 1	
LC1: D+L	-		
	Deflection (in.) =	0.06	
	Deflection Limit (in.) =	1.84	
	Deflection DCR =	0.03	
LC2: S			
	Deflection (in.) =	0.05	
	Deflection Limit (in.) =	1.23	
	Deflection DCR =	0.04	
LC3: W (Down)			
	Deflection (in.) =	0.03	
	Deflection Limit (in.) =	1.23	
	Deflection DCR =	0.03	
LC4: W (Up)			
	Deflection (in.) =	-0.04	
	Deflection Limit (in.) =	1.23	
	Deflection DCR =	0.03	

Seismic Check:

Existing Weight:

Total Existing Weight (lbs) =	66844
Total Roof Weight (lbs) =	15844
Roof Area (ft²) =	2400
Roof Weight (psf) =	7
Total Wall Weight (lbs) =	51000
Tributary Wall Area (ft ²) =	3000
Wall Weight (psf) =	1/

Additional PV Weight:

54 PV Panel Weight (lbs) = Number of Panels = 26 Total Additional PV Weight (lbs) = 1416



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Weight Increase:

(Existing W + Additional W)/(Existing W) = 1.02

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 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.