

Tuesday, September 26, 2023
Castillo Order #: C-54712

Contractor
The Solar Guys
6114 MO-9 Parkville,
Missouri 64152

RE: Roof mounted PV system
William Draisey Residence
118 NW Ambersham Dr, Lees Summit, Missouri, 64081

To Whom It May Concern,



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

Structural Engineering Certification

Upon reviewing the as-built conditions provided by the contractor, I, Ermocrates castillo PE# 2021029136 an engineer licensed pursuant to Title 73, Chapter 13, certify that the installation of the modules is in compliance with IRC 2021, 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 IEBC 2021 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 Existing Building Code 2021. Thus the existing lateral force resisting system is permitted to remain unaltered.

A. Site Visit & Documentation

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 44 modules

B. Existing Structure

Roof Style	Hip
Roof Type	Asphalt Shingle
Roof Height	25 ft
Rafter Type	Douglas Fir-Larch
Rafter Size	2x6
Rafter Spacing	24 in O.C.
Roof Slope	10/12 (39.81 deg)

C. Governing Codes

2021 INTERNATIONAL BUILDING CODE
2021 INTERNATIONAL RESIDENTIAL CODE
2021 INTERNATIONAL EXISTING BUILDING CODE
2021 INTERNATIONAL FIRE CODE
2020 NATIONAL ELECTRICAL CODE

D. Design Criteria

Wind speed (ult): 109 mph
Wind speed (asd): 84 mph
Risk category: II
Exposure: B
Sloped roof snow load: 30 psf

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	Exposed Modules
Zone 1	Attachments at 72 in O.C. with 2 rails	Attachments at 72 in O.C. with 2 rails
Zone 1'	Zone not applicable in Hip roofs	Zone not applicable in Hip roofs
Zone 2e	Attachments at 70 in O.C. with 2 rails	Attachments at 47 in O.C. with 2 rails
Zone 2n	Zone not applicable in Hip roofs	Zone not applicable in Hip roofs
Zone 2r	Attachments at 67 in O.C. with 2 rails	Attachments at 44 in O.C. with 2 rails
Zone 3e	Attachments at 53 in O.C. with 2 rails	Attachments at 35 in O.C. with 2 rails
Zone 3r	Zone not applicable in Hip roofs	Zone not applicable in Hip roofs

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:

Castillo Order #: C-54712
Subject: Wind Pressure Calculations

Site Information	
FBC VERSION	2020
MEAN ROOF HEIGHT (ft)	25
ROOF LENGTH (ft)	80
ROOF WIDTH (ft)	50
PARAPET HEIGHT (ft)	0
MODULE AREA (sq. ft.)	19.92
COMPONENT AMPLIFICATION (a _p)	1
COMPONENT OPERATING WEIGHT	45
TOTAL MODULES IN THE ARRAY	44
GROUND SNOW LOAD (psf)	30
DEAD LOAD (psf)	3
SLOPED ROOF SNOW LOAD (psf)	9.755123186
EFFECTIVE WIND AREA (ft ²)	18
GROUND ELEVATION (ft)	956
HVHZ	NO

Site Information	
RISK CATEGORY	II
EXPOSURE CATEGORY	B
ROOF SLOPE	10 /12
ROOF SLOPE (°)	39.81
ROOF TYPE	Hip
ULTIMATE WIND SPEED	109.00 mph
NOMINAL WIND SPEED	84.43 mph
EXPOSURE FACTOR (Ce)	1.00
TEMPERATURE FACTOR (Ct)	1.00
COMPONENT RESPONSE FACTOR	1.50
SPECTRAL ACCELERATION (S _{DS})	0.10
IMPORTANCE FACTOR (Is)	1.00
SLOPE FACTOR (Cs)	0.46
K _D	0.85
K _{zT}	1.00
Ke	0.97
K _z	0.67
HEIGHT B/W MODULE AND ROOF	0.50

DESIGN CALCULATIONS					
VELOCITY PRESSURE (q) =	.00256*KEK _z K _{zT} K _D V ²				
VELOCITY PRESSURE(ASD)	10.0		psf		
WIDTH OF PRESSURE COEFFICIENT	50' * 10%	=	5'	ZONE WIDTH A	4 FT
	25' * 40%	=	10'	ZONE 2 WIDTH	N/A (FOR (°) < 7°)
				ZONE 3 WIDTH	N/A (FOR (°) < 7°)

Subject: Connection Calculations

ATTACHMENT STRENGTH, NDS 2018 ALLOWABLE DESIGN STRENGTH					
2"x4"	SUPPORT MEMBER			SPECIFIC GRAVITY	0.5
5/16"	LAG SCREW	NO OF SCREWS:	1	LENGTH OF SCREW	3.75 in
0.3125	TIP LENGTH	SIDE MEMBER THICKNESS	1.5 in	ADJUSTMENT	1
		MAIN MEMBER THICKNESS	4 in		
	NDS REFERENCE WITHDRAWAL PER SCREW		515.36 LBS/IN		PER 12.2
	NDS REFERENCE WITHDRAWAL PER SCREW		515.38 LBS/IN		PER 12.2A
	ALLOWABLE DESIGN LOAD		343.57 LBS/IN		
	ATTACHMENT MODEL	Sunmodo NanoMount	Decking Only		
	ATTACHMENT STRENGTH	290 lbs		FoS=1.5	

Subject: Loading Calculations

MAX DESIGN LOADS ALLOWABLE						
LIMIT MAX SPAN TO	N/A	in				
RAFTER/SEAM SPACING	24	in	NO. OF RAILS Exposed	2	Non. Exp:	2

Roof Zone	Down	Exposed	N. Exposed		Spans (Exposed)	Spans (Non-Exposed)
1	286.8	286.8	286.8	lbs	72 in	72 in
1'	0.0	X	X	lbs	X in	X in
2e	278.8	288.7	286.7	lbs	47 in	70 in
2n	0.0	X	X	lbs	X in	X in
2r	266.9	283.7	288.0	lbs	44 in	67 in
3e	211.1	285.6	288.3	lbs	35 in	53 in
3r	0.0	X	X	lbs	X in	X in