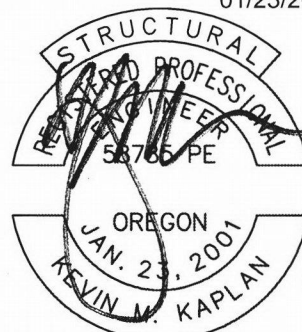
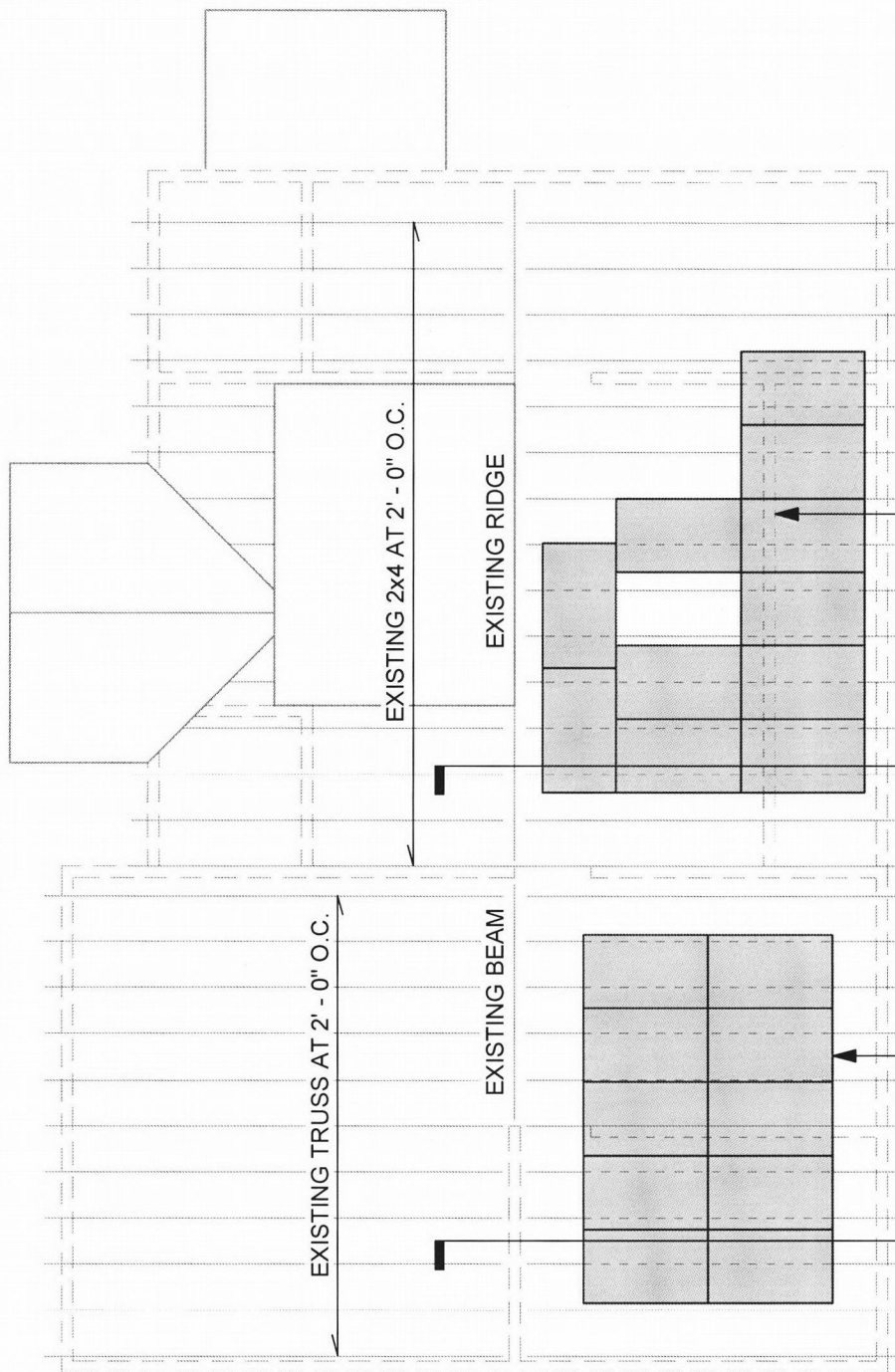
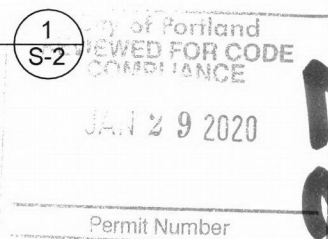
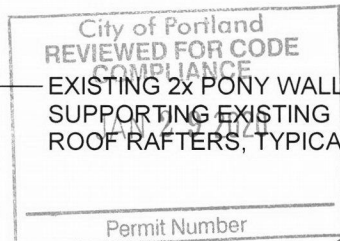


01/23/2020



EXPIRES: 6-30-2021

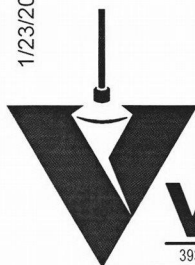


ROOF FRAMING PLAN

1/8" = 1'-0"

NOTE:
CONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS PRIOR TO CONSTRUCTION. IF CONDITIONS VARY FROM WHAT IS SHOWN OR NOTED ABOVE CONTACT THE ENGINEER.

1/23/2020 8:10:59 AM



VLMK ENGINEERING + DESIGN

3933 SW Kelly Avenue Portland, Oregon 97239 | tel: 503.222.4453 | fax: 503.248.9263 | www.vlmk.com

BENNETT SOLAR
7518 SE Lincoln Street
Portland, OR

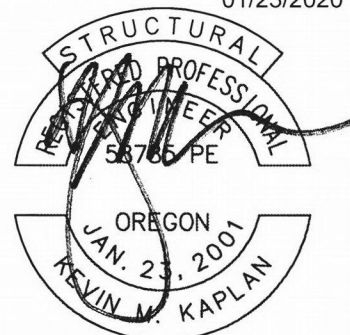
HOUSE ROOF PLAN

20190720 PROJ. NO.	01/20 DATE
SMS DRAWN	KMK CHECKED

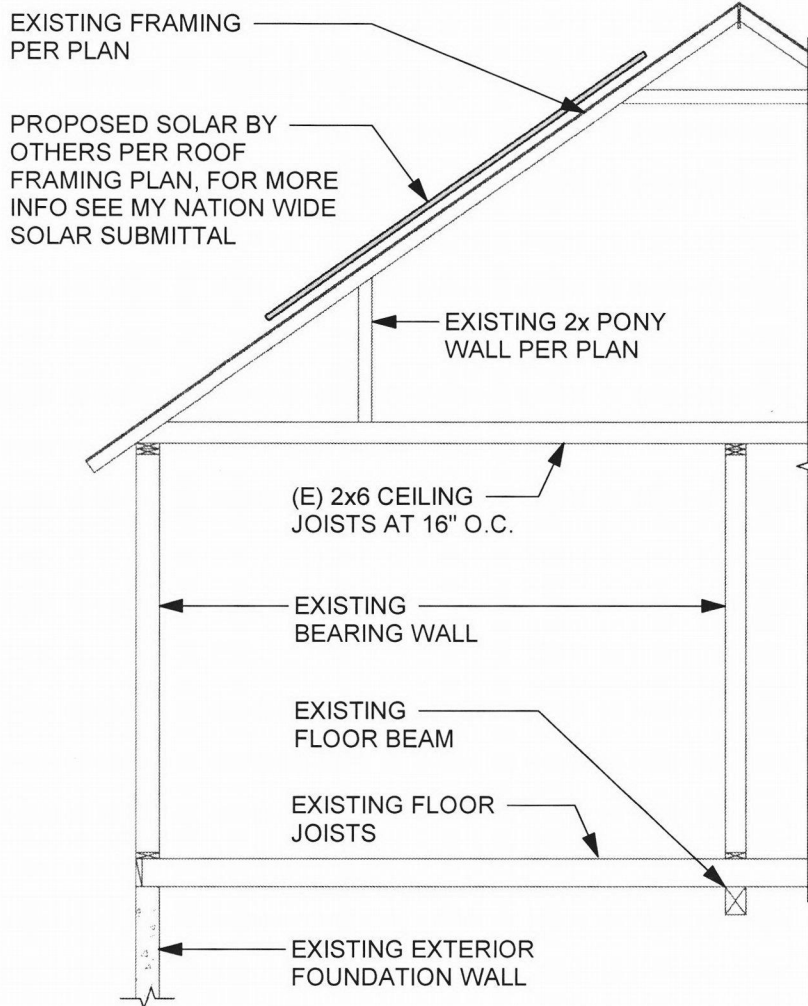
S-1

SCAN
19-264737-REV-01-25

01/23/2020



EXPIRES: 6-30-2021



City of Portland
REVIEWED FOR CODE
COMPLIANCE

JAN 29 2020

Permit Number

1
S-2 **HOUSE SECTION**
1/4" = 1'-0"

1/23/2020 8:10:59 AM



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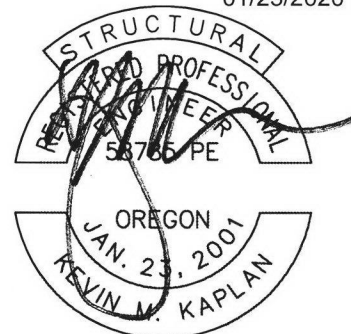
BENNETT SOLAR
7518 SE Lincoln Street
Portland, OR

HOUSE SECTION

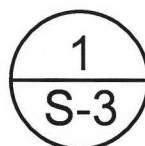
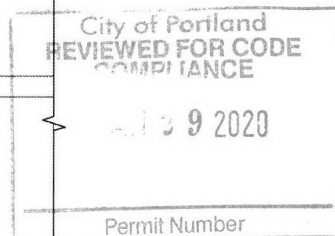
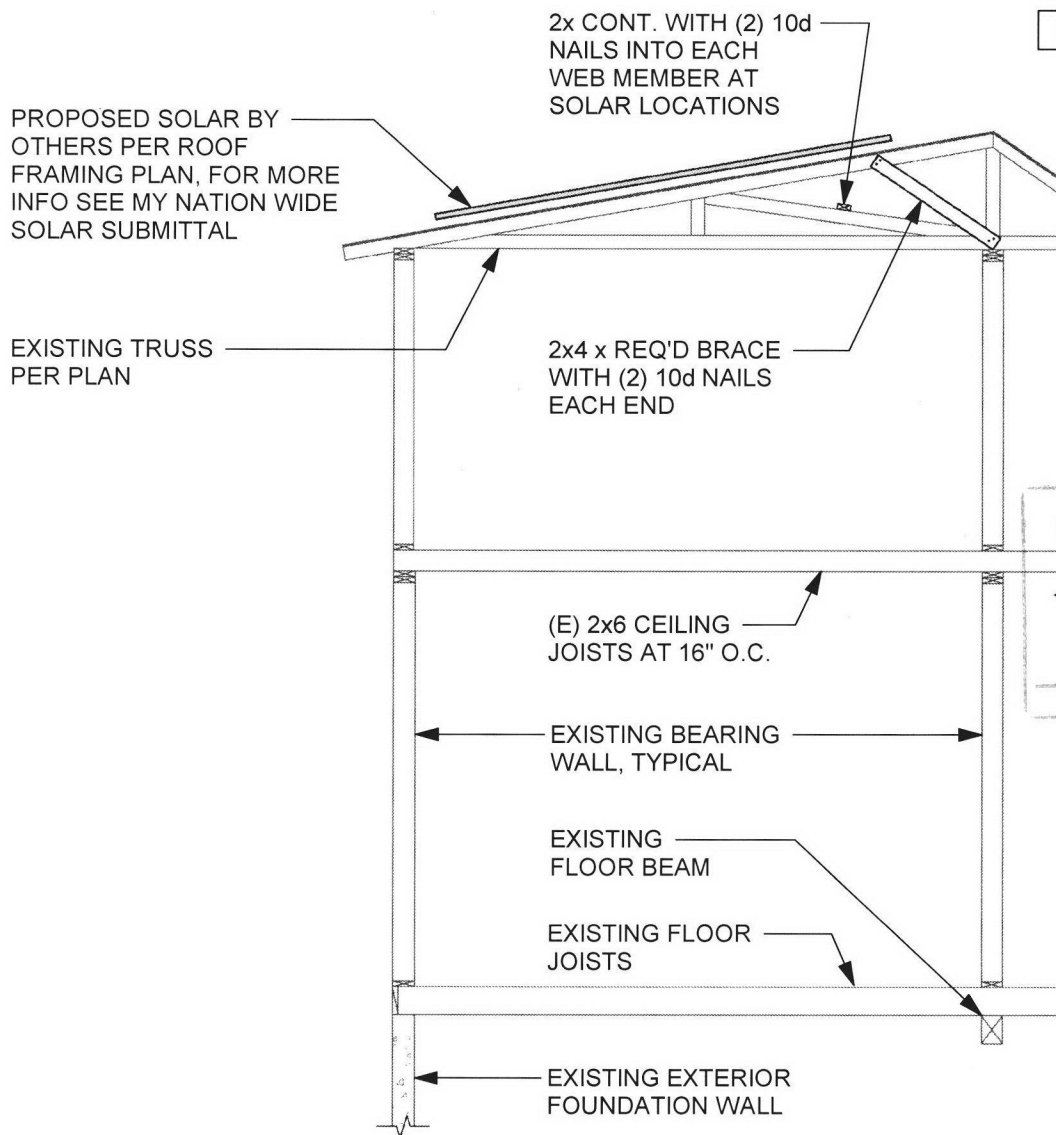
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SMS DRAWN	KMK CHECKED

S-2

01/23/2020



EXPIRES: 6-30-2021

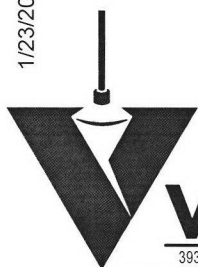


HOUSE SECTION

1/4" = 1'-0"

HOUSE SECTION_2

1/23/2020 8:10:59 AM



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BENNETT SOLAR
7518 SE Lincoln Street
Portland, OR

HOUSE SECTION

20190720	01/20
PROJ. NO.	DATE
SMS	KMK
DRAWN	CHECKED

S-3

EDWARD BENNETT SOLAR PANEL ADDITION

7518 SE Lincoln Street
Portland, OR 97215

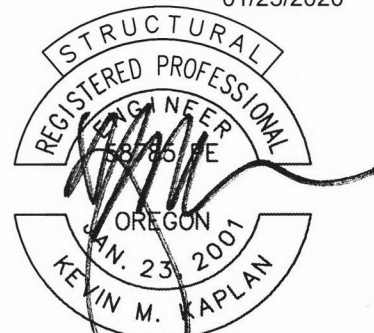
STRUCTURAL CALCULATIONS

VLMK Project Number: 20190720.02

Nationwide Solar
PO Box 821959
Vancouver, WA 98682



01/23/2020



EXPIRES: 6-30-2021

Prepared By: Bob Schneidmiller, EIT
January 23, 2020



19.264737-REV-01-RS

2

Project: Edward Bennett
Project Address: 7518 SE Lincoln Street
Portland, OR 97215

Project Number: 20190720.02
Document: Structural Calculations for
Building Permit

TABLE OF CONTENTS

Design Outline and Criteria	DC-1	thru	DC-3
Structural Details	S-1	thru	S-3
Structural Calculations	C-1	thru	C-22
References	R-1	thru	R-8

DESCRIPTION OF PROJECT

This 'Edward Bennett – Solar Panel Addition' consists of the structural evaluation for the addition of solar panels to the roof of an existing structure located at 7518 SE Lincoln Street, Portland, OR 97215. The following materials and components are being proposed for this project:

Roof Structure:	1.5"x3.75" rafters at 24" O.C.
Roofing Material:	Plywood sheathing with shingles
Solar Panels:	ALLMAX Plus
Solar Panel Rail System:	Ironridge Rail
Rail Connection System:	Ironridge Flashfoot 2
Mounting Connections:	5/16" stainless steel lag screws with 2 1/2" embedment into roof framing member

Additional information and notes:

- The existing roof construction utilizes 2x4 rafters that span between exterior walls and intermediate bearing walls/ridge rafter and collar ties. This calculation package verifies the adequacy of the existing roof system with modifications for the proposed solar loading.

*****LIMITATIONS*****

VLMK Engineering + Design was retained in a limited capacity for this project. The design is based upon information provided by the client, who is solely responsible for the accuracy of the information. No responsibility and/or liability is assumed by, nor is any to be assigned to, VLMK Engineering + Design for items beyond that shown in this Structural Calculation Package.

CODES

2019 Oregon Structural Specialty Code (Based on the 2018 International Building Code)

DESIGN LOADSLive Loads*Floor*

Habitable Attic	30	psf
-----------------	----	-----

Snow Loads

Minimum Flat Roof Snow Load (p_f) - Unobstructed	20	psf
--	----	-----

Dead Loads*Roof (Existing)*

Asphalt Shingles	2.0	psf
Plywood Sheathing	1.8	psf
Skip Sheeting	1.5	psf
2x4's at 24" o.c.	0.7	psf
Miscellaneous	0.5	psf
Total Roof Load	6.5	psf

Solar Panel System

Panels (ALLMAX Plus) = 41 lbs (65"x39.1")	2.3	psf
Racking and Miscellaneous Equipment	0.5	psf
Total Floor Load	2.8	psf

Floor

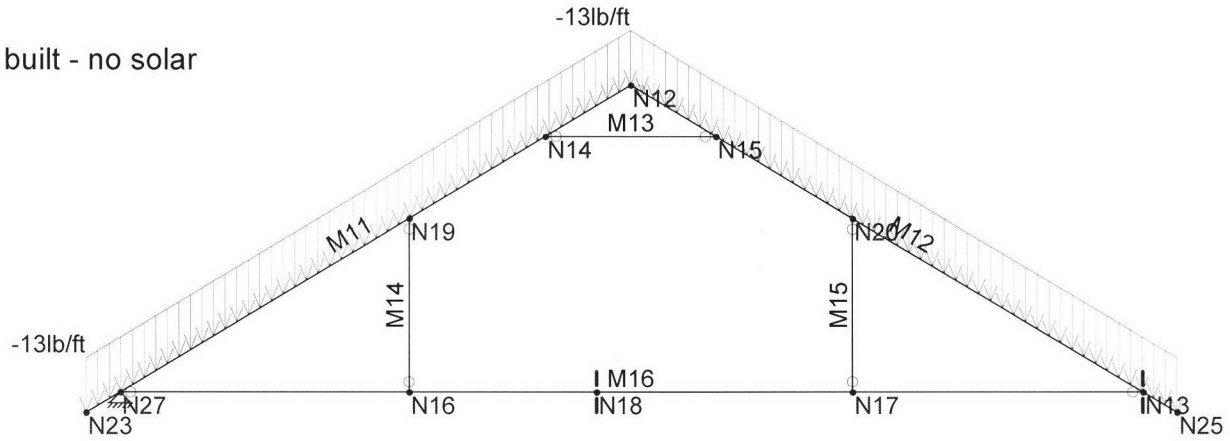
Habitable Attic	10	psf
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Wind

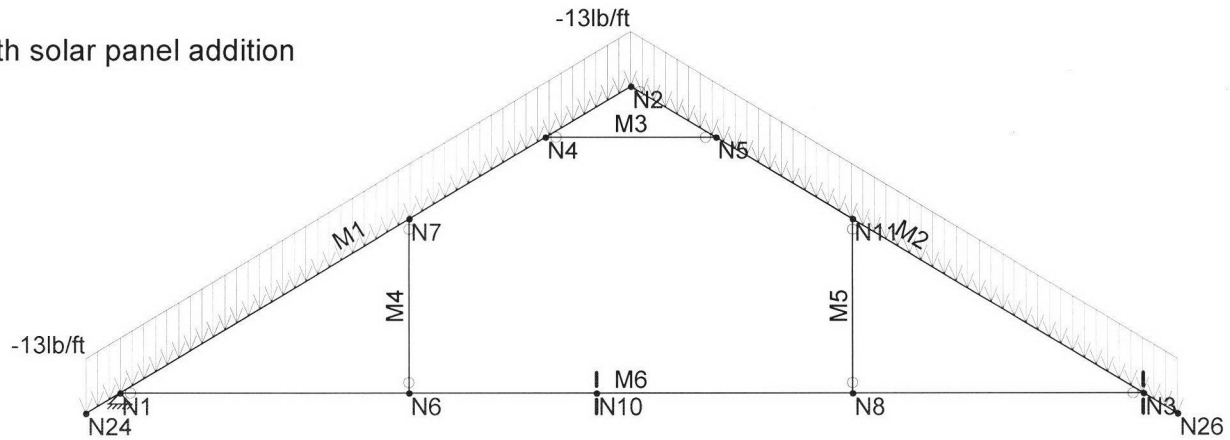
Basic Design Wind Speed, V (3-sec gust)	98 mph
Nominal Design Wind Speed, V_{asd}	76 mph
Risk Category	II
Wind Exposure	B
Internal Pressure Coefficient	$GC_{pi} = +/- 0.18$



As built - no solar



With solar panel addition



← South

Loads: BLC 1, Roof Dead

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

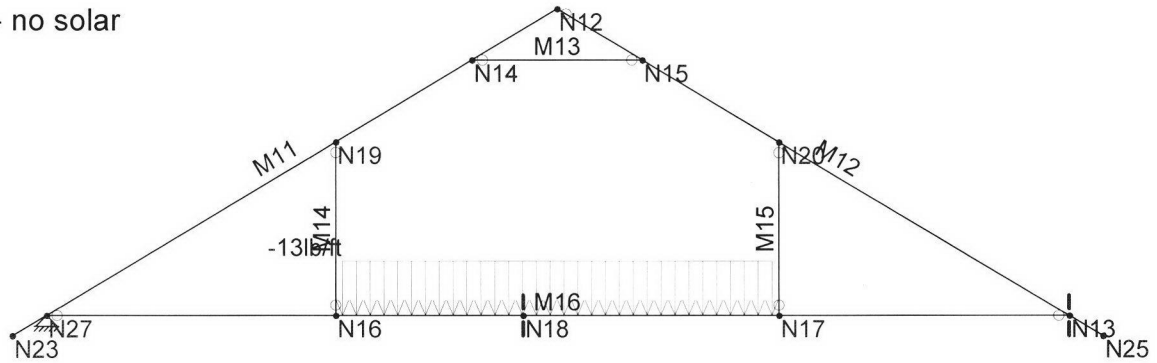
SK - 1

Jan 22, 2020 at 5:33 PM

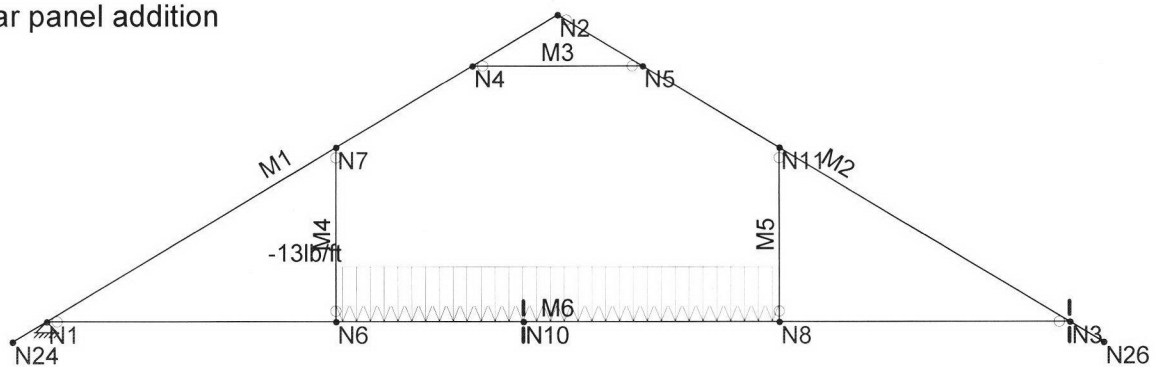
east truss.r3d



As built - no solar



With solar panel addition



← South

Loads: BLC 5, Inside Dead

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

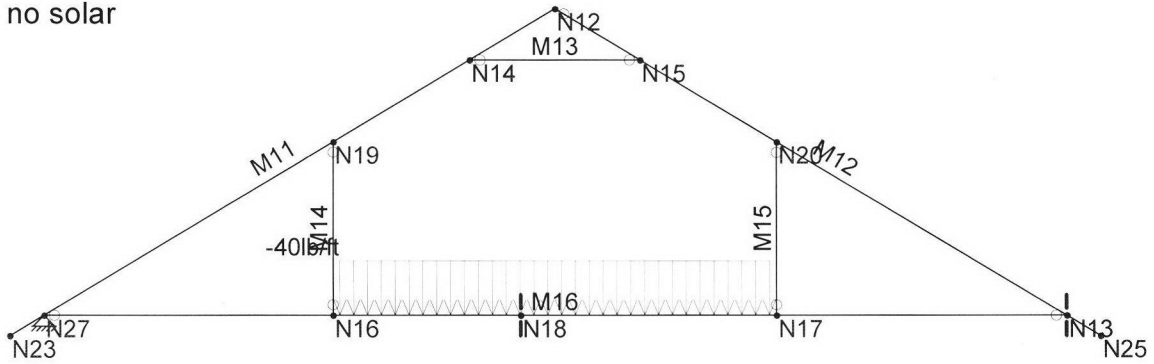
SK - 6

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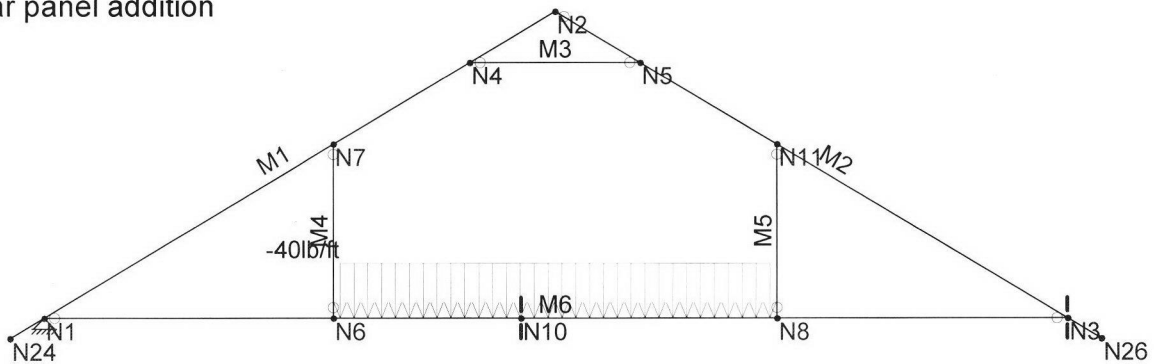
east truss.r3d



As built - no solar



With solar panel addition



← South

Loads: BLC 4, Inside Live

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

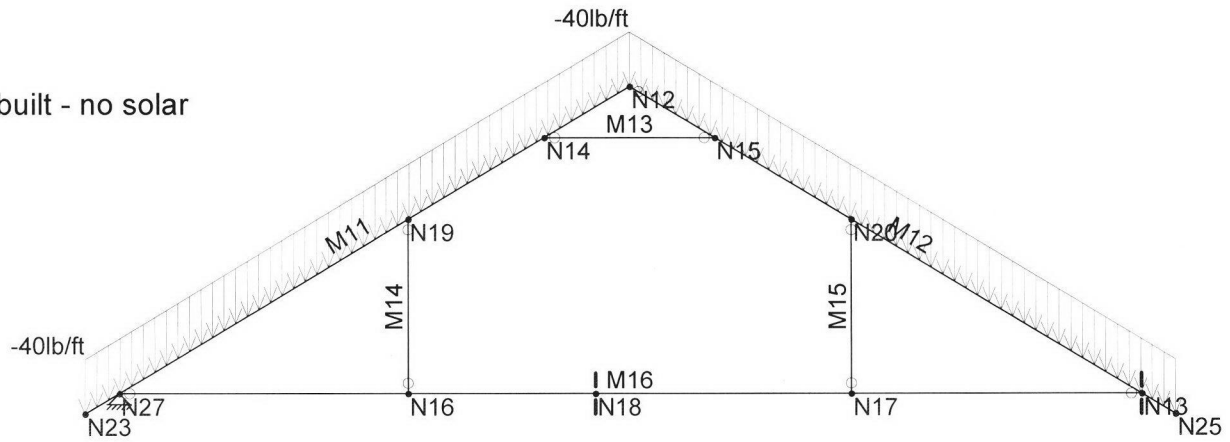
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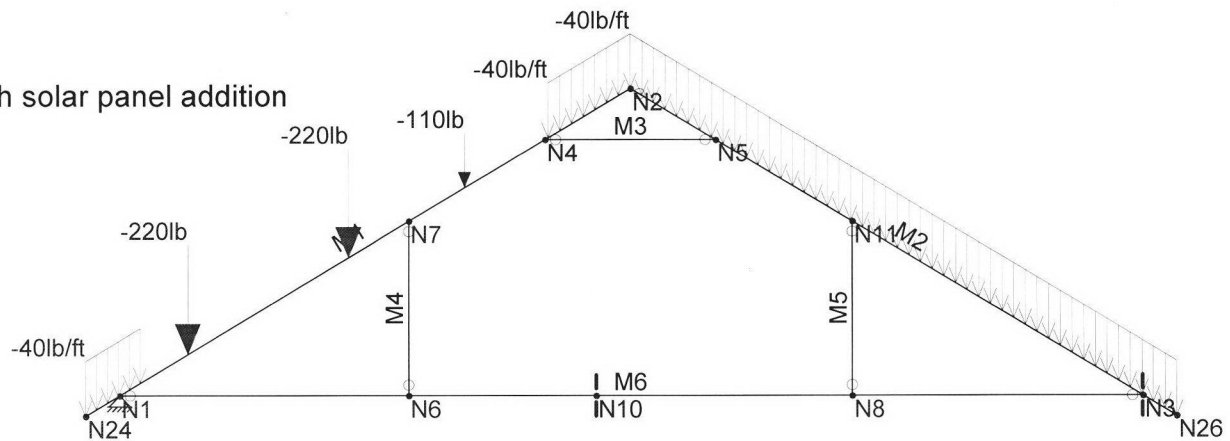
east truss.r3d



As built - no solar



With solar panel addition



← South

Loads: BLC 2, Snow

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

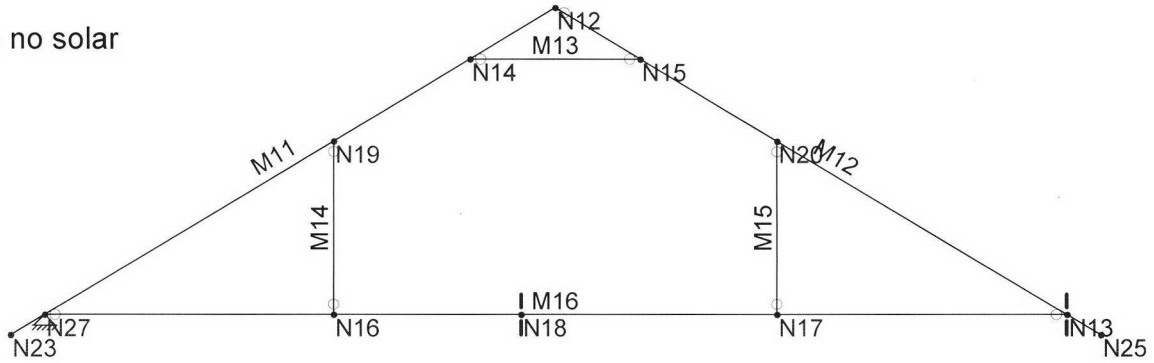
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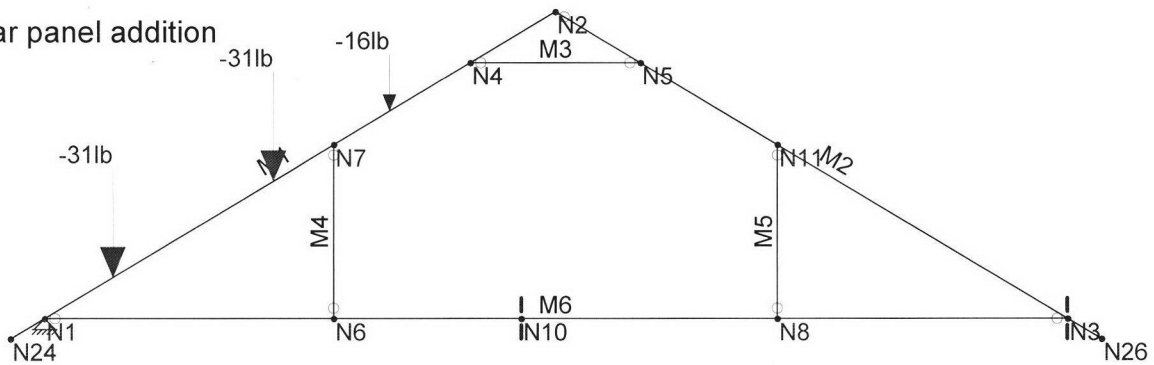
east truss.r3d



As built - no solar



With solar panel addition



← South

Loads: BLC 3, Solar

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

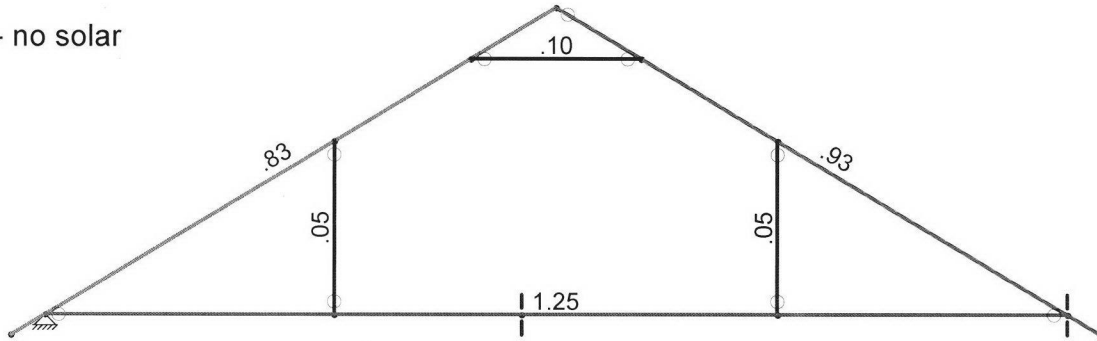
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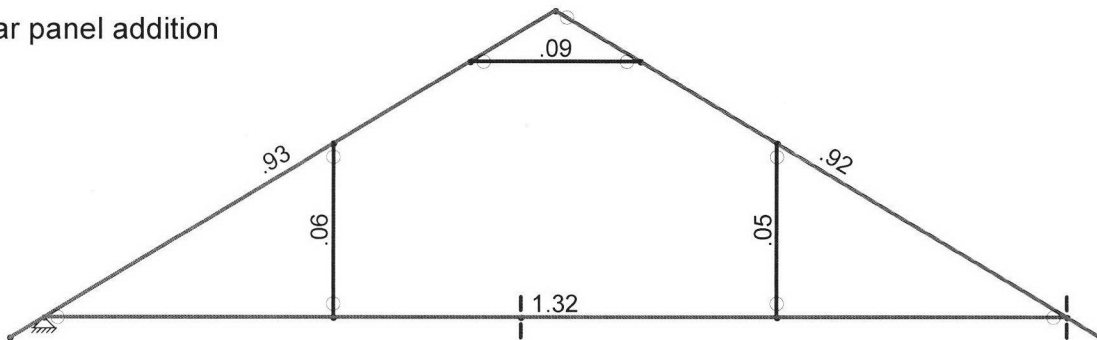
east truss.r3d



As built - no solar



With solar panel addition



$$1.317/1.254 = 1.050 = +5\% \text{ OK}$$

← South

Member Code Checks Displayed (Enveloped)
Envelope Only Solution

VLMK Engineering + Design

rjs

20190720.02

Bennett Solar

SK - 7

Jan 22, 2020 at 5:38 PM

east truss.r3d

Wood Material Properties

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

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	cross	2X4	Column	Rectangular	DF1	Typical	5.25	.984	5.359	2.877
2	bot chord	2X6	Beam	Rectangular	DF1	Typical	8.25	1.547	20.797	5.125
3	knee	2X4	Column	Rectangular	DF1	Typical	5.25	.984	5.359	2.877
4	top chord	1.5X3.75FS	Beam	Rectangular	DF1	Typical	5.625	1.055	6.592	3.158

Wood Design Parameters

	Label	Shape	Length...	le2[ft]	le1[ft]	le-bend top[ft]	le-bend bot[ft]	Kyy	Kzz	CV	Cr	y sway	z sway
1	M1	top chord	18.659	2	2	1	1				Yes		
2	M2	top chord	18.659	2	2	2	2				Yes		
3	M3	cross	5	2	2	2							
4	M4	knee	5.1	2	2	2							
5	M5	knee	5.1	2	2	2							
6	M6	bot chord	30	2	2	1	2				Yes		
7	M11	top chord	18.659	2	2	2	2				Yes		
8	M12	top chord	18.659	2	2	2	2				Yes		
9	M13	cross	5	2	2	2							
10	M14	knee	5.1	2	2	2							
11	M15	knee	5.1	2	2	2							
12	M16	bot chord	30	2	2	1	2				Yes		

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N1	1	1	0	0	
2	N2	16	10	0	0	
3	N3	31	1	0	0	
4	N4	13.5	8.5	0	0	
5	N5	18.5	8.5	0	0	
6	N6	9.5	1	0	0	
7	N7	9.5	6.1	0	0	
8	N8	22.5	1	0	0	
9	N10	15	1	0	0	
10	N11	22.5	6.1	0	0	
11	N12	16	30	0	0	
12	N13	31	21	0	0	
13	N14	13.5	28.5	0	0	
14	N15	18.5	28.5	0	0	
15	N16	9.5	21	0	0	
16	N17	22.5	21	0	0	
17	N18	15	21	0	0	
18	N19	9.5	26.1	0	0	
19	N20	22.5	26.1	0	0	

Joint Coordinates and Temperatures (Continued)

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
20	N23	0	20.4	0	0	
21	N24	0	.4	0	0	
22	N25	32	20.4	0	0	
23	N26	32	.4	0	0	
24	N27	1	21	0	0	

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribut...	Area(M...	Surface(Plate/Wall)
1	Roof Dead	DL		-1				4		
2	Snow	SL					3	5		
3	Solar	DL					3			
4	Inside Live	LL						2		
5	Inside Dead	DL						2		

Member Distributed Loads (BLC 1 : Roof Dead)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-13	-13	0	%100
2	M2	Y	-13	-13	0	%100
3	M11	Y	-13	-13	0	%100
4	M12	Y	-13	-13	0	%100

Member Distributed Loads (BLC 2 : Snow)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft,%]	End Location[ft,%]
1	M1	Y	-40	-40	0	%10
2	M2	Y	-40	-40	0	%100
3	M1	Y	-40	-40	%85	%100
4	M12	Y	-40	-40	0	%100
5	M11	Y	-40	-40	0	%100

Member Distributed Loads (BLC 4 : Inside Live)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft,%]	End Location[ft,%]
1	M6	Y	-40	-40	%29	%71
2	M16	Y	-40	-40	%29	%71

Member Distributed Loads (BLC 5 : Inside Dead)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft,%]	End Location[ft,%]
1	M6	Y	-13	-13	%29	%71
2	M16	Y	-13	-13	%29	%71

Member Point Loads (BLC 2 : Snow)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft,%]
1	M1	Y	-220	3.5
2	M1	Y	-220	9
3	M1	Y	-110	13



Company : VLMK Engineering + Design
 Designer : rjs
 Job Number : 20190720.02
 Model Name : Bennett Solar

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Member Point Loads (BLC 3 : Solar)

	Member Label	Direction	Magnitude[lb,k-ft]	Location[ft, %]
1	M1	Y	-31	9
2	M1	Y	-31	3.5
3	M1	Y	-16	13

Load Combinations

	Description	SolveP...	SRSS	BLC	Factor B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...
1	IBC 16-9	Yes		DL	1	LL	1							
2	IBC 16-10 (b)	Yes		DL	1	SL	1							
3	IBC 16-11 (b)	Yes		DL	1	LL	.75	SL	.75					

Envelope Member Section Forces

	Member	Sec		Axial[lb]	LC	y Shear[lb]	LC	z Shear[lb]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
1	M1	1	max	0	3	0	3	0	3	0	3	0	3	0	3
2			min	0	1	0	1	0	1	0	1	0	1	0	1
3		2	max	627.633	2	15.513	1	0	3	0	3	0	3	-.183	1
4				min	291.678	1	-7.354	2	0	1	0	1	0	1	-.529
5		3	max	464.014	2	-68.538	1	0	3	0	3	0	3	-.113	1
6				min	241.247	1	-280.054	2	0	1	0	1	0	1	-.289
7		4	max	571.816	2	-57.748	1	0	3	0	3	0	3	.252	2
8				min	247.721	1	-102.006	3	0	1	0	1	0	1	.115
9		5	max	-89.6	1	95.017	3	0	3	0	3	0	3	0	3
10				min	-111.751	3	62.767	1	0	1	0	1	0	1	0
11	M2	1	max	-97.547	1	-40.765	2	0	3	0	3	0	3	0	3
12			min	-136.427	3	-53.89	3	0	1	0	1	0	1	0	1
13		2	max	583.508	2	95.133	3	0	3	0	3	0	3	.104	2
14				min	239.774	1	70.994	1	0	1	0	1	0	1	.054
15		3	max	540.238	2	153.013	2	0	3	0	3	0	3	-.17	1
16				min	265.28	1	28.484	1	0	1	0	1	0	1	-.285
17		4	max	670.72	2	-28.985	1	0	3	0	3	0	3	-.168	1
18				min	299.761	1	-64.456	2	0	1	0	1	0	1	-.479
19		5	max	0	3	0	3	0	3	0	3	0	3	0	3
20				min	0	1	0	1	0	1	0	1	0	1	0
21	M3	1	max	664.466	2	3.19	3	0	3	0	3	0	3	0	3
22			min	351.255	1	3.19	1	0	1	0	1	0	1	0	1
23		2	max	664.466	2	1.595	3	0	3	0	3	0	3	-.003	3
24				min	351.255	1	1.595	1	0	1	0	1	0	1	-.003
25		3	max	664.466	2	0	3	0	3	0	3	0	3	-.004	3
26				min	351.255	1	0	1	0	1	0	1	0	1	-.004
27		4	max	664.466	2	-1.595	3	0	3	0	3	0	3	-.003	3
28				min	351.255	1	-1.595	1	0	1	0	1	0	1	-.003
29		5	max	664.466	2	-3.19	3	0	3	0	3	0	3	0	3
30				min	351.255	1	-3.19	1	0	1	0	1	0	1	0
31	M4	1	max	409.057	2	0	3	0	3	0	3	0	3	0	3
32			min	102.11	1	0	1	0	1	0	1	0	1	0	1
33		2	max	407.43	2	0	3	0	3	0	3	0	3	0	3
34				min	100.483	1	0	1	0	1	0	1	0	1	0
35		3	max	405.803	2	0	3	0	3	0	3	0	3	0	3
36				min	98.856	1	0	1	0	1	0	1	0	1	0
37		4	max	404.177	2	0	3	0	3	0	3	0	3	0	3



Company : VLMK Engineering + Design
 Designer : rjs
 Job Number : 20190720.02
 Model Name : Bennett Solar

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Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	y Shear[lb]	LC	z Shear[lb]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
38			min	97.229	1	0	1	0	1	0	1	0	1	0	1
39		5	max	402.55	2	0	3	0	3	0	3	0	3	0	3
40			min	95.602	1	0	1	0	1	0	1	0	1	0	1
41	M5	1	max	344.22	2	0	3	0	3	0	3	0	3	0	3
42			min	23.953	1	0	1	0	1	0	1	0	1	0	1
43		2	max	342.593	2	0	3	0	3	0	3	0	3	0	3
44			min	22.326	1	0	1	0	1	0	1	0	1	0	1
45		3	max	340.966	2	0	3	0	3	0	3	0	3	0	3
46			min	20.699	1	0	1	0	1	0	1	0	1	0	1
47		4	max	339.339	2	0	3	0	3	0	3	0	3	0	3
48			min	19.072	1	0	1	0	1	0	1	0	1	0	1
49		5	max	337.712	2	0	3	0	3	0	3	0	3	0	3
50			min	17.445	1	0	1	0	1	0	1	0	1	0	1
51	M6	1	max	-242.13	1	95.31	2	0	3	0	3	0	3	0	3
52			min	-541.975	2	43.007	1	0	1	0	1	0	1	0	1
53		2	max	-242.13	1	80.271	2	0	3	0	3	0	3	-.266	1
54			min	-541.975	2	27.968	1	0	1	0	1	0	1	-.658	2
55		3	max	-242.13	1	427.367	3	0	3	0	3	0	3	.949	2
56			min	-541.975	2	328.675	1	0	1	0	1	0	1	.544	1
57		4	max	-242.13	1	-44.217	1	0	3	0	3	0	3	-.388	1
58			min	-541.975	2	-103.094	2	0	1	0	1	0	1	-.83	2
59		5	max	-242.13	1	-59.256	1	0	3	0	3	0	3	0	3
60			min	-541.975	2	-118.133	2	0	1	0	1	0	1	0	1
61	M11	1	max	0	3	0	3	0	3	0	3	0	3	0	3
62			min	0	1	0	1	0	1	0	1	0	1	0	1
63		2	max	718.634	2	53.704	2	0	3	0	3	0	3	-.13	1
64			min	288.626	1	18.041	1	0	1	0	1	0	1	-.441	2
65		3	max	588.153	2	-39.428	1	0	3	0	3	0	3	-.08	1
66			min	254.145	1	-163.765	2	0	1	0	1	0	1	-.185	2
67		4	max	641.571	2	-54.503	1	0	3	0	3	0	3	.196	3
68			min	245.1	1	-81.958	3	0	1	0	1	0	1	.114	1
69		5	max	-82.779	1	81.051	3	0	3	0	3	0	3	0	3
70			min	-112.199	3	60.347	1	0	1	0	1	0	1	0	1
71	M12	1	max	-92.202	1	-44.642	1	0	3	0	3	0	3	0	3
72			min	-124.315	3	-60.858	3	0	1	0	1	0	1	0	1
73		2	max	632.103	2	102.151	3	0	3	0	3	0	3	.119	2
74			min	235.677	1	70.208	1	0	1	0	1	0	1	.041	1
75		3	max	595.394	2	151.697	2	0	3	0	3	0	3	-.178	1
76			min	261.351	1	27.418	1	0	1	0	1	0	1	-.295	3
77		4	max	725.875	2	-30.051	1	0	3	0	3	0	3	-.172	1
78			min	295.832	1	-65.772	2	0	1	0	1	0	1	-.484	2
79		5	max	0	3	0	3	0	3	0	3	0	3	0	3
80			min	0	1	0	1	0	1	0	1	0	1	0	1
81	M13	1	max	704.379	2	3.19	3	0	3	0	3	0	3	0	3
82			min	340.244	1	3.19	1	0	1	0	1	0	1	0	1
83		2	max	704.379	2	1.595	3	0	3	0	3	0	3	-.003	3
84			min	340.244	1	1.595	1	0	1	0	1	0	1	-.003	1
85		3	max	704.379	2	0	3	0	3	0	3	0	3	-.004	3
86			min	340.244	1	0	1	0	1	0	1	0	1	-.004	1
87		4	max	704.379	2	-1.595	3	0	3	0	3	0	3	-.003	3
88			min	340.244	1	-1.595	1	0	1	0	1	0	1	-.003	1
89		5	max	704.379	2	-3.19	3	0	3	0	3	0	3	0	3



Company : VLMK Engineering + Design
 Designer : rjs
 Job Number : 20190720.02
 Model Name : Bennett Solar

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Envelope Member Section Forces (Continued)

	Member	Sec		Axial[lb]	LC	y Shear[lb]	LC	z Shear[lb]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
90			min	340.244	1	-3.19	1	0	1	0	1	0	1	0	1
91	M14	1	max	363.945	2	0	3	0	3	0	3	0	3	0	3
92			min	55.947	1	0	1	0	1	0	1	0	1	0	1
93		2	max	362.318	2	0	3	0	3	0	3	0	3	0	3
94			min	54.321	1	0	1	0	1	0	1	0	1	0	1
95		3	max	360.691	2	0	3	0	3	0	3	0	3	0	3
96			min	52.694	1	0	1	0	1	0	1	0	1	0	1
97		4	max	359.064	2	0	3	0	3	0	3	0	3	0	3
98			min	51.067	1	0	1	0	1	0	1	0	1	0	1
99		5	max	357.437	2	0	3	0	3	0	3	0	3	0	3
100			min	49.44	1	0	1	0	1	0	1	0	1	0	1
101	M15	1	max	331.468	2	0	3	0	3	0	3	0	3	0	3
102			min	23.626	1	0	1	0	1	0	1	0	1	0	1
103		2	max	329.841	2	0	3	0	3	0	3	0	3	0	3
104			min	21.999	1	0	1	0	1	0	1	0	1	0	1
105		3	max	328.214	2	0	3	0	3	0	3	0	3	0	3
106			min	20.372	1	0	1	0	1	0	1	0	1	0	1
107		4	max	326.587	2	0	3	0	3	0	3	0	3	0	3
108			min	18.745	1	0	1	0	1	0	1	0	1	0	1
109		5	max	324.96	2	0	3	0	3	0	3	0	3	0	3
110			min	17.118	1	0	1	0	1	0	1	0	1	0	1
111	M16	1	max	-238.213	1	83.101	2	0	3	0	3	0	3	0	3
112			min	-588.593	2	29.036	1	0	1	0	1	0	1	0	1
113		2	max	-238.213	1	68.062	2	0	3	0	3	0	3	-.161	1
114			min	-588.593	2	13.997	1	0	1	0	1	0	1	-.567	2
115		3	max	-238.213	1	417.714	3	0	3	0	3	0	3	.883	2
116			min	-588.593	2	324.858	1	0	1	0	1	0	1	.49	1
117		4	max	-238.213	1	-47.707	1	0	3	0	3	0	3	-.414	1
118			min	-588.593	2	-101.941	2	0	1	0	1	0	1	-.821	2
119		5	max	-238.213	1	-62.747	1	0	3	0	3	0	3	0	3
120			min	-588.593	2	-116.98	2	0	1	0	1	0	1	0	1

Envelope Member End Reactions

Member	Me...		Axial[lb]	LC	y Shear[lb]	LC	z Shear[lb]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
1	M1	I	max	0	3	0	3	0	3	0	3	0	3	3
2		min	0	1	0	1	0	1	0	1	0	1	0	1
3		J	max	-89.6	1	95.017	3	0	3	0	3	0	3	3
4		min	-111.751	3	62.767	1	0	1	0	1	0	1	0	1
5	M2	I	max	-97.547	1	-40.765	2	0	3	0	3	0	3	3
6		min	-136.427	3	-53.89	3	0	1	0	1	0	1	0	1
7		J	max	0	3	0	3	0	3	0	3	0	3	3
8		min	0	1	0	1	0	1	0	1	0	1	0	1
9	M3	I	max	664.466	2	3.19	3	0	3	0	3	0	3	3
10		min	351.255	1	3.19	1	0	1	0	1	0	1	0	1
11		J	max	664.466	2	-3.19	3	0	3	0	3	0	3	3
12		min	351.255	1	-3.19	1	0	1	0	1	0	1	0	1
13	M4	I	max	409.057	2	0	3	0	3	0	3	0	3	3
14		min	102.11	1	0	1	0	1	0	1	0	1	0	1
15		J	max	402.55	2	0	3	0	3	0	3	0	3	3
16		min	95.602	1	0	1	0	1	0	1	0	1	0	1



Company : VLMK Engineering + Design
 Designer : rjs
 Job Number : 20190720.02
 Model Name : Bennett Solar

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Envelope Member End Reactions (Continued)

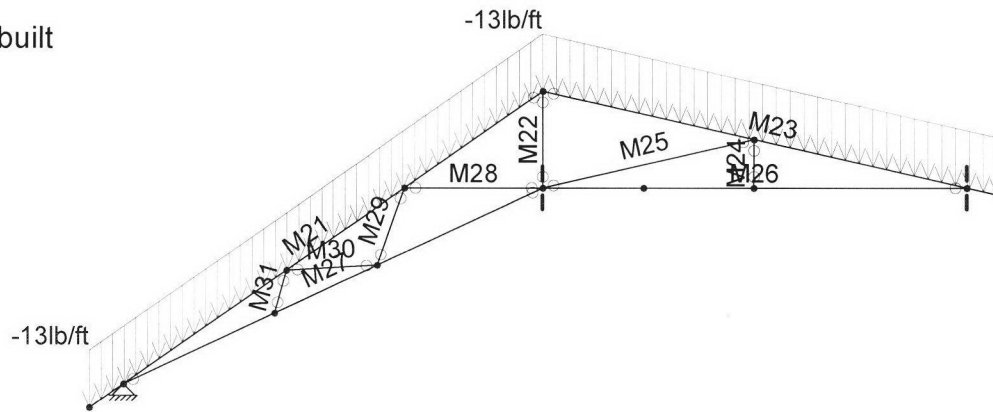
	Member	Me...		Axial[lb]	LC	y Shear[lb]	LC	z Shear[lb]	LC	Torque[k...	LC	y-y Mome...	LC	z-z Mome...	LC
17	M5	I	max	344.22	2	0	3	0	3	0	3	0	3	0	3
18			min	23.953	1	0	1	0	1	0	1	0	1	0	1
19		J	max	337.712	2	0	3	0	3	0	3	0	3	0	3
20			min	17.445	1	0	1	0	1	0	1	0	1	0	1
21	M6	I	max	-242.13	1	95.31	2	0	3	0	3	0	3	0	3
22			min	-541.975	2	43.007	1	0	1	0	1	0	1	0	1
23		J	max	-242.13	1	-59.256	1	0	3	0	3	0	3	0	3
24			min	-541.975	2	-118.133	2	0	1	0	1	0	1	0	1
25	M11	I	max	0	3	0	3	0	3	0	3	0	3	0	3
26			min	0	1	0	1	0	1	0	1	0	1	0	1
27		J	max	-82.779	1	81.051	3	0	3	0	3	0	3	0	3
28			min	-112.199	3	60.347	1	0	1	0	1	0	1	0	1
29	M12	I	max	-92.202	1	-44.642	1	0	3	0	3	0	3	0	3
30			min	-124.315	3	-60.858	3	0	1	0	1	0	1	0	1
31		J	max	0	3	0	3	0	3	0	3	0	3	0	3
32			min	0	1	0	1	0	1	0	1	0	1	0	1
33	M13	I	max	704.379	2	3.19	3	0	3	0	3	0	3	0	3
34			min	340.244	1	3.19	1	0	1	0	1	0	1	0	1
35		J	max	704.379	2	-3.19	3	0	3	0	3	0	3	0	3
36			min	340.244	1	-3.19	1	0	1	0	1	0	1	0	1
37	M14	I	max	363.945	2	0	3	0	3	0	3	0	3	0	3
38			min	55.947	1	0	1	0	1	0	1	0	1	0	1
39		J	max	357.437	2	0	3	0	3	0	3	0	3	0	3
40			min	49.44	1	0	1	0	1	0	1	0	1	0	1
41	M15	I	max	331.468	2	0	3	0	3	0	3	0	3	0	3
42			min	23.626	1	0	1	0	1	0	1	0	1	0	1
43		J	max	324.96	2	0	3	0	3	0	3	0	3	0	3
44			min	17.118	1	0	1	0	1	0	1	0	1	0	1
45	M16	I	max	-238.213	1	83.101	2	0	3	0	3	0	3	0	3
46			min	-588.593	2	29.036	1	0	1	0	1	0	1	0	1
47		J	max	-238.213	1	-62.747	1	0	3	0	3	0	3	0	3
48			min	-588.593	2	-116.98	2	0	1	0	1	0	1	0	1

Envelope Wood Code Checks

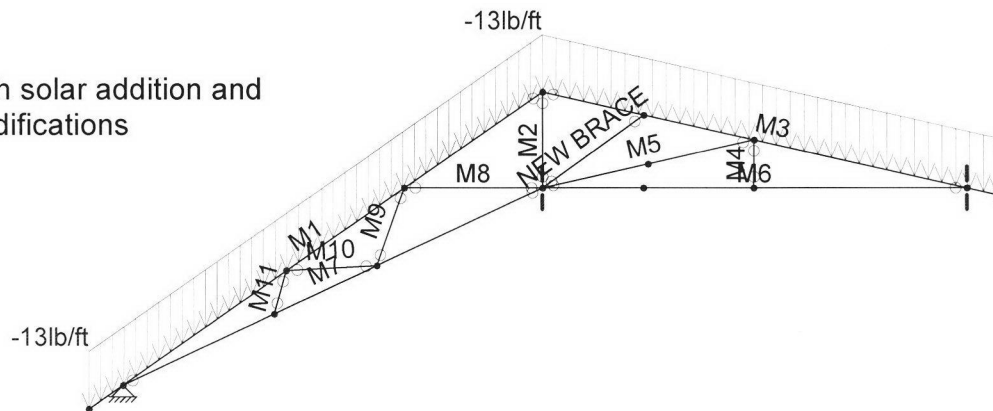
	Memb...	Shape	Code Check	Loc[ft]	LC	Shea...	Loc[ft]	Dir	LC	Fc' [... Ft' [k...	Fb1' ..Fb2' ..Fv' [...	RB	CL	CP	Eqn			
1	M1	1.5X3.75FS	.931	4.082	2	.389	11.079	y	2	1.374	1.161	1.978	2.182	.207	4.472	.997	.693	3.9-3
2	M2	1.5X3.75FS	.921	12.634	2	.302	7.58	y	2	1.374	1.158	1.972	2.182	.207	6.325	.994	.693	3.9-3
3	M3	2X4	.092	0	2	.005	5	y	1	1.374	1.149	1.702	1.897	.18	9.661	.987	.693	3.6.3
4	M4	2X4	.057	0	2	.000	0	z	3	1.374	1.148	1.701	1.897	.207	9.757	.986	.693	3.6.3
5	M5	2X4	.048	0	2	.000	0	z	3	1.374	1.148	1.701	1.897	.207	9.757	.986	.693	3.6.3
6	M6	2X6	1.317	14.063	3	.421	13.75	y	3	1.343	1.001	1.706	1.977	.207	7.659	.992	.708	3.9-1
7	M11	1.5X3.75FS	.834	5.831	2	.316	11.079	y	2	1.374	1.158	1.972	2.182	.207	6.325	.994	.693	3.9-3
8	M12	1.5X3.75FS	.934	12.634	2	.300	7.58	y	2	1.374	1.158	1.972	2.182	.207	6.325	.994	.693	3.9-3
9	M13	2X4	.098	0	2	.005	5	y	1	1.374	1.149	1.702	1.897	.18	9.661	.987	.693	3.6.3
10	M14	2X4	.050	0	2	.000	0	z	3	1.374	1.148	1.701	1.897	.207	9.757	.986	.693	3.6.3
11	M15	2X4	.046	0	2	.000	0	z	3	1.374	1.148	1.701	1.897	.207	9.757	.986	.693	3.6.3
12	M16	2X6	1.254	14.063	3	.404	14.063	y	3	1.343	1.001	1.706	1.977	.207	7.659	.992	.708	3.9-1



As-built



With solar addition and modifications



South →

Loads: BLC 1, dead

VLMK

RJS

20190720.02

Edward Bennett

SK - 1

Jan 23, 2020 at 9:05 AM

west truss.r3d

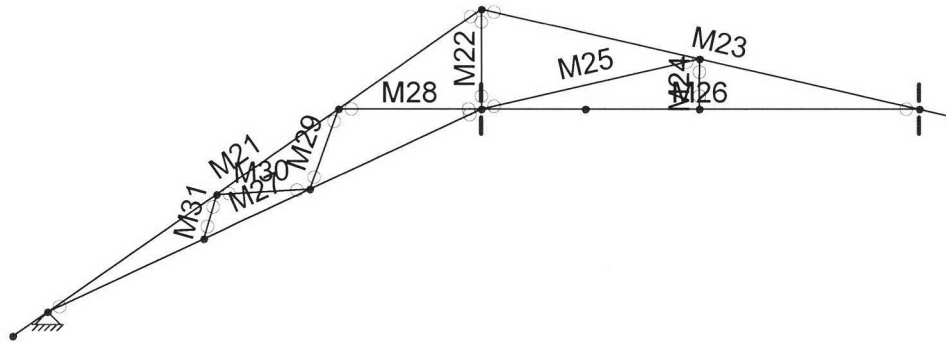
Diagram illustrating the addition of a new brace to a truss structure. The structure is subjected to a horizontal load of 40 lb/ft and vertical loads of 220 lb. The diagram shows the internal forces (M1, M2, M3, M4, M5, M6, M8, M9, M10) and the location of the new brace.

Loads: BLC 3, snow

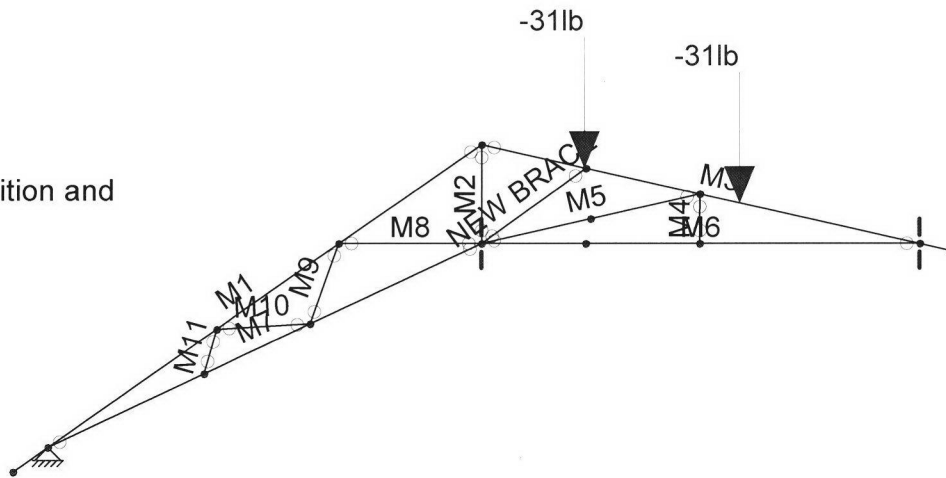
VLMK	Edward Bennett	SK - 2
RJS		Jan 23, 2020 at 9:07 AM
20190720.02		west truss.r3d



As-built



With solar addition and modifications



South →

Loads: BLC 4, solar

VLMK

RJS

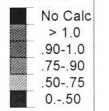
20190720.02

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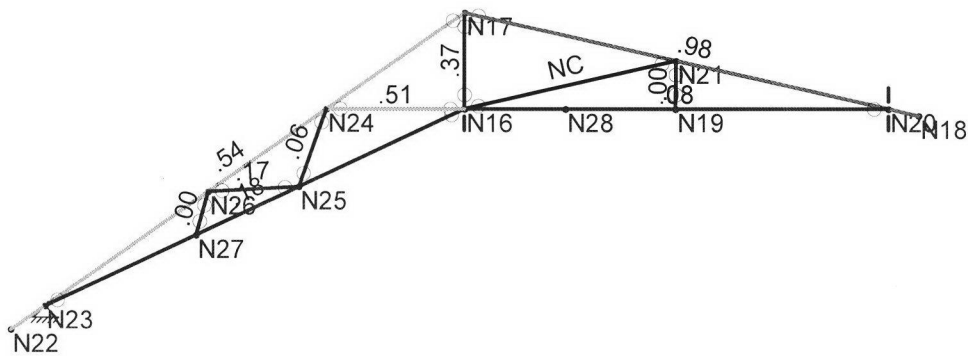
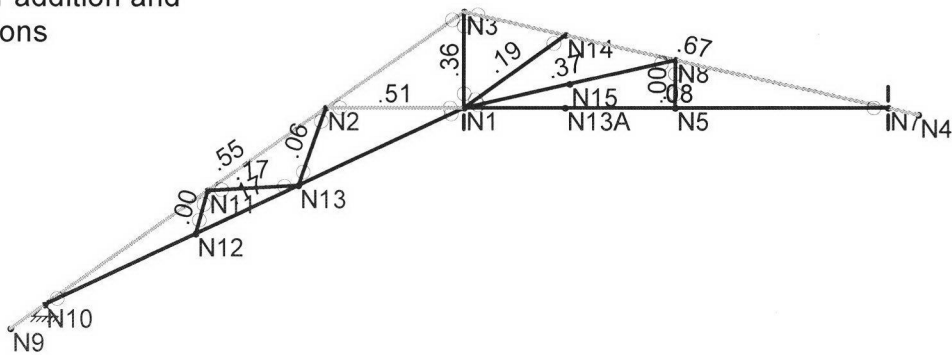
SK - 7

Jan 23, 2020 at 1:12 PM

west truss.r3d



As-built

With solar addition and
modifications

South →

Member Code Checks Displayed
Results for LC 1, IBC 16-10 (b)

VLMK

RJS

20190720.02

Edward Bennett

SK - 4

Jan 23, 2020 at 9:08 AM

west truss.r3d

Wood Material Properties

	Label	Type	Database	Species	Grade	Cm	Emod	Nu	Therm (...Dens[k...
1	DF	Solid Sawn	Visually Graded	Douglas Fir-Larch	No. 1		1	.3	.3

Wood Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	top chord	1.5X3.75FS	Beam	None	DF	Typical	5.625	1.055	6.592	3.158
2	bot chord	2X4	Beam	None	DF	Typical	5.25	.984	5.359	2.877
3	web	2X4	Column	None	DF	Typical	5.25	.984	5.359	2.877

Joint Boundary Conditions

	Joint Label	X [lb/in]	Y [lb/in]	Z [lb/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]
1	N1		Reaction	Reaction			
2	N10	Reaction	Reaction	Reaction			
3	N7		Reaction	Reaction			
4	N11			Reaction			
5	N12			Reaction			
6	N13			Reaction			
7	N2			Reaction			
8	N3			Reaction			
9	N8			Reaction			
10	N5			Reaction			
11	N4			Reaction			
12	N9			Reaction			
13	N13A			Reaction			
14	N14			Reaction			
15	N15			Reaction			
16	N16		Reaction	Reaction			
17	N17			Reaction			
18	N18			Reaction			
19	N19			Reaction			
20	N20		Reaction	Reaction			
21	N21			Reaction			
22	N22			Reaction			
23	N23	Reaction	Reaction	Reaction			
24	N24			Reaction			
25	N25			Reaction			
26	N26			Reaction			
27	N27			Reaction			
28	N28			Reaction			

Wood Design Parameters

	Label	Shape	Length...	le2[ft]	le1[ft]	le-bend top[ft]	le-bend bot[ft]	Kyy	Kzz	CV	Cr	y sway	z sway
1	M1	top chord	20.112	2	2								
2	M2	web	3.5										
3	M3	top chord	16.921	2	2	2	2						
4	M4	web	1.755										
5	M5	web	7.876	Segment	Segment								

Wood Design Parameters (Continued)

	Label	Shape	Length...	le2[ft]	le1[ft]	le-bend top[ft]	le-bend bot[ft]	Kyy	Kzz	CV	Cr	y sway	z sway
6	M6	bot chord	15.4										
7	M7	bot chord	16.856	2	2								
8	M8	web	5.022										
9	M9	web	2.991										
10	M10	web	3.314										
11	M11	web	1.625										
12	NEW BR...	web	4.544										
13	M21	top chord	20.112	2	2								
14	M22	web	3.5										
15	M23	top chord	16.921	2	2	2	2						
16	M24	web	1.755										
17	M25	web	7.876										
18	M26	bot chord	15.4										
19	M27	bot chord	16.856	2	2								
20	M28	web	5.022										
21	M29	web	2.991										
22	M30	web	3.314										
23	M31	web	1.625										

Member Point Loads (BLC 3 : snow)

	Member Label	Direction	Magnitude[lb,lb-in]	Location[ft, %]
1	M3	Y	-220	%22
2	M3	Y	-220	%55

Member Point Loads (BLC 4 : solar)

	Member Label	Direction	Magnitude[lb,lb-in]	Location[ft, %]
1	M3	Y	-31	%55
2	M3	Y	-31	%22

Member Distributed Loads (BLC 1 : dead)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft, %]	End Location[ft, %]
1	M1	Y	-13	-13	0	0
2	M3	Y	-13	-13	0	0
3	M21	Y	-13	-13	0	0
4	M23	Y	-13	-13	0	0

Member Distributed Loads (BLC 3 : snow)

	Member Label	Direction	Start Magnitude[lb/ft,F,ksf]	End Magnitude[lb/ft,F,ksf]	Start Location[ft, %]	End Location[ft, %]
1	M1	Y	-40	-40	0	0
2	M3	Y	-40	-40	0	%15
3	M3	Y	-40	-40	%79	%100
4	M21	Y	-40	-40	0	0
5	M23	Y	-40	-40	0	0

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribut...	Area(M...	Surface(Plate/Wall)
1	dead	DL		-1				4		
3	snow	SL					2	5		
4	solar	DL					2			

Load Combinations

	Description	SolveP...	SRSS	BLC	Factor B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac..B...	Fac...
1	IBC 16-10 (b)	Yes		DL	1	SL	1							

Joint Reactions

	LC	Joint Label	X [lb]	Y [lb]	Z [lb]	MX [lb-in]	MY [lb-in]	MZ [lb-in]
1	1	N1	0	1486.87	0	0	0	0
2	1	N10	0	392.633	0	0	0	0
3	1	N7	0	282.945	0	0	0	0
4	1	N11	0	0	0	0	0	0
5	1	N12	0	0	0	0	0	0
6	1	N13	0	0	0	0	0	0
7	1	N2	0	0	0	0	0	0
8	1	N3	0	0	0	0	0	0
9	1	N8	0	0	0	0	0	0
10	1	N5	0	0	0	0	0	0
11	1	N4	0	0	0	0	0	0
12	1	N9	0	0	0	0	0	0
13	1	N13A	0	0	0	0	0	0
14	1	N14	0	0	0	0	0	0
15	1	N15	0	0	0	0	0	0
16	1	N16	0	1391.783	0	0	0	0
17	1	N17	0	0	0	0	0	0
18	1	N18	0	0	0	0	0	0
19	1	N19	0	0	0	0	0	0
20	1	N20	0	298.335	0	0	0	0
21	1	N21	0	0	0	0	0	0
22	1	N22	0	0	0	0	0	0
23	1	N23	0	397.702	0	0	0	0
24	1	N24	0	0	0	0	0	0
25	1	N25	0	0	0	0	0	0
26	1	N26	0	0	0	0	0	0
27	1	N27	0	0	0	0	0	0
28	1	N28	0	0	0	0	0	0
29	1	Totals:	0	4250.267	0			
30	1	COG (ft):	X: 19.267	Y: 19.398	Z: 0			

Member Wood Code Checks (By Combination)

	LC	Member	Shape	UC Max	Loc[ft]	Shear ...	Loc[ft]	Dir	Fc' [psi]	Ft' [psi]	Fb1' [p...	Fb2' [p...	Fv' [psi]	RB	CL	CP	Eqn
1	1	M1	1.5X3...	.548	17.598	.253	8.59	y	1274.0...	898.086	1330.4...	1650	180	20.056	.887	.739	3.9-1
2	1	M2	2X4	.356	0	.000	0	z	589.831	1004.9...	1488.8...	1650	180	8.083	.993	.342	3.6.3
3	1	M3	1.5X3...	.672	7.755	.441	7.932	y	1274.0...	1008.1...	1493.4...	1650	180	6.325	.996	.739	3.9-1



Company : VLMK
 Designer : RJS
 Job Number : 20190720.02
 Model Name : Edward Bennett

Jan 23, 2020
 1:14 PM
 Checked By: SMS

Member Wood Code Checks (By Combination) (Continued)

	LC	Member	Shape	UC Max	Loc[ft]	Shear ...	Loc[ft]	Dir	Fc' [psi]	Ft' [psi]	Fb1' [p...	Fb2' [p...	Fv' [psi]	RB	CL	CP	Eqn
4	1	M4	2X4	.002	1.755	.000	0	y	1397.42	1008.9	1494.7...	1650	180	5.724	.996	.81	3.9-1
5	1	M5	2X4	.372	7.876	.008	7.876	y	477.732	992.236	1469.9...	1650	180	12.125	.98	.277	3.6.3
6	1	M6	2X4	.080	11.39	.008	15.4	y	33.5	955.11	1414.9...	1650	180	16.955	.943	.019	3.9-1
7	1	M7	2X4	.173	11.062	.013	6.672	y	1274.0	944.354	1399.0...	1650	180	17.738	.933	.739	3.9-1
8	1	M8	2X4	.511	0	.005	0	y	303.349	1001.0	1482.9...	1650	180	9.682	.989	.176	3.6.3
9	1	M9	2X4	.062	1.277	.001	0	y	768.354	1006.1	1490.6...	1650	180	7.472	.994	.445	3.9-1
10	1	M10	2X4	.167	3.314	.003	3.314	y	648.225	1005.4	1489.4...	1650	180	7.865	.993	.376	3.6.3
11	1	M11	2X4	.001	1.625	.000	0	y	1454.86	1009.2	1495.1...	1650	180	5.507	.997	.843	3.6.3
12	1	NEW ...	2X4	.191	0	.004	4.544	y	366.469	1002.3	1484.8...	1650	180	9.21	.99	.212	3.6.3
13	1	M21	1.5X3...	.543	17.598	.253	8.59	y	1274.0	898.086	1330.4...	1650	180	20.056	.887	.739	3.9-1
14	1	M22	2X4	.371	0	.000	0	z	589.831	1004.9	1488.8...	1650	180	8.083	.993	.342	3.6.3
15	1	M23	1.5X3...	.975	7.755	.373	7.755	y	1274.0	1008.1	1493.4...	1650	180	6.325	.996	.739	3.9-1
16	1	M24	2X4	.002	1.755	.000	0	y	1397.42	1008.9	1494.7...	1650	180	5.724	.996	.81	3.9-1
17	1	M25	2X4	- le/d is gre...													
18	1	M26	2X4	.084	11.229	.009	15.4	y	33.5	955.11	1414.9...	1650	180	16.955	.943	.019	3.9-1
19	1	M27	2X4	.180	10.886	.014	6.672	y	1274.0	944.354	1399.0...	1650	180	17.738	.933	.739	3.9-1
20	1	M28	2X4	.511	0	.005	0	y	303.349	1001.0	1482.9...	1650	180	9.682	.989	.176	3.6.3
21	1	M29	2X4	.062	1.277	.001	0	y	768.354	1006.1	1490.6...	1650	180	7.472	.994	.445	3.9-1
22	1	M30	2X4	.167	3.314	.003	3.314	y	648.225	1005.4	1489.4...	1650	180	7.865	.993	.376	3.6.3
23	1	M31	2X4	.001	1.625	.000	0	y	1454.86	1009.2	1495.1...	1650	180	5.507	.997	.843	3.6.3



Project: Edward Bennett Job #: 20190710.02 By: RJS
Solar Add'n

Date: Jan 2020 Sheet #:

Wind Analysis (ASCE 7-16, 29.4.4)

$$q_h = 0.00256 K_z K_{zt} K_d K_e V^2 \quad (\text{eqn 26.10-1})$$

Exp B $h = 25 \text{ ft}$

$$= 0.00256 (0.66) (1.0) (0.35) (1.0) (70 \text{ mph})^2$$

$$= 3.3 \text{ psf} \quad \leftarrow \text{ASD}$$

$$P = q_h G C_p Y_E Y_a \quad (\text{eqn 29.4-7})$$

Eff Wind Area $\approx 20 \text{ ft}^2$

$$\theta = 14^\circ \text{ to } 34^\circ$$

$$= (3.3 \text{ psf}) (-2.0) (1.5) (0.7) = -17.4 \text{ psf} \quad \theta = 14^\circ$$

$$= (3.3 \text{ psf}) (-1.5) (1.5) (0.7) = -13 \text{ psf} \quad \theta = 34^\circ$$

(all $> -10 \text{ psf ASD min}$)

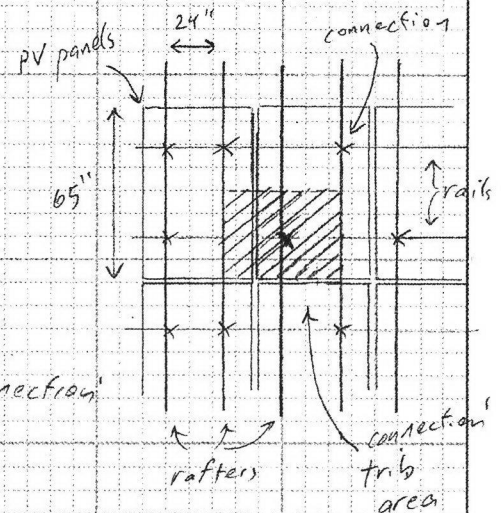
Worst uplift = -17.4 psf

Panel tie to single in-field connection

$$\frac{65''}{2} \approx 33''$$

$$\text{connection spacing} = (24'' (2)) = 48''$$

$$P_{\text{uplift}} = (-17.4 \text{ psf}) (33'') (48'') \left(\frac{1}{144} \right) = 191 \# / \text{connection}$$

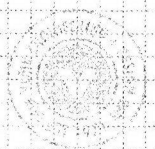


Fastener = Stainless $\frac{5}{16}$ " lag screw 266 #/in (NDS Table 12.2A)

$$(266 \#/\text{in}) (2.5'' \text{ embed}) (1.6) = 1064 \# > 191 \# \quad \text{OK}$$

W

C_D





Project: Edward J. Bennett Job #: 20190720.02 By: RJJ
Solar Add'n

Date: Jan 2020

Sheet #:

Existing beam check - west roof

$$L \approx 11 \text{ ft}$$

$$W = (6.5 \text{ psf} + 20 \text{ psf}) \left(\frac{15 \text{ ft}}{2} + \frac{15 \text{ ft}}{2} \right) = 398 \text{ plf} \quad \leftarrow (0.5-1.5)$$

$$M = \frac{W L^2}{8} = \frac{(398 \text{ plf})(11 \text{ ft})^2}{8} = 6020 \text{ ft}\cdot\text{ft}$$

W/solar

$$W = 398 \text{ plf} + (2.2 \text{ psf})(5 \text{ ft}) = 412 \text{ plf}$$

$$M = \frac{W L^2}{8} = \frac{(412 \text{ plf})(11 \text{ ft})^2}{8} = 6232 \text{ ft}\cdot\text{ft}$$

$$\frac{6232 \text{ ft}\cdot\text{ft}}{6020 \text{ ft}\cdot\text{ft}} = 1.035 \rightarrow 3.5\% < 5\% \quad \text{(OK)}$$

