



**BARUN CORP**

**25-012890-REV-01-RS**  
**25-012905-REV-01-RS**

March 25, 2025

RE:

CERTIFICATION LETTER

Project Address:

**EMERY BLEM**  
**641 NE 70TH AVE**  
**PORTLAND, OR 97213**

**Design Criteria:**

- Applicable Codes = 2021 IEBC/IBC, 2021 IRC, ASCE 7-16 and 2018 NDS
- Risk Category = II
- Wind Speed = 98 mph, Exposure Category B, Partially/Fully Enclosed Method
- Ground Snow Load = 25 psf
- Roof 1: 2 x 4 @ 24" OC, Roof DL = 7 psf, Roof LL/SL = 25 psf (Non-PV), Roof LL/SL = 20.8 psf (PV)
- Roof 2: 2 x 4 @ 24" OC, Roof DL = 7 psf, Roof LL/SL = 25 psf (Non-PV), Roof LL/SL = 17.1 psf (PV)
- Roof 2A: 2 x 4 @ 19" OC, Roof DL = 7 psf, Roof LL/SL = 25 psf (Non-PV), Roof LL/SL = 20 psf (PV)

To Whom It May Concern,

A structural evaluation of loading was conducted for the above address based on the design criteria listed above.

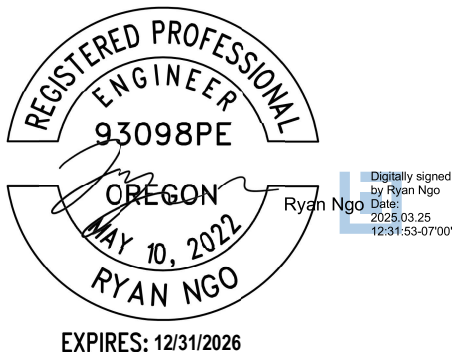
Existing roof structural framing has been reviewed for additional loading due to installation of Solar PV System on the roof. The structural review applies to the sections of roof that is directly supporting the Solar PV System.

Based on this evaluation, I certify that the alteration to the existing structure by installation of the Solar PV System along with structural upgrades for the ROOF/ARRAY/MP(s) specified below, meets the prescriptive compliance requirements of the applicable existing building and/or new building provisions adopted/referenced above.

- Roof 2: Needs 2x6 full length sister upgrade for rafters having rake span more than 12.5ft.

Additionally, the Solar PV System assembly (including attachment hardware) has been reviewed to be in accordance with the manufacturer's specifications and to meet and/or exceed the requirements set forth by the referenced codes.

Sincerely,



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**MOUNTING PLANE STRUCTURAL EVALUATION**

MOUNTING PLANE	ROOF PITCH	RESULT	GOVERNING ANALYSIS
Roof 1	20°	OK	MEMBER ANALYSIS
Roof 2	29°	OK WITH SPECIFIED UPGRADE	MEMBER ANALYSIS
Roof 2A	22°	OK	MEMBER ANALYSIS

**STANDOFF HARDWARE EVALUATION FOR WIND UPLIFT**

MOUNTING PLANE	WIND UPLIFT DCR
Roof 1	19.6%
Roof 2	6.4%
Roof 2A	8.2%

**Limits of Scope of Work and Liability:**

The existing structure has been reviewed based on the assumption that it has been originally designed and constructed per appropriate codes. The structural analysis of the subject property is based on the provided site survey data. The calculations produced for this structure's assessment are only for the roof framing supporting the proposed PV installation referenced in the stamped planset and were made according to generally recognized structural analysis standards and procedures. All PV modules, racking and attachment components shall be designed and installed per manufacturer's approved guidelines and specifications. These plans are not stamped for water leakage or existing damage to the structural component that was not accessed during the site survey. Prior to commencement of work, the PV system installer should verify that the existing roof and connections are in suitable condition and inspect framing noted on the certification letter and inform the Engineer of Record of any discrepancies prior to installation. The installer should also check for any damages such as water damage, cracked framing, etc. and inform the Engineer of Record of existing deficiencies which are unknown and/or were not observable during the time of survey and have not been included in this scope of work. Any change in the scope of the work shall not be accepted unless such change, addition, or deletion is approved in advance and in writing by the Engineer of Record. The Engineer of Record and Barun Corp claim no responsibility for misuse and improper installation.

**PV PANELS DEAD LOAD (PV-DL)**

PV Panels Weight	= 2.50 psf
Hardware Assembly Weight	= 0.50 psf
<b>Total PV Panels Weight</b>	<b>PV-DL = 3.00 psf</b>

**ROOF DEAD LOAD (R-DL)**

Existing Roofing Material Weight	Composite Shingle Roof	1 Layer(s)	= 2.50 psf
Underlayment Weight			= 0.50 psf
Plywood/OSB Sheathing Weight			= 1.50 psf
Framing Weight	2 x 4 @ 24 in. O.C.		= 0.73 psf
No Vaulted Ceiling			= 0.00 psf
Miscellaneous			= 1.50 psf
<b>Total Roof Dead Load</b>			<b>R-DL = 6.70 psf</b>

**REDUCED ROOF LIVE LOAD (Lr)**

Roof Live Load	Lo = 20.00 psf
Member Tributary Area	At < 200 ft <sup>2</sup>
Roof 1 Pitch	20° or 5/12
Tributary Area Reduction Factor	R1 = 1.00
Roof Slope Reduction Factor	R2 = 0.98
<b>Reduced Roof Live Load, Lr = Lo (R1) (R2)</b>	<b>Lr = 19.50 psf</b>

**SNOW LOAD**

Ground Snow Load	pg = 25.00 psf
Effective Roof Slope	20°
Snow Importance Factor	Is = 1.00
Snow Exposure Factor	Ce = 1.00
Snow Thermal Factor	Ct = 1.10
Minimum Flat Roof Snow Load	pf-min = 25.00 psf
<b>Flat Roof Snow Load</b>	<b>pf = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON ROOF (Non-Slippery Surfaces)**

Roof Slope Factor	Cs-roof = 1.00
<b>Sloped Roof Snow Load on Roof</b>	<b>ps-roof = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON PV PANELS (Unobstructed Slippery Surfaces)**

Roof Slope Factor	Cs-PV = 0.83
<b>Sloped Roof Snow Load on PV Panels</b>	<b>ps-PV = 20.80 psf</b>



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Roof 1

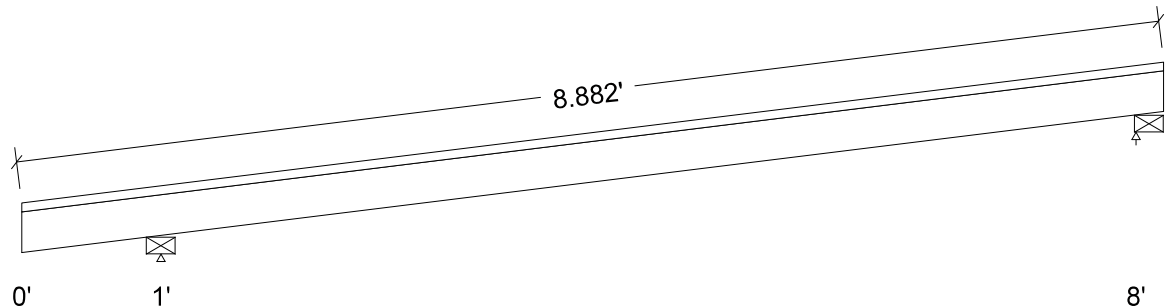
## Design Check Calculation Sheet

WoodWorks Sizer 2023

### Loads:

Load	Type	Distribution	Pat- tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
DL	Dead	Full Area	No			6.70 (24.0")		psf
DL-PV	Dead	Partial Area	No	1.00	6.50	3.00 (24.0")		psf
SL-PV	Snow	Partial Area	No	1.00	6.50	20.80 (24.0")		psf
SL-ROOF	Snow	Partial Area	No	0.00	1.00	25.00 (24.0")		psf
SL-ROOF1	Snow	Partial Area	No	6.50	8.00	25.00 (24.0")		psf

### Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:					
Dead			88		67
Snow			200		154
Factored:					
Total			288		220
Bearing:					
F'theta			691		691
Capacity					
Joist			2982		2593
Support			2344		2344
Des ratio					
Joist			0.10		0.09
Support			0.12		0.09
Load comb			#2		#2
Length			2.50		2.50
Min req'd			0.31**		0.24**
Cb			1.15		1.00
Cb min			1.75		1.00
Cb support			1.00		1.00
Fcp sup			625		625

\*\*Minimum bearing length governed by the required width of the supporting member.

### Lumber-soft, D.Fir-L, No.2, 2x4 (1-1/2"x3-1/2")

Supports: All - Lumber-soft Beam, D.Fir-L No.2

Roof joist spaced at 24.0" c/c; Total length: 9.0'; Clear span(horz): 0.875', 6.875'; Volume = 0.3 cu.ft.; Pitch: 5/12

Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);

**This section PASSES the design code check.**

**Analysis vs. Allowable Stress and Deflection using NDS 2018 :**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	$f_v = 53$	$F_v' = 207$	psi	$f_v/F_v' = 0.26$
Bending(+)	$f_b = 1445$	$F_b' = 1785$	psi	$f_b/F_b' = 0.81$
Bending(-)	$f_b = 126$	$F_b' = 1689$	psi	$f_b/F_b' = 0.07$
Deflection:				
Interior Live	$0.30 = L/307$	$0.51 = L/180$	in	0.59
Total	$0.51 = L/177$	$0.76 = L/120$	in	0.68
Cantil. Live	$-0.13 = L/101$	$0.14 = L/90$	in	0.89
Total	$-0.22 = L/57$	$0.22 = L/60$	in	1.04

**Additional Data:**

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
$F_v'$	180	1.15	1.00	1.00	-	-	-	-	1.00	1.00	2
$F_b'+$	900	1.15	1.00	1.00	1.000	1.500	-	1.15	1.00	1.00	2
$F_b'-$	900	1.15	1.00	1.00	0.946	1.500	-	1.15	1.00	1.00	2
$F_{cp}'$	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-
$E'$	1.6 million	1.00	1.00	-	-	-	-	-	1.00	1.00	2
$E_{min}'$	0.58 million	1.00	1.00	-	-	-	-	-	1.00	1.00	2

**CRITICAL LOAD COMBINATIONS:**

Shear : LC #2 = D + S  
 Bending(+): LC #2 = D + S  
 Bending(-): LC #2 = D + S  
 Deflection: LC #2 = D + S (live)  
                   LC #2 = D + S (total)  
 Bearing : Support 1 - LC #2 = D + S  
                   Support 2 - LC #2 = D + S

D=dead S=snow

All LC's are listed in the Analysis output

Load combinations: ASD Basic from ASCE 7-16 2.4

**CALCULATIONS:**

$V_{max} = 207$ ,  $V_{design} = 186$  (NDS 3.4.3.1(a)) lbs;  $M(+)$  = 369 lbs-ft;  $M(-)$  = 32 lbs-ft  
 $EI = 8.57e06$  lb-in<sup>2</sup>

"Live" deflection is due to all non-dead loads (live, wind, snow...)

Total deflection = 1.50 permanent + "live"

Bearing: Allowable bearing at an angle  $F'\theta$  calculated for each support as per NDS 3.10.3

Lateral stability(-):  $L_u = 7.56'$   $L_e = 11.81'$   $RB = 14.8$ ;  $L_u$  based on full span

**Design Notes:**

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2021) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. SLOPED BEAMS: level bearing is required for all sloped beams.
6. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

**SITE INFORMATION**

Ultimate Wind Speed =	98.00 mph	Roof Pitch =	20°
Risk Category =	II	Roof Type =	Gable
Exposure Category =	B	Velocity Pressure Exposure Coefficient, Kz =	0.57
Mean Roof Height =	15.00 ft	Topographic Factor, Kzt =	1.00
Solar Array Dead Load =	3.00 psf	Wind Directionality Factor, Kd =	0.85
a =	3.00 ft	Ground Elevation Factor, Ke =	1.00

**DESIGN CALCULATIONS**

DESIGN CALCULATIONS			
Wind Velocity Pressure, qh =		12.01 psf	(0.00256*Kz*Kzt*Kd*Ke*(V^2))
Solar Array Pressure Equalization Factor, ya =		0.60	
Hardware Type =		Unirac Stronghold w/ Butyl	
Allowable Load =		624.00 lbs	SPF, #14 Wood Screw x 2, 2" Embedment
Array Edge Factor, γE =		1.50	Exposed Condition
Max. X - Spacing (Zone 1 & 2e) =		2.00 ft	Effective Wind Area 5.66 ft²
Max. Y - Spacing (Zone 1 & 2e) =		2.83 ft	
Max. X - Spacing (Zone 2n - 3e) =		2.00 ft	Effective Wind Area 5.66 ft²
Max. Y - Spacing (Zone 2n - 3e) =		2.83 ft	
Max. X - Spacing (Zone 3r) =		2.00 ft	Effective Wind Area 5.66 ft²
Max. Y - Spacing (Zone 3r) =		2.83 ft	
ROOF ZONE	GCp (-) UPLIFT	UPLIFT PRESSURE	PULLOUT FORCE
1 & 2e	-2.00	-11.28 psf	63.84 lbs
2n - 3e	-3.00	-17.76 psf	100.55 lbs
3r	-3.60	-21.66 psf	122.57 lbs

**NOTE:**

- Wind calculation is based on ASCE 7-16, 29.4 - C&C, LC #7: 0.6DL + 0.6WL is used.

**PV PANELS DEAD LOAD (PV-DL)**

PV Panels Weight	= 2.50 psf
Hardware Assembly Weight	= 0.50 psf
<b>Total PV Panels Weight</b>	<b>PV-DL = 3.00 psf</b>

**ROOF DEAD LOAD (R-DL)**

Existing Roofing Material Weight	Composite Shingle Roof	1 Layer(s)	= 2.50 psf
Underlayment Weight			= 0.50 psf
Plywood/OSB Sheathing Weight			= 1.50 psf
Framing Weight	2 x 4 @ 24 in. O.C.		= 0.73 psf
No Vaulted Ceiling			= 0.00 psf
Miscellaneous			= 1.50 psf
<b>Total Roof Dead Load</b>			<b>R-DL = 6.70 psf</b>

**REDUCED ROOF LIVE LOAD (Lr)**

Roof Live Load	Lo = 20.00 psf
Member Tributary Area	At < 200 ft <sup>2</sup>
Roof 2 Pitch	29° or 7/12
Tributary Area Reduction Factor	R1 = 1.00
Roof Slope Reduction Factor	R2 = 0.88
<b>Reduced Roof Live Load, Lr = Lo (R1) (R2)</b>	<b>Lr = 17.50 psf</b>

**SNOW LOAD**

Ground Snow Load	pg = 25.00 psf
Effective Roof Slope	29°
Snow Importance Factor	Is = 1.00
Snow Exposure Factor	Ce = 1.00
Snow Thermal Factor	Ct = 1.10
Minimum Flat Roof Snow Load	pf-min = 25.00 psf
<b>Flat Roof Snow Load</b>	<b>pf = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON ROOF (Non-Slippery Surfaces)**

Roof Slope Factor	Cs-roof = 1.00
<b>Sloped Roof Snow Load on Roof</b>	<b>ps-roof = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON PV PANELS (Unobstructed Slippery Surfaces)**

Roof Slope Factor	Cs-PV = 0.68
<b>Sloped Roof Snow Load on PV Panels</b>	<b>ps-PV = 17.10 psf</b>



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Roof 2

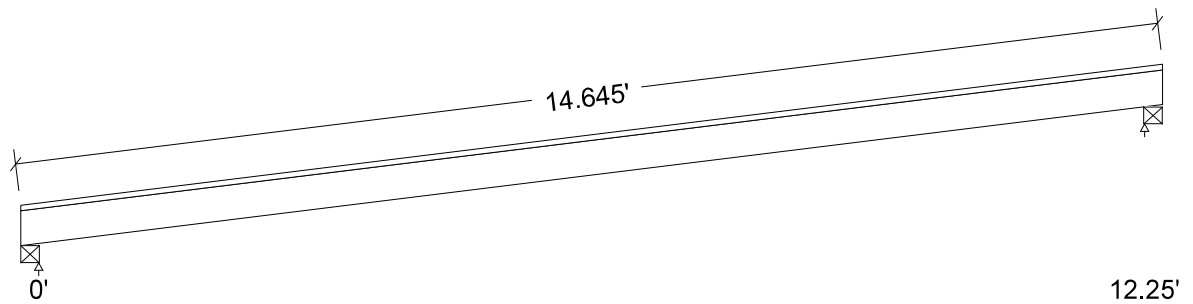
## Design Check Calculation Sheet

WoodWorks Sizer 2023

### Loads:

Load	Type	Distribution	Pat- tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
DL	Dead	Full Area				6.70 (24.0")		psf
DL-PV	Dead	Partial Area		0.20	9.20	3.00 (24.0")		psf
SL-PV	Snow	Partial Area		0.20	9.20	17.10 (24.0")		psf
SL-ROOF	Snow	Partial Area		9.20	12.45	25.00 (24.0")		psf

### Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	137		121
Snow	216		254
Factored:			
Total	354		375
Bearing:			
F'theta	745		745
Capacity			
Joist	5568		5568
Support	4672		4672
Des ratio			
Joist	0.06		0.07
Support	0.08		0.08
Load comb	#2		#2
Length	2.50		2.50
Min req'd	0.19**		0.20**
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.00		1.00
Fcp sup	625		625

\*\*Minimum bearing length governed by the required width of the supporting member.

### Lumber-soft, D.Fir-L, No.2, 3"x4-5/8"

Supports: All - Lumber-soft Beam, D.Fir-L No.2

Roof joist spaced at 24" c/c; Total length: 14.88'; Clear span(horz): 12.25'; Volume = 1.4 cu.ft.; Pitch: 7/12

Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);

**This section PASSES the design code check.**

WARNING: This CUSTOM SIZE is not in the database. Refer to online help.



**Analysis vs. Allowable Stress and Deflection using NDS 2018 :**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	$f_v = 33$	$F_v' = 207$	psi	$f_v/F_v' = 0.16$
Bending(+)	$f_b = 1231$	$F_b' = 1666$	psi	$f_b/F_b' = 0.74$
Live Defl'n	$0.64 = L/266$	$0.95 = L/180$	in	0.68
Total Defl'n	$1.20 = L/142$	$1.42 = L/120$	in	0.84

**Additional Data:**

FACTORS:	F/E(ksi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
$F_v'$	180	1.15	1.00	1.00	-	-	-	-	1.00	1.00	2
$F_b' +$	900	1.15	1.00	1.00	1.000	1.400	-	1.15	1.00	1.00	2
$F_{cp}'$	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-
$E'$	1.6 million	1.00	1.00	-	-	-	-	-	1.00	1.00	2

**CRITICAL LOAD COMBINATIONS:**

Shear : LC #2 = D + S  
 Bending(+): LC #2 = D + S  
 Deflection: LC #2 = D + S (live)  
                   LC #2 = D + S (total)  
 Bearing : Support 1 - LC #2 = D + S  
                   Support 2 - LC #2 = D + S

D=dead S=snow

All LC's are listed in the Analysis output

Load combinations: ASD Basic from ASCE 7-16 2.4

**CALCULATIONS:**

$V_{max} = 321$ ,  $V_{design} = 302$  (NDS 3.4.3.1(a)) lbs;  $M(+)$  = 1086 lbs-ft

$EI = 39.06e06$  lb-in<sup>2</sup>

"Live" deflection is due to all non-dead loads (live, wind, snow...)

Total deflection = 1.50 permanent + "live"

Bearing: Allowable bearing at an angle  $F'\theta$  calculated for each support as per NDS 3.10.3

**Design Notes:**

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2021) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. SLOPED BEAMS: level bearing is required for all sloped beams.

**SITE INFORMATION**

Ultimate Wind Speed =	98.00 mph	Roof Pitch =	29°
Risk Category =	II	Roof Type =	Hip
Exposure Category =	B	Velocity Pressure Exposure Coefficient, Kz =	0.57
Mean Roof Height =	15.00 ft	Topographic Factor, Kzt =	1.00
Solar Array Dead Load =	3.00 psf	Wind Directionality Factor, Kd =	0.85
a =	3.00 ft	Ground Elevation Factor, Ke =	1.00

**DESIGN CALCULATIONS**

DESIGN CALCULATIONS			
Wind Velocity Pressure, qh =		12.01 psf	(0.00256*Kz*Kzt*Kd*Ke*(V^2))
Solar Array Pressure Equalization Factor, ya =		0.60	
Hardware Type =		Unirac Stronghold w/ Butyl	
Allowable Load =		624.00 lbs	SPF, #14 Wood Screw x 2, 2" Embedment
Array Edge Factor, γE =		1.50	Exposed Condition
Max. X - Spacing (Zone 1) =		2.00 ft	Effective Wind Area 3.80 ft²
Max. Y - Spacing (Zone 1) =		1.90 ft	
Max. X - Spacing (Zone 2e & 2r) =		2.00 ft	Effective Wind Area 3.80 ft²
Max. Y - Spacing (Zone 2e & 2r) =		1.90 ft	
Max. X - Spacing (Zone 3) =		2.00 ft	Effective Wind Area 3.80 ft²
Max. Y - Spacing (Zone 3) =		1.90 ft	
ROOF ZONE	GCp (-) UPLIFT	UPLIFT PRESSURE	PULLOUT FORCE
1	-1.20	-6.19 psf	23.53 lbs
2e & 2r	-1.66	-9.22 psf	35.02 lbs
3	-1.88	-10.59 psf	40.24 lbs

**NOTE:**

- Wind calculation is based on ASCE 7-16, 29.4 - C&C, LC #7: 0.6DL + 0.6WL is used.

**PV PANELS DEAD LOAD (PV-DL)**

PV Panels Weight	= 2.50 psf
Hardware Assembly Weight	= 0.50 psf
<b>Total PV Panels Weight</b>	<b>PV-DL = 3.00 psf</b>

**ROOF DEAD LOAD (R-DL)**

Existing Roofing Material Weight	Composite Shingle Roof	1 Layer(s)	= 2.50 psf
Underlayment Weight			= 0.50 psf
Plywood/OSB Sheathing Weight			= 1.50 psf
Framing Weight	2 x 4 @ 19 in. O.C.		= 0.92 psf
No Vaulted Ceiling			= 0.00 psf
Miscellaneous			= 1.50 psf
<b>Total Roof Dead Load</b>			<b>R-DL = 6.90 psf</b>

**REDUCED ROOF LIVE LOAD (Lr)**

Roof Live Load	Lo = 20.00 psf
Member Tributary Area	At < 200 ft <sup>2</sup>
Roof 2A Pitch	22° or 5/12
Tributary Area Reduction Factor	R1 = 1.00
Roof Slope Reduction Factor	R2 = 0.95
<b>Reduced Roof Live Load, Lr = Lo (R1) (R2)</b>	<b>Lr = 19.00 psf</b>

**SNOW LOAD**

Ground Snow Load	pg = 25.00 psf
Effective Roof Slope	22°
Snow Importance Factor	Is = 1.00
Snow Exposure Factor	Ce = 1.00
Snow Thermal Factor	Ct = 1.10
Minimum Flat Roof Snow Load	pf-min = 25.00 psf
<b>Flat Roof Snow Load</b>	<b>pf = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON ROOF (Non-Slippery Surfaces)**

Roof Slope Factor	Cs-roof = 1.00
<b>Sloped Roof Snow Load on Roof</b>	<b>ps-roof = 25.00 psf</b>

**SLOPED ROOF SNOW LOAD ON PV PANELS (Unobstructed Slippery Surfaces)**

Roof Slope Factor	Cs-PV = 0.80
<b>Sloped Roof Snow Load on PV Panels</b>	<b>ps-PV = 20.00 psf</b>



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Feb. 25, 2025 18:26

Roof 2a

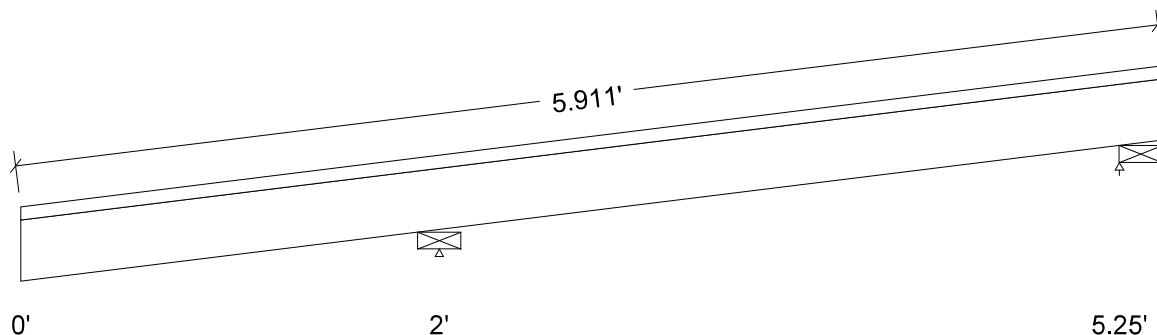
## Design Check Calculation Sheet

WoodWorks Sizer 2023

### Loads:

Load	Type	Distribution	Pat- tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
DL	Dead	Full Area	No			6.90 (19.0")		psf
DL-PV	Dead	Partial Area	No	1.50	5.25	3.00 (19.0")		psf
SL-PV	Snow	Partial Area	No	1.50	5.25	20.00 (19.0")		psf
SL-ROOF	Snow	Partial Area	No	0.00	1.50	25.00 (19.0")		psf

### Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:					
Dead			60		23
Snow			147		31
Factored:					
Total			207		54
Bearing:					
F'theta			691		691
Capacity					
Joist			2982		2593
Support			2344		2344
Des ratio					
Joist			0.07		0.02
Support			0.09		0.02
Load comb			#2		#2
Length			2.50		2.50
Min req'd			0.22**		0.06**
Cb			1.15		1.00
Cb min			1.75		1.00
Cb support			1.00		1.00
Fcp sup			625		625

\*\*Minimum bearing length governed by the required width of the supporting member.

### Lumber-soft, D.Fir-L, No.2, 2x4 (1-1/2"x3-1/2")

Supports: All - Lumber-soft Beam, D.Fir-L No.2

Roof joist spaced at 19.0" c/c; Total length: 6.06'; Clear span(horz): 1.875', 3.125'; Volume = 0.2 cu.ft.; Pitch: 5/12

Lateral support: top = continuous, bottom = at supports; Repetitive factor: applied where permitted (refer to online help);

**This section PASSES the design code check.**

**Analysis vs. Allowable Stress and Deflection using NDS 2018 :**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	$f_v = 25$	$F_v' = 207$	psi	$f_v/F_v' = 0.12$
Bending(+)	$f_b = 91$	$F_b' = 1785$	psi	$f_b/F_b' = 0.05$
Bending(-)	$f_b = 402$	$F_b' = 1751$	psi	$f_b/F_b' = 0.23$
Deflection:				
Interior Live	$-0.00 = < L/999$	$0.23 = L/180$	in	0.01
Total	$0.00 = < L/999$	$0.35 = L/120$	in	0.01
Cantil. Live	$0.04 = L/697$	$0.29 = L/90$	in	0.13
Total	$0.05 = L/550$	$0.43 = L/60$	in	0.11

**Additional Data:**

FACTORS:	F/E(ksi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cf <sub>rt</sub>	Ci	LC#
$F_v'$	180	1.15	1.00	1.00	-	-	-	-	1.00	1.00	2
$F_b'+$	900	1.15	1.00	1.00	1.000	1.500	-	1.15	1.00	1.00	2
$F_b'-$	900	1.15	1.00	1.00	0.981	1.500	-	1.15	1.00	1.00	2
$F_{cp}'$	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-
$E'$	1.6 million	1.00	1.00	-	-	-	-	-	1.00	1.00	2
$E_{min}'$	0.58 million	1.00	1.00	-	-	-	-	-	1.00	1.00	2

**CRITICAL LOAD COMBINATIONS:**

Shear : LC #2 = D + S  
 Bending(+): LC #2 = D + S  
 Bending(-): LC #2 = D + S  
 Deflection: LC #2 = D + S (live)  
                   LC #1 = D only (total)  
 Bearing : Support 1 - LC #2 = D + S  
                   Support 2 - LC #2 = D + S

D=dead S=snow

All LC's are listed in the Analysis output

Load combinations: ASD Basic from ASCE 7-16 2.4

**CALCULATIONS:**

$V_{max} = 102$ ,  $V_{design} = 86$  (NDS 3.4.3.1(a)) lbs;  $M(+)$  = 23 lbs-ft;  $M(-)$  = 102 lbs-ft  
 $EI = 8.57e06$  lb-in<sup>2</sup>

"Live" deflection is due to all non-dead loads (live, wind, snow...)

Total deflection = 1.50 permanent + "live"

Bearing: Allowable bearing at an angle  $F'\theta$  calculated for each support as per NDS 3.10.3

Lateral stability(-):  $L_u = 3.50'$   $L_e = 5.94'$   $RB = 10.5$ ;  $L_u$  based on full span

**Design Notes:**

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2021) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. SLOPED BEAMS: level bearing is required for all sloped beams.
6. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

**SITE INFORMATION**

Ultimate Wind Speed =	98.00 mph	Roof Pitch =	22°
Risk Category =	II	Roof Type =	Hip
Exposure Category =	B	Velocity Pressure Exposure Coefficient, Kz =	0.57
Mean Roof Height =	15.00 ft	Topographic Factor, Kzt =	1.00
Solar Array Dead Load =	3.00 psf	Wind Directionality Factor, Kd =	0.85
a =	3.00 ft	Ground Elevation Factor, Ke =	1.00

**DESIGN CALCULATIONS**

DESIGN CALCULATIONS			
Wind Velocity Pressure, qh =		12.01 psf	(0.00256*Kz*Kzt*Kd*Ke*(V^2))
Solar Array Pressure Equalization Factor, ya =		0.60	
Hardware Type =		Ecofasten RockIt Comp Slide	
Allowable Load =		624.00 lbs	SPF, #14 Wood Screw x 2, 2" Embedment
Array Edge Factor, γE =		1.50	Exposed Condition
Max. X - Spacing (Zone 1) =		1.60 ft	Effective Wind Area 4.53 ft²
Max. Y - Spacing (Zone 1) =		2.83 ft	
Max. X - Spacing (Zone 2e & 2r) =		1.60 ft	Effective Wind Area 4.53 ft²
Max. Y - Spacing (Zone 2e & 2r) =		2.83 ft	
Max. X - Spacing (Zone 3) =		1.60 ft	Effective Wind Area 4.53 ft²
Max. Y - Spacing (Zone 3) =		2.83 ft	
ROOF ZONE	GCp (-) UPLIFT	UPLIFT PRESSURE	PULLOUT FORCE
1	-1.40	-7.41 psf	33.57 lbs
2e & 2r	-2.00	-11.30 psf	51.20 lbs
3	-2.00	-11.30 psf	51.20 lbs

**NOTE:**

- Wind calculation is based on ASCE 7-16, 29.4 - C&C, LC #7: 0.6DL + 0.6WL is used.