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STRUCTURAL ANALYSIS

for the

ROOFTOP PV SOLAR INSTALLATION

Project: Marguerite Stearman, 450 Se Margaret Dr, Lake City, FL 32025

Prepared for:

Lunex Power

4721 N Grady Ave - Tampa, FL 33614

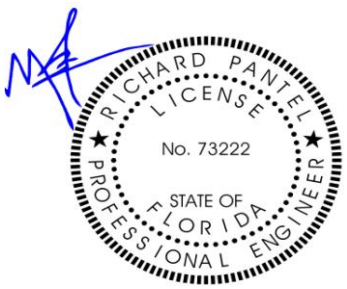
Calculation Report Index

Project No: 66.432231, Rev. 0

Report Date: 03/11/2026

Report Prepared by:

This item has been digitally signed and sealed by Richard Pantel, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.



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Loading Summary

Exposure and Occupancy Categories		
B		*Exposure Category (ASCE 7-22 Table 26.7.3, Page 274)*
II		*Building Use Occupancy / Risk Category (ASCE 7-22 Table 1.5-1, Page 5)*

Wind Loading:			
v	165	*mph*	*Value overridden from ASCE Hazards default*
qz	41.47	*psf*	*Velocity qz, calculated at height z*

Snow Loading			
pg	4.05	*psf*	*Ground Snow Load pg (Value overridden from ASCE Hazards default)*
Total Snow Load			
ps	4.05	*psf*	*Effective snow load on roof and modules*

Module Data			
Peimar: DR10H450M (FB)			
Dimensions	*mm*	*ft*	*in*
Length	1,906	6.25	75.04
Width	1,134	3.72	44.65
Area (m^2, ft^2)	2.2	23.27	
Weight	kg	lb	psf load
Module	24.00	52.91	2.27

Roof Panel (Cladding) Loading Summary		Module Loading Summary			
Support Point Loads		*Upward*	*Upward*	*Upward*	*Downward*
Roof Zones		1,2e	2n,2r,3e	3r	All
Net load per module	*lb*	-128	-158	-227	101

Positive values indicate net downward force

Primary Stanchion: Unirac NXT Horizon Stronghold Attachment

StanchionFastener Pull-out and Spacing Calculations			
Framing spacing	*ft*	2.00	
Rails / Module	*ea*	2	
Max proposed stanchion span	*ft*	4.00	
# fasteners per stanchion		1	
Bolt thread embedment depth	*in*	1.50	
Safety Factor		1.10	
Pull-out for 5/16 threaded fasteners	*lb/in*	220	*lb per inch of embedment*
Factored max fastener uplift capacity	*lb*	299	
Fastener details *Material* Stainless	*Size*	5/16	*Predrill hole 0.16" dia or use self tapping*
Max stanchion uplift capacity	*lb*	1089	
Max support point uplift capacity	*lb*	299	

Roof Zones		*1,2e*	*2n,2r,3e*	*3r*
Net lift per module	*lb*	128	158	227
Min tot bolt thread embedment depth rq'd	*in*	0.64	0.79	1.14
Net uplift pressure 7. 0.60D - 0.6W	*psf*	-17.20	-21.25	-30.47
Allowable lift area / support point	*sf*	17.40	14.09	9.83
Max rail span per support spacing	*ft*	4.00	4.00	4.00
Landscape Modules				
Length along rafter	*ft*	3.72		
Lift calc'ed max stanchion EW spacing	*ft*	> 6	6.00	4.00
Max stanchion EW spacing	*ft*	4.00	4.00	4.00
Maximum module area / support point	*sf*	7.44	7.44	7.44
Factored lift per support point	*lb*	-128	-158	-227
Portrait Modules				

Length along rafter	*ft*	6.25		
Lift calc'ed max stanchion EW spacing	*ft*	4.00	4.00	2.00
Max stanchion EW spacing	*ft*	4.00	4.00	2.00
Maximum module area / support point	*sf*	12.51	12.51	6.25
Factored lift per support point	*lb*	-215	-266	-191

Stanchion support threaded fastener sizes are indicated in the Module Loading Summary table above. Lift forces were determined from GCp and other coefficients contained in the ASCE nomographs

Conclusions

We were asked to review the roof

Building design plans were used in the preparation of the roof structural calculations combined with the PV solar module locations shown on the PV solar roof layout design prepared by Lunex Power. Loads are calculated to combine the existing building and environmental loads with the proposed new PV array loads.

The Unirac NXT Umount Rail racking and Unirac NXT Horizon Stronghold Attachment stanchions were selected for this project by Lunex Power. The racking and support stanchions shall be placed as shown on their plans, dated 03/11/2026, and shall be fastened to the roof framing using fastener sizes indicated in this report. Rack support spacing shall be no more than that shown above. Note that support points for alternating rows shall share the same roof support member. Intermediate rows shall move the support points laterally to the next roof support member.

Google Location Map

Framing Summary

	Ex. Framing	Total Ex DL
MP 1: 1.50" x 5.50" member @ 24" OC	0.79 psf	5.94 psf
MP 2: 1.50" x 5.50" member @ 24" OC	0.79 psf	5.94 psf

** Wood species used in these calculations assumes spruce, pine or fir, #2 grade.*

Based upon the attached calculations and in accordance with the 2023 FBC Section R324.4 and the FBC's reference to 2021 IBC Section 1607.12.5.2, the existing roofs' framing systems are capable of supporting the additional loading for the proposed PV solar system along with the existing building and environmental loads. No supplemental roof framing structural supports are required. No further structural alterations or modifications are needed to support the system..

Wood fastener notes: 1) Fastener threads must be embedded in the side grain of a roof support structural member or other structural member integrated into the building's structure. 2) Fastener must be located in the middle third of the structural member. 3) Install fasteners with head and where required, washer, flush to material surface (no gap). Do not over-torque.

References and Codes:

1) *ASCE 7-22 Minimum Design Loads for Buildings and Other Structures*
2) *2021 IBC*
3) *2023 FBC*
4) *American Wood Council, NDS 2018,Table 12.2A, 12.3.3A.*
5) *American Wood Council, Wood Structural Design, 1992, Figure 6.*

Geometric Data			
Θ	*deg.*	18.0	*Angle of roof plane from horizontal, in degrees*
ω	*deg.*	0.0	*Angle the solar panel makes with the roof surface*
L	*ft.*	38.08	*Length of roof plane, in feet (meters)*
W	*ft.*	14.33	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	12.46	*Average height of roof above grade, in feet (meters)*

Roof Wind Zone Width			
	use, a =	3.00	*ft*

Wind Velocity Pressure, q_z evaluated at the height z						
q_z=	41.47	*psf*	*Vasd* q_z=	24.96	*psf*	Basic wind pressure
V=	165	mph				

Framing Data		
# Framing Members / Support		1
Rafter / Truss OC	*in*	24.00
Member Total Length	*ft*	14.20

2.00	Rack Support Spacing (ft)
48.00	Max. Rack Support Spacing (in)
12	# Modules / Roof Plane

Member Properties		**Member**
Name		(1)1.5x5.5

** Mem properties based upon field measurements*

Roof Support Member

Module Data			
Weight	kg	lb	psf load
Module	24.00	52.91	2.27
4 Stanchions	1.36	3.0	0.13

Existing Dead Loads	*Units*	*Value*	*Description*
Framing Members	*psf*	0.79	1.57 plf / 2.00 ft spacing
Roof Deck & Surface Material*	*psf*	5.15	*0.50 in. Plywood w/ Shingles, Asphalt, Architectural (Typical)*
Proposed PV Dead Load			
PV Module + Stanchion	*psf*	2.40	

ASCE 7-22 Method for Calculating Uplift on PV Modules

Notation
Lp = Panel chord length.
p = uplift wind pressure
γa = Solar panel pressure equalization factor, defined in Fig. 29.4-8.
γE = Array edge factor as defined in Section 29.4.4.
θ = Angle of plane of roof from horizontal, in degrees.

29.4.4 Rooftop Solar Panels Parallel to the Roof Surface on Buildings of All Heights and Roof Slopes.

Θ >= 7 deg TRUE

Min.d1: Exposed **FALSE**
Max.d1: Exposed **FALSE** ***Use NOT EXPOSED for uplift calculations***

1.5(Lp) =	9.38
γE =	1
γa =	0.65

$p = qh(GCp)\ (\gamma_E)\ (\gamma_a)$ (lb/ft2) (29.4-7)

Zones	1,2e	2n,2r,3e	3r
GCp	-1.91	-2.32	-3.26
p, Windload (psf)	-31.08	-37.82	-53.18

Downward, Zones All Zones
GCp 0.47

Wind Loading	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
Zones	1,2e	2n,2r,3e	3r	All Zones
GCp	-1.91	-2.32	-3.26	0.47
Vasd Windload (psf)	-31.08	-37.82	-53.18	11.67

Roof Live Load (Lr)					
Ex. Roof Design Live Load per ASCE 7-22 Table 4-1	*psf*	20	20	20	20

ASCE 7-22 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
2.2 SYMBOLS AND NOTATION	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
D = dead load of Sum Existing DL Roof Loads	5.94	5.94	5.94	5.94
Lr = roof live load	20.00	20.00	20.00	20.00
S = snow load Zeroed out to test for IBC 5% Dead Load Only	0.00	0.00	0.00	0.00
W = Vasd Windload	-31.08	-37.82	-53.18	11.67

2.4 Combining Nominal Loads Using Allowable Stress Design (in psf)				
2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member being considered. Effects of one or more loads not acting shall be considered.				
Combination Formulae	*Upward*	*Upward*	*Upward*	*Downward*

ASCE 7-22 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e	2n,2r,3e	3r	All Zones
2.2 SYMBOLS AND NOTATION	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
D = dead load of Existing Dead Loads and Proposed PV Dead Load	8.34	8.34	8.34	8.34
Lr = roof live load	20.00	20.00	20.00	20.00
W = Vasd Windload	-31.08	-37.82	-53.18	11.67
Use this loading combination for DOWNWARD for Existing Dead Loads				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	25.94	25.94	25.94	31.19

Use this loading combination for DOWNWARD for Existing Dead Loads and Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	28.34	28.34	28.34	33.59
Module Support point load (lb)	105	105	105	125

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-17.20	-21.25	-30.47	4.78
Module Support point load (lb)	-64	-79	-113	18

Check % Roof Load Increase		
Total Roof Area	*sf*	541
Existing Downward Roof Load	*psf*	31.19
Existing Downward Roof Load	*lb*	16,865
Number of PV Modules	*ea*	12
Area of PV Modules	*sf*	279
Total weight of Existing Roof + PV	*lb*	17,536
% increase in total loading		4.0%
Check if % increase < 5%		**OK**

# Modules Proposed	*ea*	12	*Within Limits*
# Modules Allowed	*ea*	15	***OK***

In accordance with 'IBC 3404.3 Existing Structures Carrying Gravity Loads', the net increase in roof load after adding the PV modules, is less than 5%. Hence, no structural modifications for this structure are required.

Geometric Data			
Θ	*deg.*	18.0	*Angle of roof plane from horizontal, in degrees*
ω	*deg.*	0.0	*Angle the solar panel makes with the roof surface*
L	*ft.*	45.75	*Length of roof plane, in feet (meters)*
W	*ft.*	14.33	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	12.46	*Average height of roof above grade, in feet (meters)*

Roof Wind Zone Width			
	use, a =	3.00	*ft*

Wind Velocity Pressure, q_z evaluated at the height z						
q_z=	41.47	*psf*	*Vasd* q_z=	24.96	*psf*	Basic wind pressure
V=	165	mph				

Framing Data		
# Framing Members / Support		1
Rafter / Truss OC	*in*	24.00
Member Total Length	*ft*	14.20

2.00	Rack Support Spacing (ft)
48.00	Max. Rack Support Spacing (in)
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** Mem properties based upon field measurements*

Roof Support Member

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Existing Dead Loads	*Units*	*Value*	*Description*
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Proposed PV Dead Load			
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$p = qh(GCp)\ (\gamma_E)\ (\gamma_a)$ (lb/ft2) (29.4-7)

Zones	1,2e	2n,2r,3e	3r
GCp	-1.91	-2.32	-3.26
p, Windload (psf)	-46.61	-56.73	-79.77

Downward, Zones All Zones
GCp 0.47

Wind Loading	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
Zones	1,2e	2n,2r,3e	3r	All Zones
GCp	-1.91	-2.32	-3.26	0.47
Vasd Windload (psf)	-46.61	-56.73	-79.77	11.67

Roof Live Load (Lr)					
Ex. Roof Design Live Load per ASCE 7-22 Table 4-1	*psf*	20	20	20	20

ASCE 7-22 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
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S = snow load Zeroed out to test for IBC 5% Dead Load Only	0.00	0.00	0.00	0.00
W = Vasd Windload	-46.61	-56.73	-79.77	11.67

2.4 Combining Nominal Loads Using Allowable Stress Design (in psf)				
2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member being considered. Effects of one or more loads not acting shall be considered.				
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ASCE 7-22 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
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W = Vasd Windload	-46.61	-56.73	-79.77	11.67
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Use this loading combination for DOWNWARD for Existing Dead Loads and Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	28.34	28.34	28.34	33.59
Module Support point load (lb)	105	105	105	125

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-26.53	-32.59	-46.42	4.78
Module Support point load (lb)	-99	-121	-173	18

Check % Roof Load Increase		
Total Roof Area	*sf*	650
Existing Downward Roof Load	*psf*	31.19
Existing Downward Roof Load	*lb*	20,262
Number of PV Modules	*ea*	2
Area of PV Modules	*sf*	47
Total weight of Existing Roof + PV	*lb*	20,374
% increase in total loading		0.6%
Check if % increase < 5%		**OK**

# Modules Proposed	*ea*	2	*Within Limits*
# Modules Allowed	*ea*	18	***OK***

In accordance with 'IBC 3404.3 Existing Structures Carrying Gravity Loads', the net increase in roof load after adding the PV modules, is less than 5%. Hence, no structural modifications for this structure are required.

Snow Loading Analysis

where:

		Fully Exposed	Exposure category
Ce	=	0.9	Exposure Factor, Ce (ASCE 7-22 Table 7.3-1, Page 61)
Ct	=	1.0	Thermal Factor, Ct (ASCE 7-22 Table 7.3-2, Page 61)
Is	=	1.0	Snow Importance Factor, Is (ASCE 7-22 Table 1.5-2, Page 5)
p_g	=	4.05	Ground Snow Load pg (Value overridden from ASCE Hazards default)

p_f = **0.7CeCtIsPg** Flat Roof Snow Load, pf (ASCE 7-22 Table 7.3-1, Page 61)

p_f = **2.55** psf

but where Pf is not less than the following:

Minimum Snow Load pm (ASCE 7-22 Table 7.3.4, Page 62)

p_m = **4.05** When Pg <=20 psf, then use Pf = Pg x Is

p_f = **4.05** psf. Resultant Snow pressure to be used with Roof slope factor below

p_s = $C_s p_f$ Sloped Roof Snow Load ps (ASCE 7-22 Table 7.4, Page 61)

Roof Type Warm Roofs

Roof slope factor Cs for Warm Roofs, where Ct = 1.0

Roof surface condition = Slippery Roof

C_s = 1.00 Roof Slope Factor, Cs (ASCE 7-22 Table 7.4-1a, Page 62)

Total Snow Load

p_s	=	**4.05**	**psf**	Roof snow load