

24-101480 REV 01 RS

February 25, 2025

RE:

Project Address:

CERTIFICATION LETTER

ERIN HANLY 908 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: 2 x 4 @ 24" OC, Roof DL = 7 psf, Roof LL/SL = 25 psf (Non-PV), Roof LL/SL = 20 psf (PV)
- Roof 3, 4 & 5: 2 x 4 @ 24" 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.

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.



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RESULTS SUMMARY

ERIN HANLY, 908 NE 70TH AVE, PORTLAND, OR 97213

MOUNTING PLANE STRUCTURAL EVALUATION									
MOUNTING PLANE ROOF PITCH RESULT GOVERNING ANALYSIS									
Roof 1, 2	22°	ОК	MEMBER ANALYSIS						
Roof 3, 4 & 5	22°	ОК	MEMBER ANALYSIS						

STANDOFF HARDWARE EVA	STANDOFF HARDWARE EVALUATION FOR WIND UPLIFT				
MOUNTING PLANE	WIND UPLIFT DCR				
Roof 1, 2	19.8%				
Roof 3, 4 & 5	11.3%				

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.

LOAD CALCULATION

Roof 1, 2

ERIN HANLY, 908 NE 70TH AVE, PORTLAND, OR 97213

PV PANELS DEAD LOAD (PV-DL)	
PV Panels Weight	= 2.50 psf
Hardware Assembly Weight	= 0.50 psf
Total PV Panels Weight (Stacked Attachments)	PV-DL = 3.00 psf

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			
Total Roof Dead Load			R-DL = 6.70 psf			

REDUCED ROOF LIVE LOAD (Lr)		
Roof Live Load	Lo = 20.00 psf	
Member Tributary Area	$At < 200 ft^2$	
Roof 1, 2 Pitch	22° or 5/12	
Tributary Area Reduction Factor	R1 = 1.00	
Roof Slope Reduction Factor	R2 = 0.95	
Reduced Roof Live Load, Lr = Lo (R1) (R2)	Lr = 19.00 psf	

SNOW LOAD	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				
Flat Roof Snow Load	pf = 25.00 psf				

SLOPED ROOF SNOW LOAD ON ROOF (Non-Slippery Surfaces)				
Roof Slope Factor Cs-roof = 1.00				
Sloped Roof Snow Load on Roof	ps-roof = 25.00 psf			

SLOPED ROOF SNOW LOAD ON PV PANELS (Unobstructed Slippery Surfaces)				
Roof Slope Factor Cs-PV = 0.80				
Sloped Roof Snow Load on PV Panels (Stacked Attachments)	ps-PV = 20.00 psf			

Lateral Capacity check for Ecofasten	Rockit Comp slide attachments.		
Attachment type =	Ecofasten RockIT Comp Slide	Number of rows in Array =	1
Attachment Max. X-spacing =	2.00 ft	Array Lateral Capacity factor =	2.00
Attachment Max. Y-spacing =	6.20 ft		
Lateral load on each attachment =	106.84 lbs		
Lateral capacity of the attachment =	402.00 lbs (Based on	hardware manufacturer)	
	Pass. Provided spacing is Oka	у.	



PROJECT

Feb. 24, 2025 17:14 Roof 1 & 2

Design Check Calculation Sheet

WoodWorks Sizer 2023

Loads:

Load	Туре	Distribution	Pat-	Locatio	on [ft]	Magnitud	е	Unit
			tern	Start	End	Start	End	
DL	Dead	Full Area	No			6.70(24.	0")	psf
DL-PV	Dead	Partial Area	No	1.00	6.75	3.00(24.	0")	psf
SL-PV	Snow	Partial Area	No	1.00	6.75	20.00(24.	0")	psf
SL-ROOF	Snow	Partial Area	No	0.00	1.00	25.00(24.	0")	psf
SL-ROOF1	Snow	Partial Area	No	6.75	11.40	25.00(24.	0")	psf

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



Unfactored: Dead Snow	61 134	114 272	33 106
Total	195	386	139
F'theta Capacity	691	691	691
Joist Support	4538 2550	4538 2550	4149 2550
Des ratio Joist	0.04	0.09	0.03
Support Load comb	0.08 #2	0.15 #2	0.05 #2
Min req'd	4.00 0.31**	4.00 0.61**	0.22**
Cb min Cb support	1.05	1.62	1.00
Fcp sup	425	425	425

**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 - Timber-soft Beam, S-P-F No.2

Roof joist spaced at 24.0" c/c; Total length: 12.81'; Clear span(horz): 0.813', 4.875', 5.0'; Volume = 0.5 cu.ft.; Pitch: 5/12 Lateral support: top = continuous, bottom = at all supports; Repetitive factor: applied where permitted (refer to online help); This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Roof 1 & 2

WoodWorks® Sizer 2023

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Analysis vs. Allow	wable Stress and I	Deflection u	sing NDS 20 [,]	18:				
Criterion	Analysis Value	Design Va	alue Un	it	Analy	sis/Des	sign	
Shear	fv = 47	Fv' = 2	07 ps	i	fv	/Fv' =	0.23	
Bending(+)	fb = 501	Fb' = 17	85 ps	i	fb	/Fb' =	0.28	
Bending(-)	fb = 799	Fb' = 17	24 ps	i	fb	/Fb' =	0.46	
Deflection:								
Interior Live	0.06 = < L/999	0.38 = L	/180 in				0.15	
Total	0.07 = L/956	0.56 = L	/120 in				0.13	
Cantil. Live	-0.01 = L/932	0.14 = L	/90 in				0.10	
Total	-0.03 = L/377	0.22 = L	/60 in				0.16	
		CT.	an af.	0	05+	<u></u>	тощ	
FACTORS: F/E (ps.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$		CF CIU	Cr			LС# 2	
FV 100	1 15 1 00 1 00		= = 500 =	- 1 15	1 00	1 00	2	
ED + 900	1 15 1 00 1 00	1.000 1	500 -	1 15	1 00	1 00	2	
$F_{CD} = 900$	- 1 00 1 00		.500 -		1 00	1 00	2 _	
E' 16m	1.00 1.00) <u> </u>		_	1 00	1 00	2	
Emin' 0.58 m	$\frac{111100}{11100} = 1.00 = 1.00$) –		_	1 00	1 00	2	
	ABINATIONS.	5			1.00	1.00	2	
Shear : LC	#2 = D + S							
Bending(+): LC	#2 = D + S							
Bending(-): LC	#2 = D + S							
Deflection: LC	#2 = D + S (live	e)						
LC	#2 = D + S (tota	al)						
Bearing : Sup	port 1 - LC #2 = I	D + S						
Sup	port 2 - LC #2 = I	D + S						
Sup	port 3 - LC #2 = I	D + S						
D=dead S=snow								
All LC's are li	sted in the Analys	sis output						
Load combinatio:	ns: ASD Basic from	n ASCE 7-16	2.4					
CALCULATIONS:								
V max = 189, V	design = 166 (NDS	3.4.3.1(a)) lbs; M(+) = 128	lbs-f	t; M(-)	= 204	lbs-ft
EI = 8.57e06 lb	-in^2							
"Live" deflecti	on is due to all n	non-dead loa	ads (live,	wind,	snow)			
Total deflection	n = 1.50 permanent	t + "live"						
Bearing: Allowal	ble bearing at an	angle F'the	eta calcu	lated f	for eac	h suppo	ort	
as per NDS 3.10	.3							
Lateral stabili	ty(-): Lu = 5.63	Le = 9.0	0' RB = 1	3.0; Lu	ı based	l on ful	ll 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.

WIND UPLIFT CALCULATION

Roof 1, 2

ERIN HANLY, 908 NE 70TH AVE, PORTLAND, OR 97213

SITE INFORMATION					
Ultimate Wind Speed =	98.00 mph	Roof Pitch =	22°		
Risk Category =	II	Roof Type =	Hip		
Exposure Category =	В	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					
	Wind Velo	ocity Pressure, qh =	12.01 psf	(0.00256*Kz*Kzt*Kd*Ke*(V^2))	
Solar	Array Pressure Equa	lization Factor, γa =	0.60		
	Hardware Type =	Ecofasten Rocklt Co	omp Slide	-	
	Allowable Load =	680.00 lbs	D. Fir - L, 5/16" Lag	Screw x 1, 2" Embedment	
			-		
Arr	ay Edge Factor, γE =	1.50	Exposed Condition		
Max. X - Spacing (Zone 1) = 2.00 ft Effective Wind Area		Effective Wind Area			
Max. Y - Spacing (Zone 1) = 6.20 ft				12.40 ft ²	
Max. X - Spacing (Zone 2e & 2r) = 2.00 ft Effective Wind Area		Effective Wind Area			
Max. Y - Spacing (Zone 2e & 2r) = 6.20 ft 12.40 ft ²		12.40 ft ²			
Max. X	 Spacing (Zone 3) = 	2.00 ft	Effective Wind Area		
Max. Y	- Spacing (Zone 3) =	3.10 ft	6.20 ft ²		
ROOF ZONE	GCp (-) UPLIFT	UPLIFT PRESSURE		PULLOUT FORCE	
1	-1.34	-7.05 psf		87.38 lbs	
2e & 2r	-1.93	-10.84 psf		134.37 lbs	
3	-2.00	-11.30 psf 70.07 lbs		70.07 lbs	

NOTE:

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

LOAD CALCULATION

Roof 3, 4 & 5

ERIN HANLY, 908 NE 70TH AVE, PORTLAND, OR 97213

PV PANELS DEAD LOAD (PV-DL)			
PV Panels Weight	= 2.50 psf		
Hardware Assembly Weight	= 0.50 psf		
Total PV Panels Weight (Stacked Attachments) PV-DL = 3.00 psf			

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		
Total Roof Dead Load R-DL = 6.70 psf					

REDUCED ROOF LIVE LOAD (Lr)		
Roof Live Load	Lo = 20.00 psf	
Member Tributary Area	$At < 200 ft^2$	
Roof 3, 4 & 5 Pitch	22° or 5/12	
Tributary Area Reduction Factor	R1 = 1.00	
Roof Slope Reduction Factor	R2 = 0.95	
Reduced Roof Live Load, Lr = Lo (R1) (R2)	Lr = 19.00 psf	

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		
Flat Roof Snow Load	pf = 25.00 psf		

SLOPED ROOF SNOW LOAD ON ROOF (Non-Slippery Surfaces)				
Roof Slope Factor	Cs-roof = 1.00			
Sloped Roof Snow Load on Roof	ps-roof = 25.00 psf			

SLOPED ROOF SNOW LOAD ON PV PANELS (Unobstructed Slippery Surfaces)				
Roof Slope Factor Cs-PV = 0.80				
Sloped Roof Snow Load on PV Panels (Stacked Attachments)	ps-PV = 20.00 psf			

Lateral Capacity check for Ecofasten	Rockit Comp slide attachments.		
Attachment type =	Ecofasten RockIT Comp Slide	Number of rows in Array =	3
Attachment Max. X-spacing =	2.00 ft	Array Lateral Capacity factor =	1.33
Attachment Max. Y-spacing =	3.40 ft		
Lateral load on each attachment =	58.59 lbs		
Lateral capacity of the attachment =	267.33 lbs (Based on	hardware manufacturer)	
	Pass. Provided spacing is Oka	у.	



PROJECT

Feb. 24, 2025 17:28 Roo

28 Roof 3, 4 & 5

Design Check Calculation Sheet

WoodWorks Sizer 2023

Loads:

Load	Туре	Distribution	Pat-	Location [ft]	Magnitude	Unit
			tern	Start End	Start End	
DL	Dead	Full Area	No		6.70(24.0")	psf
DL-PV	Dead	Partial Area	No	1.00 10.50	3.00(24.0")	psf
SL-PV	Snow	Partial Area	No	1.00 10.50	20.00(24.0")	psf
SL-ROOF	Snow	Partial Area	No	0.00 1.00	25.00(24.0")	psf
SL-ROOF1	Snow	Partial Area	No	10.50 14.21	25.00(24.0")	psf

Maximum Reactions (Ibs), Bearing Capacities (Ibs) and Bearing Lengths (in) :



13	.9'
----	-----

	I		
Unfactored:			
Dead	70	155	43
Snow	154	320	141
Factored:			
Total	224	475	184
Bearing:			
F'theta	691	691	691
Capacity			
Joist	4538	4538	4149
Support	2550	2550	2550
Des ratio			
Joist	0.05	0.10	0.04
Support	0.09	0.19	0.07
Load comb	#2	#2	#2
Length	4.00	4.00	4.00
Min req'd	0.35**	0.75**	0.29**
Cb	1.09	1.09	1.00
Cb min	1.75	1.50	1.00
Cb support	1.00	1.00	1.00
Fcp sup	425	425	425

**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 - Timber-soft Beam, S-P-F No.2

Roof joist spaced at 24.0" c/c; Total length: 15.5'; Clear span(horz): 0.813', 6.125', 6.25'; Volume = 0.6 cu.ft.; Pitch: 5/12 Lateral support: top = continuous, bottom = at all supports; Repetitive factor: applied where permitted (refer to online help); This section PASSES the design code check.

WoodWorks® Sizer

SOFTWARE FOR WOOD DESIGN

Roof 3, 4 & 5

WoodWorks® Sizer 2023

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Analysis vs. Allowable Stress and Deflection using NDS 2018 :								
Criterion	Analysis Value	Design Value	Unit	Analysis/Design				
Shear	fv = 59	Fv' = 207	psi	fv/Fv' = 0.	28			
Bending(+)	fb = 748	Fb' = 1785	psi	fb/Fb' = 0.	42			
Bending(-)	fb = 1229	Fb' = 1701	psi	fb/Fb' = 0.	72			
Deflection:								
Interior Live	0.11 = L/735	0.47 = L/180	in	0.	24			
Total	0.16 = L/510	0.70 = L/120	in	0.	24			
Cantil. Live	-0.04 = L/350	0.14 = L/90	in	0.	26			
Total	-0.08 = L/170	0.22 = L/60	in	0.	35			
Additional Data:								
FACTORS: F/E (ps	i) CD CM Ct	CI. CF	Cfu Cr	Cfrt Ci LC	#			
Fv' 180	1.15 1.00 1.00) – –		1.00 1.00 2	11			
Fb' + 900	1.15 1.00 1.00	1.000 1.500	- 1.15	1.00 1.00 2				
Fb'- 900	1.15 1.00 1.00	0.953 1.500	- 1.15	1.00 1.00 2				
Fcp' 625	- 1.00 1.00	D – – C		1.00 1.00 -				
E' 1.6 m	illion 1.00 1.00	D – – C		1.00 1.00 2				
Emin' 0.58 m	illion 1.00 1.00	D – – C		1.00 1.00 2				
CRITICAL LOAD CON	ABINATIONS:							
Shear : LC	#2 = D + S							
Bending(+): LC	#2 = D + S							
Bending(-): LC	#2 = D + S							
Deflection: LC	#2 = D + S (live	e)						
LC	#2 = D + S (tota	al)						
Bearing : Sup	port 1 - LC #2 = 1) + S						
Sup	port 2 - LC #2 = 1) + S						
Sup	port 3 - LC #2 = 1	D + S						
D=dead S=snow								
All LC's are li	sted in the Analys	sis output						
Load combinatio	ns: ASD Basic from	n ASCE 7-16 2.4						
CALCULATIONS:								
$V \max = 229, V$	design = 206 (NDS	3.4.3.1(a)) lbs	; $M(+) = 191$	l lbs-ft; M(-) =	314 lbs-ft			
EI = 8.57e06 lb	-in^2							
"Live" deflecti	"Live" deflection is due to all non-dead loads (live, wind, snow)							
Total deflection	n = 1.50 permanent	t + "live"						
Bearing: Allowa	ble bearing at an	angle F'theta	calculated f	for each support				
as per NDS 3.10	.3							
Lateral stabili	ty(-): Lu = 7.00	' Le = 10.94' H	RB = 14.3; I	Lu 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.

WIND UPLIFT CALCULATION

Roof 3, 4 & 5

ERIN HANLY, 908 NE 70TH AVE, PORTLAND, OR 97213

SITE INFORMATION								
Ultimate Wind Speed =	98.00 mph	Roof Pitch =	22°					
Risk Category =	II	Roof Type =	Hip					
Exposure Category =	В	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								
Wind Velocity Pressure, qh =			12.01 psf	(0.00256*Kz*Kzt*Kd*Ke*(V^2))				
Solar Array Pressure Equalization Factor, γa =			0.60					
Hardware Type = Ecofasten RockIt Comp Slide								
Allowable Load =		680.00 lbs	D. Fir - L, 5/16" Lag Screw x 1, 2" Embedment					
Array Edge Factor, γE =		1.50	Exposed Condition					
Max. X - Spacing (Zone 1) =		2.00 ft	Effective Wind Area					
Max. Y - Spacing (Zone 1) =		3.40 ft	6.80 ft ²					
Max. X - Spacing (Zone 2e & 2r) =		2.00 ft	Effective Wind Area					
Max. Y - Spacing (Zone 2e & 2r) =		3.40 ft	6.80 ft ²					
Max. X - Spacing (Zone 3) =		2.00 ft	Effective Wind Area					
Max. Y - Spacing (Zone 3) =		1.70 ft	3.40 ft ²					
ROOF ZONE	GCp (-) UPLIFT	UPLIFT P	RESSURE	PULLOUT FORCE				
1	-1.40	-7.41 psf		50.39 lbs				
2e & 2r	-2.00	-11.30 psf		76.85 lbs				
3	-2.00	-11.3	0 psf	38.43 lbs				

NOTE:

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