BLACK & VEATCH CORPORATION
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March 21, 2022

Site ID: 150111
Site Address: 1460 Route 9, Wappingers Falls, NY 12590-4425

To Whom It May Concern:

The purpose of this letter is to certify that a structural analysis was performed for the existing roof members that are to support the solar PV panels, racking, and ballast weight, if applicable, as shown in the attached calculation document. The calculations were performed in accordance with the edition of the Building Code of New York State that is currently in effect in the jurisdiction where the noted site is located. The design criteria upon which the calculations are based on can be found within the attached calculation document.

Based on the results and findings of this structural analysis, it can be certified that the individual existing roof members that support the PV panels, and the individual roof members as described in the attached report, are adequate to support the design loads as required by the applicable building code and design standards.

Should you have any questions or comments, please feel free to contact Black & Veatch.

Very truly yours,

BLACK & VEATCH CORPORATION

Nathaniel E. Bolds Jr.

Nathaniel Bolds P.E.*
Civil/Structural Engineer

* Registered in New York

cc: JP Morgan

STATE OF NEW YORK
NATHANIEL ELLIS BOLDS JR.
102997
LICENSED PROFESSIONAL ENGINEER

Date Signed: 03/21/2022
License Expires: 04/30/2023

WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

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CALCULATION RECORD

Confidential and Proprietary Business Information of Black & Veatch

Client Name:	JP Morgan & Chase	Page 1	of 43
Project Name:	Rooftop Solar Program	Project No.: 400134	
Calculation Title:	Structural Evaluation of Existing Roof for Proposed Solar PV Array		
Calculation No./File No.:	10.00.150111		

Verification Method:	☑ Check and Review	☐ Alternate Calculations

Objective:
The purpose of this calculation is to evaluate existing building structure for addition of rooftop PV solar module.

Unverified Assumptions Requiring Subsequent Verification

No.	Assumption	Verified By	Date

Refer to Page _____ of this calculation for additional assumptions

This Section Used for Software-Generated Calculations

Program Name/Version: Microsoft Excel 2016, Mathcad Prime 5.0.0.0

If a nonstandard B&V application is used, the approved deviation permit number shall be listed below and the approved deviation permit attached to the calculation as a reference.

Review and Approval

Revision	Prepared By*	Date	Verified By*	Date	Approved By*	Date
0	Charloemphon T.	5/11/2020	Amir Tabarestani	5/12/2020	Nathaniel E. Bolds, Jr.	3/21/2022

*Signature required.

TABLE OF CONTENTS

LIST OF APPENDICES

1.0. PURPOSE OF CALCULATION

The purpose of this calculation is to evaluate the existing building structure for addition of rooftop PV solar array.

2.0. SUMMARY OF CONCLUSIONS

Per IEBC 2018 "Section 502.4 - Existing structural elements carrying gravity load" and "Section 502.5 - Existing structural elements carrying lateral load", the gravity and lateral structural systems are permitted to remain unaltered. Addition of Rooftop PV Solar Array is acceptable.

3.0. REFERENCES

1. Local Building Code: 2020 Building Code of New York State
2. International Building Code: International Building Code 2018
3. International Existing Building Code 2018
4. International Fire Code 2018
5. UNIRAC Code Compliant Engineering Letter for NY State
6. ASCE7-16, Minimum Design Loads for Buildings and Other Structures
7. Report SEAOC PV2-2017, Wind Design for Solar Arrays
8. Report SEAOC PV1-2012, Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Arrays
9. 2016 SEAOC Convention Proceedings Page 922 to 929, Wind Loads on Rooftop Photovoltaic Panel Systems Installed Parallel to Roof Planes
10. Michael O'Rourke et.al, Snow Loads on Solar-Paneled Roofs
11. NDS 2018, National Design Specification for Wood Construction
12. Supplement NDS 2018, National Design Specification Design Values for Wood Construction
13. Design of Wood Structures, 6th Edition
14. AISC Steel Construction manual, 14th Edition, 2011
15. 75 Year Steel Joist Manual by Steel Joist Institute
16. B&V Calculation 284980.01.01.862084.03 Standard Pitched Roof Racking Plus Module Dead Load Rev. 0
17. (Not Used)
18. S-5-U & S-5-U Mini S5! Clamp Load Test Results
19. Versabracket S5! Load Test Results
20. Portland Bolt Website - ASTM F593, https://www.portlandbolt.com/technical/specifications/astm-f593/
21. National Design Specification for Wood Construction, 2018 Edition
22. Supplement NDS - Design Values for Wood Construction, 2018 Edition
23. Quick Mount PV Tile Replacement Mount State Compliance Letters
24. Quick Mount PV TRM System for use with Everest CrossRail 48 PV Panel Mounting System
25. Quick Mount PV Tile Replacement Mount Installation Instructions
26. Quick Mount PV QBase Mount System State Compliance Letters
27. Quick Mount PV QBase Mount System for use with Everest CrossRail 48 PV Panel Mounting System
28. Quick Mount PV QBase Universal Tile Mounting Installation Instructions
29. Quick Mount PV QHook Mount System State Compliance Letters
30. Quick Mount PV QHook Mount System for use with Everest CrossRail 48 PV Panel Mounting System
31. Quick Mount PV QHook Mounting Installation Instructions
32. Laboratory Load Test of the QMHLS with 6061 Base Plate
33. Laboratory Load Test of the QMHSS with 6061 Base Plate
34. Laboratory Load Test of the QMHLB with 6061 Base Plate
35. Laboratory Load Test of the QMHSB with 6061 Base Plate
36. U-Anchor Testing & Engineering Reports (U-Anchor 2400 & 2600)
37. Structural Certification of IronRidge Knockout Tile Roof Attachment

ROOF 1 LOAD ANALYSIS (150111)
MAIN BUILDING

4.0. Site Information

Building ID: 150111
Project Name: Wappinger
Address: 1460 Route 9, Wappingers Falls, NY, 12590-4425

5.0. Building Code and Design Parameters

International Building Code: International Building Code 2018
Local Building Code: 2020 Building Code of New York State
Structural Risk Category: II

Wind Load Data

Wind Speed, V: 113 *mph*
Exposure Category: B
Topographic Factor K_{zt}: 1.0

Roof Snow Load Data

Ground Snow Load, Pg: 30.0 *psf*
Flat-roof Snow Load, Pf: 21.0 *psf*
Snow Exposure Factor, Ce: 1.0
Snow Thermal Factor, Ct: 1.0
Snow Load Importance Factor, Is: 1.0

Seismic Load Data

Spectral acceleration, S_{DS}: 0.231 *g*
Seismic Design Category: B

Roof Characteristics

Mean Roof Height: 14.50 *ft*
Roof Angle: 0.0 *degrees*

6.0. Load Determination

6.1. Existing Roof Dead Load

Roof Dead Load: **D_{roof}:** 25.4 *psf*

Component:	Membrane	Insulation - 1	Insulation - 2	Deck	Structure	Utilities	Ceiling - 1	Ceiling - 2	Other - 1	Other - 2	Total
Dead Load (psf):	0.7	3		2.5	1	4	1				12.2
Material:	TPO/PVC, Waterproofing membrane	Rigid insulation 2-in		Deck, metal, 20 gauge	Steel Joist (Assumption if specification is not known)	Standard, Mechanical duct allowances	Acoustical Fiber board, "drop-ceiling"				

6.2. Proposed Solar Array Dead Load

Solar Array dead load including PV modules, racking, ballast (ref. Racking Design Report)
Solar Array Dead Load: **D_{PV}:** 6.99 *psf*

6.3. Existing Roof Design Live Load

Exist Design Roof Live Load: **RLL_{exist}:** 20.00 *psf*

6.4. New Design Live Load in Area Occupied by Solar Array

Live load need not be applied in area occupied by solar array.
New Design Roof Live Load: **RLL_{new}:** 0 *psf*

6.5. Wind Load on Roof Components and Cladding

ASCE 7-16 WIND LOADS

Referenced sections, equations, and tables are found in ASCE 7-16.

	Roof Type:		Gable Roof		(ref. Drawings, Site Survey Data, Aurora Layout)
1.	Risk Category:		II		Table 1.5-1
2.	Basic Wind Speed:	V:	113	*mph*	Figures 26.5-1A, B, C & D
3.	Wind Load Parameters				
3a.	Directionality Factor:	Kd:	0.85		Table 26.6-1
3b.	Exposure Category:		B		Section 26.7
3c.	Topographic Factor:	Kzt:	1		Section 26.8, Table 26.8-1
3d.	Gust-effect Factor:	G:	0.85		Section 26.11
3e.	Enclosure Classification:		Enclosed		Section 26.12
	Wind Flow Obstruction:				Fig. 30.7-1,2,3 Note 2 (for open buildings)
3f.	Internal Pressure Coefficient:	GCpi:	0.18		Section 26.11, Table 26.13-1
4.	Boundary Layer Height:	zg:	1200	*feet*	Table 26.10-1
	3-sec gust-speed exponent:	α:	7		Table 26.10-1
	Mean Roof Height:	h:	14.5	*feet*	(ref. Drawings, Site Survey Data, Aurora Layout)
	Parapet height:	h_{pt}:	6.5	*feet*	(ref. Drawings, Site Survey Data, Aurora Layout)
	Horizontal dimension of building:	L:	NA	*feet*	(measured along wind direction for open buildings. Ref. Fig 30.7-1, 30.7-2, 30.7-3)
	Roof Angle from Horizontal:	θ:	0	*deg*	
	Ground Elevation above sea level:	Zg:	163.4	*feet*	Section 26.9
	Ground Elevation Factor:	Ke:	0.99		Table 26.9-1: Ke = $e^{-0.0000362*Zg}$ (where Zg = ground elevation above sea level in ft)
	Velocity Pressure Exposure Coefficient:	Kz:	0.70		Table 26.10-1 and Table 26.11-1: Kz = 2.01*(z/zg)$^{2/\alpha}$ (Exp B: z = 30 ft min, z = 15 ft min otherwise)
5.	Velocity Pressure at height h:	q_h:	19.35	*psf*	Equation 26.10-1: q_z = 0.00256KzKztKdKeV^2
6.	Effective Wind Area:	A:	1300	*ft²*	
7.	Zone dimension:	a:	8.70	*feet*	For h<=60, a: 10% of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft.
					For h>60, a: 10% of least horizontal dimension but not less than 3 ft.
8.	External Pressure Coefficients, GCp (enclosed bldg) or Net Pressure Coefficients, C_N (open bldg)				Figure 30.3-1, 2A to 2H, 3, 4, 5A, 5B, 6, 7 (enclosed) or Figure 30.7-1,2,3 (open)
9	Wind Pressure on Roof				
	without overhang (use GCp or GC_N):	p:	(see table)		Equation 30.3-1, 30.5-1: p = qh(GCp - GCpi) [for enclosed and partially enclosed]
	with overhang (use GCp_oh):	p_oh:	(see table)		Equation 30.9-1: p = q_h(GCp - GCpi) [for overhangs]
					*GCp for roof overhangs include pressure contributions from both upper and lower surfaces
					Equation 30.7-1: p = q_h(GC_N) [for open buildings]
					Section 30.2.2, p >= 16 psf (acting in either direction normal to the surface)

	A (ft²)	GCp1'-	GCp1-	GCp2-	GCp2e-	GCp2n-	GCp2r-	GCp2'-	GCp3-	GCp3e-	GCp3r-	GCp3'-	GCp1'+	GCp1+	GCp2+, 2'+	GCp3+, 3'+
1	1300	-0.40	-1.00	-1.40	0.00	0.00	0.00	0.00	-1.40	0.00	0.00	0.00	0.20	0.20	0.63	0.63
2																
3																
4																
5																
6																
7																

	A (ft²)	GCp_oh1'-	GCp_oh1-	GCp_oh2-	GCp_oh2e-	GCp_oh2n-	GCp_oh2r-	GCp_oh3-	GCp_oh3e-	GCp_oh3r-
1	1300	-1.00	-1.00	-1.10	0.00	0.00	0.00	-1.10	0.00	0.00
2										
3										
4										
5										
6										
7										

	A	Clear Wind Flow						Obstructed Wind Flow					
	(ft²)	C_N1-	C_N2-	C_N3-	C_N1+	C_N2+	C_N3+	C_N1-	C_N2-	C_N3-	C_N1+	C_N2+	C_N3+
8	1300												
9													
10													
11													
12													
13													
14													

Enclosed or Partially Enclosed Buildings:

A (ft²)	p1'- (psf)	p1- (psf)	p2- (psf)	p2e- (psf)	p2n- (psf)	p2r- (psf)	p2'- (psf)	p3- (psf)	p3e- (psf)	p3r- (psf)	p3'- (psf)	p1'+ (psf)	p1+ (psf)	p2+, p2'+ (psf)	p3+, p3'+ (psf)
1300	-16.0	-22.8	-30.6					-30.6				16.0	16.0	16.0	16.0

A (ft²)	p_oh1'- (psf)	p_oh1- (psf)	p_oh2- (psf)	p_oh2e- (psf)	p_oh2n- (psf)	p_oh2r- (psf)	p_oh3- (psf)	p_oh3e- (psf)	p_oh3r- (psf)
1300	-22.8	-22.8	-24.8				-24.8		

Open Buildings:

	A	Clear Wind Flow						Obstructed Wind Flow					
	(ft²)	p1- (psf)	p2- (psf)	p3- (psf)	p1+ (psf)	p2+ (psf)	p3+ (psf)	p1- (psf)	p2- (psf)	p3- (psf)	p1+ (psf)	p2+ (psf)	p3+ (psf)
	1300												

6.6. Wind Load on Solar Array

This wind load calculation is for low profile arrays, with dimensions such that either ASCE7-16 Section 29.4.3, or ASCE7-16 Section 29.4.4 are applicable.
Referenced sections, equations, and tables in this section are found in ASCE 7-16.

Overall building Length	W_L:	62.15	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Overall building width	W_S:	62.45	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Building width normal to wind direction	B:	62.15	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Effective wind area of element:	A:	1300	ft^2	(ref. Drawings, Site Survey Data, Aurora Layout)
Components and Cladding Zone dimension:	a:	8.70	*ft*	Figure 30.3-1, 2A to 2H, 3, 4, 5A, 5B, 6, 7 (enclosed) or Figure 30.7-1,2,3 (open)
Basic Wind Speed (ASCE7-16):	V:	113	*mph*	Figures 26.5-1A, B, C & D
Velocity Pressure at height h:	q_h:	19.35	*psf*	Equation 26.10-1: $q_z = 0.00256KzKztKdKeV^2$
Angle of solar panel relative to roof:	ϖ:	8	*deg*	Sec 29.4.3 angle limit - - - **OK** (ref. Applicable Racking Data)
Panel Chord Length:	Lp:	3.28	*ft*	Sec 29.4.3 length limit - - - **OK** (ref. Applicable Racking Data)
Parapet factor:	γ_p:	1.20		Sec 29.4.3 γ_p=min(1.2,0.9+h_{pp}/h)
Chord factor:	γ_c:	0.80		Sec 29.4.3 γ_c=max(0.6+0.06L_{pp},0.8)
Pressure equalization factor:	γ_a:	0.40		Fig. 29.4-8: 0.8 for A<=10; 0.4 for A>=100; 1.2-0.4*LOG(A) otherwise.
Edge factor for uplift loads (Exposed Panels)	γ_{E_Exp}:	1.5		Sec 29.4.3: γ_E=1.5 for uplift loads on panels that are exposed and within 1.5Lp from exposed edge.
Edge factor for uplift loads (Non Exposed Panels)	γ_{E_NonExp}:	1		γ_E=1.0 elsewhere for uplift loads.
Edge factor for downward loads (all panels)	γ_E:	1		γ_E=1.0 for all downward loads.
Normalized wind area:	An:	5777.8	ft^2	Fig 29.4-7: An = [1000/max(Lb,15)^2]A
Height of gap between panel and roof at lower edge:	h_1:	0.35	*ft*	Sec 29.4.3 height limit - - - **OK** (ref. Applicable Racking Data)
Height of gap between panel and roof at higher edge:	h_2:	0.81	*ft*	Sec 29.4.3 height limit - - - **OK** (ref. Applicable Racking Data)
Normalized building length:	Lb:	12.01	*ft*	Fig. 29.4-7: Lb =minimum of 0.4*(hW_L)$^{0.5}$ or h or W_S
Uplift Wind Pressure				Eqn. 29.4-5: p = q_hGCrn (for panels on flat roofs with θ<=7deg)
Exposed panels (use GCrn_Exp-):	p_Exp-:	(see table)	*psf*	Eqn. 29.4-7: p = q_h(GCp)$\gamma_E\gamma_a$ (for panels parallel to roof surface)
Non Exposed panels (use GCrn_Nexp-):	p_NExp-:	(see table)	*psf*	
Downward Wind Pressure				Eqn. 29.4-5: p = q_hGCrn (for panels on flat roofs with θ<=7deg)
All panels (use GCrn+):	p+:	(see table)	*psf*	Eqn. 29.4-7: p = q_h(GCp)$\gamma_E\gamma_a$ (for panels parallel to roof surface)
Nominal Net Pressure coefficient:	(GCrn)nom:	(see table)		Fig 29.4-7
Net Pressure Coefficient:	(GCrn):	(see table)		Eqn. 29.4-6: (GCrn)=(γ_p)(γ_c)(γ_E)(GCrn)nom

	A (ft^2)	An (ft^2)	(GCrn)nom1	(GCrn)nom2	(GCrn)nom3	GCrn1_Exp-	GCrn2_Exp-	GCrn3_Exp-	GCrn1_NExp-	GCrn2_NExp-	GCrn3_NExp-	GCrn1+	GCrn2+	GCrn3+
15	1300	5777.8	0.15	0.21	0.23	-0.21	-0.30	-0.34	-0.14	-0.20	-0.22	0.14	0.20	0.22
16	21	95.0	0.74	0.98	1.14	-1.07	-1.41	-1.65	-0.71	-0.94	-1.10	0.71	0.94	1.10
17	13	58.3	0.84	1.12	1.31	-1.21	-1.61	-1.88	-0.81	-1.07	-1.25	0.81	1.07	1.25
18	9	38.8	0.92	1.23	1.44	-1.32	-1.78	-2.08	-0.88	-1.18	-1.38	0.88	1.18	1.38
19	10	43.7	0.90	1.20	1.40	-1.29	-1.73	-2.02	-0.86	-1.15	-1.35	0.86	1.15	1.35
20														
21														

	A (ft^2)	GCp1'-	GCp1-	GCp2-	GCp2e-	GCp2n-	GCp2r-	GCp2'-	GCp3-	GCp3e-	GCp3r-	GCp3'-	GCp1'+	GCp1+	GCp2+, 2'+	GCp3+, 3'+
22	1300	-0.40	-1.00	-1.40	0.00	0.00	0.00	0.00	-1.40	0.00	0.00	0.00	0.20	0.20	0.63	0.63
23	21	-0.90	-1.56	-2.13	0.00	0.00	0.00	0.00	-2.13	0.00	0.00	0.00	0.27	0.27	0.85	0.85
24	13	-0.90	-1.65	-2.24	0.00	0.00	0.00	0.00	-2.24	0.00	0.00	0.00	0.29	0.29	0.88	0.88
25	9	-0.90	-1.70	-2.30	0.00	0.00	0.00	0.00	-2.30	0.00	0.00	0.00	0.30	0.30	0.90	0.90
26	10	-0.90	-1.70	-2.30	0.00	0.00	0.00	0.00	-2.30	0.00	0.00	0.00	0.30	0.30	0.90	0.90
27																
28																

	A	Clear Wind Flow						Obstructed Wind Flow					
	(ft^2)	C_N1-	C_N2-	C_N3-	C_N1+	C_N2+	C_N3+	C_N1-	C_N2-	C_N3-	C_N1+	C_N2+	C_N3+
29	1300												
30	21												
31	13												
32	9												
33	10												
34													
35													

Sec. 29.4.3: Rooftop Solar Panels for Buildings of All Heights with Flat Roofs or Gable or Hip Roofs with Slopes Less Than 7 degrees

A (ft^2)	An (ft^2)	p1_Exp- (psf)	p2_Exp- (psf)	p3_Exp- (psf)	p1_NExp- (psf)	p2_NExp- (psf)	p3_NExp- (psf)	p1+ (psf)	p2+ (psf)	p3+ (psf)
1300	5777.8	-4.0	-5.8	-6.5	-2.7	-3.9	-4.4	2.7	3.9	4.4
21.37	95.0	-20.7	-27.3	-31.9	-13.8	-18.2	-21.2	13.8	18.2	21.2
13.11	58.3	-23.4	-31.2	-36.4	-15.6	-20.8	-24.3	15.6	20.8	24.3
8.74	38.8	-25.6	-34.4	-40.2	-17.1	-22.9	-26.8	17.1	22.9	26.8
9.83	43.7	-25.0	-33.4	-39.1	-16.7	-22.3	-26.0	16.7	22.3	26.0

Sec. 29.4.4: Rooftop Solar Panels Parallel to the Roof Surface on Buildings of All Heights and Roof Slopes

A (ft^2)	p1'_Exp- (psf)	p1_Exp- (psf)	p2_Exp- (psf)	p2e_Exp- (psf)	p2n_Exp- (psf)	p2r_Exp- (psf)	p2'_Exp- (psf)	p3_Exp- (psf)	p3e_Exp- (psf)	p3r_Exp- (psf)	p3'_Exp- (psf)	p1'+ (psf)	p1+ (psf)	p2+, p2'+ (psf)	p3+, p3'+ (psf)
1300															
21															
13															
9															
10															

A (ft^2)	p1'_NExp- (psf)	p1_NExp- (psf)	p2_NExp- (psf)	p2e_NExp- (psf)	p2n_NExp- (psf)	p2r_NExp- (psf)	p2'_NExp- (psf)	p3_NExp- (psf)	p3e_NExp- (psf)	p3r_NExp- (psf)	p3'_NExp- (psf)
1300											
21											
13											
9											
10											

6.7. Snow Load

This snow load calculation is in accordance with ASCE 7-16.
Referenced sections, equations, and tables in this section are found in ASCE 7-16.

Ground snow load,	p_g:	30	*psf*	Figure 7.2-1 (Table 7.2-1 for Alaska Locations)
Exposure Factor,	C_e:	1		Table 7.3-1
Thermal Factor,	C_t:	1		Table 7.3-2
Risk Category of Building:		II		Table 1.5-1
Snow Importance Factor,	I_s:	1.0		Table 1.5-2
Elevation Differential Between High Roof and Low roof,	H:	0.0	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Length of higher roof parallel to drift,	l_u:	0.0	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Length of lower roof parallel to drift,	l_l:	0.0	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)
Roof eave to ridge horizontal distance,	W:	0.0	*ft*	(ref. Drawings, Site Survey Data, Aurora Layout)

Flat Roof Snow Load

Flat snow load,	p_f:	21.0	*psf*	Eqn. 7.3-1: pf = 0.7*Ce*Ct*Is*pg
Minimum snow load for low-slope,	p_m:	20.0	*psf*	Sec. 7.3.4: $p_m = I_s*p_g$ if p_g<=20; p_m = 20(Is) if p_g>20. [p_m need not be used in drift, sliding, unbalanced or partial loads]
Design flat roof snow Load,	p_f:	21.00	*psf*	Sec. 7.3.4: $p_f = \max(p_f, p_m)$ [can not be less than AHJ specified minimum design snow load]
Roof Surface Type:		Other		Fig 7.4-1
Roof Slope Factor	C_s:	1.00		Fig 7.4-1
Sloped roof snow load,	p_s:	21.00	*psf*	Eqn. 7.4-1: $p_s = Cs*pf$
Snow density,	γ:	17.90	*pcf*	Sec. 7.7: γ = 0.13*pg+14 < 30 pcf
Height of balanced snow load,	h_b:	1.17	*ft*	Sec. 7.7.1: $h_b = (Cs*p_f)/\gamma$

Drift Snow Loads from Higher Roof

Height from top of balanced snow to upper roof,	h_c:	0.00	*ft*	Fig. 7-8
Ratio of h_c to h_b,	h_c/h_b:	0.00		Sec. 7.7.1: h_c/h_b must be greater than 0.2 in order for drift loads to be applied
Drift loads need not be applied.				
Leeward Drift:				
Height of drift,	h_d:	0.00	*ft*	Sec. 7.7.1, Fig. 7.6-1: $h_d = (0.43 * (l_u)^{1/3} * (p_g + 10)^{1/4} - 1.5)*I_s^{1/2}$ but not greater than $0.6*I_L$
width of snow drift,	w:	0.00	*ft*	Sec. 7.7.1: w = (4 * h_d), if $h_d \le h_c$, or, w = (4 * h_d^2)/h_c if $h_d > h_c$; w shall not exceed $8h_c$
Maximum intensity of drift surcharge load,	p_d:	0.00	*psf*	Sec. 7.7.1: $p_d = h_d * \gamma$
Windward Drift:				
height of drift,	h_d:	0.00	*ft*	Sec. 7.7.1, Fig. 7.6-1: $h_d = 0.75 * (0.43 * (l_L)^{1/3} * (p_g + 10)^{1/4} - 1.5)*I_s^{1/2}$
width of snow drift,	w:	0.00	*ft*	Sec. 7.7.1: w = (4 * h_d), if $h_d \le h_c$, or, w = (4 * h_d^2)/h_c if $h_d > h_c$; w shall not exceed $8h_c$
Maximum intensity of drift surcharge load,	p_d:	0.00	*psf*	Sec. 7.7.1: $p_d = h_d * \gamma$

Drift Snow Loads from Parapet

Height from top of balanced snow to parapet top,	h_c:	5.33	*ft*	Fig. 7.7-2
Ratio of h_c to h_b,	h_c/h_b:	4.54		Sec. 7.7.1: h_c/h_b must be > 0.2, and roof side length > 15ft for drift loads to be applied
Drift loads must be applied:				
Windward Drift:				
height of drift,	h_d:	1.08	*ft*	Sec. 7.7.1, Fig. 7-9: $h_d = 0.75 * (0.43 * (l_L)^{1/3} * (p_g + 10)^{1/4} - 1.5)*I_s^{1/2}$
width of snow drift,	w:	4.31	*ft*	Sec. 7.7.1: w = (4 * h_d), if $h_d \le h_c$, or, w = (4 * h_d^2)/h_c if $h_d > h_c$; w shall not exceed $8h_c$
Maximum intensity of drift surcharge load,	p_d:	19.27	*psf*	Sec. 7.7.1: $p_d = h_d * \gamma$

Unbalanced Snow Loads

Unbalanced loads need not be considered.

Unbalanced load on leeward side,	I_s*p_g:	0.00	*psf*	Sec. 7.6.1, Fig. 7.6-2
Unbalanced load on leeward side,	p_s:	0.00	*psf*	Eqn. 7.4-1, Fig 7.6-1: ps = Cs*pf
Unbalanced surcharge load on leeward side,	$h_d*\gamma/sqrt(S)$:	0.00	*psf*	Sec. 7.6.1, Fig. 7.6-1; [where: $h_d = (0.43 * (l_u)^{1/3} * (p_g + 10)^{1/4} - 1.5)*I_s^{1/2}$]
Unbalanced surcharge load width,	$(8/3)*sqrt(S)*h_d$:	0.00	*ft*	[l_u is eave to ridge distance for widward portion of roof; S is roof slope run for a rise of one]
Unbalanced load on windward side,	$0.3*p_s$:	0.00	*psf*	Fig. 7-5: p_{unb} = 0 if W<20 ft; $p_{unb} = 0.3*(C_s*p_f)$ if W>=20ft:

Rain-on-Snow Surcharge Load

Rain-on-snow surcharge load need not be applied.

Rain-on-snow surcharge load,	p_{rs}:	0.00	*psf*	Sec. 7.10

Sliding Snow Loads from Solar Panel

hp < hb, sliding loads need not be considered. See Ref. 9, Chapter 3.

Height of panel at higher edge:	h_p:	0.95	*ft*	(hp = h_2 plus 1.6" allowance for panel thickness)

Drift Snow Loads from Solar Panel

hp < 1.2hb, drift loads need not be considered. See Ref. 9, Chapter 3.

6.8. Rain Load

This rain load calculation is in accordance with ASCE 7-16.

Depth of Water upto inlet of secondary drainage,	d_s:	2.5	*in*	(ref. Drawings, Site Survey Data, Aurora Layout)
Depth of Water above inlet of secondary drainage,	d_h:	0.0	*in*	Table C8.3-1 to C8.3-6 (Q = 0.0104*A*I, where A = roof area serviced by a single drainage system, i=design rainfall intensity)
Rain Load,	R:	13.00	*psf*	Eqn. 8.3-1: R = 5.2*(d_s + d_h)

6.9. Seismic Load

This seismic load calculation is in accordance with ASCE 7-16.
Per ASCE7-16 Section 13.6.12, rooftop solar panels and their attachments are designed for forces determined in section 13.3.
Referenced sections, equations, and tables in this section are found in ASCE 7-16.

Horizontal Seismic Design Force, $F_p = 0.4\, a_p\, S_{DS}\, W_p\, (1 + 2\, z/h) / (R_p/I_p)$ — Eqn. 13.3-1
$= 0.4 \times 1.00 \times 0.23\, (1 + 2 \times 1.00) / (1.50 / 1.00)$
$F_p =$ 0.19 W_p **(Controls)**

Max Horizontal Seismic Design Force, $F_p = 1.6\, S_{DS}\, I_p\, W_p$ — Eqn. 13.3-2
$= 1.6 \times 0.23 \times 1.00 \times W_p$
$F_p =$ 0.37 W_p (maximum)

Min Horizontal Seismic Design Force, $F_p = 0.30\, S_{DS}\, I_p\, W_p$ — Eqn. 13.3.3
$= 0.30 \times 0.23 \times 1.00 \times W_p$
$F_p =$ 0.07 W_p (minimum)

Short period spectral acceleration,	S_{DS} =	0.23	Sec. 11.4.5, ASCE 7 Hazard Tool
Seismic Design Category,	SDC =	B	ASCE7 Hazard Tool
Component Importance Factor	Ip =	**1.00**	Sec. 13.1.3
Component response modification factor,	Rp =	**1.50**	Table 13.5-1/13.6-1
Component amplification factor,	ap =	**1.00**	Table 13.5-1/13.6-1
Maximum z/h value,	z/h =	**1.00**	

Seismic Shear:

Height from grade, h = 14.50 *ft* (ref. Drawings, Site Survey Data, Aurora Layout)

Horizontal Seismic Load, $F_p =$ 0.19 x W_p =
= 0.19 W_p

Vertical Seismic Load, $E_v = +/- 0.2\, S_{DS}\, W_p$ — Sec. 13.3.1.2
= 0.0462 W_p

Weight of PV array,	W_{pv} =	8.0	*kip*
Weight of roof,	Wroof =	103.3	*kip*
Wall + Other Weight tributary to N-S SFRS,	W_{NS_Wall} =	0.0	*kip*
Wall + Other Weight tributary to E-W SFRS,	W_{EW_Wall} =	0.0	*kip*

Exist Effective Seismic Weight (N/S Dir), W_{NS_exist} = 103.3 *kip* — Exist Dwg Seismic Weight tributary to North-South Seismic Direction, W_{NS} (kip) — Exist W_{NS} = kip
Exist Effective Seismic Weight (E/W Dir), W_{EW_exist} = 103.3 *kip* — Exist Dwg Seismic Weight tributary to East-West Seismic Direction, W_{EW} (kip) — Exist W_{EW} = kip

New Effective Seismic Weight (N/S Dir), W_{NS_new} = 111.4 *kip* <= W_{NS_exist} = 113.7 *kip*
New Effective Seismic Weight (E/W Dir), W_{EW_new} = 111.4 *kip* <= W_{EW_exist} = 113.7 *kip*

Component:	North Wall - 1	North Wall - 2	South Wall - 1	South Wall - 2	East Wall - 1	East Wall - 2	West Wall - 1	West Wall - 2	Other - NS	Other - EW
Dead Load (psf):										
Total Area (ft^2):										
% Area:										
Material:										

7.0. Load Comparison Before and After Solar PV Array Installation

Summary of Loads on Roof (Gravity direction)

Load Type	Before PV Array (psf)	After PV Array (psf)
Dead Load	25.40	32.39
Roof Live Load	20.00	0.00
Rain Load	13.00	13.00
Snow Load	32.00	21.00
Wind (downward - Zone 1)	16.00	16.00
Wind (downward - Zone 2)	16.00	16.00
Wind (downward - Zone 3)	16.00	16.00
Without Overhang:		
Wind (uplift - Zone 1)	-22.83	-22.83
Wind (uplift - Zone 2)	-30.58	-30.58
Wind (uplift - Zone 3)	-30.58	-30.58
With Overhang:		
Wind (uplift - Zone 1)	-22.83	-22.83
Wind (uplift - Zone 2)	-24.77	-24.77
Wind (uplift - Zone 3)	-24.77	-24.77
Vertical Seismic Load	1.17	1.50

ASD Load Combinations	Before PV Array (psf)	After PV Array (psf)	% Increase
Downward Load Cases (Gravity direction)			
D+ (RLL or R)	45.40	45.39	
D+S	57.40	53.39	
D+0.6W (Zone 1)	35.00	41.99	
D+0.6W (Zone 2)	35.00	41.99	
D+0.6W (Zone 3)	35.00	41.99	
D+0.45W+0.75(RLL or R)-Zone 1	47.60	49.34	
D+0.45W+0.75(RLL or R)-Zone 2	47.60	49.34	
D+0.45W+0.75(RLL or R)-Zone 3	47.60	49.34	
D+0.45W+0.75S (Zone 1)	56.60	55.34	
D+0.45W+0.75S (Zone 2)	56.60	55.34	
D+0.45W+0.75S (Zone 3)	56.60	55.34	
D+0.7E	26.22	33.44	
D+0.525E+0.75S	50.02	48.93	
Uplift Load Cases (Gravity Direction)			
Without Overhang:			
0.6D+0.6W (Zone 1)	1.54	5.73	
0.6D+0.6W (Zone 2)	-3.11	1.09	
0.6D+0.6W (Zone 3)	-3.11	1.09	
With Overhang:			
0.6D+0.6W (Zone 1)	1.54	5.73	
0.6D+0.6W (Zone 2)	0.38	4.57	
0.6D+0.6W (Zone 3)	0.38	4.57	
0.6D+0.7E	14.42	18.39	
Governing LC (downward)	57.40	55.34	**-3.59**
Governing LC (uplift case)	-3.11	1.09	**0.0**
Allowable PV Array (psf)			11.92

Gravity Check: **New governing design load is less than existing design load. Per IEBC 2018 Section 502.4, structure is permitted to remain unaltered.**

Summary of Lateral Seismic Loads

Load Type	Before PV Array (kip)	After PV Array (kip)	% Increase
Effective Seismic Weight (N/S Dir)	103.34	111.37	7.8
Effective Seismic Weight (E/W Dir)	103.34	111.37	7.8
		Max:	7.8

Allowable PV Array Weight (kip)	10.33

Lateral Check: The increase in seismic demand-capacity due to addition of PV arrays is less than 10% of the existing demand-capacity. Per IEBC 2018 Section 502.5, Existing structure is permitted to remain unaltered.

Panel Pressure Load Check

Allowable Panel Pressure: Flat Roof Panels	50	psf
Allowable Panel Pressure: Pitch Roof Panels	78	psf

Max Wind Load:	31.9	psf
Max Wind Load Override:		psf
Max Snow Load:	40.27	psf

Note: User may used max wind load override to adjust for roof zone and module exposure criteria applicable for a specific site.

8.0. Connection Design Loads (Not Applicable)

Balanced Snow Load Areas

A (ft^2)	Module Edge Exposure	Maximum Tension (lb)			Maximum Compression (lb)			Max. Shear (lb)	Max. Comb. Tension/Shear (lb)			Max. Comb. Compression/Shear (lb)		
		Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3	All Zones	Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													

Unbalanced / Drift Snow Load Areas

A (ft^2)	Module Edge Exposure	Maximum Tension (lb)			Maximum Compression (lb)			Max. Shear (lb)	Max. Comb. Tension/Shear (lb)			Max. Comb. Compression/Shear (lb)		
		Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3	All Zones	Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													
	Exposed													
	Non-Exposed													

Roof Coefficient of Friction, μ =	

Summary of Connection Design Loads

		Effective Area, A (ft^2)					
Load (lb)	Max Value						
Maximum Tension (Exposed module)							
Maximum Tension (Non-Exposed module)							
Maximum Compression							
Maximum Shear							
Maximum Combined Tension/Shear (Exposed module)							
Maximum Combined Tension/Shear (Non-Exposed module)							
Maximum Combined Compression/Shear							

9.0. Connection Design Capacity (Not Applicable)

Connection Type		
Tension Capacity		lb
Compression Capacity		lb
Shear Capacity		lb
Comb. Tension / Shear Capacity (Exposed Module)		lb
Comb. Tension / Shear Capacity (Non-Exposed Module)		lb
Comb. Compression / Shear Capacity		lb
Geometry Check		

Connection Design Loads

Connection Effective Area, A		ft^2
Maximum Tension (Exposed module)		lb
Maximum Tension (Non-Exposed module)		lb
Maximum Compression		lb
Maximum Shear		lb
Maximum Combined Tension/Shear (Exposed module)		lb
Maximum Combined Tension/Shear (Non-Exposed module)		lb
Maximum Combined Compression/Shear		lb
Allowable Connection Spacing (based on Tension Capacity), S		ft

SS21-1: Lag Screw

Referenced sections, equations, and tables on this page are from NDS 2018, unless noted otherwise.

Depth of Top Chord/Rafter (Main Member),	d_{rafter}:	in	
Decking (side member),			
Decking (side member) Thickness,	d_{deck}:	in	
Embedment Length in Main Member,	p_t:	in	(in 1/2" increments. 2" min, not to exceed member depth)
Specific Gravity of Rafter Species,	G_{truss}:		Table 12.3.3A (Use G=0.42 for unknown species)
Specific Gravity of Deck Species,	G_{deck}:		Table 12.3.3B (Use G=0.42 for unknown species.
Lag Screw Diameter,	D:	in	Table L2
Lag Screw Root Diameter,	D_r:	in	Table L2
Lag Screw Bending Yield Strength,	F_{yb}:	psi	Portland Bolt - ASTM F593, https://www.portlandbolt.com/technical/specifications/astm-f593/
Length of Lag Screw Tappered Tip,	E:	in	Table L2
Design Embedment Length in Main Member	l_m:	in	
Embedment Length in Side Member,	l_s:	in	
Dowel Bearing Strength of Main Member,	F_{em}:	psi	Table 12.3.3, Fem = 11200*Gtruss
Dowel Bearing Strength of Side Member,	F_{es}:	psi	Table 12.3.3, Fes = 6100*Gpanel$^{1.45}$/sqrt(D)

Yield Limit Equations for Single Shear Dowel Type Connections

Diameter Coefficient,	K_D:	Table 12.3.1B, K_D = 10D+0.5 for 0.17"<D<0.25"
Angle to Grain Coefficient,	K_θ:	Table 12.3.1B, K_θ = 1+0.25(θ/90) where θ angle b/n load direction and grain direction (0<=θ<=90)
Reduction term,	R_d:	Table 12.3.1B, Rd = K_D*K_θ
	R_e:	Table 12.3.1A, Re = Fem/Fes
	R_t:	Table 12.3.1A, Rt = lm/ls ,
	k_1:	Table 12.3.1A, k1 = (sqrt(Re+2*Re^2*(1+Rt+Rt^2)+Rt^2*Re^3)-Re*(1+Rt))/(1+Re) ,
	k_2:	Table 12.3.1A, Sec. 12.3.7, k2 = -1+SQRT(2*(1+Re)+(2*Fyb*(1+2*Re)*Dr^2)/(3*Feml*lm^2))
	k_3:	Table 12.3.1A, Sec. 12.3.7, k3 = -1+SQRT(2*(1+Re)/Re+(2*Fyb*(2+Re)*Dr^2)/(3*Feml*ls^2))

Reference Single Shear Design Value, Z

Yield Mode Im	Z:	lb	Eqn. 12.3-1, Sec. 12.3.7, Z = Dr*lm*Fem/(R_D)
Yield Mode Is	Z:	lb	Eqn. 12.3-2, Sec. 12.3.7, Z = Dr*ls*Fes/(R_D)
Yield Mode II	Z:	lb	Eqn. 12.3-3, Sec. 12.3.7, Z = k_1*Dr*ls*Fes/(R_D)
Yield Mode IIIm	Z:	lb	Eqn. 12.3-4, Sec. 12.3.7, Z = k_2*Dr*lm*Fem/((1+2*R_e)*R_D)
Yield Mode IIIs	Z:	lb	Eqn. 12.3-5, Sec. 12.3.7, Z = k_3*Dr*ls*Fem/((2+Re)*R_D)
Yield Mode IV	Z:	lb	Eqn. 12.3-6, Sec. 12.3.7, Z = Dr^2/(R_D)*sqrt(2*Fem*Fyb/(3*(1+Re)))
Governing Mode	Z:	lb	
Load Duration Factor,	C_D:		Table 2.3.2, (1.15 if governed by snow, 1.6 if governed by seismic)
Wet Serive Factor,	C_M:		Table 10.3.3
Temperature Factor,	C_t:		Table 11.3.4
Geometry Factor,	C_Δ:		Sec. 12.5.1
Adjusted Shear Capacity,	Z':	lb	Sec. 12.3.2, Table 11.3.1, Z' = Z*C_D*D_M*C_t*D_Δ

Withdrawal Capacity

Reference Withdrawal Capacity,	W:	lb/in	Eqn. 12.2-1, W = 1800*G^(3/2)*D^(3/4)
Load Duration Factor,	C_D:		Table 2.3.2 (1.6 because uplift is governed by Wind or Seismic)
Wet Serive Factor,	C_M:		Table 10.3.3
Temperature Factor,	C_t:		Table 11.3.4
Geometry Factor,	C_Δ:		Sec. 12.5.1
Adjusted Withdrawal Capacity per inch,	W':	lb/in	Sec. 12.2.1, Table 12.2A, W' = W'*C_D*D_M*C_t*D_Δ
Adjusted Withdrawal Capacity,	W':	lb	Sec. 12.2.1, Table 12.2A, W' = W'*lm

Combined Shear and Withdrawal Capacity

Angle Between Load and Wood Surface (Exposed Edge),	α_{Exp}:	deg	
Angle Between Load and Wood Surface (Non-Exposed Edge),	α_{NExp}:	deg	
Adjusted Comb. Shear & Withdrawal Capacity (Exposed Edge),	Z'_{α_EXP}:	lb	Eqn. 12.4-1, $Z'\alpha_{Exp}$ = W'*p_t*Z'*(0.9/C_D)/(W'*p_t)*$\cos^2\alpha_{Exp}$+Z'*(0.9/C_D)*$\mathrm{Sin}^2\alpha_{Exp}$)
Adjusted Comb. Shear & Withdrawal Capacity (Non-Exposed Edge),	Z'_{α_NEXP}:	lb	Eqn. 12.4-1, $Z'\alpha_{NExp}$ = W'*p_t*Z'*(0.9/C_D)/(W'*p_t)*$\cos^2\alpha_{NExp}$+Z'*(0.9/C_D)*$\mathrm{Sin}^2\alpha_{NExp}$)

SS21-2: U-Anchor (U-Anchor 2400 or 2600 (F.O.S = 3))

Uplift Capacity,	$UAnchor_{uplift}$:		*lb*	Refs. 36
Shear Capacity,	$UAnchor_{shear}$:		*lb*	Refs. 36

SS21-3: S-5U (S-5U! Universal Clamp for Standing Seam Roofs)

Uplift Capacity,	$S5U_{uplift}$:		*lb*	Ref. 18
Shear Capacity,	$S5U_{shear}$:		*lb*	Ref. 18

SS21-4: Versabracket (F.O.S = 1.5)

Anchor Material,				
Uplift Capacity,	$Versabrkt_{uplift}$:		*lb*	Ref. 19
Shear Capacity,	$Versabrkt_{shear}$:		*lb*	Ref. 19

SS21-5: Bolt to Steel

Referenced sections, equations, and tables are found in AISC 14th Edition, unless noted otherwise.

Bot Diameter,	d_b:		*in*	
Nominal Shear Strength,	$F_{nv}\Omega$:		*ksi*	Table 7-1
Nominal Tension Strength,	$F_{nt}\Omega$:		*ksi*	Table 7-2
Nominal Bolt Area,	A_b:		in^2	
Bolt Shear Strength,	$r_{nv}\Omega$:		*lb*	J5.2,J3.6, F_{nv_Ω} = 0.85*Fnv*Ab
Bolt Tension Strength,	$r_{nt}\Omega$:		*lb*	J5.2,J3.6, F_{nv_Ω} = Fnt*Ab

Member Bearing Strength

Steel Member Yield Strength,	F_y:		*ksi*	
Steel Member Ultimate Stregth,	F_u:		*ksi*	
Member Flange Thickness,	t_f:		*in*	
Member Flange Width,	b_f:		*in*	
Member Web Thickness,	t_w:		*in*	
k1 Dimension,	k_{des}:		*in*	
Workable Gauge,	**gauge:**		*in*	
Min. Allowable Clear Distance,	l_c:		*in*	Table J3.4, lc = db+1/4-db/2-1/32 (in)
ASD Bearing Reduction Factor,	Ω_{brg}:			Sec. J3.10
Bearing Strength,	$R_n\Omega$:		*lb*	Sec. J3.10, R_{n_Ω} = min(1.2*lc*tf*Fu, 2.4*db*tf(Fu)/Ω_{brg}

Member Flange Bending

Effective Flange Width,	b_{eff}:		*in*	b_{eff} = (gage/2-k_{des})*2
Moment of Inertia,	I_{flange}:		in^4	I_{flange} = b_{eff}*t_f^3/12
Plastic Section Modulus,	Z_{flange}:		in^3	Z_{flange} = b_{eff}*d_i^2/4
ASD Bending Reduction Factor,	Ω_{bnd}:			Sec. F1
Flange Bending Strength,	$M_n\Omega$:		*kip.in*	M_{n_Ω} = Fy*S_{flange}/Ω_{bnd}
Maximum Tension for Moment,	T_{max}:		*lb*	T_{max} = M_{n_Ω} / (gage/2 - k_{des})

Geometry and Member Capacity Checks

Nut Diameter/Width,	G_{nut}:		*in*	(Nut Width = 0.557" across corners)
Nut Clearance Check,	**Clearance Check:**			

Tile Roof Connections

Load capacities are referenced in from Quick Mount PV State Compliance Letters. See Reference List in Section 3.0.

Roof Deck Thickness,	t_{deck}:		*in*	
Specific Gravity of Wood,	G_{truss}:			

SS22-1: Quick Hook Side **SS22-4: Quick Hook Bottom** (Quick Mount PV Quick Hook Mount (QMHLB, QMHLS, QMHSB, QMHSS))

Uplift Capacity Reduction,				Refs. 29 & 31, applied to adjust for deck thickness
Compression Capacity of QHook,	$QMH_{compression}$:		*lb*	Refs. 29 - 35
Uplift Capacity of QHook,	QMH_{uplift}:		*lb*	Refs. 29 - 35
Shear Capacity of QHook,	QMH_{shear}:		*lb*	Refs. 29 - 35

SS22-2: QBase (Quick Mount PV Qbase Universal Tile Mount (QMUTM))

Uplift Capacity Reduction,				Refs. 26 & 28, applied to adjust for deck thickness
Uplift Capacity of QBase,	$QBase_{uplift}$:		*lb*	Refs. 26 & 27
Shear Capacity of QBase,	$QBase_{shear}$:		*lb*	Refs. 26 & 27

SS22-3: Tile Replacement (Quick Mount PV Tile Replacement Mount (QMTRM))

Uplift Capacity Reduction,				Refs. 23 & 25, applied to adjust for deck thickness per Note 6.
Uplift Capacity of Tile Replacement Mount,	$QMTRM_{uplift}$:		*lb*	Refs. 23 & 24
Shear Capacity of Tile Replacement Mount,	$QMTRM_{shear}$:		*lb*	Refs. 23 & 24

SS22-5: IronRidge KO Tile (IronRidge Knockout Tile Roof Attachment)

Uplift Capacity of KO Tile Assembly,	**Uplift:**		*lb*	Ref. 37
Compression Capacity of KO Tile Assembly,	**Compression:**		*lb*	Ref. 37
Downslope Shear Capacity of KO Tile Assemb	**Downslope Shear:**		*lb*	Ref. 37
Across Slope Shear Capacity of KO Tile Assem	**Across Slope Shear:**		*lb*	Ref. 37

APPENDIX A
ASCE7 HAZARDS REPORT

ASCE 7 Hazards Report

Address:
1460 Route 9
Wappingers Falls, New York
12590

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Elevation: 163.43 ft (NAVD 88)
Latitude: 41.588387
Longitude: -73.907554

Wind

Results:

Wind Speed:	113 Vmph
10-year MRI	75 Vmph
25-year MRI	84 Vmph
50-year MRI	89 Vmph
100-year MRI	94 Vmph
Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4
Date Accessed:	Fri Jul 12 2019

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Mountainous terrain, gorges, ocean promontories, and special wind regions should be examined for unusual wind conditions.

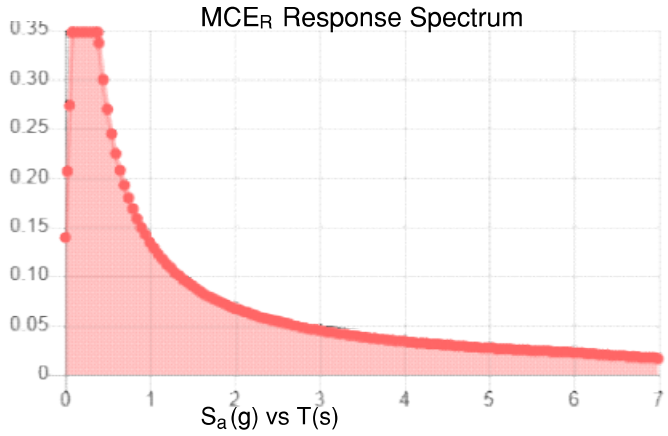
Seismic

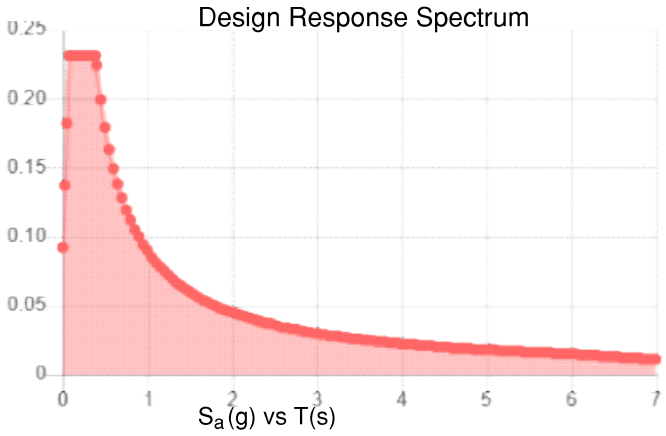
Site Soil Class: D - Default (see Section 11.4.3)

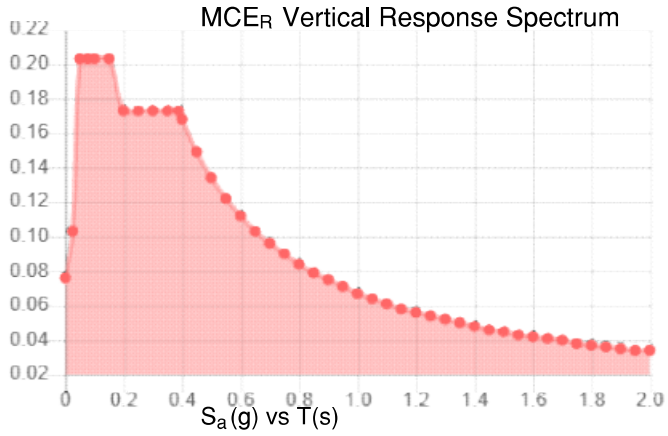
Results:

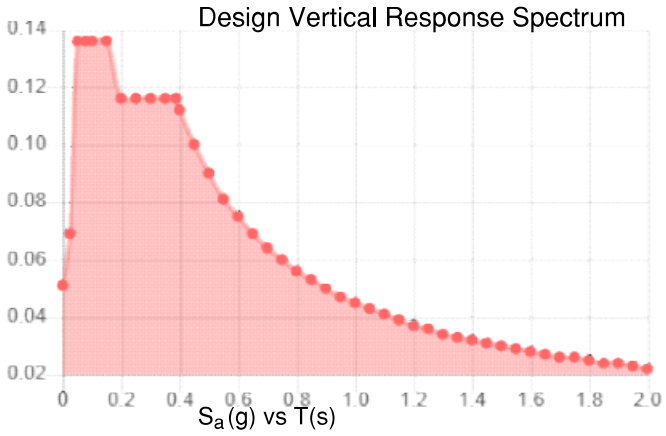
S_S :	0.217	S_{D1} :	0.09
S_1 :	0.056	T_L :	6
F_a :	1.6	PGA :	0.123
F_v :	2.4	PGA_M :	0.192
S_{MS} :	0.347	F_{PGA} :	1.553
S_{M1} :	0.134	I_e :	1
S_{DS} :	0.231	C_v :	0.733

Seismic Design Category B









Data Accessed: Fri Jul 12 2019

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

Ice

Results:

Ice Thickness:	1.00 in.
Concurrent Temperature:	15 F
Gust Speed:	40 mph
Data Source:	Standard ASCE/SEI 7-16, Figs. 10-2 through 10-8
Date Accessed:	Fri Jul 12 2019

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 500-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Snow

Results:

Ground Snow Load, p_g :	30 lb/ft^2
Elevation:	163.4 ft
Data Source:	ASCE/SEI 7-16, Table 7.2-8
Date Accessed:	Fri Jul 12 2019

Values provided are ground snow loads. In areas designated "case study required," extreme local variations in ground snow loads preclude mapping at this scale. Site-specific case studies are required to establish ground snow loads at elevations not covered.

Rain

Results:

15-minute Precipitation Intensity: 5.82 in./h

60-minute Precipitation Intensity: 2.51 in./h

Data Source: NOAA National Weather Service, Precipitation Frequency Data Server, Atlas 14 (https://www.nws.noaa.gov/oh/hdsc/)

Date Accessed: Fri Jul 12 2019

APPENDIX B
AURORA SHADE REPORT (SOLAR PANEL LAYOUT)

Aurora Shade Report

Customer
BatchK JPMCTrancheNY

Address
1460 Route 9
Wappingers Falls, NY
12590-4425

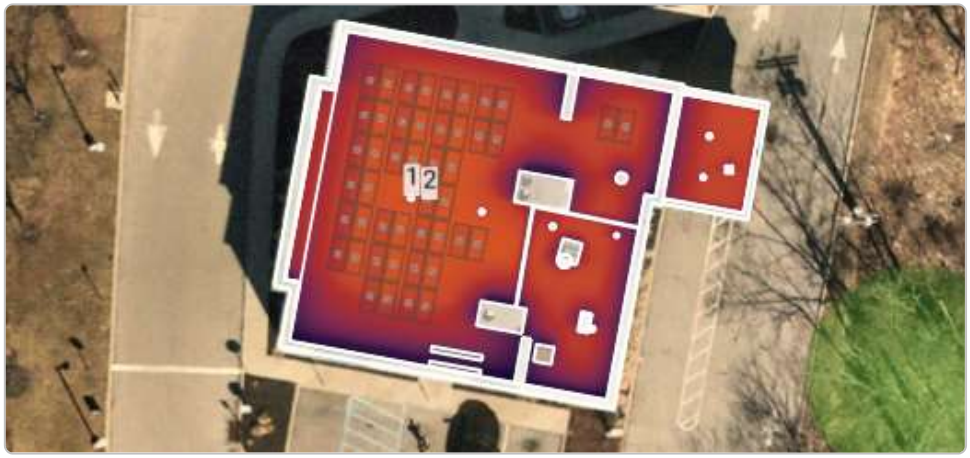
Designer
Charloemphon Thanasattayaviboon

Coordinates
(41.588136, -73.907589)

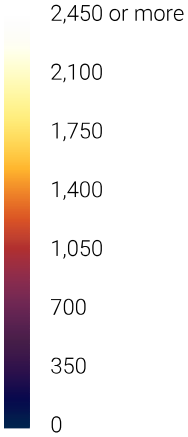
Organization
Black and Veatch

Date
12 May 2020

Annual irradiance



kWh/m^2/year



Summary

Array	Panel Count	Azimuth (deg.)	Pitch (deg.)	Annual TOF (%)	Annual Solar Access (%)	Annual TSRF (%)
1	23	281	8	84	92	78
2	23	101	8	86	95	81
Weighted average by panel count	-	-	-	-	93.5	79.5

Monthly solar access (%) across arrays

Array	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	87	90	92	94	94	94	94	94	93	92	90	86
2	89	92	94	96	96	96	96	96	95	93	92	89

Customer
BatchK JPMCTrancheNY

Address
1460 Route 9
Wappingers Falls, NY
12590-4425

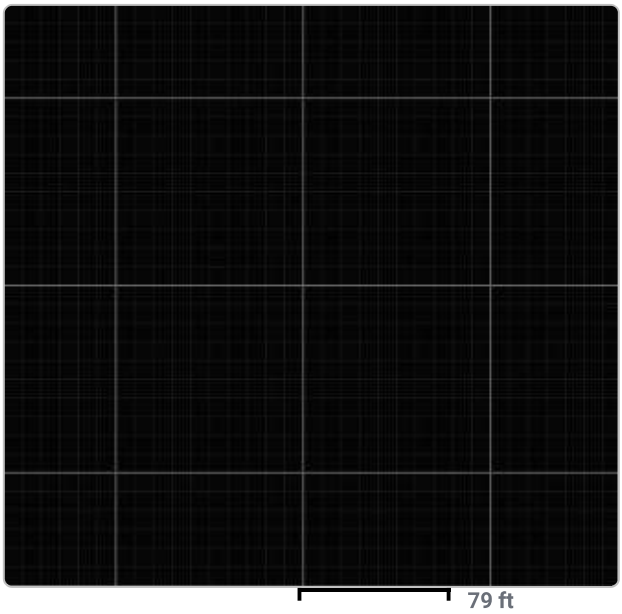
Designer
Charloemphon Thanasattayaviboon

Coordinates
(41.588136, -73.907589)

Organization
Black and Veatch

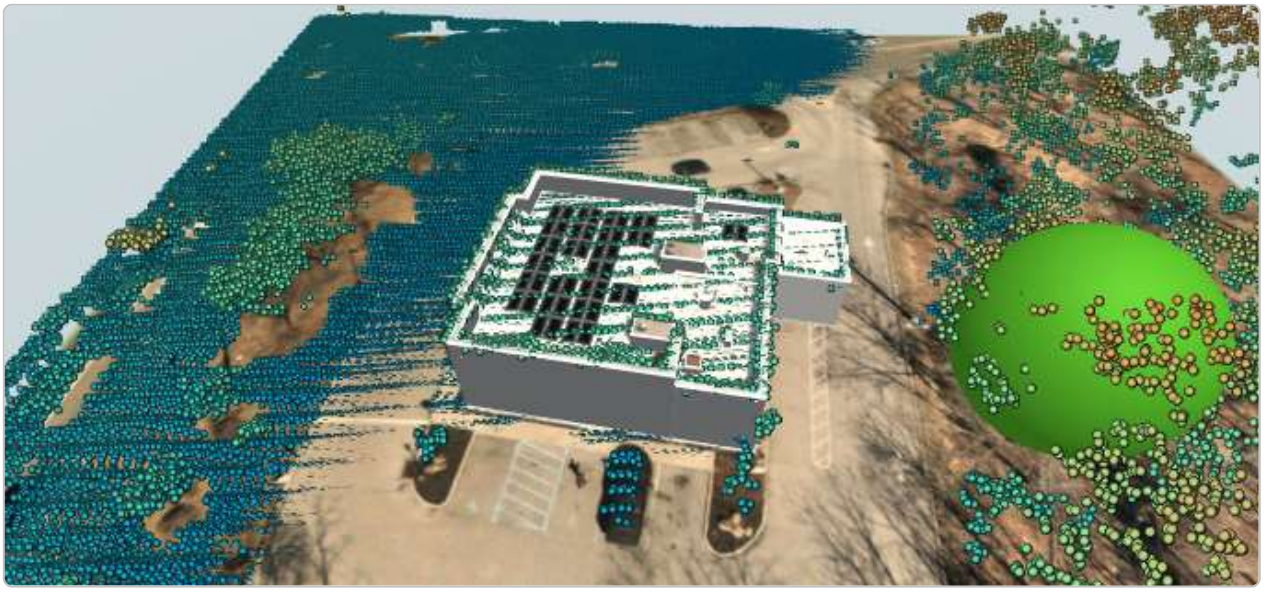
Date
12 May 2020

Zoomed out satellite view



3D model

3D model with LIDAR overlay



Customer
BatchK JPMCTrancheNY

Address
1460 Route 9
Wappingers Falls, NY
12590-4425

Designer
Charloemphon Thanasattayaviboon

Coordinates
(41.588136, -73.907589)

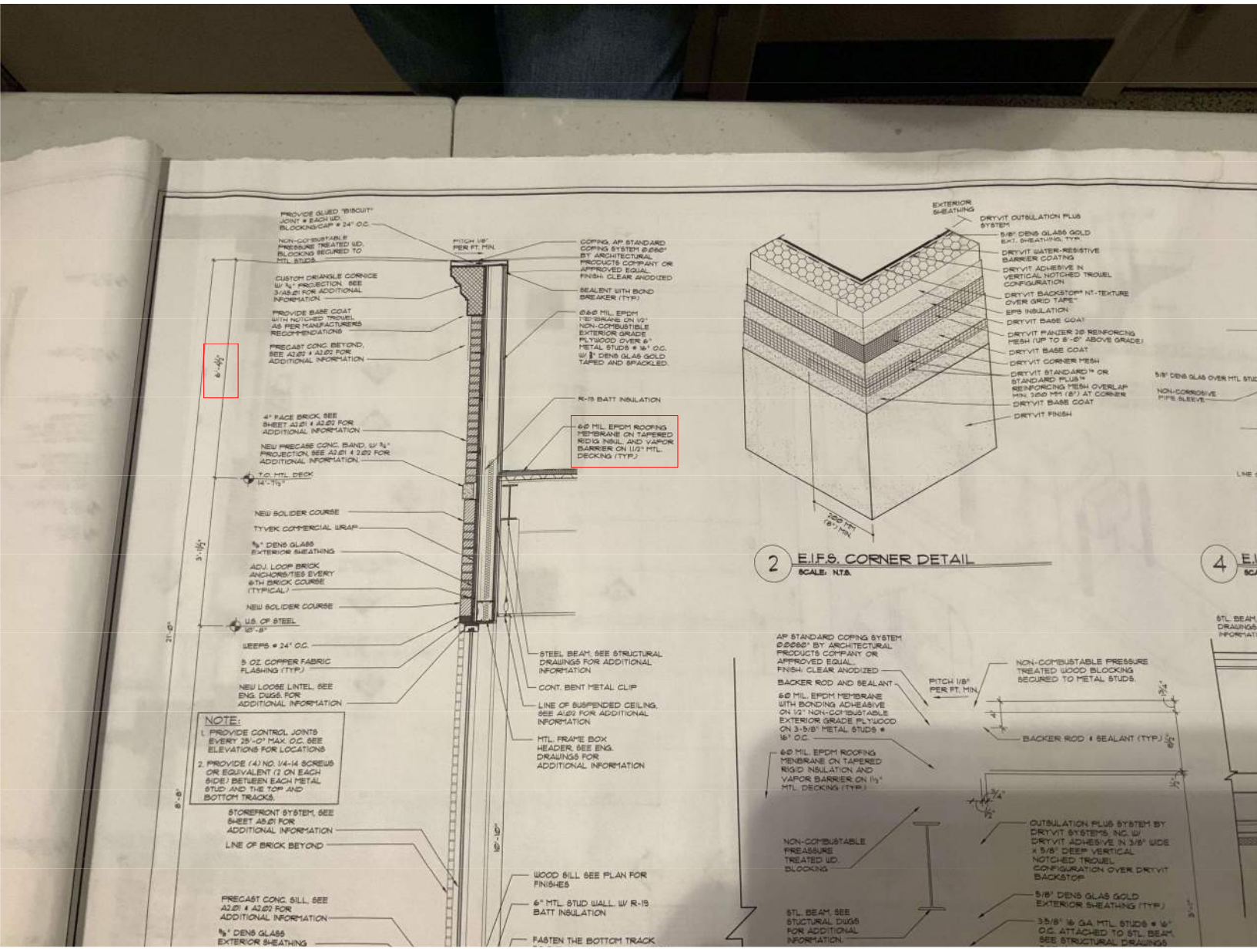
Organization
Black and Veatch

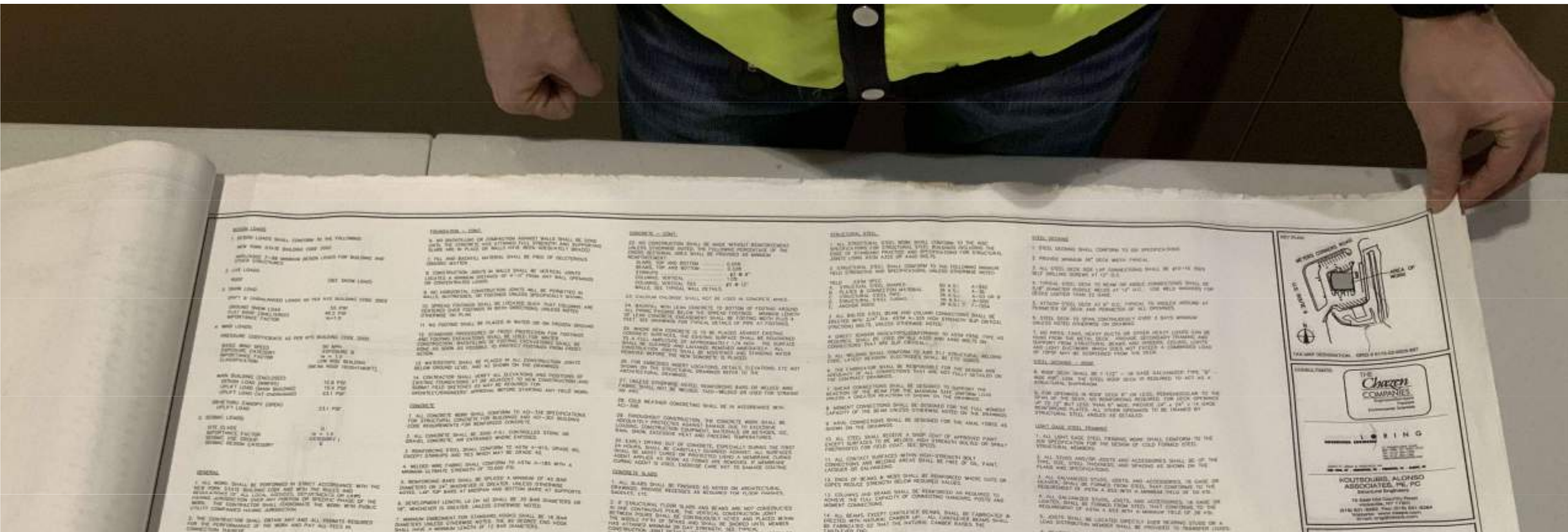
Date
12 May 2020

Street view and corresponding 3D model

I, **Charloemphon Thanasattayaviboon**, certify that I have generated this shading report to the best of my abilities, and I believe its contents to be accurate.

APPENDIX C
REFERENCE DRAWINGS


PROVIDE GLUED "BISCUIT" JOINT @ EACH WD. BLOCKING/CAP @ 24" O.C.
NON-COMBUSTABLE PRESSURE TREATED WD. BLOCKING SECURED TO MTL. STUDS.
CUSTOM DRIANGLE CORNICE W/ ¾" PROJECTION. SEE 3/A5.01 FOR ADDITIONAL INFORMATION.
PROVIDE BASE COAT WITH NOTCHED TROWEL AS PER MANUFACTURERS RECOMMENDATIONS
PRECAST CONC. BEYOND, SEE A2.01 & A2.02 FOR ADDITIONAL INFORMATION
4" FACE BRICK, SEE SHEET A2.01 & A2.02 FOR ADDITIONAL INFORMATION
NEW PRECAST CONC. BAND, W/ ¾" PROJECTION, SEE A2.01 & 2.02 FOR ADDITIONAL INFORMATION.
T.O. MTL. DECK 12'-1½"
NEW SOLIDER COURSE
TYVEK COMMERCIAL WRAP
⅝" DENS GLASS EXTERIOR SHEATHING
ADJ. LOOP BRICK ANCHORS/TIES EVERY 6TH BRICK COURSE (TYPICAL)
NEW SOLIDER COURSE
U.S. OF STEEL 10'-8"
WEEPS @ 24" O.C.
5 OZ. COPPER FABRIC FLASHING (TYP.)
NEW LOOSE LINTEL, SEE ENG. DWGS. FOR ADDITIONAL INFORMATION
NOTE:
1. PROVIDE CONTROL JOINTS EVERY 25'-0" MAX. O.C. SEE ELEVATIONS FOR LOCATIONS
2. PROVIDE (4) NO. 1/4-14 SCREWS OR EQUIVALENT (2 ON EACH SIDE) BETWEEN EACH METAL STUD AND THE TOP AND BOTTOM TRACKS.
STOREFRONT SYSTEM, SEE SHEET A5.01 FOR ADDITIONAL INFORMATION
LINE OF BRICK BEYOND
PRECAST CONC. SILL, SEE A2.01 & A2.02 FOR ADDITIONAL INFORMATION
⅝" DENS GLASS EXTERIOR SHEATHING
PITCH 1/8" PER FT. MIN.
COPING, AP STANDARD COPING SYSTEM @ 2@60° BY ARCHITECTURAL PRODUCTS COMPANY OR APPROVED EQUAL. FINISH: CLEAR ANODIZED
SEALENT WITH BOND BREAKER (TYP.)
60 MIL. EPDM 1'-0" BRAND ON ½" NON-COMBUSTIBLE EXTERIOR GRADE PLYWOOD OVER 6" METAL STUDS @ 16" O.C. W/ ⅝" DENS GLAS GOLD TAPED AND SPACKLED.
R-19 BATT INSULATION
60 MIL. EPDM ROOFING MEMBRANE ON TAPERED RIGID INSUL. AND VAPOR BARRIER ON 1½" MTL. DECKING (TYP.)
STEEL BEAM, SEE STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION
CONT. BENT METAL CLIP
LINE OF SUSPENDED CEILING, SEE A1.02 FOR ADDITIONAL INFORMATION
MTL. FRAME BOX HEADER, SEE ENG. DRAWINGS FOR ADDITIONAL INFORMATION
WOOD SILL SEE PLAN FOR FINISHES
6" MTL. STUD WALL, W/ R-19 BATT INSULATION
FASTEN THE BOTTOM TRACK
21'-6"
3'-11½"
8'-8"
6'-4½"
18'-10"
EXTERIOR SHEATHING
DRYVIT OUTSULATION PLUS SYSTEM
5/8" DENS GLASS GOLD EXT. SHEATHING, TYP.
DRYVIT WATER-RESISTIVE BARRIER COATING
DRYVIT ADHESIVE IN VERTICAL NOTCHED TROWEL CONFIGURATION
DRYVIT BACKSTOP® NT-TEXTURE OVER GRID TAPE™
EPS INSULATION
DRYVIT BASE COAT
DRYVIT PANZER 20 REINFORCING MESH (UP TO 8'-0" ABOVE GRADE)
DRYVIT BASE COAT
DRYVIT CORNER MESH
DRYVIT STANDARD™ OR STANDARD PLUS™ REINFORCING MESH, OVERLAP MIN. 3/50 MM (8") AT CORNER
DRYVIT BASE COAT
DRYVIT FINISH
5/8" DENS GLAS OVER MTL STUD
NON-CORROSIVE PIPE SLEEVE
200 MM (8") MIN.
2 E.I.F.S. CORNER DETAIL
SCALE: N.T.S.
4 E.I
SCA
AP STANDARD COPING SYSTEM @2@60° BY ARCHITECTURAL PRODUCTS COMPANY OR APPROVED EQUAL. FINISH: CLEAR ANODIZED
BACKER ROD AND SEALANT
60 MIL. EPDM MEMBRANE WITH BONDING ADHESIVE ON ½" NON-COMBUSTABLE EXTERIOR GRADE PLYWOOD ON 3-5/8" METAL STUDS @ 16" O.C.
60 MIL. EPDM ROOFING MEMBRANE ON TAPERED RIGID INSULATION AND VAPOR BARRIER ON 1½" MTL. DECKING (TYP.)
PITCH 1/8" PER FT. MIN.
NON-COMBUSTABLE PRESSURE TREATED WOOD BLOCKING SECURED TO METAL STUDS.
BACKER ROD & SEALANT (TYP.)
NON-COMBUSTABLE PRESSURE TREATED WD. BLOCKING
OUTSULATION PLUS SYSTEM BY DRYVIT SYSTEMS, INC. W/ DRYVIT ADHESIVE IN 3/8" WIDE x 5/8" DEEP VERTICAL NOTCHED TROWEL CONFIGURATION OVER DRYVIT BACKSTOP
5/8" DENS GLAS GOLD EXTERIOR SHEATHING (TYP.)
STL. BEAM, SEE STUCTURAL DWGS FOR ADDITIONAL INFORMATION
3.5/8" 16 GA MTL. STUDS @ 16" O.C. ATTACHED TO STL. BEAM, SEE STRUCTURAL DRAWINGS
STL. BEAM DRAWINGS INFORMATI



THE Chazen COMPANIES
LORING
KOUTSOUBIS, ALONSO ASSOCIATES, PE, PC
DATE
DESCRIPTION
ISSUED FOR BID
BLDG DEPT SUB
REV.
DATE
DESCRIPTION
JPMorganChase
NEW BRANCH BUILDING
WAPPINGER FALLS, NY, 12590
TOWN OF WAPPINGER
JRS ARCHITECT, P.C.
30 West 24th Street, 3rd Floor, New York, NY
797 State Road, Princeton, NJ 08540-1414
THESE DRAWINGS ARE INSTRUMENTS OF SERVICE AND AS SUCH ARE THE PROPERTY OF JRS ARCHITECT, P.C. ANY INFRINGEMENTS OR ALTERATIONS BY OTHERS ARE PROHIBITED.
DRAWING TITLE:
STRUCTURAL NOTES
DRAWN BY:
CHECKED BY:
DATE:
SCALE:
AS NOTED
FILE NAME:
JRS NUMBER:
05135
SHEET NUMBER:
S1.01

DESIGN LOADS

1. DESIGN LOADS SHALL CONFORM TO THE FOLLOWING:

   NEW YORK STATE BUILDING CODE 2002

   ANSI/ASCE 7-98 MINIMUM DESIGN LOADS FOR BUILDING AND OTHER STRUCTURES

2. LIVE LOADS:

ROOF	(SEE SNOW LOAD)

3. SNOW LOAD:

   DRIFT & UNBALANCED LOADS AS PER NYS BUILDING CODE 2002

GROUND SNOW LOAD	55 PSF
FLAT ROOF (SHELTERED)	46.2 PSF
IMPORTANCE FACTOR	Is=1.0

4. WIND LOADS:

   PRESSURE COEFFICIENTS AS PER NYS BUILDING CODE 2002

BASIC WIND SPEED	90 MPH
EXPOSURE CATEGORY	EXPOSURE B
IMPORTANCE FACTOR	Iw = 1.0
CLASSIFICATION	LOW RISE BUILDING (MEAN ROOF HEIGHT<60FT)
MAIN BUILDING (ENCLOSED):	
DESIGN LOAD (MWFRS)	12.8 PSF
UPLIFT LOAD (MAIN BUILDING)	15.4 PSF
UPLIFT LOAD (AT OVERHANGS)	23.1 PSF
DRIVETHRU CANOPY (OPEN):	
UPLIFT LOAD	23.1 PSF

5. SEISMIC LOADS:

SITE CLASS	D
IMPORTANCE FACTOR	Ie = 1.0
SEISMIC USE GROUP	CATEGORY I
SEISMIC DESIGN CATEGORY	B

GENERAL

1. ALL WORK SHALL BE PERFORMED IN STRICT ACCORDANCE WITH THE NEW YORK STATE BUILDING CODE AND WITH THE RULES AND REGULATIONS OF ALL LOCAL AGENCIES, DEPARTMENTS OR LAWS HAVING JURISDICTION OVER ANY PORTION OR SPECIFIC PHASE OF THE WORK. THE CONTRACTOR SHALL COORDINATE THE WORK WITH PUBLIC UTILITY COMPANIES HAVING JURISDICTION.

2. THE CONTRACTOR SHALL OBTAIN ANY AND ALL PERMITS REQUIRED FOR THE PERFORMANCE OF THE WORK AND PAY ALL FEES IN CONNECTION THEREOF.

3. CONTRACTOR SHALL COORDINATE [illegible]

FOUNDATION - CONT.

6. NO BACKFILLING OR COMPACTION AGAINST WALLS SHALL BE DONE UNTIL THE CONCRETE HAS ATTAINED FULL STRENGTH AND SUPPORTING SLABS ARE IN PLACE OR WALLS HAVE BEEN ADEQUATELY BRACED.

7. FILL AND BACKFILL MATERIAL SHALL BE FREE OF DELETERIOUS ORGANIC MATTER.

8. CONSTRUCTION JOINTS IN WALLS SHALL BE VERTICAL JOINTS LOCATED A MINIMUM DISTANCE OF 4'-0" FROM ANY WALL OPENINGS OR CONCENTRATED LOADS.

9. NO HORIZONTAL CONSTRUCTION JOINTS WILL BE PERMITTED IN WALLS, BUTTRESSES, OR FOOTINGS UNLESS SPECIFICALLY SHOWN.

10. SPREAD FOOTINGS SHALL BE LOCATED SUCH THAT COLUMNS ARE CENTERED OVER FOOTINGS IN BOTH DIRECTIONS, UNLESS NOTED OTHERWISE ON PLAN.

11. NO FOOTING SHALL BE PLACED IN WATER OR ON FROZEN GROUND.

12. STANDARD PROCEDURES OF FROST PROTECTION FOR FOOTINGS AND FOOTING EXCAVATIONS SHALL BE USED FOR WINTER CONSTRUCTION. BACKFILLING OF FOOTING EXCAVATIONS SHALL BE DONE AS SOON AS POSSIBLE TO PROTECT FOOTINGS FROM FROST ACTION.

13. WATERSTOPS SHALL BE PLACED IN ALL CONSTRUCTION JOINTS BELOW GROUND LEVEL AND AS SHOWN ON THE DRAWINGS.

14. CONTRACTOR SHALL VERIFY ALL ELEVATIONS AND POSITIONS OF EXISTING FOUNDATIONS AT OR ADJACENT TO NEW CONSTRUCTION AND SUBMIT FIELD SKETCHES AS MAY BE REQUIRED FOR ARCHITECT/ENGINEERS' APPROVAL BEFORE STARTING ANY FIELD WORK.

CONCRETE

1. ALL CONCRETE WORK SHALL CONFORM TO ACI-318 SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS AND ACI-301 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.

2. ALL CONCRETE SHALL BE 3500 P.S.I. CONTROLLED STONE OR GRAVEL CONCRETE, AIR ENTRAINED WHERE EXPOSED.

3. REINFORCING STEEL SHALL CONFORM TO ASTM A-615, GRADE 60, EXCEPT STIRRUPS AND TIES WHICH MAY BE GRADE 40.

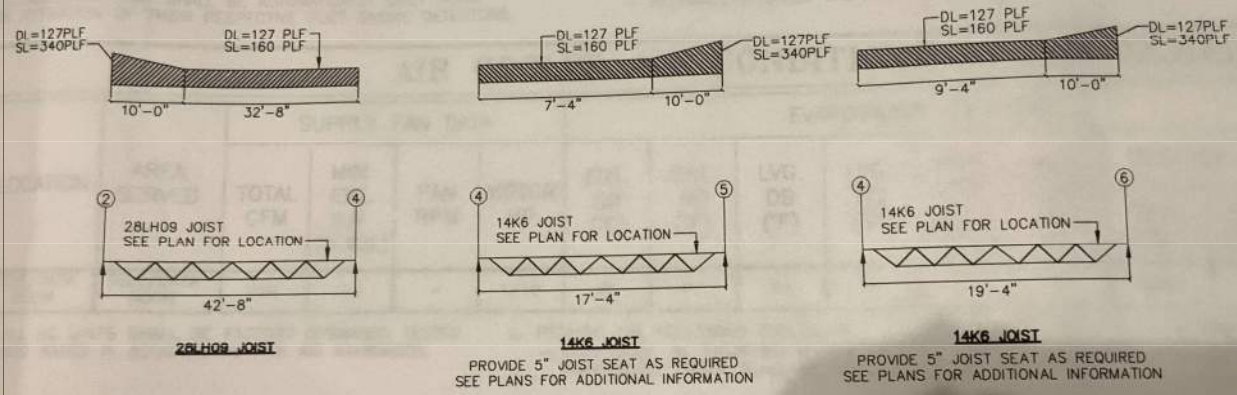
4. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A-185 WITH A MINIMUM ULTIMATE STRENGTH OF 70,000 PSI.

5. REINFORCING BARS SHALL BE SPLICED A MINIMUM OF 45 BAR DIAMETERS OR 24" WHICHEVER IS GREATER, UNLESS OTHERWISE NOTED. LAP TOP BARS AT MIDSPAN AND BOTTOM BARS AT SUPPORTS.

6. DEVELOPMENT LENGTH, Ld (or ld) SHALL BE 35 BAR DIAMETERS OR 18", WHICHEVER IS GREATER, UNLESS OTHERWISE NOTED.

7. MINIMUM EMBEDMENT FOR STANDARD HOOKS SHALL BE 16 BAR DIAMETERS UNLESS OTHERWISE NOTED. THE 90 DEGREE END HOOK SHALL HAVE A MINIMUM LENGTH OF 12 BAR DIAMETERS.

8. MINIMUM CONCRETE COVERING OF [illegible]



28LH09 JOIST

14K6 JOIST

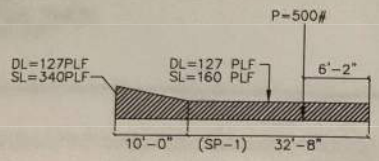
PROVIDE 5" JOIST SEAT AS REQUIRED
SEE PLANS FOR ADDITIONAL INFORMATION

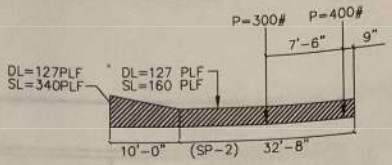
14K6 JOIST

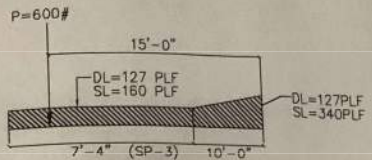
PROVIDE 5" JOIST SEAT AS REQUIRED
SEE PLANS FOR ADDITIONAL INFORMATION

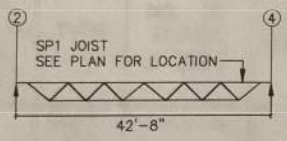
TYPICAL LOADING AT OPEN-WEB JOISTS

DL=127PLF
SL=340PLF

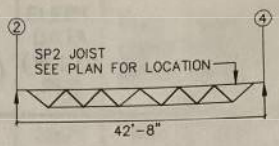




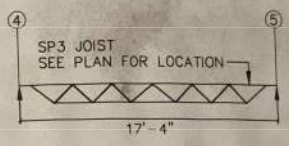




SP1 JOIST AT RTU-1



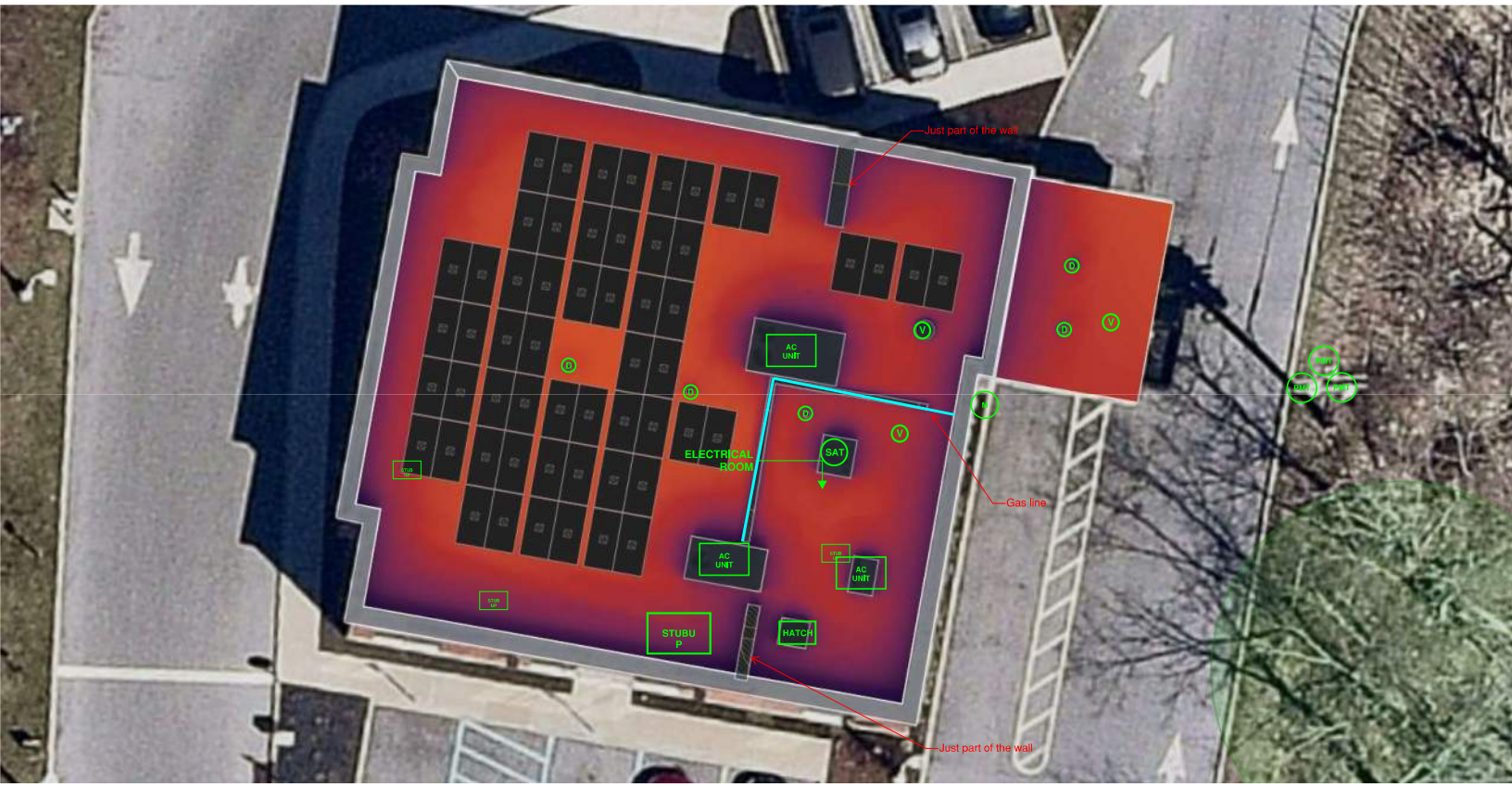
SP2 JOIST AT RTU-2

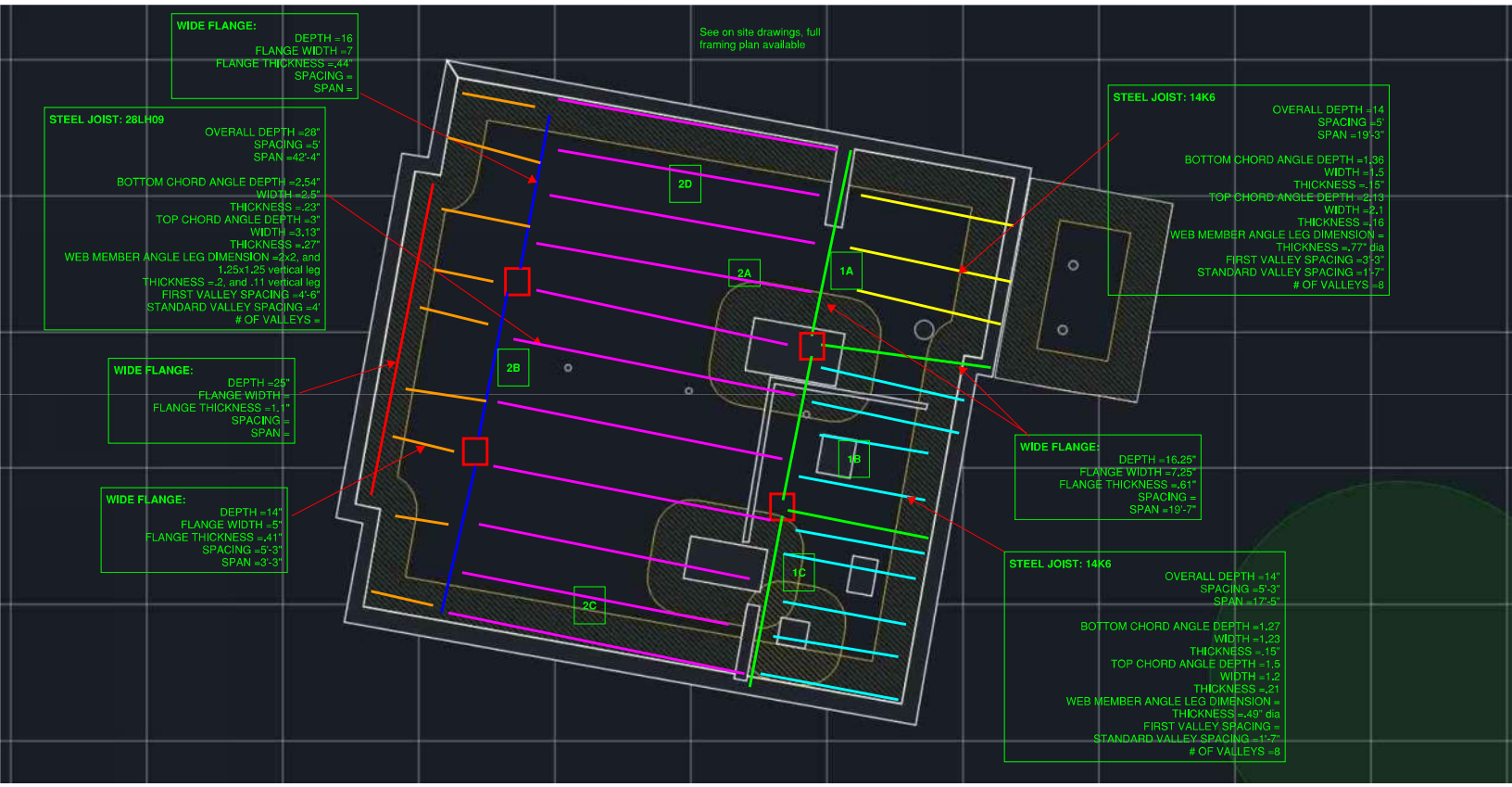


SP3 JOIST AT RTU-1

SPECIAL LOADING AT OPEN-WEB JOISTS

APPENDIX D
SITE INSPECTION DATA


Just part of the wall
AC UNIT
ELECTRICAL ROOM
SAT
Gas line
AC UNIT
AC UNIT
STUBU P
HATCH
Just part of the wall


WIDE FLANGE:
DEPTH =16
FLANGE WIDTH =7
FLANGE THICKNESS =.44"
SPACING =
SPAN =
See on site drawings, full framing plan available
STEEL JOIST: 28LH09
OVERALL DEPTH =28"
SPACING =5'
SPAN =42'-4"
BOTTOM CHORD ANGLE DEPTH =2.54"
WIDTH =2.5"
THICKNESS =.23"
TOP CHORD ANGLE DEPTH =3"
WIDTH =3.13"
THICKNESS =.27"
WEB MEMBER ANGLE LEG DIMENSION =2x2, and 1.25x1.25 vertical leg
THICKNESS =.2, and .11 vertical leg
FIRST VALLEY SPACING =4'-6"
STANDARD VALLEY SPACING =4'
OF VALLEYS =
STEEL JOIST: 14K6
OVERALL DEPTH =14
SPACING =5'
SPAN =19'-3"
BOTTOM CHORD ANGLE DEPTH =1.36
WIDTH =1.5
THICKNESS =.15"
TOP CHORD ANGLE DEPTH =2.13
WIDTH =2.1
THICKNESS =.16
WEB MEMBER ANGLE LEG DIMENSION =
THICKNESS =.77" dia
FIRST VALLEY SPACING =3'-3"
STANDARD VALLEY SPACING =1'-7"
OF VALLEYS =8
WIDE FLANGE:
DEPTH =25"
FLANGE WIDTH =
FLANGE THICKNESS =1.1"
SPACING =
SPAN =
WIDE FLANGE:
DEPTH =14"
FLANGE WIDTH =5"
FLANGE THICKNESS =.41"
SPACING =5'-3"
SPAN =3'-3"
WIDE FLANGE:
DEPTH =16.25"
FLANGE WIDTH =7.25"
FLANGE THICKNESS =.61"
SPACING =
SPAN =19'-7"
STEEL JOIST: 14K6
OVERALL DEPTH =14"
SPACING =5'-3"
SPAN =17'-5"
BOTTOM CHORD ANGLE DEPTH =1.27
WIDTH =1.23
THICKNESS =.15"
TOP CHORD ANGLE DEPTH =1.5
WIDTH =1.2
THICKNESS =.21
WEB MEMBER ANGLE LEG DIMENSION =
THICKNESS =.49" dia
FIRST VALLEY SPACING =
STANDARD VALLEY SPACING =1'-7"
OF VALLEYS =8
2D
2A
1A
2B
1B
1C
2C

APPENDIX E
RACKING DESIGN REPORT

UNIRAC

U-BUILDER PROJECT REPORT

VERSION: 2.2.7

PROJECT TITLE	PROJECT ID	CREATED
NY-150111	47B9DD70	Dec. 12, 2019, 10:58 a.m.

NAME	Black & Veatch
ADDRESS	1460 Route 9
CITY, STATE	Wappingers Falls, NY
MODULE	Mission MSE385SR9S

Designed by JPMCRooftopSolar@bv.com

ROOFMOUNT RMDT

Mission

46 - MSE385SR9S

997.57 ft^2

17.71 KW

BILL OF MATERIALS

LEGEND: Base System Part Accessory

PART NUMBER	PART TYPE	DESCRIPTION	QUANTITY	SUGGESTED QUANTITY	UNIT PRICE (USD)	TOTAL LIST PRICE (USD)
UserSupplied	Ballast Block	Ballast Block	161	161	0.00	0.00
310802	Ballast Bay	RMDT Valley Bay	40	40	26.19	1047.60
310825	Mid Clamp	RMDT Mid Clamp 36-40mm	60	60	2.05	123.00
310820	End Clamp	RM End Clamp 32-40mm	120	120	1.94	232.80
310860	Nut	Kit 1/4 20 Clip On Nut SS 18-8	180	180	0.32	57.60
310801	Ballast Bay (Ridge)	RMDT Ridge Bay	30	30	29.43	882.90
008002S	Grounding Lug (Weeb)	GROUND WEEBLUG #1	2	2	6.44	12.88

BASE SYSTEM PRICE	ACCESSORIES PRICE	TOTAL PRICE
$2343.90	$12.88	$2356.78
$0.132 PER WATT	$0.001 PER WATT	$0.133 PER WATT

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International Building Code 2009, 2012, 2015, 2018 and ASCE 7-05, ASCE 7-10, ASCE 7-16 and California Building Code 2010, 2016. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

DETAILED PARTS DESCRIPTION

QTY

Ballast Block UserSupplied Ballast Block — 161

Standard 4x8x16 inch cap blocks. Nationwide availability. Please confirm the weight of your ballast block as this will affect the total blocks required for your installation.

Ballast Bay 310802 RMDT Valley Bay — 40

Galvanized steel bay attaches to east and west module edges and provides ballast placement location.

Mid Clamp 310825 RMDT Mid Clamp 36-40mm — 60

Stainless steel mid clamp with ¼-20 stainless bolt, pairs with Ridge bay.

End Clamp 310820 RM End Clamp 32-40mm — 120

Stainless steel end clamp (32-40mm) with ¼-20 stainless bolt, pairs with Valley bay.

Nut 310860 Kit 1/4 20 Clip On Nut SS 18-8 — 180

Stainless steel clip-on 1/4-20 u-nut.

Ballast Bay (Ridge) 310801 RMDT Ridge Bay — 30

Galvanized steel bay attaches to east and west module edges and provides ballast placement location.

Grounding Lug (Weeb) 008002S GROUND WEEBLUG #1 — 2

For electrical bonding of PV modules and rails. Accepts one 14AWG to 6AWG or two 12 AWG to 10 AWG copper wires. Tin plated copper body, 1/4" stainless steel fasteners.

ENGINEERING REPORT

Plan review

AVERAGE PSF	**6.99 psf**
TOTAL NUMBER OF MODULES	46
TOTAL KW	17.71 KW
TOTAL AREA	~1149 ft^2
TOTAL WEIGHT ON ROOF	8031 lbs
RACKING WEIGHT	487 lbs
MODULE WEIGHT	2392 lbs
BALLAST WEIGHT	5152 lbs
MAX BAY LOAD (DEAD)	221 lbs

Loads Used for Design

BUILDING CODE	ASCE 7-16
BASIC WIND SPEED	115.00 mph
GROUND SNOW LOAD	30.00 psf
SEISMIC (SS)	0.21
ELEVATION	164.00 ft
WIND EXPOSURE	B
MRI	50

Loads Determined by Zip 12590

CITY, STATE	Wappingers Falls, NY
BASIC WIND SPEED	104.00 mph
GROUND SNOW LOAD	30.00 psf

Inspection

PRODUCT	ROOFMOUNT RMDT
MODULE MANUFACTURER	Mission
MODEL	MSE385SR9S
MODULE WATTS	385 watts
MODULE LENGTH	78.70"
MODULE WIDTH	39.68"
MODULE THICKNESS	1.58"
MODULE WEIGHT	52.00 lbs
BALLAST BLOCK (CMU) WEIGHT	32.0 lbs
BUILDING HEIGHT	20.00 ft
ROOF TYPE	OTHER
PARAPET HEIGHT	> 1 Array Height (> 10 inches)

Array 1

AVERAGE PSF	6.99 psf

TOTAL NUMBER OF MODULES:	46
TOTAL KW:	17.71 KW
TOTAL AREA:	1149 ft^2
TOTAL WEIGHT ON ROOF:	8031 lbs
RACKING WEIGHT:	487 lbs
MODULE WEIGHT:	2392 lbs
BALLAST WEIGHT:	5152 lbs

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	12.0"
TO FIXED OBJECT ON ROOF:	24.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	24.0"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	48.0"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	29
MAX NUMBER OF EAST-WEST COLUMNS:	35

*See ASCE 7-16 Section 13.6.12 for more details

RMDT U-BUILDER PRODUCT ASSUMPTIONS

RMDT – Ballasted Flat Roof Systems

Limitations of Responsibility: It is the user's responsibility to ensure that inputs are correct for your specific project.
Unirac is not the solar, electrical, or building engineer of record and is not responsible for the solar, electrical, or building design for this project.

Building Assumptions

1. Risk Category II
2. Building Height ≤ 50 ft
3. Building Height > 50 ft: only where (longest length of building x building height)^0.5 ≤ 100 ft
4. Roof Slope ≥ 0° (0:12) and ≤ 3° (5/8:12) for Seismic Design Category C, D, E and F. For low seismic regions Seismic Design Category A and B (provided Array Importance factor = 1.0), Roof Slope ≥ 0° (0:12) and ≤ 7° (1 1/2:12).
5. Roofing Material Types: EDPM, PVC, TPO, or Mineral Cap
6. Surrounding Building Grade: Level

Ballast Blocks

The installer is responsible for procuring the ballast blocks (Concrete Masonry Units – CMU) and verifying the required minimum weight needed for this design. CMU should comply with ASM standard specification for concrete roof pavers designation (C1491 or C90 with an integral water repellant suitable for the climate it is placed. It is recommended that the blocks are inspected periodically for any signs of degradation. If degradation of the block is observed, the block should immediately be replaced.
The CMU ballast block should have nominal dimensions of 4"x8"x16". The actual block dimensions are 3/8" less than the nominal dimensions. Ballast blocks should have a weight as specified for the project in the "Inspection" section of this report.

Design Parameters

1. Risk Category II
2. Wind Design
    a. Basic Wind Speed: 110-150 mph (ASCE 7-10)/90-180 mph (ASCE 7-16)
    b. Exposure: B or C (ASCE 7-10/ASCE 7-16)
    c. 25 year Design Life/50 year Design Life for ASCE 7-16
    d. Elevation: Insertion of the project at - grade elevation can result in a reduction of wind pressure. If your project is in a special case study region or in an area where wind studies have been performed, please verify with your jurisdiction to ensure that elevation effects have not already been factored into the wind speed. If elevation effects have been included in your wind speed, please select 0 ft as the project site elevation.
    e. Wind Tunnel Testing: Wind tunnel testing coefficients have been utilized for design of the system.
3. Snow Design
    a. Ground Snow Load: 0-80 psf (ASCE 7-10/ASCE 7-16)
    b. Exposure Factor: 0.9
    c. Thermal Factor: 1.2
    d. Roof Snow Load: Calculation per Section 7.3 (ASCE 7-10/ASCE 7-16)
    e. Unbalanced/Drifting/Sliding: Results are based on the uniform snow loading and do not consider unbalanced, drifting, and sliding conditions
4. Seismic Design
    a. Report *SEAOC PV1-2012/ASCE 7-16 SECTION 13.6.12 – Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Arrays*
    b. Seismic Site Class: A, B, C, or D (ASCE 7-10/ASCE 7-16)
    c. Importance Factor Array (Ip): 1.0
    d. Importance Factor Building (Ie): 1.0
    e. Site Class: D

Properties

1. Ridge Bay Weight: ~7.7 lbs
2. Valley Bay Weight: ~5.6 lbs
3. Module Gaps (N/S) = 0.25 in
4. Bays: East and west column bays overhang the module by ~7.9 inches.

Testing

1. Coefficient of Friction
2. Wind Tunnel
3. UL 2703
4. Component Testing (Bay and Clamp)

Setbacks

For the wind tunnel recommendations in U-Builder to apply, the following setbacks should be observed/followed for U-Builder wind design:

1. Modules should be placed a minimum of 3 feet from the edge of the building in any direction.
2. If the array is located near an obstruction that is 3.5 feet wide and 3.5 feet high or larger, the nearest module of the array must be located a distance from the obstruction that is greater than or equal to the height of the obstruction.
3. Installations within the setbacks listed above require site specific engineering[2]
4. The setbacks above are for wind. High seismic areas, fire access isles, mechanical equipment, etc., may require larger setbacks than listed above for wind.

Site Specific Engineering

Conditions listed below are beyond the current capabilities of U-Builder. Site specific engineering is required.

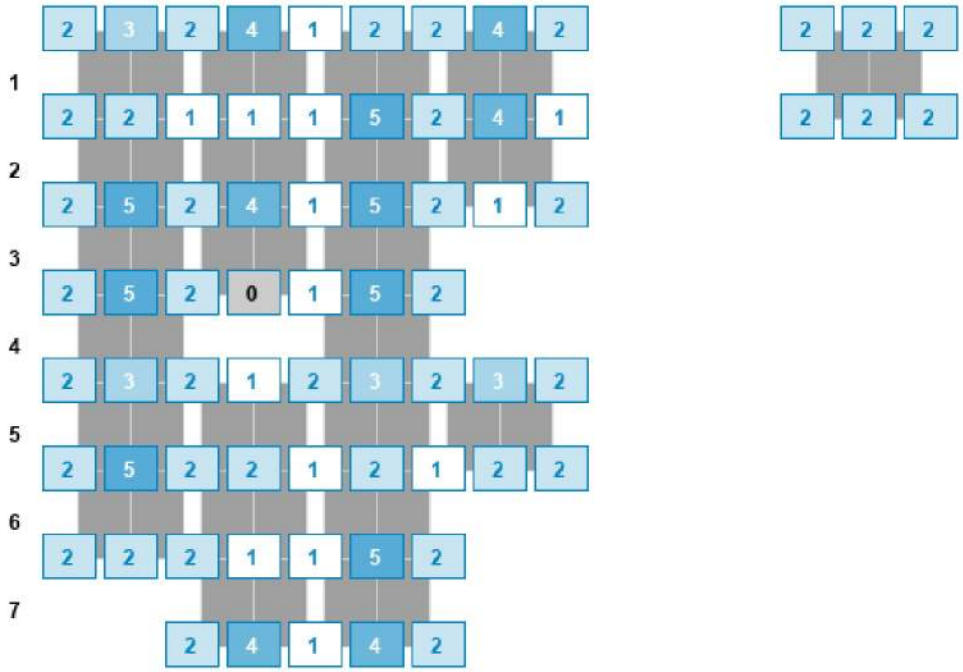
1. Wind designs for a project design life exceeding 25 years[1]/ASCE 7-16
2. Building assumptions and design parameters outside of U-Builder assumptions[2]
3. Attachments[2]
4. Risk Category III or IV projects (U-Builder can be adjusted for the correct wind, but not the seismic or snow design)[2]
5. Wind tunnel testing reduction factors are not permitted by the Authority Having Jurisdiction (AHJ)[3]
6. Seismic designs that fall outside SEAOC PV1-2012/ASCE 7-16 SECTION 13.6.12 recommendations (>3% roof slope, or AHJ's that require shake table testing or non-linear site-specific response history analysis)[3]
7. Signed and sealed site-specific calculations, layouts, and drawings[3]

Notes:

[1]Please contact info@unirac.com.
[2] Please contact EngineeringServices@unirac.com for more information.
[3]Please contact Theresa Allen with PZSE Structural Engineers at theresa@pzse.com. These items will require direct coordination with PZSE to complete the requested services.

INSTALLATION AND DESIGN PLAN

Roof Area 1 / Array 1



LEGEND

Module

1 Standard corner bay with CMU block count

4 Supplemental bay with CMU block count

NOTE

Bays in the space beside modules are supplemental bays. You can fit a maximum of 2 blocks in valley bays, and 5 blocks in ridge bays. If the number in these bays is greater, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 46.03 ft
EW DIMENSION	~ 52.10 ft

ROW	MODULES	BAYS	BALLAST BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	10	12	28	896
2	8	12	25	800
3	6	9	24	768

4	4	7	17	544
5	8	9	20	640
6	6	9	19	608
7	4	7	15	480
8	0	5	13	416

APPENDIX F
SOLAR ARRAY WEIGHT SUMMARY
(NOT USED)

APPENDIX G
DETAILED MEMBER CHECK
(NOT USED)

APPENDIX H
REFERENCE CATALOG / BROCHURE
(NOT USED)