Friday, June 14, 2024

Contractor
Southern Energy Management
5908 Triangle Dr.,
Raleigh, NC 27617

RE: Roof mounted PV system
James Schmadeke Residence
151 Fieldstone Dr., Holly Springs, North Carolina 27540

Castillo Engineering
CASTILLO ENGINEERING SERVICES, LLC
407-289-2575
WWW.CASTILLOPE.COM
1060 MAITLAND CENTER COMMONS,
SUITE 270, MAITLAND, FL 32751

To Whom It May Concern,

Structural Engineering Certification

Upon reviewing the as-built conditions provided by the contractor, I, Ermocrates Castillo PE #50478 an engineer licensed pursuant to General Statute 89c, certify that the installation of the modules is in compliance with IRC: Residential 2018, Chapter 3 and that the building structure will safely accommodate wind, lateral and uplift forces, and equipment dead loads. The member forces in the area of the solar panels are not increased by more than 5%; thus, the stresses of the structural elements are not increased by more than 5%. Therefore, the requirements of section 805.2 of the IEBC 2018 are met and the structure is permitted to remain unaltered. The solar array will be flush-mounted and parallel to the roof surface. Thus, it is concluded that any additional wind loading on the structure related to the addition of the proposed solar array is negligible. The attached calculations verify the capacity of the connections of the solar array to the existing roof against wind (uplift), the governing load case. Because the increase in lateral forces is less than 10%, this addition meets the requirements of the exception in 805.3 of the IEBC 2018. Thus the existing lateral force resisting system is permitted to remain unaltered.

After adequate review, the existing roof framing has been determined to be adequate to support the imposed loads without any additional structural upgrades.

A. Site Visit, Documentation and Existing Site Conditions

Roof Style	Hip	Rafter Type	Southern Pine
Roof Type	Asphalt Shingle	Rafter Size	2x8 in
Roof Height	25 ft	Rafter Spacing	16 in
Roof Slope	12/12 (45 deg)	Module Count	21 modules

A site visit was performed by the contractor to identify the size and spacing of the existing roof's framing structure. The roof is evaluated for a module count of 21 modules.

B. Governing Codes

North Carolina Residential Code 2018
North Carolina Building Code 2018
North Carolina Plumbing Code 2018
North Carolina Mechanical Code 2018
North Carolina Fire Code 2018
All Local City and County Ordinances,
National Electrical Code 2017 (NEC)
ASCE 7-16

D. Design Criteria

Wind speed (ult):	116 mph
Wind speed (asd):	89 mph
Risk category:	B
Exposure:	II
Ground snow load:	15.00 psf
Sloped Roof snow load:	5.76 psf

E. Factors Considered

Exposure Factor (Ce)	1.000	Effective Wind Area Of Module	20.00	ft
Temperature Factor (Ct)	1.000	Component Amplification (a_p)	1.00	
Component Response Factor	1.500	Component Operating Weight	50.00	lbs
Spectral Acceleration (S_{ds})	0.138	Total Modules In The Array	21.00	Nos
Importance Factor (Is)	1.000	Dead Load	3.00	psf
Slope Factor (Cs)	0.385	Ground Elevation	399.00	ft
K_D	0.850	Zone width "A"	4.00	ft
K_{ZT}	1.000	Array Edge Factor	1.50	
Ke	0.986	Solar Panel Equalization Factor	0.680	
K_z	0.665	HVHZ	NO	

F. Design Calculations

Velocity Pressure (ASD) = $.00256*KEK_ZK_{ZT}K_DV^2$

Velocity Pressure (ASD) = 11.51581 psf

External Pressure Coefficients

Zones	Positive Pressure		Negative Pressure		
	Positive Pressure Coefficient	Positive Design Pressure (psf)	Negative Pressure Coefficient	Negative Design Pressure (Non-Exposed) (psf)	Negative Design Pressure (Exposed) (psf)
Zone 1	0.5754	16.00	-1.3583	-16.00	-16.00
Zone 1'	X	X	X	X	X
Zone 2e	0.5754	16.00	-2.3634	-18.50	-27.74
Zone 2n	X	X	X	X	X
Zone 2r	0.5754	16.00	-2.4811	-19.42	-29.13
Zone 3e	0.5754	16.00	-3.1393	-24.57	-36.85
Zone 3r	X	X	X	X	X

Maximum Seismic Load Calculation		
Horizontal Force	141.55	lbs
Vertical Force	1.38	lbs
Total Seismic Load (1.2D + E_v + E_h+ .2S)	147.68	lbs

Structural Attachment Strength Calculation

Specific Gravity of Southern Pine 0.55 Screw Diameter 1/4"

Attachment strength of Quickmount Hug attachment 625 lbs

For Two Self drilling screw #14, wood tip with 2.5" Minimum Embedment into Structural Member per FPA FL #41858.6

Roof Zone	Non-Exposed		Exposed		Down
	Number of rails		Number of rails		
	2		2		
	Spans (in)	Point Load (lbs)	Spans (in)	Point Load (lbs)	Point Load (lbs)
1	48	213.33	48	213.33	213.33
1'	X	X	X	X	X
2e	48	246.61	48	369.91	213.33
2n	X	X	X	X	X
2r	48	258.89	48	388.34	213.33
3e	48	327.58	48	491.37	213.33
3r	X	X	X	X	X

E. Attachment Spans

The solar panels shall be mounted in accordance with the most recent installation manual. Considering the wind speed, risk category, exposure, roof slopes, snow load, seismic load, size and spacing of framing members, and condition of the roof, the span tables provided by the manufacturer is not applicable and so the contractor what install the mounting system no greater than the below attachment spans:

	Non Exposed Modules	Cantilever	Exposed Modules	Cantilever	
Zone 1	Attachments at 48 in O.C. with 2 rails	16 in	Attachments at 48 in O.C. with 2 rails	16 in	Zone 1
Zone 1'	Zone not applicable in Hip roofs	-	Zone not applicable in Hip roofs	-	Zone 1'
Zone 2e	Attachments at 48 in O.C. with 2 rails	16 in	Attachments at 48 in O.C. with 2 rails	16 in	Zone 2e
Zone 2n	Zone not applicable in Hip roofs	-	Zone not applicable in Hip roofs	-	Zone 2n
Zone 2r	Attachments at 48 in O.C. with 2 rails	16 in	Attachments at 48 in O.C. with 2 rails	16 in	Zone 2r
Zone 3e	Attachments at 48 in O.C. with 2 rails	16 in	Attachments at 48 in O.C. with 2 rails	16 in	Zone 3e
Zone 3r	Zone not applicable in Hip roofs	-	Zone not applicable in Hip roofs	-	Zone 3r

F. Limitations

Castillo Engineering Services, LLC takes no responsibility for the installation of the system. The contractor has supplied the as-built conditions and shall cease construction and notify Castillo should any discrepancies between the provided as-built conditions and the condition described in this letter be found. The design and engineering of the racking, mounting, waterproofing, fire pathways and setbacks, electrical system and system labels are the responsibility of others. The contractor must adhere to the spans provided within this letter and all connections to the existing roof must adhere to industry standard and per manufacturer's most recent installation instructions.

PE Certification:

Digitally signed by Ermocrates E Castillo
Date: 2024.06.14 12:58:59 -04'00'

Ermocrates Castillo, P.E
North Carolina License #50478