



JUL 25, 2016, 02:55 PM

PROJECT TITLE: YPSILANTI FIRE STATION
PROJECT ID: E841C2DF

Name:	McNaughton - McKay Elec.	Designed by JMadrid
Address:	None	RM-BALLASTED FLAT ROOF
City, State:	Unknown,	176 - 285 Watt Panels
Module:	SolarWorld SW 285 mono (33mm)	4914 Sq Ft.
	285 Watts	50.2 kWs

BILL OF MATERIALS

PARTS AND ACCESSORIES





Legend: ● Base System ● Part Accessory

Part Number	Part Type	Description	Quantity	Suggested Quantity	Unit Price (USD)	Total List Price (USD)
310710	Ballast Bay	RM Ballast Bay 10 Degree	232	232	81.20	18838.40
310750	Module Clip	RM Module Clip	812	812	2.15	1745.80
UserSupplied	Ballast Block	Ballast Block	527	527	0.00	0.00
310751	RM Hex Bolt	RM Hex Bolt (Module Clip)	812	812	0.90	730.80

BASE SYSTEM \$21315.00 \$0.42 PER WATT	ACCESSORIES \$0.00 \$0.00 PER WATT	TOTAL PRICE \$21315.00 \$0.42 PER WATT
---	---	---

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International Building Code 2003, 2006, 2009, 2012 and ASCE 7-02, ASCE 7-05, ASCE 7-10 and California Building Code 2010. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

DETAILED PARTS DESCRIPTIONS

	310710 RM Ballast Bay 10 Degree Aluminum ballast bay attaches to north and south module edges (for 10 degree tilt installations) and provides ballast placement location.	Ballast Bay 232
	310750 RM Module Clip Aluminum clip fastens module frame to ballast bay and provides bonding path from module to bay to module.	Module Clip 812
	UserSupplied Ballast Block 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 Block 527
	310751 RM Hex Bolt (Module Clip) Hex bolt with integrated locking patch.	RM Hex Bolt 812



JUL 25, 2016, 02:55 PM

PROJECT TITLE: YPSILANTI FIRE STATION
PROJECT ID: E841C2DF

Name:	McNaughton - McKay Elec.	Designed by JMadrid
Address:	None	RM-BALLASTED FLAT ROOF
City, State:	Unknown,	176 - 285 Watt Panels
Module:	SolarWorld SW 285 mono (33mm)	4914 Sq Ft.
	285 Watts	50.2 kWs

ENGINEERING REPORT

Plan review

Average PSF: 5.02 lbs/ft²

Total Number of Modules:	176
Total KW:	50 KW
Total Area:	4914 ft ²
Total weight on roof:	24663 lbs
- Racking weight:	812 lbs
- Module weight:	6987 lbs
- Ballast weight:	16864 lbs
- Max Bay Load (Dead):	171 lbs

Loads Used for Design

- Building Code:	ASCE 7-05
- Wind Speed:	90 mph
- Ground Snow Load:	0 psf
- Roof Snow Load:	0.0 psf
- Seismic (Ss):	0.00
- Wind Exposure:	B

Loads Determined by Zip

- City, State:	Unknown
- Wind Speed:	0 mph
- Ground Snow Load:	0 psf

Inspection

Product:	RM-BALLASTED FLAT ROOF
Module Manufacturer:	SolarWorld
Model:	SW 285 mono (33mm)
Module Watts:	285 watts
Module Length:	65.94 "
Module Width:	39.41 "
Module Thickness:	1.30 "
Module Weight:	39.70 lbs
Ballast Block Weight:	32 lbs
Max Blocks per Bucket:	4
Building Height:	25 ft
Roof Type:	Other
Parapet Height:	None

WORKSPACE 1

Average PSF:	5.02 lbs/ft ²
Total Number of Modules:	176
Total KW:	50.2 KW
Total Area:	4914 ft ²
Total weight on roof:	24663 lbs
- Racking weight:	812 lbs
- Module weight:	6987 lbs
- Ballast weight:	16864 lbs

Minimum Seismic Separation:	
- Array to Array:	3 in
- To Obstruction or Parapet:	6 in
- To Roof Edge (no Parapet):	9 in
Max Array Dimensions (Seismic):	
- NS Dimension:	0 ft
- EW Dimension:	0 ft

RM PRODUCT ASSUMPTIONS

RM – Ballasted Flat Roof Systems

1. Importance Factor = 1
2. Building Height \leq 60 ft.
3. Roof Slope \geq 1.2° and $<$ 3°
4. Topographic Factor (K_{zt}) = 1
5. ASCE 7-05: Basic Wind Speed: 85-150 mph (IBC 2006/ASCE 7-05). Wind Exposure: B or C.
6. ASCE 7-10: Basic Wind Speed: 110-180 mph (IBC 2012/ASCE 7-10). Wind Exposure: B or C.
7. Ballast Calculations are based on ASCE 7-05 & ASCE 7-10 load combinations and product specific wind tunnel testing per ASCE 7-05 and ASCE 7-10
8. Ground Snow Load: 0-60 psf. (Reduction can be input if this is acceptable with your local building authority). Results are based on uniform snow loading and do not consider unbalanced, drifting, and sliding conditions.
9. Roof Snow Load: Reduction calculated per Section 7.3 of ASCE 7-05 with the following assumptions: Exposure factor = 0.9, Thermal factor = 1.2, Importance factor = 1. Please verify these are appropriate for your site before using the max bay loads reported above.
10. Dead Load Due to Racking: 3.5 lbs. per ballast tray
11. Module Gaps (E/W): 0.25 in.
12. Seismic: Installations must be in seismic site class A, B, C, or D as defined in IBC 2006/ASCE 7-05.

SEAO PV1-2012 describes Structural Seismic Requirements for Rooftop Photovoltaic Arrays

Minimum Separation Distance: SEAO PV1-2012 prescribes a minimum separation distance for unattached PV arrays on rooftops.

Array Size Limits for Seismic: SEAO PV1-2012 limits the size of an unattached array by the design strength of the system connections.

Assumptions:

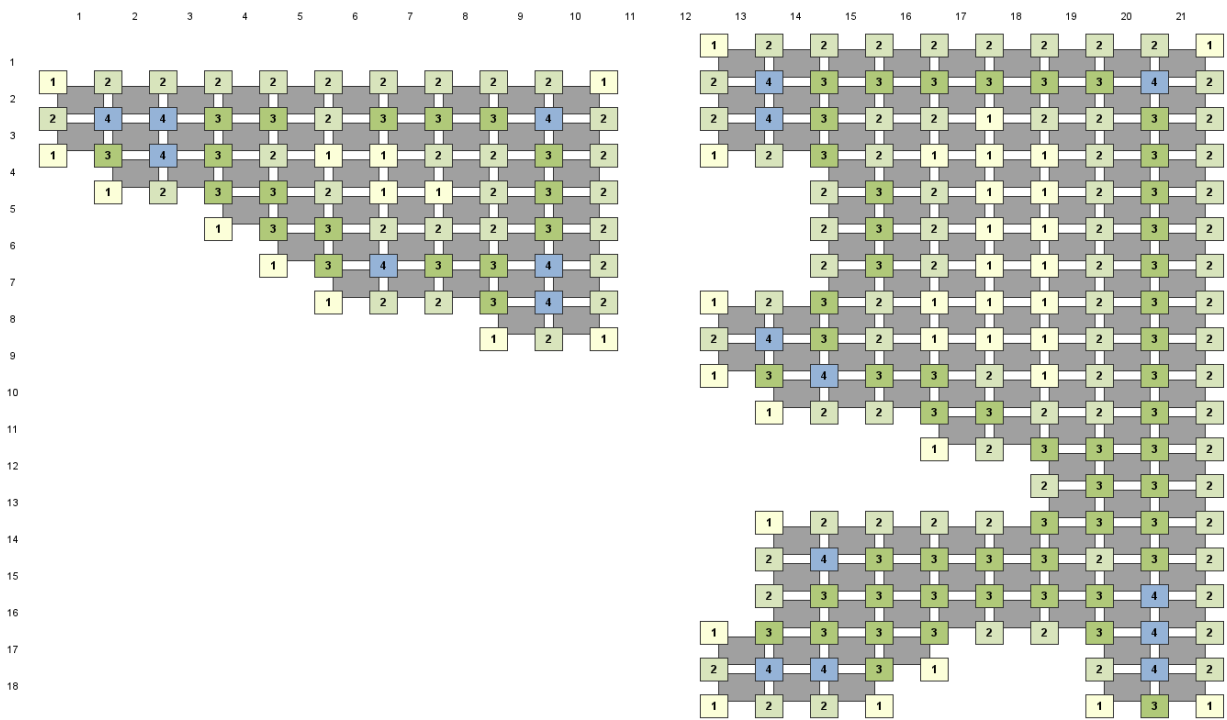
1. For Unattached Rooftop Photovoltaic Arrays
2. Array Importance Factor, $I_p = 1.0$
3. Building Importance Factor, $I_e = 1.0$
4. Site Class = D
5. Separation (S) is to a qualified parapet or rooftop obstruction
6. Array to Array Minimum Distance = $0.5 * S$
7. Array to Unqualified Parapet Minimum Distance = $1.5 * S$
8. S_s : Spectral response acceleration parameter at short periods per ASCE 7-05
9. S_d : Design, 5 percent damped spectral acceleration parameter at short periods per ASCE 7-05
10. A minimum module return flange of 0.9in (when using 1-3/4 in. clip bolts) is required for all RM installations
11. A minimum module return flange of 0.65in (when using 2 in. clip bolts) is required for all RM installations
12. Coefficient of friction used for calculations = 0.4

PROJECT TITLE: YPSILANTI FIRE STATION
PROJECT ID: E841C2DF

Name:	McNaughton - McKay Elec.	Designed by JMadrid
Address:	None	RM-BALLASTED FLAT ROOF
City, State:	Unknown,	176 - 285 Watt Panels
Module:	SolarWorld SW 285 mono (33mm)	4914 Sq Ft.
	285 Watts	50.2 kW

INSTALLATION AND DESIGN PLAN

LAYOUT WORKSPACE 1



Note: Blocks above with values greater than 4 require extra ballast bays. The proper number of bays are provided in the Bill of Materials. The installer must install these extra bays as near to the indicated location as possible.

Layout Dimensions				
NS Dimension:		~89.1 ft		
EW Dimension:		~115.8 ft		
Row	Modules	Buckets	Ballast Blocks	Ballast Weight
1	9	10	18	576
2	19	21	50	1600
3	19	21	56	1792

4	16	21	42	1344
5	14	18	36	1152
6	13	16	34	1088
7	12	15	36	1152
8	11	16	32	1024
9	9	13	25	800
10	8	10	24	768
11	5	9	20	640
12	3	6	14	448
13	3	4	10	320
14	8	9	20	640
15	8	9	25	800
16	8	9	26	832
17	6	10	26	832
18	5	8	22	704
19	0	7	11	352