Domus Structural Engineering, LLC
P.O. Box 6986
Broomfield, CO 80021
530-864-7055
Domusstructural@gmail.com

March 17, 2021

To: Blue Raven Solar
1403 North Research Way, Building J
Orem, UT. 84097

Subject: Certification Letter
Espinor Residence
5119 SE 46th Ave.
Portland, OR. 97206

20-217819 REV 01 RS

To Whom It May Concern,

A jobsite observation of the condition of the existing framing system was performed by an audit team of Blue Raven Solar as a request from Domus Structural Engineering. All review is based on these observations and the design criteria listed below and only deemed valid if provided information is true and accurate.

On the above referenced project, the roof structural framing has been reviewed for additional loading due to the installation of the solar PV addition to the roof. The structural review only applies to the section of the roof that is directly supporting the solar PV system and its supporting elements. The observed roof framing is described below. If field conditions differ, contractor to notify engineer prior to starting construction.

The roof structure of (MP1) consists of composition shingle on roof plywood that is supported by 2x4 rafters @ 24"o.c. paired with 2x6 ceiling joists @ 16"o.c.. The rafters have a max projected horizontal span of 8'-6", with a slope of 35 degrees. The rafters are connected at the ridge to a ridge board and are supported at the eave by a load bearing wall.

The roof structures of (MP2&3) consist of composition shingle on roof plywood that is supported by nominal 2x4 rafters @ 24"o.c. paired with 2x8 ceiling joists @ 16"o.c.. The rafters have a max projected horizontal span of 8'-0", with a slope of 35 degrees. The rafters are connected at the ridge to a ridge board and are supported at the eave by a load bearing wall.

The existing roof framing system of (MP1) is judged to be inadequate to withstand the loading imposed by the installation of the solar panels. Structural reinforcement is required. Sister upgrade is required for (MP1) on all rafters that directly support solar PV. Stitch new 2x4 DF#2 (min) to existing member with Simpson SDW 22300 screws @ 16''o.c. or 10d nails @ 6''o.c.. Lap as needed with 4'-0'' minimum lap per attached detail. In addition, install (2) py 2x4 collar tie at approx. exisiting collar tie height. If collar tie already exisits install second ply per the Section 1 Details.

The existing roof framing systems of (MP2&3) are judged to be inadequate to withstand the loading imposed by the installation of the solar panels. Structural reinforcement is required. Sister upgrade is required for (MP2&3) on all rafters that directly support solar PV. Stitch new 2x4 DF#2 (min) to existing member with Simpson SDW 22300 screws @ 16''o.c. or 10d nails @ 6''o.c.. Lap as needed with 4'-0'' lap per attached detail.

The spacing of the solar standoffs should be kept at 48" o.c. for landscape and 48" o.c. for portrait orientation, with a staggered pattern to ensure proper distribution of loads.

The scope of this report is strictly limited to an evaluation of the fastener attachment, underlying framing and supporting structure only. The attachment's to the existing structure are required to be in a staggered pattern to ensure proper distribution of loading. All panels, racking and hardware shall be installed per manufacturer specifications and within specified design limitations. All waterproofing shall be provided by the manufacturer. Domus Structural Engineering assumes no responsibility for misuse or improper installation of the solar PV panels or racking.

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Note: Seismic check is required since Ss>.4g and Seismic Design Category (SDC) > B

Design Criteria:

- Applicable Codes = 2019 OSISC & 2017 ORSC, ASCE 7-16
- Roof Dead Load = 8 psf (MP1) -- 8 psf (MP2&3)
- Roof Live Load = 20 psf
- Wind Speed = 120 mph (Vult), Exposure C
- Ground Snow Load = 25 psf - Roof Snow Load = 20 psf
- Attachments: 1 - 5/16" dia. lag screw with 2.5 inch min embedment depth, at spacing shown above.

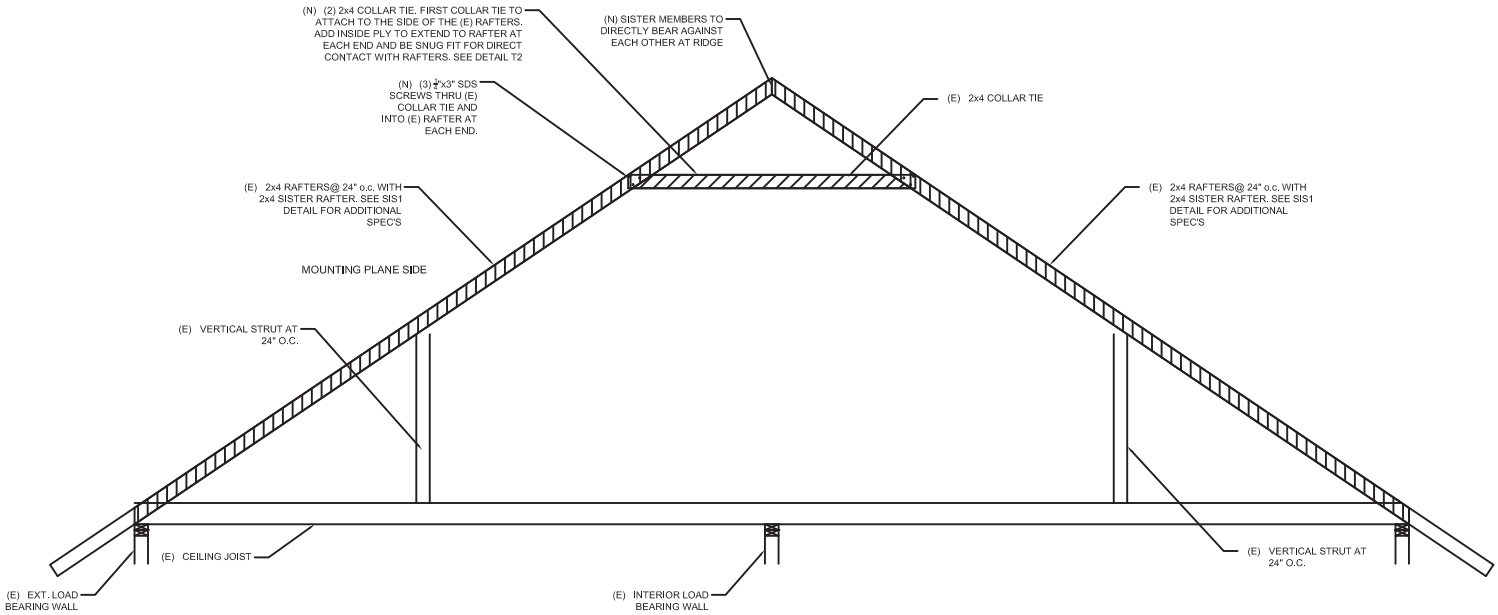
Please contact me with any further questions or concerns regarding this project.

Sincerely,

John Calvert, P.E.
Project Engineer

Exp: 12/31/21

Digitally signed by John A. Calvert
Date: 2021.03.17 14:33:38 -06'00'

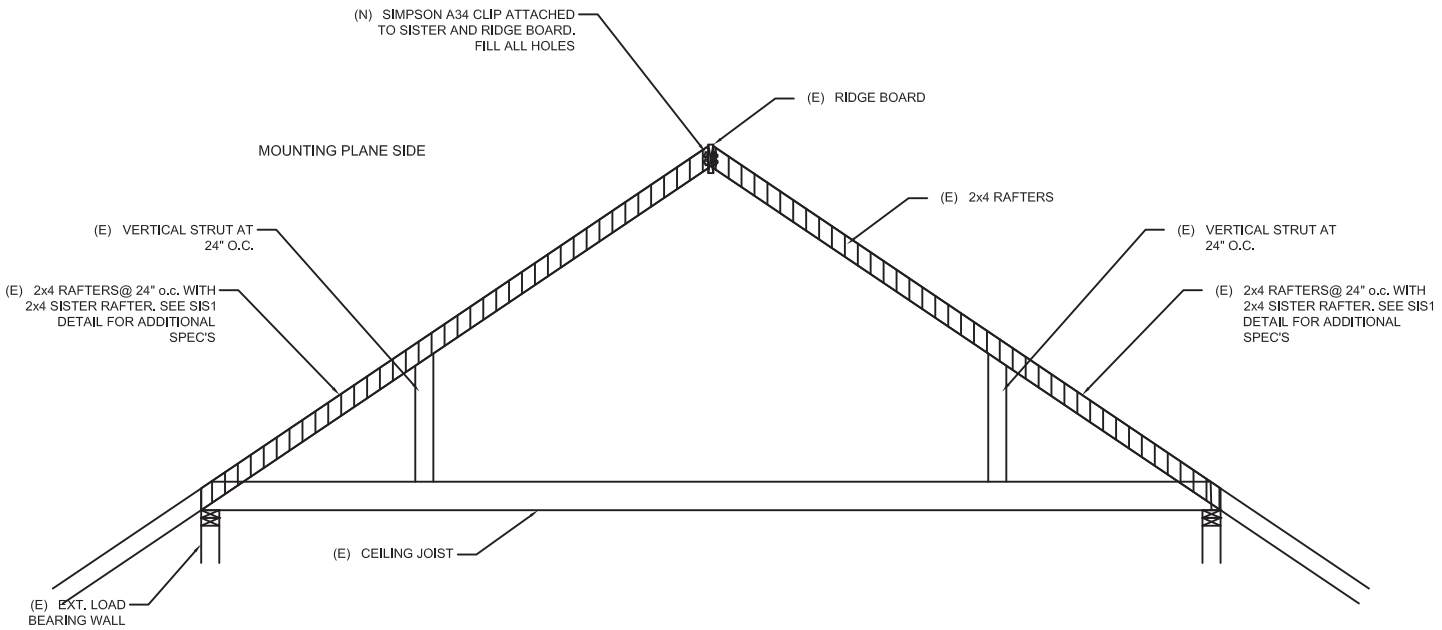


T2 SECTION VIEW OF COLLAR TIE

1 Section 1 - ELEV.

Exp: 12/31/21

PROJECT NAME: Section 1 upgrades		Scale: N.T.S.	
Domus Structural Engineering, LLC. P.O. BOX 6986 Broomfield, CO 80021 (530) 864-7055 Domusstructural@gmail.com		11/18/2020	
		Project Number: Solar PV	
	Project Description: Section 1 upgrade	Drawn By: JAC	Drawing Name: Section 1
		Revisions:	
		A	
		B	

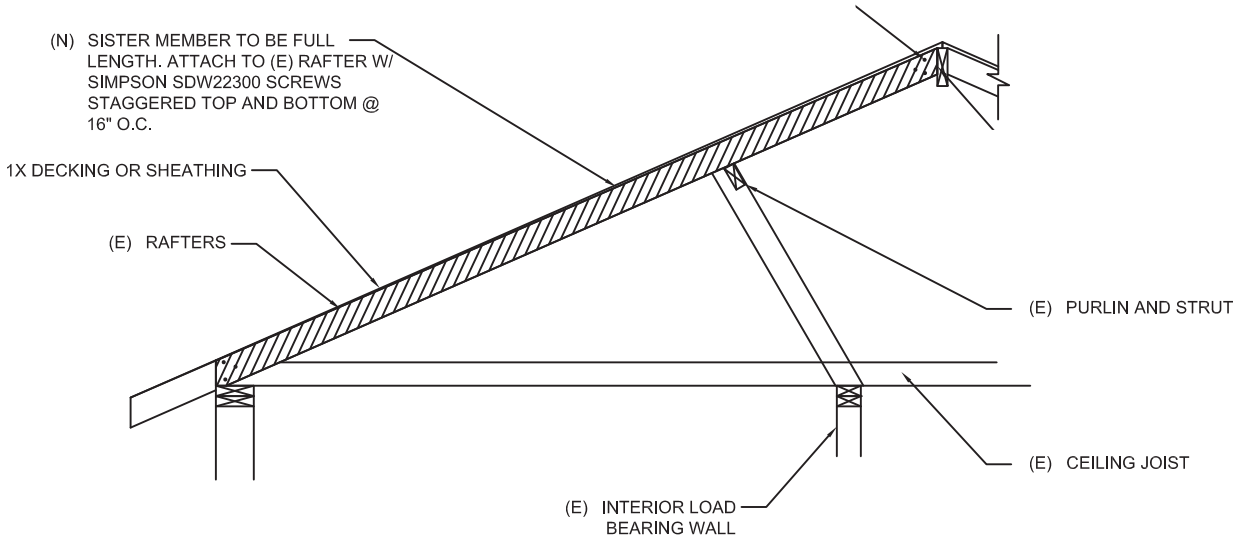


2 Section 2 - ELEV.

REGISTERED PROFESSIONAL ENGINEER
90345PE
OREGON
MAY 16, 2015
JOHN A. CALVERT

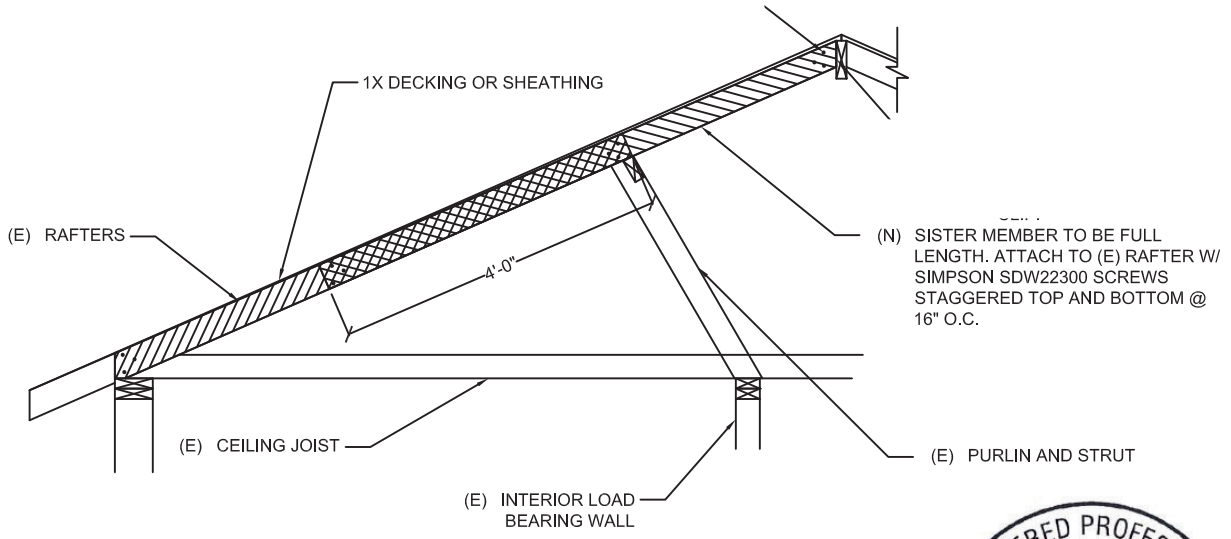
Exp: 12/31/21

PROJECT NAME: Section 2 upgrades		Scale: N.T.S.	
Domus Structural Engineering, LLC. P.O. BOX 6986 Broomfield, CO 80021 (530) 864-7055 Domusstructural@gmail.com		11/18/2020	
		Project Number: Solar PV	
	Project Description: Section 2 upgrade	Drawn By: JAC	Drawing Name: Section 2
		Revisions:	
		A	
		B	



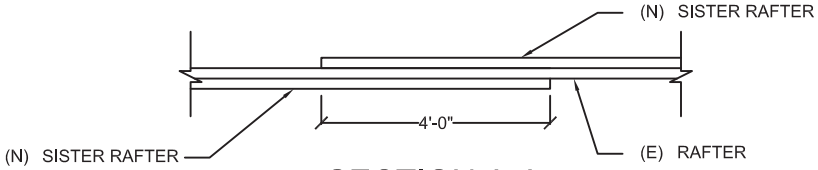
OPTION 1 - FULL LENGTH SISTER

SEE LETTER FOR UPGRADE LAP LENGTH AND SIZE.



OPTION 2 - OVERLAPPED SISTER

SEE LETTER FOR UPGRADE LAP LENGTH AND SIZE.



SECTION A-A

REGISTERED PROFESSIONAL ENGINEER
90345PE
OREGON
MAY 16, 2015
JOHN A. CALVERT

Exp: 12/31/21

S1 SISTER UPGRADE OPTIONS

ALTERNATIVE FASTENER SCHEDULE: 10d NAILS STAGGERED TOP AND BOTTOM AT 6" O.C.

PROJECT NAME: Alternate install of upgrade.		Scale: N.T.S.	
Domus Structural Engineering, LLC. P.O. BOX 6986 Broomfield, CO 80021 (530) 864-7055 Domusstructural@gmail.com		Date:2/4/2020	
		Project Number: Solar PV	
	Project Description:Alt. Sister upgrade detail and specifications.	Drawn By: JAC	Drawing Name: F-SIS
		Revisions:	
		A	
		B	

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Gravity Loading

Roof Snow Load Calculations		
p_g = Ground Snow Load =	25 psf	
$p_f = 0.7\ C_e\ C_t\ I\ p_g$		(ASCE7 - Eq 7-1)
C_e = Exposure Factor =	1	(ASCE7 - Table 7-2)
C_t = Thermal Factor =	1	(ASCE7 - Table 7-3)
I = Importance Factor =	1	
p_f = Flat Roof Snow Load =	20.0 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
Cs = Slope Factor =	1	
p_s = Sloped Roof Snow Load =	**20.0 psf**	
Point Load portrait	**220 lb**	
Point Load Landscape	**140 lb**	

PV Dead Load = 3 psf (Per Blue Raven Solar)	
DL Adjusted to 35 Degree Slope	3.66 psf
PV System Weight	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
X Standoff Spacing =	4.00 ft
Y Standoff Spacing =	2.75 ft
Standoff Tributary Area =	11.00 sft
Point Loads of Standoffs- Portrait	**33 lb**
Point Loads of Standoffs- Landscape	**21 lb**

Note: PV standoffs are staggered to ensure proper distribution of loading

Roof Live Load = 20 psf

Note: Roof live load is removed in area's covered by PV array.

Roof Dead Load (MP1)		
Composition Shingle	4.00	
Roof Plywood	2.00	
Double 2x4 Rafters @ 24"o.c.	1.46	
Vaulted Ceiling	0.00	(Ceiling Not Vaulted)
Miscellaneous	0.54	
Total Roof DL (MP1)	**8.0 psf**	
DL Adjusted to 35 Degree Slope	9.8 psf	

Roof Dead Load (MP2&3)		
Composition Shingle	4.00	
Roof Plywood	2.00	
Double 2x4 Rafters @ 24"o.c.	1.46	
Vaulted Ceiling	0.00	(Ceiling Not Vaulted)
Miscellaneous	0.54	
Total Roof DL (MP2&3)	**8.0 psf**	
DL Adjusted to 35 Degree Slope	9.77	

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Wind Calculations
Per ASCE 7-16 Components and Cladding

Input Variables	
Wind Speed	120 mph
Exposure Category	C
Roof Shape	Gable Roof
Roof Slope	35 degrees
Mean Roof Height	20 ft
Effective Wind Area	19.3 ft
Ground Elevation	0 ft

Design Wind Pressure Calculations		
qh = 0.00256 * Kz * Kzt * Kd * Ke * V^2		(Eq. 26.10-1)
Kz (Exposure Coefficient) =	0.90	(Table 30.3-1)
Kzt (topographic factor) =	1.00	(Fig. 26.8-1)
Kd (Wind Directionality Factor) =	0.85	(Table 26.6-1)
Ke (Ground Elevation Factor) =	1.00	
V (Design Wind Speed) =	120 mph	(Fig. 26.5-1A)
Risk Category =	II	(Table 1.5-1)
qh =	28.26	

Standoff Uplift Calculations-Portrait					
	Zone 1	Zone 2	Zone 3	Positive	
y_a =	0.79	0.79	0.80	0.79	
GCp =	-1.76	-1.97	-2.63	0.88	(Fig. 30.3)
Uplift Pressure =	-39.1 psf	-43.7 psf	-59.4 psf	19.6 psf	(Eq. 29.4-7)
ASD Uplift Pressure =	-23.4 psf	-26.2 psf	-35.7 psf	11.8 psf	
X Standoff Spacing =	4.00	4.00	2.67		
Y Standoff Spacing =	2.75	2.75	2.75		
Tributary Area =	11.00	11.00	7.33		
Dead Load on attachment =	33 lb	33 lb	22 lb		
Footing Uplift (0.6D+0.6W) =	**-225 lb**	**-256 lb**	**-240 lb**		

Standoff Uplift Calculations-Landscape					
	Zone 1	Zone 2	Zone 3	Positive	
y_a =	0.80	0.80	0.80	0.80	
GCp =	-1.80	-2.00	-2.83	0.90	(Fig. 30.3)
Uplift Pressure =	-40.7 psf	-45.2 psf	-63.9 psf	20.3 psf	(Eq. 29.4-7)
ASD Uplift Pressure (0.6W)=	-24.4 psf	-27.1 psf	-38.4 psf	12.2 psf	
X Standoff Spacing =	4.00	4.00	2.67		
Y Standoff Spacing =	1.75	1.75	1.75		
Tributary Area =	7.00	7.00	4.67		
Dead Load on attachment =	21.00	21.00	14.00		
Footing Uplift (0.6D+0.6W) =	**-150 lb**	**-169 lb**	**-165 lb**		

Standoff Uplift Check	
Maximum Design Uplift =	-256 lb
Standoff Uplift Capacity =	450 lb
450 lb capacity > 256 lb demand	**Therefore, OK**

Fastener Capacity Check	
Fastener =	1 - 5/16" dia Lag
Number of Fasteners =	1
Embedment Depth =	2.5
Pullout Capacity Per Inch =	250 lb
Fastener Capacity =	625 lb
w/ F.S. of 1.5 & DOL of 1.6=	667 lb
667.2 lb capacity > 256 lb demand	**Therefore, OK**

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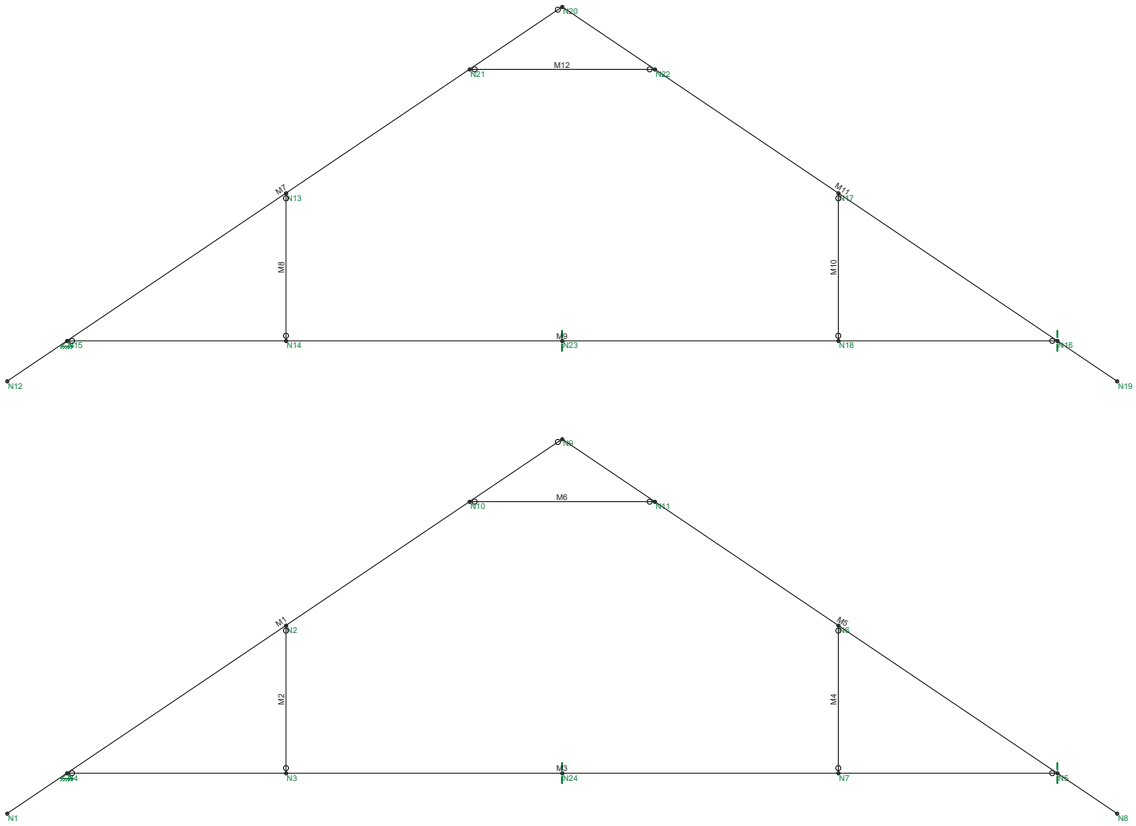
Existing Weight of Effected Building				
Level	**Area**	**Weight (psf)**	**Weight (lb)**	
Roof	2200 sf	9.8 psf	21486 lb	
Ceiling	2200 sf	6.0 psf	13200 lb	
Wood Siding	100 ft	5.0 psf	2000 lb	(8'-0" Wall Height)
Int. Walls	100 ft	6.4 psf	2560 lb	
Existing Weight of Effected Building			**39246 lb**	

Proposed Weight of PV System	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
Approx. Area of Proposed PV System	366 sf
Approximate Total Weight of PV System	**1098 lb**

10% Comparison	
10% of Existing Building Weight (Allowed)	3925 lb
Approximate Weight of PV System (Actual)	1098 lb
Percent Increase	2.8%
3925 lb > 1098 lb, Therefore OK	



Envelope Only Solution

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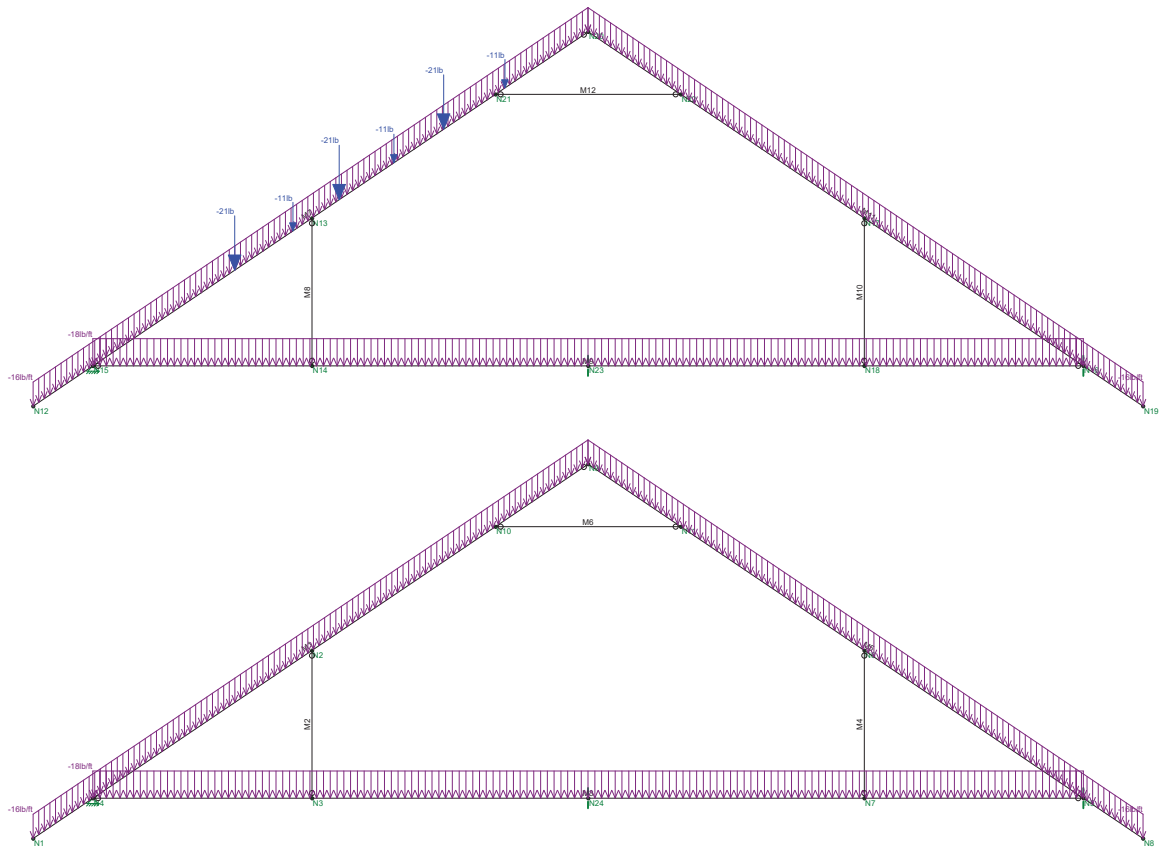
		Mar 17, 2021 at 2:02 PM
		Section 1-No attic.R2D



Loads: BLC 1, Dead
Envelope Only Solution

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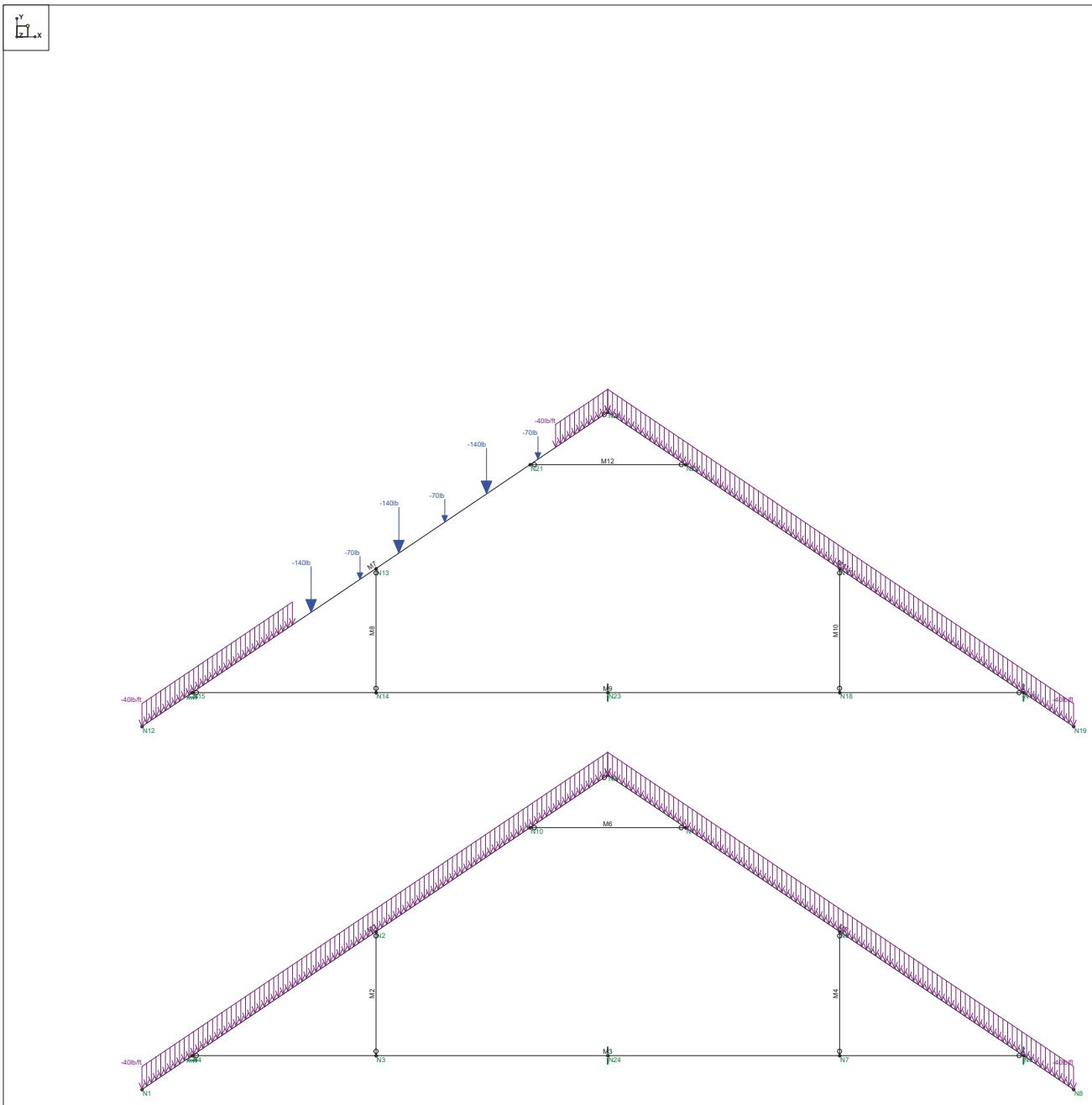
		Section 1-No attic.R2D



Loads: BLC 2, Snow
Envelope Only Solution

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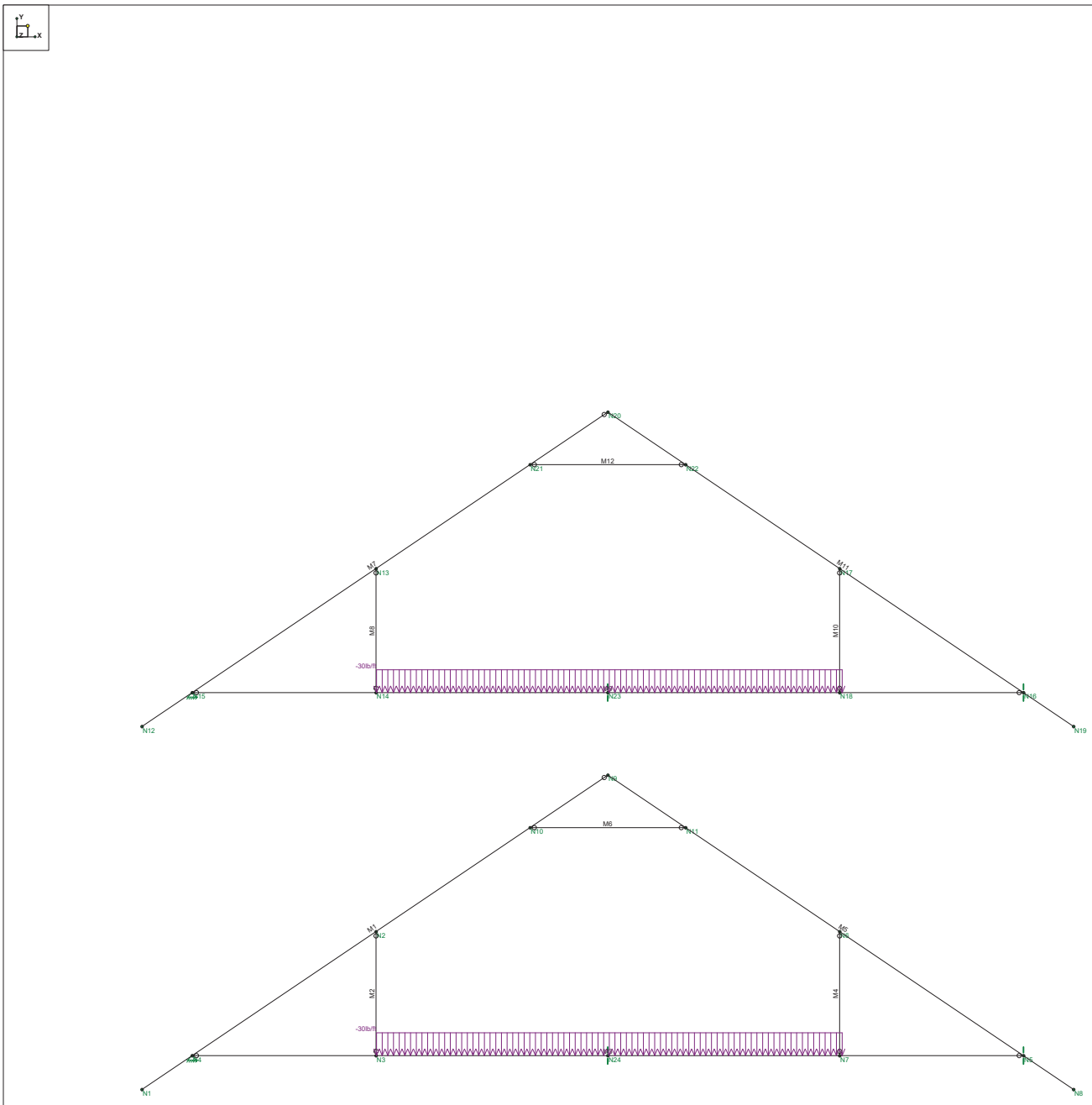
		Section 1-No attic.R2D



Loads: BLC 3, Live Load
Envelope Only Solution

		SK - Live 4
		Mar 17, 2021 at 2:03 PM
		Section 1-No attic.R2D

Wood Material Properties

	Label	Type	Database	Species	Grade	Cm	Emod	Nu	Ther...	Dens[k...
1	DF	Solid S...	Visually Graded	Douglas Fir-Larch	No.2		1	.3	.3	.035
2	DF1	Solid S...	Visually Graded	Douglas Fir-Larch	No.1		1	.3	.3	.035

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	I (90,270...	I (0,180) ...
1	R1	2X4	Beam	Rectangular	DF	Typical	5.25	.984	5.359
2	R2	2-2X4	Beam	Rectangular Double	DF	Typical	10.5	7.875	10.719
3	Wall	2X4	Column	Rectangular	DF	Typical	5.25	.984	5.359
4	CJ	2X6	Beam	Rectangular	DF	Typical	8.25	1.547	20.797
5	CT	2X4	Beam	Rectangular	DF	Typical	5.25	.984	5.359

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Temp [F]
1	N1	-1.658075	-1.118386	0
2	N2	6.079609	4.100748	0
3	N3	6.079609	0	0
4	N4	0	0	0
5	N5	27.496413	0	0
6	N6	21.416804	4.100748	0
7	N7	21.416804	0	0
8	N8	29.154488	-1.118386	0
9	N9	13.748206	9.273282	0
10	N10	11.177012	7.53899	0
11	N11	16.319401	7.53899	0
12	N12	-1.658075	10.881614	0
13	N13	6.079609	16.100748	0
14	N14	6.079609	12	0
15	N15	0	12	0
16	N16	27.496413	12	0
17	N17	21.416804	16.100748	0
18	N18	21.416804	12	0
19	N19	29.154488	10.881614	0
20	N20	13.748206	21.273282	0
21	N21	11.177012	19.53899	0
22	N22	16.319401	19.53899	0
23	N23	13.748206	12	0
24	N24	13.748206	0	0

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Rotation[k-ft/rad]
1	N4	Reaction	Reaction	
2	N15	Reaction	Reaction	
3	N16		Reaction	
4	N5		Reaction	
5	N23		Reaction	
6	N24		Reaction	

Member Primary Data

	Label	I Joint	J Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N9		R1	Beam	Rectangular	DF	Typical
2	M2	N2	N3		Wall	Column	Rectangular	DF	Typical
3	M3	N4	N5		CJ	Beam	Rectangular	DF	Typical
4	M4	N6	N7		Wall	Column	Rectangular	DF	Typical
5	M5	N8	N9		R1	Beam	Rectangular	DF	Typical
6	M6	N10	N11		CT	Beam	Rectangular	DF	Typical
7	M7	N12	N20		R2	Beam	Rectangular D...	DF	Typical
8	M8	N13	N14		Wall	Column	Rectangular	DF	Typical
9	M9	N15	N16		CJ	Beam	Rectangular	DF	Typical
10	M10	N17	N18		Wall	Column	Rectangular	DF	Typical
11	M11	N19	N20		R2	Beam	Rectangular D...	DF	Typical
12	M12	N21	N22		CT	Beam	Rectangular	DF	Typical

Wood Design Parameters

	Label	Shape	Leng...	Le-out[ft]	Le-in[ft]	le-bend top...	le-bend ...	K-out	K-in	CV	Cr	Out s...	In sw...
1	M1	R1	18.583	1	Segment	1	Segment				Yes		
2	M2	Wall	4.101			Lb out							
3	M3	CJ	27.496	1	Segment	1	1				Yes		
4	M4	Wall	4.101			Lb out							
5	M5	R1	18.583	1	Segment	1	Segment				Yes		
6	M6	CT	5.142			Lb out							
7	M7	R2	18.583	1	Segment	1	Segment				Yes		
8	M8	Wall	4.101			Lb out							
9	M9	CJ	27.496	1	Segment	1	1				Yes		
10	M10	Wall	4.101			Lb out							
11	M11	R2	18.583	1	Segment	1	Segment				Yes		
12	M12	CT	5.142			Lb out							

Joint Loads and Enforced Displacements

Joint Label	L,D,M	Direction	Magnitude[(lb,lb-ft), (in,rad), (lb*s^...
No Data to Print ...			

Member Distributed Loads (BLC 1 : Dead)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...
1	M7	Y	-16	-16	0	0
2	M11	Y	-16	-16	0	0
3	M1	Y	-16	-16	0	0
4	M5	Y	-16	-16	0	0
5	M9	Y	-18	-18	0	0
6	M3	Y	-18	-18	0	0

Member Distributed Loads (BLC 2 : Snow)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...
1	M7	Y	-40	-40	0	6
2	M11	Y	-40	-40	0	0
3	M1	Y	-40	-40	0	0
4	M5	Y	-40	-40	0	0
5	M7	Y	-40	-40	16.5	0

Member Distributed Loads (BLC 3 : Live Load)

Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...

Member Distributed Loads (BLC 3 : Live Load) (Continued)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...
1	M3	Y	-30	-30	6.1	21.5
2	M9	Y	-30	-30	6.1	21.5

Member Point Loads (BLC 1 : Dead)

	Member Label	Direction	Magnitude[lb,lb-ft]	Location[ft,%]
1	M7	Y	-21	6.75
2	M7	Y	-11	8.7
3	M7	Y	-21	10.25
4	M7	Y	-11	12.083
5	M7	Y	-21	13.75
6	M7	Y	-11	15.8

Member Point Loads (BLC 2 : Snow)

	Member Label	Direction	Magnitude[lb,lb-ft]	Location[ft,%]
1	M7	Y	-140	6.75
2	M7	Y	-70	8.7
3	M7	Y	-140	10.25
4	M7	Y	-70	12.083
5	M7	Y	-140	13.75
6	M7	Y	-70	15.8

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Joint	Point	Distributed
1	Dead	DL				6	6
2	Snow	SL				6	5
3	Live Load	LL					2

Load Combinations

	Descripti...	Solve	PDelta	SRSS	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...
1	IBC 16-8	Yes			DL	1																		
2	IBC 16-9	Yes			DL	1	LL	1	LLS	1														
3	IBC 16-1...	Yes			DL	1	RLL	1																
4	IBC 16-1...	Yes			DL	1	SL	1	S...	1														
5	IBC 16-1...	Yes			DL	1	RL	1																
6	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	RLL	.75												
7	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	SL	.75	S...	.75										
8	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	RL	.75												

Envelope Member Section Forces

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
1	M1	1	max	0	8	0	1	0	1
2			min	0	1	0	1	0	1
3		2	max	797.361	4	66.065	4	-87.035	1
4			min	264.693	1	25.377	1	-244.415	4
5		3	max	651.878	4	-28.881	2	-50.314	4
6			min	223.126	1	-149.623	4	-115.502	2
7		4	max	662.886	4	-53.148	1	88.244	7
8			min	211.726	1	-133.303	4	43.841	1
9		5	max	-37.26	5	46.825	7	0	1
10			min	-69.257	7	25.132	1	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
11	M2	1	max	279.852	4	0	1	0	1
12			min	24.243	2	0	1	0	1
13		2	max	279.852	4	0	1	0	1
14			min	24.243	2	0	1	0	1
15		3	max	279.852	4	0	1	0	1
16			min	24.243	2	0	1	0	1
17		4	max	279.852	4	0	1	0	1
18			min	24.243	2	0	1	0	1
19		5	max	279.852	4	0	1	0	1
20			min	24.243	2	0	1	0	1
21	M3	1	max	-205.249	5	199.186	4	0	1
22			min	-624.099	4	113.326	1	0	1
23		2	max	-205.249	5	-38.796	2	-310.868	1
24			min	-624.099	4	-204.4	4	-728.231	7
25		3	max	-205.249	5	429.462	7	1261.266	7
26			min	-624.099	4	-328.134	4	556.796	1
27		4	max	-205.249	5	204.397	4	-310.863	1
28			min	-624.099	4	39.921	2	-734.017	7
29		5	max	-205.249	5	-113.325	1	0	1
30			min	-624.099	4	-199.183	4	0	1
31	M4	1	max	279.846	4	0	1	0	1
32			min	23.694	2	0	1	0	1
33		2	max	279.846	4	0	1	0	1
34			min	23.694	2	0	1	0	1
35		3	max	279.846	4	0	1	0	1
36			min	23.694	2	0	1	0	1
37		4	max	279.846	4	0	1	0	1
38			min	23.694	2	0	1	0	1
39		5	max	279.846	4	0	1	0	1
40			min	23.694	2	0	1	0	1
41	M5	1	max	0	8	0	1	0	1
42			min	0	1	0	1	0	1
43		2	max	797.363	4	-25.378	1	244.422	4
44			min	264.693	1	-66.068	4	87.037	1
45		3	max	651.88	4	149.62	4	117.353	2
46			min	223.126	1	28.627	2	50.334	4
47		4	max	662.884	4	133.305	4	-43.838	1
48			min	211.726	1	53.149	1	-87.537	7
49		5	max	-37.26	5	-25.132	1	0	1
50			min	-69.36	7	-46.673	7	0	1
51	M6	1	max	690.729	4	0	1	0	1
52			min	250.193	1	0	1	0	1
53		2	max	690.729	4	0	1	0	1
54			min	250.193	1	0	1	0	1
55		3	max	690.729	4	0	1	0	1
56			min	250.193	1	0	1	0	1
57		4	max	690.729	4	0	1	0	1
58			min	250.193	1	0	1	0	1
59		5	max	690.729	4	0	1	0	1
60			min	250.193	1	0	1	0	1
61	M7	1	max	0	8	0	1	0	1
62			min	0	1	0	1	0	1
63		2	max	1069.494	4	125.342	4	-139.841	1
64			min	370.627	1	45.335	1	-401.252	4
65		3	max	862.313	4	-31.231	2	-157.666	1
66			min	311.166	1	-181.816	4	-315.22	7
67		4	max	789.461	4	-98.038	1	76.781	2

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
68			min	273.92	1	-289.825	4	21.636	4
69		5	max	-89.767	5	93.125	7	0	1
70			min	-194.066	7	44.341	1	0	1
71	M8	1	max	347.051	4	0	1	0	1
72			min	14.059	2	0	1	0	1
73		2	max	347.051	4	0	1	0	1
74			min	14.059	2	0	1	0	1
75		3	max	347.051	4	0	1	0	1
76			min	14.059	2	0	1	0	1
77		4	max	347.051	4	0	1	0	1
78			min	14.059	2	0	1	0	1
79		5	max	347.051	4	0	1	0	1
80			min	14.059	2	0	1	0	1
81	M9	1	max	-281.912	5	240.888	4	0	1
82			min	-816.561	4	120.876	1	0	1
83		2	max	-281.912	5	-27.475	2	-357.386	1
84			min	-816.561	4	-229.897	4	-954.876	4
85		3	max	-281.912	5	-187.318	1	1173.372	7
86			min	-816.561	4	-439.638	7	504.976	1
87		4	max	-281.912	5	149.465	4	-187.222	1
88			min	-816.561	4	3.677	2	-439.575	7
89		5	max	-281.912	5	-89.652	1	0	1
90			min	-816.561	4	-139.434	4	0	1
91	M10	1	max	165.165	4	0	1	0	1
92			min	-42.849	2	0	1	0	1
93		2	max	165.165	4	0	1	0	1
94			min	-42.849	2	0	1	0	1
95		3	max	165.165	4	0	1	0	1
96			min	-42.849	2	0	1	0	1
97		4	max	165.165	4	0	1	0	1
98			min	-42.849	2	0	1	0	1
99		5	max	165.165	4	0	1	0	1
100			min	-42.849	2	0	1	0	1
101	M11	1	max	0	8	0	1	0	1
102			min	0	1	0	1	0	1
103		2	max	1042.01	4	-34.435	1	293.44	4
104			min	363.275	1	-84.594	4	111.001	1
105		3	max	896.526	4	131.094	4	236.752	7
106			min	321.708	1	15.171	2	127.831	1
107		4	max	843.402	4	209.853	4	-123.508	1
108			min	282.796	1	84.879	1	-294.175	4
109		5	max	-74.739	5	-66.62	1	0	1
110			min	-159.043	7	-145.208	4	0	1
111	M12	1	max	1020.666	4	0	1	0	1
112			min	381.128	1	0	1	0	1
113		2	max	1020.666	4	0	1	0	1
114			min	381.128	1	0	1	0	1
115		3	max	1020.666	4	0	1	0	1
116			min	381.128	1	0	1	0	1
117		4	max	1020.666	4	0	1	0	1
118			min	381.128	1	0	1	0	1
119		5	max	1020.666	4	0	1	0	1
120			min	381.128	1	0	1	0	1

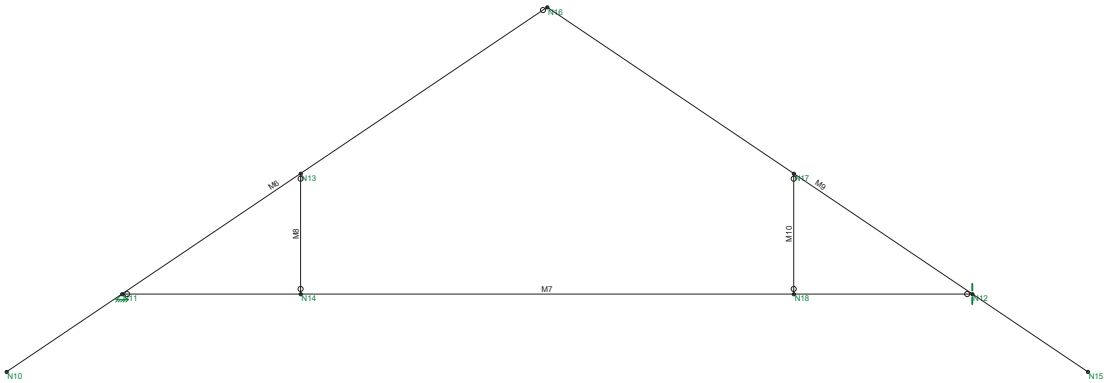
Envelope Joint Reactions

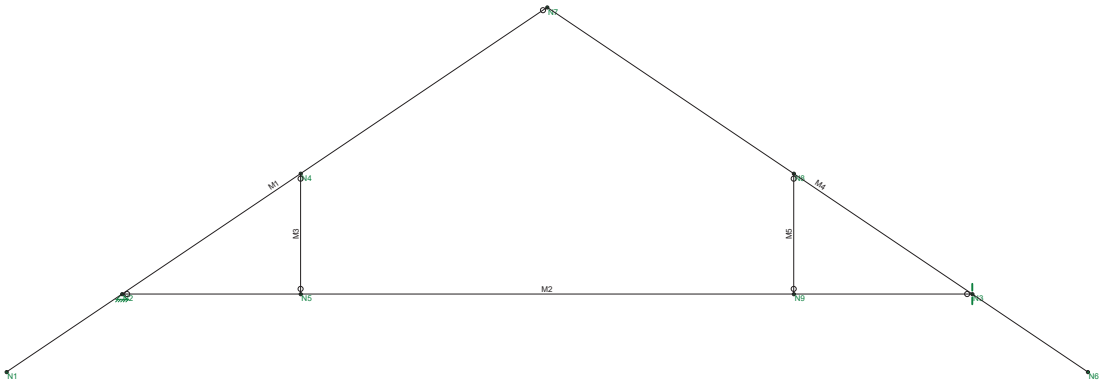
	Joint		X [lb]	LC	Y [lb]	LC	Moment [lb-ft]	LC
1	N4	max	0	8	960.002	4	0	8
2		min	0	1	356.712	1	0	1
3	N15	max	0	8	1203.022	4	0	8
4		min	0	1	440.046	1	0	1
5	N16	max	0	8	1052.417	4	0	8
6		min	0	1	395.674	1	0	1
7	N5	max	0	8	960.002	4	0	8
8		min	0	1	356.712	1	0	1
9	N23	max	0	8	813.481	7	0	8
10		min	0	1	349.882	1	0	1
11	N24	max	0	8	858.083	7	0	8
12		min	0	1	376.178	1	0	1
13	Totals:	max	0	8	5458.538	4		
14		min	0	1	2275.204	1		

Envelope Wood Code Checks

	Memb...	Shape	Code Check	Loc[ft]	LC	She...	Loc...	LC	Fc' [ksi]	Ft' [k...	Fb' [...	Fv' [...	RB	CL	CP	Eqn
1	M1	2X4	.836	6.001	4	.271	15....	4	.677	.992	1.781	.207	4.32	.998	.379	3.9-3
2	M2	2X4	.127	0	4	.000	0	8	.421	.992	1.537	.207	8.749	.99	.236	3.6.3
3	M3	2X6	1.370	13.748	7	.377	13....	7	1.183	.86	1.542	.207	5.416	.997	.693	3.9-1
4	M4	2X4	.127	0	4	.000	0	8	.421	.992	1.537	.207	8.749	.99	.236	3.6.3
5	M5	2X4	.854	6.001	4	.271	15....	4	.677	.992	1.741	.207	11.7	.975	.379	3.9-3
6	M6	2X4	.480	0	4	.000	0	8	.274	.992	1.532	.207	9.798	.987	.153	3.6.3
7	M7	2-2X4	.730	6.775	4	.212	15....	4	.677	.992	1.784	.207	2.16	.999	.379	3.9-3
8	M8	2X4	.157	0	4	.000	0	8	.421	.992	1.537	.207	8.749	.99	.236	3.6.3
9	M9	2X6	1.305	13.748	7	.386	13....	7	1.183	.86	1.542	.207	5.416	.997	.693	3.9-1
10	M10	2X4	.075	0	4	.000	0	8	.421	.992	1.537	.207	8.749	.99	.236	3.6.3
11	M11	2-2X4	.743	15.486	4	.199	15....	4	1.594	.992	1.784	.207	2.16	.999	.893	3.9-1
12	M12	2X4	.710	0	4	.000	0	8	.274	.992	1.532	.207	9.798	.987	.153	3.6.3

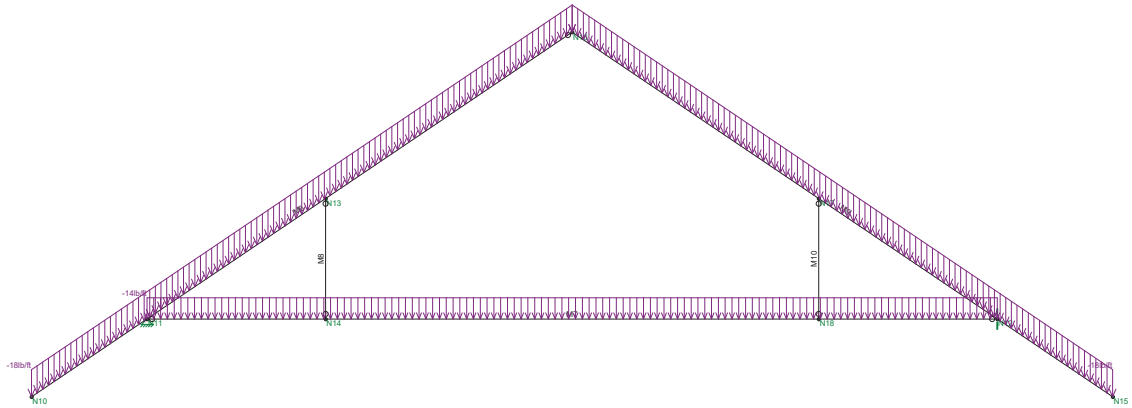
M3 and M9 are at 16" not 24" o.c..
Therefore a reduction in stress of 16/24 = 0.67 should be applied.
1.37*.67 = 0.92 therefore ok as is.

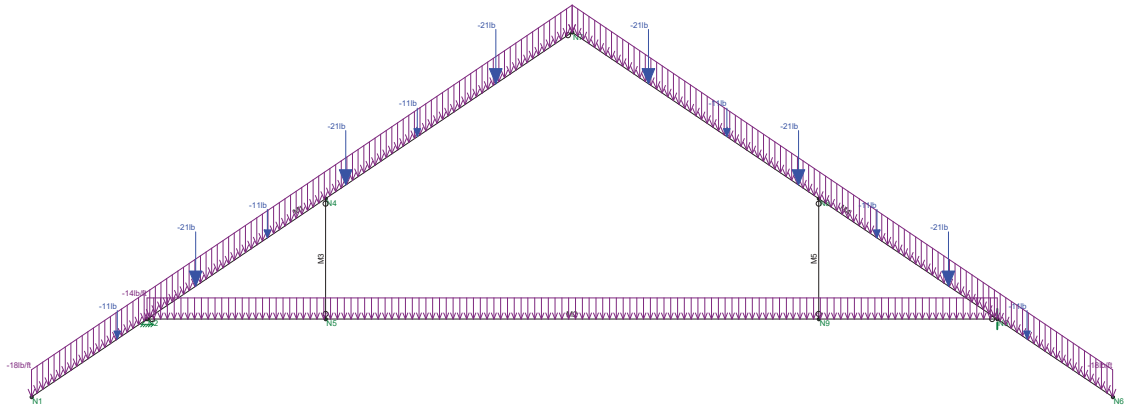




Envelope Only Solution

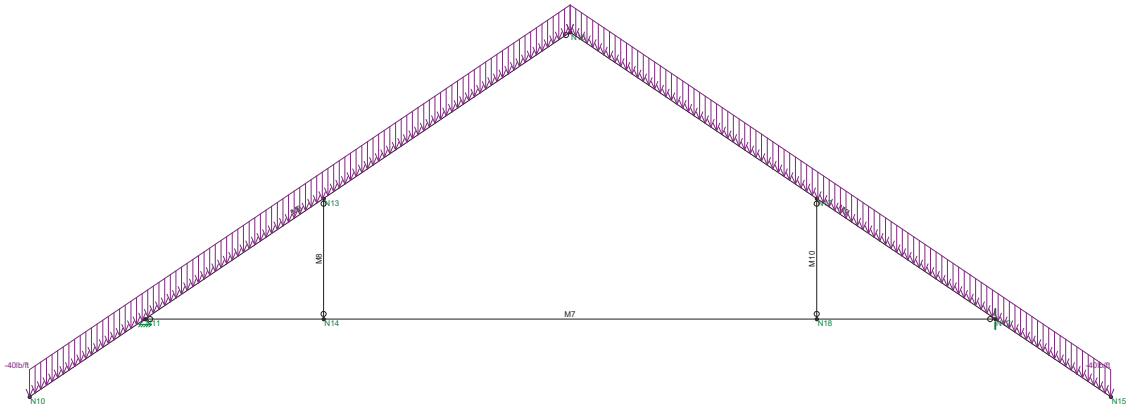
		SK - Members 1
		Mar 17, 2021 at 2:23 PM
		Section 2.R2D

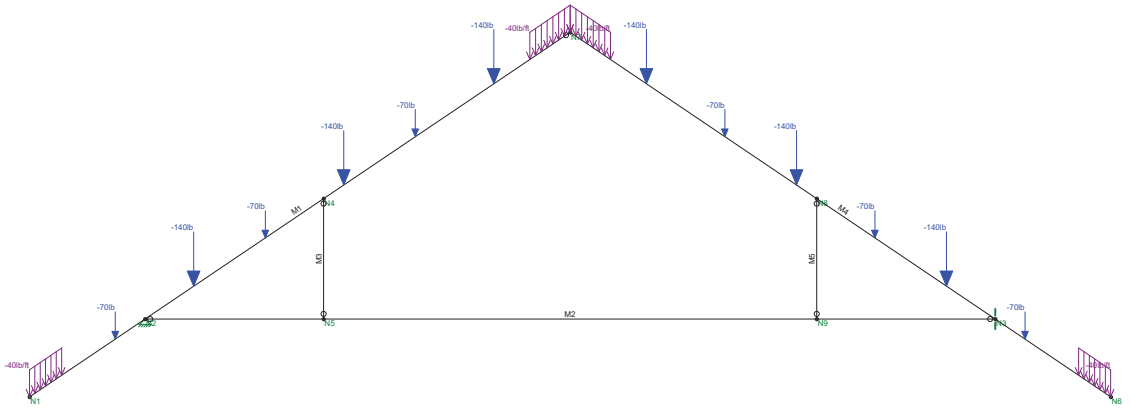




Loads: BLC 1, Dead
Envelope Only Solution

		SK - Dead 2
		Mar 17, 2021 at 2:23 PM
		Section 2.R2D





Loads: BLC 2, Snow
Envelope Only Solution

		SK - Snow 3
		Mar 17, 2021 at 2:24 PM
		Section 2.R2D

Wood Material Properties

	Label	Type	Database	Species	Grade	Cm	Emod	Nu	Ther...	Dens[k...
1	DF	Solid S...	Visually Graded	Douglas Fir-Larch	No.2		1	.3	.3	.035

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rul...	A [in2]	I (90,270...	I (0,180) ...
1	R1	2X4	Beam	Rectangular	DF	Typical	5.25	.984	5.359
2	R2	2-2X4	Beam	Rectangular	DF	Typical	10.5	7.875	10.719
3	Wall	2X4	Column	Rectangular	DF	Typical	5.25	.984	5.359
4	CJ	2X8	Beam	Rectangular	DF	Typical	10.875	2.039	47.635

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Temp [F]
1	N1	-2.232933	-1.506132	0
2	N2	0	0	0
3	N3	16.443923	0.	0
4	N4	3.454323	2.32997	0
5	N5	3.454323	0	0
6	N6	18.676856	-1.506132	0
7	N7	8.221961	5.545783	0
8	N8	12.9896	2.32997	0
9	N9	12.9896	1.895e-14	0
10	N10	-2.232933	8.493868	0
11	N11	0	10	0
12	N12	16.443923	10	0
13	N13	3.454323	12.32997	0
14	N14	3.454323	10	0
15	N15	18.676856	8.493868	0
16	N16	8.221961	15.545783	0
17	N17	12.9896	12.32997	0
18	N18	12.9896	10	0

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Rotation[k-ft/rad]
1	N2	Reaction	Reaction	
2	N3		Reaction	
3	N11	Reaction	Reaction	
4	N12		Reaction	

Member Primary Data

	Label	I Joint	J Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N7		R2	Beam	Rectangular	DF	Typical
2	M2	N2	N3		CJ	Beam	Rectangular	DF	Typical
3	M3	N4	N5		Wall	Column	Rectangular	DF	Typical
4	M4	N6	N7		R2	Beam	Rectangular	DF	Typical
5	M5	N8	N9		Wall	Column	Rectangular	DF	Typical
6	M6	N10	N16		R1	Beam	Rectangular	DF	Typical
7	M7	N11	N12		CJ	Beam	Rectangular	DF	Typical
8	M8	N13	N14		Wall	Column	Rectangular	DF	Typical
9	M9	N15	N16		R1	Beam	Rectangular	DF	Typical
10	M10	N17	N18		Wall	Column	Rectangular	DF	Typical

Wood Design Parameters

	Label	Shape	Leng...	Le-out[ft]	Le-in[ft]	le-bend top...	le-bend ...	K-out	K-in	CV	Cr	Out s...	In sw...
1	M1	R2	12.611	1	Segment	1	Segment				Yes		
2	M2	CJ	16.444	1	Segment	Lb out					Yes		
3	M3	Wall	2.33			Lb out							
4	M4	R2	12.611	1	Segment	1	Segment				Yes		
5	M5	Wall	2.33			Lb out							
6	M6	R1	12.611	1	Segment	1	Segment				Yes		
7	M7	CJ	16.444	1	Segment	Lb out					Yes		
8	M8	Wall	2.33			Lb out							
9	M9	R1	12.611	1	Segment	1	Segment				Yes		
10	M10	Wall	2.33			Lb out							

Joint Loads and Enforced Displacements

Joint Label	L,D,M	Direction	Magnitude[(lb,lb-ft), (in,rad), (lb*s^...
No Data to Print ...			

Member Distributed Loads (BLC 1 : Dead)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...
1	M1	Y	-18	-18	0	0
2	M4	Y	-18	-18	0	0
3	M2	Y	-14	-14	0	0
4	M6	Y	-18	-18	0	0
5	M7	Y	-14	-14	0	0
6	M9	Y	-18	-18	0	0

Member Distributed Loads (BLC 2 : Snow)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[f...	End Location[ft...
1	M1	Y	-40	-40	0	.75
2	M4	Y	-40	-40	0	.75
3	M6	Y	-40	-40	0	0
4	M9	Y	-40	-40	0	0
5	M1	Y	-40	-40	11.67	0
6	M4	Y	-40	-40	11.67	0

Member Point Loads (BLC 1 : Dead)

	Member Label	Direction	Magnitude[lb,lb-ft]	Location[ft,%]
1	M1	Y	-11	2
2	M1	Y	-21	3.83
3	M1	Y	-11	5.5
4	M1	Y	-21	7.33
5	M1	Y	-11	9
6	M1	Y	-21	10.83
7	M4	Y	-11	2
8	M4	Y	-21	3.83
9	M4	Y	-11	5.5
10	M4	Y	-21	7.33
11	M4	Y	-11	9
12	M4	Y	-21	10.83

Member Point Loads (BLC 2 : Snow)

Member Label	Direction	Magnitude[lb,lb-ft]	Location[ft,%]

Member Point Loads (BLC 2 : Snow) (Continued)

	Member Label	Direction	Magnitude[lb,lb-ft]	Location[ft,%]
1	M1	Y	-70	2
2	M1	Y	-140	3.83
3	M1	Y	-70	5.5
4	M1	Y	-140	7.33
5	M1	Y	-70	9
6	M1	Y	-140	10.83
7	M4	Y	-70	2
8	M4	Y	-140	3.83
9	M4	Y	-70	5.5
10	M4	Y	-140	7.33
11	M4	Y	-70	9
12	M4	Y	-140	10.83

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Joint	Point	Distributed
1	Dead	DL		-1		12	6
2	Snow	SL				12	6

Load Combinations

	Descripti...	Solve	PDelta	SRSS	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...
1	IBC 16-8	Yes			DL	1																		
2	IBC 16-9	Yes			DL	1	LL	1	LLS	1														
3	IBC 16-1...	Yes			DL	1	RLL	1																
4	IBC 16-1...	Yes			DL	1	SL	1	S...	1														
5	IBC 16-1...	Yes			DL	1	RL	1																
6	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	RLL	.75												
7	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	SL	.75	S...	.75										
8	IBC 16-1...	Yes			DL	1	LL	.75	LLS	.75	RL	.75												

Envelope Member Section Forces

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
1	M1	1	max	0	8	0	1	0	1
2			min	0	1	0	1	0	1
3		2	max	835.751	4	305.497	4	23.914	4
4			min	323.432	1	122.759	1	9.947	1
5		3	max	664.193	4	51.152	4	-241.96	1
6			min	269.305	1	42.513	1	-470.059	4
7		4	max	580.114	4	-40.419	1	-243.104	1
8			min	213.368	1	-73.5	4	-568.776	4
9		5	max	432.806	4	-111.546	1	0	1
10			min	165.392	1	-291.893	4	0	1
11	M2	1	max	-199.492	8	296.219	4	0	1
12			min	-522.037	4	136.565	1	0	1
13		2	max	-199.492	8	68.41	1	-420.933	1
14			min	-522.037	4	68.388	4	-972.417	4
15		3	max	-199.492	8	-.01	1	-561.548	1
16			min	-522.037	4	-.032	4	-1112.943	4
17		4	max	-199.492	8	-68.43	1	-420.851	1
18			min	-522.037	4	-68.452	4	-972.157	4
19		5	max	-199.492	8	-136.537	1	0	1
20			min	-522.037	4	-296.132	4	0	1
21	M3	1	max	156.438	4	0	1	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
22			min	-3.238	1	0	1	0	1
23		2	max	157.181	4	0	1	0	1
24			min	-2.495	1	0	1	0	1
25		3	max	157.924	4	0	1	0	1
26			min	-1.752	1	0	1	0	1
27		4	max	158.667	4	0	1	0	1
28			min	-1.008	1	0	1	0	1
29		5	max	159.411	4	0	1	0	1
30			min	-.265	1	0	1	0	1
31	M4	1	max	0	8	0	1	0	1
32			min	0	1	0	1	0	1
33		2	max	835.799	4	-122.782	1	-9.936	1
34			min	323.448	1	-305.569	4	-23.881	4
35		3	max	664.242	4	-42.536	1	470.32	4
36			min	269.321	1	-51.225	4	242.043	1
37		4	max	580.079	4	73.552	4	568.941	4
38			min	213.356	1	40.435	1	243.157	1
39		5	max	432.771	4	291.945	4	0	1
40			min	165.38	1	111.563	1	0	1
41	M5	1	max	156.287	4	0	1	0	1
42			min	-3.286	1	0	1	0	1
43		2	max	157.031	4	0	1	0	1
44			min	-2.543	1	0	1	0	1
45		3	max	157.774	4	0	1	0	1
46			min	-1.8	1	0	1	0	1
47		4	max	158.517	4	0	1	0	1
48			min	-1.056	1	0	1	0	1
49		5	max	159.26	4	0	1	0	1
50			min	-.313	1	0	1	0	1
51	M6	1	max	0	8	0	1	0	1
52			min	0	1	0	1	0	1
53		2	max	499.147	4	172.476	4	93.855	4
54			min	200.781	1	73.279	1	22.625	1
55		3	max	394.644	4	22.896	1	-128.983	1
56			min	166.798	1	17.545	4	-205.689	4
57		4	max	367.621	4	-19.778	1	-141.769	1
58			min	138.013	1	-22.518	4	-315.2	4
59		5	max	263.119	4	-70.161	1	0	1
60			min	104.03	1	-177.449	4	0	1
61	M7	1	max	-125.478	8	278.347	4	0	1
62			min	-317.364	4	149.103	1	0	1
63		2	max	-125.478	8	68.413	1	-464.246	1
64			min	-317.364	4	68.398	4	-910.688	4
65		3	max	-125.478	8	-.007	1	-604.872	1
66			min	-317.364	4	-.022	4	-1051.253	4
67		4	max	-125.478	8	-68.427	1	-464.186	1
68			min	-317.364	4	-68.442	4	-910.506	4
69		5	max	-125.478	8	-149.083	1	0	1
70			min	-317.364	4	-278.286	4	0	1
71	M8	1	max	138.556	4	0	1	0	1
72			min	9.297	1	0	1	0	1
73		2	max	139.3	4	0	1	0	1
74			min	10.04	1	0	1	0	1
75		3	max	140.043	4	0	1	0	1
76			min	10.784	1	0	1	0	1
77		4	max	140.786	4	0	1	0	1
78			min	11.527	1	0	1	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	Shear[lb]	LC	Moment[lb-ft]	LC
79		5	max	141.53	4	0	1	0	1
80			min	12.27	1	0	1	0	1
81	M9	1	max	0	8	0	1	0	1
82			min	0	1	0	1	0	1
83		2	max	499.181	4	-73.295	1	-22.617	1
84			min	200.792	1	-172.526	4	-93.832	4
85		3	max	394.678	4	-17.595	4	205.871	4
86			min	166.809	1	-22.913	1	129.042	1
87		4	max	367.597	4	22.555	4	315.316	4
88			min	138.005	1	19.79	1	141.807	1
89		5	max	263.094	4	177.486	4	0	1
90			min	104.022	1	70.172	1	0	1
91	M10	1	max	138.451	4	0	1	0	1
92			min	9.263	1	0	1	0	1
93		2	max	139.194	4	0	1	0	1
94			min	10.006	1	0	1	0	1
95		3	max	139.938	4	0	1	0	1
96			min	10.749	1	0	1	0	1
97		4	max	140.681	4	0	1	0	1
98			min	11.493	1	0	1	0	1
99		5	max	141.424	4	0	1	0	1
100			min	12.236	1	0	1	0	1

Envelope Joint Reactions

	Joint		X [lb]	LC	Y [lb]	LC	Moment [lb-ft]	LC
1	N2	max	0	8	1192.628	4	0	8
2		min	0	1	494.993	1	0	1
3	N3	max	0	8	1192.628	4	0	8
4		min	0	1	494.993	1	0	1
5	N11	max	0	8	887.336	4	0	8
6		min	0	1	382.901	1	0	1
7	N12	max	0	8	887.336	4	0	8
8		min	0	1	382.901	1	0	1
9	Totals:	max	0	8	4159.929	4		
10		min	0	1	1755.788	1		

Envelope Wood Code Checks

	Memb...	Shape	Code Check	Loc[ft]	LC	She...	Loc...	LC	Fc' [ksi]	Ft' [k...	Fb' [...	Fv' [...	RB	CL	CP	Eqn
1	M1	2-2X4	.697	8.933	4	.215	2.7...	4	.99	.992	1.784	.207	2.16	.999	.554	3.9-3
2	M2	2X8	.772	8.222	4	.197	0	4	1.216	.793	1.422	.207	6.218	.996	.746	3.9-1
3	M3	2X4	.028	2.33	4	.000	0	8	1.066	.992	1.544	.207	6.595	.995	.597	3.6.3
4	M4	2-2X4	.699	8.933	4	.216	2.7...	4	.99	.992	1.779	.207	5.18	.996	.554	3.9-3
5	M5	2X4	.028	2.33	4	.000	0	8	1.066	.992	1.544	.207	6.595	.995	.597	3.6.3
6	M6	2X4	.755	8.933	4	.265	2.7...	4	.99	.992	1.781	.207	4.32	.998	.554	3.9-3
7	M7	2X8	.709	8.222	4	.185	0	4	1.216	.793	1.422	.207	6.218	.996	.746	3.9-1
8	M8	2X4	.025	2.33	4	.000	0	8	1.066	.992	1.544	.207	6.595	.995	.597	3.6.3
9	M9	2X4	.767	8.933	4	.265	2.7...	4	.99	.992	1.753	.207	10.3...	.982	.554	3.9-3
10	M10	2X4	.025	2.33	4	.000	0	8	1.066	.992	1.544	.207	6.595	.995	.597	3.6.3