Patented. Copyright © 2020-2025 Richard Pantel. All Rights Reserved. Paper or PDF copies of this report may be distributed only to employees of the company listed below under "Prepared for", or to Authorities Having Jurisdiction (AHJ's) for their review purposes. This document contains Intellectual Property (IP) created by the Author, and as such, no parts of this calculation report or related data input form(s) may be copied in format, content or intent without permission in writing from the Author. Dis-assembly or reverse engineering of this calculation report or related data input form is strictly prohibited. The Author's contact information is: RPantel@iroofa.solar, web-site: www.iroofa.solar; tel: 908-507-5500. Trademark: iRooF® and iRooFA®.

iRooFA™

Instant Roof Framing Analysis

www.iroofa.solar

tel: 540.313.5317 - email: info@iRooFA.solar

STRUCTURAL ANALYSIS

for the

ROOFTOP PV SOLAR INSTALLATION

Project: Donna M Jenkins, 389Dewar St, Fuquay-Varina, NC

Prepared for:

TOP TIER SOLAR SOLUTIONS

Top Tier

1530 Center Park Dr - Charlotte, NC 28217

Calculation Report Index

Pages	Description	Pages	Description
1	Cover	2-6	Loading Summary
Roof Structural Calculations for PV Solar Installation		*Roof Structural Calculations for PV Solar Installation*	
7-10	Location: MP 1	11-14	Location: MP 2
15-18	Location: MP 3		
19-19	Snow Loading Calculations		
20-25	Truss FEA Calculations		

Project No: 66.420885, Rev. 0

Report Date: 08/07/2025

Report Prepared by:

NORTH CAROLINA PROFESSIONAL SEAL 043326 ENGINEER RICHARD PANTEL

Richard Pantel, P.E.
NC License No. 43326
Sealed 08/07/2025

Richard Pantel Digitally signed by Richard Pantel
Date: 2025.08.07 08:39:51 -05'00'

Loading Summary

Exposure and Occupancy Categories		
C		*Exposure Category (ASCE 7-16 Table 26.7.3, Page 274)*
II		*Building Use Occupancy / Risk Category (ASCE 7-16 Table 1.5-1, Page 5)*

Wind Loading:			
v	116	*mph*	*ASCE 7-16, Figure 26.5-1 A, B or C, pp 249-251. [(116 mph, 50 year wind MRI)]*
qz	25.01	*psf*	*Velocity qz, calculated at height z [ASD]*

Snow Loading			
pg	15.00	*psf*	*Ground Snow Load pg (ASCE 7-16 Table 7.2-1, Page 56-60)*
Total Snow Load			
ps	15.00	*psf*	*Effective snow load on roof and modules*

Module Data			
JA Solar: JAM54S31-405/MR			
Dimensions	*mm*	*ft*	*in*
Length	1,722	5.65	67.80
Width	1,134	3.72	44.65
Area (m^2, ft^2)	2.0	21.02	
Weight	kg	lb	
Module	21.50	47.40	

Roof Panel (Cladding) Loading Summary		Module Loading Summary			
Support Point Loads		*Upward*	*Upward*	*Upward*	*Downward*
Roof Zones		1,2e,2r	2n,3r	3e	All
Net load per module	*lb*	-343	-437	-580	334

Positive values indicate net downward force

 iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Primary Stanchion: IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1)

StanchionFastener Pull-out and Spacing Calculations				
Framing spacing		*ft*	2.00	
Rails / Module		*ea*	2	
Max proposed stanchion span		*ft*	6.00	
# fasteners per stanchion			2	
Bolt thread embedment depth		*in*	1.75	
Safety Factor			1.10	
Pull-out for #14 threaded fasteners		*lb/in*	134	*lb per inch of embedment*
Factored max fastener uplift capacity		*lb*	425	
Fastener details	*Material* Stainless	*Size*	#14	*Predrill hole 0.12" dia or use self tapping*
Max stanchion uplift capacity		*lb*	1100	
Max support point uplift capacity		*lb*	425	

Roof Zones		*1,2e,2r*	*2n,3r*	*3e*
Net lift per module	*lb*	343	437	580
Min tot bolt thread embedment depth rq'd	*in*	1.41	1.80	2.39
Net uplift pressure 7. 0.60D - 0.6W	*psf*	-8.69	-11.23	-15.04
Allowable lift area / support point	*sf*	48.88	37.84	28.24
Max rail span per support spacing	*ft*	6.00	6.00	6.00
Landscape Modules				
Length along rafter	*ft*	3.72		
Lift calc'ed max stanchion EW spacing	*ft*	> 6	> 6	> 6
Max stanchion EW spacing	*ft*	6.00	6.00	6.00
Maximum module area / support point	*sf*	11.16	11.16	11.16
Factored lift per support point	*lb*	-97	-125	-168
Portrait Modules				
Length along rafter	*ft*	5.65		
Lift calc'ed max stanchion EW spacing	*ft*	> 6	> 6	> 6
Max stanchion EW spacing	*ft*	6.00	6.00	6.00
Maximum module area / support point	*sf*	16.95	16.95	16.95
Factored lift per support point	*lb*	-147	-190	-255

Alternate Stanchion Fastener Pull-out and Spacing Calculations IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) - 6 screws				
Framing spacing		*ft*	2.00	
Rails / Module		*ea*	2	
Max proposed stanchion span		*ft*	6.00	
# fasteners per stanchion			6	
Bolt thread embedment depth		*in*	0.50	
Safety Factor			1.10	
Pull-out for 1/4 threaded fasteners		*lb/in*	134	
Factored max fastener uplift capacity		*lb*	364	
Fastener details	*Material* Stainless	*Size*	1/4	*Predrill hole 0.12" dia or use self tapping*
Max stanchion uplift capacity		*lb*	1100	
Max support point uplift capacity		*lb*	364	

Roof Zones		*1,2e,2r*	*2n,3r*	*3e*
Net lift per module	*lb*	343	437	580
Min tot bolt thread embedment depth rq'd	*in*	0.47	0.60	0.80
Net uplift pressure 7. 0.60D - 0.6W	*psf*	-8.69	-11.23	-15.04
Allowable lift area / support point	*sf*	41.89	32.43	24.21
Max rail span per framing spacing	*ft*	6.00	6.00	6.00
Landscape Modules				
Length along rafter	*ft*	3.72		
Lift calc'ed max stanchion EW spacing	*ft*	> 6	> 6	> 6
Max stanchion EW spacing	*ft*	6.00	6.00	6.00

 iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Maximum module area / support point	*sf*	11.16	11.16	11.16
Factored lift per support point	*lb*	-97	-125	-168
Portrait Modules				
Length along rafter	*ft*	5.65		
Lift calc'ed max stanchion EW spacing	*ft*	> 6	> 6	> 6
Max stanchion EW spacing	*ft*	6.00	6.00	6.00
Maximum module area / support point	*sf*	16.95	16.95	16.95
Factored lift per support point	*lb*	-147	-190	-255

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

 iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

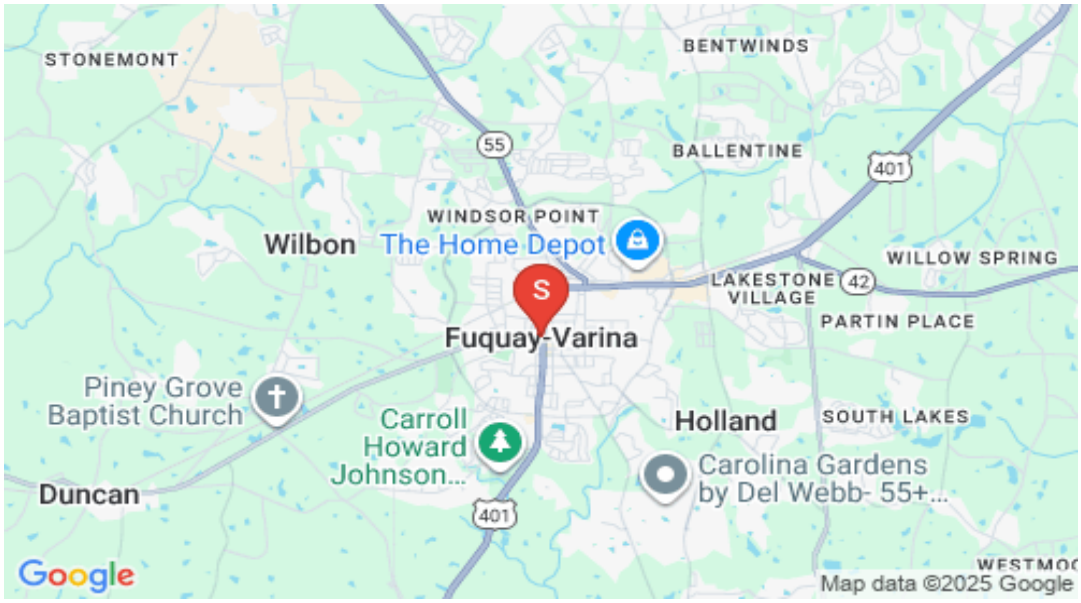
Conclusions

We were asked to review the roof of Donna M Jenkins, located at 389Dewar St, Fuquay-Varina, NC, by Top Tier, to determine its suitability to support a PV solar system installation.

The referenced building's roof structure was field measured by Top Tier. The attached framing analyses reflect the results of those field measurements combined with the PV solar module locations shown on the PV solar roof layout design prepared by Top Tier. Loads are calculated to combine the existing building and environmental loads with the proposed new PV array loads.

The IronRidge XR10 Rail racking and IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) along with the alternate IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) - 6 screws stanchions were selected for this project by Top Tier. The racking and support stanchions shall be placed as shown on their plans, dated 08/06/2025, 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.

 iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.



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
MP 3: 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, 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. Minimum required anchorage fastening is described above.

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 7-16 Minimum Design Loads for Buildings and Other Structures*
2) *2018 IBC*
3) *2018 NC Building Code*
4) *American Wood Council, NDS 2018,Table 12.2A, 12.3.3A.*
5) *American Wood Council, Wood Structural Design, 1992, Figure 6.*

 iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Roof Structural Calculations for PV Solar Installation **Array AR-1**
Location: MP 1 ***Roof shape: Gable***
Member: Truss - Total Length 15 ft, Unsupported 15 ft

Geometric Data			
Θ	*deg.*	30.0	*Angle of roof plane from horizontal, in degrees*
ω	*deg.*	0.0	*Angle the solar panel makes with the roof surface*
L	*ft.*	15.92	*Length of roof plane, in feet (meters)*
W	*ft.*	13.83	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	14.23	*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=	25.01	*psf*	*Vasd* q_z=	15.32	*psf*	Basic wind pressure
V=	116	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*	15.00

3	# Rafters / Rack Support Width
6.00	Rack Support Spacing (ft)
72.00	Max. Rack Support Spacing (in)
2	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	21.50	47.40	2.26
4 Stanchions	0.91	2.0	0.10

Existing Dead Loads	*Units*	*Value*	*Description*
Roof Deck & Surface Material*	*psf*	5.15	*Truss members' self weight added to FEA analysis*

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

Rack Support Spacing and Loading				
Across rafters	*ft*	6.0		
Along rafter slope	*ft*	5.6		
Area / support point	*sf*	16.9		
Uphill gap between modules	*in*	1.0	0.08	*ft*

Member Total Length	*ft*	15.00	
Maximum member free span	*ft*	15.00	Truss top chord span

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 **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 =	0.67

Use EXPOSED for uplift calculations

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

Zones	1,2e,2r	2n,3r	3e
GCp	-1.48	-1.75	-2.16
p, Windload (psf)	-22.77	-27.00	-33.36

Downward, Zones All Zones
GCp 0.77

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e,2r	2n,3r	3e	All Zones
2.2 SYMBOLS AND NOTATION	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
D = dead load of PV Module + Stanchion	2.35	2.35	2.35	2.35
S = snow load	15.00	15.00	15.00	15.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-22.77	-27.00	-33.36	11.81

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)	17.35	17.35	17.35	22.66
Module Support point load (lb)	294	294	294	384
Cr Factored Module Support point load (lb)	256	256	256	334

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-8.69	-11.23	-15.04	8.29
Module Support point load (lb)	-147	-190	-255	140

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	2.17		334		Portrait
1	7.82			Support placed on adjoining truss	Portrait
2	7.90			Support placed on adjoining truss	Portrait
2	13.55		334		Portrait

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Truss Data and Loading for MP 1

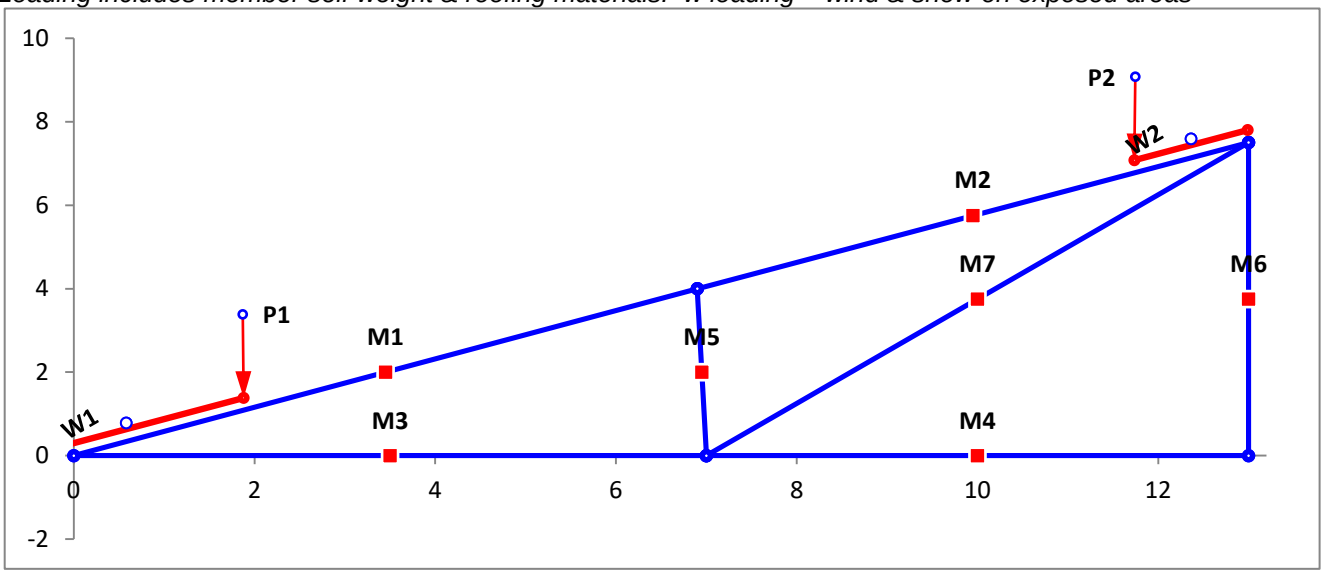
Roof slope (degrees)	30.00
Top ridge height above floor plane	7.50

	Length of roof plane	15.00
	Length of floor plane	13.00

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*



iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Roof Structural Calculations for PV Solar Installation **Array AR-2**
Location: MP 2 ***Roof shape: Gable***
Member: Truss - Total Length 21 ft, Unsupported 21 ft

Geometric Data			
Θ	*deg.*	30.0	*Angle of roof plane from horizontal, in degrees*
ω	*deg.*	0.0	*Angle the solar panel makes with the roof surface*
L	*ft.*	32.50	*Length of roof plane, in feet (meters)*
W	*ft.*	19.08	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	24.75	*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=	27.60	*psf*	*Vasd* q_z=	16.90	*psf*	Basic wind pressure
V=	116	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*	21.00

3	# Rafters / Rack Support Width
6.00	Rack Support Spacing (ft)
72.00	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	21.50	47.40	2.26
4 Stanchions	0.91	2.0	0.10

Existing Dead Loads	*Units*	*Value*	*Description*
Roof Deck & Surface Material*	*psf*	5.15	*Truss members' self weight added to FEA analysis*

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

Rack Support Spacing and Loading				
Across rafters	*ft*	6.0		
Along rafter slope	*ft*	5.6		
Area / support point	*sf*	16.9		
Uphill gap between modules	*in*	1.0	0.08	*ft*

Member Total Length	*ft*	21.00	
Maximum member free span	*ft*	21.00	Truss top chord span

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 **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 =	0.67

Use EXPOSED for uplift calculations

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

Zones	1,2e,2r	2n,3r	3e
GCp	-1.48	-1.75	-2.16
p, Windload (psf)	-25.13	-29.80	-36.81

Downward, Zones All Zones
GCp 0.77

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e,2r	2n,3r	3e	All Zones
2.2 SYMBOLS AND NOTATION	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
D = dead load of PV Module + Stanchion	2.35	2.35	2.35	2.35
S = snow load	15.00	15.00	15.00	15.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-25.13	-29.80	-36.81	13.03

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)	17.35	17.35	17.35	23.21
Module Support point load (lb)	294	294	294	393
Cr Factored Module Support point load (lb)	256	256	256	342

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-10.11	-12.91	-17.12	8.29
Module Support point load (lb)	-171	-219	-290	140

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	3.17		342		Portrait
1	8.82			Support placed on adjoining truss	Portrait
2	8.90			Support placed on adjoining truss	Portrait
2	14.55		342		Portrait
3	14.64		342		Portrait
3	20.29			Support placed on adjoining truss	Portrait

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Truss Data and Loading for MP 2

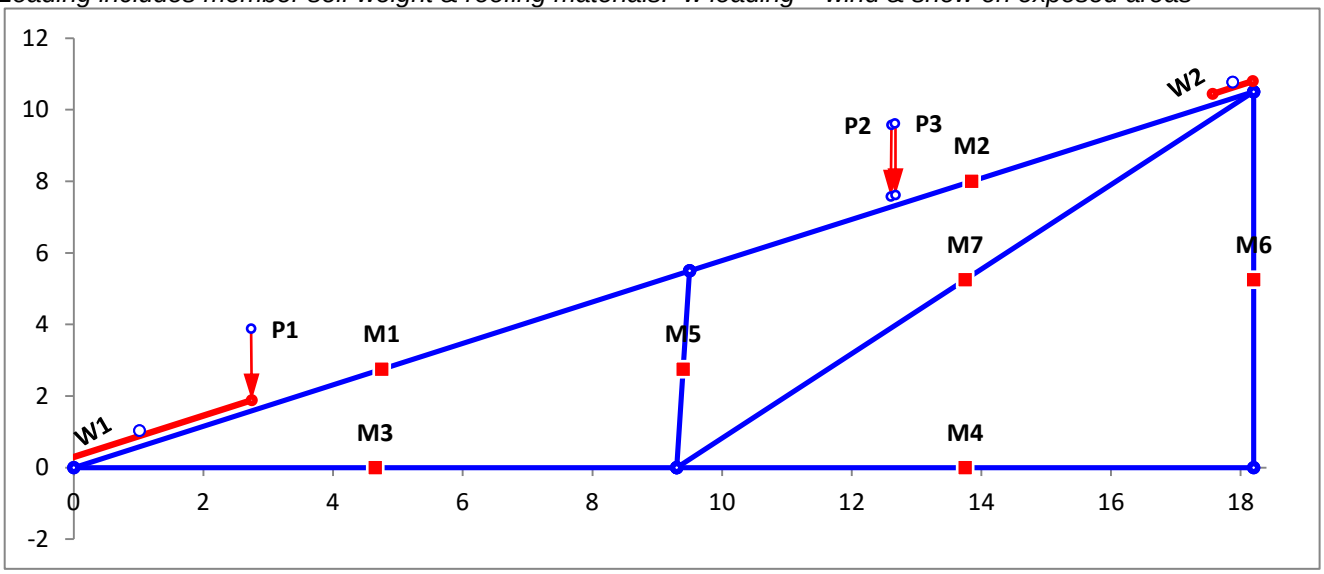
Roof slope (degrees)	30.00
Top ridge height above floor plane	10.50

	Length of roof plane	21.00
	Length of floor plane	18.25

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*



iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Roof Structural Calculations for PV Solar Installation **Array AR-3**
Location: MP 3 ***Roof shape: Gable***
Member: Truss - Total Length 21 ft, Unsupported 21 ft

Geometric Data			
Θ	*deg.*	30.0	*Angle of roof plane from horizontal, in degrees*
ω	*deg.*	0.0	*Angle the solar panel makes with the roof surface*
L	*ft.*	12.92	*Length of roof plane, in feet (meters)*
W	*ft.*	19.08	*Plan view width of roof plane, in feet (meters)*
h	*ft.*	24.75	*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=	27.60	*psf*	*Vasd* q_z=	16.90	*psf*	Basic wind pressure
V=	116	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*	21.00

3	# Rafters / Rack Support Width
6.00	Rack Support Spacing (ft)
72.00	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	21.50	47.40	2.26
4 Stanchions	0.91	2.0	0.10

Existing Dead Loads	*Units*	*Value*	*Description*
Roof Deck & Surface Material*	*psf*	5.15	*Truss members' self weight added to FEA analysis*

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

Rack Support Spacing and Loading				
Across rafters	*ft*	6.0		
Along rafter slope	*ft*	5.6		
Area / support point	*sf*	16.9		
Uphill gap between modules	*in*	1.0	0.08	*ft*

Member Total Length	*ft*	21.00	
Maximum member free span	*ft*	21.00	Truss top chord span

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 **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 =	0.67

Use EXPOSED for uplift calculations

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

Zones	1,2e,2r	2n,3r	3e
GCp	-1.48	-1.75	-2.16
p, Windload (psf)	-25.13	-29.80	-36.81

Downward, Zones All Zones
GCp 0.77

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

ASCE 7-16 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e,2r	2n,3r	3e	All Zones
2.2 SYMBOLS AND NOTATION	*Module Upward*	*Module Upward*	*Module Upward*	*Downward*
D = dead load of PV Module + Stanchion	2.35	2.35	2.35	2.35
S = snow load	15.00	15.00	15.00	15.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-25.13	-29.80	-36.81	13.03

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)	17.35	17.35	17.35	23.21
Module Support point load (lb)	294	294	294	393
Cr Factored Module Support point load (lb)	256	256	256	342

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-10.11	-12.91	-17.12	8.29
Module Support point load (lb)	-171	-219	-290	140

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	3.17		342		Portrait
1	8.82			Support placed on adjoining truss	Portrait
2	8.90			Support placed on adjoining truss	Portrait
2	14.55		342		Portrait
3	14.64		342		Portrait
3	20.29			Support placed on adjoining truss	Portrait

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Truss Data and Loading for MP 3

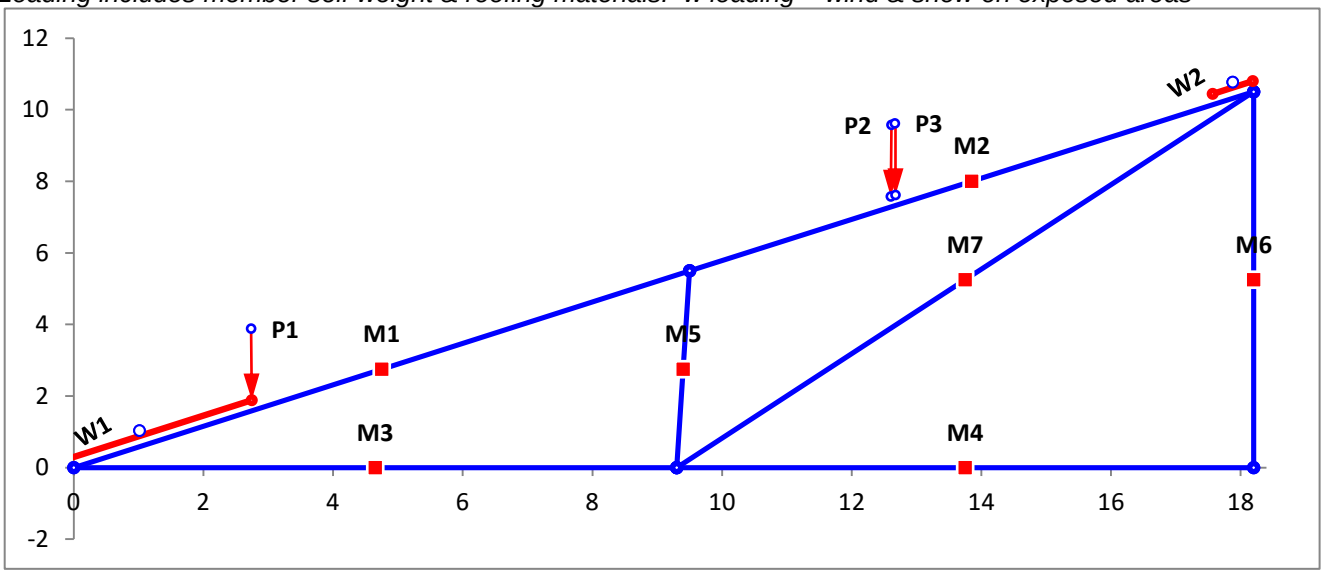
Roof slope (degrees)	30.00
Top ridge height above floor plane	10.50

	Length of roof plane	21.00
	Length of floor plane	18.25

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*



iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

Snow Loading Analysis

where:

		Fully Exposed	Exposure category
Ce	=	0.9	Exposure Factor, Ce (ASCE 7-16 Table 7.3-1, Page 61)
Ct	=	1.0	Thermal Factor, Ct (ASCE 7-16 Table 7.3-2, Page 61)
Is	=	1.0	Snow Importance Factor, Is (ASCE 7-16 Table 1.5-2, Page 5)
p_g	=	15.00	Ground Snow Load pg (ASCE 7-16 Table 7.2-1, Page 56-60)

p_f = **0.7CeCtIsPg** Flat Roof Snow Load, pf (ASCE 7-16 Table 7.3-1, Page 61)

p_f = **9.45** psf

but where Pf is not less than the following:

Minimum Snow Load pm (ASCE 7-16 Table 7.3.4, Page 62)

p_m = **15.00** When Pg <=20 psf, then use Pf = Pg x Is

p_f = **15.00** psf. Resultant Snow pressure to be used with Roof slope factor below

p_s = $C_s p_f$ Sloped Roof Snow Load ps (ASCE 7-16 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 7-16 Table 7.4-1a, Page 62)

Total Snow Load

p_s	=	**15.00**	**psf**	Roof snow load

iRooFA® Copyright © 2020-2025 Richard Pantel. All Rights Reserved.

FEA Calculation Results for Roof Plane MP 1 for Top Tier Client DONNA M JENKINS

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

Equilibrium check	FX	FY	0.00052
Total applied forces	0.00	1714	
Total output reactions	0.00	-1714	
Output error	-1.33E-12	-4.55E-13	

	Shear	Ax
Max (psi)	7	236
Allowable (psi)	115	5,610
# of segments/beam	1	

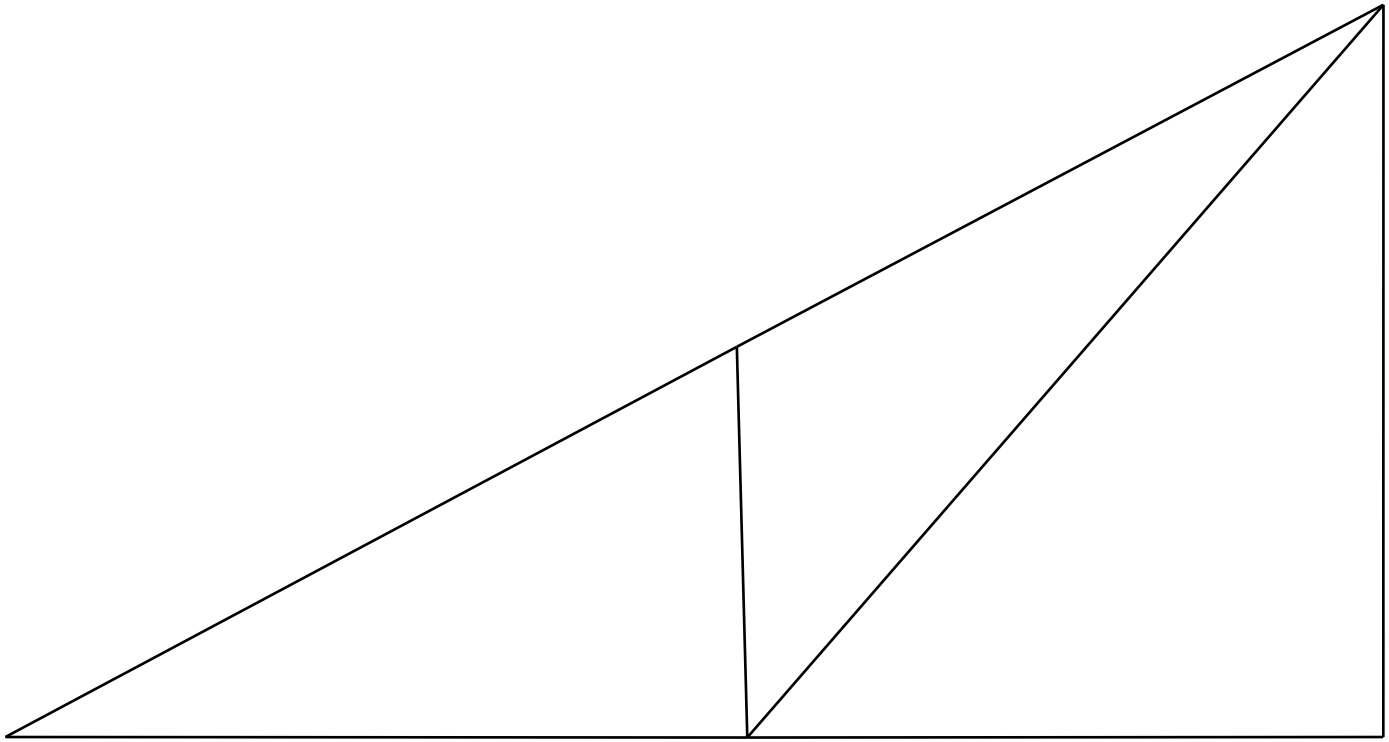
Maximum Deflections	
-1.05E-03	-2.69E-03

** 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	-196	650	0
DY1	0.00E+00	-474	1-2	199	421	0
RZ1	0.00E+00	0	2-1	-167	618	0
DX2	-1.03E-03	0	2-2	745	95	0
DY2	2.69E-03	0	3-1	21	-464	0
RZ2	0.00E+00	0	3-2	125	-464	0
DX3	3.97E-04	0	4-1	0	0	0
DY3	9.82E-04	0	4-2	0	0	0
RZ3	0.00E+00	0	5-1	0	425	0
DX4	-3.45E-04	0	5-2	0	413	0
DY4	2.53E-03	0	6-1	0	1240	0
RZ4	0.00E+00	0	6-2	0	1205	0
DX5	-3.45E-04	0	7-1	-10	-713	0
DY5	0.00E+00	-1240	7-2	24	-756	0
RZ5	0.00E+00	0				
Rel1-3	5.30E-04	0				
Rel1-6	6.82E-04	0				

Beam	X	Shear	Mom	Axial	DX	DY	RZ
1	0.00	-196	0	650	0.00E+00	0.00E+00	0.00E+00
1	7.98	135	386	458	-1.05E-03	-2.68E-03	3.93E-04
2	0.00	-167	0	618	-1.03E-03	-2.69E-03	0.00E+00
2	7.03	427	6378	277	5.97E-05	-7.88E-04	-1.08E-02
3	0.00	21	0	-464	0.00E+00	0.00E+00	0.00E+00
3	7.00	61	390	-464	-3.45E-04	-2.53E-03	4.69E-04
4	0.00	0	0	0	-3.45E-04	-2.53E-03	0.00E+00
4	6.00	0	0	0	-3.45E-04	4.34E-19	-4.21E-04
5	0.00	0	0	425	-3.45E-04	-2.53E-03	0.00E+00
5	4.00	0	0	417	-1.03E-03	-2.69E-03	1.71E-04
6	0.00	0	0	1240	-3.45E-04	0.00E+00	0.00E+00
6	7.50	0	0	1212	3.97E-04	-9.81E-04	-9.91E-05
7	0.00	-10	0	-713	-3.45E-04	-2.53E-03	0.00E+00
7	9.60	19	3	-749	3.97E-04	-9.81E-04	-1.72E-04

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



Scaled 2X Deflected Truss Plot
Roof Plane MP 1 for Top Tier Client DONNA M JENKINS

FEA Calculation Results for Roof Plane MP 2 for Top Tier Client DONNA M JENKINS

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

Equilibrium check	FX	FY	0.00055
Total applied forces	0.00	2710	
Total output reactions	0.00	-2710	
Output error	-6.54E-13	-3.18E-12	

	Shear	Ax
Max (psi)	9	279
Allowable (psi)	115	5,610
# of segments/beam	1	

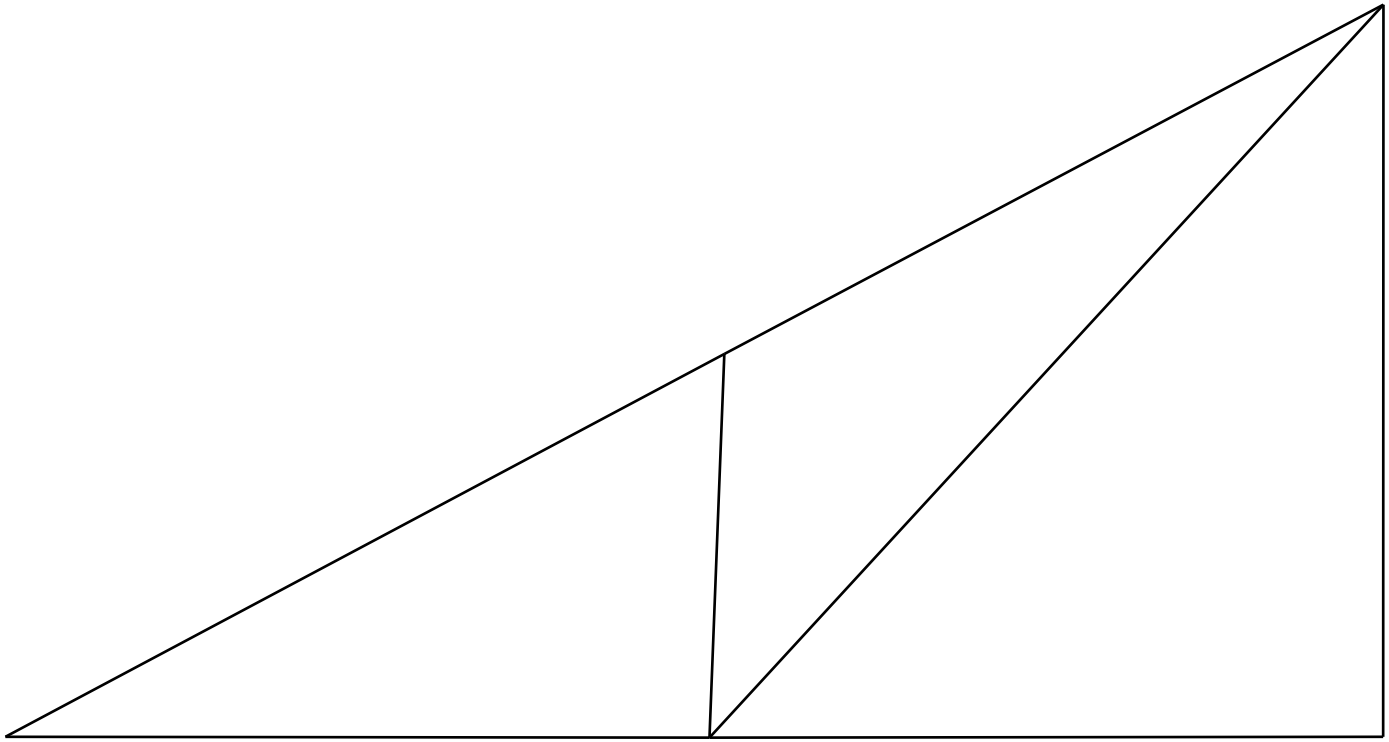
Maximum Deflections	
-2.53E-03	-6.34E-03

** 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	-209	990	0
DY1	0.00E+00	-1242	1-2	247	726	0
RZ1	0.00E+00	0	2-1	-561	1230	0
DX2	-2.50E-03	0	2-2	738	484	0
DY2	6.34E-03	0	3-1	-566	-752	0
RZ2	0.00E+00	0	3-2	-75	-752	0
DX3	1.33E-03	0	4-1	0	0	0
DY3	1.62E-03	0	4-2	0	0	0
RZ3	0.00E+00	0	5-1	0	971	0
DX4	-7.44E-04	0	5-2	1	950	0
DY4	5.72E-03	0	6-1	0	1467	0
RZ4	0.00E+00	0	6-2	0	1402	0
DX5	-7.44E-04	0	7-1	-22	-1191	0
DY5	0.00E+00	-1467	7-2	48	-1274	0
RZ5	0.00E+00	0				
Rel1-3	8.29E-04	0				
Rel1-6	9.78E-04	0				

Beam	X	Shear	Mom	Axial	DX	DY	RZ
1	0.00	-209	0	990	0.00E+00	0.00E+00	0.00E+00
1	10.98	157	539	778	-2.53E-03	-6.33E-03	6.52E-04
2	0.00	-561	0	1230	-2.50E-03	-6.34E-03	0.00E+00
2	10.03	260	9736	758	8.18E-04	-1.32E-03	-1.19E-02
3	0.00	-566	0	-752	0.00E+00	0.00E+00	0.00E+00
3	9.30	-162	524	-752	-7.44E-04	-5.72E-03	9.78E-04
4	0.00	0	0	0	-7.44E-04	-5.72E-03	0.00E+00
4	8.90	0	0	0	-7.44E-04	0.00E+00	-6.42E-04
5	0.00	0	0	971	-7.44E-04	-5.72E-03	0.00E+00
5	5.50	0	0	955	-2.50E-03	-6.34E-03	3.23E-04
6	0.00	0	0	1467	-7.44E-04	0.00E+00	0.00E+00
6	10.50	0	0	1412	1.33E-03	-1.62E-03	-1.98E-04
7	0.00	-22	0	-1191	-7.44E-04	-5.72E-03	0.00E+00
7	13.76	40	4	-1264	1.33E-03	-1.62E-03	-3.59E-04

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



Scaled 2X Deflected Truss Plot
Roof Plane MP 2 for Top Tier Client DONNA M JENKINS

FEA Calculation Results for Roof Plane MP 3 for Top Tier Client DONNA M JENKINS

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	2710
Total output reactions	0.00	-2710
Output error	-6.54E-13	-3.18E-12

0.0005

	Shear	Ax
Max (psi)	9	279
Allowable (psi)	115	5,610
# of segments/beam	1	

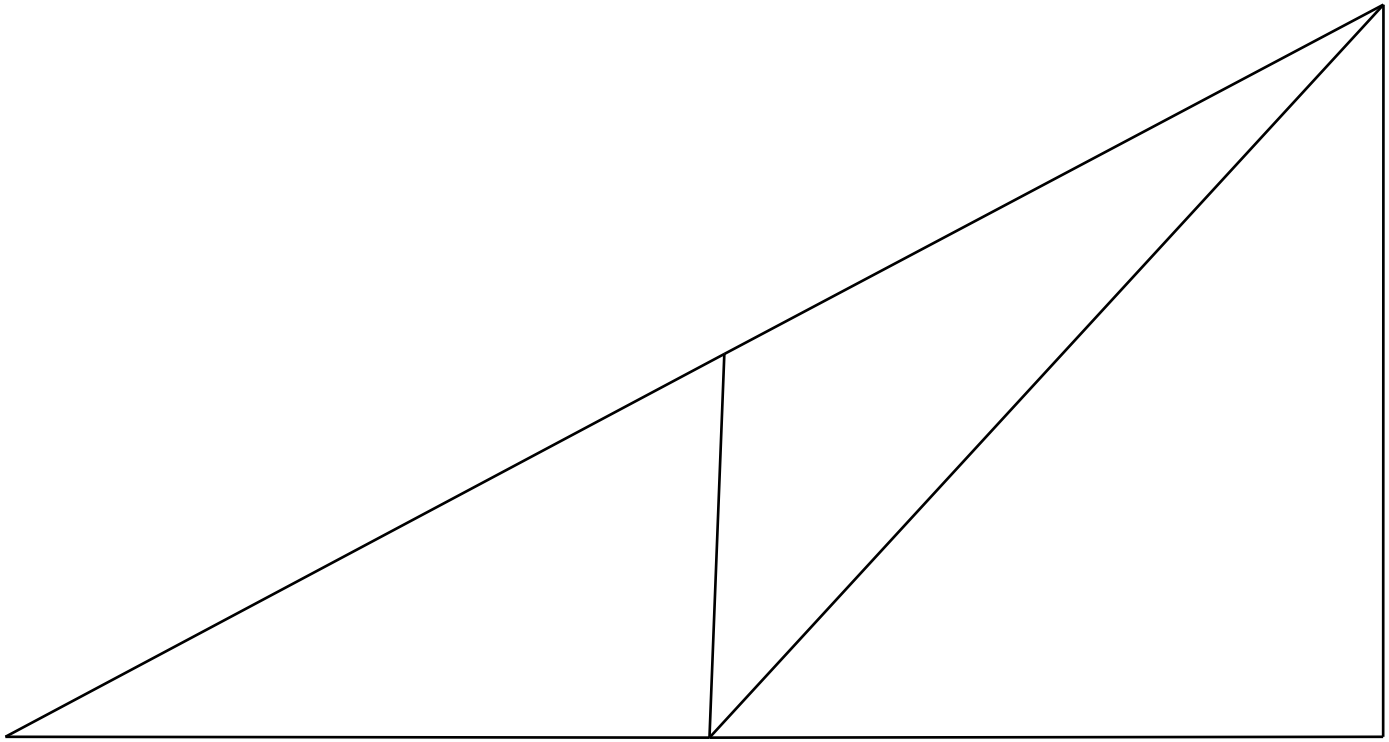
Maximum Deflections	
-2.53E-03	-6.34E-03

** 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	-209	990	0
DY1	0.00E+00	-1242	1-2	247	726	0
RZ1	0.00E+00	0	2-1	-561	1230	0
DX2	-2.50E-03	0	2-2	738	484	0
DY2	6.34E-03	0	3-1	-566	-752	0
RZ2	0.00E+00	0	3-2	-75	-752	0
DX3	1.33E-03	0	4-1	0	0	0
DY3	1.62E-03	0	4-2	0	0	0
RZ3	0.00E+00	0	5-1	0	971	0
DX4	-7.44E-04	0	5-2	1	950	0
DY4	5.72E-03	0	6-1	0	1467	0
RZ4	0.00E+00	0	6-2	0	1402	0
DX5	-7.44E-04	0	7-1	-22	-1191	0
DY5	0.00E+00	-1467	7-2	48	-1274	0
RZ5	0.00E+00	0				
Rel1-3	8.29E-04	0				
Rel1-6	9.78E-04	0				

Beam	X	Shear	Mom	Axial	DX	DY	RZ
1	0.00	-209	0	990	0.00E+00	0.00E+00	0.00E+00
1	10.98	157	539	778	-2.53E-03	-6.33E-03	6.52E-04
2	0.00	-561	0	1230	-2.50E-03	-6.34E-03	0.00E+00
2	10.03	260	9736	758	8.18E-04	-1.32E-03	-1.19E-02
3	0.00	-566	0	-752	0.00E+00	0.00E+00	0.00E+00
3	9.30	-162	524	-752	-7.44E-04	-5.72E-03	9.78E-04
4	0.00	0	0	0	-7.44E-04	-5.72E-03	0.00E+00
4	8.90	0	0	0	-7.44E-04	0.00E+00	-6.42E-04
5	0.00	0	0	971	-7.44E-04	-5.72E-03	0.00E+00
5	5.50	0	0	955	-2.50E-03	-6.34E-03	3.23E-04
6	0.00	0	0	1467	-7.44E-04	0.00E+00	0.00E+00
6	10.50	0	0	1412	1.33E-03	-1.62E-03	-1.98E-04
7	0.00	-22	0	-1191	-7.44E-04	-5.72E-03	0.00E+00
7	13.76	40	4	-1264	1.33E-03	-1.62E-03	-3.59E-04

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



Scaled 2X Deflected Truss Plot
Roof Plane MP 3 for Top Tier Client DONNA M JENKINS