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STRUCTURAL ANALYSIS

for the

ROOFTOP PV SOLAR INSTALLATION

Project: Eva Williams, 1452 Ne Washington St, Lake City, FL 32055

Prepared for:

Lunex Power

4721 N Grady Ave - Tampa, FL 33614

Calculation Report Index

Project No: 66.432232, 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)*
III		*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	4.10	*psf*	*Ground Snow Load pg (Value overridden from ASCE Hazards default)*
Total Snow Load			
ps	4.10	*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*	-144	-182	-268	64

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*	144	182	268
Min tot bolt thread embedment depth rq'd	*in*	0.72	0.91	1.34
Net uplift pressure 7. 0.60D - 0.6W	*psf*	-22.97	-29.03	-42.86
Allowable lift area / support point	*sf*	13.04	10.31	6.99
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*	6.00	4.00	2.00
Max stanchion EW spacing	*ft*	4.00	4.00	2.00
Maximum module area / support point	*sf*	7.44	7.44	3.72
Factored lift per support point	*lb*	-171	-216	-159
Portrait Modules				

Length along rafter	*ft*	6.25		
Lift calc'ed max stanchion EW spacing	*ft*	4.00	2.00	2.00
Max stanchion EW spacing	*ft*	4.00	2.00	2.00
Maximum module area / support point	*sf*	12.51	6.25	6.25
Factored lift per support point	*lb*	-287	-182	-268

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 truss. Intermediate rows shall move the support points laterally to the next truss.

Google Location Map

Framing Summary

	Ex. Framing	Total Ex DL
MP 1: Truss @ 24" OC	0.79 psf	5.94 psf
MP 2: Truss @ 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.*

Roof Structural Calculations for PV Solar Installation **Array AR-1**
Location: MP 1 ***Roof shape: Gable***
Member: Truss top chord - Total Length 19 ft, Unsupported 19 ft

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.*	28.50	*Length of roof plane, in feet (meters)*
W	*ft.*	18.83	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	13.19	*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		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support		1
Rafter / Truss OC	*in*	24.00
Member Total Length	*ft*	19.00

2	# Rafters / Rack Support Width
2.00	Rack Support Spacing (ft)
48.00	Max. Rack Support Spacing (in)
3	Max # of mod's / Truss top chord

Member Properties		**Member**
Name		(1) 2x4
Repetitive Member Factor (Cr)		1.15

** Mem properties based upon field measurements*

Truss top chord

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*
Roof Deck & Surface Material*	*psf*	5.15	*Truss members' self weight added to FEA analysis*
Sum Existing DL Roof Loads	*psf*	5.94	

** Roof surface: Shingles, Asphalt, Architectural (Typical)*

Rack Support Spacing and Loading						
Across rafters	*ft*	2.0				
Along rafter slope	*ft*	6.3				
Area / support point	*sf*	6.3				
Uphill gap between modules	*in*	1.0	0.08	*ft*	*Support from mod. Edge (in)*	1

Member Total Length	*ft*	19.00	
Maximum member free span	*ft*	19.00	Truss top chord span

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	**TRUE**
1.5(Lp) =	5.58
γE =	1.5
γa =	0.65

Use EXPOSED for uplift calculations

$p = qh(GCp)\ (\gamma_E)\ (\gamma_a)$ (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

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 PV Module + Stanchion	2.40	2.40	2.40	2.40
S = snow load	4.10	4.10	4.10	4.10
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.				
Combination Formulae	*Upward*	*Upward*	*Upward*	*Downward*
Use this loading combination for DOWNWARD for Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	6.50	6.50	6.50	11.75
Module Support point load (lb)	41	41	41	73
Cr Factored Module Support point load (lb)	35	35	35	64

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-22.97	-29.03	-42.86	8.34
Module Support point load (lb)	-144	-182	-268	52

DOWNWARD

Presume loading directly over member.

Combined Dead and Wind Pressure Downward Loading					
	Truss top chord span				
PV Module Row	Point load loc's from Left support	Point Load #'s	Module Support Point Load	Comment	Module Orientation
	ft from left		*lb*		
1	2.67			Support placed on adjoining truss	Portrait
1	6.92		64		Portrait
2	9.01			Support placed on adjoining truss	Portrait
2	13.26		64		Portrait
3	15.34		64		Landscape
3	17.06		64		Landscape

Truss Data and Loading for MP 1

Roof slope (degrees)	18.00
Top ridge height above floor plane	5.87

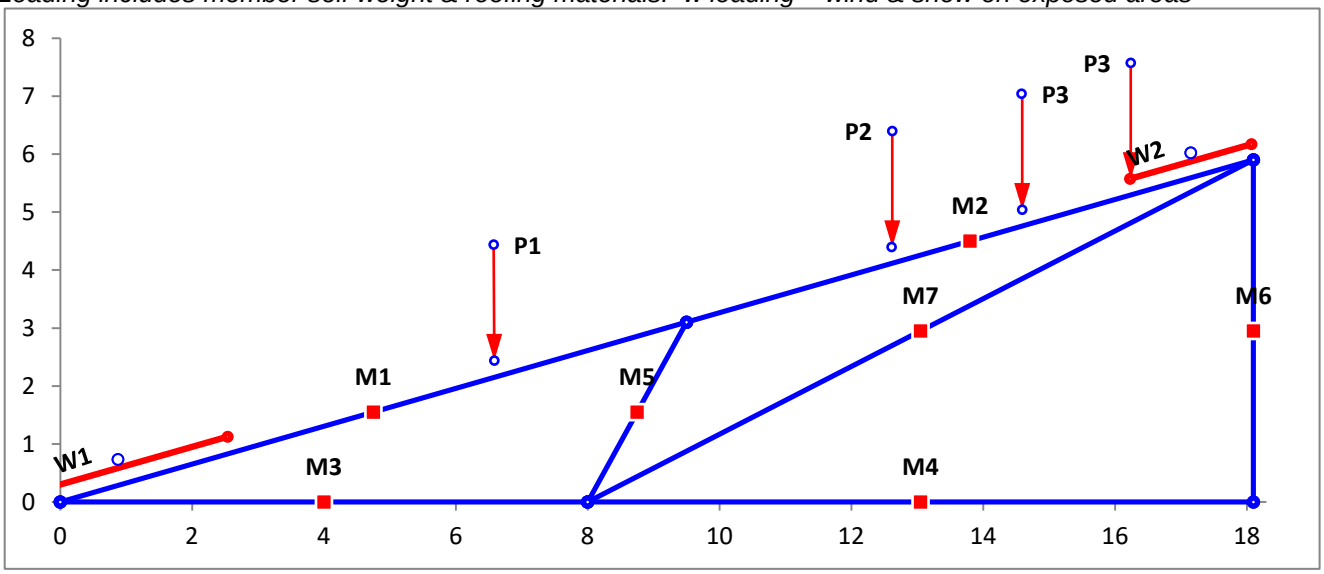
	Length of roof plane	19.00
	Length of floor plane	18.00

Truss Segments

Roof Plane		*Floor Plane*	
Mem #	*Mem Type*	Mem #	*Mem Type*
1	2x4	3	2x4
2	2x4	4	2x4

Diagonals		*Diagonals*	
Mem #	*Mem Type*	Mem #	*Mem Type*
5	2x4	7	2x4
6	2x4		

** Loading includes member self weight & roofing materials. w loading = wind & snow on exposed areas*



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.*	14.08	*Length of roof plane, in feet (meters)*
W	*ft.*	16.00	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	12.73	*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		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support		1
Rafter / Truss OC	*in*	24.00
Member Total Length	*ft*	16.00

2	# Rafters / Rack Support Width
2.00	Rack Support Spacing (ft)
48.00	Max. Rack Support Spacing (in)
1	Max # of mod's / Truss top chord

Member Properties		**Member**
Name		(1) 2x4
Repetitive Member Factor (Cr)		1.15

** Mem properties based upon field measurements*

Truss top chord

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*
Roof Deck & Surface Material*	*psf*	5.15	*Truss members' self weight added to FEA analysis*
Sum Existing DL Roof Loads	*psf*	5.94	

** Roof surface: Shingles, Asphalt, Architectural (Typical)*

Rack Support Spacing and Loading					
Across rafters	*ft*	2.0			
Along rafter slope	*ft*	6.3			
Area / support point	*sf*	6.3			
Uphill gap between modules	*in*	1.0	0.08	*ft Support from mod. Edge (in)*	1

Member Total Length	*ft*	16.00	
Maximum member free span	*ft*	16.00	Truss top chord span

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	**TRUE**
1.5(Lp) =	5.58
γE =	1.5
γa =	0.65

Use EXPOSED for uplift calculations

$p = qh(GCp)\ (\gamma_E)\ (\gamma_a)$ (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

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 PV Module + Stanchion	2.40	2.40	2.40	2.40
S = snow load	4.10	4.10	4.10	4.10
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.				
Combination Formulae	*Upward*	*Upward*	*Upward*	*Downward*
Use this loading combination for DOWNWARD for Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	6.50	6.50	6.50	11.75
Module Support point load (lb)	41	41	41	73
Cr Factored Module Support point load (lb)	35	35	35	64

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-22.97	-29.03	-42.86	8.34
Module Support point load (lb)	-144	-182	-268	52

DOWNWARD

Presume loading directly over member.

Combined Dead and Wind Pressure Downward Loading					
	Truss top chord span				
PV Module Row	Point load loc's from Left support	Point Load #'s	Module Support Point Load	Comment	Module Orientation
	ft from left		*lb*		
1	9.17		64		Portrait
1	13.42			Support placed on adjoining truss	Portrait

Truss Data and Loading for MP 2

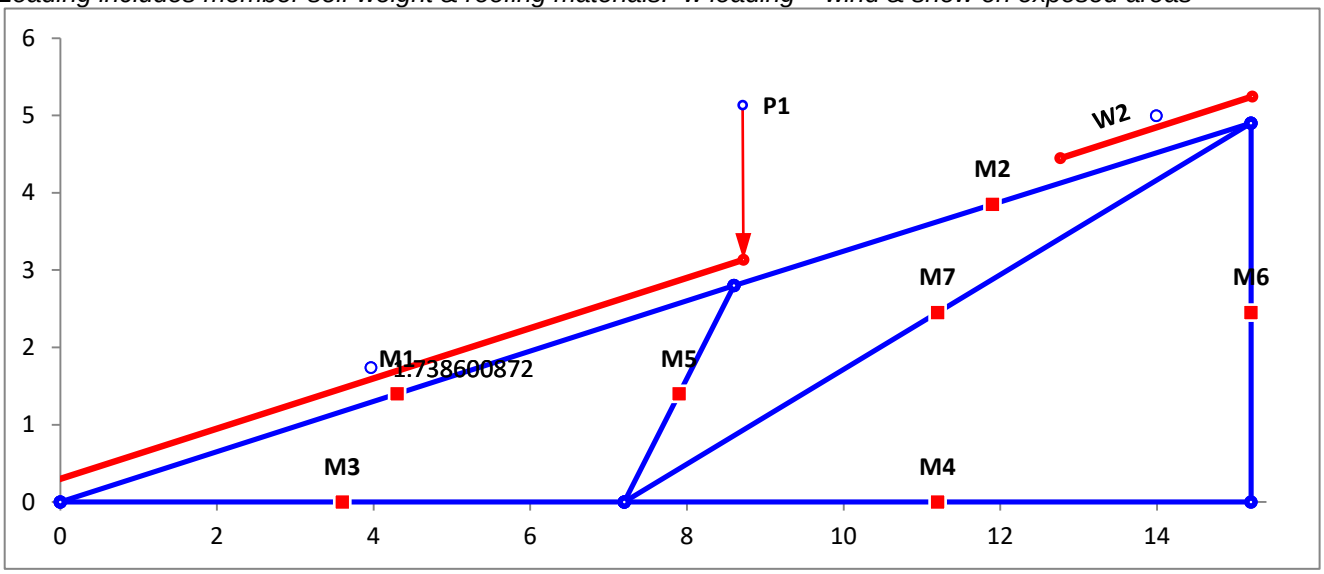
Roof slope (degrees)	18.00
Top ridge height above floor plane	4.94

	Length of roof plane	16.00
	Length of floor plane	15.17

Truss Segments

Roof Plane		*Floor Plane*		*Diagonals*		*Diagonals*	
Mem #	*Mem Type*	Mem #	*Mem Type*	Mem #	*Mem Type*	Mem #	*Mem Type*
1	2x4	3	2x4	5	2x4	7	2x4
2	2x4	4	2x4	6	2x4		

** Loading includes member self weight & roofing materials. w loading = wind & snow on exposed areas*



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	=	4.10	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	=	**2.58**	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	=	**4.10**	When Pg <=20 psf, then use Pf = Pg x Is
p_f	=	**4.10**	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	=	**4.10**	**psf**	Roof snow load

FEA Calculation Results for Roof Plane MP 1 for Lunex Power Client EVA WILLIAMS

IDSPL - 2D Frame Analysis of a 2D frame subject to distributed loads, point loads and moments

Equilibrium check	FX	FY
Total applied forces	0.00	1170
Total output reactions	0.00	-1170
Output error	3.06E-12	2.50E-12

0.00147

	Shear	Ax
Max (psi)	3	228
Allowable (psi)	115	5,610
# of segments/beam	1	

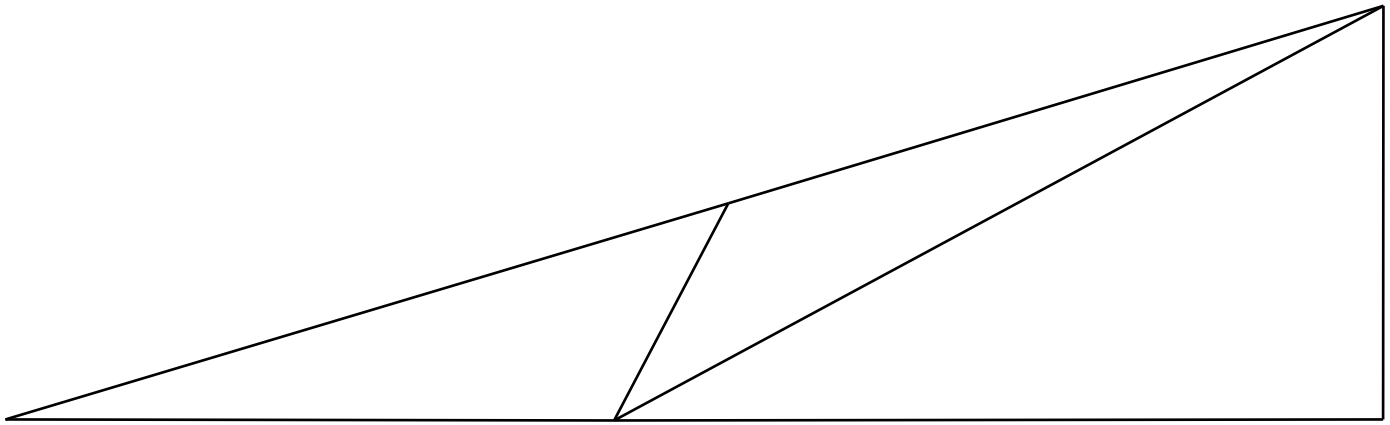
Maximum Deflections	
-1.85E-03	-8.46E-03

** vertical deflections do not take into account any supporting intermediate walls*

	Node Results			Beam End Results		
Direction	Deflection	Reaction	Beam	Shear	Axial	BM
DX1	0.00E+00	0	1-1	-12	832	0
DY1	0.00E+00	-425	1-2	204	762	0
RZ1	0.00E+00	0	2-1	-168	1123	0
DX2	-1.83E-03	0	2-2	383	944	0
DY2	8.46E-03	0	3-1	-156	-787	0
RZ2	0.00E+00	0	3-2	95	-787	0
DX3	1.85E-03	0	4-1	0	0	0
DY3	4.64E-04	0	4-2	0	0	0
RZ3	0.00E+00	0	5-1	-1	527	0
DX4	-6.70E-04	0	5-2	3	518	0
DY4	7.68E-03	0	6-1	0	745	0
RZ4	0.00E+00	0	6-2	0	721	0
DX5	-6.70E-04	0	7-1	-21	-1164	0
DY5	0.00E+00	-745	7-2	48	-1205	0
RZ5	0.00E+00	0				
Rel1-3	8.99E-04	0				
Rel1-6	1.35E-03	0				

Beam	X	Shear	Mom	Axial	DX	DY	RZ
1	0.00	-12	0	832	0.00E+00	0.00E+00	0.00E+00
1	9.99	115	537	791	-1.85E-03	-8.45E-03	1.01E-03
2	0.00	-168	0	1123	-1.83E-03	-8.46E-03	0.00E+00
2	9.04	150	1937	1019	1.79E-03	-4.43E-04	-5.64E-04
3	0.00	-156	0	-787	0.00E+00	0.00E+00	0.00E+00
3	8.00	21	448	-787	-6.70E-04	-7.68E-03	1.14E-03
4	0.00	0	0	0	-6.70E-04	-7.68E-03	0.00E+00
4	10.10	0	0	0	-6.70E-04	8.67E-19	-7.61E-04
5	0.00	-1	0	527	-6.70E-04	-7.68E-03	0.00E+00
5	3.44	2	1	521	-1.83E-03	-8.46E-03	4.02E-04
6	0.00	0	0	745	-6.70E-04	0.00E+00	0.00E+00
6	5.90	0	0	727	1.85E-03	-4.63E-04	-4.27E-04
7	0.00	-21	0	-1164	-6.70E-04	-7.68E-03	0.00E+00
7	11.70	38	5	-1199	1.85E-03	-4.63E-04	-6.77E-04

* vertical deflections do not take into account any supporting intermediate walls



Scaled 2X Deflected Truss Plot
Roof Plane MP 1 for Lunex Power Client EVA WILLIAMS

FEA Calculation Results for Roof Plane MP 2 for Lunex Power Client EVA WILLIAMS

IDSPL - 2D Frame Analysis of a 2D frame subject to distributed loads, point loads and moments

Equilibrium check	FX	FY	0.00089
Total applied forces	0.00	748	
Total output reactions	0.00	-748	
Output error	1.03E-13	3.41E-12	

	Shear	Ax
Max (psi)	2	171
Allowable (psi)	115	5,610
# of segments/beam	1	

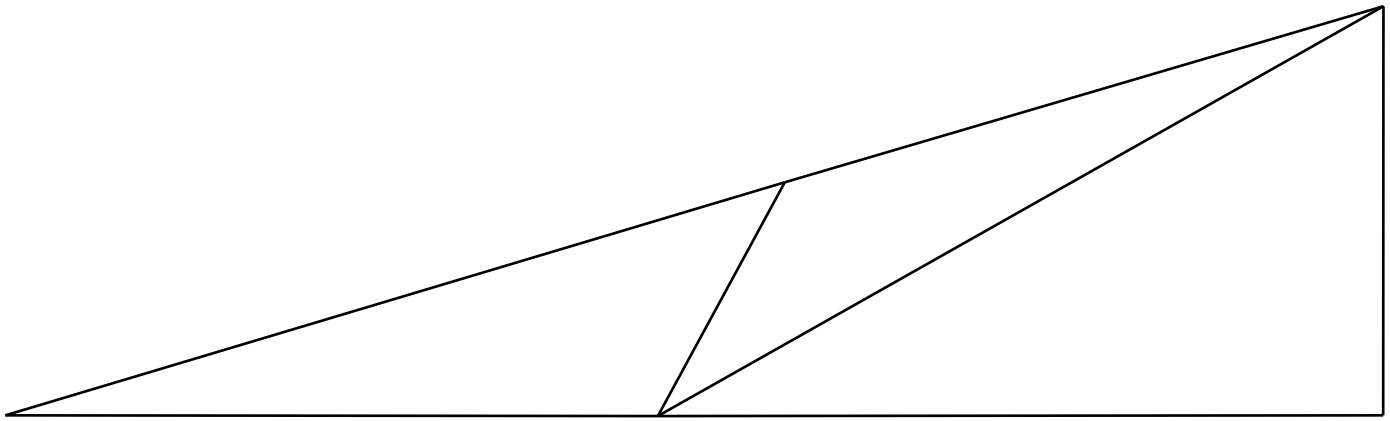
Maximum Deflections	
1.11E-03	-4.94E-03

** vertical deflections do not take into account any supporting intermediate walls*

Node Results			Beam End Results			
Direction	Deflection	Reaction	Beam	Shear	Axial	BM
DX1	0.00E+00	0	1-1	12	622	0
DY1	0.00E+00	-161	1-2	209	558	0
RZ1	0.00E+00	0	2-1	-42	804	0
DX2	-9.76E-04	0	2-2	297	696	0
DY2	4.94E-03	0	3-1	20	-595	0
RZ2	0.00E+00	0	3-2	128	-595	0
DX3	1.11E-03	0	4-1	0	0	0
DY3	3.04E-04	0	4-2	0	0	0
RZ3	0.00E+00	0	5-1	-1	355	0
DX4	-4.56E-04	0	5-2	3	348	0
DY4	4.55E-03	0	6-1	0	587	0
RZ4	0.00E+00	0	6-2	0	571	0
DX5	-4.56E-04	0	7-1	-14	-875	0
DY5	0.00E+00	-587	7-2	32	-903	0
RZ5	0.00E+00	0				
Rel1-3	5.85E-04	0				
Rel1-6	1.04E-03	0				

Beam	X	Shear	Mom	Axial	DX	DY	RZ
1	0.00	12	0	622	0.00E+00	0.00E+00	0.00E+00
1	9.04	68	491	604	-9.92E-04	-4.94E-03	7.16E-04
2	0.00	-42	0	804	-9.76E-04	-4.94E-03	0.00E+00
2	6.93	121	1474	752	1.06E-03	-2.89E-04	-5.64E-04
3	0.00	20	0	-595	0.00E+00	0.00E+00	0.00E+00
3	7.20	62	402	-595	-4.56E-04	-4.55E-03	7.46E-04
4	0.00	0	0	0	-4.56E-04	-4.55E-03	0.00E+00
4	8.00	0	0	0	-4.56E-04	0.00E+00	-5.69E-04
5	0.00	-1	0	355	-4.56E-04	-4.55E-03	0.00E+00
5	3.13	2	1	350	-9.76E-04	-4.94E-03	2.04E-04
6	0.00	0	0	587	-4.56E-04	0.00E+00	0.00E+00
6	4.90	0	0	575	1.11E-03	-3.04E-04	-3.20E-04
7	0.00	-14	0	-875	-4.56E-04	-4.55E-03	0.00E+00
7	9.38	24	4	-898	1.11E-03	-3.04E-04	-4.87E-04

* vertical deflections do not take into account any supporting intermediate walls



Scaled 2X Deflected Truss Plot
Roof Plane MP 2 for Lunex Power Client EVA WILLIAMS