CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools **DEPARTMENT PRIORITY:** 7

(1) **PROJECT NAME:** Paving Replacement/Storm Water - Districtwide
PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) **PROJECT DESCRIPTION AND JUSTIFICATION:**

This request for capital budget funding is for the continued upgrades of existing parking areas, driveways, and stormwater management systems at District Schools. Additionally, this project also continues the District's efforts to comply with National Pollutant Discharge Elimination System (NPDES) regulations, which require all City and School buildings' stormwater run-off, including from roofs, is pretreated prior to allowing stormwater to run into streams, brooks, ponds, etc. This project will focus on improvements at Barbieri Elementary School. This request includes projected project costs, design, and a design and construction contingency.

Barbieri Elementary School Improvements
Pavement mill and overlay; new ADA compliant sidewalk and pedestrian ramps; parking and driveway restriping; expansion and repaving of emergency access road behind building (utilized as a bus pickup/dropoff road); stormwater management system upgrades; project design and administration;

Design - $76,500
Construction- $992,000
Contingency- $131,500
TOTAL - $1,200,000

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) **PURPOSE OF PROJECT:**

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) **BUDGET REQUEST BY YEAR:**

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design	76,500					
d.	Construction	992,000					
e.	Equipment/Vehicles						
f.	Contingency	131,500					
g.	Other						
	TOTAL	1,200,000	-	-	-	-	-

(5) **PRIORITY:**

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.	X	**service improvement**	new or improved service to meet demand

(6) **EFFECTS ON ANNUAL OPERATING BUDGET:**

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) **PROPOSED FUNDING SOURCE(S):**
1) **Bond**
2)
3)

(10) **PROJECT OR EQUIPMENT LOCATION:** **Districtwide - Barbieri**

(11) **ASSET TYPE:** **Site Infrastructure**

(7a) **POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)**

(8)	**PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)**	
	TBD	
(9)	**FINANCE DEPARTMENT NOTES:**	

7. **Paving / Stormwater Improvements –Barbieri Elementary School**

FY25:

This request for capital budget funding is for the continued upgrades of existing parking areas, driveways, and stormwater management systems at District School's. Additionally, this project also continues the District's efforts to comply with National Pollutant Discharge Elimination System (NPDES) regulations, which require all City and School buildings' stormwater run-off, including from roofs, is pretreated prior to allowing stormwater to run into streams, brooks, ponds, etc. This project will focus on improvements at Barbieri Elementary School. This request includes projected project costs, design, and a design and construction contingency.

- **Barbieri Elementary School Improvements**
  Pavement mill and overlay; new ADA compliant sidewalk and pedestrian ramps; parking and driveway restriping; expansion and repaving of emergency access road behind building (utilized as a bus pickup/dropoff road); stormwater management system upgrades; project design and administration;

- Design - $76,500
- Construction- $992,000
- Contingency- $131,500
- **TOTAL - $1,200,000**

Paving and Stormwater Improvement Design and Construction Barbieri				
Location	**Cost**			
Design	*$76,500*			
Construction	*$992,000*			
Subtotal	*$1,068,500*			
Contingency	*$131,426*			
PROJECT TOTAL	**$1,199,926**			

City of Framingham
Department of Public Works
IFB# PW345-On Call Road Rehab - Barbieri Elementary School

Item No.	Estimated	Unit	Description	Newport Construction (2023) Price	Cost
101.	0.2	AC	Clearing and Grubbing	$ 1,500.00	$ 300.00
120.1	3,220	CY	Unclassified Excavation	$ 15.00	$ 48,300.00
129.	3,300	SY	Hot Mix Asphalt Pavement Milling	$ 8.00	$ 26,400.00
151.	2,020	CY	Gravel Borrow	$ 5.00	$ 10,100.00
170.	9,087	SY	Fine Grading and Compacting	$ 22.00	$ 199,914.00
201.5	3	EA	Catch Basin Municipal Standard	$ 9,000.00	$ 27,000.00
252.12	50	FT	12 Inch Corrugated Plastic Pipe	$ 220.00	$ 11,000.00
452.	859	GAL	Asphalt Emulsion for Tack Coat	$ 15.00	$ 12,885.00
455.23	1,099	TON	Superpave Surface Course - 12.5 (SSC - 12.5)	$ 127.00	$ 139,513.73
455.31	1,706	TON	Superpave Intermediate Course - 12.5 (SIC - 12.5)	$ 127.00	$ 216,648.90
504.	410	FT	Granite Curb Type VA-4 - Straight	$ 68.00	$ 27,880.00
509.	78	FT	Granite Transition Curb for Wheelchair Ramps (Straight/Curved Avg)	$ 75.00	$ 5,850.00
580.	280	FT	Curb Removed and Reset	$ 15.00	$ 4,200.00
701.2	96	SY	Cement Concrete Wheelchair Ramp	$ 200.00	$ 19,200.00
702.	81	TON	Hot Mix Asphalt Walk Surface	$ 260.00	$ 21,060.00
751.9	102	CY	Loam Borrow and Seed	$ 10.00	$ 1,020.00
860.92	3,940	FT	6 Inch Reflectorized White Line (Epoxy Resin)	$ 3.00	$ 11,820.00
864.07	30	SF	Pavement Arrow and Legends (Epoxy)	$ 1.50	$ 45.00
874.7	7	EA	Miscellaneous Signs Removed and Stacked	$ 500.00	$ 3,500.00
	1	LS	Stormwater Management	$ 40,000.00	$ 40,000.00
					$ 826,636.64
				Cont. 20%	$ 165,327.33
					$ 991,963.97
			Construction Total		**$ 992,000.00**

Engineering	$28,000
Survey	$5,000
Permitting	$8,500
CA Services	$35,000
Total	**$76,500**

Framingham
PUBLIC SCHOOLS
Embracing differences. Inspiring futures.

FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Paving and Stormwater Improvements - $1,200,000

Barbieri Elementary School

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 11

(1) PROJECT NAME: Farley Rooftop Solar System Purchase and Installation

PROJECT STATUS: NEW Project This Year

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital funding is for the design and installation of a photovoltaic panel system at the Farley Administration Building.

FPS initiated a feasibility study through Gale and Solar Design Associates (SDS). The provided study was comprehensive and included a roof area plan with added PV array loading for each roof area. The study incorporated a structural analysis, feasibility assessment, proposed system size and helioscope. Gale also provided an opinion on the structural capacity of the existing roof framing to support the proposed PV array loading. Gale believes the roof framing at Farley can support an increased loading of 6.5 lbs per sf. The PV array that SDS proposes has a load of around 5 lbs per square foot. The consensus being Farley Roof can fully support the system.

This funding request of $1,750,000 would allow the Department to work with on-call engineering firms to engage in design development of a complete solar photovoltaic system and purchase the system/installation outright.

This project will reduce our carbon footprint, reduce greenhouse gas emissions, and lower energy costs. .

The Farley Administration Building was constructed in 1973. The roof at Farley was recently replaced (summer of 2023). This enabling work has provided a solid platform for photovoltaic panels. The District has recently returned to this facility, utilizing it as a welcome center and central office for administration. The building is currently co-occupied with MassBay Community College, whose lease expires in December of 2023.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
X	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction	1,750,000					
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	1,750,000	-	-	-	-	-

(5) PRIORITY:

a.		**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.		**level service maintenance**	maintains City desired level of service
c.	X	**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION: **Farley Administration Building**

(11) ASSET TYPE:

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

State Incentive Programs (possibility)

(8)	**PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)**	
	TBD	
(9)	**FINANCE DEPARTMENT NOTES:**	

11. **Farley Rooftop Solar PV**

This request for capital funding is for the design and installation of a photovoltaic panel system at the Farley Administration Building.

FPS initiated a feasibility study through Gale and Solar Design Associates (SDS). The provided study was comprehensive and included a roof area plan with added PV array loading for each roof area. The study incorporated a structural analysis, feasibility assessment, proposed system size and helioscope. Gale also provided an opinion on the structural capacity of the existing roof framing to support the proposed PV array loading. Gale believes the roof framing at Farley can support an increased loading of 6.5 lbs per sf. The PV array that SDS proposes has a load of around 5 lbs per square foot. The consensus being Farley Roof can fully support the system.

This funding request of $1,750,000 would allow the Department to work with on-call engineering firms to engage in design development of a complete solar photovoltaic system and purchase the system/installation outright.

This project will reduce our carbon footprint, reduce greenhouse gas emissions, and lower energy costs. .

The Farley Administration Building was constructed in 1973. The roof at Farley was recently replaced (summer of 2023). This enabling work has provided a solid platform for photovoltaic panels. The District has recently returned to this facility, utilizing it as a welcome center and central office for administration. The building is currently co-occupied with MassBay Community College, whose lease expires in December of 2023.

- Design - $150,000
- Construction - $1,400,000
- Contingency - $200,000
- **TOTAL - $1,750,000**

Farley Rooftop Solar System
Purchase and Installation

Location	Cost			
Design	*$150,000*			
Construction	*$1,400,000*			
Total	*$1,550,000*			
Project Contingency	*$200,000*			
PROJECT TOTAL	**$1,750,000**			

Gale Associates, Inc.
300 Ledgewood Place, Suite 300 | Rockland, MA 02370
P 781.335.6465 F 781.335.6467
www.galeassociates.com

April 13, 2023

Framingham Public Schools
73 Mount Wayte Avenue, Suite #5
Framingham, MA 01701

Attn: Mr. Thomas Begin, Assistant Director
Buildings & Grounds Department
Framingham Public Schools
19 Flagg Drive
Framingham, MA
T: (508) 782-6864
E: tbegin@framingham.k12.ma.us

Re: Photovoltaic Array Feasibility Study
Farley School
19 Flagg Drive
Framingham, MA 01702
Gale JN 840180

Dear Mr. Begin:

In accordance with our Contract Amendment No. 001, Gale Associates, Inc. (Gale) is submitting to Framingham Public Schools (FPS) a photovoltaic (PV) array feasibility study for the Farley School, located at 19 Flagg Drive, Framingham, MA. This study includes a roof plan designating acceptable added PV array loading for each roof area as determined by our structural analysis (Appendix A) and a PV array feasibility assessment with various attachments developed by our PV array consultant, Solar Design Associates (SDA). Gale also performed a structural review of the roof framing to provide an opinion regarding the structural capacity of the existing roof framing to support the proposed PV array loading presented in SDA's feasibility assessment.

Gale had initially analyzed the existing roof framing with 6.5 pounds per square foot (psf) of added loading. It is Gale's experience that ballasted PV array systems often result in increased loading between 4 and 8 psf. Gale provided an opinion that the existing roof joists have the capacity to support 6.5 psf maximum of added loading, with the exception of one area that is outlined on the attached roof plan (Appendix A). Gale shared this loading information with SDA, which was incorporated in their feasibility assessment. Upon further review of the 2015 International Building Code (IBC), it is Gale's opinion that the roof framing in this outlined area can also support an increase loading of 6.5 psf.

Following receipt of SDA's April 11, 2023 PV array feasibility assessment, Gale reviewed the preliminary average PV array loading provided in Table 3 of SDA's report (Appendix B, Page 6). This table shows that SDA's preliminary PV array layout/ballast results in average loading below 6.5 psf for each roof area. It should be noted there will be areas where the loading on individual joints/framing members may be larger than the associated average loading since PV array ballast is not distributed evenly. At this time, Gale has not reviewed framing members for PV array loading higher than 6.5 psf. If FPS intends to proceed with the design phase for PV array installation, detailed structural analysis will need to be performed with consideration of the specific PV array ballast layout and associated loading with respect to each framing member supporting the array (not currently included in our proposed services). This detailed structural analysis will require additional information about the PV array layout, including a drawing locating all PV arrays on the structural framing plan, total loading applied at each panel, and an accurate cut sheet of the PV array system showing the array support members and ballast blocks.

The enclosed SDA feasibility assessment also summarizes various PV array incentive potentials and other PV array-specific information. SDA informed Gale that they anticipate that minimal roof penetrations will be associated with the current PV array plan (currently assumed to be two penetrations for conduit and two anchorage locations; this information would be more clearly defined during a subsequent design phase).

We trust this information meets your needs at this time. Please do not hesitate to contact the undersigned if you require additional information regarding this matter.

Best regards,

GALE ASSOCIATES, INC.

Kathryn M. Crouchley/lad

Kathryn M. Crouchley
Staff Designer
Structural Group

Allison E. O'Neill/lad

Allison E. O'Neill, P.E.
President
Structural Group

John W. Kurpeski/lad

John W. Kurpeski, P.E.
Project Manager
BECC Group

KMC/AEO/JWK/lad

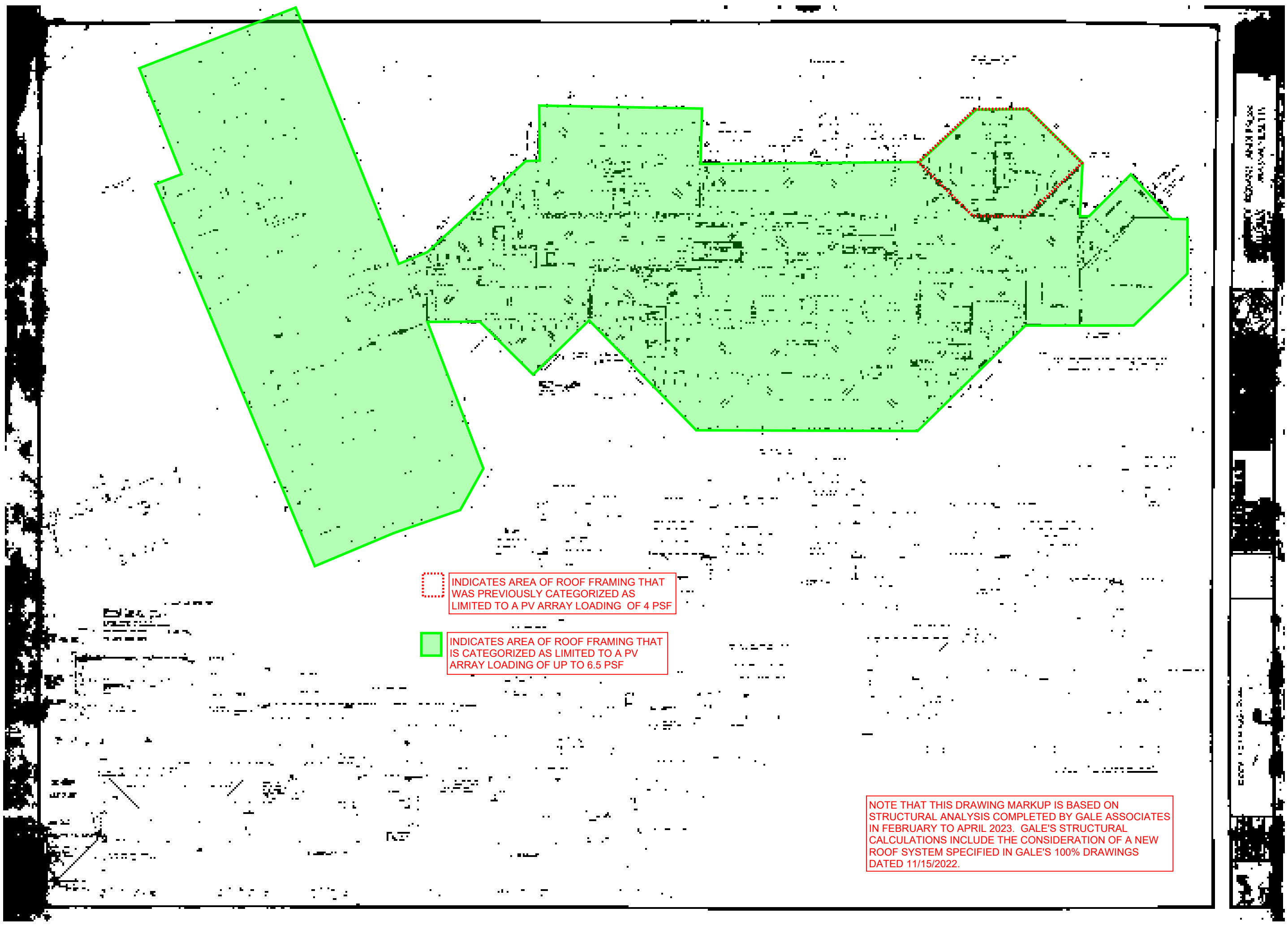
Enclosures:

- Appendix A – FPS Farley School Roof Framing Plan
- Appendix B – SDA PV Array Report/Feasibility Study

CC: Matthew Torti (FPS, mtorti@framingham.k12.ma.us)
Andrew Rovan (FPS, arovan@framingham.k12.ma.us)
Shawn Luz (Framingham, sluz@framinghamma.gov)
Gale Team (AEO, SPJ, KMC, JWK, BHN, CGK)

APPENDIX A

FPD FARLEY SCHOOL ROOF FRAMING PLAN



INDICATES AREA OF ROOF FRAMING THAT WAS PREVIOUSLY CATEGORIZED AS LIMITED TO A PV ARRAY LOADING OF 4 PSF
INDICATES AREA OF ROOF FRAMING THAT IS CATEGORIZED AS LIMITED TO A PV ARRAY LOADING OF UP TO 6.5 PSF
NOTE THAT THIS DRAWING MARKUP IS BASED ON STRUCTURAL ANALYSIS COMPLETED BY GALE ASSOCIATES IN FEBRUARY TO APRIL 2023. GALE'S STRUCTURAL CALCULATIONS INCLUDE THE CONSIDERATION OF A NEW ROOF SYSTEM SPECIFIED IN GALE'S 100% DRAWINGS DATED 11/15/2022.

APPENDIX B

SDA PV ARRAY REPORT/FEASIBILITY STUDY

Farley School, Framingham MA
Solar Feasibility Assessment

Table of Contents

List of Attachments

1 Executive Summary

Gale Associates (Gale) has retained Solar Design Associates (SDA) to investigate the solar potential of the roof of the proposed Farley Middle School located in Framingham, MA. The focus of the study was to document existing conditions on the roof surfaces including locations of rooftop equipment, and document the existing electrical infrastructure at the facility to determine the feasibility of interconnection a photovoltaic system behind the meter (BTM) of the facility. at the intersection of Flagg Dr and Normandy Rd in Framingham MA, the respective equipment layouts (vents, HVAC, and roof drains) of the roof of the Farley School and their effect on potential solar photovoltaic production were examined.

SDA conducted a drone survey of the site on December 29nd, 2022 and the resulting orthomosaic image and 3D model were used to generate the as-built conditions, which were then used for a detailed CAD layout of the potential rooftop PV array.

Figure 1: A composite drone image of the Farley School (December 2022).

1.1 Design Results and Conclusions

With the as-built conditions known SDA produced a rooftop PV layout seeking to maximum available space, provide access to existing and future equipment, and comply with known requirements for roof edge setbacks and walkways in accordance with the applicable building codes. SDA selected the RM5 5° from Unirac due to its high density (kW/ft^2) and integrated wire management capabilities. The 7.5" row-to-row spacing of the system still permits electricians to service the system without the need to removed modules to do so.

The module selected as the basis of design is a 480W PV module from Qcells with a form factor of 87.2" x 41.1" and weighing in at 58.4 lbs. each. Depending on market conditions at the time of order, higher wattage modules may be available in this same form factor, up to 495W.

Using Uniracs's online configuration tool and site specific information on wind speed, building height, importance factor, and applicable code, SDA produced an anticipated ballast plan for the system. The resultant analysis proposed a hybrid of ballast and physical attachments to the roof deck to provide the required resistance to uplift.

The proposed layout optimizes roof coverage while maximizing system size. If required, these array options may be scaled down at a later time due to the addition/relocation of rooftop equipment or a change in the overall roof plan. A summary of the proposed options is presented in Table 1.

System	Module Count	DC Power (kW)	Estimated Production (kWh)	Estimated Upfront Const. Cost	1st Year Electrical Savings	Simple Payback Period (yr)
Max PV W/Current AC Equipment	938/480W	450.24	536,363	$1,350,720	$157,036	4.8

Table 1: An overview of the basic economic costs and payouts of the PV system options.

After the hardware was selected and a layout generated, a detailed financial analysis was completed using Energy Toolbase. This analysis utilized the existing utility bills from the school to compare load to generation ratios, input the schools electrical rate structure, and made assumptions regarding installed cost and available incentives.

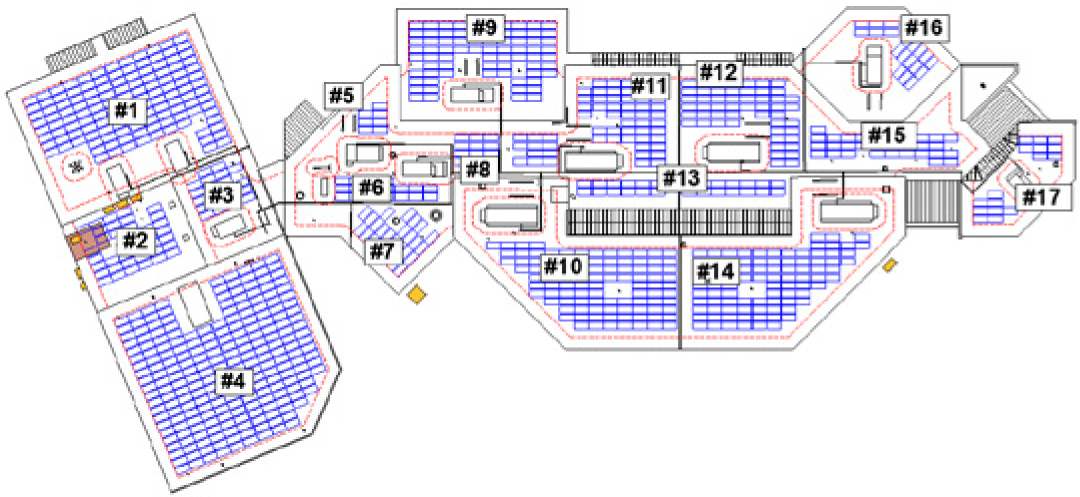
An electrical production model was generated using Helioscope and a 3D model of the facility, which takes into account surround shade objects (trees and other buildings), as well as localized shading from HVAC units and differences in roof height.

2 Basis of Design

2.1 System Layout

Figure 2: Proposed System Layout

2.2 Estimated roof structural requirements



Roof #	Average PSF
1	3.90
2	4.55
3	4.60
4	3.75
5	5.59
6	4.81
7	5.58
8	5.28
9	4.26
10	4.00
11	4.35
12	4.35
13	5.29
14	4.04
15	4.67
16	5.69
17	5.69
Average	4.23

Table 3: Preliminary Average weight per sq ft of solar PV system and racking

Table 3 tabulated the average PSF imposed by the PV system on the roof structure below. It confirms the average 6.5 psf Uniform load requirement on all areas of the building with some exceptions on the roof only potentially allowing to hold 4 psf.

3 Economic Analysis

3.1 Direct Ownership vs. PPA

Direct Ownership allows the customer take full ownership of the system, incurring all immediate upfront costs directly, and also being responsible for all operations and maintenance of the system. This includes recommended yearly commissioning of the system, and any and all repairs that may be required in order to maintain the functionality of the array. With the direct ownership model, the customer benefits from all revenue and savings provided by the PV system, including (but not limited to); the avoided cost of energy, net metered energy, and any state or federal incentives. Direct Ownership also aligns the interests of all parties; facility owner and PV system owner. The owner is incentivized to ensure the PV asset is well designed, installed, and maintained at peak operation.

A Power Purchase Agreement is a method of PV system procurement where the facility owner would enter into an agreement with a third-party PPA provider, who would be the one who owns the system outright. Under this arrangement, the customer generally would pay no money upfront for the system, and would receive discounts on the electricity produced by the PV system (generally 10% off the utility rate). However, the third party owner would benefit from all the revenue and incentives associated with the system. There are a variety of pricing structures that could be implemented. The first being a roof lease in which the third party owner pays the property owner a monthly (or yearly) lease payment for the right to construct and operate the system on the owners property. A second pricing structure puts in place an agreement in which the property owner purchases the PV generated kWhrs at a reduced rate than that of the servicing utility. The exact structuring of these agreements typically varies from site to site and customer to customer depending on SMART block allocation, anticipated construction costs, site development costs, utility upgrade costs, net metering availability, the ability to interconnect behind an existing building meter, etc. At the end of the term, the host customer generally has the option to buy the asset as a pre-determined value, or elect to have the asset owner remove the system. A historical disadvantage of a PPA is the asset owner is incentivized to produce kWhs in the least expensive manner possible. Generally this manifests as not using proper wire management methods to save on hardware and installation time, and O&M procedures that do no justify replacement of faulty hardware.

Assumptions:

1. Electric Distribution company: Eversource
2. Rate Class: G-3 (B3)
3. Compensation Type: Net Metered
4. SMART Program Capacity block: 8

Option	kWdc	kWhr/yr	Estimated Const. Cost	Incentive Rate ($/kWh)	Avoided $ of Energy (1 Yr)	30% ITC – Direct Pay	Payback Period (yr)	20 Year Cash Flow
Direct	450.24	536,363	$1,350,720	0.0643	$157,036	$405,216	4.8	+ $3,689,765
PPA	450.24	536,363	N/A	N/A	$2,1454.52	N/A	N/A	$429,090

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solar design associates inc

ATTACHMENT A – SMART Value of Energy Workbook

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

Solar Massachusetts Renewable Target (SMART) Solar Incentive Calculator*
for Behind-the-Meter Solar Tariff Generation Units

Criteria	Click on cells below, choose from dropdown options	Results
Electric Distribution Company	Eversource	Eversource
Service Area	GreaterBoston	EasternMass
Rate Class	G-3 (B3)	G-3(B3)
Compensation Type	Net Metered	Net Metered
Capacity Block	8	8
Project Size (kW AC)	>250-500	>250-500
Location Based Adder	Building	$0.01920
Off-taker Based Adder	Public Entity	$0.03840
Solar Tracking Adder	N/A	$0.00000
Pollinator Adder	N/A	$0.00000
Energy Storage Adder*	Enter value in cell E15	

Instructions: Starting at the top of the calculator, input system information using the drop-down menus in the green cells. If you change an entry, be sure to confirm all other entries, as drop-down menus are dependent on one another. Purple cells will populate based on choices made in green cells.

Notes:
*Follow the link below to access DOER's Energy Storage Guideline, which has a separate calculator to calculate the Energy Storage Adder
https://www.mass.gov/doc/energy-storage-adder-calculator

Calculated Rates	
Base Compensation Rate ($/kWh)	$0.15968
Compensation Rate Adders ($/kWh)	$0.05760
Total Compensation Rate ($/kWh)	$0.21728
Value of Energy ($/kWh)	$0.15298

SMART Incentive	
Solar Incentive Payment ($/kWh)	$0.06430
Length of Compensation Rate Term (Years)	20

DISCLAIMER: This SMART Incentive Calculator is intended to provide those that are considering installing a Behind-the-Meter Solar Tariff Generation Unit under the SMART Program with estimates of their Value of Energy and solar incentive payment rate, which will be fixed for the duration of their tariff term. The information contained in this tool is derived from available utility rate information and from DOER's Guideline on Capacity Blocks, Base Compensation Rates, and Compensation Rate Adders. The calculator is provided for estimation purposes only. Neither the Department of Energy Resources nor the Electric Distribution Companies make any warranties or representations, expressed or implied, as to the usefulness, completeness, or accuracy of the information contained, described, disclosed, or referred to in this tool.

ATTACHMENT B – Helioscope Year1 Production Estimate

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

2023-0308 Rooftop Gale Associates - Framingham, 19 Flagg Dr. Framingham, ma

Report

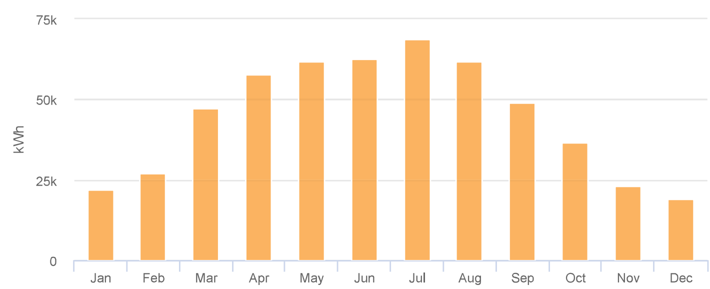
Project Name	Gale Associates - Framingham
Project Address	19 Flagg Dr. Framingham, ma
Prepared By	Nicholas Lawrence nlawrence@solardesign.com

System Metrics

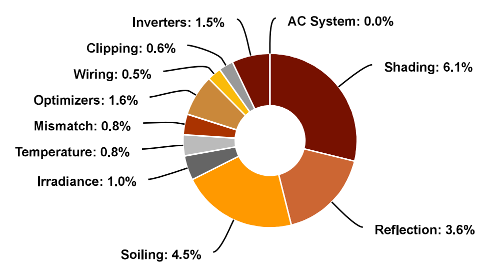
Design	2023-0308 Rooftop
Module DC Nameplate	450.2 kW
Inverter AC Nameplate	360.0 kW Load Ratio: 1.25
Annual Production	536.4 MWh
Performance Ratio	80.6%
kWh/kWp	1,191.3
Weather Dataset	TMY, 10km grid (42.25,-71.45), NREL (prospector)
Simulator Version	abf32ef1c3-9798783dde-8c5e838783-647ba438af

Project Location

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,428.5	
	POA Irradiance	1,477.6	3.4%
	Shaded Irradiance	1,387.7	-6.1%
	Irradiance after Reflection	1,337.1	-3.6%
	Irradiance after Soiling	1,276.3	-4.5%
	Total Collector Irradiance	**1,276.4**	**0.0%**
Energy (kWh)	Nameplate	574,567.0	
	Output at Irradiance Levels	569,028.7	-1.0%
	Output at Cell Temperature Derate	564,324.6	-0.8%
	Output After Mismatch	559,764.4	-0.8%
	Optimizer Output	550,683.5	-1.6%
	Optimal DC Output	547,660.2	-0.5%
	Constrained DC Output	544,559.5	-0.6%
	Inverter Output	536,363.2	-1.5%
	Energy to Grid	**536,363.2**	**0.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp		12.4 °C
	Avg. Operating Cell Temp		18.8 °C
Simulation Metrics			
		Operating Hours	4689
		Solved Hours	4689

Condition Set

Description	Condition Set 1
Weather Dataset	TMY, 10km grid (42.25,-71.45), NREL (prospector)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model
Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	-2.5% to 2.5%
AC System Derate	0.00%

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
15	20	10	5	2	1.5	1	1	1	2	3	10

Module Characterizations

Module	Uploaded By	Characterization
Q.Peak DUO XL-G10.2 480 (Hanwha Q Cells)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
P1101 (SolarEdge)	HelioScope	Mfg Spec Sheet
SE120KUS (2022) (SolarEdge)	HelioScope	Spec Sheet

Components

Component	Name	Count
Inverters	SE120KUS (2022) (SolarEdge)	3 (360.0 kW)
Home Runs	2 AWG (Copper)	3 (25.7 ft)
Combiners	1 input Combiner	3
Combiners	10 input Combiner	2
Combiners	11 input Combiner	1
Strings	10 AWG (Copper)	31 (7,886.3 ft)
Optimizers	P1101 (SolarEdge)	473 (520.3 kW)
Module	Hanwha Q Cells, Q.Peak DUO XL-G10.2 480 (480W)	938 (450.2 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	32	13-31	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Landscape (Horizontal)	5°	207.92°	0.6 ft	1x1	226	226	108.5 kW
Field Segment 2	Fixed Tilt	Landscape (Horizontal)	5°	207.92°	0.6 ft	1x1	21	21	10.1 kW
Field Segment 3	Fixed Tilt	Landscape (Horizontal)	5°	207.92°	0.6 ft	1x1	129	129	61.9 kW
Field Segment 4	Fixed Tilt	Landscape (Horizontal)	5°	229.49606°	0.6 ft	1x1	125	125	60.0 kW
Field Segment 5	Fixed Tilt	Landscape (Horizontal)	5°	230.38832°	0.6 ft	1x1	31	31	14.9 kW
Field Segment 6	Fixed Tilt	Landscape (Horizontal)	5°	230.91138°	0.6 ft	1x1	97	97	46.6 kW
Field Segment 7	Fixed Tilt	Landscape (Horizontal)	5°	229.84993°	0.6 ft	1x1	90	90	43.2 kW
Field Segment 8	Fixed Tilt	Landscape (Horizontal)	5°	230.3486°	0.6 ft	1x1	73	73	35.0 kW
Field Segment 9	Fixed Tilt	Landscape (Horizontal)	5°	207.92°	0.6 ft	1x1	38	38	18.2 kW
Field Segment 10	Fixed Tilt	Landscape (Horizontal)	5°	230.82854°	0.6 ft	1x1	48	48	23.0 kW
Field Segment 11	Fixed Tilt	Landscape (Horizontal)	5°	184.373°	0.6 ft	1x1	25	25	12.0 kW
Field Segment 12	Fixed Tilt	Landscape (Horizontal)	5°	184.373°	0.6 ft	1x1	13	13	6.24 kW
Field Segment 13	Fixed Tilt	Landscape (Horizontal)	5°	225.55281°	0.6 ft	1x1	6	6	2.88 kW
Field Segment 14	Fixed Tilt	Landscape (Horizontal)	5°	229.17393°	0.6 ft	1x1	16	16	7.68 kW

Detailed Layout

solar design associates inc

ATTACHMENT C – Energy ToolBase ROI Estimate

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

Solar System Financial Assessment for Gale Associates - Farley School

Prepared For
Gale Associates - Farley School

Prepared By
Stephen Coffrin
978-891-0360
scoffrin@solardesign.com

Revised
2/10/2023

Proposed rooftop photovoltaic array for the Gale Associates - Farley Building

Table of Contents

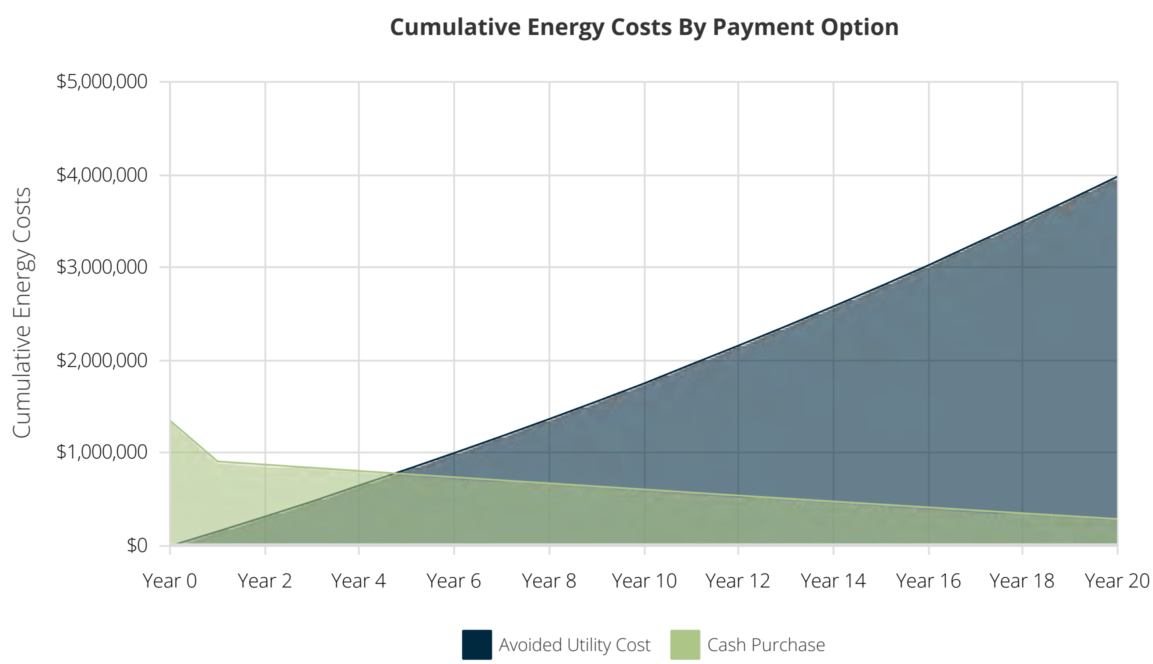
1 Project Summary

Payment Options	Cash Purchase
IRR - Term	20.1%
LCOE PV Generation	$0.029 /kWh
Net Present Value	$1,833,730
Payback Period	4.8 Years
Total Payments	$1,350,720
Total Incentives	$1,059,594
Net Payments	$291,126
Electric Bill Savings - Term	$3,980,891
Upfront Payment	$1,350,720

Combined Solar PV Rating
Power Rating: 450.2 kW-DC
Power Rating 360.0 kW-AC

Combined ESS Ratings
Energy Capacity: 0.0 kWh
Power Rating: 0.0 kW

The total PV system cost not including batteries is based on a $/W value of $3.00/Wdc. This estimate is a good, somewhat conservative starting point for a system of this design and size. This will be subject to change as the specific system components are chosen.



1.1.1 PV System Details

General Information
Facility: Meter #1
Address: 19 Flagg Dr Framingham MA 01702

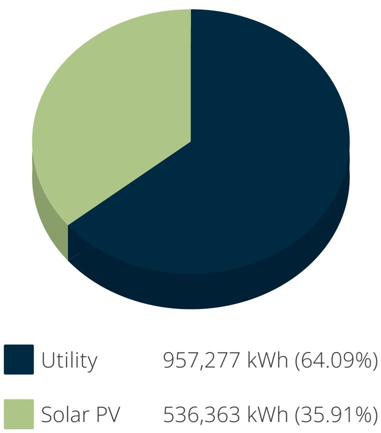
Solar PV Equipment Description*
Solar Panels: (938) Hanwha Q Cells Q.Peak DUO XL-G10.2 480
Inverters: (3) SolarEdge SE120KUS (2022)

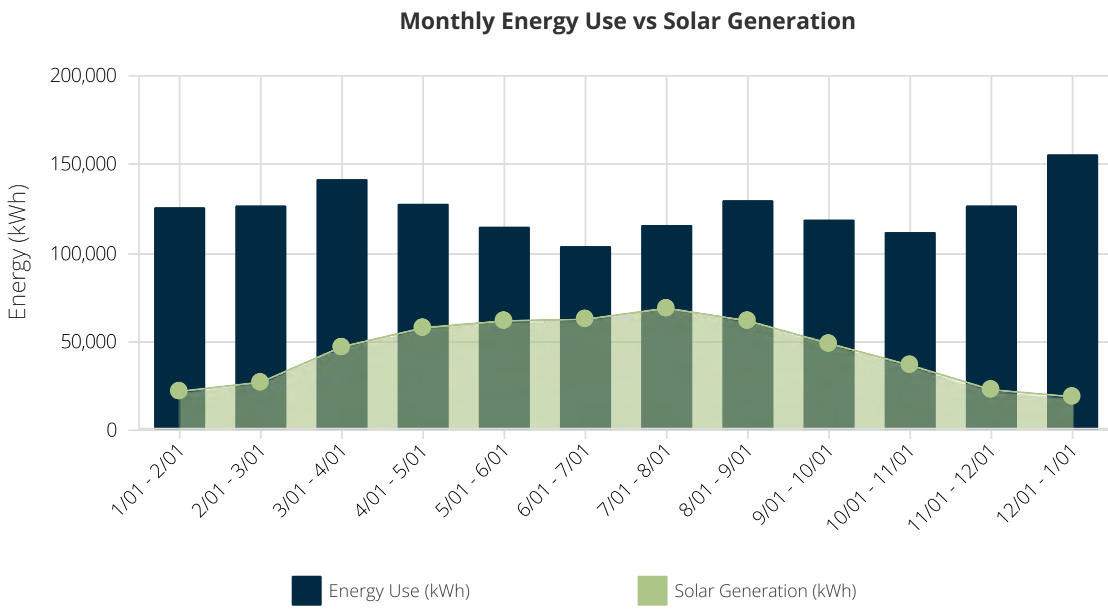
Solar PV Equipment Typical Lifespan
Solar Panels: Greater than 30 Years
Inverters: 15 Years

Solar PV System Cost and Incentives	
Solar PV System Cost	$1,350,720
Direct pay - 30% ITC	-$405,216
(SMART) Program - PV	-$654,378
Net Solar PV System Cost	**$291,126**

Solar PV System Rating
Power Rating: 450.2 kW-DC
Power Rating: 360.0 kW-AC

Energy Consumption Mix
Annual Energy Use: 1,493,640 kWh





**Equipment chosen as the basis of design will be subject to change as the project progresses. The chosen Q.Cells module is on the high end of mid-to-premium range modules, and final wattage may fluctuate somewhat. The SolarEdge inverters are one of the most specified inverters.*

1.1.2 Rebates and Incentives

This section summarizes all incentives available for this project. The actual rebate and incentive amounts for this project are shown in each example.

Direct Pay, Investment Tax Credit (ITC) - 30%

The Inflation Reduction Act (IRA) of 2022 contains a "direct pay" provision that enables certain tax-exempt customers, including state and local government, to receive a direct cash payment in lieu of an investment tax credit (ITC). Entities that qualify for direct pay are eligible to receive a 30% direct payment, assuming they meet the IRA established prevailing wage and apprenticeship requirements in order to qualify for the full 30% “increased rate”, rather than a 6% “base rate”. The IRA states that direct pay is only available for entities, including: an entity exempt from the tax, any State government (or political subdivision thereof), the Tennessee Valley Authority, an Indian tribal government, an Alaska Native Corporation, any corporation operating on a cooperative basis which is engaged in furnishing electric energy to persons in rural areas. These entities may take direct pay for solar and storage in the ITC and PTC as well as the ITC/PTC when tech neutral starts after 2025.

Total Incentive Value: $405,216

Solar Massachusetts Renewable Target (SMART) - PV Incentive

Massachusetts SMART Tariff for those considering installing a Behind-the-Meter System (Tariff Generation Unit under the SMART Program.) The Solar Massachusetts Renewable Target (SMART) Program is the newest program established to support the development of solar in Massachusetts. The DOER regulation in 225 CMR 20.00 sets the regulatory framework for the program. The tariff based incentive is paid directly by the utility company to the system owner, following the approval of the application by the Solar Program Administrator. The SMART Program is a 1600MW declining block incentive program. Eligible projects must be interconnected by one of three investor owned utility companies in Massachusetts: Eversource, National Grid, and Unitil. Each utility has established blocks that decline in incentive rates between each block. If adding Energy Storage to the Proposal and claiming the SMART Tariff make sure to enter the Energy Storage Adder on the Excel calculator to include it in the total incentive value.

Total Incentive Value: $654,378

1.1.3 Current Electric Bill

The table below shows the assumed annual electricity costs.

Rate Schedule: NSTAR - B3 - 90%

Time Periods	Energy Use (kWh)		Max Demand (kW)	Charges				
Bill Ranges & Seasons	On Peak	Off Peak	NC / Max	Other	NBC	Energy	Demand	Total
1/1/2023 - 2/1/2023 W:Q1	57,013	68,267	882	$618	$0	$52,165	$21,680	$74,463
2/1/2022 - 3/1/2022 W:Q1	59,205	67,035	453	$618	$0	$52,565	$11,135	$64,318
3/1/2022 - 4/1/2022 W:Q1	61,105	80,135	1,040	$618	$0	$58,811	$25,563	$84,992
4/1/2022 - 5/1/2022 W:Q2	58,698	68,982	1,203	$618	$0	$16,015	$29,570	$46,202
5/1/2022 - 6/1/2022 W:Q2	55,282	58,718	1,155	$618	$0	$14,299	$28,390	$43,307
6/1/2022 - 7/1/2022 S:Q2	45,334	57,746	1,193	$618	$0	$12,929	$29,324	$42,871
7/1/2022 - 8/1/2022 S:Q3	48,640	66,560	1,135	$618	$0	$27,142	$27,898	$55,658
8/1/2022 - 9/1/2022 S:Q3	51,958	77,522	1,176	$618	$0	$30,507	$28,906	$60,031
9/1/2022 - 10/1/2022 S:Q3	42,740	75,580	1,176	$618	$0	$27,877	$28,906	$57,401
10/1/2022 - 11/1/2022 W:Q4	49,142	62,338	1,153	$618	$0	$35,998	$28,341	$64,956
11/1/2022 - 12/1/2022 W:Q4	56,500	69,620	885	$618	$0	$40,725	$21,753	$63,096
12/1/2022 - 1/1/2023 W:Q4	60,344	95,176	1,086	$618	$0	$50,219	$26,694	$77,531
Total	645,961	847,679	-	$7,413	-	$419,253	$308,159	$734,826

1.1.4 New Electric Bill

Rate Schedule: NSTAR - B3 - 90%

Time Periods	Solar PV (kWh)		Energy Import (kWh)		Energy Export (kWh)		Max Demand (kW)	Charges				
Bill Ranges & Seasons	On Peak	Off Peak	On Peak	Off Peak	On Peak	Off Peak	NC / Max	Other	NBC	Energy	Demand	Total
1/1/2023 - 2/1/2023 W:Q1	16,058	5,871	41,433	63,180	478	784	882	$618	$0	$43,052	$21,680	$65,349
2/1/2022 - 3/1/2022 W:Q1	18,232	8,896	41,217	59,984	244	1,845	427	$618	$0	$41,298	$10,496	$52,411
3/1/2022 - 4/1/2022 W:Q1	34,179	12,961	33,988	70,206	7,062	3,032	852	$618	$0	$39,321	$20,942	$60,880
4/1/2022 - 5/1/2022 W:Q2	39,208	18,568	31,143	57,991	11,652	7,577	1,161	$618	$0	$9,032	$28,537	$38,187
5/1/2022 - 6/1/2022 W:Q2	42,082	19,667	25,700	47,496	12,499	8,445	925	$618	$0	$6,841	$22,737	$30,195
6/1/2022 - 7/1/2022 S:Q2	40,649	21,959	14,591	43,646	9,907	7,859	1,101	$618	$0	$5,320	$27,063	$33,000
7/1/2022 - 8/1/2022 S:Q3	40,693	28,162	14,497	47,703	6,550	9,306	932	$618	$0	$11,136	$22,909	$34,663
8/1/2022 - 9/1/2022 S:Q3	41,443	20,302	17,882	62,318	7,367	5,098	1,129	$618	$0	$16,130	$27,751	$44,498
9/1/2022 - 10/1/2022 S:Q3	33,236	15,731	17,710	65,787	8,206	5,938	1,140	$618	$0	$16,534	$28,021	$45,173
10/1/2022 - 11/1/2022 W:Q4	23,577	13,104	31,294	54,274	5,729	5,040	1,044	$618	$0	$24,301	$25,662	$50,580
11/1/2022 - 12/1/2022 W:Q4	18,364	4,502	39,316	65,386	1,181	268	864	$618	$0	$33,361	$21,237	$55,216
12/1/2022 - 1/1/2023 W:Q4	14,410	4,509	45,952	90,668	18	0	932	$618	$0	$44,110	$22,909	$67,637
Total	362,131	174,232	354,723	728,639	70,893	55,192	-	$7,413	-	$290,435	$279,942	$577,790

Annual Electricity Savings: $157,036

2.1 Cash Purchase

Assumptions and Key Financial Metrics

IRR - Term	20.1%	Net Present Value	$1,833,730	Payback Period	4.8 Years
ROI	273.2%	PV Degradation Rate	0.54%	Discount Rate	5.0%
Energy Cost Escalation Rate	3.0%	Federal Income Tax Rate	30.0%	State Income Tax Rate	8.0%
Total Project Costs	$1,350,720				

Years	Project Costs	Direct pay - 30% ITC	(SMART) Program - PV	Electric Bill Savings	Total Cash Flow	Cumulative Cash Flow
Upfront	-$1,350,720	-	-	-	-$1,350,720	-$1,350,720
1	-	$405,216	$34,488	$157,036	$596,740	-$753,980
2	-	-	$34,302	$160,874	$195,176	-$558,804
3	-	-	$34,116	$164,800	$198,916	-$359,888
4	-	-	$33,929	$168,818	$202,747	-$157,140
5	-	-	$33,743	$172,928	$206,671	$49,531
6	-	-	$33,557	$177,133	$210,690	$260,220
7	-	-	$33,371	$181,434	$214,805	$475,025
8	-	-	$33,184	$185,834	$219,019	$694,044
9	-	-	$32,998	$190,335	$223,333	$917,377
10	-	-	$32,812	$194,939	$227,751	$1,145,128
11	-	-	$32,626	$199,647	$232,273	$1,377,401
12	-	-	$32,440	$204,463	$236,902	$1,614,304
13	-	-	$32,253	$209,388	$241,641	$1,855,944
14	-	-	$32,067	$214,424	$246,491	$2,102,436
15	-	-	$31,881	$219,574	$251,455	$2,353,890
16	-	-	$31,695	$224,840	$256,535	$2,610,425
17	-	-	$31,508	$230,225	$261,733	$2,872,158
18	-	-	$31,322	$235,730	$267,052	$3,139,210
19	-	-	$31,136	$241,358	$272,494	$3,411,704
20	-	-	$30,950	$247,112	$278,061	$3,689,765
Totals:	-$1,350,720	$405,216	$654,378	$3,980,891	$3,689,765	-

State and Federal income tax rates, as well as the discount rate, were left at their default values for this financial model. A more accurate model can be produced if the customer provides actual tax rates and desired discount rate.

2.2 Cash Purchase

Assumptions and Key Financial Metrics

IRR - Term	20.1%	Net Present Value	$1,833,730	Payback Period	4.8 Years
ROI	273.2%	PV Degradation Rate	0.54%	Discount Rate	5.0%
Energy Cost Escalation Rate	3.0%	Federal Income Tax Rate	30.0%	State Income Tax Rate	8.0%
Total Project Costs	$1,350,720				

Years	**Upfront**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Cash												
Project Costs	-$1,350,720	-	-	-	-	-	-	-	-	-	-	-
Direct pay - 30% ITC	-	$405,216	-	-	-	-	-	-	-	-	-	-
(SMART) Program - PV	-	$34,488	$34,302	$34,116	$33,929	$33,743	$33,557	$33,371	$33,184	$32,998	$32,812	$32,626
Electric Bill Savings	-	$157,036	$160,874	$164,800	$168,818	$172,928	$177,133	$181,434	$185,834	$190,335	$194,939	$199,647
Cash Total	-$1,350,720	$596,740	$195,176	$198,916	$202,747	$206,671	$210,690	$214,805	$219,019	$223,333	$227,751	$232,273
Total Cash Flow	-$1,350,720	$596,740	$195,176	$198,916	$202,747	$206,671	$210,690	$214,805	$219,019	$223,333	$227,751	$232,273
Cumulative Cash Flow	-$1,350,720	-$753,980	-$558,804	-$359,888	-$157,140	$49,531	$260,220	$475,025	$694,044	$917,377	$1,145,128	$1,377,401

2.2 Cash Purchase

Assumptions and Key Financial Metrics

IRR - Term	20.1%	Net Present Value	$1,833,730	Payback Period	4.8 Years
ROI	273.2%	PV Degradation Rate	0.54%	Discount Rate	5.0%
Energy Cost Escalation Rate	3.0%	Federal Income Tax Rate	30.0%	State Income Tax Rate	8.0%
Total Project Costs	$1,350,720				

Years	12	13	14	15	16	17	18	19	20	Totals
Cash										
Project Costs	-	-	-	-	-	-	-	-	-	-$1,350,720
Direct pay - 30% ITC	-	-	-	-	-	-	-	-	-	$405,216
(SMART) Program - PV	$32,440	$32,253	$32,067	$31,881	$31,695	$31,508	$31,322	$31,136	$30,950	$654,378
Electric Bill Savings	$204,463	$209,388	$214,424	$219,574	$224,840	$230,225	$235,730	$241,358	$247,112	$3,980,891
Cash Total	$236,902	$241,641	$246,491	$251,455	$256,535	$261,733	$267,052	$272,494	$278,061	$3,689,765
Total Cash Flow	$236,902	$241,641	$246,491	$251,455	$256,535	$261,733	$267,052	$272,494	$278,061	$3,689,765
Cumulative Cash Flow	$1,614,304	$1,855,944	$2,102,436	$2,353,890	$2,610,425	$2,872,158	$3,139,210	$3,411,704	$3,689,765	-

ATTACHMENT D – Unirac Ballast Estimates

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

U-BUILDER PROJECT REPORT

APPLICATION VERSION: 6.0.4
PROJECT VERSION: 0.0.27

PROJECT TITLE	PROJECT ID	LAST UPDATED
ROOFMOUNT RM5	AF1B1058	Apr. 11, 2023
		ORIGINALLY CREATED
		Mar. 3, 2023

NAME	ASH
ADDRESS	19 Flagg Dr, Framingham, MA 01702, USA
CITY, STATE	Framingham, MA
MODULE	Hanwha/Q-Cells Q.Peak Duo XL-G10.2-480 - Ubuilder V3

Designed by aharania@solardesign.com

ROOFMOUNT RM5

Hanwha/Q-Cells

938 - Q.Peak Duo XL-G10.2-480 - Ubuilder V3

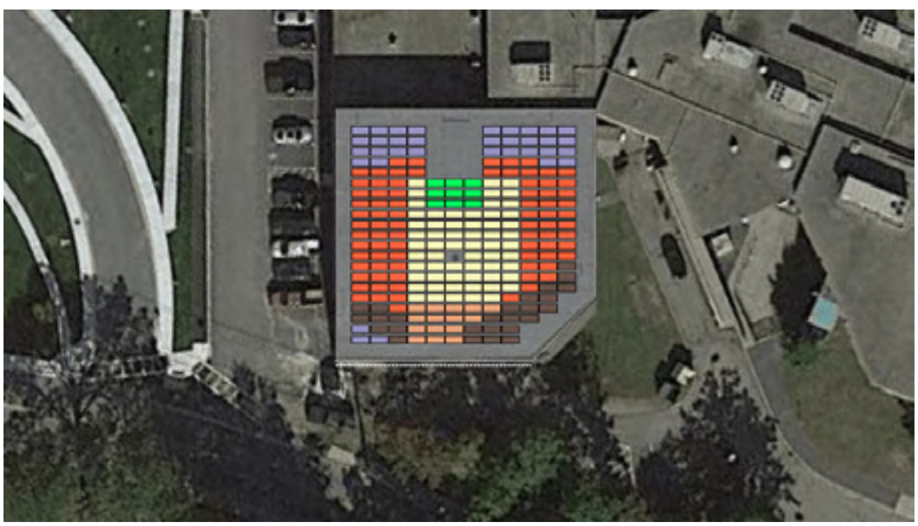
28233 ft^2

450.24 KW

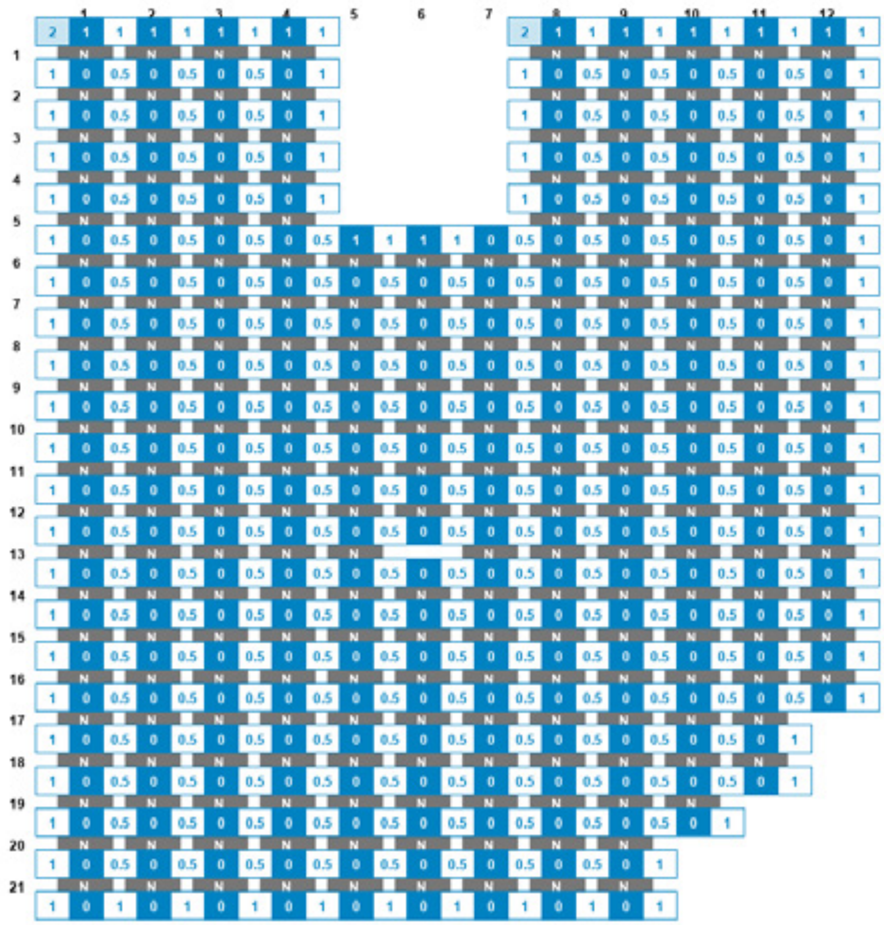
NOTE: Installation of the project is intended to happen within the year of project designed in UBuilder. If it's past one year please rerun the design or contact Unirac Engineering Services.

INSTALLATION AND DESIGN PLAN

Roof Area 1



Roof Area 1 / Roof Area 1 - Array 1



LEGEND

- N — Module with north wind deflector (for uplift)
- S — Module with south wind deflector (for fire requirements - type 2)
- NS — Module with both deflector types
- Module with no deflectors
- 1 — Standard corner bay with CMU block count
- 4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

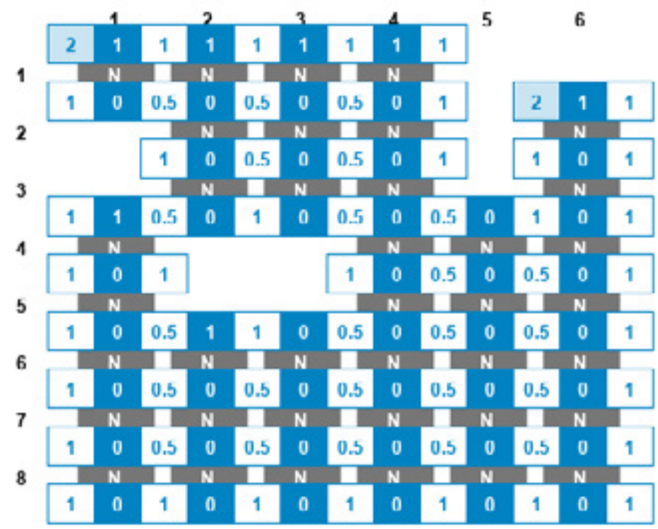
Layout Dimensions

NS DIMENSION	~ 86.04 ft
EW DIMENSION	~ 87.24 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	9	9	20	22.0 / 0.0	704
2	9	9	20	4.0 / 7.0	240
3	9	9	20	4.0 / 7.0	240
4	9	9	20	4.0 / 7.0	240
5	9	9	20	4.0 / 7.0	240
6	12	12	25	6.0 / 9.0	336
7	12	12	25	2.0 / 11.0	240
8	12	12	25	2.0 / 11.0	240
9	12	12	25	2.0 / 11.0	240
10	12	12	25	2.0 / 11.0	240
11	12	12	25	2.0 / 11.0	240
12	12	12	25	2.0 / 11.0	240
13	11	11	25	2.0 / 11.0	240
14	12	12	25	2.0 / 11.0	240
15	12	12	25	2.0 / 11.0	240
16	12	12	25	2.0 / 11.0	240
17	11	11	25	2.0 / 11.0	240
18	11	11	23	2.0 / 10.0	224
19	10	10	23	2.0 / 10.0	224
20	9	9	21	2.0 / 9.0	208
21	9	9	19	2.0 / 8.0	192
22	0	0	19	10 / 0	320

Roof Area 2

Roof Area 2 / Roof Area 2 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

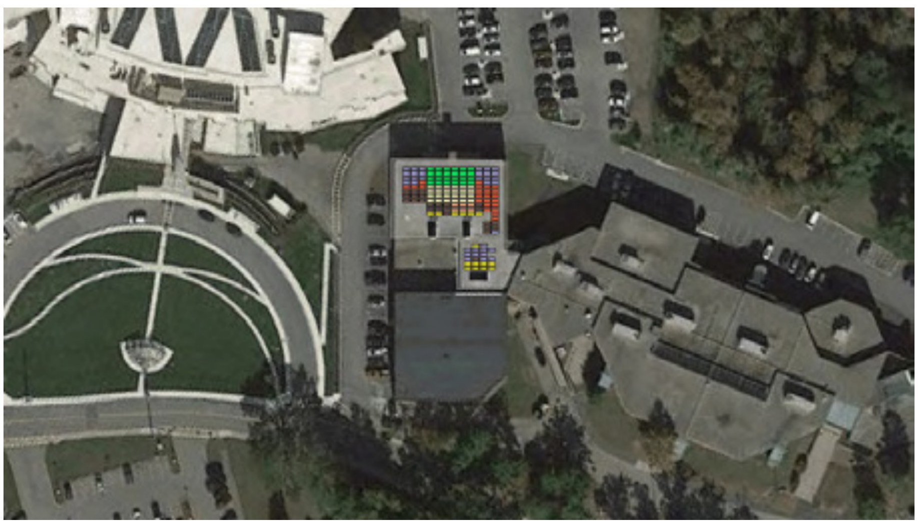
Layout Dimensions

NS DIMENSION	~ 33.34 ft
EW DIMENSION	~ 43.62 ft

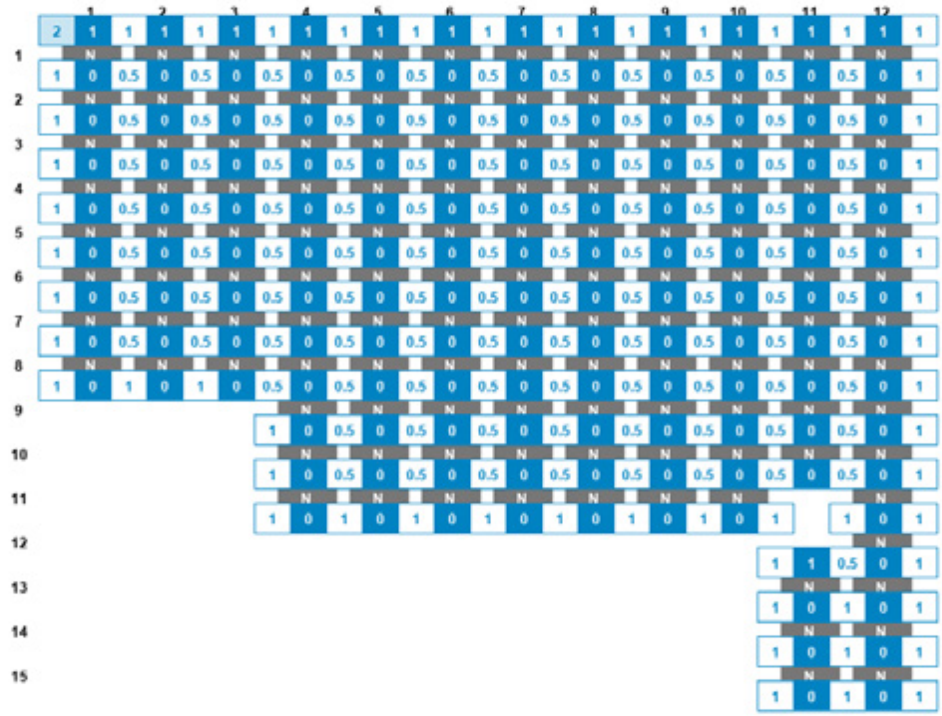
ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	4	4	9	10.0 / 0.0	320

2	4	4	12	6.0 / 3.0	240
3	4	4	10	4.0 / 2.0	160
4	4	4	13	5.0 / 3.0	208
5	4	4	10	4.0 / 2.0	160
6	6	6	13	4.0 / 4.0	192
7	6	6	13	2.0 / 5.0	144
8	6	6	13	2.0 / 5.0	144
9	0	0	13	7 / 0	224

Roof Area 3



Roof Area 3 / Roof Area 3 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

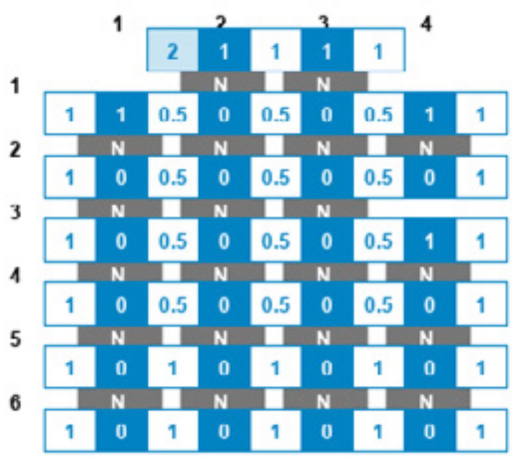
Layout Dimensions

NS DIMENSION	~ 61.72 ft
EW DIMENSION	~ 87.24 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	12	12	25	26.0 / 0.0	832

2	12	12	25	2.0 / 11.0	240
3	12	12	25	2.0 / 11.0	240
4	12	12	25	2.0 / 11.0	240
5	12	12	25	2.0 / 11.0	240
6	12	12	25	2.0 / 11.0	240
7	12	12	25	2.0 / 11.0	240
8	12	12	25	2.0 / 11.0	240
9	9	9	25	4.0 / 9.0	272
10	9	9	19	2.0 / 8.0	192
11	8	8	19	2.0 / 8.0	192
12	1	1	18	10 / 0	320
13	2	2	5	3.0 / 1.0	112
14	2	2	5	3.0 / 0.0	96
15	2	2	5	3.0 / 0.0	96
16	0	0	5	3 / 0	96

Roof Area 3 / Roof Area 3 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

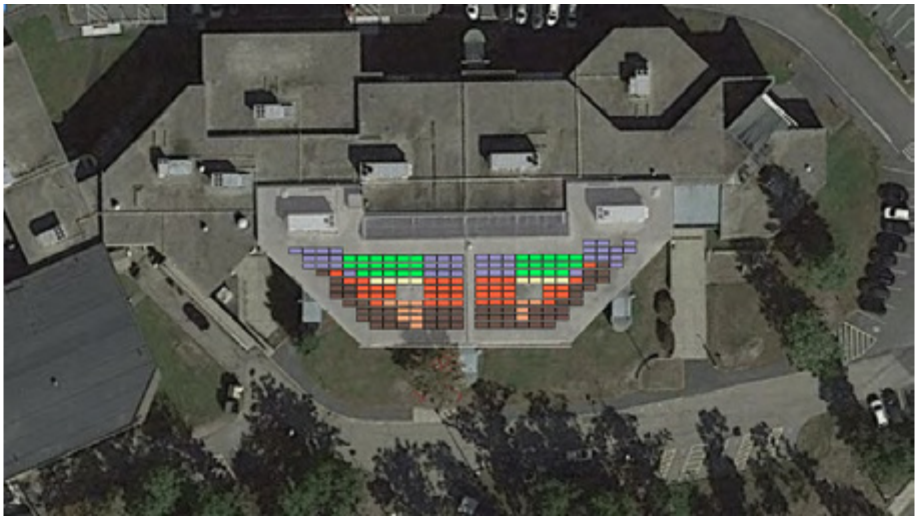
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

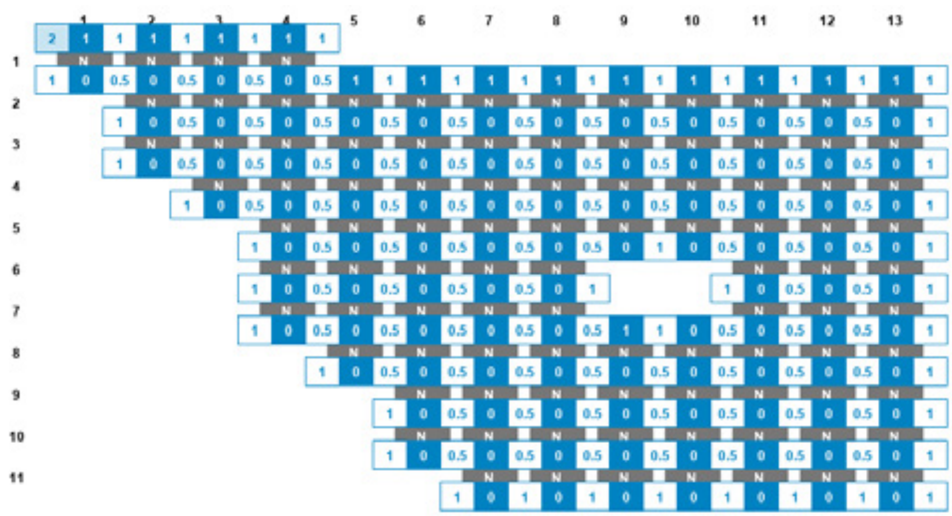
NS DIMENSION	~ 25.24 ft
EW DIMENSION	~ 29.08 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	2	2	5	6.0 / 0.0	192
2	4	4	9	4.0 / 3.0	176
3	3	3	9	2.0 / 3.0	112
4	4	4	9	3.0 / 3.0	144
5	4	4	9	2.0 / 3.0	112
6	4	4	9	5.0 / 0.0	160
7	0	0	9	5 / 0	160

Roof Area 4



Roof Area 4 / Roof Area 4 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

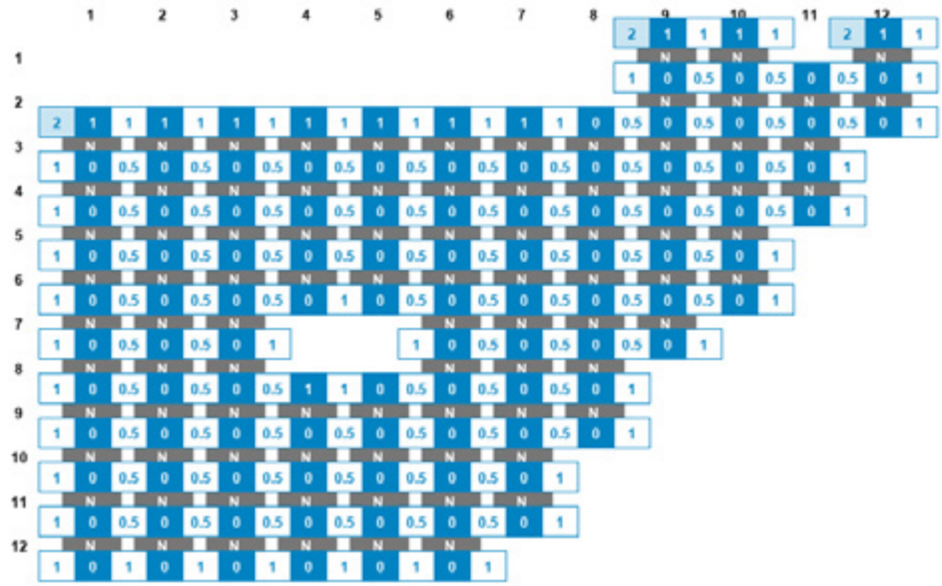
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 45.50 ft
EW DIMENSION	~ 94.51 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	4	4	9	10.0 / 0.0	320
2	12	12	27	19.0 / 4.0	672
3	12	12	25	2.0 / 11.0	240
4	11	11	25	2.0 / 11.0	240
5	10	10	23	2.0 / 10.0	224
6	8	8	21	3.0 / 8.0	224
7	8	8	18	4.0 / 6.0	224
8	9	9	21	4.0 / 8.0	256
9	8	8	19	2.0 / 8.0	192
10	8	8	17	2.0 / 7.0	176
11	7	7	17	2.0 / 7.0	176
12	0	0	15	8 / 0	256

Roof Area 4 / Roof Area 4 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

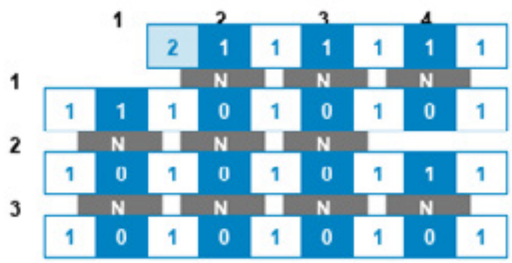
NS DIMENSION	~ 49.56 ft
EW DIMENSION	~ 87.24 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	3	3	8	10.0 / 0.0	320
2	4	4	9	2.0 / 3.0	112
3	11	11	25	17.0 / 4.0	608

4	11	11	23	2.0 / 10.0	224
5	10	10	23	2.0 / 10.0	224
6	10	10	21	2.0 / 9.0	208
7	7	7	21	3.0 / 8.0	224
8	6	6	16	4.0 / 5.0	208
9	8	8	17	4.0 / 6.0	224
10	7	7	17	2.0 / 7.0	176
11	7	7	15	2.0 / 6.0	160
12	6	6	15	2.0 / 6.0	160
13	0	0	13	7 / 0	224

Roof Area 5

Roof Area 5 / Roof Area 5 - Array 1



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

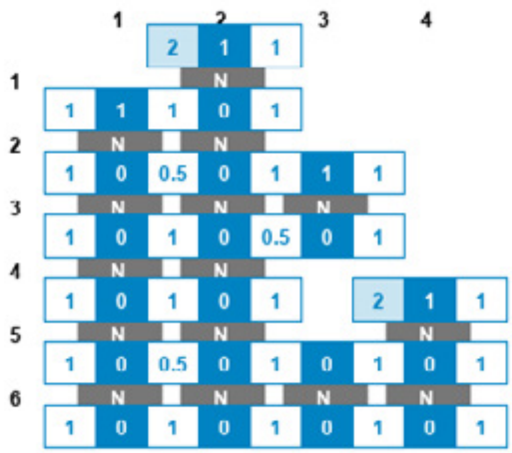
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 13.08 ft
EW DIMENSION	~ 29.08 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	3	3	7	8.0 / 0.0	256
2	3	3	9	6.0 / 0.0	192
3	4	4	9	6.0 / 0.0	192
4	0	0	9	5 / 0	160

Roof Area 5 / Roof Area 5 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

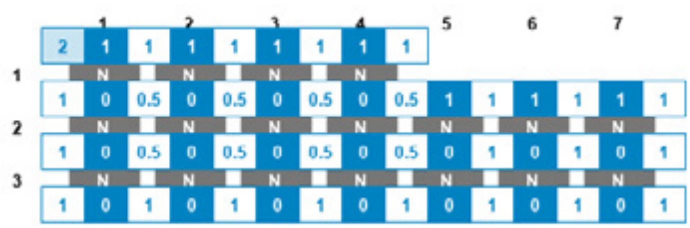
NS DIMENSION	~ 25.24 ft
EW DIMENSION	~ 29.08 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	1	1	3	4.0 / 0.0	128
2	2	2	5	4.0 / 0.0	128
3	3	3	7	4.0 / 1.0	144
4	2	2	7	3.0 / 1.0	112
5	3	3	8	7.0 / 0.0	224
6	4	4	9	4.0 / 1.0	144

7	0	0	9	5 / 0	160

Roof Area 6

Roof Area 6 / Roof Area 6 - Array 1



LEGEND

- N — Module with north wind deflector (for uplift)
- S — Module with south wind deflector (for fire requirements - type 2)
- NS — Module with both deflector types
- Module with no deflectors
- 1 — Standard corner bay with CMU block count
- 4 — Supplemental bay with CMU block count

NOTE

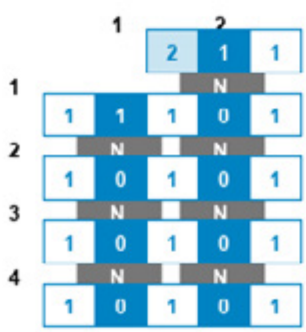
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 13.08 ft
EW DIMENSION	~ 50.89 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	4	4	9	10.0 / 0.0	320
2	7	7	15	7.0 / 4.0	288
3	7	7	15	4.0 / 4.0	192
4	0	0	15	8 / 0	256

Roof Area 6 / Roof Area 6 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

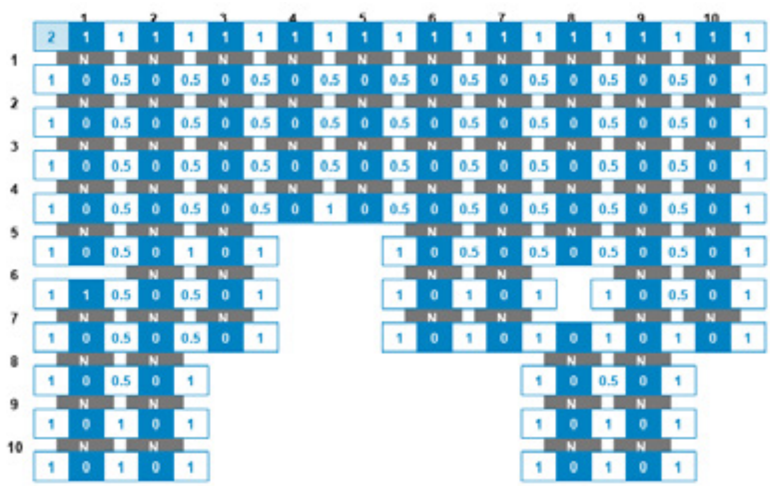
Layout Dimensions

NS DIMENSION	~ 17.13 ft
EW DIMENSION	~ 14.54 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	1	1	3	4.0 / 0.0	128
2	2	2	5	4.0 / 0.0	128
3	2	2	5	3.0 / 0.0	96
4	2	2	5	3.0 / 0.0	96
5	0	0	5	3 / 0	96

Roof Area 7

Roof Area 7 / Roof Area 7 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

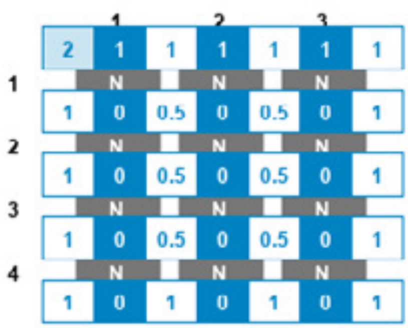
Layout Dimensions

NS DIMENSION	~ 41.45 ft
EW DIMENSION	~ 72.70 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	10	10	21	22.0 / 0.0	704
2	10	10	21	2.0 / 9.0	208
3	10	10	21	2.0 / 9.0	208
4	10	10	21	2.0 / 9.0	208
5	8	8	21	3.0 / 8.0	224
6	6	6	18	5.0 / 5.0	240
7	7	7	17	8.0 / 3.0	304
8	4	4	18	8.0 / 2.0	288
9	4	4	10	4.0 / 2.0	160
10	4	4	10	6.0 / 0.0	192
11	0	0	10	6 / 0	192

Roof Area 8

Roof Area 8 / Roof Area 8 - Array 1



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

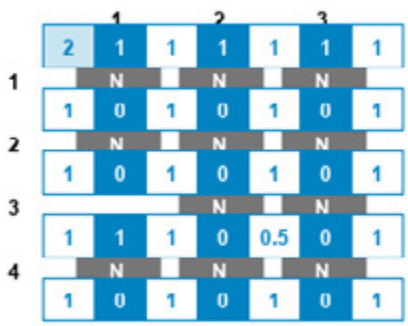
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 17.13 ft
EW DIMENSION	~ 21.81 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	3	3	7	8.0 / 0.0	256
2	3	3	7	2.0 / 2.0	96
3	3	3	7	2.0 / 2.0	96
4	3	3	7	2.0 / 2.0	96
5	0	0	7	4 / 0	128

Roof Area 8 / Roof Area 8 - Array 2



LEGEND

- **N** — Module with north wind deflector (for uplift)
- **S** — Module with south wind deflector (for fire requirements - type 2)
- **NS** — Module with both deflector types
- Module with no deflectors
- **1** — Standard corner bay with CMU block count
- **4** — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

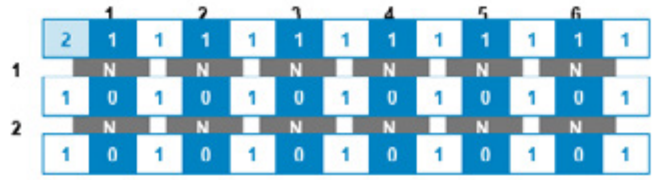
Layout Dimensions

NS DIMENSION	~ 17.13 ft
EW DIMENSION	~ 21.81 ft

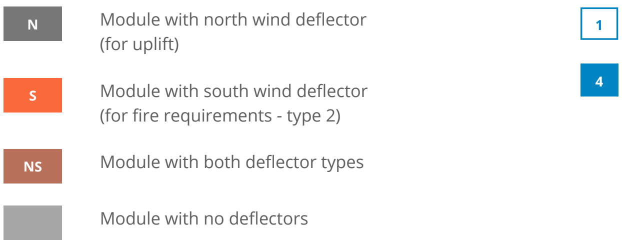
ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	3	3	7	8.0 / 0.0	256
2	3	3	7	4.0 / 0.0	128
3	2	2	7	4.0 / 0.0	128
4	3	3	7	4.0 / 1.0	144
5	0	0	7	4 / 0	128

Roof Area 9

Roof Area 9 / Roof Area 9 - Array 1



LEGEND



N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

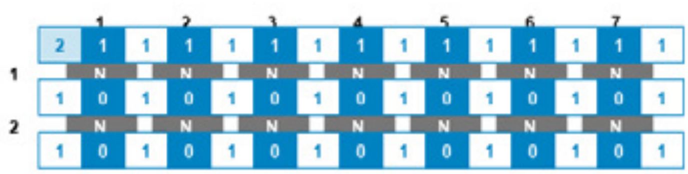
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 9.02 ft
EW DIMENSION	~ 43.62 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	6	6	13	14.0 / 0.0	448
2	6	6	13	7.0 / 0.0	224
3	0	0	13	7 / 0	224

Roof Area 9 / Roof Area 9 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

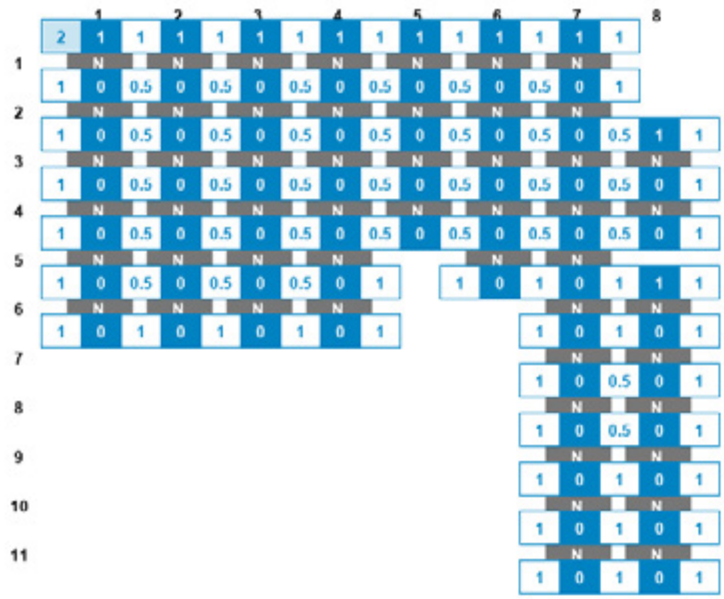
Layout Dimensions

NS DIMENSION	~ 9.02 ft
EW DIMENSION	~ 50.89 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	7	7	15	16.0 / 0.0	512
2	7	7	15	8.0 / 0.0	256
3	0	0	15	8 / 0	256

Roof Area 10

Roof Area 10 / Roof Area 10 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

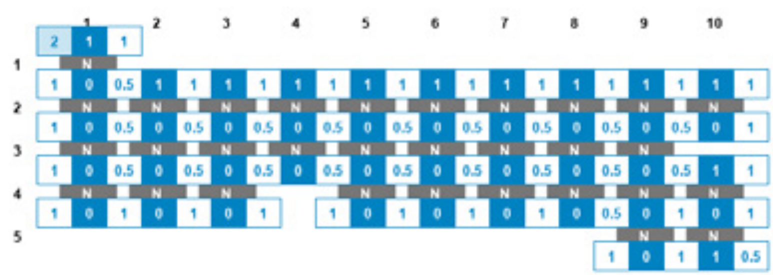
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 45.50 ft
EW DIMENSION	~ 58.16 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	7	7	15	16.0 / 0.0	512
2	7	7	15	2.0 / 6.0	160
3	8	8	17	3.0 / 7.0	208
4	8	8	17	2.0 / 7.0	176
5	6	6	17	2.0 / 7.0	176
6	6	6	16	7.0 / 3.0	272
7	2	2	14	8.0 / 0.0	256
8	2	2	5	2.0 / 1.0	80
9	2	2	5	2.0 / 1.0	80
10	2	2	5	3.0 / 0.0	96
11	2	2	5	3.0 / 0.0	96
12	0	0	5	3 / 0	96

Roof Area 10 / Roof Area 10 - Array 2



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

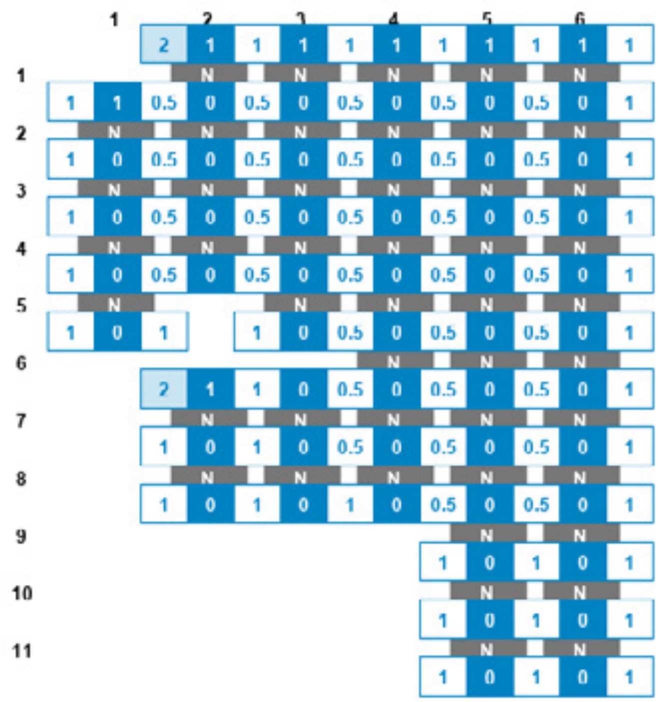
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 21.18 ft
EW DIMENSION	~ 72.70 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	1	1	3	4.0 / 0.0	128
2	10	10	21	19.0 / 1.0	624
3	9	9	21	2.0 / 9.0	208
4	9	9	21	3.0 / 9.0	240
5	2	2	20	10.0 / 1.0	336
6	0	0	5	3.0 / 1.0	112

Roof Area 10 / Roof Area 10 - Array 3



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

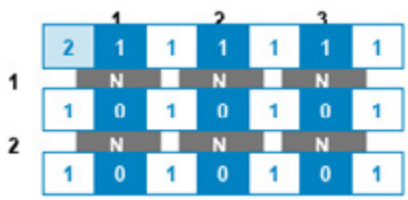
Layout Dimensions

NS DIMENSION	~ 45.50 ft
EW DIMENSION	~ 43.62 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	5	5	11	12.0 / 0.0	384
2	6	6	13	3.0 / 5.0	176
3	6	6	13	2.0 / 5.0	144
4	6	6	13	2.0 / 5.0	144
5	5	5	13	2.0 / 5.0	144
6	3	3	12	4.0 / 3.0	176
7	5	5	11	5.0 / 3.0	208
8	5	5	11	3.0 / 3.0	144
9	2	2	11	4.0 / 2.0	160
10	2	2	5	3.0 / 0.0	96
11	2	2	5	3.0 / 0.0	96
12	0	0	5	3 / 0	96

Roof Area 11

Roof Area 11 / Roof Area 11 - Array 1



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

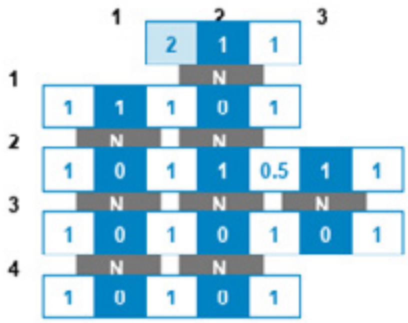
Layout Dimensions

NS DIMENSION	~ 9.02 ft
EW DIMENSION	~ 21.81 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	3	3	7	8.0 / 0.0	256
2	3	3	7	4.0 / 0.0	128
3	0	0	7	4 / 0	128

Roof Area 13

Roof Area 13 / Roof Area 13 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

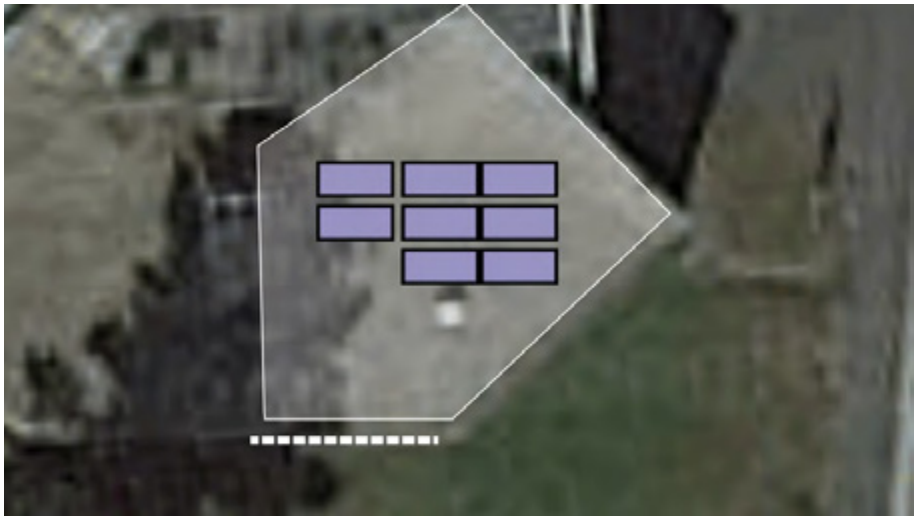
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

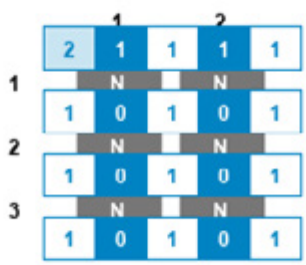
NS DIMENSION	~ 17.13 ft
EW DIMENSION	~ 21.81 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	1	1	3	4.0 / 0.0	128
2	2	2	5	4.0 / 0.0	128
3	3	3	7	5.0 / 1.0	176
4	2	2	7	4.0 / 0.0	128
5	0	0	5	3 / 0	96

Roof Area 14



Roof Area 14 / Roof Area 14 - Array 1



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

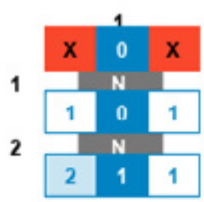
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 13.08 ft
EW DIMENSION	~ 14.54 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	2	2	5	6.0 / 0.0	192
2	2	2	5	3.0 / 0.0	96
3	2	2	5	3.0 / 0.0	96
4	0	0	5	3 / 0	96

Roof Area 14 / Roof Area 14 - Array 2



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

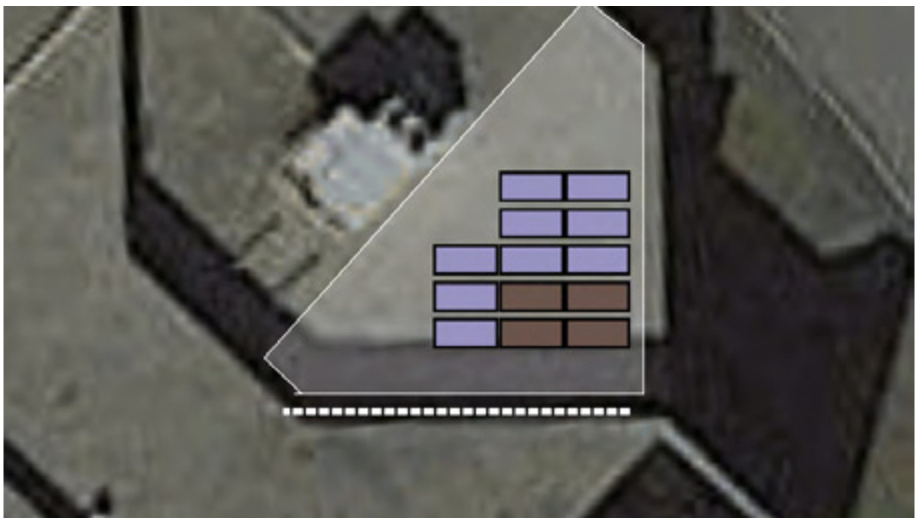
Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

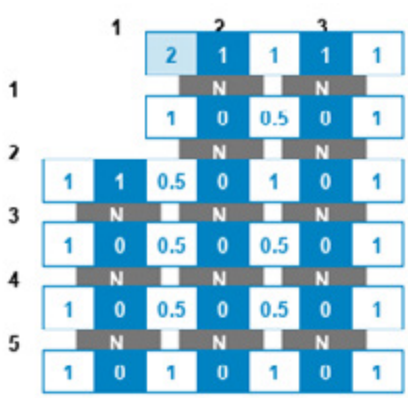
NS DIMENSION	~ 9.02 ft
EW DIMENSION	~ 7.27 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	1	1	3	0 / 0	0
2	1	1	3	2 / 0	64
3	0	0	3	4.0 / 0.0	128

Roof Area 15



Roof Area 15 / Roof Area 15 - Array 1



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Layout Dimensions

NS DIMENSION	~ 21.18 ft
EW DIMENSION	~ 21.81 ft

ROW	MODULES	MODULES WITH DEFLECTORS	BAYS	FULL / HALF BLOCKS (CMU)	BALLAST WEIGHT (LBS)
1	2	2	5	6.0 / 0.0	192
2	2	2	5	2.0 / 1.0	80
3	3	3	7	4.0 / 1.0	144
4	3	3	7	2.0 / 2.0	96
5	3	3	7	2.0 / 2.0	96
6	0	0	7	4 / 0	128

ATTACHMENT E – Unirac Ballast Engineering Report

U-BUILDER PROJECT REPORT

APPLICATION VERSION: 6.0.4
PROJECT VERSION: 0.0.27

PROJECT TITLE	PROJECT ID	LAST UPDATED
ROOFMOUNT RM5	AF1B1058	Apr. 11, 2023
		ORIGINALLY CREATED
		Mar. 3, 2023

NAME	ASH
ADDRESS	19 Flagg Dr, Framingham, MA 01702, USA
CITY, STATE	Framingham, MA
MODULE	Hanwha/Q-Cells Q.Peak Duo XL-G10.2-480 - Ubuilder V3

Designed by aharania@solardesign.com

ROOFMOUNT RM5

Hanwha/Q-Cells

938 - Q.Peak Duo XL-G10.2-480 - Ubuilder V3

28233 ft^2

450.24 KW

NOTE: Installation of the project is intended to happen within the year of project designed in UBuilder. If it's past one year please rerun the design or contact Unirac Engineering Services.

NOTE: Mid support required for (modules larger than 87" and snow load higher than 20 psf) or snow load higher than 60 psf.

ENGINEERING REPORT

Plan review

AVERAGE PSF	4.23 psf

TOTAL NUMBER OF MODULES	938
TOTAL KW	450.24 KW
TOTAL STRUCTURE AREA	~28233 ft^2
TOTAL WEIGHT ON ROOF	119364 lbs
RACKING WEIGHT	27606 lbs
MODULE WEIGHT	54798 lbs
BALLAST WEIGHT	36960 lbs
MAX BAY LOAD (DEAD)	155 lbs
SEISMIC ATTACHMENTS COUNT	1
TOTAL ATTACHMENT COUNT	2

Loads Used for Design

BUILDING CODE	ASCE 7-10
BASIC WIND SPEED	127.00 mph
GROUND SNOW LOAD	40.00 psf
SEISMIC, S_S	0.216
SEISMIC, S_1	0.069
ELEVATION	170.00 ft
RISK CATEGORY	III
WIND EXPOSURE	B
MRI	25
VELOCITY PRESSURE, Q_Z	21.23 psf
DEAD LOAD FACTOR MODIFICATION	1.000 psf

Inspection

PRODUCT	ROOFMOUNT RM5
MODULE MANUFACTURER	Hanwha/Q-Cells
MODEL	Q.Peak Duo XL-G10.2-480 - Ubuilder V3
MODULE WATTS	480 watts
MODULE LENGTH	87.24"
MODULE WIDTH	41.14"
MODULE THICKNESS	1.38"
MODULE WEIGHT	58.42 lbs
ADD SUPPLEMENTAL BAYS	Yes
SETBACK DISTANCE	3 ft
HALF BLOCK ALLOWED	Yes
HALF BLOCK WEIGHT	16.0 lbs
BALLAST BLOCK (CMU) WEIGHT	32.0 lbs
MAX BLOCKS PER BAY	4.5
BUILDING HEIGHT	30.00 ft
LONGEST BUILDING LENGTH	225.00 ft
ROOF TYPE	OTHER
SHORTEST BUILDING LENGTH	30.00 ft
PARAPET HEIGHT	<= 1/2 Array Height (<= 4 inches)
WIND DEFLECTORS	Everywhere
DEAD LOAD FACTOR	1.000
ATTACHMENTS OPTIMIZATION CRITERIA	Psf Limit
ROOF PSF LIMIT	6.50 psf
ATTACHMENT TYPE	UNIRAC FLASHLOC RM
ATTACHMENT CAPACITY UPLIFT	355.0 lbs
ATTACHMENT CAPACITY SHEAR	194.0 lbs
CONTROLLING COMPONENT UPLIFT CAPACITY	RACKING
CONTROLLING COMPONENT SHEAR CAPACITY	RACKING

Roof Area 1 - Array 1

AVERAGE PSF	3.75 psf
TOTAL NUMBER OF MODULES:	226
TOTAL KW:	108.48 KW
TOTAL AREA:	6697 ft^2
TOTAL WEIGHT ON ROOF:	25099 lbs
RACKING WEIGHT:	6088 lbs
MODULE WEIGHT:	13203 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	5808 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

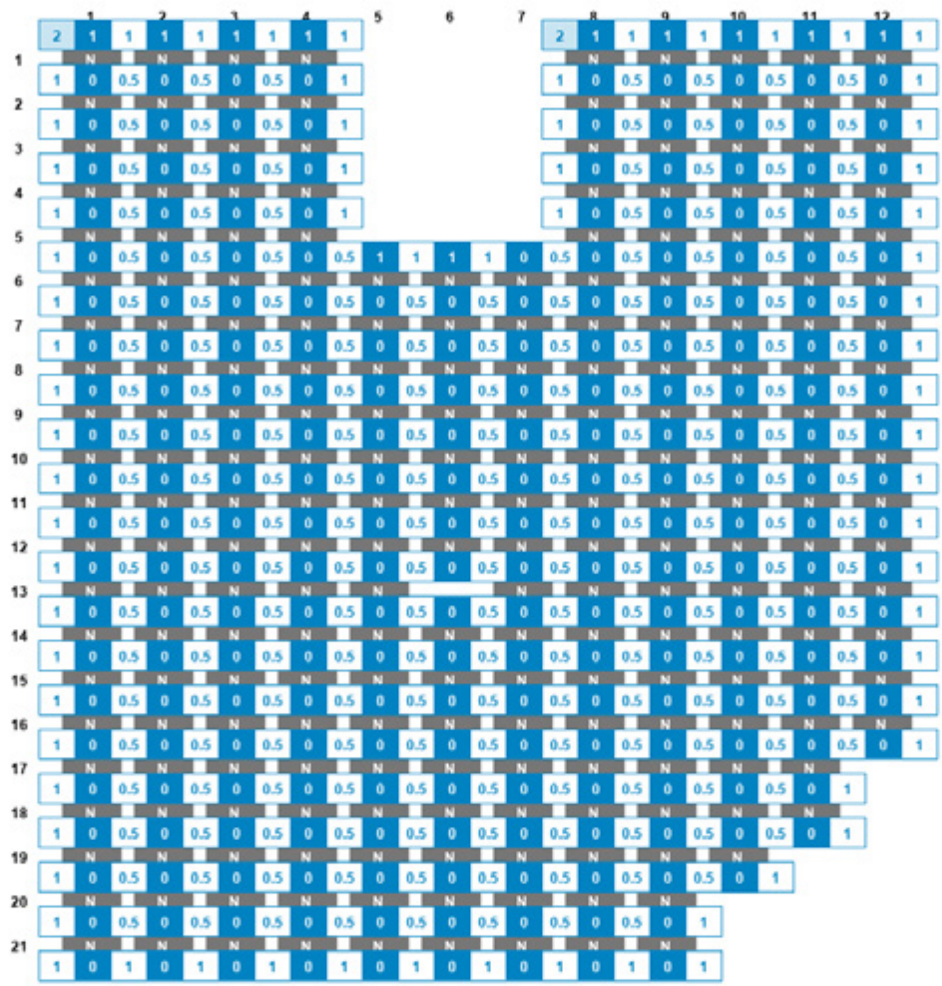
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	505
BALLAST BLOCK	84
BALLAST HALF BLOCK	195
RM5 98" WIND DEFLECTOR	226
RM END CLAMP 30-40MM	1923
KIT 1/4 20 CLIP ON NUT SS 18-8	2928
KIT, WIND DEFLECTOR ATTACHMENT	1005
MLPE TIGER CLIP	226

Roof Area 1 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

- **N** — Module with north wind deflector (for uplift)
- **S** — Module with south wind deflector (for fire requirements - type 2)
- **NS** — Module with both deflector types
- Module with no deflectors
- **1** — Standard corner bay with CMU block count
- **4** — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 2 - Array 1

AVERAGE PSF	4.55 psf
TOTAL NUMBER OF MODULES:	38
TOTAL KW:	18.24 KW
TOTAL AREA:	1143 ft^2
TOTAL WEIGHT ON ROOF:	5201 lbs
RACKING WEIGHT:	1189 lbs
MODULE WEIGHT:	2220 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1792 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

BOM

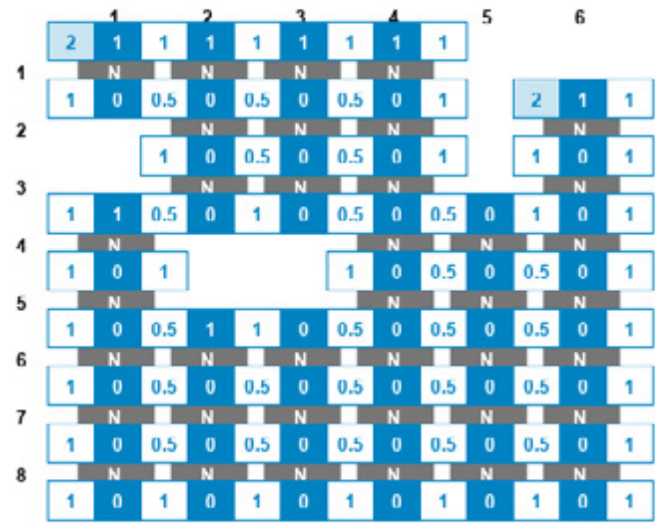
PART	QTY
RM5 BAY	106
BALLAST BLOCK	44
BALLAST HALF BLOCK	24
RM5 98" WIND DEFLECTOR	38
RM END CLAMP 30-40MM	360
KIT 1/4 20 CLIP ON NUT SS 18-8	553
KIT, WIND DEFLECTOR ATTACHMENT	193
MLPE TIGER CLIP	38

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	18

*In jurisdictions that follow SEAOC PV-1 methodology.

Roof Area 2 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)	1	Standard corner bay with CMU block count
S	Module with south wind deflector (for fire requirements - type 2)	4	Supplemental bay with CMU block count
NS	Module with both deflector types		
	Module with no deflectors		

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 3 - Array 1

AVERAGE PSF	3.90 psf
TOTAL NUMBER OF MODULES:	129
TOTAL KW:	61.92 KW
TOTAL AREA:	3848 ft^2
TOTAL WEIGHT ON ROOF:	14998 lbs
RACKING WEIGHT:	3574 lbs
MODULE WEIGHT:	7536 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	3888 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

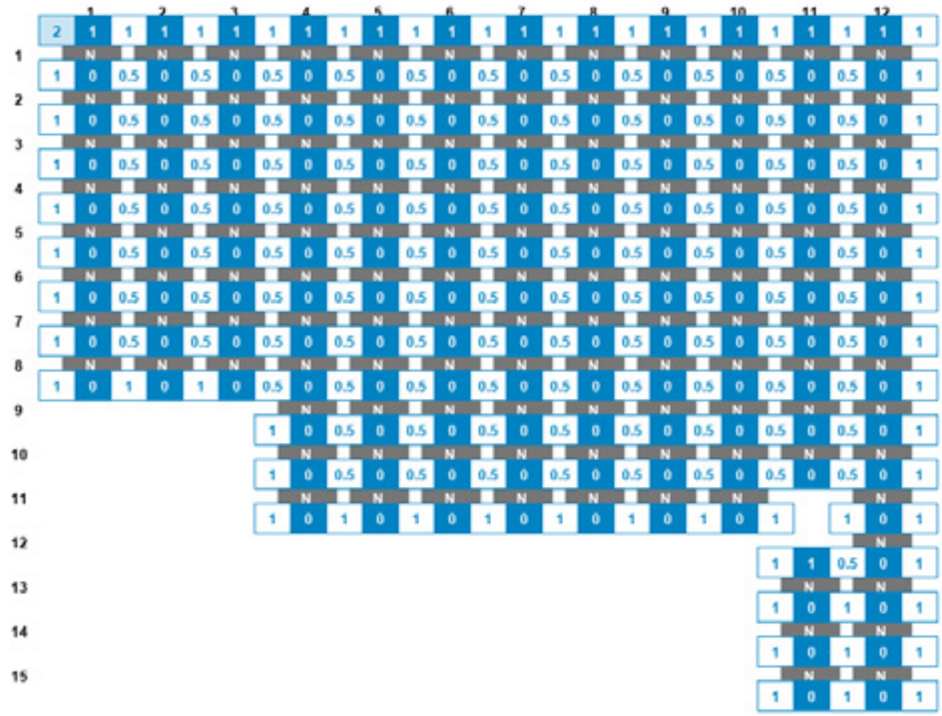
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	301
BALLAST BLOCK	70
BALLAST HALF BLOCK	103
RM5 98" WIND DEFLECTOR	129
RM END CLAMP 30-40MM	1116
KIT 1/4 20 CLIP ON NUT SS 18-8	1763
KIT, WIND DEFLECTOR ATTACHMENT	647
MLPE TIGER CLIP	129

Roof Area 3 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

- N — Module with north wind deflector (for uplift)
- S — Module with south wind deflector (for fire requirements - type 2)
- NS — Module with both deflector types
- Module with no deflectors
- 1 — Standard corner bay with CMU block count
- 4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 3 - Array 2

AVERAGE PSF	4.60 psf
TOTAL NUMBER OF MODULES:	21
TOTAL KW:	10.08 KW
TOTAL AREA:	640 ft^2
TOTAL WEIGHT ON ROOF:	2942 lbs
RACKING WEIGHT:	659 lbs
MODULE WEIGHT:	1227 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1056 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

BOM

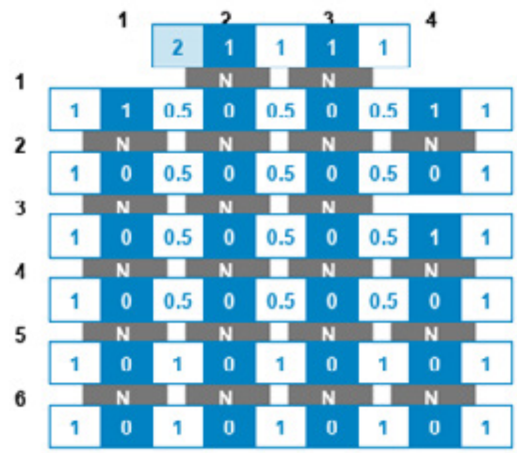
PART	QTY
RM5 BAY	59
BALLAST BLOCK	27
BALLAST HALF BLOCK	12
RM5 98" WIND DEFLECTOR	21
RM END CLAMP 30-40MM	196
KIT 1/4 20 CLIP ON NUT SS 18-8	297
KIT, WIND DEFLECTOR ATTACHMENT	101
MLPE TIGER CLIP	21

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

Roof Area 3 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 4 - Array 1

AVERAGE PSF	**4.00 psf**
TOTAL NUMBER OF MODULES:	97
TOTAL KW:	46.56 KW
TOTAL AREA:	2908 ft^2
TOTAL WEIGHT ON ROOF:	11636 lbs
RACKING WEIGHT:	2770 lbs
MODULE WEIGHT:	5667 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	3200 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

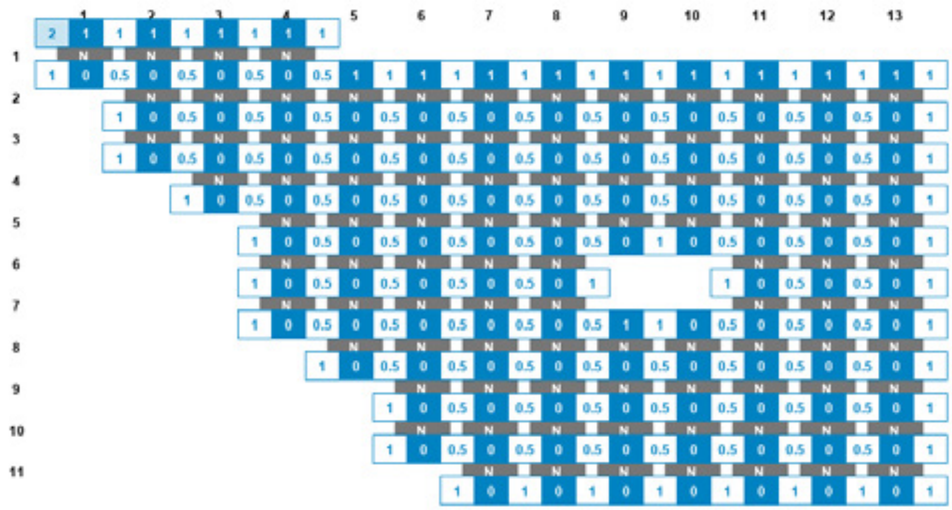
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	237
BALLAST BLOCK	60
BALLAST HALF BLOCK	80
RM5 98" WIND DEFLECTOR	97
RM END CLAMP 30-40MM	855
KIT 1/4 20 CLIP ON NUT SS 18-8	1353
KIT, WIND DEFLECTOR ATTACHMENT	498
MLPE TIGER CLIP	97

Roof Area 4 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 4 - Array 2

AVERAGE PSF	4.04 psf
TOTAL NUMBER OF MODULES:	90
TOTAL KW:	43.20 KW
TOTAL AREA:	2703 ft^2
TOTAL WEIGHT ON ROOF:	10926 lbs
RACKING WEIGHT:	2597 lbs
MODULE WEIGHT:	5258 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	3072 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

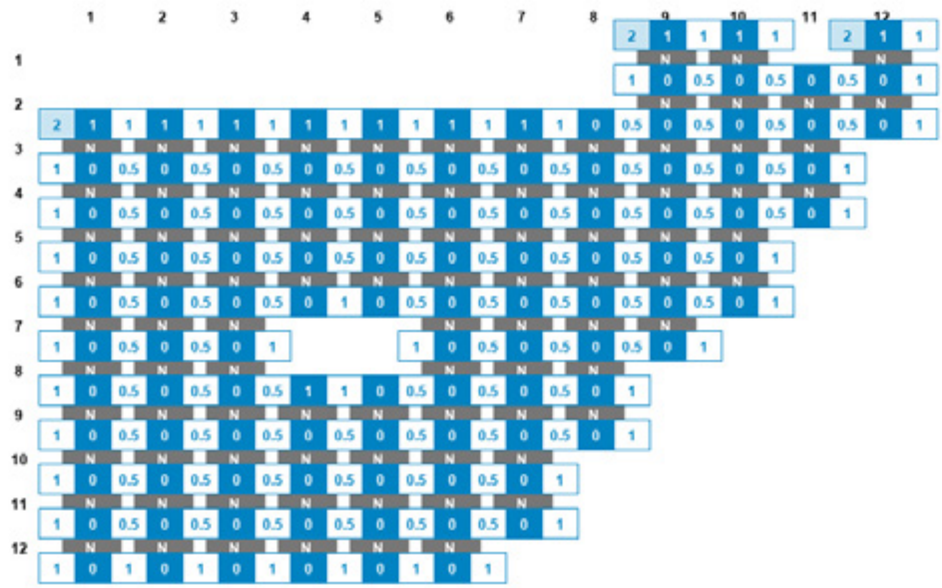
BOM

PART	QTY
RM5 BAY	223
BALLAST BLOCK	59
BALLAST HALF BLOCK	74
RM5 98" WIND DEFLECTOR	90
RM END CLAMP 30-40MM	805
KIT 1/4 20 CLIP ON NUT SS 18-8	1295
KIT, WIND DEFLECTOR ATTACHMENT	490
MLPE TIGER CLIP	90

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

Roof Area 4 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 5 - Array 1

AVERAGE PSF	5.58 psf
TOTAL NUMBER OF MODULES:	10
TOTAL KW:	4.80 KW
TOTAL AREA:	312 ft^2
TOTAL WEIGHT ON ROOF:	1741 lbs
RACKING WEIGHT:	357 lbs
MODULE WEIGHT:	584 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	800 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

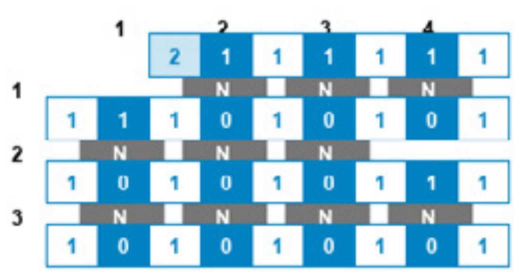
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	34
BALLAST BLOCK	25
RM5 98" WIND DEFLECTOR	10
RM END CLAMP 30-40MM	95
KIT 1/4 20 CLIP ON NUT SS 18-8	144
KIT, WIND DEFLECTOR ATTACHMENT	49
MLPE TIGER CLIP	10

Roof Area 5 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 5 - Array 2

AVERAGE PSF	5.25 psf
TOTAL NUMBER OF MODULES:	15
TOTAL KW:	7.20 KW
TOTAL AREA:	463 ft^2
TOTAL WEIGHT ON ROOF:	2434 lbs
RACKING WEIGHT:	518 lbs
MODULE WEIGHT:	876 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1040 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

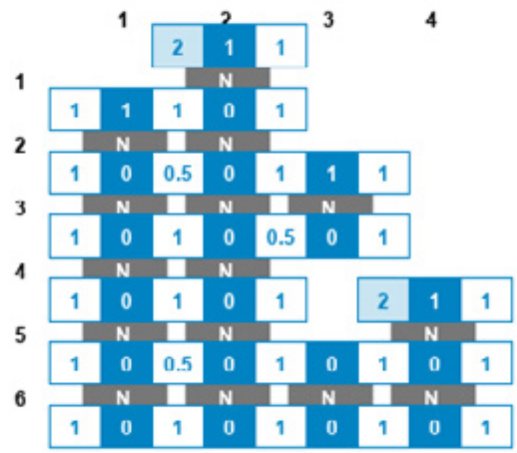
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	48
BALLAST BLOCK	31
BALLAST HALF BLOCK	3
RM5 98" WIND DEFLECTOR	15
RM END CLAMP 30-40MM	153
KIT 1/4 20 CLIP ON NUT SS 18-8	244
KIT, WIND DEFLECTOR ATTACHMENT	91
MLPE TIGER CLIP	15

Roof Area 5 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 6 - Array 1

AVERAGE PSF	4.81 psf
TOTAL NUMBER OF MODULES:	18
TOTAL KW:	8.64 KW
TOTAL AREA:	561 ft^2
TOTAL WEIGHT ON ROOF:	2694 lbs
RACKING WEIGHT:	587 lbs
MODULE WEIGHT:	1052 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1056 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

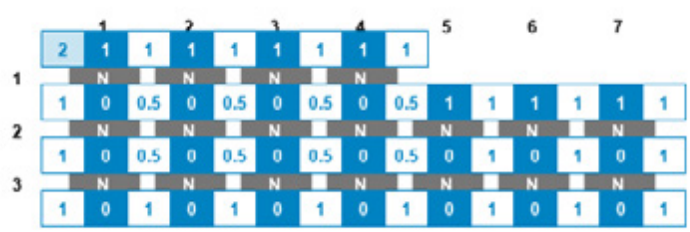
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	54
BALLAST BLOCK	29
BALLAST HALF BLOCK	8
RM5 98" WIND DEFLECTOR	18
RM END CLAMP 30-40MM	161
KIT 1/4 20 CLIP ON NUT SS 18-8	245
KIT, WIND DEFLECTOR ATTACHMENT	84
MLPE TIGER CLIP	18

Roof Area 6 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 6 - Array 2

AVERAGE PSF	5.59 psf
TOTAL NUMBER OF MODULES:	7
TOTAL KW:	3.36 KW
TOTAL AREA:	215 ft^2
TOTAL WEIGHT ON ROOF:	1200 lbs
RACKING WEIGHT:	247 lbs
MODULE WEIGHT:	409 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	544 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

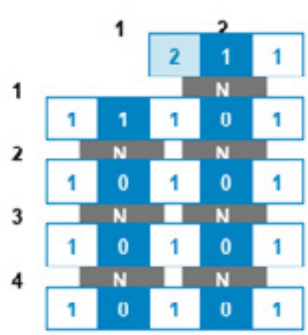
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	23
BALLAST BLOCK	17
RM5 98" WIND DEFLECTOR	7
RM END CLAMP 30-40MM	73
KIT 1/4 20 CLIP ON NUT SS 18-8	111
KIT, WIND DEFLECTOR ATTACHMENT	38
MLPE TIGER CLIP	7

Roof Area 6 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 7 - Array 1

AVERAGE PSF	4.26 psf
TOTAL NUMBER OF MODULES:	73
TOTAL KW:	35.04 KW
TOTAL AREA:	2194 ft^2
TOTAL WEIGHT ON ROOF:	9354 lbs
RACKING WEIGHT:	2162 lbs
MODULE WEIGHT:	4265 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	2928 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

BOM

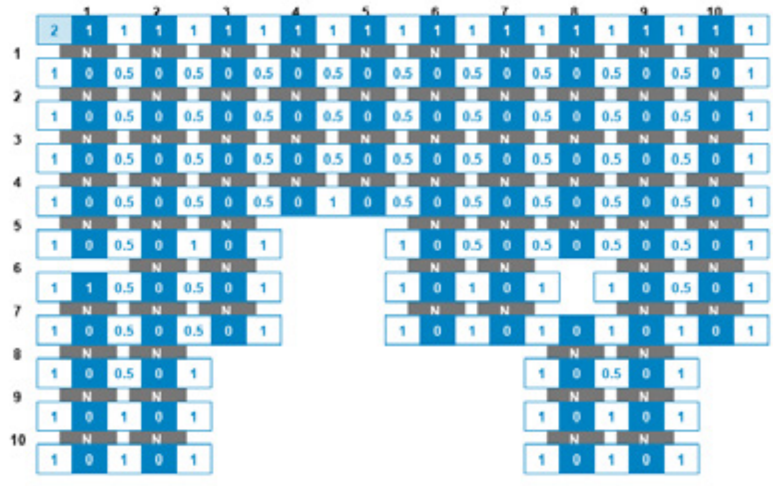
PART	QTY
RM5 BAY	188
BALLAST BLOCK	68
BALLAST HALF BLOCK	47
RM5 98" WIND DEFLECTOR	73
RM END CLAMP 30-40MM	665
KIT 1/4 20 CLIP ON NUT SS 18-8	1039
KIT, WIND DEFLECTOR ATTACHMENT	374
MLPE TIGER CLIP	73

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

Roof Area 7 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

- N — Module with north wind deflector (for uplift)
- S — Module with south wind deflector (for fire requirements - type 2)
- NS — Module with both deflector types
- Module with no deflectors
- 1 — Standard corner bay with CMU block count
- 4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 8 - Array 1

AVERAGE PSF	**4.80 psf**
TOTAL NUMBER OF MODULES:	12
TOTAL KW:	5.76 KW
TOTAL AREA:	366 ft^2
TOTAL WEIGHT ON ROOF:	1759 lbs
RACKING WEIGHT:	386 lbs
MODULE WEIGHT:	701 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	672 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

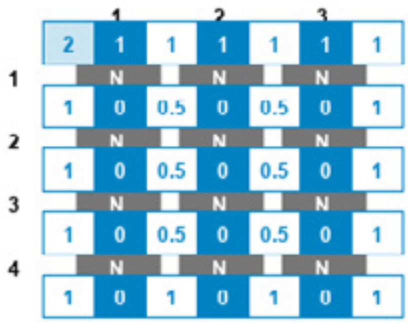
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	35
BALLAST BLOCK	18
BALLAST HALF BLOCK	6
RM5 98" WIND DEFLECTOR	12
RM END CLAMP 30-40MM	112
KIT 1/4 20 CLIP ON NUT SS 18-8	168
KIT, WIND DEFLECTOR ATTACHMENT	56
MLPE TIGER CLIP	12

Roof Area 8 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N — Module with north wind deflector (for uplift)

S — Module with south wind deflector (for fire requirements - type 2)

NS — Module with both deflector types

Module with no deflectors

1 — Standard corner bay with CMU block count

4 — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 8 - Array 2

AVERAGE PSF	5.28 psf
TOTAL NUMBER OF MODULES:	11
TOTAL KW:	5.28 KW
TOTAL AREA:	341 ft^2
TOTAL WEIGHT ON ROOF:	1802 lbs
RACKING WEIGHT:	376 lbs
MODULE WEIGHT:	643 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	784 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

BOM

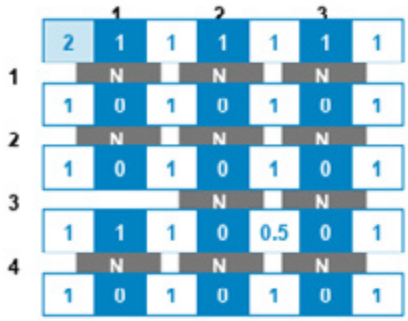
PART	QTY
RM5 BAY	35
BALLAST BLOCK	24
BALLAST HALF BLOCK	1
RM5 98" WIND DEFLECTOR	11
RM END CLAMP 30-40MM	106
KIT 1/4 20 CLIP ON NUT SS 18-8	159
KIT, WIND DEFLECTOR ATTACHMENT	53
MLPE TIGER CLIP	11

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

Roof Area 8 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N Module with north wind deflector (for uplift)

S Module with south wind deflector (for fire requirements - type 2)

NS Module with both deflector types

Module with no deflectors

1 Standard corner bay with CMU block count

4 Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 9 - Array 1

AVERAGE PSF	5.29 psf
TOTAL NUMBER OF MODULES:	12
TOTAL KW:	5.76 KW
TOTAL AREA:	380 ft^2
TOTAL WEIGHT ON ROOF:	2009 lbs
RACKING WEIGHT:	411 lbs
MODULE WEIGHT:	701 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	896 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

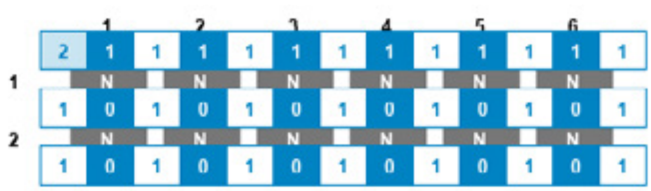
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	39
BALLAST BLOCK	28
RM5 98" WIND DEFLECTOR	12
RM END CLAMP 30-40MM	104
KIT 1/4 20 CLIP ON NUT SS 18-8	156
KIT, WIND DEFLECTOR ATTACHMENT	52
MLPE TIGER CLIP	12

Roof Area 9 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

- **N** — Module with north wind deflector (for uplift)
- **S** — Module with south wind deflector (for fire requirements - type 2)
- **NS** — Module with both deflector types
- Module with no deflectors
- **1** — Standard corner bay with CMU block count
- **4** — Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 9 - Array 2

AVERAGE PSF	**5.23 psf**
TOTAL NUMBER OF MODULES:	14
TOTAL KW:	6.72 KW
TOTAL AREA:	443 ft^2
TOTAL WEIGHT ON ROOF:	2318 lbs
RACKING WEIGHT:	476 lbs
MODULE WEIGHT:	818 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1024 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

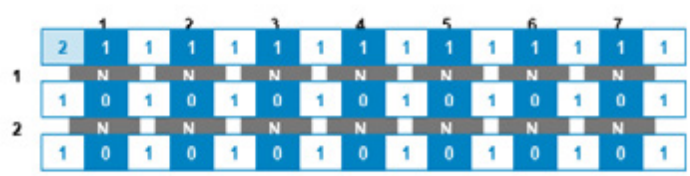
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	45
BALLAST BLOCK	32
RM5 98" WIND DEFLECTOR	14
RM END CLAMP 30-40MM	120
KIT 1/4 20 CLIP ON NUT SS 18-8	180
KIT, WIND DEFLECTOR ATTACHMENT	60
MLPE TIGER CLIP	14

Roof Area 9 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 10 - Array 1

AVERAGE PSF	**4.35 psf**
TOTAL NUMBER OF MODULES:	52
TOTAL KW:	24.96 KW
TOTAL AREA:	1564 ft^2
TOTAL WEIGHT ON ROOF:	6803 lbs
RACKING WEIGHT:	1557 lbs
MODULE WEIGHT:	3038 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	2208 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

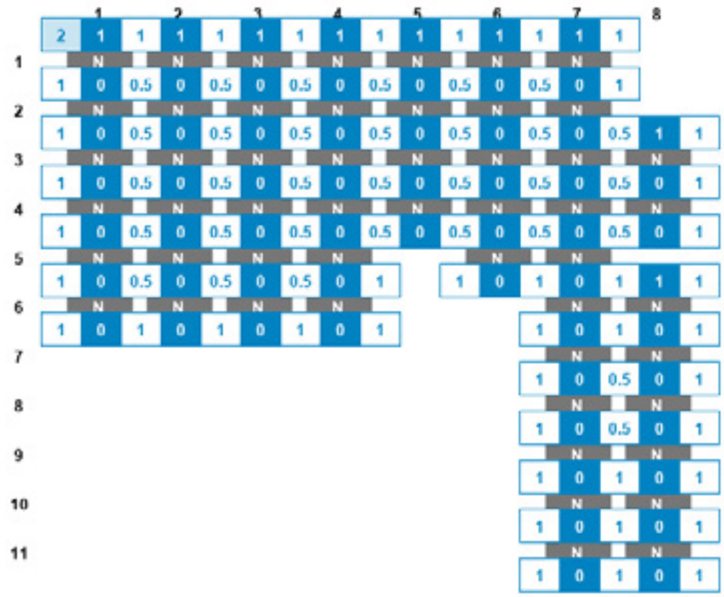
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	136
BALLAST BLOCK	53
BALLAST HALF BLOCK	32
RM5 98" WIND DEFLECTOR	52
RM END CLAMP 30-40MM	480
KIT 1/4 20 CLIP ON NUT SS 18-8	782
KIT, WIND DEFLECTOR ATTACHMENT	302
MLPE TIGER CLIP	52

Roof Area 10 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 10 - Array 2

AVERAGE PSF	**4.67 psf**
TOTAL NUMBER OF MODULES:	31
TOTAL KW:	14.88 KW
TOTAL AREA:	956 ft^2
TOTAL WEIGHT ON ROOF:	4465 lbs
RACKING WEIGHT:	1006 lbs
MODULE WEIGHT:	1811 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1648 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

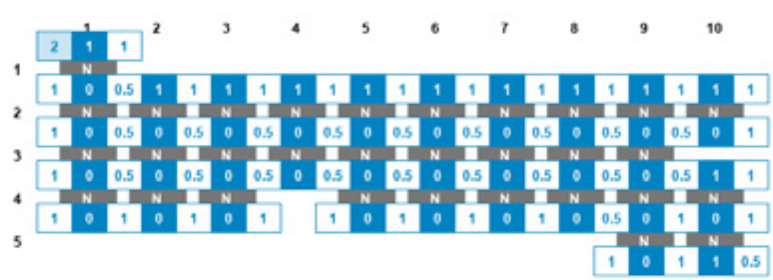
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	91
BALLAST BLOCK	41
BALLAST HALF BLOCK	21
RM5 98" WIND DEFLECTOR	31
RM END CLAMP 30-40MM	304
KIT 1/4 20 CLIP ON NUT SS 18-8	474
KIT, WIND DEFLECTOR ATTACHMENT	170
MLPE TIGER CLIP	31

Roof Area 10 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 10 - Array 3

AVERAGE PSF	4.32 psf
TOTAL NUMBER OF MODULES:	47
TOTAL KW:	22.56 KW
TOTAL AREA:	1417 ft^2
TOTAL WEIGHT ON ROOF:	6123 lbs
RACKING WEIGHT:	1409 lbs
MODULE WEIGHT:	2746 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	1968 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

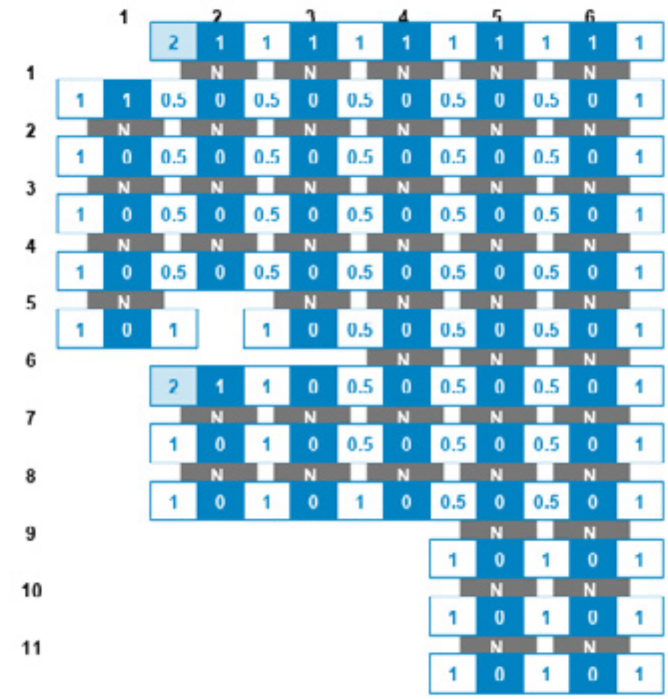
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	123
BALLAST BLOCK	46
BALLAST HALF BLOCK	31
RM5 98" WIND DEFLECTOR	47
RM END CLAMP 30-40MM	436
KIT 1/4 20 CLIP ON NUT SS 18-8	682
KIT, WIND DEFLECTOR ATTACHMENT	246
MLPE TIGER CLIP	47

Roof Area 10 - Array 3 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay. If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 11 - Array 1

AVERAGE PSF	5.69 psf
TOTAL NUMBER OF MODULES:	6
TOTAL KW:	2.88 KW
TOTAL AREA:	190 ft^2
TOTAL WEIGHT ON ROOF:	1081 lbs
RACKING WEIGHT:	218 lbs
MODULE WEIGHT:	351 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	512 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

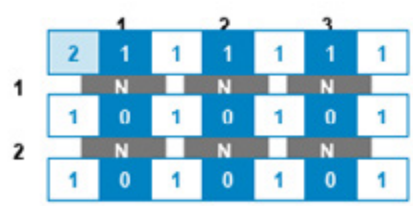
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	21
BALLAST BLOCK	16
RM5 98" WIND DEFLECTOR	6
RM END CLAMP 30-40MM	56
KIT 1/4 20 CLIP ON NUT SS 18-8	84
KIT, WIND DEFLECTOR ATTACHMENT	28
MLPE TIGER CLIP	6

Roof Area 11 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 13 - Array 1

AVERAGE PSF	**5.67 psf**
TOTAL NUMBER OF MODULES:	8
TOTAL KW:	3.84 KW
TOTAL AREA:	249 ft^2
TOTAL WEIGHT ON ROOF:	1410 lbs
RACKING WEIGHT:	287 lbs
MODULE WEIGHT:	467 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	656 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

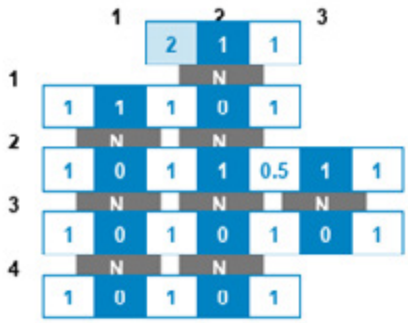
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	27
BALLAST BLOCK	20
BALLAST HALF BLOCK	1
RM5 98" WIND DEFLECTOR	8
RM END CLAMP 30-40MM	83
KIT 1/4 20 CLIP ON NUT SS 18-8	130
KIT, WIND DEFLECTOR ATTACHMENT	47
MLPE TIGER CLIP	8

Roof Area 13 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 14 - Array 1

AVERAGE PSF	5.63 psf
TOTAL NUMBER OF MODULES:	6
TOTAL KW:	2.88 KW
TOTAL AREA:	185 ft^2
TOTAL WEIGHT ON ROOF:	1043 lbs
RACKING WEIGHT:	212 lbs
MODULE WEIGHT:	351 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	480 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

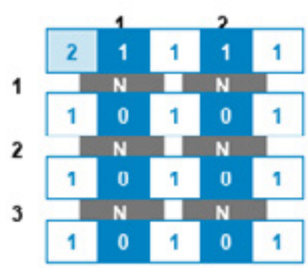
MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	20
BALLAST BLOCK	15
RM5 98" WIND DEFLECTOR	6
RM END CLAMP 30-40MM	60
KIT 1/4 20 CLIP ON NUT SS 18-8	90
KIT, WIND DEFLECTOR ATTACHMENT	30
MLPE TIGER CLIP	6

Roof Area 14 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 14 - Array 2

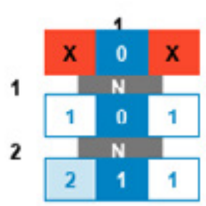
AVERAGE PSF	6.48 psf

TOTAL NUMBER OF MODULES:	2
TOTAL KW:	0.96 KW
TOTAL AREA:	63 ft^2
TOTAL WEIGHT ON ROOF:	410 lbs
RACKING WEIGHT:	101 lbs
MODULE WEIGHT:	117 lbs
MODIFIED DEAD LOAD FACTOR	0.6
BALLAST WEIGHT:	192 lbs
ROW SPACING:	7.5"
SEISMIC ATTACHMENTS COUNT	1
TOTAL ATTACHMENT COUNT:	2

BOM

PART	QTY
RM5 BAY	9
BALLAST BLOCK	6
RM5 98" WIND DEFLECTOR	2
RM END CLAMP 30-40MM	24
KIT 1/4 20 CLIP ON NUT SS 18-8	36
KIT, WIND DEFLECTOR ATTACHMENT	12
FLASHLOC RM KIT	2
RM5/RMDT H-ATTACHMENT KIT	2
MLPE TIGER CLIP	2

Roof Area 14 - Array 2 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

Roof Area 15 - Array 1

AVERAGE PSF	4.84 psf
TOTAL NUMBER OF MODULES:	13
TOTAL KW:	6.24 KW
TOTAL AREA:	395 ft^2
TOTAL WEIGHT ON ROOF:	1915 lbs
RACKING WEIGHT:	420 lbs
MODULE WEIGHT:	759 lbs
MODIFIED DEAD LOAD FACTOR	1.0
BALLAST WEIGHT:	736 lbs
ROW SPACING:	7.5"
TOTAL ATTACHMENT COUNT:	0

MINIMUM SEISMIC SEPARATION (UNATTACHED ARRAYS) *	
ARRAY TO ARRAY:	3.0"
TO FIXED OBJECT ON ROOF:	6.0"
TO ROOF EDGE WITH QUALIFYING PARAPET:	7.5"
TO ROOF EDGE WITHOUT QUALIFYING PARAPET:	11.3"

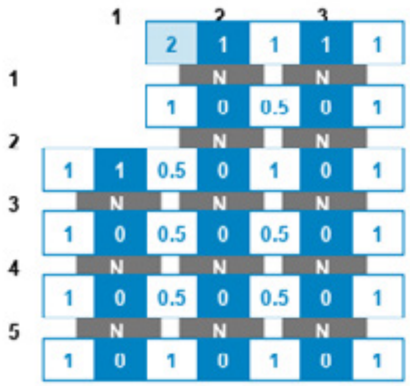
MAX ARRAY (SEISMIC) (FOR UNATTACHED ARRAYS) *	
MAX NUMBER OF NORTH-SOUTH ROWS:	23
MAX NUMBER OF EAST-WEST COLUMNS:	19

*In jurisdictions that follow SEAOC PV-1 methodology.

BOM

PART	QTY
RM5 BAY	38
BALLAST BLOCK	20
BALLAST HALF BLOCK	6
RM5 98" WIND DEFLECTOR	13
RM END CLAMP 30-40MM	125
KIT 1/4 20 CLIP ON NUT SS 18-8	191
KIT, WIND DEFLECTOR ATTACHMENT	66
MLPE TIGER CLIP	13

Roof Area 15 - Array 1 - Ballast Map with Attachment And Deflectors



LEGEND

N	Module with north wind deflector (for uplift)
S	Module with south wind deflector (for fire requirements - type 2)
NS	Module with both deflector types
	Module with no deflectors
1	Standard corner bay with CMU block count
4	Supplemental bay with CMU block count

NOTE

Bays in the space above and below modules are supplemental bays. You can fit a maximum of 2 blocks in each bay.
If the number of blocks in these bays is more than 2, you will need to add an additional supplemental bay.

WIND DESIGN DETAIL

Terrain Category	B	
Basic Wind Speed	127.00 mph	
Elevation	170.00 ft	
Exposure	B	Section 26.7 (ASCE 7-10)
Risk Category	III	Table 1.5-1 (ASCE 7-10)
Mean Roof Height	30.00 ft	
Numerical coefficient	0.002555	Section 26.10.1 (ASCE 7-10)
Topographic Factor, K_{zt}	1.00	Section 26.8.2 (ASCE 7-10)
Wind Directionality Factor, K_d	0.85	Section 26.6-1 (ASCE 7-10)
Velocity Pressure Exposure Coefficient, K_z	0.70	Section 30.3-1 (ASCE 7-10)
Design Life Factor[2], f_c^2	0.8649	Equation 26.5-2 (ASCE 7-10)
Velocity Pressure at Height, q_z	24.54 psf	Section 30.3.1 (ASCE 7-10)
Design Life Velocity Pressure, $q_z \times f_c^2$	21.23 psf	Equation C26.5-4 (ASCE 7-10)

SEISMIC DESIGN PER SEAOC PV1-2012 (UNATTACHED SYSTEM)

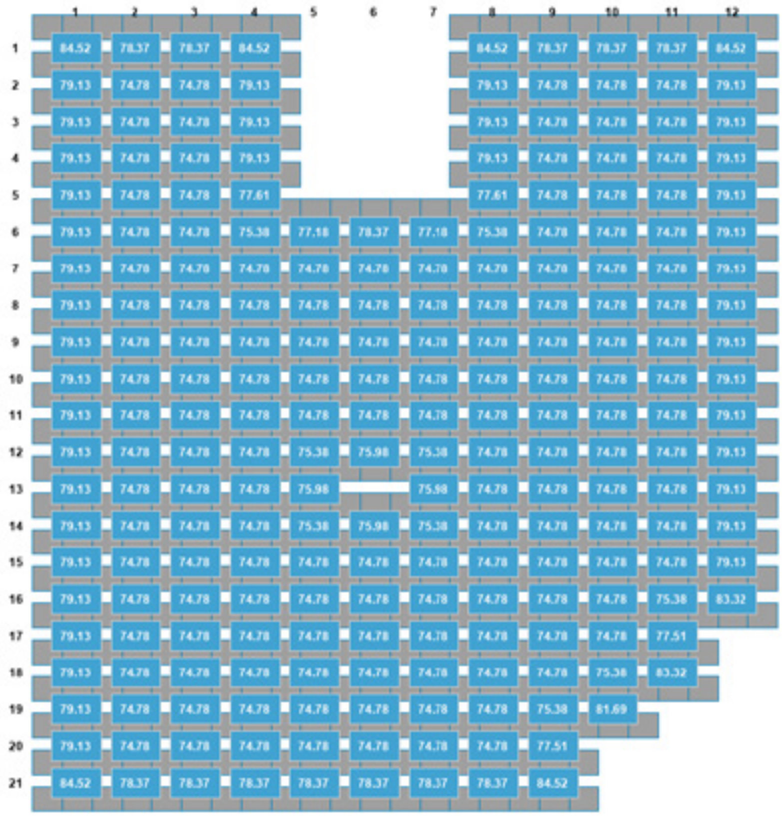
Site Classification	D_DEFAULT	
S_s	0.216 g	Section 11.4.1 (ASCE 7-10)
Risk Category	III	
Site Coefficient, F_a	1.6	Table 11.4-1 (ASCE 7-10)
S_{MS}	0.346 g	Section 11.4.3 (ASCE 7-10)
S_{DS}	0.230 g	Section 11.4.4 (ASCE 7-10)
Module Weight	58.42 lbs	
Racking and Ballast Weight to One Module	90.10 lbs	
Capacity of Connections to One Module (N/S)	348.00 lbs	
Capacity of Connections to One Module (E/W)	284.00 lbs	
W1 (Module, Racking, and Ballast Weight to One Module)	148.52 lbs	
Maximum of 0.133 S_{DS} W1 or 0.1 W1	14.85 lbs	
Maximum Number of Modules per Row (N-S)	23	
Maximum Number of Modules per Column (E-W)	19	
Building Importance Factor, I_e	1.25	Table 1.5-2 (ASCE 7-10)
Importance Factor of Array, I_p	1.00	Section 13.6-1 (ASCE 7-10)
Design for Seismic Separation δ_{mpv} =[$(S_{DS}$-0.4$)^2$ x 60 in] or 6 in	6.00 in	SEAOC PV1-6
Setback Between Arrays (0.5 x I_p x δ_{mpv})	3.00 in	SEAOC PV1-6
Setback Between Array and Objects (I_P x δ_{mpv})	6.00 in	SEAOC PV1-6
Setback Between Array and Edge of Parapet (I_e x δ_{mpv})	7.50 in	SEAOC PV1-6
Setback Between Array and Roof Edge without Parapet (1.5 x I_e x δ_{mpv})	11.25 in	SEAOC PV1-6

SNOW DESIGN

Risk Category	III	Table 1.5-1 (ASCE 7-10)
Importance Factor, I_S	1.10	Table 1.5-2 (ASCE 7-10)
Exposure Category	B	Section 26.7 (ASCE 7-10)
Exposure Factor, C_e	1.00	Table 7.2 (ASCE 7-10)
Thermal Factor, C_t	1.00	Section C7.8 (ASCE 7-10)
Ground Snow, p_g	40.00 psf	
Tilt Angle	5°	
Minimum Snow Load, p_m		
$p_m = I_s\, p_g$, For $p_g \leq 20$ psf	44.00 psf	Section 7.3.4 (ASCE 7-10)
$p_m = 20\, I_s$, For $p_g > 20$ psf	22.00 psf	Section 7.3.4 (ASCE 7-10)
Flat Roof Snow Load, $p_f = \mathrm{Max}(0.7\, C_e\, C_t\, I_s\, p_g,\, p_m)$	30.80 psf	Equation 7.3-1 (ASCE 7-10)
Slope Factor, C_s	1.00	Figure 7-2a (ASCE 7-10)*
Sloped Roof Snow Load, $p_s = C_s\, p_f$	30.80 psf	Equation 7.4-1 (ASCE 7-10)*

*Section C7.8 states "collectors should be designed to sustain a load calculated by using the "unobstructed slippery surfaces" curve in Fig. 7-2a." This indicates that Ct ≤ 1.0. Per Figure 7-2a for a roof slope of 5° with the unobstructed slippery surfaces graph, Cs = 1.0.

DEAD LOAD PER MODULE(D) - Roof Area 1 - Array 1



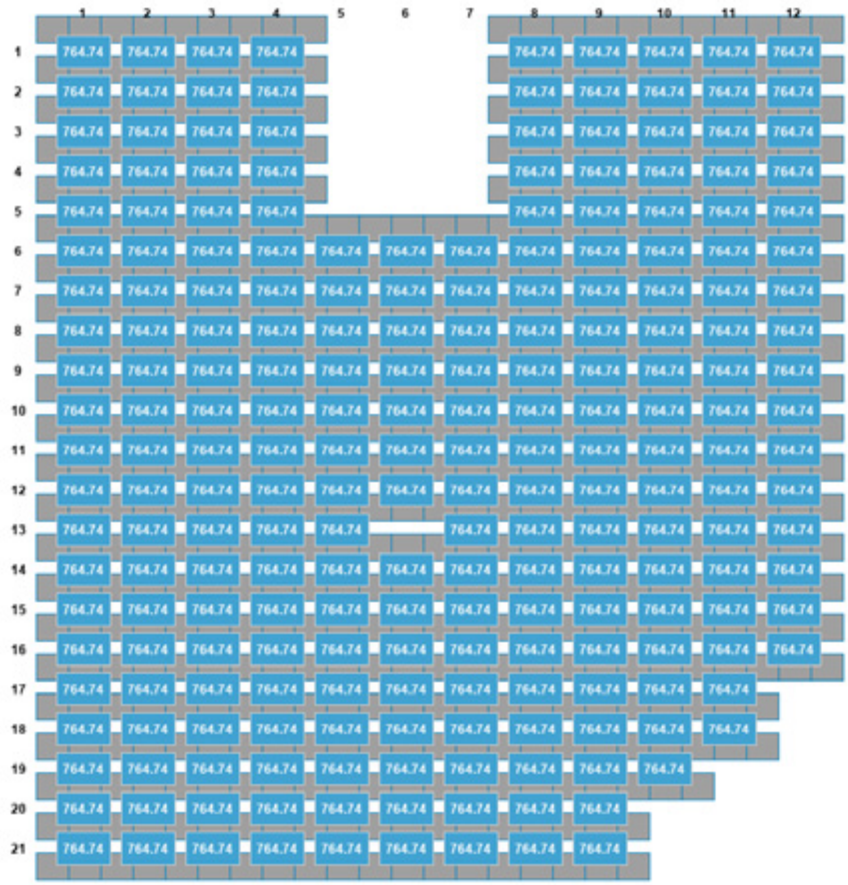
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 1 - Array 1

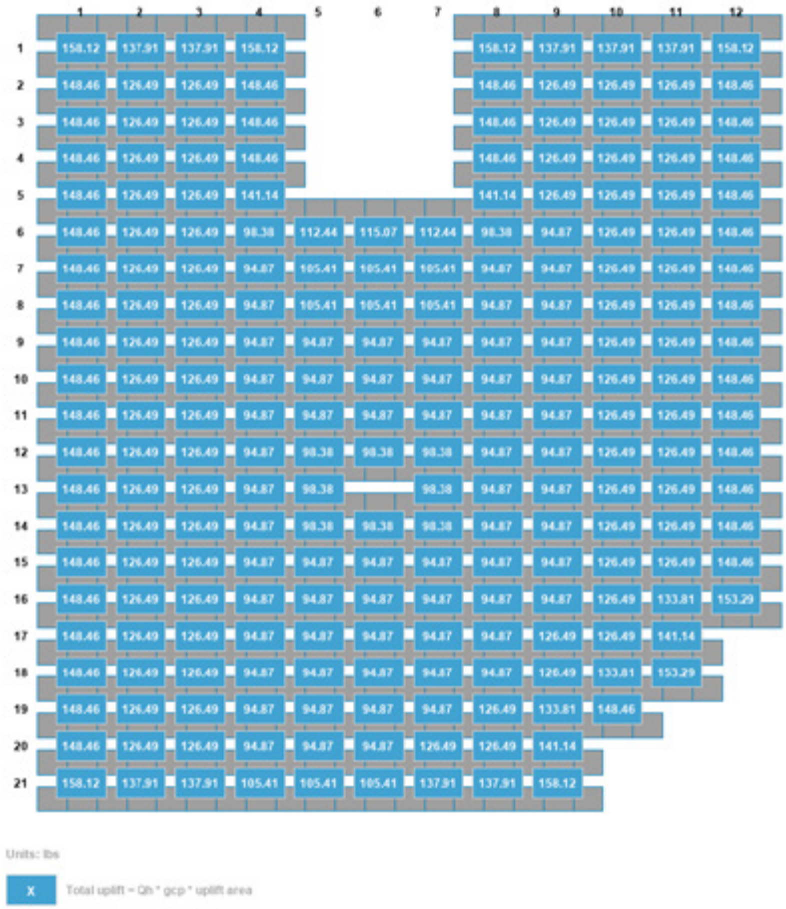


Units: lbs

LEGEND

Module

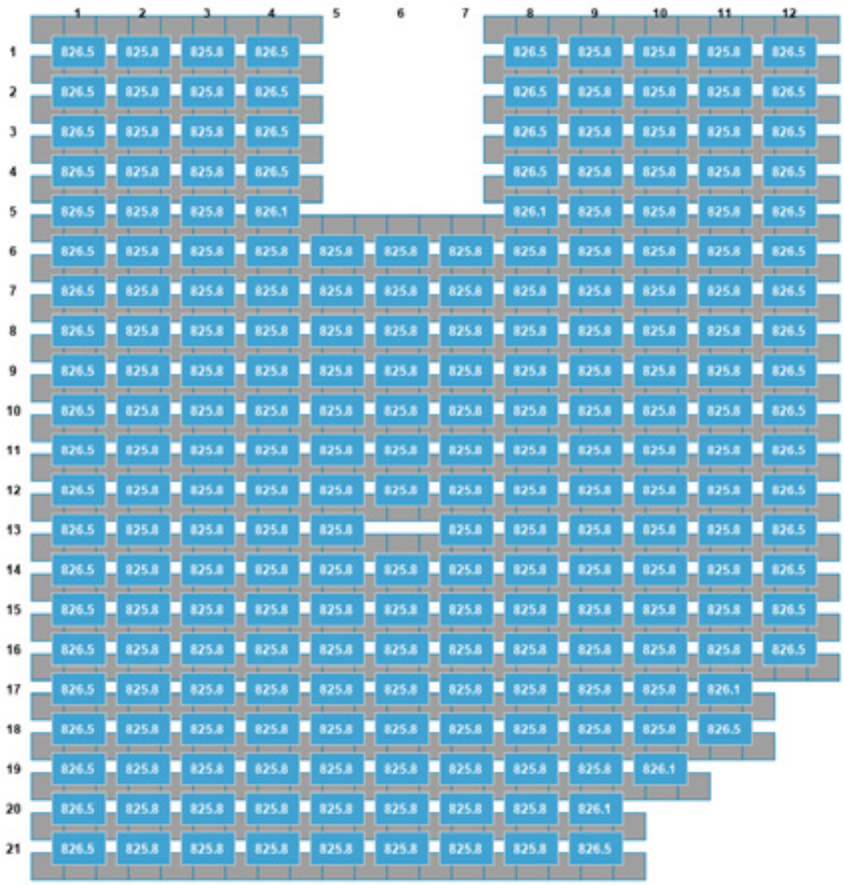
WIND LOAD (UPWARD) PER MODULE - Roof Area 1 - Array 1



LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 1 - Array 1



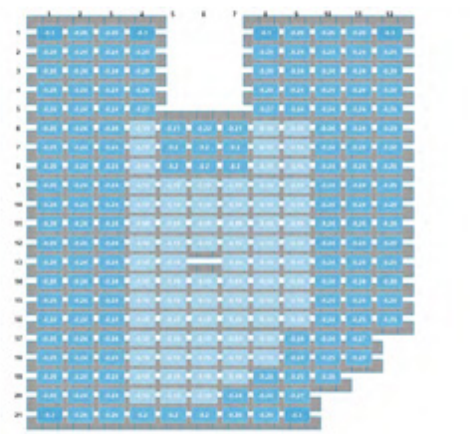
Units: lbs

LEGEND

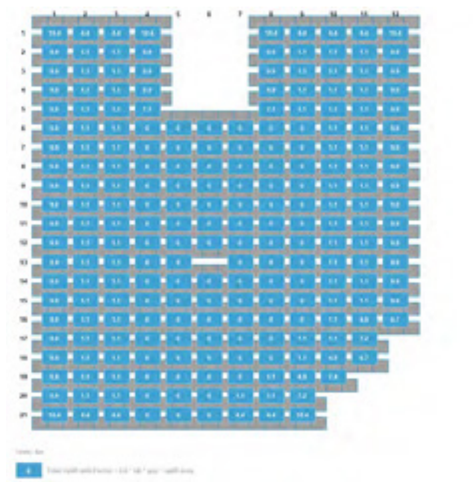
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 1 - Array 1



Factored total wind uplift map - Roof Area 1 - Array 1

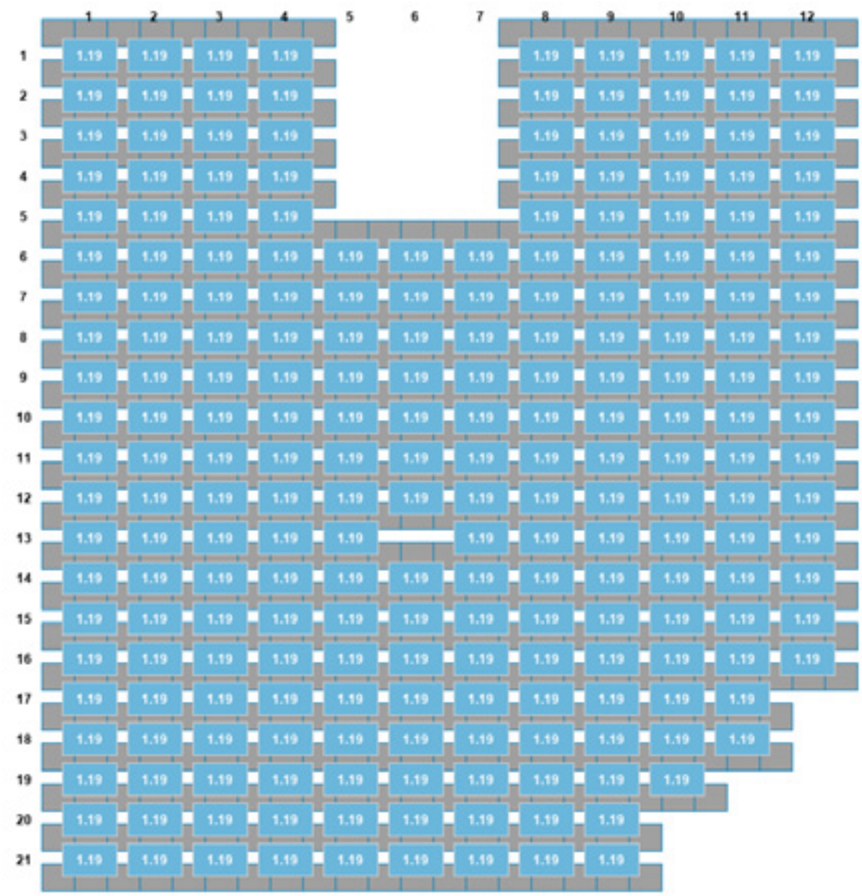


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 1 - Array 1

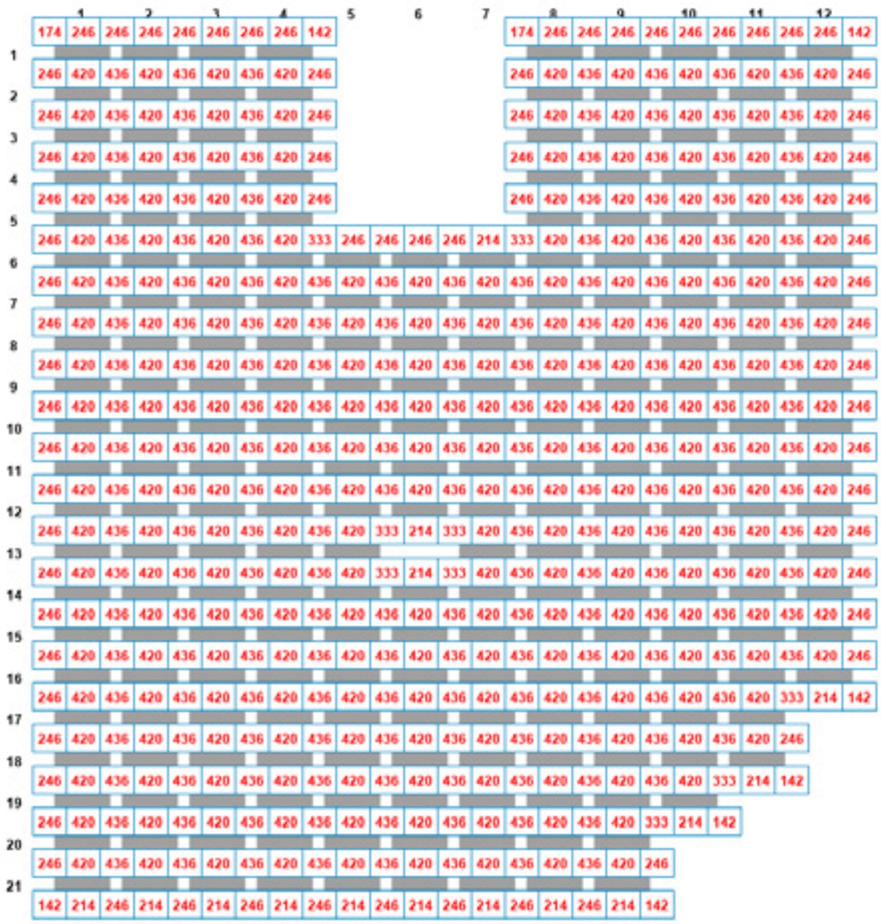


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 1 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

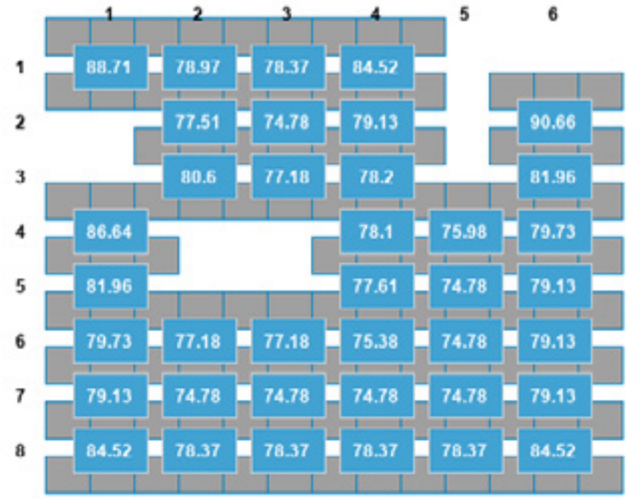
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 2 - Array 1



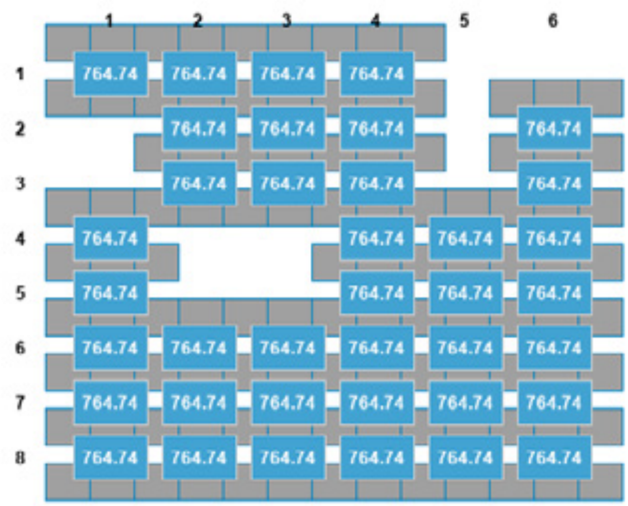
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 2 - Array 1

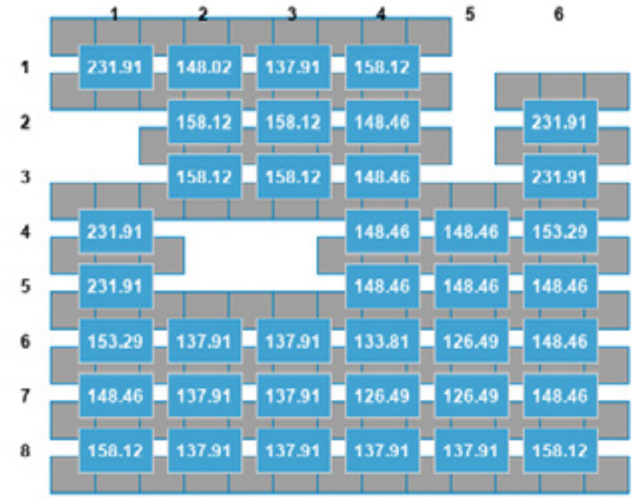


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 2 - Array 1



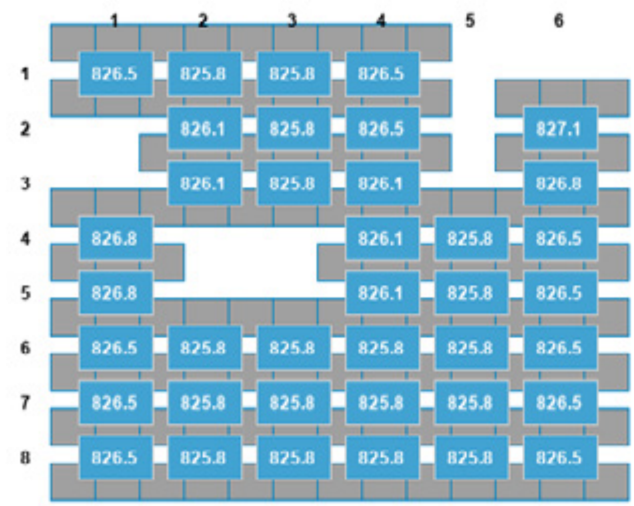
Units: lbs

x Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 2 - Array 1



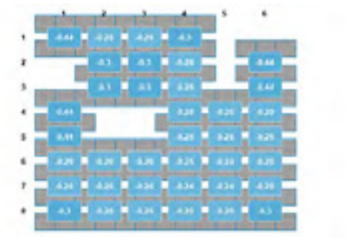
Units: lbs

LEGEND

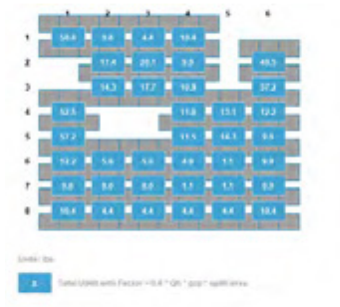
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 2 - Array 1



Factored total wind uplift map - Roof Area 2 - Array 1



LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 2 - Array 1

LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 2 - Array 1

LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 3 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12
1	84.52	78.37	78.37	78.37	78.37	78.37	78.37	78.37	78.37	78.37	78.37	84.52
2	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
3	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
4	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
5	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
6	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
7	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
8	84.52	78.37	77.18	75.38	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
9				77.51	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
10				79.13	74.78	74.78	74.78	74.78	74.78	75.38	75.98	79.73
11				84.52	78.37	78.37	78.37	78.37	78.37	82.89		81.86
12												81.96
13											83.32	79.73
14											79.13	79.13
15											84.52	84.52

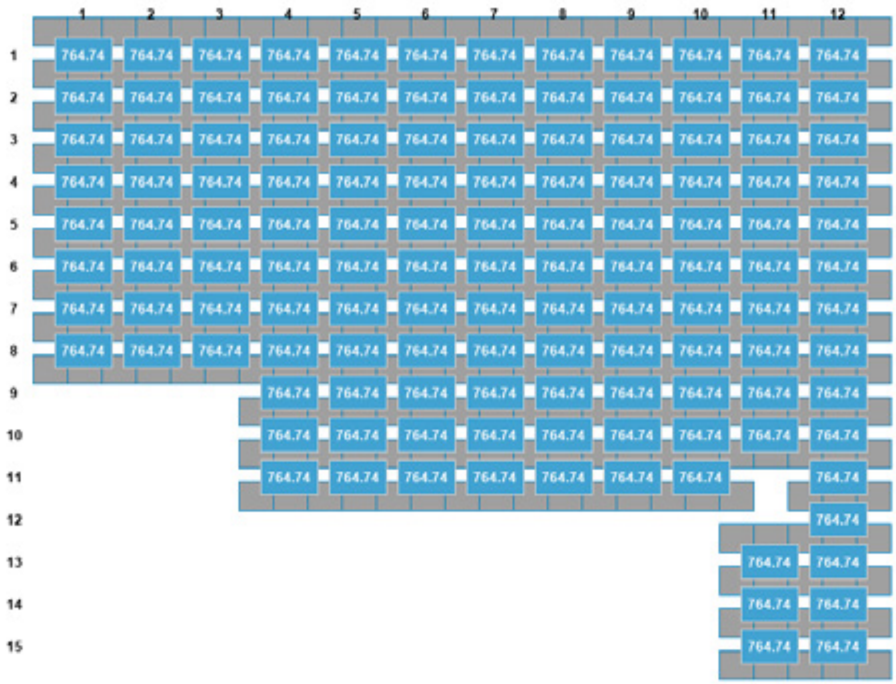
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 3 - Array 1



Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 3 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12
1	158.12	137.91	137.91	115.07	115.07	115.07	115.07	115.07	115.07	137.91	137.91	158.12
2	148.46	126.49	126.49	105.41	105.41	105.41	105.41	105.41	105.41	126.49	126.49	148.46
3	148.46	126.49	126.49	105.41	105.41	105.41	105.41	105.41	105.41	126.49	126.49	148.46
4	148.46	126.49	126.49	94.87	94.87	94.87	94.87	94.87	94.87	126.49	126.49	148.46
5	148.46	126.49	126.49	94.87	94.87	94.87	94.87	94.87	94.87	126.49	126.49	148.46
6	148.46	126.49	126.49	94.87	94.87	94.87	94.87	94.87	94.87	126.49	126.49	148.46
7	148.46	126.49	126.49	94.87	94.87	94.87	94.87	94.87	94.87	126.49	126.49	148.46
8	158.12	137.91	141.14	98.38	94.87	94.87	94.87	94.87	94.87	126.49	126.49	148.46
9				141.14	126.49	126.49	94.87	94.87	94.87	126.49	126.49	148.46
10				148.46	126.49	126.49	94.87	94.87	94.87	133.81	133.81	153.29
11				205.55	179.29	137.91	137.04	137.04	179.29	192.42		221.37
12												221.37
13											200.28	184.91
14											200.28	184.91
15											200.28	184.91

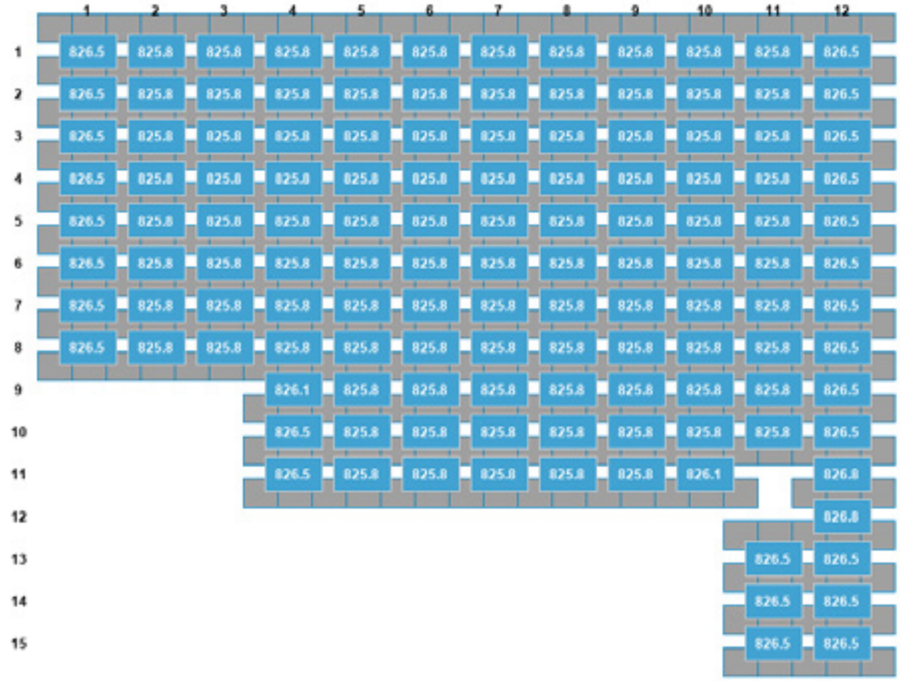
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 3 - Array 1



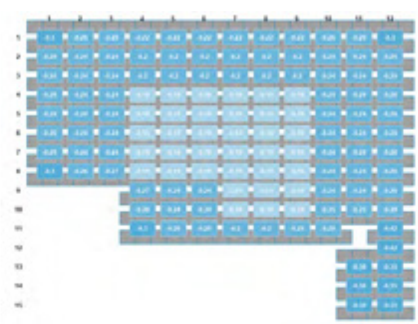
Units: lbs

LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 3 - Array 1



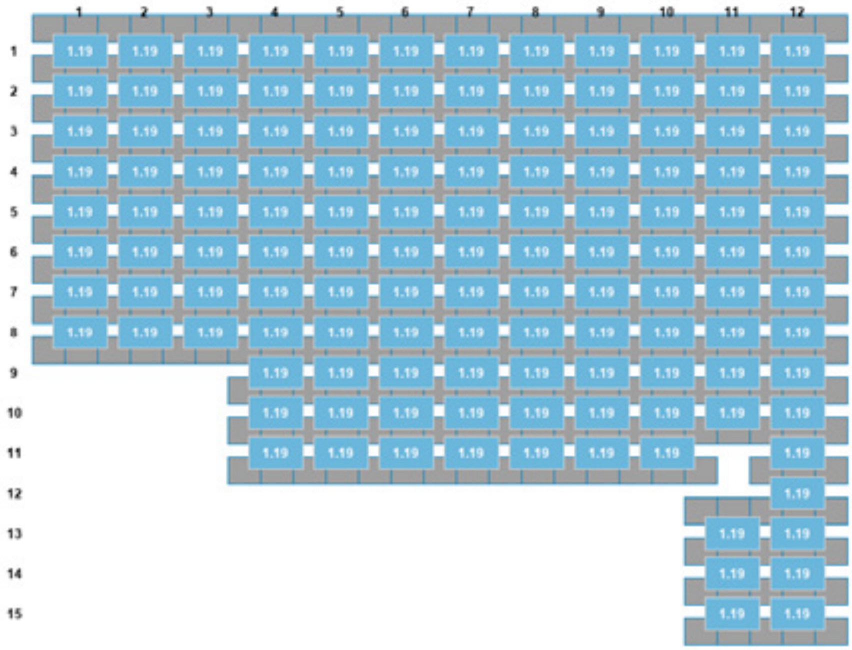
Factored total wind uplift map - Roof Area 3 - Array 1

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 3 - Array 1

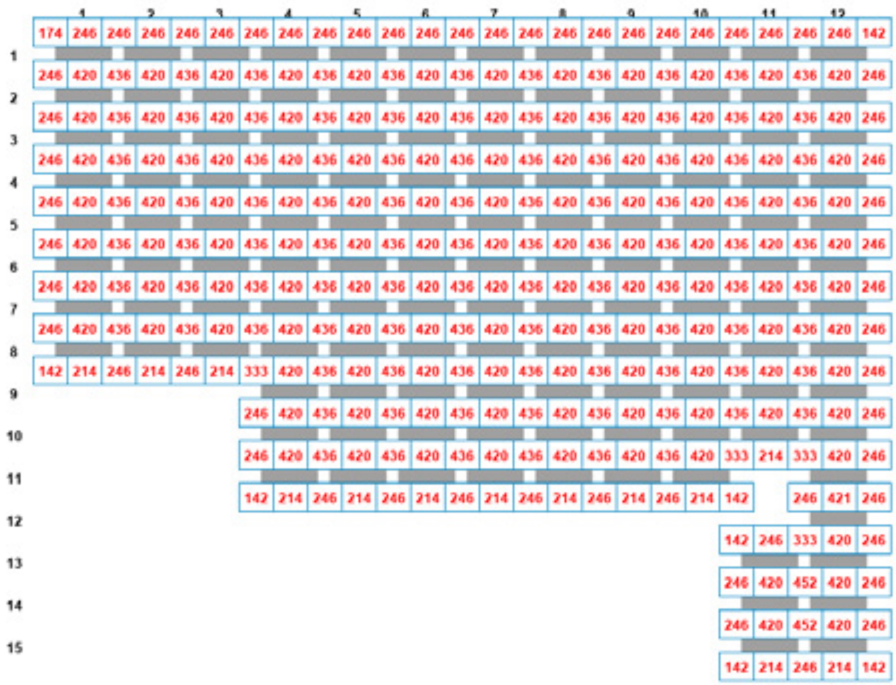


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 3 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

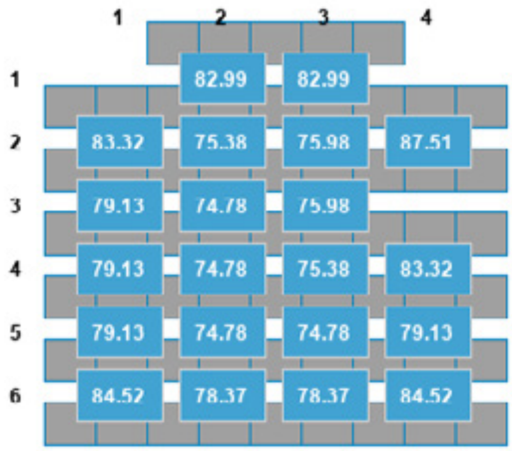
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 3 - Array 2



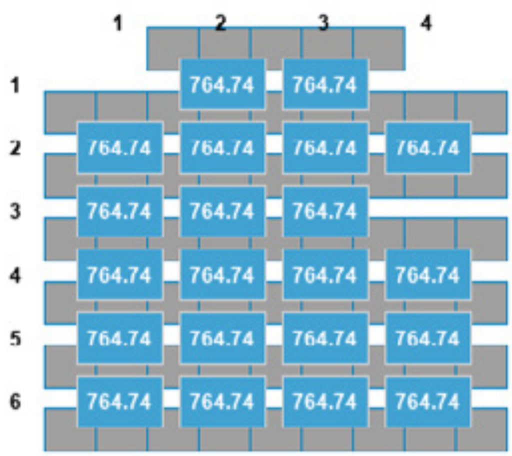
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 3 - Array 2

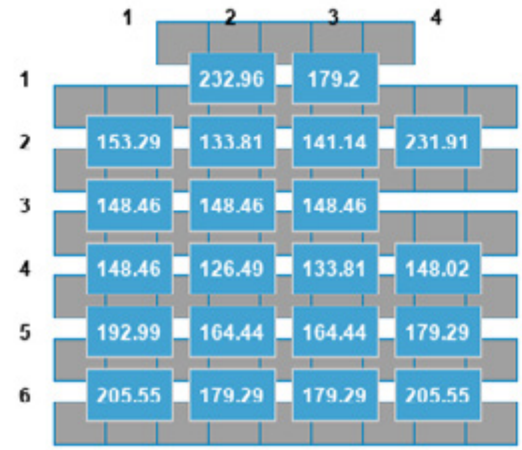


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 3 - Array 2



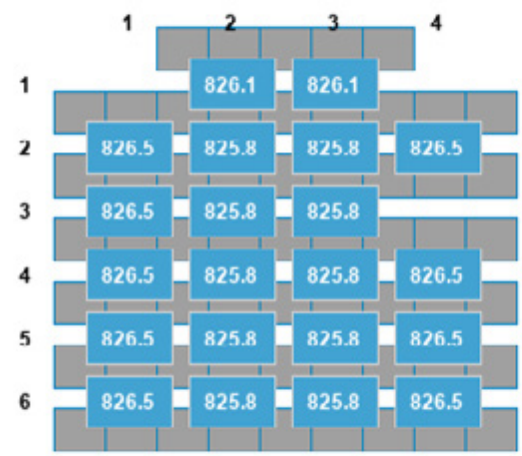
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 3 - Array 2



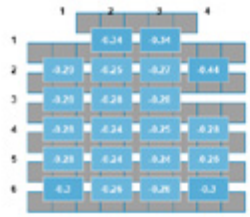
Units: lbs

LEGEND

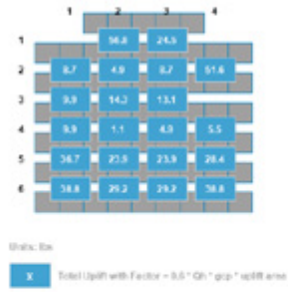
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 3 - Array 2



Factored total wind uplift map - Roof Area 3 - Array 2

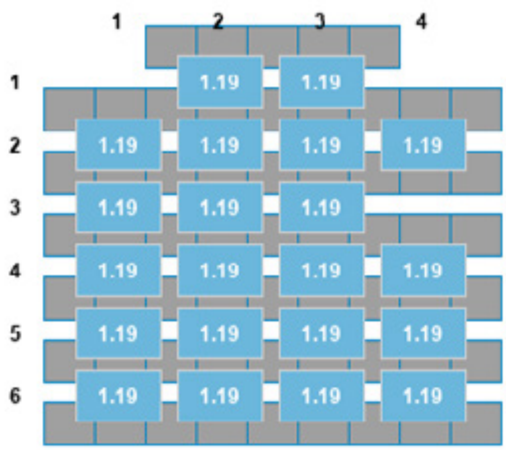


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 3 - Array 2

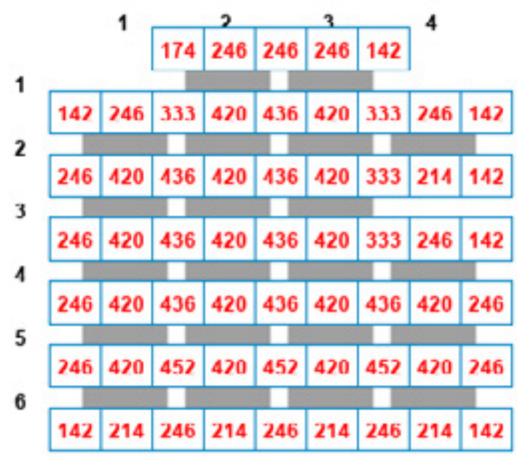


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 3 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 4 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	88.71	78.97	78.37	82.99									
2		77.51	74.78	75.38	77.18	78.37	78.37	78.37	78.37	78.37	78.37	78.37	84.52
3		83.32	75.38	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
4			81.69	75.38	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	79.13
5				77.51	74.78	74.78	74.78	75.38	77.18	77.18	75.38	74.78	79.13
6				79.13	74.78	74.78	74.78	77.51			77.51	74.78	79.13
7				83.32	75.38	74.78	74.78	77.61			77.61	74.78	79.13
8					81.69	75.38	74.78	75.38	77.18	77.18	75.38	74.78	79.13
9						77.51	74.78	74.78	74.78	74.78	74.78	74.78	79.13
10						83.32	75.38	74.78	74.78	74.78	74.78	74.78	79.13
11							82.89	78.37	78.37	78.37	78.37	78.37	84.52

Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 4 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	764.74	764.74	764.74	764.74									
2		764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
3		764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
4			764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
5				764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
6				764.74	764.74	764.74	764.74	764.74			764.74	764.74	764.74
7				764.74	764.74	764.74	764.74	764.74			764.74	764.74	764.74
8					764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
9						764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
10						764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
11							764.74	764.74	764.74	764.74	764.74	764.74	764.74

Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 4 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	273.19	148.02	137.91	148.02									
2		137.91	126.49	133.81	112.44	115.07	115.07	115.07	115.07	115.07	137.91	137.91	158.12
3		148.02	133.81	126.49	105.41	105.41	105.41	105.41	105.41	105.41	126.49	126.49	148.46
4			148.46	133.81	126.49	105.41	105.41	105.41	105.41	105.41	126.49	126.49	148.46
5				141.14	126.49	126.49	94.87	98.38	101.9	101.9	133.81	126.49	148.46
6				148.46	126.49	126.49	126.49	141.14			148.46	148.46	148.46
7				153.29	133.81	126.49	126.49	141.14			148.46	148.46	148.46
8					148.46	133.81	126.49	98.38	101.9	101.9	133.81	126.49	148.46
9						141.14	126.49	126.49	94.87	94.87	126.49	126.49	148.46
10						153.29	133.81	126.49	94.87	94.87	126.49	126.49	148.46
11							148.02	137.91	137.91	105.41	137.91	137.91	158.12

Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 4 - Array 1

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	826.5	825.8	825.8	826.1									
2		826.1	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	826.5
3		826.5	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	826.5
4			826.1	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	826.5
5				826.1	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	826.5
6				826.5	825.8	825.8	825.8	826.1			826.1	825.8	826.5
7				826.5	825.8	825.8	825.8	826.1			826.1	825.8	826.5
8					826.1	825.8	825.8	825.8	825.8	825.8	825.8	825.8	826.5
9						826.1	825.8	825.8	825.8	825.8	825.8	825.8	826.5
10						826.5	825.8	825.8	825.8	825.8	825.8	825.8	826.5
11							826.1	825.8	825.8	825.8	825.8	825.8	826.5

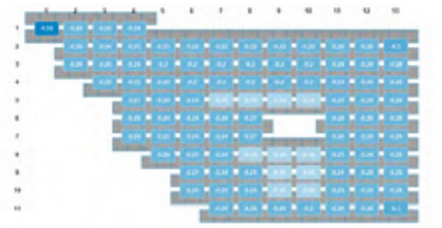
Units: lbs

LEGEND

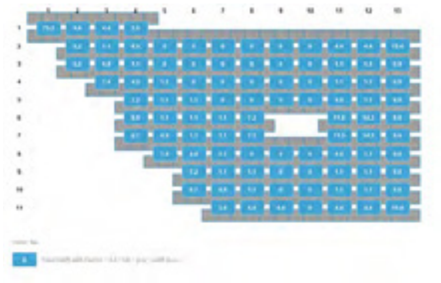
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 4 - Array 1



Factored total wind uplift map - Roof Area 4 - Array 1

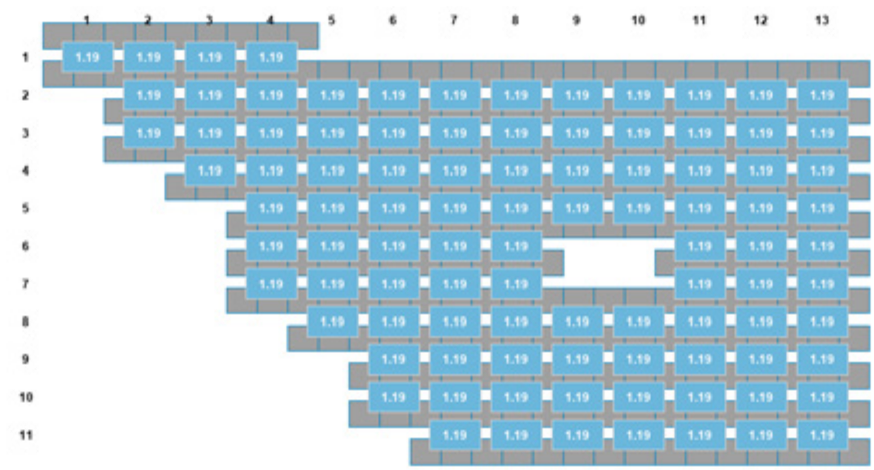


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 4 - Array 1

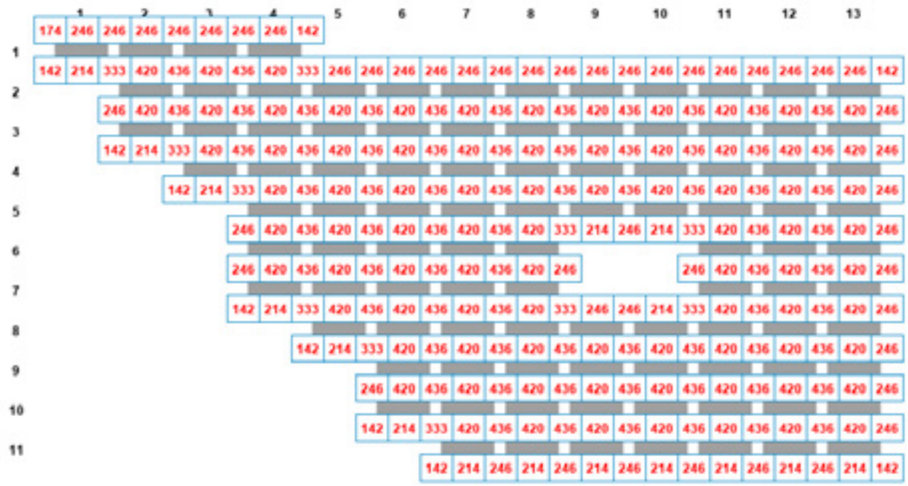


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 4 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 4 - Array 2

	1	2	3	4	5	6	7	8	9	10	11	12
1									84.52	82.99		89.14
2									77.61	75.38	76.58	83.92
3	84.52	78.37	78.37	78.37	78.37	78.37	78.37	77.18	75.38	74.78	77.51	
4	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	75.38	83.32	
5	79.13	74.78	74.78	74.78	74.78	74.78	74.78	74.78	74.78	77.51		
6	79.13	74.78	75.38	77.18	77.18	75.38	74.78	74.78	75.38	83.32		
7	79.13	74.78	77.51			77.51	74.78	75.38	81.69			
8	79.13	74.78	77.61			77.61	74.78	77.51				
9	79.13	74.78	75.38	77.18	77.18	75.38	75.38	83.32				
10	79.13	74.78	74.78	74.78	74.78	74.78	77.51					
11	79.13	74.78	74.78	74.78	74.78	75.38	83.32					
12	84.52	78.37	78.37	78.37	78.37	82.89						

Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 4 - Array 2

	1	2	3	4	5	6	7	8	9	10	11	12
1									764.74	764.74		764.74
2									764.74	764.74	764.74	764.74
3	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	
4	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	
5	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74		
6	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74		
7	764.74	764.74	764.74			764.74	764.74	764.74	764.74			
8	764.74	764.74	764.74			764.74	764.74	764.74				
9	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74				
10	764.74	764.74	764.74	764.74	764.74	764.74	764.74					
11	764.74	764.74	764.74	764.74	764.74	764.74	764.74					
12	764.74	764.74	764.74	764.74	764.74	764.74						

Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 4 - Array 2

	1	2	3	4	5	6	7	8	9	10	11	12
1									179.2	179.2		273.19
2									141.14	133.81	137.91	184.91
3	158.12	137.91	137.91	115.07	115.07	115.07	115.07	112.44	133.81	126.49	137.91	
4	148.46	126.49	126.49	105.41	105.41	105.41	105.41	105.41	126.49	133.81	148.02	
5	148.46	126.49	126.49	105.41	105.41	105.41	105.41	126.49	126.49	141.14		
6	148.46	126.49	133.81	101.9	101.9	98.38	94.87	126.49	133.81	153.29		
7	148.46	148.46	148.46			141.14	126.49	133.81	148.46			
8	148.46	148.46	148.46			148.46	148.46	148.46				
9	148.46	126.49	133.81	101.9	101.9	133.81	133.81	153.29				
10	148.46	126.49	126.49	94.87	126.49	126.49	141.14					
11	148.46	126.49	126.49	94.87	126.49	133.81	153.29					
12	158.12	137.91	137.91	137.91	137.91	148.02						

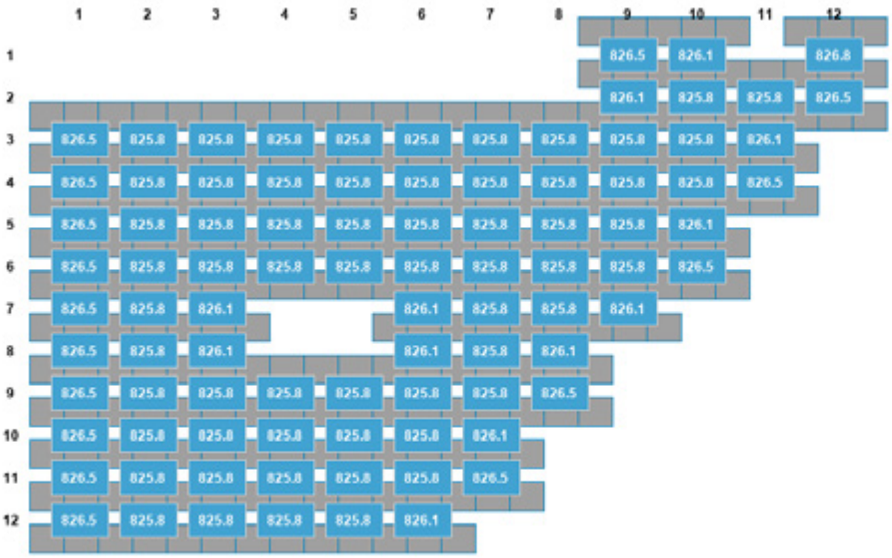
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 4 - Array 2



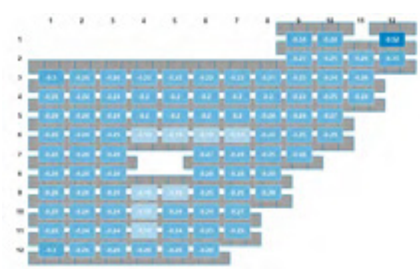
Units: lbs

LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 4 - Array 2



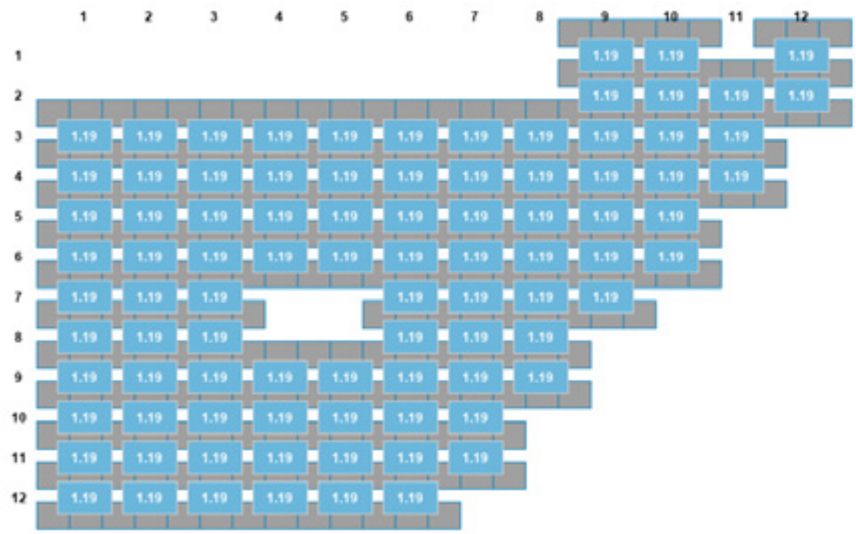
Factored total wind uplift map - Roof Area 4 - Array 2

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 4 - Array 2

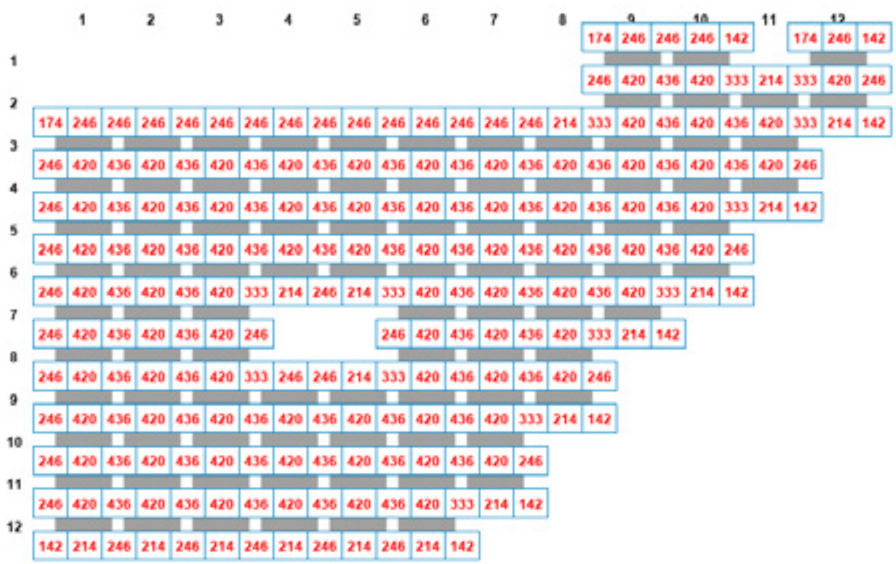


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 4 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

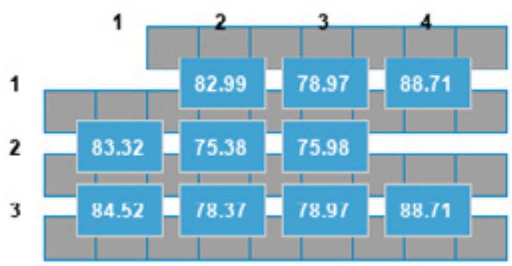
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 5 - Array 1



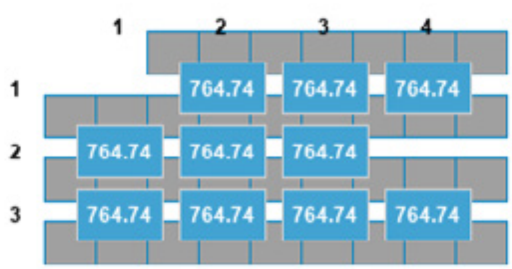
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 5 - Array 1

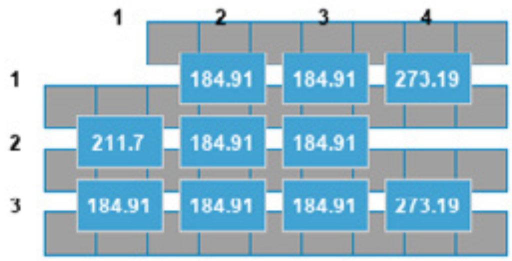


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 5 - Array 1



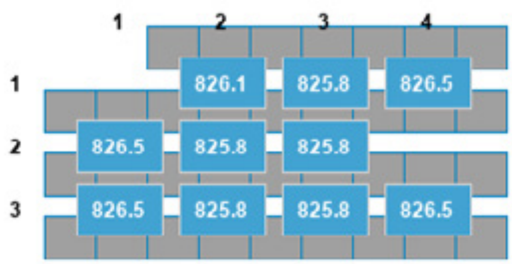
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 5 - Array 1



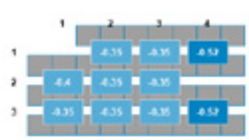
Units: lbs

LEGEND

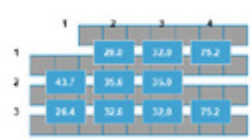
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 5 - Array 1



Factored total wind uplift map - Roof Area 5 - Array 1

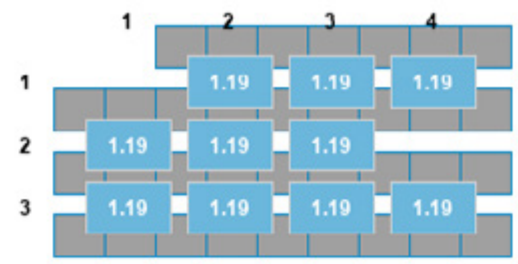


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 5 - Array 1

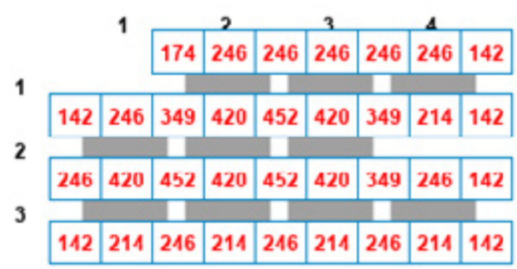


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 5 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

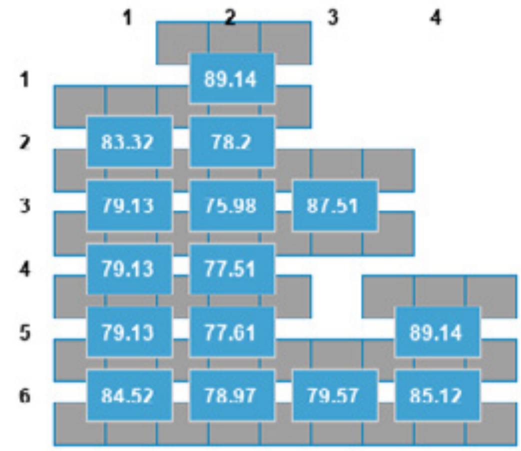
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 5 - Array 2



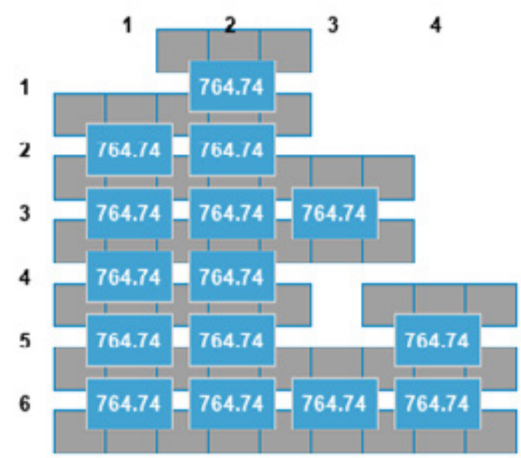
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 5 - Array 2

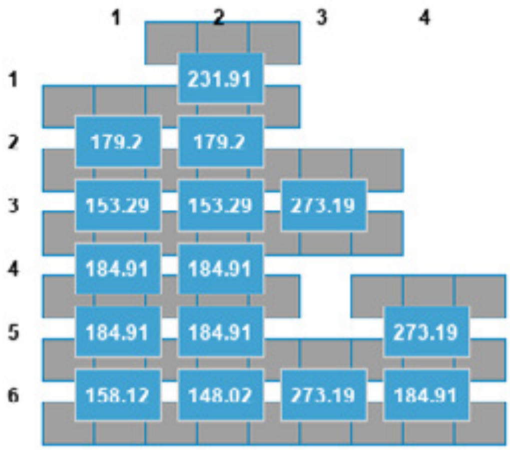


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 5 - Array 2



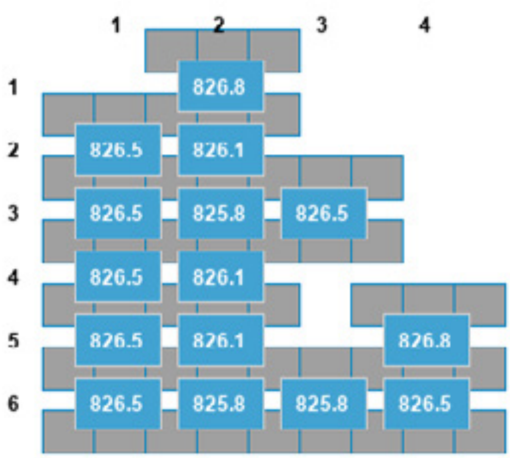
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 5 - Array 2



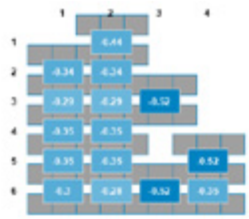
Units: lbs

LEGEND

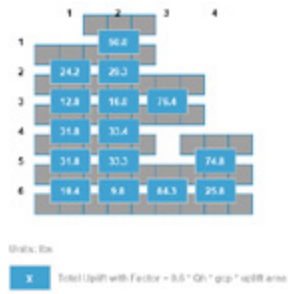
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 5 - Array 2



Factored total wind uplift map - Roof Area 5 - Array 2

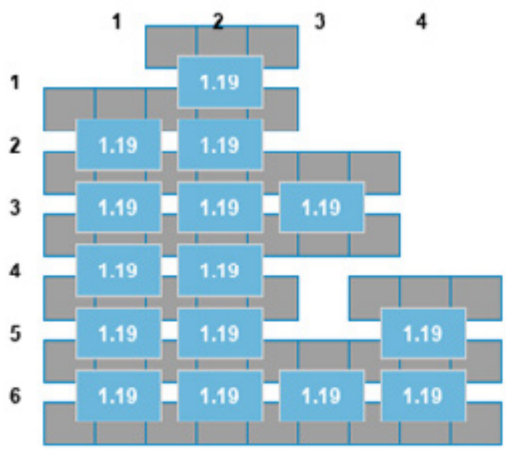


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 5 - Array 2

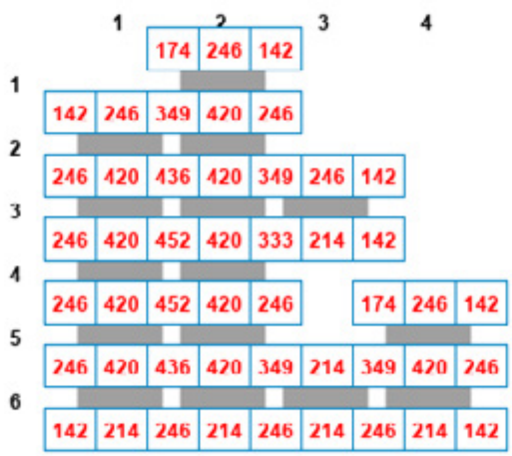


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 5 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

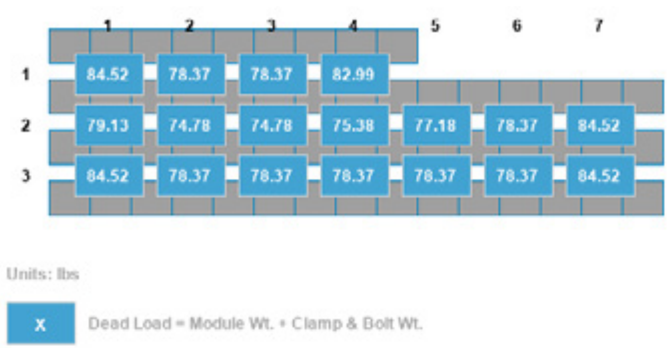
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

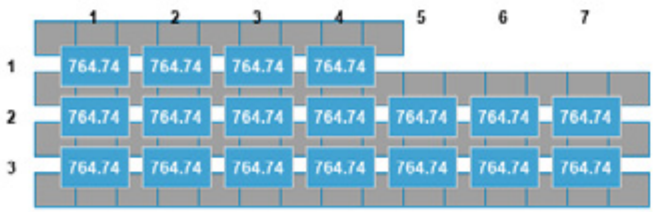
DEAD LOAD PER MODULE(D) - Roof Area 6 - Array 1



LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 6 - Array 1

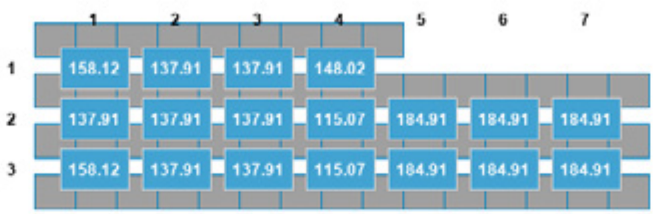


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 6 - Array 1



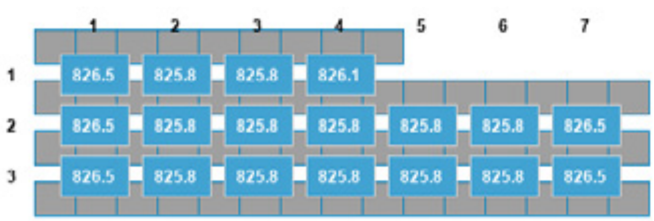
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 6 - Array 1



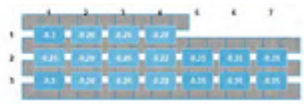
Units: lbs

LEGEND

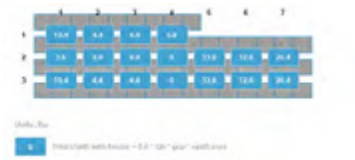
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 6 - Array 1



Factored total wind uplift map - Roof Area 6 - Array 1

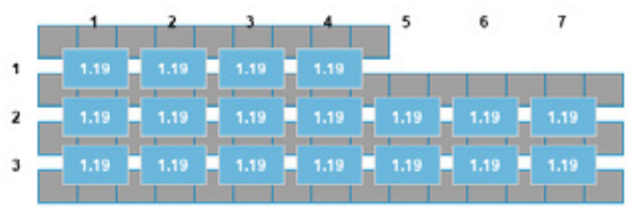


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 6 - Array 1

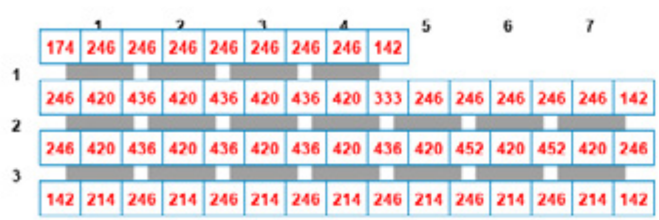


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 6 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

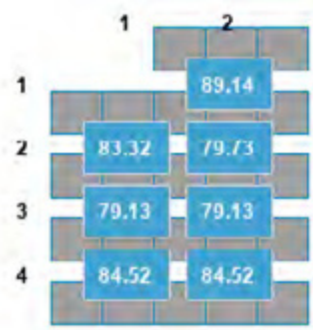
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 6 - Array 2



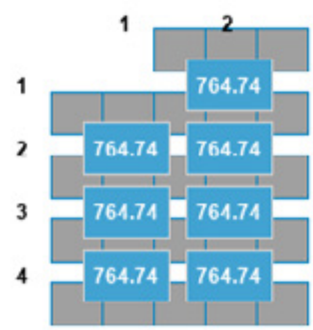
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 6 - Array 2

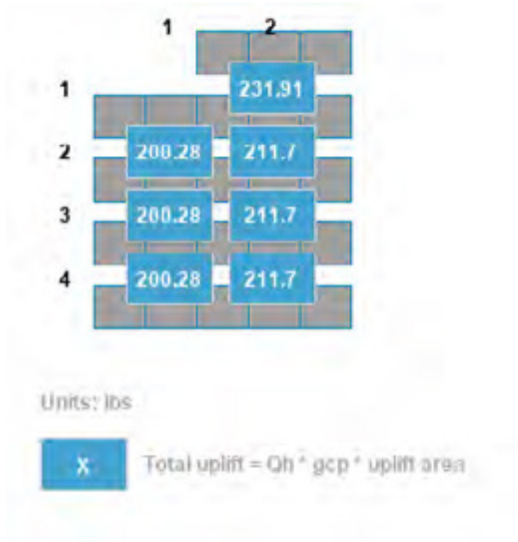


Units: lbs

LEGEND

Module

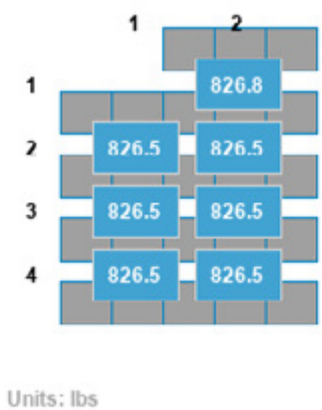
WIND LOAD (UPWARD) PER MODULE - Roof Area 6 - Array 2



LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 6 - Array 2

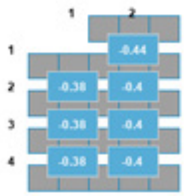


LEGEND

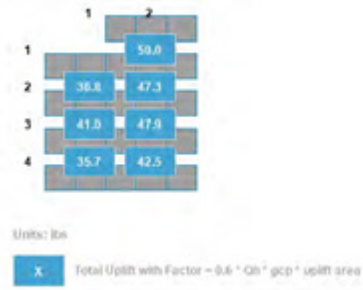
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 6 - Array 2



Factored total wind uplift map - Roof Area 6 - Array 2

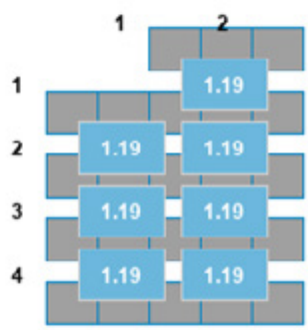


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 6 - Array 2

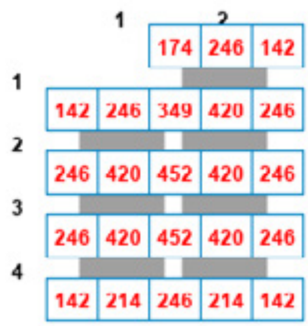


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 6 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

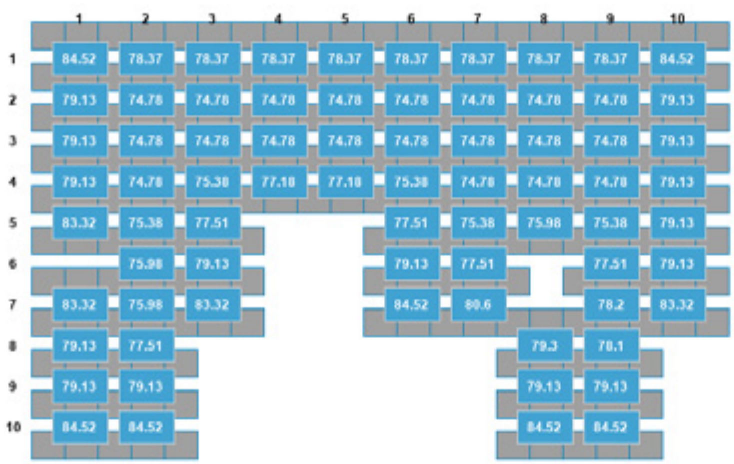
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 7 - Array 1



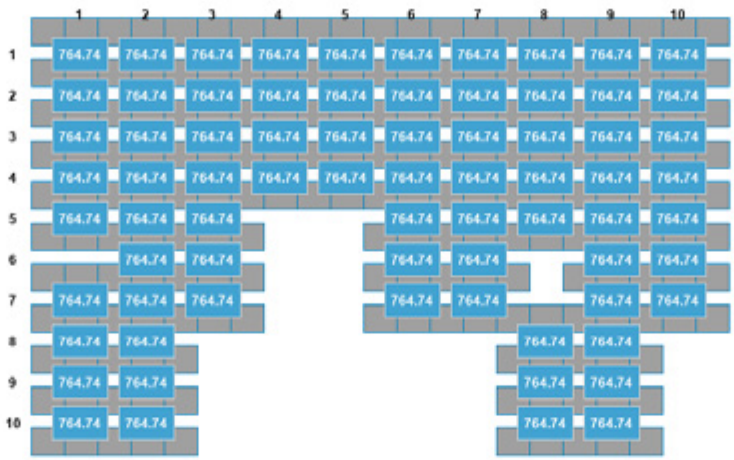
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 7 - Array 1

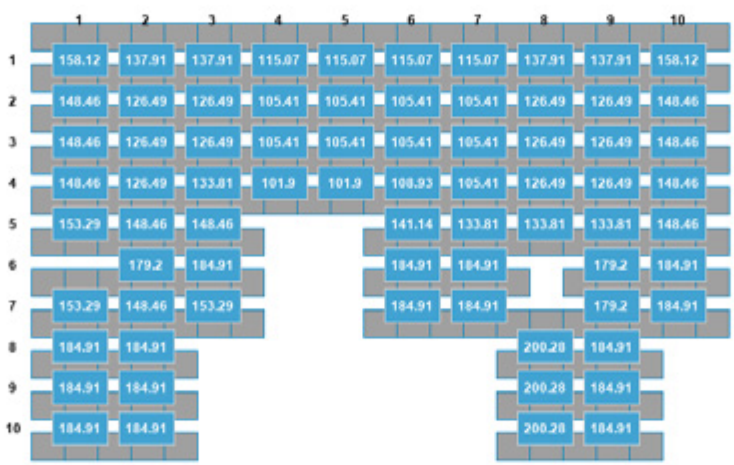


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 7 - Array 1



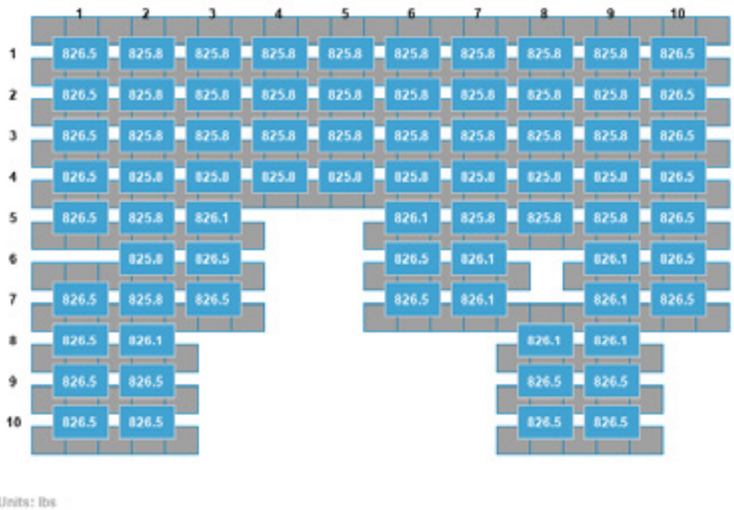
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 7 - Array 1



LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 7 - Array 1

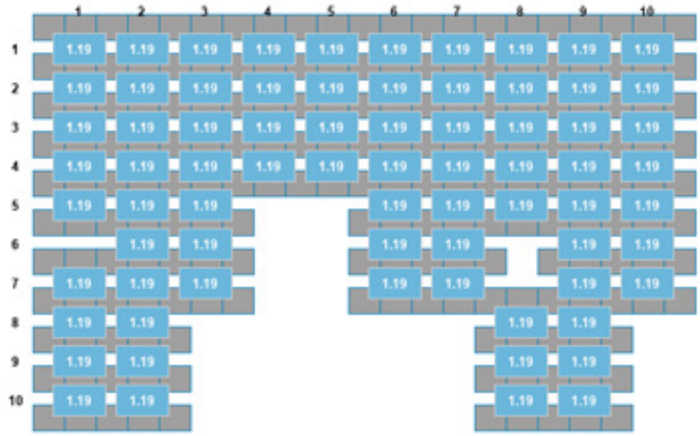
Factored total wind uplift map - Roof Area 7 - Array 1

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 7 - Array 1



LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 7 - Array 1

LEGEND

Module

x Bay - Downpoint load in range

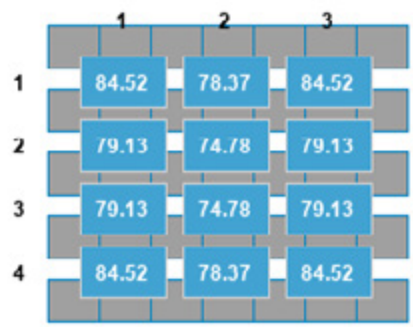
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 8 - Array 1



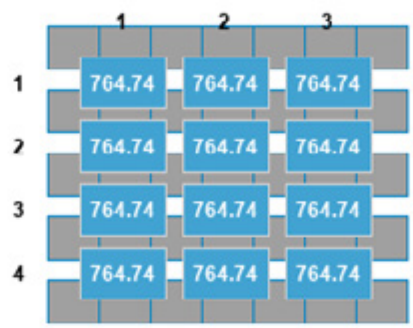
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 8 - Array 1

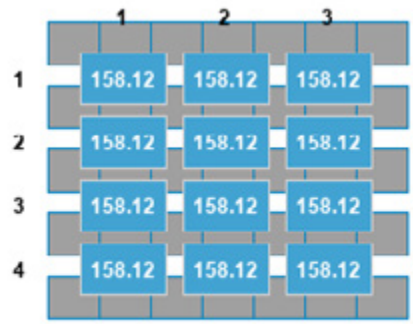


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 8 - Array 1



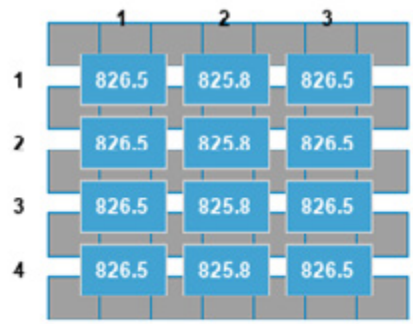
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 8 - Array 1



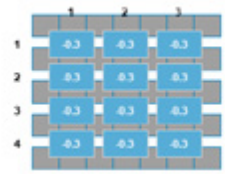
Units: lbs

LEGEND

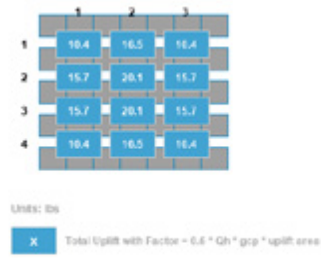
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 8 - Array 1



Factored total wind uplift map - Roof Area 8 - Array 1

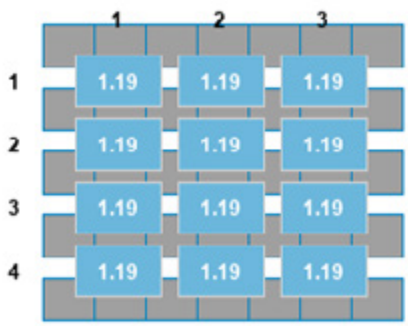


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 8 - Array 1

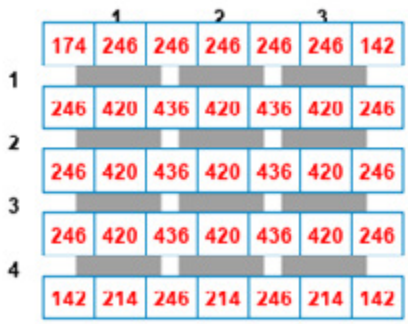


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 8 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

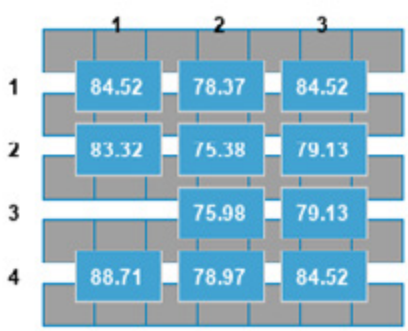
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 8 - Array 2



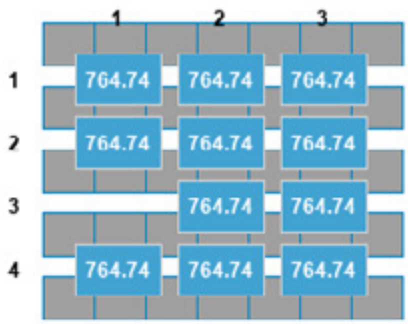
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 8 - Array 2

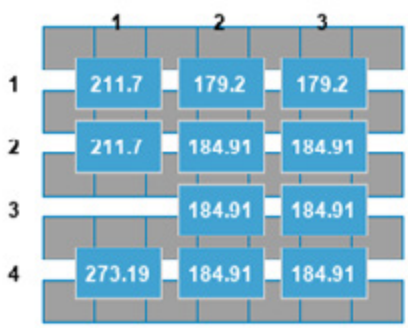


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 8 - Array 2



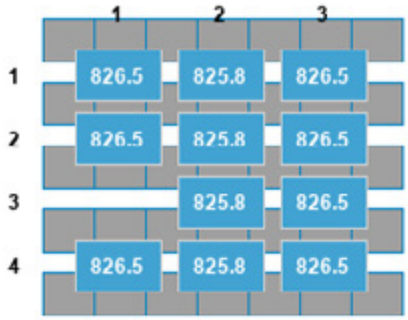
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 8 - Array 2



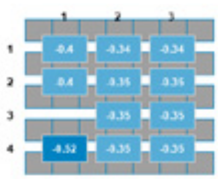
Units: lbs

LEGEND

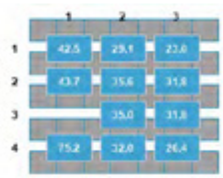
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 8 - Array 2



Factored total wind uplift map - Roof Area 8 - Array 2



Units: lbs

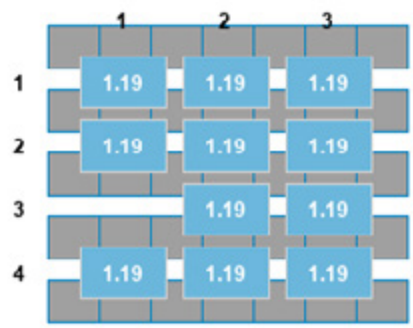
X

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 8 - Array 2

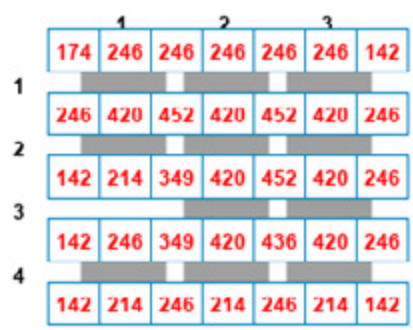


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 8 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 9 - Array 1

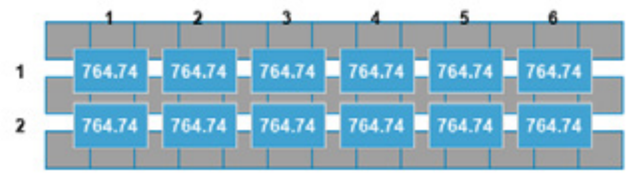
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 9 - Array 1

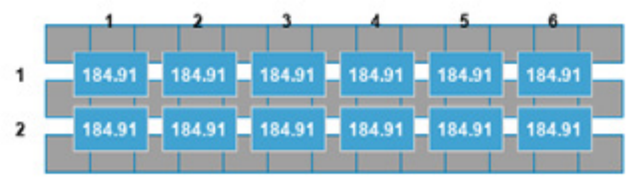


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 9 - Array 1



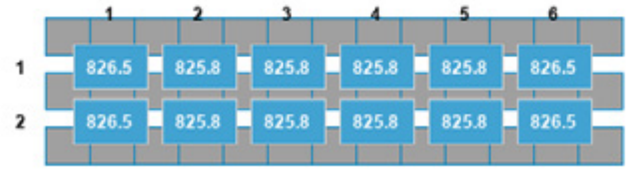
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 9 - Array 1



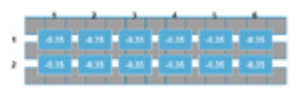
Units: lbs

LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 9 - Array 1



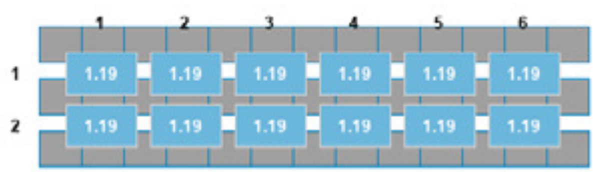
Factored total wind uplift map - Roof Area 9 - Array 1

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 9 - Array 1

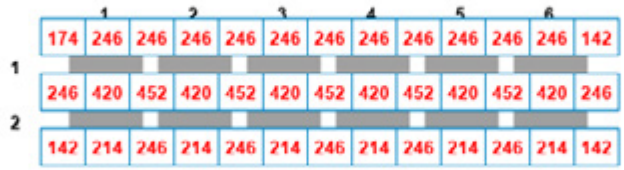


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 9 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

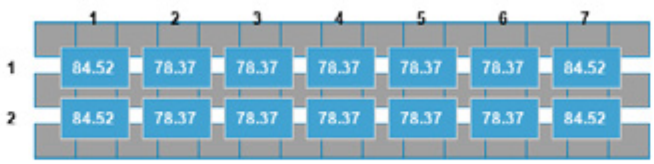
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 9 - Array 2



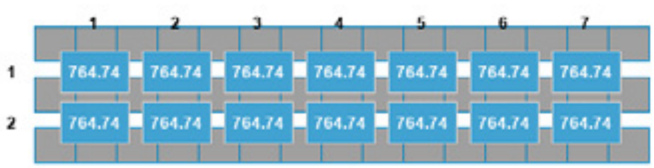
Units: lbs

x Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 9 - Array 2

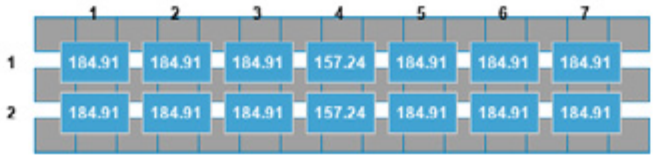


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 9 - Array 2



Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 9 - Array 2

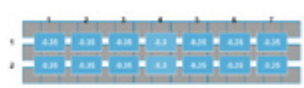
Units: lbs

LEGEND

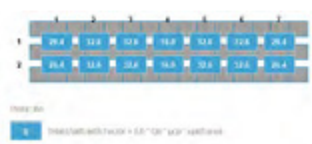
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 9 - Array 2



Factored total wind uplift map - Roof Area 9 - Array 2

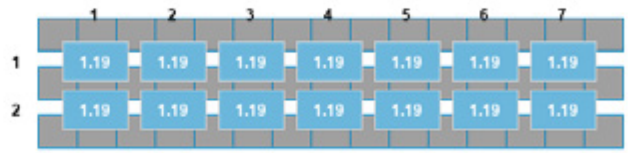


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 9 - Array 2

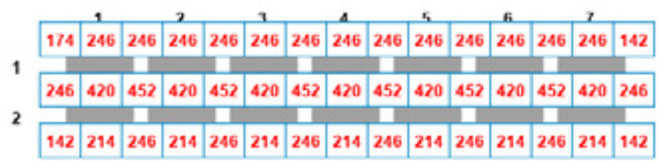


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 9 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 10 - Array 1

	1	2	3	4	5	6	7	8
1	84.52	78.37	78.37	78.37	78.37	78.37	84.52	
2	79.13	74.78	74.78	74.78	74.78	74.78	77.61	
3	79.13	74.78	74.78	74.78	74.78	74.78	75.38	83.32
4	79.13	74.78	74.78	75.38	75.98	75.38	75.38	83.32
5	79.13	74.78	74.78	77.51		81.69	76.58	
6	84.52	78.37	78.37	84.52			78.1	83.32
7							79.13	79.13
8							79.13	79.13
9							79.13	79.13
10							79.13	79.13
11							84.52	84.52

Units: lbs

X — Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 10 - Array 1

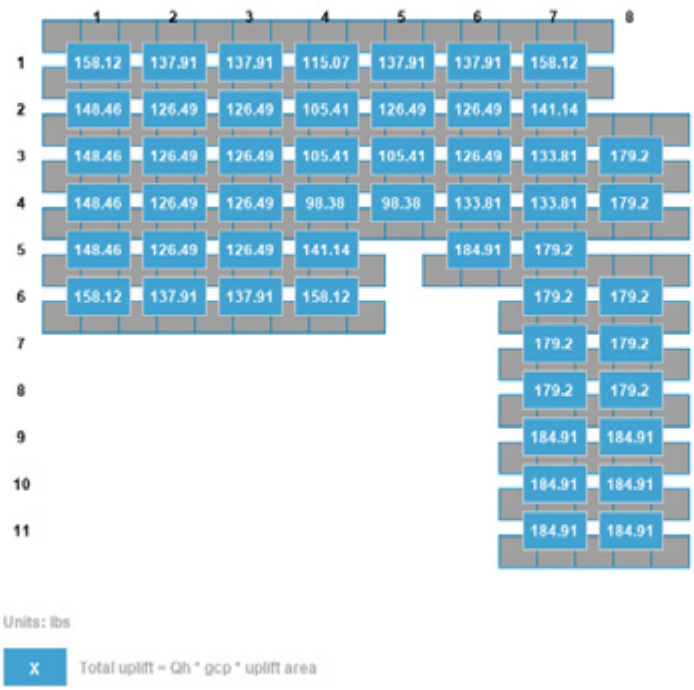
	1	2	3	4	5	6	7	8
1	764.74	764.74	764.74	764.74	764.74	764.74	764.74	
2	764.74	764.74	764.74	764.74	764.74	764.74	764.74	
3	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
4	764.74	764.74	764.74	764.74	764.74	764.74	764.74	764.74
5	764.74	764.74	764.74	764.74		764.74	764.74	
6	764.74	764.74	764.74	764.74			764.74	764.74
7							764.74	764.74
8							764.74	764.74
9							764.74	764.74
10							764.74	764.74
11							764.74	764.74

Units: lbs

LEGEND

Module

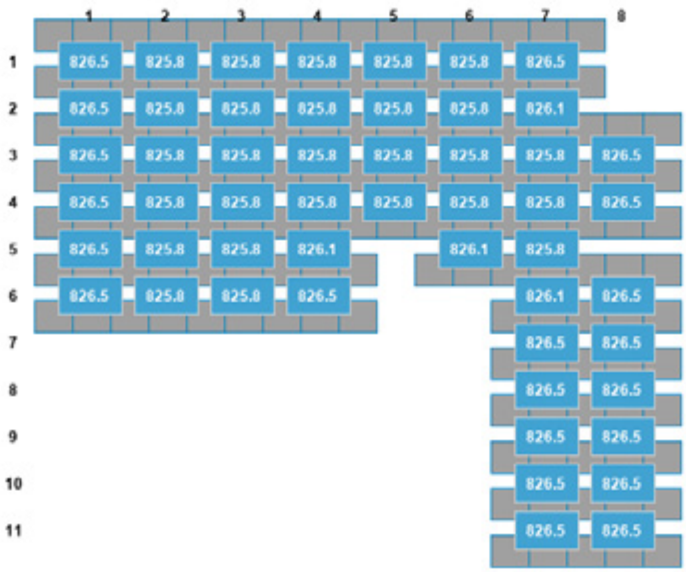
WIND LOAD (UPWARD) PER MODULE - Roof Area 10 - Array 1



LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 10 - Array 1



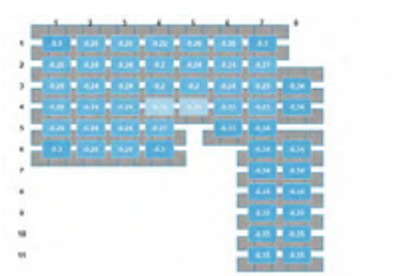
Units: lbs

LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 10 - Array 1



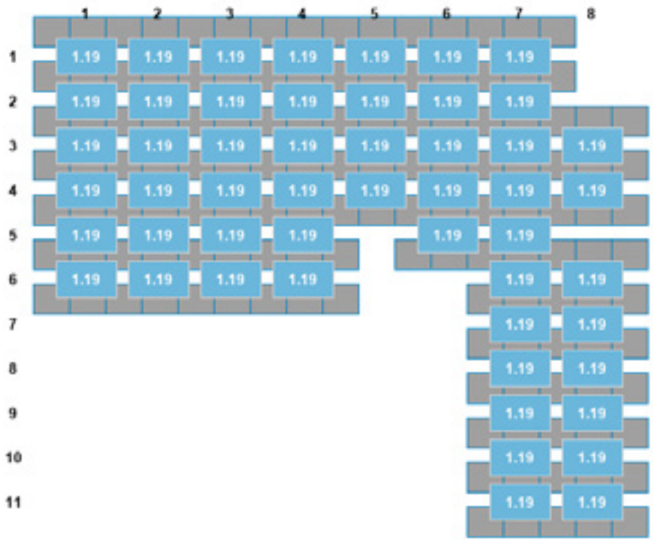
Factored total wind uplift map - Roof Area 10 - Array 1

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 10 - Array 1

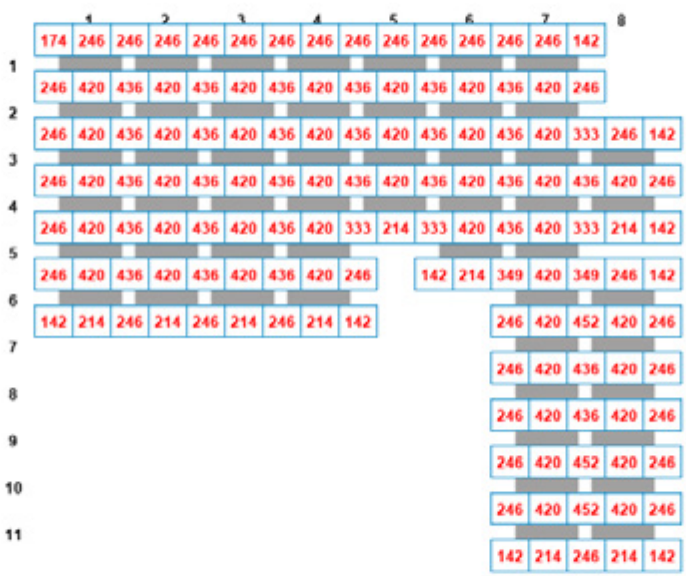


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 10 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

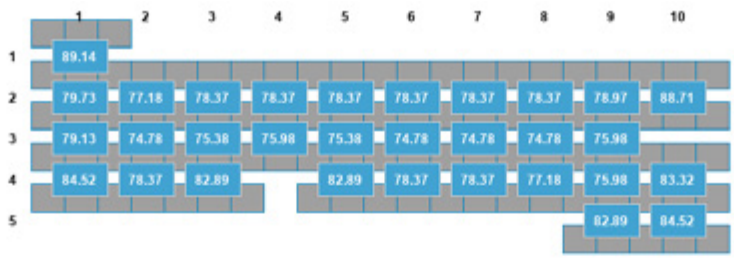
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 10 - Array 2



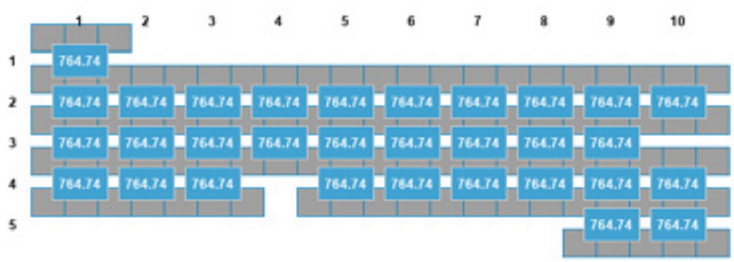
Units: lbs

x Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 10 - Array 2

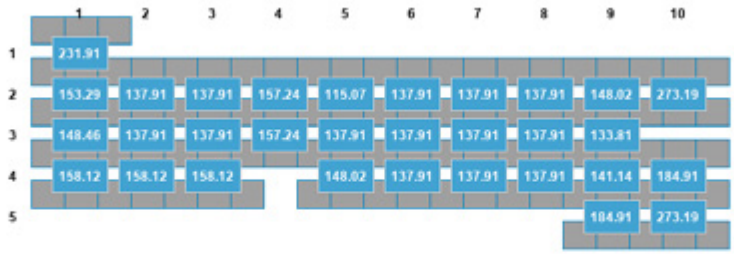


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 10 - Array 2



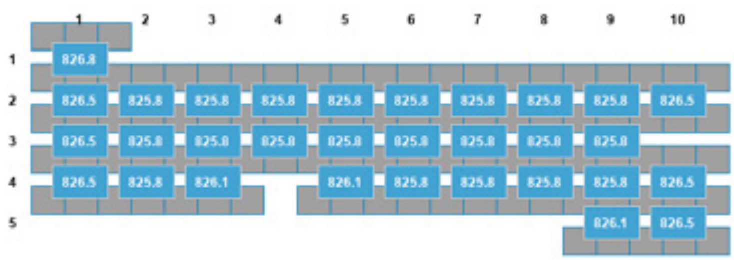
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 10 - Array 2



Units: lbs

LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 10 - Array 2

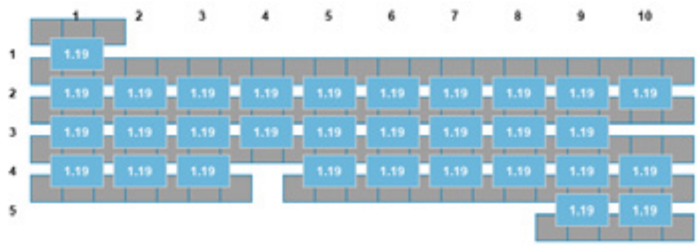
Factored total wind uplift map - Roof Area 10 - Array 2

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 10 - Array 2

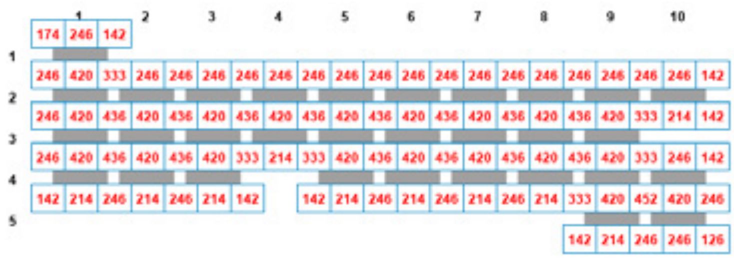


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 10 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

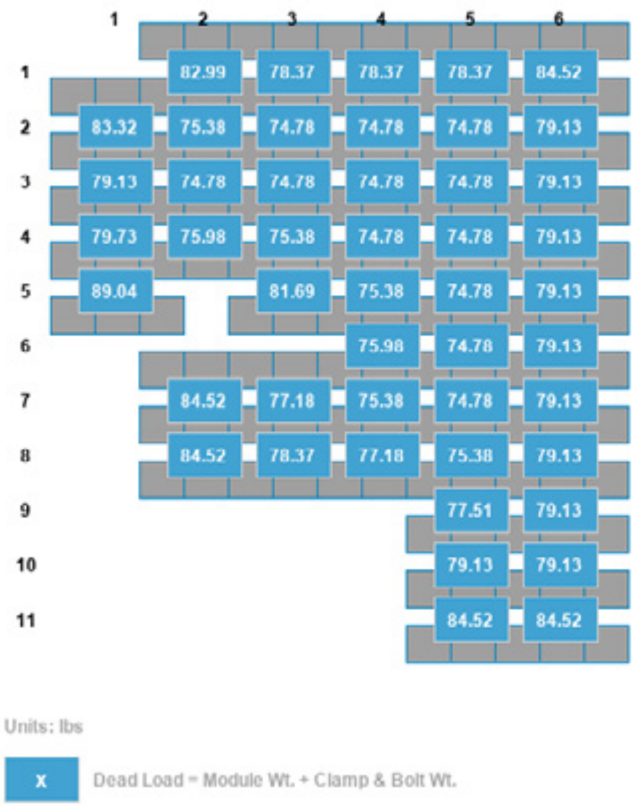
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

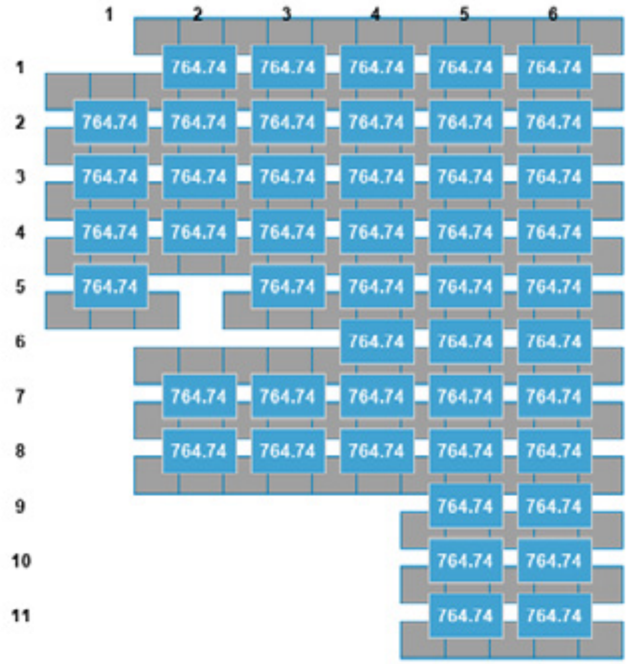
DEAD LOAD PER MODULE(D) - Roof Area 10 - Array 3



LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 10 - Array 3

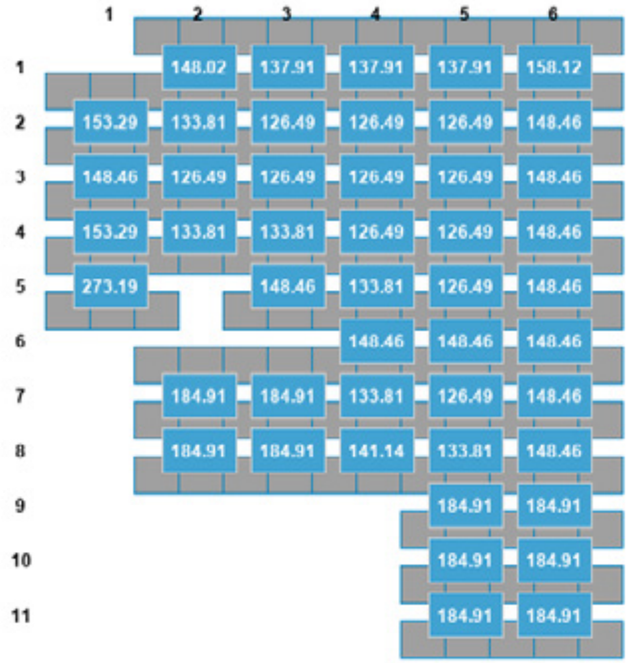


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 10 - Array 3



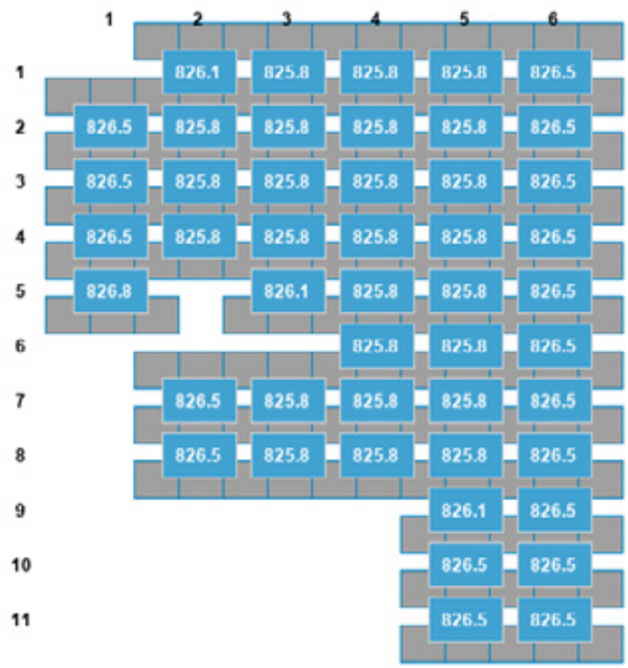
Units: lbs

x Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 10 - Array 3



Units: lbs

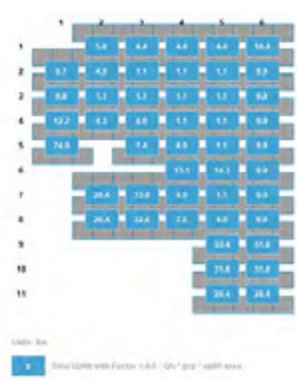
LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 10 - Array 3

Factored total wind uplift map - Roof Area 10 - Array 3

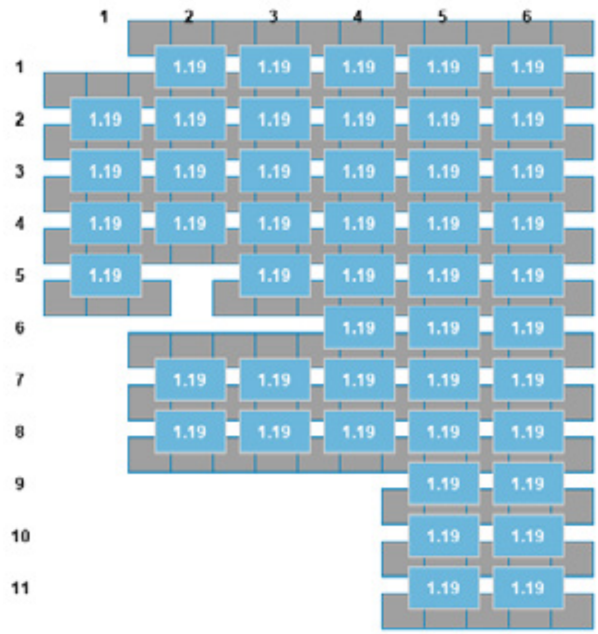


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 10 - Array 3

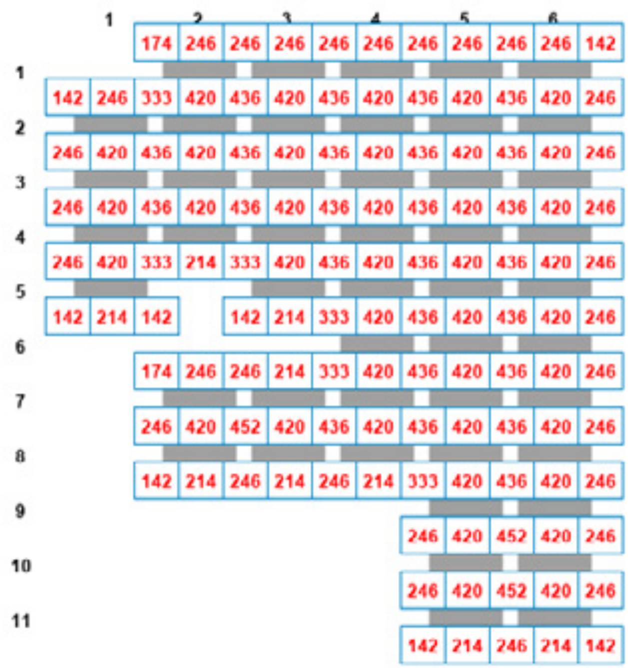


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 10 - Array 3



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

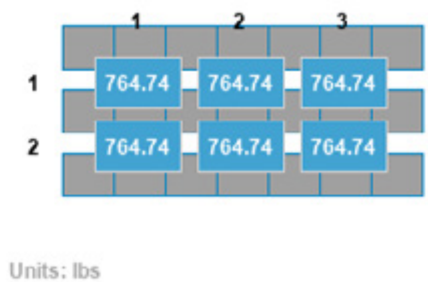
For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 11 - Array 1

LEGEND

Module

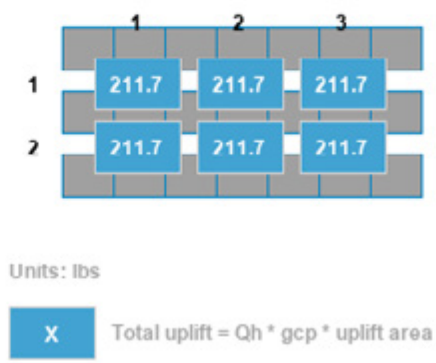
SNOW LOAD PER MODULE(S) - Roof Area 11 - Array 1



LEGEND

Module

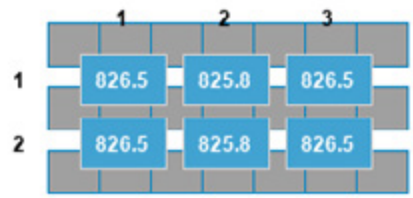
WIND LOAD (UPWARD) PER MODULE - Roof Area 11 - Array 1



LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 11 - Array 1



Units: lbs

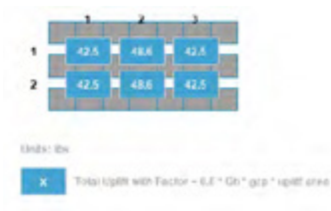
LEGEND

Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 11 - Array 1

Factored total wind uplift map - Roof Area 11 - Array 1

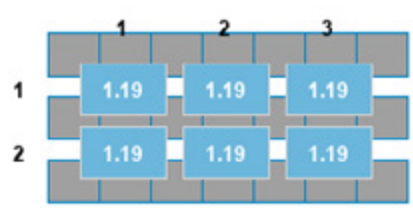


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 11 - Array 1

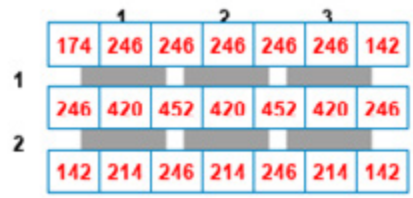


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 11 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

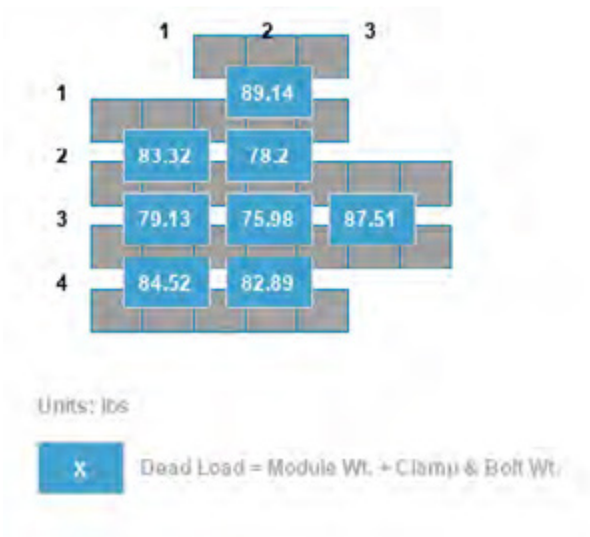
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

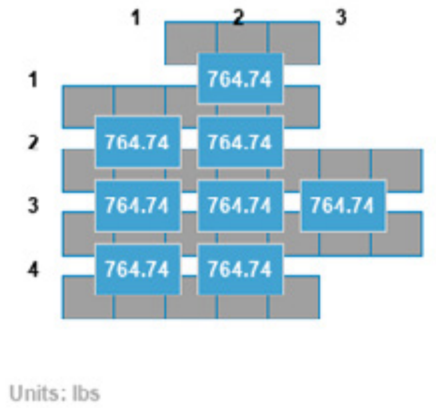
DEAD LOAD PER MODULE(D) - Roof Area 13 - Array 1



LEGEND

Module

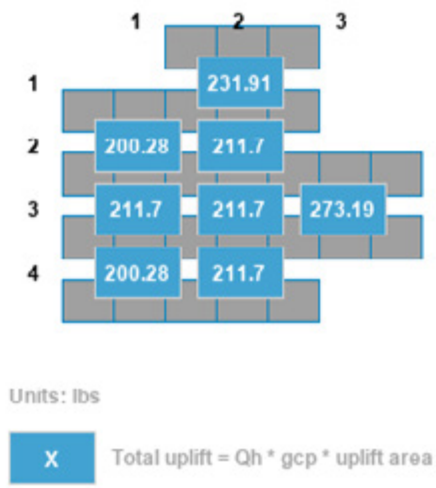
SNOW LOAD PER MODULE(S) - Roof Area 13 - Array 1



LEGEND

Module

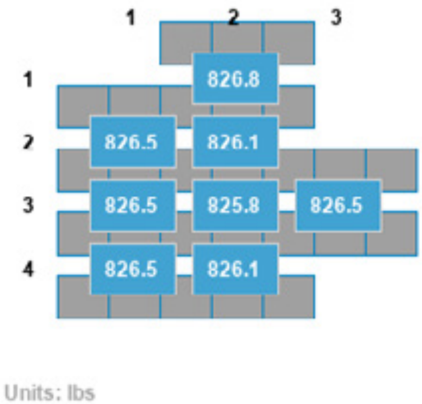
WIND LOAD (UPWARD) PER MODULE - Roof Area 13 - Array 1



LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 13 - Array 1

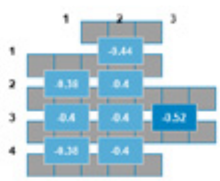


LEGEND

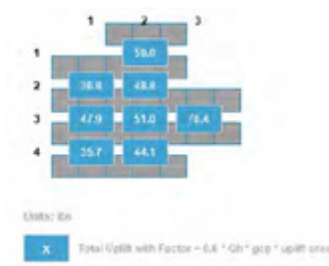
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 13 - Array 1



Factored total wind uplift map - Roof Area 13 - Array 1

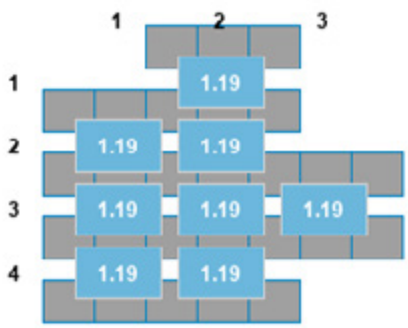


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 13 - Array 1

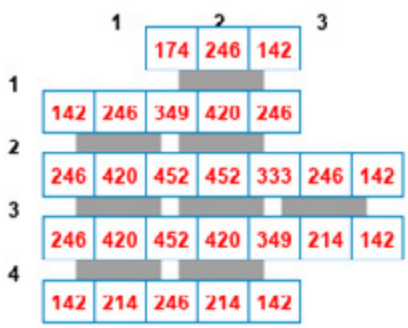


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 13 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

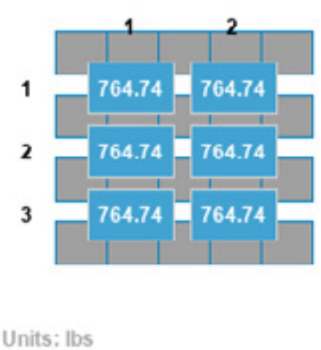
For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 14 - Array 1

LEGEND

Module

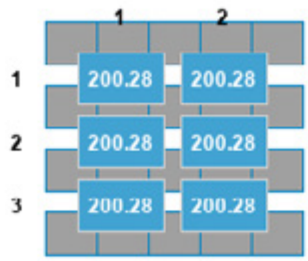
SNOW LOAD PER MODULE(S) - Roof Area 14 - Array 1



LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 14 - Array 1



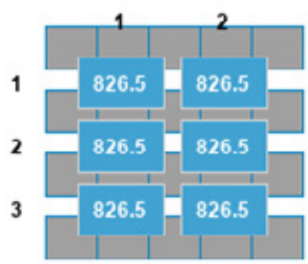
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 14 - Array 1



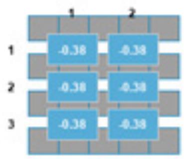
Units: lbs

LEGEND

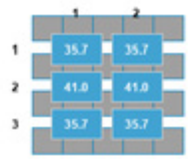
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 14 - Array 1



Factored total wind uplift map - Roof Area 14 - Array 1



Units: lbs

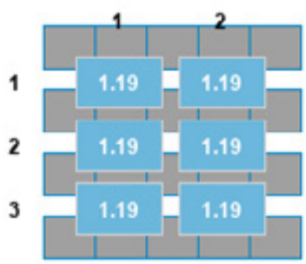
X Total Uplift with Factor = 0.6 * Qh * gcp * uplift area

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 14 - Array 1

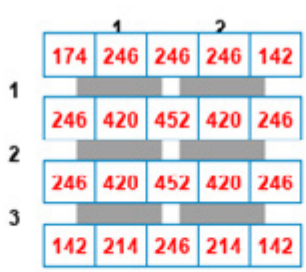


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 14 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

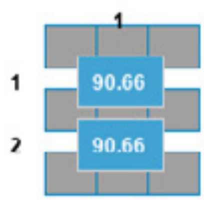
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 14 - Array 2



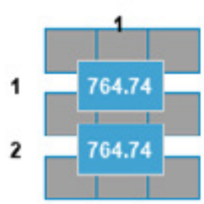
Units: lbs

X Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 14 - Array 2

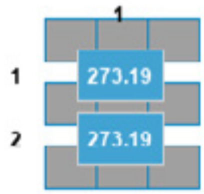


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 14 - Array 2



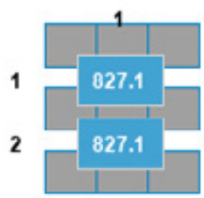
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 14 - Array 2



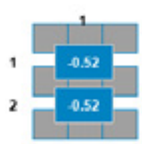
Units: lbs

LEGEND

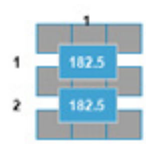
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 14 - Array 2



Factored total wind uplift map - Roof Area 14 - Array 2



Units: lbs

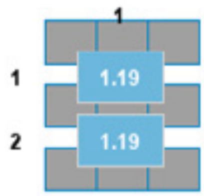
X Total Uplift with Factor = 0.6 * Qh * gcp * uplift area

LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 14 - Array 2

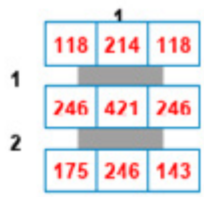


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 14 - Array 2



LEGEND

Module

x Bay - Downpoint load in range

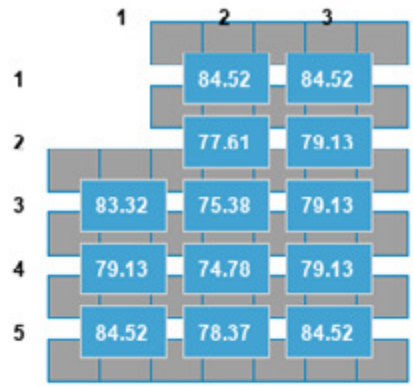
x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

DEAD LOAD PER MODULE(D) - Roof Area 15 - Array 1



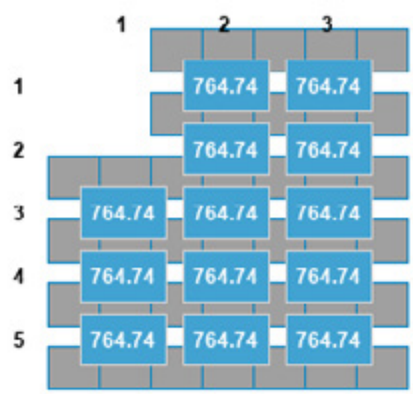
Units: lbs

Dead Load = Module Wt. + Clamp & Bolt Wt.

LEGEND

Module

SNOW LOAD PER MODULE(S) - Roof Area 15 - Array 1

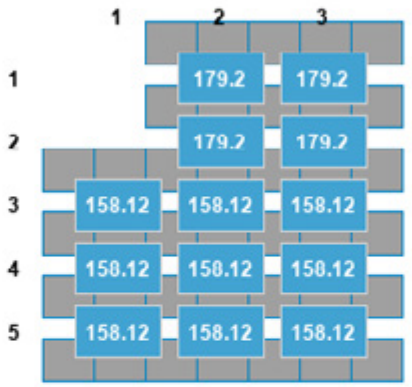


Units: lbs

LEGEND

Module

WIND LOAD (UPWARD) PER MODULE - Roof Area 15 - Array 1



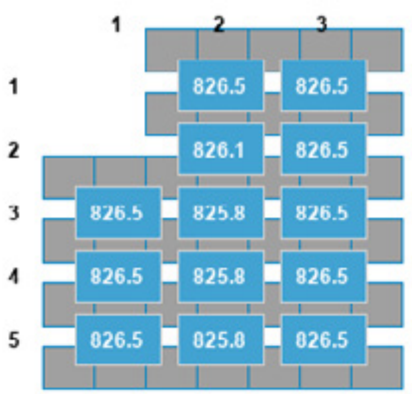
Units: lbs

X Total uplift = Qh * gcp * uplift area

LEGEND

Module

FINAL DOWNLOAD PER MODULE MAP - Roof Area 15 - Array 1



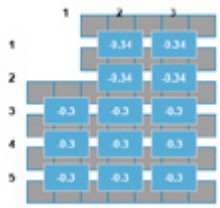
Units: lbs

LEGEND

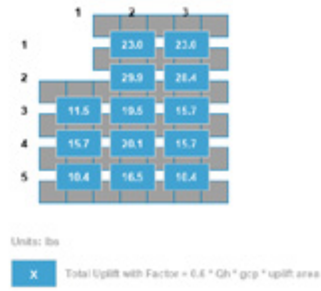
Module

UPLIFT CALCULATIONS

Gcp factor per module (uplift) map - Roof Area 15 - Array 1



Factored total wind uplift map - Roof Area 15 - Array 1

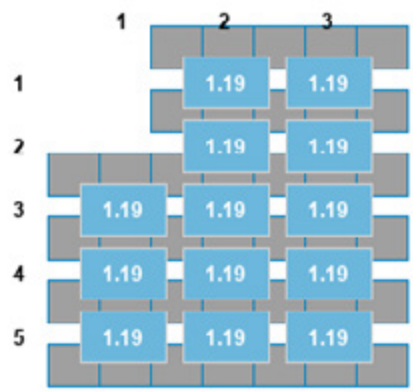


LEGEND

Module

DRAG CALCULATIONS

Drag Gcp factor per module - Roof Area 15 - Array 1

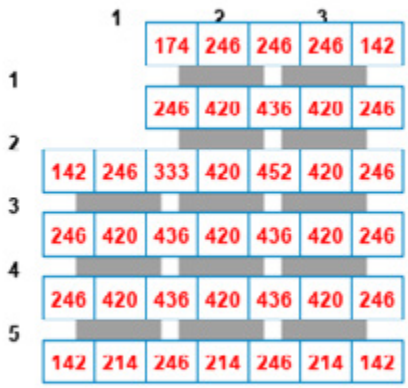


LEGEND

Module

TOTAL DOWNLOAD CALCULATIONS

Total downpoint load per bay - Roof Area 15 - Array 1



LEGEND

Module

x Bay - Downpoint load in range

x Bay - At maximum downpoint load

x Bay - Maximum downpoint load exceeded

NOTE

For exact values please check DXF file.

NOTE

1. Unirac testing was performed as per AISI S100-2007 standards
2. Terrapin testing report roof mount ballast support coefficient of friction testing RM 2.0 family (July 13, 2016) (Static,Kinetic,Wet and Dry testing performed)

RM5 U-BUILDER PRODUCT ASSUMPTIONS

RM5 – 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 I to IV
2. Minimum allowed setback distance is 1 ft
3. Building Height ≤ 150 ft
4. Building Height > 50 ft: only where (longest length of building x building height)^0.5 ≤ 100 ft
5. 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).
6. Roofing Material Types: EDPM, PVC, TPO, or Mineral Cap
7. Surrounding Building Grade: Level
8. Building Height > 60 ft requires attachments

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 repellent 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 I to IV
2. Wind Design
    a. Basic Wind Speed: 85-120 mph (ASCE 7-05)/110-150 mph (ASCE 7-10)/90-180 mph (ASCE 7-16)
    b. Exposure: B, C or D (ASCE 7-05/ASCE 7-10)
    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: 0-100 psf (ASCE 7-10/ASCE 7-16)
    b. Roof Snow Load: Calculation per Section 7.3 (ASCE 7-05/ASCE 7-10/ASCE 7-16)
    c. 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 7-05/ASCE 7-10/ASCE 7-16)

Properties

1. Bay Weight: ~7.2 lbs
2. Wind Deflector Weight: 7187.893999999999 lbs
3. Module Gaps (E/W) = 0.25 in
4. Wind Deflectors: Wind deflectors on the east and west edges of the array should overhang the east and west modules by six inches for Type 1 modules on the north rows only. Wind deflectors on the east and west edges of the array should overhang the east and west modules by six inches for Type II modules.
5. Bays: North row bays overhang the module by ~6.5 inches and south row bays overhang the module by ~12.25 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. Exception: When using ASCE 7-16 Building Code and using the obstruction feature in the module editor to accurately model the size and location of 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
3. Attachments
4. Risk Category III or IV projects (U-Builder can be adjusted for the correct wind, but not the seismic or snow design)
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)
7. Signed and sealed site-specific calculations, layouts, and drawings
8. Building that is not enclosed and categorized as open structures, carport or others

Notes:

1. Please contact info@unirac.com.
2. Please contact EngineeringServices@unirac.com for more information.

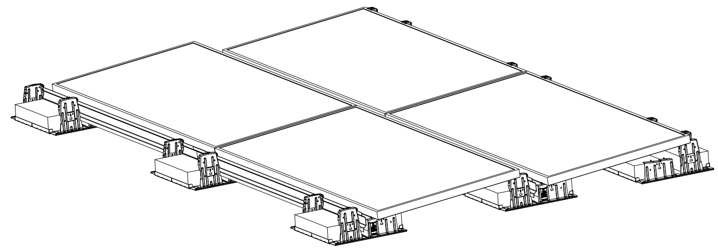
solar design associates inc

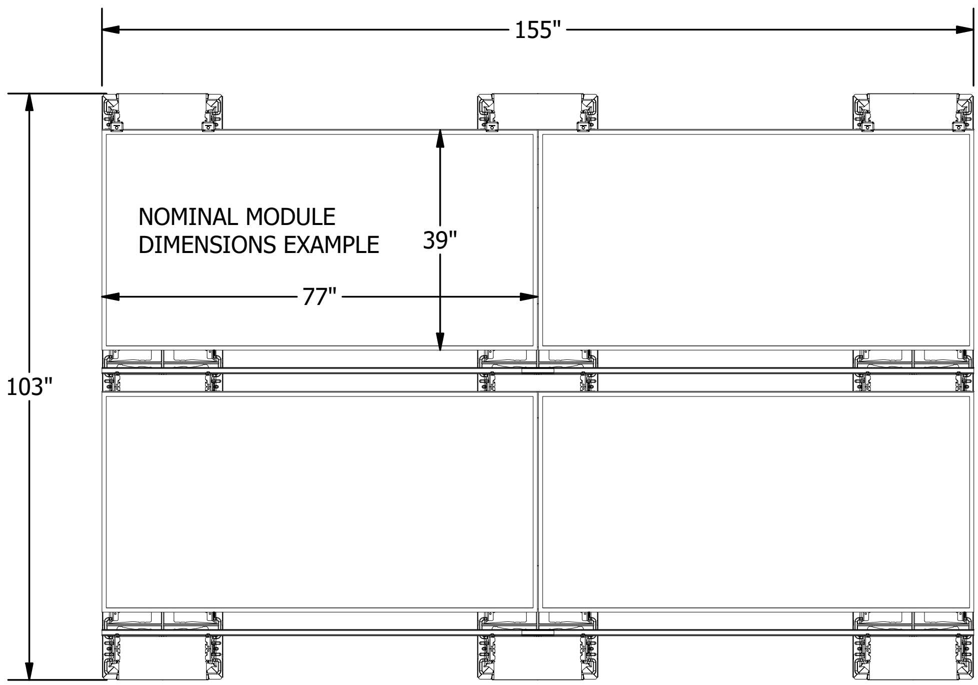
ATTACHMENT F – Unirac Detail Drawings

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

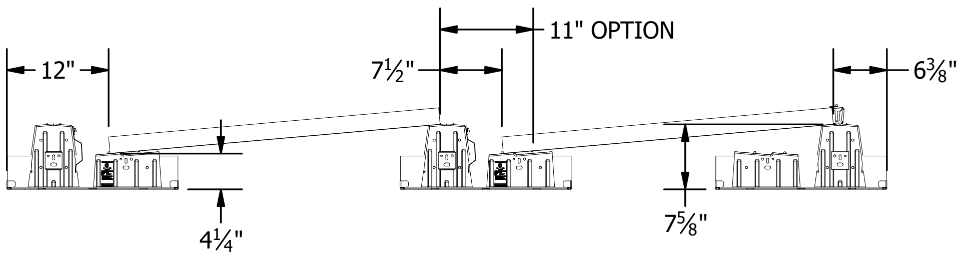
NOTES:

1. ARRAY DIMENSIONS WILL VARY BASED ON MODULE WIDTH & LENGTH.





TOP



RIGHT SIDE

UNIRAC

1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	ASSEMBLY
DESCRIPTION:	RM5 - 4 MODULE LAYOUT
REVISION DATE:	10/14/2020

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

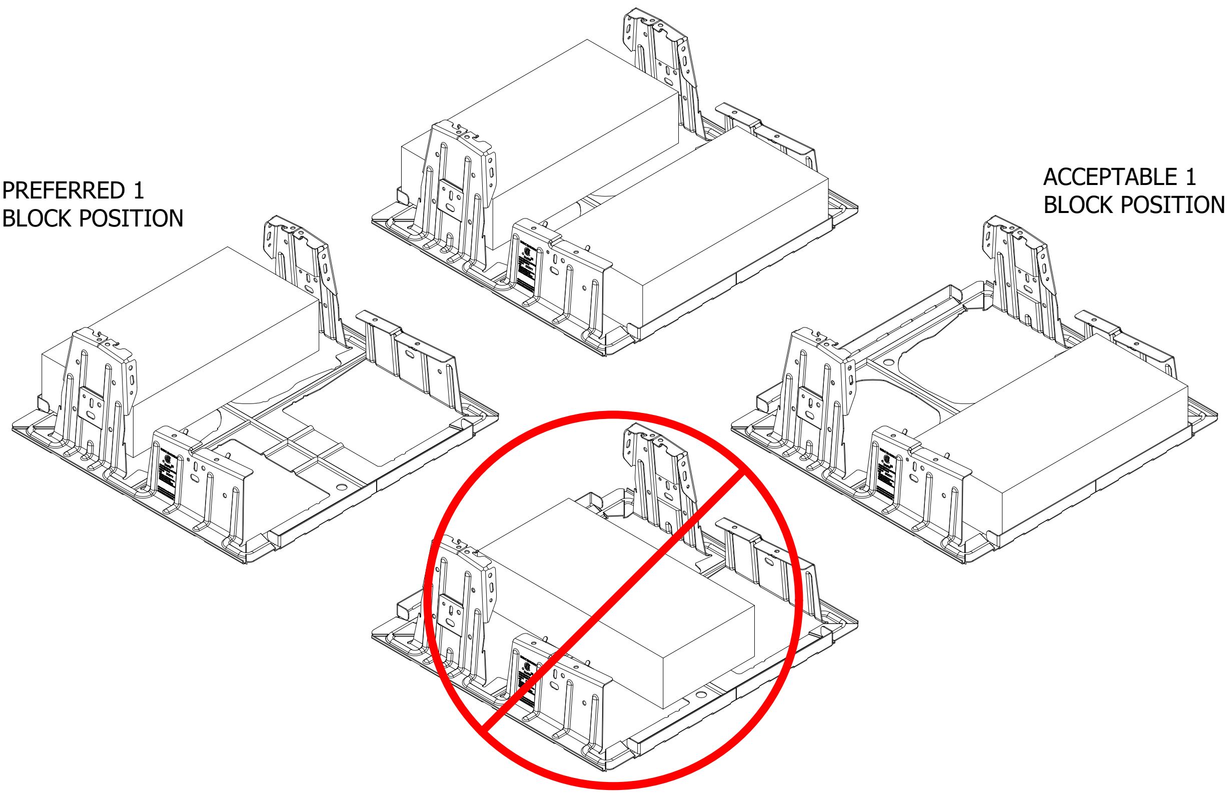
RM5-A01

SHEET

NORMAL 2 BLOCK
POSITION ON BAY

PREFERRED 1
BLOCK POSITION

ACCEPTABLE 1
BLOCK POSITION



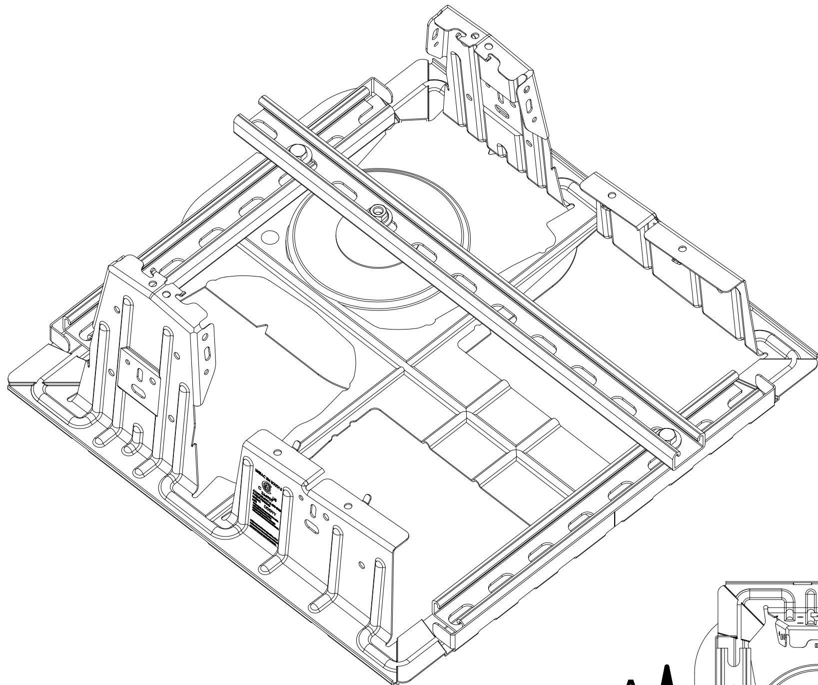
ROTATED BLOCK POSITION
NOT ACCEPTABLE

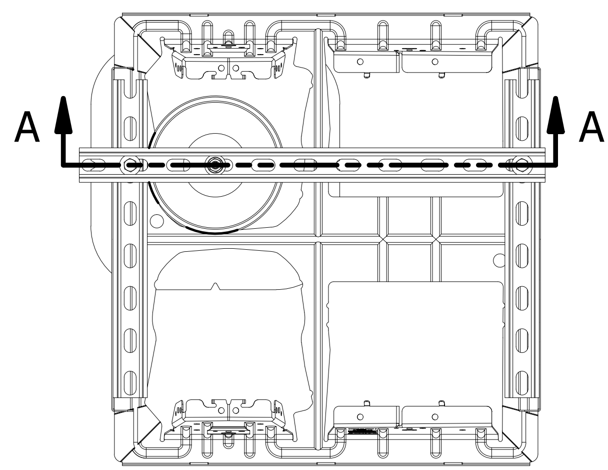
UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

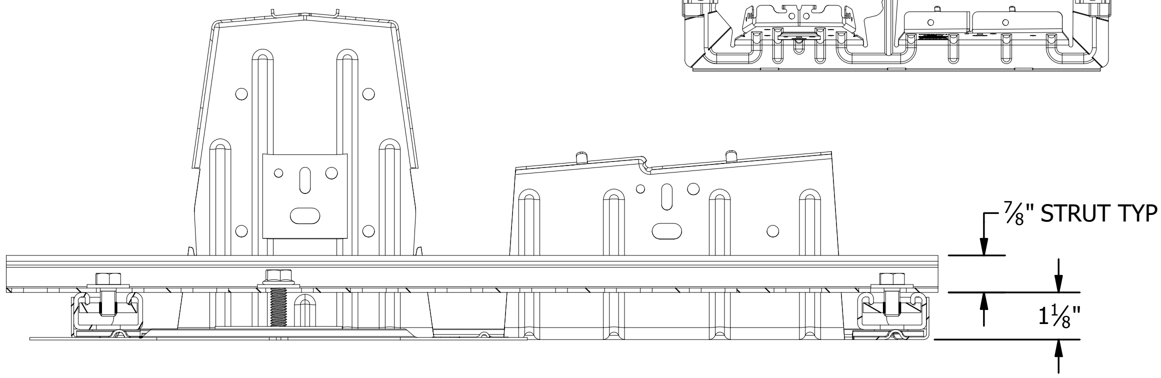
PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	ASSEMBLY
DESCRIPTION:	BAY & BALLAST BLOCKS
REVISION DATE:	2/10/2020

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE
NOMINAL

RM5-A02
SHEET







SECTION A-A

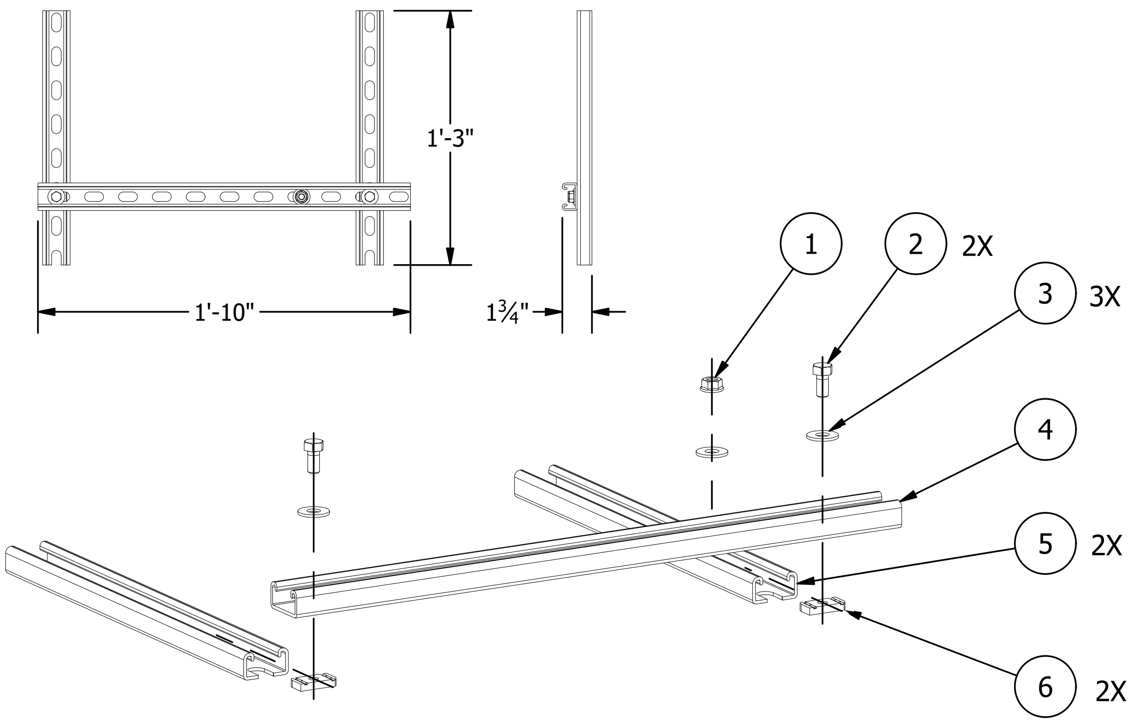
UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	ASSEMBLY
DESCRIPTION:	RM5 BAY & H-ATTACHMENT
REVISION DATE:	2/10/2020

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

RM5-A03
SHEET

H-ATTACHMENT PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	M30380	3/8-16 HEX FLANGE NUT, SS
2	2	M30304	3/8-16 X 3/4 HEX BOLT, SS
3	3	M31130	3/8 WASHER, SS
4	1	M40603	7/8 X 1 5/8 X 22 IN STRUT, GALV
5	2	M40604	7/8 X 1 5/8 X 15 IN STRUT, GALV
6	2	M30383	3/8-16 STRUT NUT, ZN



ASSEMBLY # TABLE	
P/N	DESCRIPTION
310882	RM5/DT H-ATTACHMENT KIT

UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	ASSEMBLY
DESCRIPTION:	RM5/DT H-ATTACHMENT KIT
REVISION DATE:	2/10/2020

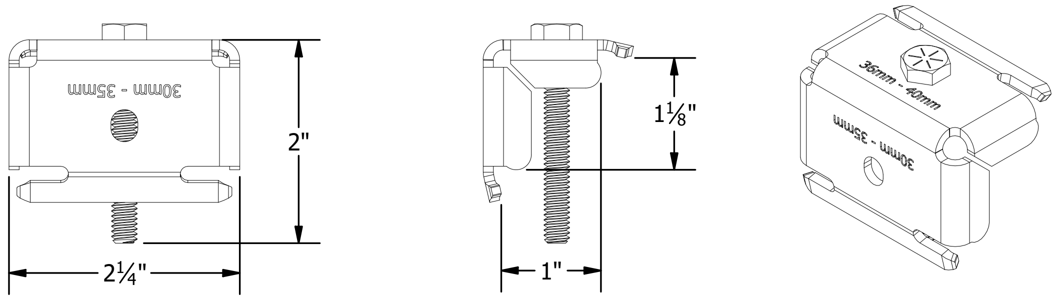
DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE OR MORE US PATENTS

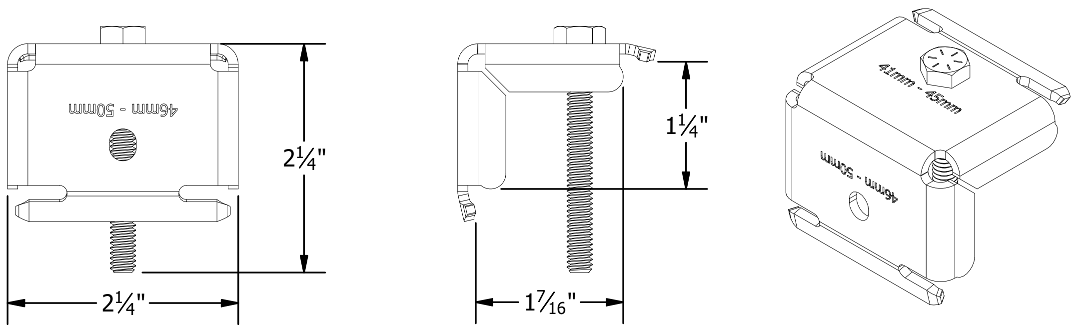
LEGAL NOTICE

RM5-A04

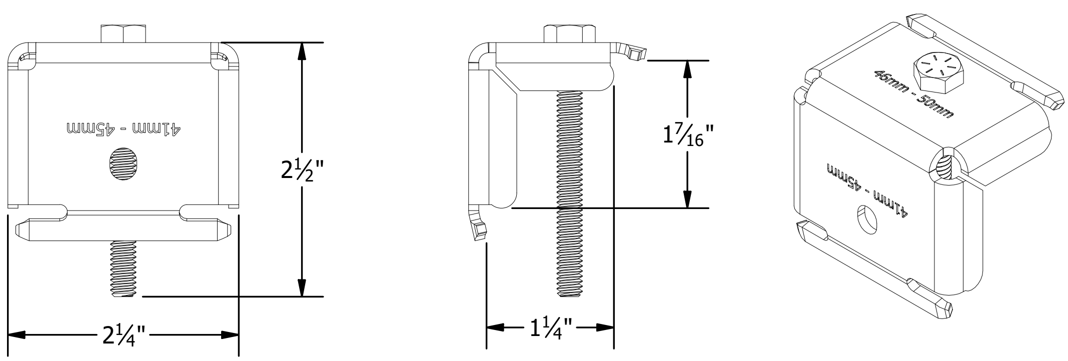
SHEET



310820 - ENDCLAMP

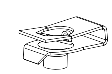


310821 - ENDCLAMP



310822 - ENDCLAMP

PART # TABLE	
P/N	DESCRIPTION
310820	RM5/DT ENDCLAMP 30-40MM
310821	RM5/DT ENDCLAMP 41-45MM
310822	RM5/DT ENDCLAMP 46-50MM
310860	RM5/DT 1/4-20 CLIP U-NUT SS 18-8



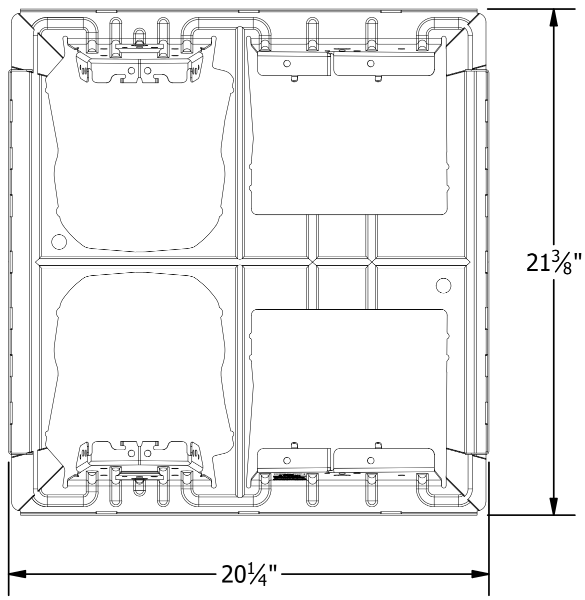
310860 - 1/4-20 CLIP U-NUT

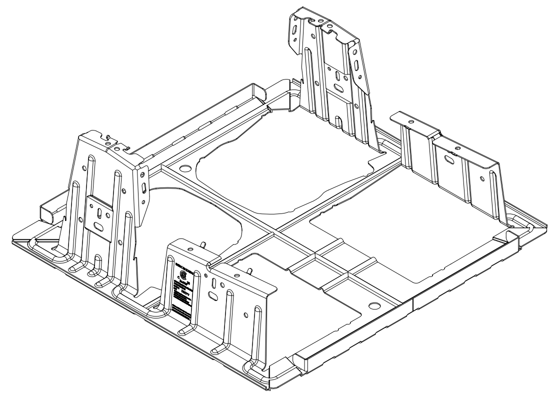
UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

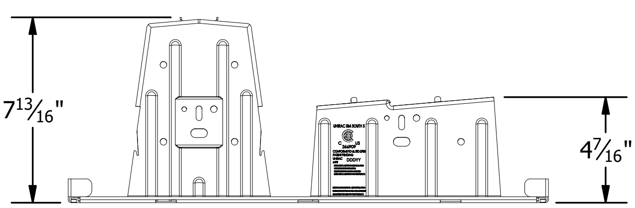
PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	ASSEMBLY
DESCRIPTION:	ENDCLAMPS & 1/4" CLIP U-NUT
REVISION DATE:	2/10/2020

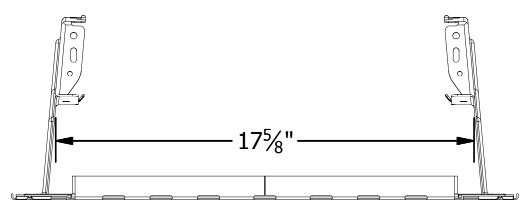
DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

RM5-A05
SHEET









PART # TABLE	
P/N	DESCRIPTION
310800	RM5 BAY

UNIRAC

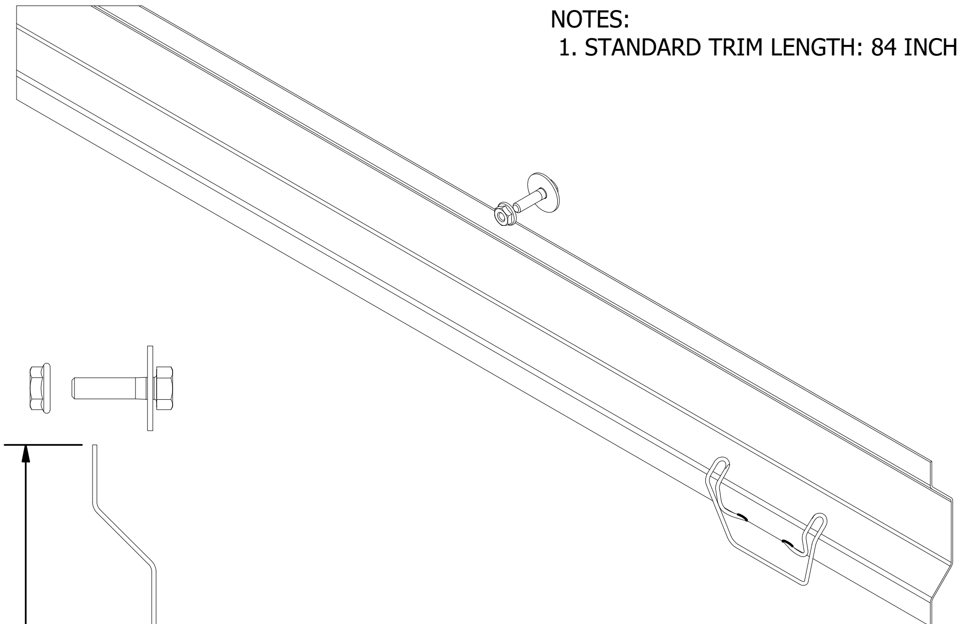
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

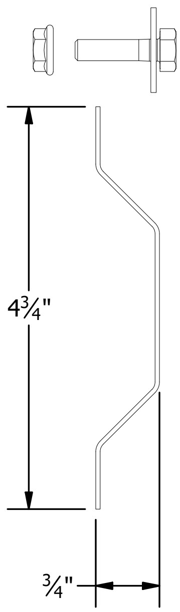
PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	PART
DESCRIPTION:	RM5 BAY
REVISION DATE:	2/10/2020

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE
NOMINAL

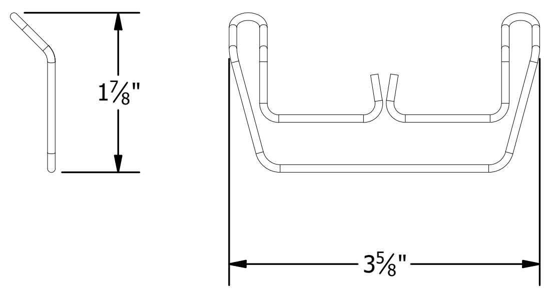
RM5-P01
SHEET

NOTES:
1. STANDARD TRIM LENGTH: 84 INCH





WIND DEFLECTOR &
HRDWR FASTENER



WIRE CLIP FOR WIND DEFLECTOR

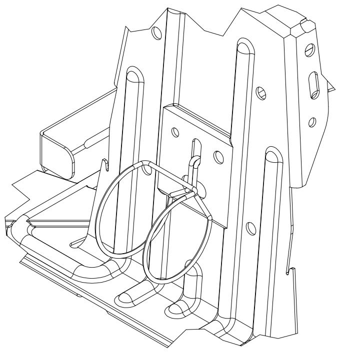
PART # TABLE		
P/N	DESCRIPTION	LENGTH
310810	RM5 WIND DEFLECTOR	84"
310850	RM5 WD WIRE MGMT CLIP	-
310861	RM5 WIND DEFLECTOR HDW KIT	-

UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

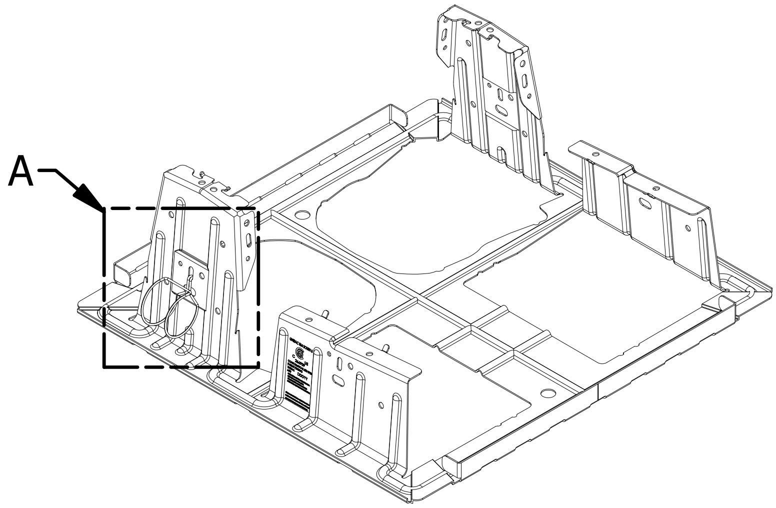
PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	PART
DESCRIPTION:	WIND DEFLECTOR, HDWR & WIRE CLIP
REVISION DATE:	2/10/2020

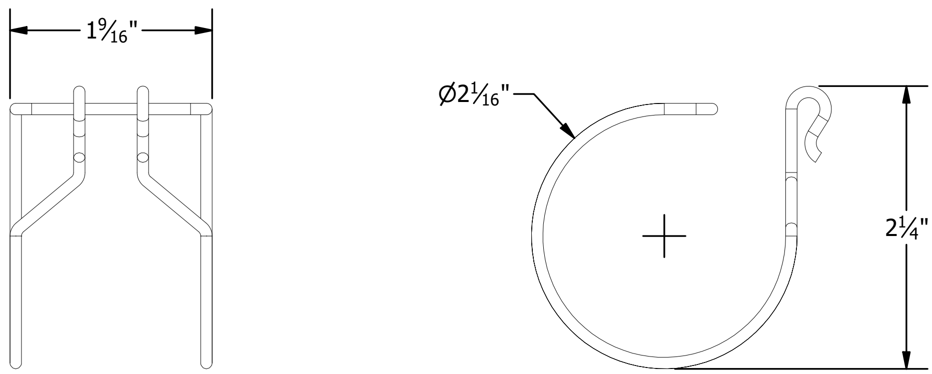
DRAWING NOT TO SCALE
ALL DIMENSIONS ARE
NOMINAL

RM5-P02
SHEET



DETAIL A





RM5/DT WIRE MGMT CLIP

PART # TABLE	
P/N	DESCRIPTION
310850	RM5/DT WIRE MGMT CLIP

UNIRAC

1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	RM5 ROOFMOUNT
DRAWING TYPE:	PART
DESCRIPTION:	RM5/DT WIRE MGMT CLIP
REVISION DATE:	2/10/2020

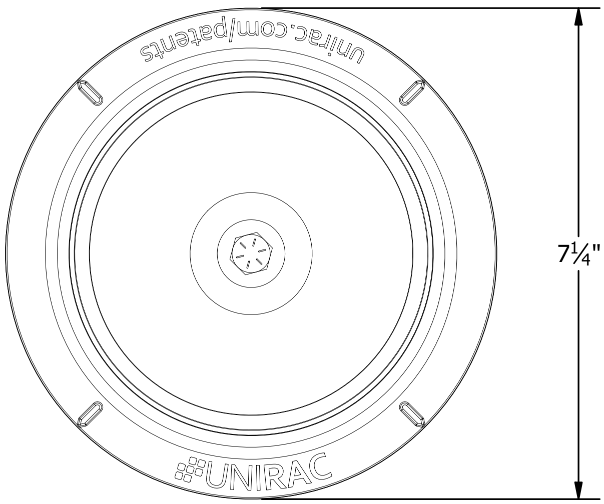
DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

RM5-P03

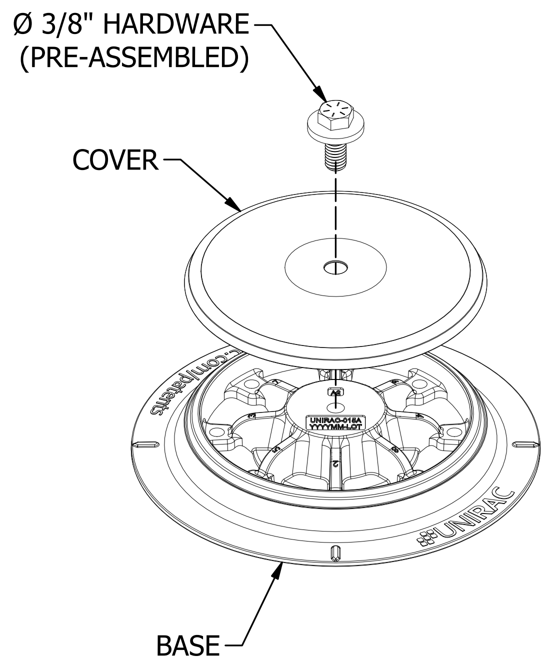
SHEET

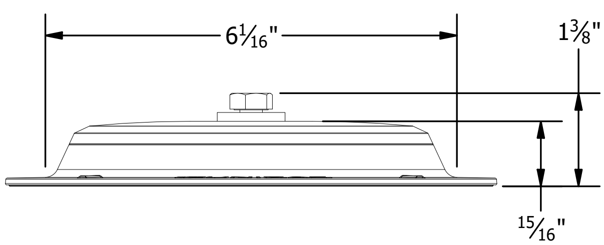
NOTES:

1. ATTACHMENT CAN ACCOMMODATE ROOFING SCREW SIZES #12 - #15. FASTENER SIZE, LENGTH, AND QUANTITY TO BE SELECTED BY STRUCTURAL ENGINEER OF RECORD WHEN DESIGNING FOR THE SPECIFIC PROJECT CONSTRUCTION AND CAPACITY.
2. REFER TO THE UNIRAC INSTALLATION GUIDE FOR PROPER USE OF CHEM LINK M1 AND ONE-PART SEALANTS FOR WATER TIGHT INSTALLATION.



TOP VIEW





PART # TABLE	
P/N	DESCRIPTION
310999	FLASHLOC RM KIT

ULTIMATE TEST LOAD (WITH 8 ROOF FASTENERS)

UPLIFT ULTIMATE CAPACITY	6,670 lbs.
SHEAR ULTIMATE CAPACITY	5,760 lbs.

UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	RM
DRAWING TYPE:	ASSEMBLY DETAIL
DESCRIPTION:	FLASHLOC RM KIT
REVISION DATE:	6/26/2020

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE OR MORE US PATENTS

LEGAL NOTICE

RMF-A01

SHEET

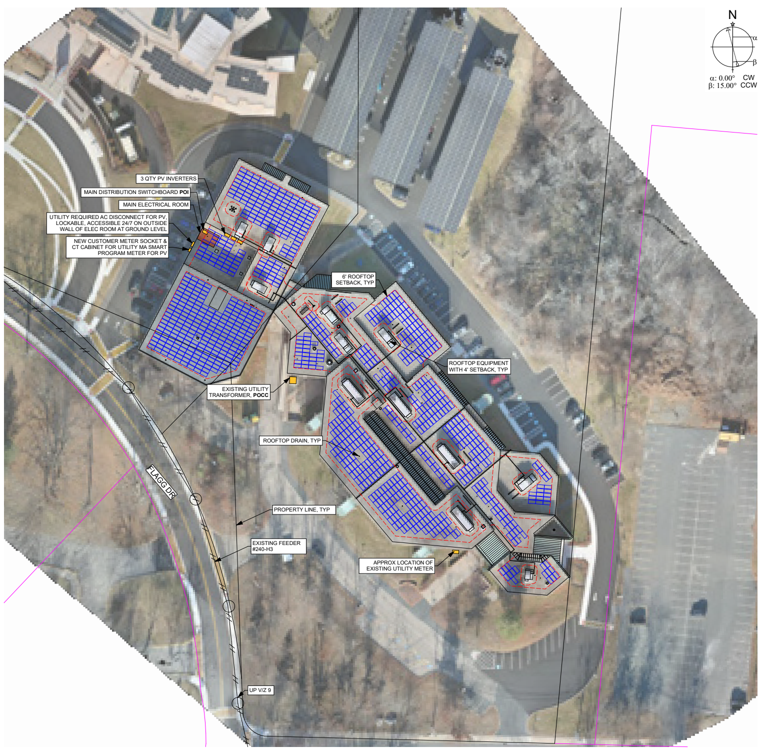
solar design associates inc

Attachment G – Solar Design Associates Schematic Design Drawings

Box 242, Harvard, Massachusetts 01451-0242
(978) 456-6855 ● www.solardesign.com

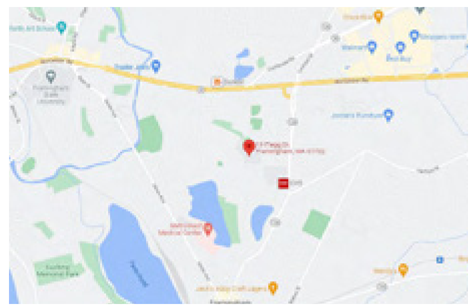
PHOTOVOLTAIC SYSTEM FOR GALE ASSOCIATES - FARLEY BUILDING

19 FLAGG DRIVE, FRAMINGHAM MA 01705



1 450.24 kWdc (360.00 kWac) PV ARRAY WITH 938QTY 480W MODULES AT 5° TILT

0 20' 40' 80'



2 LOCUS MAP

0 1250' 2500'

3 SIMILAR PV ARRAY

TOTAL ARRAY SIZE (kWdc)	450.24
MODULE MODEL	Q.PEAK DUO XL-G10.2-480
TOTAL NUMBER OF MODULES IN ARRAY	938
MODULE WATTAGE	480
NUMBER OF STRINGS	27
NUMBER OF MODULES PER STRING	34-36
ARRAY TYPE	FIXED TILT BALLASTED
ARRAY TILT	5°
SOLAR AZIMUTH	230.1°, 184.7° & 207.6°
MOUNTING SYSTEM	UNIRAC RM5
INVERTER MODEL	(3) SOLAREDGE SE120K-US
TOTAL SYSTEM SIZE (kWac)	360.00
ANNUAL PRODUCTION (MWhr)	527,930.6

ESTIMATED ANNUAL ENERGY PRODUCTION BASED ON:
HELIOSCOPE CALCULATOR
LAT, LON 42.44, -71.40 WEATHER DATA
PREMIUM MODULE
16% SYSTEM LOSSES
FIXED TILT
98.5% INV EFFICIENCY

APPLICABLE STANDARDS
- 2023 NATIONAL ELECTRIC CODE
- MASSACHUSETTS AMENDMENTS TO 2023 NEC
- 9TH EDITION MASSACHUSETTS BUILDING CODE
- 2017 NATIONAL ELECTRICAL SAFETY CODE
- EVERSOURCE CONSTRUCTION STANDARDS
- FRAMINGHAM, MA BUILDING & ELECTRICAL INSPECTORS (AHJs)

solar design associates inc
HARVARD, MA 01451-0242 tel: 978-456-6855
www.solardesign.com fax: 978-772-9715

NOT FOR CONSTRUCTION

GALE ASSOCIATES - FARLEY BUILDING

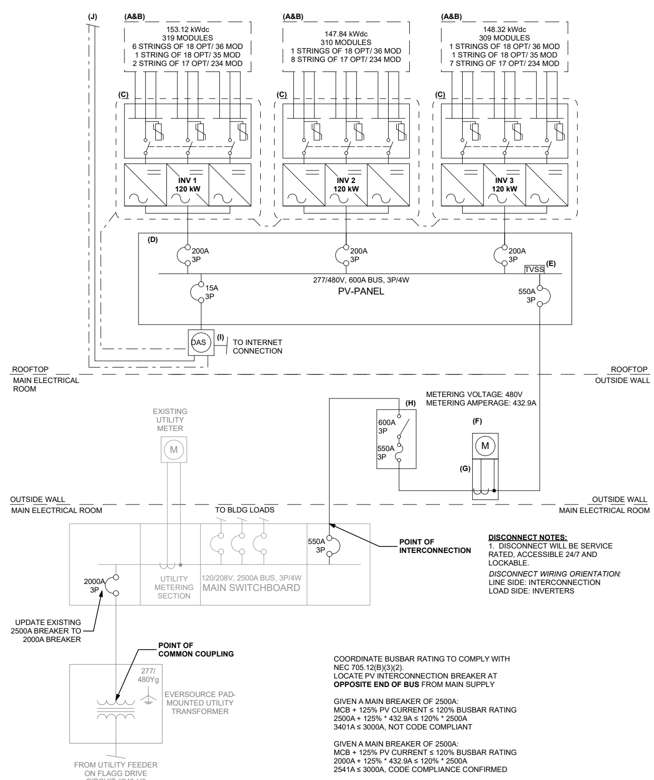
SUBMISSION: INTERCONNECTION APPLICATION
Monday, March 20, 2023

PROFESSIONAL STAMP

REVISION NOTES

MARK	DATE	DESCRIPTION
-	01/24/2023	SCHEMATIC LAYOUT
-	02/10/2023	INTERCONNECTION APPLICATION

CONTRACTOR	NAME	
	STREET	
	CITY/ST/ZIP	
	NOTES	
SITE	NAME	GALE ASSOCIATES - FARLEY BUILDING
	STREET	19 FLAGG DRIVE
	CITY/ST/ZIP	FRAMINGHAM, MA 01705
	NOTES	
DRAWING	FILE NAME	2022-1219 Gale Associates - Farley Middle School.pln
	SCALE	AS NOTED
	DRAWN BY	NL DATE DRAFTED: 3/20/2023
	CHECKED BY	#Architect SHEET SIZE: ARCH D
	DRAWING NO.	PV001
	DRAWING TITLE	PV SITE PLAN



DISCONNECT NOTES:
1. DISCONNECT WILL BE SERVICE RATED, ACCESSIBLE 24/7 AND LOCKABLE.

DISCONNECT WIRING ORIENTATION:
LINE SIDE: INTERCONNECTION
LOAD SIDE: INVERTERS

COORDINATE BUSBAR RATING TO COMPLY WITH NEC 705.12(B)(3)(2).
LOCATE PV INTERCONNECTION BREAKER AT **OPPOSITE END OF BUS** FROM MAIN SUPPLY

GIVEN A MAIN BREAKER OF 2500A:
MCB + 125% PV CURRENT ≤ 120% BUSBAR RATING
2500A + 125% * 432.9A ≤ 120% * 2500A
3401A ≤ 3000A, NOT CODE COMPLIANT

GIVEN A MAIN BREAKER OF 2500A:
MCB + 125% PV CURRENT ≤ 120% BUSBAR RATING
2000A + 125% * 432.9A ≤ 120% * 2500A
2541A ≤ 3000A, CODE COMPLIANCE CONFIRMED

1 360 kWac (450.24 kWdc) PV SINGLE LINE

SITE CONDITIONS

LOCATION	FRAMINGHAM, MA	
MAX AVG TEMP:	32	°C
MIN EXPECTED TEMP:	-20	°C

DUAL TILT PV ARRAY CONFIGURATION

Manufacturer:	HANWHA Q CELLS
Model:	Q.PEAK DUO XL-G10.2 480
Module Qty:	938
Module per String:	34-36
Optimzers per String:	17, 18
Total series strings:	27

PV MODULE OUTPUT*

Voc:	53.61	Vdc
Voc Temp Coeff.	-0.27	%/ °C
Voc (Temp Adjusted)	60.12	Vdc
Isc:	11.26	Adc
Vmp:	44.81	Vdc
Imp:	10.71	Adc.

PV POWER OPTIMIZER OUTPUT (SOLAREDGE P1101)

Maximum Output Voltage:	80	Vdc
Typical Operating Voltage:	60	Vdc
Shutdown Standby Voltage:	1	Vdc
Maximum Output Current:	18	Adc
Typical Operating Current:	18	Adc

POWER OPTIMIZER SOURCE CIRCUIT OUTPUT

Maximum Output Voltage:	1000	Vdc
Typical Operating Voltage:	850	Vdc
Shutdown Standby Voltage:	18	Vdc
Maximum Current:	18	Adc
Typical Operating Current:	18	Adc

PV INVERTER OUTPUT (SOLAREDGE SE120K-US)

Max Rated Power:	120	kWac
Max Apparent Power:	120	kVA
Operating Voltage (Line-to-Line):	480	Vac
Max Current:	144.3	Aac
Output Frequency:	60	Hz

* BASED ON MODULE PERFORMANCE AT STANDARD TEST CONDITIONS (STC)

TABLE 1: PHOTOVOLTAIC SYSTEM EQUIPMENT LIST

(A)	HANWHA Q CELLS Q.PEAK DUO XL-G10.2 480W	938
(B)	SOLAREDGE P1101 POWER OPTIMIZER, CONNECTED TO TWO MODULES IN SERIES	470
(C)	SOLAREDGE SE120K-US INVERTER, 120kW, 144.3Aac MAX OUTPUT CURRENT, 277/480Vac OUTPUT, DC DISCONNECTS, AFCI, WITH DC SURGE PROTECTION, NEMA3R	3
(D)	PV PANELBOARD, 277/480V, 800A BUSBAR, 600A MAIN BREAKER, BRANCH BREAKERS AS NOTED, NEMA3R	1
(E)	TRANSIENT VOLTAGE SURGE SUPPRESSOR INTEGRATED INTO PANEL	1
(F)	CUSTOMER OWNED CT CABINET FOR UTILITY OWNED SMART PROGRAM METER CTs, 800A CONTINUOUS DUTY, THREE CONNECTORS PER PHASE, MILLBANK #U1855-O-NE OR EQUIVALENT	1
(G)	CUSTOMER OWNED METER SOCKET FOR UTILITY OWNED SMART PROGRAM METER, 20A CONTINUOUS DUTY, 600V, TEST SWITCH BYPASS, MILLBANK #UC4966-O-WC-21-NST OR EQUIVALENT	1
(H)	UTILITY REQUIRED HEAVY DUTY AC DISCONNECT, 277/480Vac, 600A BLADE WITH 550A FUSES, LOCKABLE, VISIBLE BREAK, NEMA3R, ACCESSIBLE 24/7, SERVES AS RAPID SHUTDOWN INTIATION POINT	1
(I)	CUSTOMER OWNED DATAAQUISITION SYSTEM (DAS) WITH REVENUE GRADE METERING, ALSO ENERGY OR EQUIVALENT	1
(J)	WEATHER STATION WITH POA IRRADIANCE SENSOR AND BACK-OF-MODULE TEMPERATURE SENSOR	1

TABLE 2: TRIP LEVEL SETTINGS TO STOP 208V INVERTER V_{NOM} **= 277V L-G**

ID	DESCRIPTION	SET POINT	TOTAL CLEAR TIME
1	LINE UNDER VOLTAGE (FAST)	138.5 V	1.1 SEC
2	LINE UNDER VOLTAGE (SLOW)	243.7 V	2.0 SEC
3	LINE OVER VOLTAGE (SLOW)	304.7 V	2.0 SEC
4	LINE OVER VOLTAGE (FAST)	332.4 V	0.16 SEC
5	LINE UNDER FREQUENCY (FAST)	56.5 Hz	0.16 SEC
6	LINE UNDER FREQUENCY (SLOW)	58.5 Hz	300 SEC
7	LINE OVER FREQUENCY (SLOW)	61.2 Hz	300 SEC
8	LINE OVER FREQUENCY (FAST)	62.0 Hz	0.16 SEC

NOTES:
1. INVERTER TOTAL CLEARING TIME INCLUDES MECHANICAL OPERATION TIME OF 3 CYCLES (0.05s)
2. UTILITY RESTORATION DETECTION WILL USE THE FACTORY SETTINGS OF A UL 1741 SA CERTIFIED INVERTER.
3. INVERTER LROV SETTING SHALL BE SET 1.4pu VOTAGE AT 1 ms.

solar design associates inc
HARVARD, MA 01451-0242
www.solardesign.com
tel: 978-456-6855
fax: 978-772-9715

NOT FOR CONSTRUCTION

GALE ASSOCIATES - FARLEY BUILDING

SUBMISSION
INTERCONNECTION APPLICATION
Monday, March 20, 2023

PROFESSIONAL STAMP

REVISION NOTES

MARK	DATE	DESCRIPTION
-	01/24/2023	SCHEMATIC LAYOUT
-	02/10/2023	INTERCONNECTION APPLICATION

CONTRACTOR

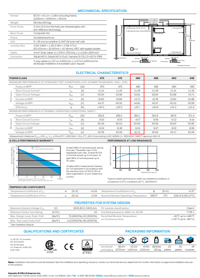
NAME	
STREET	
CITY/ST/ZIP	
NOTES	

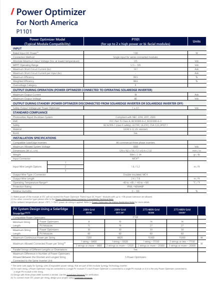
SITE

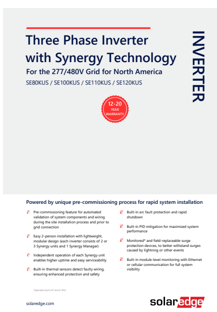
NAME	GALE ASSOCIATES - FARLEY BUILDING
STREET	19 FLAGG DRIVE
CITY/ST/ZIP	FRAMINGHAM, MA 01705
NOTES	

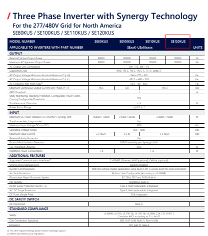
DRAWING

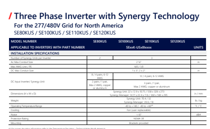
FILE NAME	2022-1219 Gale Associates - Farley Middle School.pln
SCALE	AS NOTED
DRAWN BY	NL DATE DRAFTED: 3/20/2023
CHECKED BY	#Architect SHEET SIZE: ARCH D
DRAWING NO.	PV601
DRAWING TITLE	SINGLE LINE

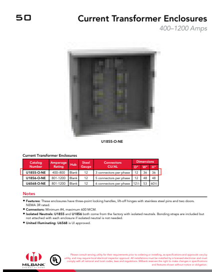


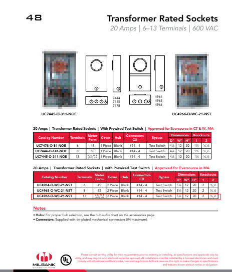












solar design associates inc

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NOT FOR CONSTRUCTION

THIS DRAWING IS FOR INFORMATION PURPOSES ONLY. CERTIFICATION OR VALIDATION IS TO BE DONE BY A PROFESSIONAL WITH EXPERTISE IN THE REQUIRED FIELD AND A LICENSE IN THE STATE THAT THE INSTALLATION WILL RESIDE. CERTFICIATION OR VALIDATION TO BE INCLUDED AS PART OF THE SUBMITTALS FOR PERMITTING OF THE OVERALL PROJECT.

GALE ASSOCIATES - FARLEY BUILDING

SUBMISSION

INTERCONNECTION APPLICATION

Monday, March 20, 2023

PROFESSIONAL STAMP

REVISION NOTES

MARK	DATE	DESCRIPTION
-	01/24/2023	SCHEMATIC LAYOUT
-	02/10/2023	INTERCONNECTION APPLICATION

CONTRACTOR

NAME	
STREET	
CITY/ST/ZIP	
NOTES	

SITE

NAME	GALE ASSOCIATES - FARLEY BUILDING
STREET	19 FLAGG DRIVE
CITY/ST/ZIP	FRAMINGHAM, MA 01705
NOTES	

DRAWING

FILE NAME	2022-1219 Gale Associates - Farley Middle School.pln	
SCALE	AS NOTED	
DRAWN BY	NL	DATE DRAFTED: 3/20/2023
CHECKED BY	#Architect	SHEET SIZE: ARCH D
DRAWING NO.	PV602	
DRAWING TITLE	DATASHEETS	

Framingham
PUBLIC SCHOOLS
Embracing differences. Inspiring futures.

FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Farley Rooftop Solar Canopy Purchase and Installation - $1,750,000
Solar Canopy on new Farley Administration Building Roof

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 10

(1) PROJECT NAME: Fuller Field Upgrades

PROJECT STATUS: NEW Project This Year

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital budget funding is for continued upgrades to the Fuller Turf Fields, specifically, for the purchase and installation of field lights. During the original design conversations between members of the building committee, school committee, buildings & grounds, parks department, and FPS leadership, part of the field planning conversation including the possibility of lighting at the field. It was decided during that process that the inclusion of field lights and the cost associated with that could jeopardize a possible capital funding request. The proposal that grew from there focused on constructing two turf fields at Fuller, providing the first fields dedicated to multiple organizations and programs. Since the initial capital request for these fields, conversations have been held during school building committee meetings, school committee meetings, department meetings between the school's and city, and community to explore moving a project forward that focuses on installing lights at Fuller. As part of that effort, the Superintendent sent a mailing to abutters surrounding the fuller site. Most of the feedback received expressed apprehension, and requested additional community meetings to further discuss this possibility, if this were to move forward. At this time, we have not held community meetings to review and discuss this potential proposal. However, FPS staff have met preliminarily with Parks Department staff to discuss this possibility and what the next steps would be in a community meeting. We are still in an exploratory phase at this time. This cost estimate was created by using a proposal from Musco that provided pricing for these fields assuming there are no issues with subsurface conditions. As we found during the Fuller construction project, if we were to move forward with this there would be the need to manage subsurface soil conditions, carrying an additional cost.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
X	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction	2,250,000					
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	2,250,000	-	-	-	-	-

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.		**level service maintenance**	maintains City desired level of service
c.	X	**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION: **Fuller Middle School**

(11) ASSET TYPE:

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8)	**PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)**	
	TBD	
(9)	**FINANCE DEPARTMENT NOTES:**	

10. **Fuller Field Upgrades**

FY25:

This request for capital budget funding is for continued upgrades to the Fuller Turf Fields, specifically, for the purchase and installation of field lights. During the original design conversations between members of the building committee, school committee, buildings & grounds, parks department, and FPS leadership, part of the field planning conversation including the possibility of lighting at the field. It was decided during that process that the inclusion of field lights and the cost associated with that could jeopardize a possible capital funding request. The proposal that grew from there focused on constructing two turf fields at Fuller, providing the first fields dedicated to multiple organizations and programs. Since the initial capital request for these fields, conversations have been held during school building committee meetings, school committee meetings, department meetings between the school's and city, and community to explore moving a project forward that focuses on installing lights at Fuller. As part of that effort, the Superintendent sent a mailing to abutters surrounding the fuller site. Most of the feedback received expressed apprehension, and requested additional community meetings to further discuss this possibility, if this were to move forward. At this time, we have not held community meetings to review and discuss this potential proposal. However, FPS staff have met preliminarily with Parks Department staff to discuss this possibility and what the next steps would be in a community meeting. We are still in an exploratory phase at this time. This cost estimate was created by using a proposal from Musco that provided pricing for these fields assuming there are no issues with subsurface conditions. As we found during the Fuller construction project, if we were to move forward with this there would be the need to manage subsurface soil conditions, carrying an additional cost.

- Light towers, equipment, and installation - **$1,700,000**
- Design - **$30,000**
- Environmental Remediation - **$300,000**
- Project Contingency - **$220,000**
- **TOTAL - $2,250,000**

Fuller Turf Field Upgrades

Location	Cost			
LIght towers, equipment, and installation	*$1,700,000*			
Design	*$30,000*			
Environmental Remediation	*$300,000*			
Total	*$2,030,000*			
Project Contingency	*$219,240*			
PROJECT TOTAL	**$2,249,240**			

REF: 212641

Fuller Middle School Fields

Framingham, MA

July 15, 2022

Estimate – Materials only

Musco's Light-Structure System™ as described below, and delivered to the job site:

Football/Soccer Fields ....$560,000 - $570,000

Installation ....$250,000 - $300,000

Sales tax and bonding are not included.

Pricing furnished is effective for 30 days unless otherwise noted and is considered confidential.

Light-Structure System™ with Total Light Control – TLC for LED™ technology

System Description – Light-Structure System™ in 5 Easy Pieces™

Factory built, wired, aimed, and tested lighting system includes:

- Pre-cast concrete bases
- Galvanized steel poles
- Remote electrical component enclosures
- Pole length wire harnesses
- Factory aimed and assembled luminaires, including BallTracker® technology
- UL listed as a complete system

On Field Performance, Control, and Warranty Services

- Guaranteed light levels of 50 footcandles for all fields.
- BallTracker® technology – targeted aerial light optimizing visibility of the ball in play with no glare for players.
- Control-Link® control and monitoring system for remote on/off control, dimming (high/med/low), and monitoring with 24/7 customer support.

Budget Estimate

Notes

Estimate is based on:

- Shipment of entire project together to one location.
- 480 Volt, 3 phase electrical system requirement.
- Structural code and wind speed = 2015 IBC, 130 mi/h, and exposure: C, Importance Factor II.
- Owner is responsible for getting electrical power to the site, coordination with the utility, and any power company fees
- Standard soil conditions – rock, bottomless, wet, or unsuitable soil may require additional engineering, special installation methods and additional cost.
- Confirmation of pole locations prior to production.

Thank you for considering our Team for your sports lighting needs. Please contact me with any questions.

Mike Berry
Sales Executive
Musco Sports Lighting, LLC
Phone: 617-571-3714
E-mail: mike.berry@Musco.com

Fuller Middle School Fields

Framingham, MA

Lighting System

Pole / Fixture Summary

Pole ID	Pole Height	Mtg Height	Fixture Qty	Luminaire Type	Load	Circuit
F1-F2	70'	70'	9	TLC-LED-1200	10.53 kW	A
		16'	2	TLC-BT-575	1.15 kW	A
F3	100'	100'	10	TLC-LED-1200	11.70 kW	B
		100'	9	TLC-LED-1200	10.53 kW	A
		16'	1	TLC-BT-575	0.58 kW	A
		16'	1	TLC-BT-575	0.58 kW	B
F4-F5	70'	70'	9	TLC-LED-1200	10.53 kW	B
		16'	2	TLC-BT-575	1.15 kW	B
F6	100'	100'	10	TLC-LED-1200	11.70 kW	B
		100'	9	TLC-LED-1200	10.53 kW	A
		16'	1	TLC-BT-575	0.58 kW	B
		16'	1	TLC-BT-575	0.58 kW	A
6			***86***		***93.48 kW***	

Circuit Summary

Circuit	Description	Load	Fixture Qty
A	Multipurpose 1	45.57 kW	42
B	Multipurpose 2	47.91 kW	44

Fixture Type Summary

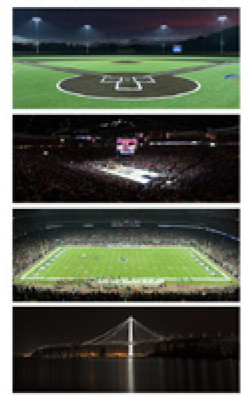
Type	Source	Wattage	Lumens	L90	L80	L70	Quantity
TLC-LED-1200	LED 5700K - 75 CRI	1170W	136,000	>120,000	>120,000	>120,000	74
TLC-BT-575	LED 5700K - 75 CRI	575W	52,000	>120,000	>120,000	>120,000	12

Light Level Summary

Calculation Grid Summary

Grid Name	Calculation Metric	Illumination					Circuits	Fixture Qty
		Ave	Min	Max	Max/Min	Ave/Min		
150' Spill Line	Horizontal	0.04	0	0.19	38.80		A,B	86
150' Spill Line	Max Candela (by Fixture)	5462	1426	12307	8.63	3.83	A,B	86
150' Spill Line	Max Vertical Illuminance Metric	0.12	0.03	0.44	15.02	4.13	A,B	86
Football 2	Horizontal Illuminance	51.4	38	62	1.63	1.35	B	44
Football	Horizontal Illuminance	52.8	42	63	1.51	1.26	A	42
Soccer 2	Horizontal Illuminance	50.6	38	61	1.58	1.33	B	44
Soccer	Horizontal Illuminance	52.8	42	63	1.51	1.26	A	42
Zero Grid	Horizontal Illuminance	5.40	0	60	0.00		A,B	86

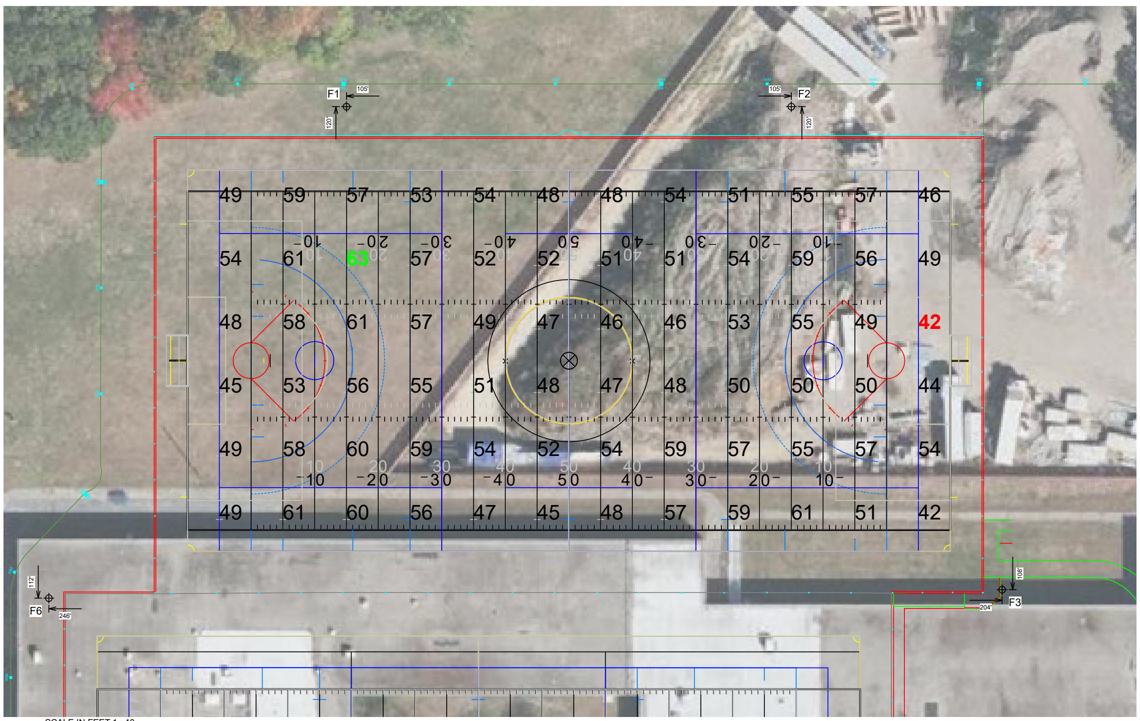
From Hometown to Professional



We Make It Happen.

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

EQUIPMENT LIST FOR AREAS SHOWN								
Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
2	F1-F2	70'	-	15.5'	TLC-BT-575	2	2	0
				70'	TLC-LED-1200	9	9	0
2	F3, F6	100'	-	15.5'	TLC-BT-575	2	1	1
				100'	TLC-LED-1200	19	9	10
4	TOTALS					64	42	22



SCALE IN FEET 1 : 40

0' 40' 80'

Pole location(s) ⌖ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY	
Name:	**Football**
Size:	360' x 160'
Spacing:	30.0' x 30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY	
MAINTAINED HORIZONTAL FOOTCANDLES	
	Entire Grid
Guaranteed Average:	**50**
Scan Average:	52.8
Maximum:	63
Minimum:	42
Avg / Min:	1.27
Guaranteed Max / Min:	**2**
Max / Min:	1.51
UG (adjacent pts):	1.29
CU:	0.66
No. of Points:	72
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	**42**
Total Load:	45.57 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

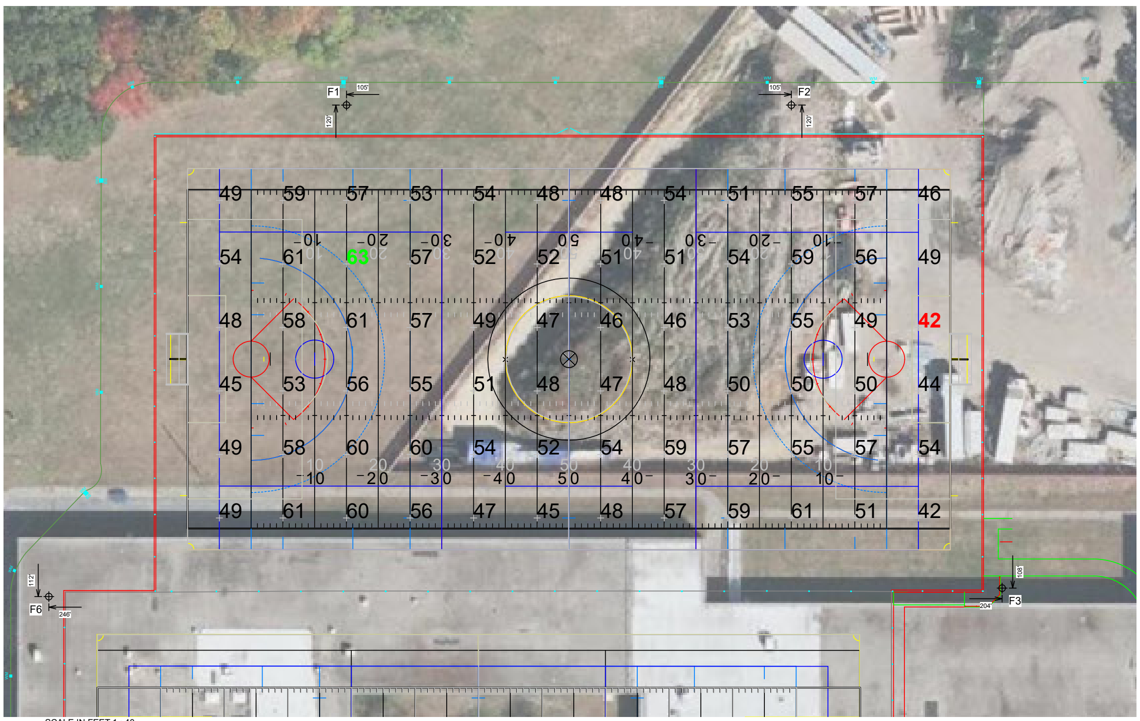
Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

We Make It Happen.

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
2	F1-F2	70'	0'	15.52'	TLC-BT-575	2	2	0
				70'	TLC-LED-1200	9	9	0
2	F3, F6	100'	0'	15.52'	TLC-BT-575	2	1	1
				100'	TLC-LED-1200	19	9	10
4	TOTALS					64	42	22



SCALE IN FEET 1 : 40

0' 40' 80'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY

Name:	**Soccer**
Size:	360' x 180'
Spacing:	30.0' x 30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED HORIZONTAL FOOTCANDLES	
	Entire Grid
Guaranteed Average:	**50**
Scan Average:	52.8
Maximum:	63
Minimum:	42
Avg / Min:	1.27
Guaranteed Max / Min:	**2**
Max / Min:	1.51
UG (adjacent pts):	1.29
CU:	0.66
No. of Points:	72
LUMINAIRE INFORMATION	
Applied Circuits:	A
No. of Luminaires:	**42**
Total Load:	45.57 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

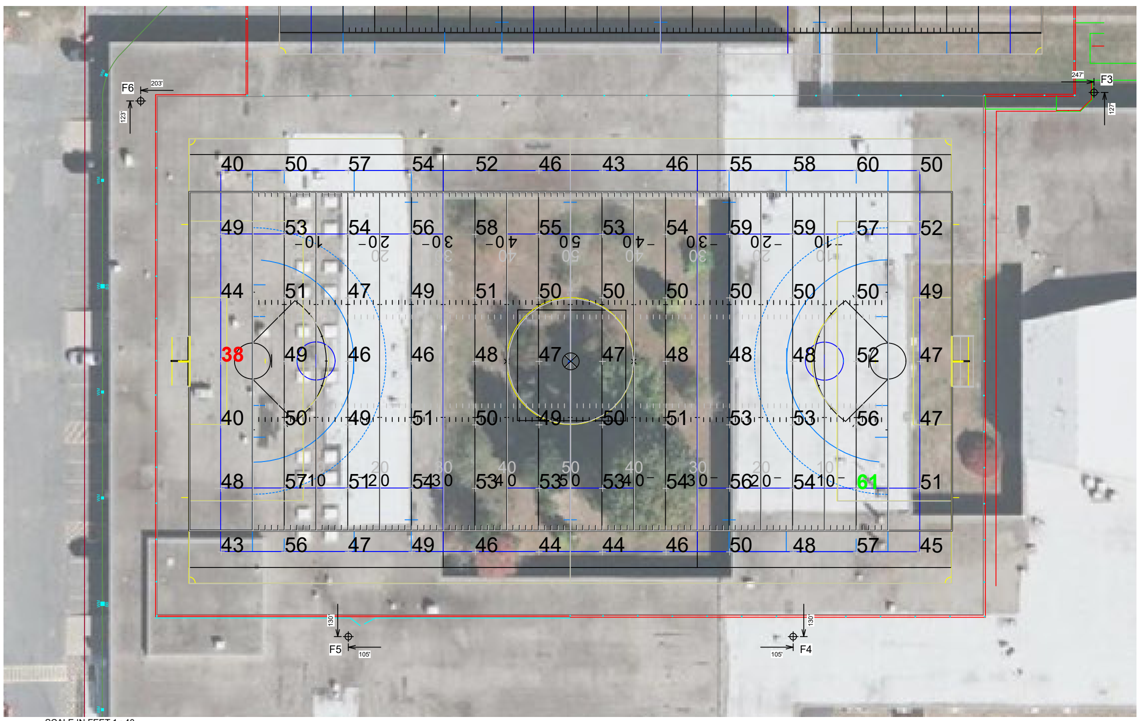
Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

We Make It Happen

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
2	F3, F6	100'	0'	15.52' 100'	TLC-BT-575 TLC-LED-1200	2 19	1 10	1 9
2	F4-F5	70'	0'	15.52' 70'	TLC-BT-575 TLC-LED-1200	2 9	2 9	0 0
4	TOTALS					64	44	20



SCALE IN FEET 1 : 40

0' 40' 80'

Pole location(s) ⌖ dimensions are relative to 0,0 reference point(s) ⊗

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY

Name:	**Soccer 2**
Size:	360' x 210'
Spacing:	30.0' x 30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED HORIZONTAL FOOTCANDLES	
	Entire Grid
Guaranteed Average:	**50**
Scan Average:	50.6
Maximum:	61
Minimum:	38
Avg / Min:	1.32
Guaranteed Max / Min:	**2**
Max / Min:	1.58
UG (adjacent pts):	1.29
CU:	0.71
No. of Points:	84
LUMINAIRE INFORMATION	
Applied Circuits:	B
No. of Luminaires:	**44**
Total Load:	47.91 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

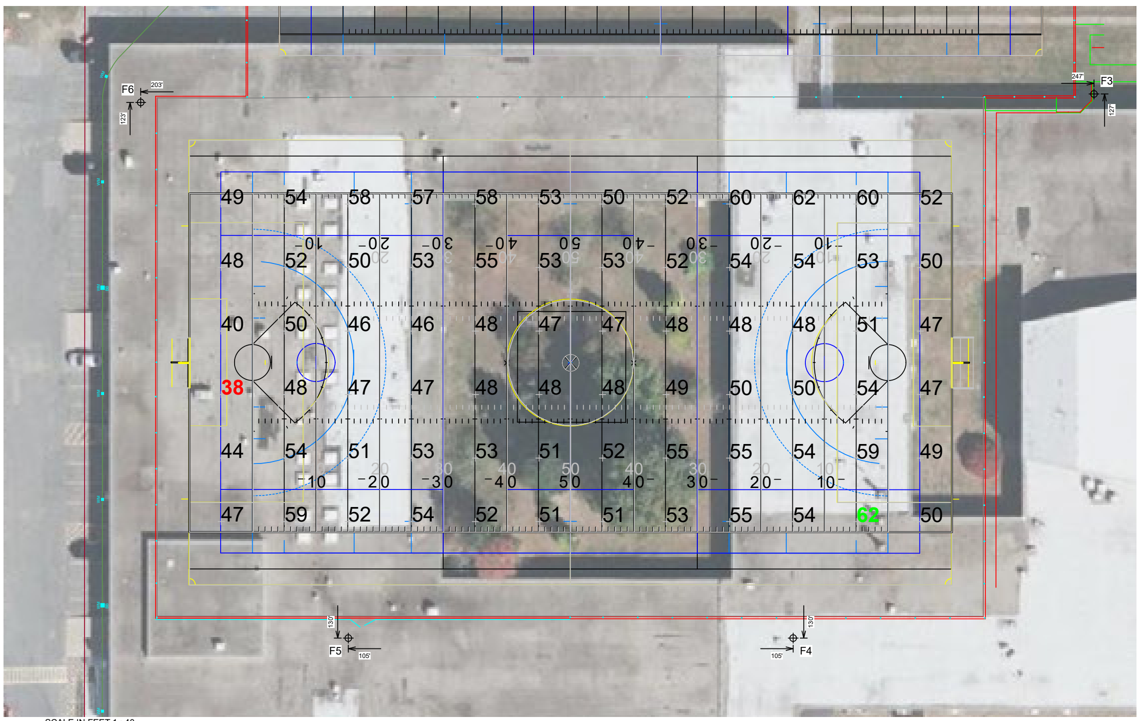
Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

We Make It Happen.

EQUIPMENT LIST FOR AREAS SHOWN								
Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
2	F3, F6	100'	-	15.5' 100'	TLC-BT-575 TLC-LED-1200	2 19	1 10	1 9
2	F4-F5	70'	-	15.5' 70'	TLC-BT-575 TLC-LED-1200	2 9	2 9	0 0
4	TOTALS					64	44	20



SCALE IN FEET 1 : 40

0' 40' 80'

Pole location(s) ⌖ dimensions are relative to 0,0 reference point(s) ⊗

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY	
Name:	**Football 2**
Size:	360' x 160'
Spacing:	30.0' x 30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY	
MAINTAINED HORIZONTAL FOOTCANDLES	
	Entire Grid
Guaranteed Average:	**50**
Scan Average:	51.4
Maximum:	62
Minimum:	38
Avg / Min:	1.36
Guaranteed Max / Min:	**2**
Max / Min:	1.63
UG (adjacent pts):	1.27
CU:	0.61
No. of Points:	72
LUMINAIRE INFORMATION	
Applied Circuits:	B
No. of Luminaires:	**44**
Total Load:	47.91 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

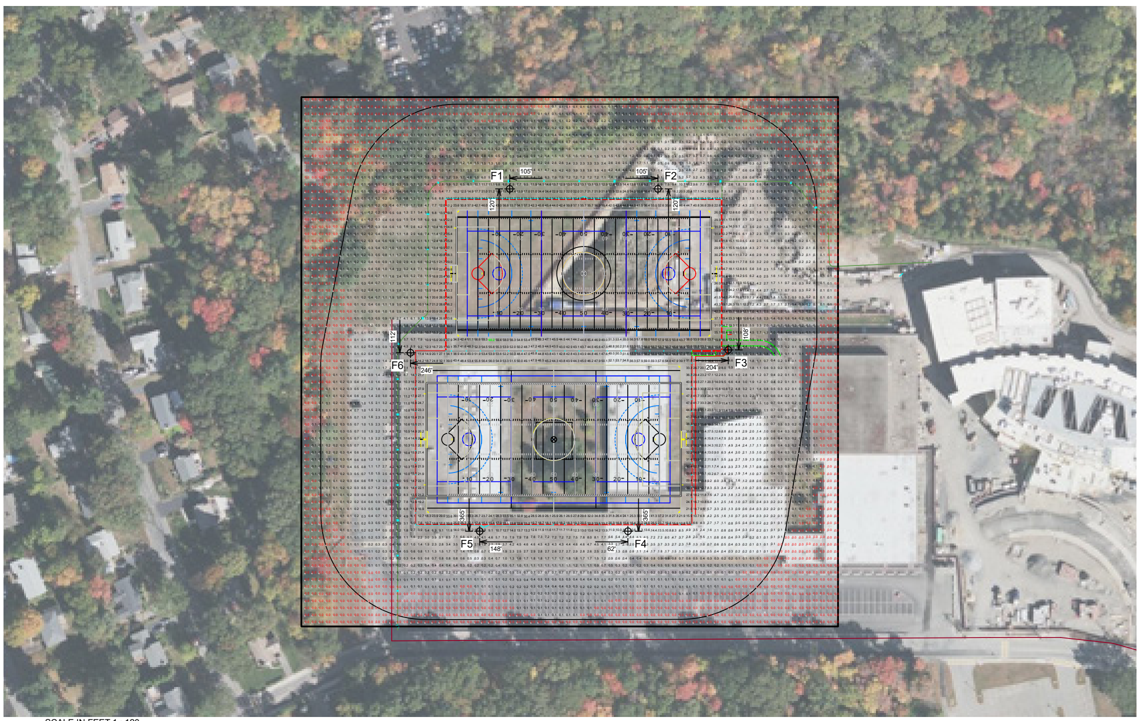
Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

We Make It Happen

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	F1-F2	70'	-	70'	TLC-LED-1200	9	9	0
	F4-F5			15.5'	TLC-BT-575	2	2	0
2	F3, F6	100'	-	15.5'	TLC-BT-575	2	2	0
				100'	TLC-LED-1200	19	19	0
6	TOTALS					86	86	0



SCALE IN FEET 1 : 120

0' 120' 240'

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY

Name:	**Zero Grid**
Size:	760' x 750'
Spacing:	10.0' x 10.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAINTAINED HORIZONTAL FOOTCANDLES	
	Entire Grid
Scan Average:	**5.4**
Maximum:	60
Minimum:	0
Avg / Min:	-
Max / Min:	**-**
UG (adjacent pts):	3.43
CU:	0.93
No. of Points:	4257
LUMINAIRE INFORMATION	
Applied Circuits:	A, B
No. of Luminaires:	**86**
Total Load:	93.48 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document and includes a 0.95 dirt depreciation factor.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

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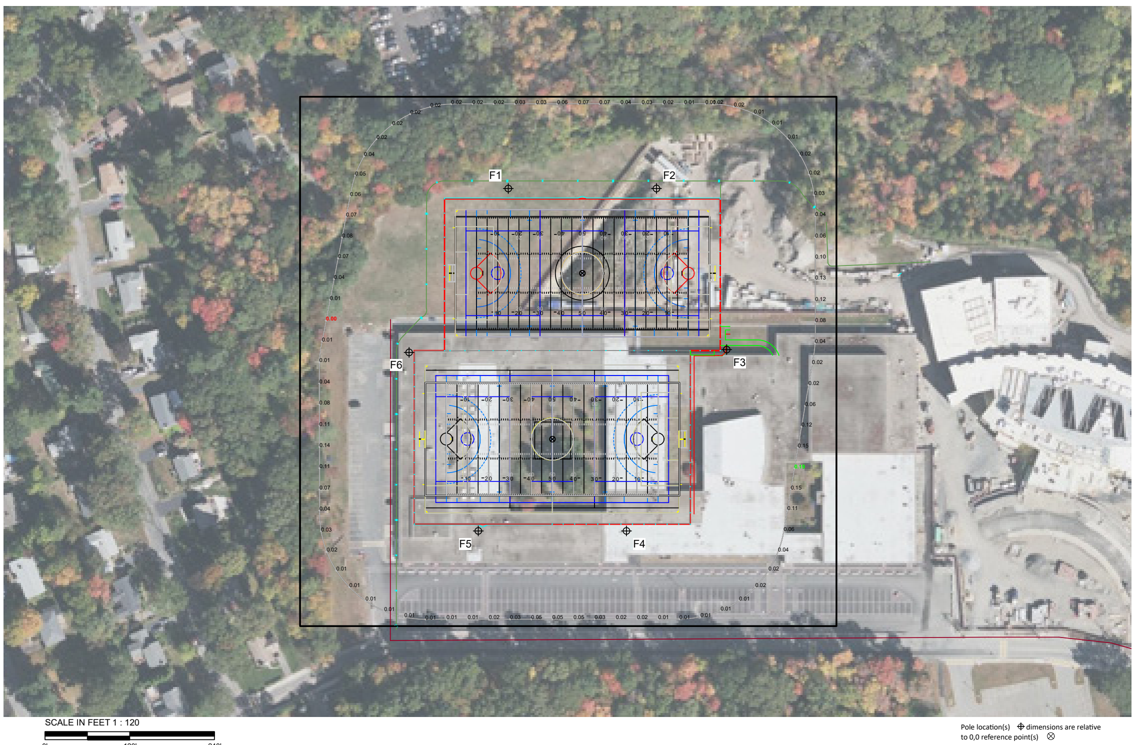
EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	F1-F2	70'	-	70'	TLC-LED-1200	9	9	0
	F4-F5			15.5'	TLC-BT-575	2	2	0
2	F3, F6	100'	-	15.5'	TLC-BT-575	2	2	0
				100'	TLC-LED-1200	19	19	0
6	TOTALS					86	86	0



Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY	
Name:	**150' Spill Line**
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY	
HORIZONTAL FOOTCANDLES	
	Entire Grid
Scan Average:	0.043
Maximum:	0.19
Minimum:	0.00
No. of Points:	85
LUMINAIRE INFORMATION	
Applied Circuits:	A, B
No. of Luminaires:	**86**
Total Load:	93.48 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

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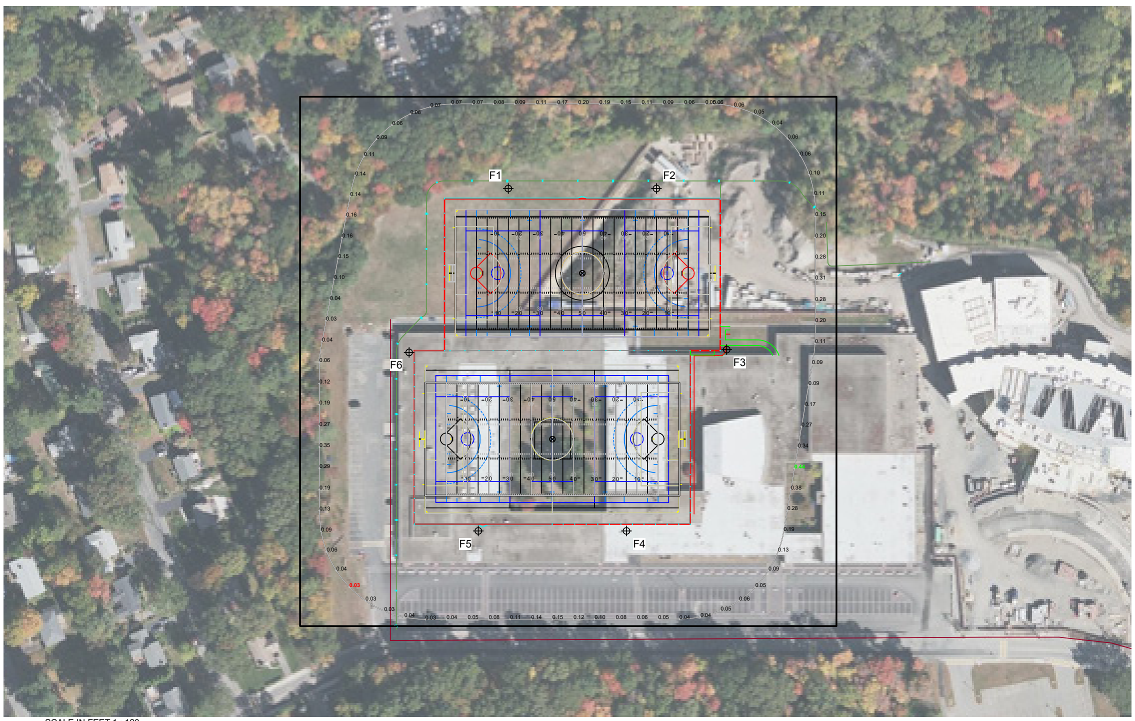
ILLUMINATION SUMMARY

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	F1-F2	70'	-	70'	TLC-LED-1200	9	9	0
	F4-F5			15.5'	TLC-BT-575	2	2	0
2	F3, F6	100'	-	15.5'	TLC-BT-575	2	2	0
				100'	TLC-LED-1200	19	19	0
6	TOTALS					86	86	0



SCALE IN FEET 1 : 120

0' 120' 240'

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY

Name:	**150' Spill Line**
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

MAX VERTICAL FOOTCANDLES	
	Entire Grid
Scan Average:	0.124
Maximum:	0.44
Minimum:	0.03
No. of Points:	85
LUMINAIRE INFORMATION	
Applied Circuits:	A, B
No. of Luminaires:	**86**
Total Load:	93.48 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

Pole location(s) ⌖ dimensions are relative to 0,0 reference point(s) ⊗

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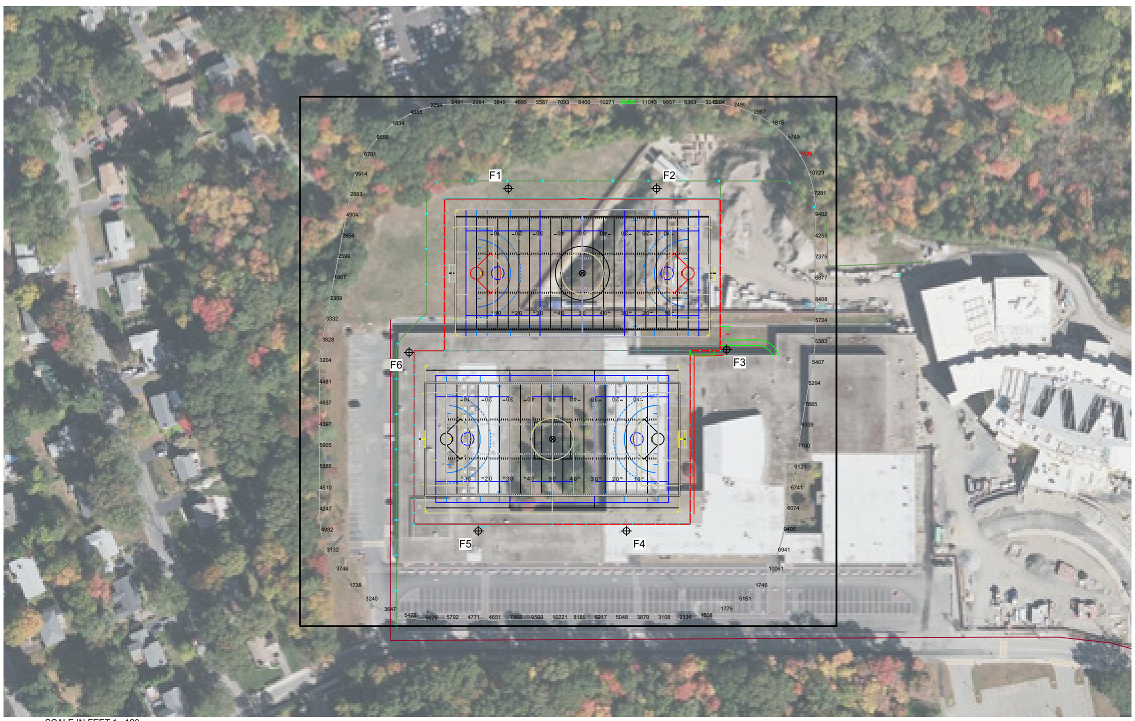
EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires				
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE	THIS GRID	OTHER GRIDS
4	F1-F2	70'	-	70'	TLC-LED-1200	9	9	0
	F4-F5			15.5'	TLC-BT-575	2	2	0
2	F3, F6	100'	-	15.5'	TLC-BT-575	2	2	0
				100'	TLC-LED-1200	19	19	0
6	TOTALS					86	86	0



SCALE IN FEET 1 : 120

0' 120' 240'

Fuller Middle School Fields

Framingham, MA

GRID SUMMARY

Name:	**150' Spill Line**
Spacing:	30.0'
Height:	3.0' above grade

ILLUMINATION SUMMARY

CANDELA (PER FIXTURE)	
	Entire Grid
Scan Average:	5462.057
Maximum:	12306.90
Minimum:	1425.64
No. of Points:	85
LUMINAIRE INFORMATION	
Applied Circuits:	A, B
No. of Luminaires:	**86**
Total Load:	93.48 kW

Guaranteed Performance: The ILLUMINATION described above is guaranteed per your Musco Warranty document.

Field Measurements: Individual field measurements may vary from computer-calculated predictions and should be taken in accordance with IESNA RP-6-15.

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

Pole location(s) ⊕ dimensions are relative to 0,0 reference point(s) ⊗

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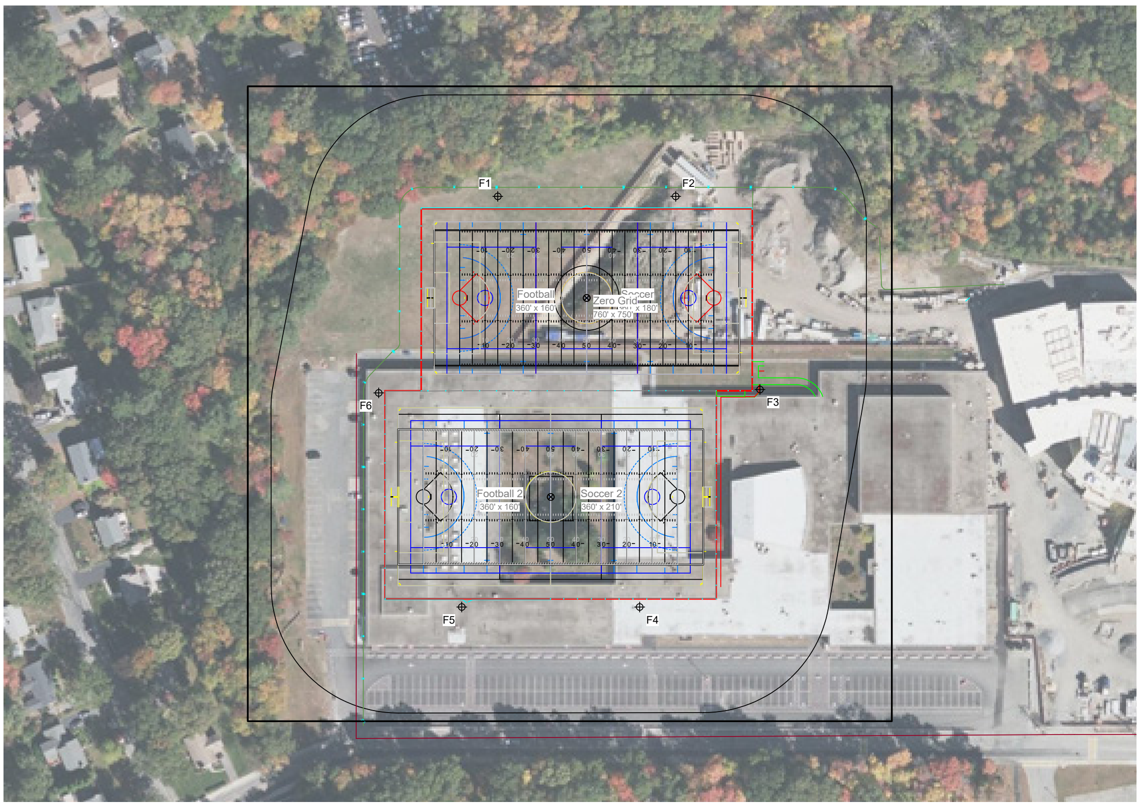

SCALE IN FEET 1 : 100

0' 100' 200'

Pole location(s) ⌖ dimensions are relative to 0,0 reference point(s) ⊗

ENGINEERED DESIGN By: · File #212641B · 15-Aug-22

Fuller Middle School Fields

Framingham, MA

EQUIPMENT LAYOUT

INCLUDES:
· Football
· Football 2
· Soccer
· Soccer 2
· Zero Grid

Electrical System Requirements: Refer to Amperage Draw Chart and/or the **"Musco Control System Summary"** for electrical sizing.

Installation Requirements: Results assume ± 3% nominal voltage at line side of the driver and structures located within 3 feet (1m) of design locations.

EQUIPMENT LIST FOR AREAS SHOWN

Pole				Luminaires		
QTY	LOCATION	SIZE	GRADE ELEVATION	MOUNTING HEIGHT	LUMINAIRE TYPE	QTY / POLE
4	F1-F2 F4-F5	70'	-	70' 15.5'	TLC-LED-1200 TLC-BT-575	9 2
2	F3, F6	100'	-	15.5' 100'	TLC-BT-575 TLC-LED-1200	2 19
6	TOTALS					86

SINGLE LUMINAIRE AMPERAGE DRAW CHART

Ballast Specifications (.90 min power factor)	Line Amperage Per Luminaire (max draw)						
Single Phase Voltage	208 (60)	220 (60)	240 (60)	277 (60)	347 (60)	380 (60)	480 (60)
TLC-LED-1200	7.0	6.6	6.1	5.2	4.2	4.0	3.0
TLC-BT-575	3.4	3.2	2.9	2.5	2.0	1.8	1.5

We Make It Happen.

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools **DEPARTMENT PRIORITY:** 6

(1) PROJECT NAME: Fire Alarm Systems Upgrades
PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital funding is for the design and installation of a new fire alarm (FA) system at Harmony Grove.

This system was installed in 1999 and is original to the building. The fire panel periodically reports fault and trouble codes at the main panel. Most FA systems have a useful life of 20-25 years. This system is nearing the end of useful life; parts for panels, devices, and controls throughout the building are becoming harder to source. Due to the aging condition with this system, the District has needed to undertake repairs. This project will include complete replacement of the entire system, including the main panel. Low voltage communication lines for all devices throughout the building will most likely require replacement, as NFPA now requires an addressable system by code. The work identified will ensure continued fire alarm monitoring and reporting throughout the building which will continue to provide a safe and secure environment for hundreds of students, parents, and staff daily. The existing system is currently adequate for intended use but no longer meets today's code(s).

This funding request of $300,000 would allow the Department to work with on-call engineering firms to engage in the design development of a new FA system as well as the funds for implementation.

This project will reduce safety issues, enhance emergency address capability, and improve system coverage throughout the entire building.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction						
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other	300,000	300,000	300,000	300,000	300,000	1,500,000
	TOTAL	300,000	300,000	300,000	300,000	300,000	1,500,000

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) **EFFECTS ON ANNUAL OPERATING BUDGET:**

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) **PROPOSED FUNDING SOURCE(S):**

1) **Bond**
2)
3)

(10) **PROJECT OR EQUIPMENT LOCATION:**

District wide

(11) **ASSET TYPE:**

Building Infrastructure

(7a) **POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)**

(8) **PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)**

TBD

(9) **FINANCE DEPARTMENT NOTES:**

6. FA System at Harmony Grove

This request for capital funding is for the design and installation of a new fire alarm (FA) system at Harmony Grove.

This system was installed in 1999 and is original to the building. The fire panel periodically reports fault and trouble codes at the main panel. Most FA systems have a useful life of 20-25 years. This system is nearing the end of useful life; parts for panels, devices, and controls throughout the building are becoming harder to source. Due to the aging condition with this system, the District has needed to undertake repairs. This project will include complete replacement of the entire system, including the main panel. Low voltage communication lines for all devices throughout the building will most likely require replacement, as NFPA now requires an addressable system by code. The work identified will ensure continued fire alarm monitoring and reporting throughout the building which will continue to provide a safe and secure environment for hundreds of students, parents, and staff daily. The existing system is currently adequate for intended use but no longer meets today's code(s).

This funding request of $300,000 would allow the Department to work with on-call engineering firms to engage in the design development of a new FA system as well as the funds for implementation.

This project will reduce safety issues, enhance emergency address capability, and improve system coverage throughout the entire building.

- **Replacement/Upgrades - $300,000**

Framingham
PUBLIC SCHOOLS
Embracing differences. Inspiring futures.

FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Fire Alarm System Replacements/Upgrades - $300,000

Harmony Grove Elementary School, Districtwide Improvements

- Current Fire Alarm Controls and Devices are Simplex;
- System is 25 Years Old and Original To The Renovated Building;
- System Continuously Reports Faults and Troubles Due to Failing Devices and Aging Controls;
- This Project Will Include Replacement of Controls and Select Failing Devices Throughout the Building;

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: City/Schools

DEPARTMENT PRIORITY: 5

(1) PROJECT NAME: PA System Upgrades and Replacements Design - Framingham High School FY25

PROJECT STATUS: NEW Project This Year

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital funding is for the design of a new public address (PA) system at Framingham High School

On June 19th, 2023, Pro AV conducted a functionality audit of the existing paging system currently installed in Framingham High School. The goals of this audit were to determine the following:

1. Are the current paging loudspeakers producing audio?
2. Are the loudspeakers producing audio with adequate volume levels?
3. Is the paging audio clearly intelligible?

In order to test these parameters, spoken-word audio was played over the paging system by using a handset in the main office. Audio was played over the paging system as an "all call" at a consistent input volume for the duration of the test, which lasted approximately 5 hours. Based on the results of the testing, Pro AV would describe the status of the current system as adequate for everyday use, but unfit for emergency situations. Major issues included insufficient output volume, poor intelligibility, and insufficient coverage in various areas.

This funding request of $250,000 would allow the Department to work with on-call engineering firms to engage in the design development of a new PA system as well as the funds for implementation.

This project will reduce safety issues, enhance public address capability, and improve system coverage throughout the entire FHS campus.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design	250,000					
d.	Construction						
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	250,000	-	-	-	-	-

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.	X	**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) **PROPOSED FUNDING SOURCE(S):**

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION:

Framingham High School

(11) ASSET TYPE:

School Building

(7a) **POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)**

(8) **PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)**

TBD

(9) **FINANCE DEPARTMENT NOTES:**

5. PA System Upgrades at FHS

This request for capital funding is for the design of a new public address (PA) system at Framingham High School

On June 19th, 2023, Pro AV conducted a functionality audit of the existing paging system currently installed in Framingham High School. The goals of this audit were to determine the following:

1. Are the current paging loudspeakers producing audio?
2. Are the loudspeakers producing audio with adequate volume levels?
3. Is the paging audio clearly intelligible?

In order to test these parameters, spoken-word audio was played over the paging system by using a handset in the main office. Audio was played over the paging system as an “all call” at a consistent input volume for the duration of the test, which lasted approximately 5 hours. Based on the results of the testing, Pro AV would describe the status of the current system as adequate for everyday use, but unfit for emergency situations. Major issues included insufficient output volume, poor intelligibility, and insufficient coverage in various areas.

This funding request of $250,000 would allow the Department to work with on-call engineering firms to engage in the design development of a new PA system
This project will reduce safety issues, enhance public address capability, and improve system coverage throughout the entire FHS campus.

- **Design - $200,000**

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QUOTE: ***07062023-TC***
Prepared by:Taylor Crane

Modified: 7/6/2023
Revision: 1
Contract: OFF50

Framingham Public Schools

Attention:
Matthew Torti
mtorti@framingham.k12.ma.us

Site:
Winch Park 115 A St
Framingham
MA
01701

High School Paging Audit - Analysis & Results

Framingham
PUBLIC SCHOOLS

Executive Summary

On June 19th, 2023, Pro AV conducted a functionality audit of the existing paging system currently installed in Framingham High School. The goals of this audit were to determine the following:

1. Are the current paging loudspeakers producing audio?
2. Are the loudspeakers producing audio with adequate volume levels?
3. Is the paging audio clearly intelligible?

In order to test these parameters, spoken-word audio was played over the paging system by using a handset in the main office. Audio was played over the paging system as an "all call" at a consistent input volume for the duration of the test, which lasted approximately 5 hours.

Based on the results of the testing, Pro AV would describe the status of the current system as adequate for everyday use, but unfit for emergency situations.

Major issues included insufficient output volume, poor intelligibility, and insufficient coverage in various areas *(See FINDINGS section for more details)*.

Introduction

In February of 2023, Framingham High School experienced an emergency security event. In the wake of this event, it was deemed that the mass communication systems of the school (which included the paging/public address system) were not sufficient for supporting the school's emergency response plan.

Framingham Public Schools then reached out to Pro AV for a consultation specifically regarding functionality of the paging/PA system. Upon initial review of the existing system, Pro AV facilitated a conversation between Framingham PS and Atlas/IED-Singlewire, a specialty mass-communication hardware & service provider. The outcome of that conversation outlined the need for a comprehensive understanding of the current systems abilities/limitations. Pro AV then supplied Framingham PS with a quote to provide a functionality audit of the school's paging system. FPS accepted and the audit was performed on June 19th, 2023.

Audit Methodology

Using a Gold-Line STICI Talkbox, spoken-word audio was played into the paging system via the primary handset located in the main office. An "all page" was used to ensure that consistent audio was being broadcast to each paging endpoint.

Pro AV then visited each room in the school building and used a handheld Db meter to record the average volume (Db-A) of each room/corridor and made a general note of clarity and intelligibility of the audio. Other notes included visual inspection for damage and confirmation that speakers were producing baseline audio.

In total, 320 locations were tested with a total of 473 individual speakers.

Definition of Terms for Audio Clarity

Good: Speech was clearly intelligible with no distortion.

Poor: Speech was intelligible but had noticeable humming and/or distortion.

Very Poor: Speech was somewhat intelligible but had significant humming and/or distortion.

Fail: Speech was not intelligible, but speaker was producing audio.

None: The room had no paging speakers.

Findings – 1/3

Clarity:
As shown in *Figure 1*, 195 rooms received a Poor rating for audio clarity. It was generally noted throughout the school that a loud, consistent 60-cycle hum was present at all times during the testing. This loud humming is a product of older analog wiring and noticeably reduces the intelligibility in all areas. In these rooms, speech was intelligible but not ideal.

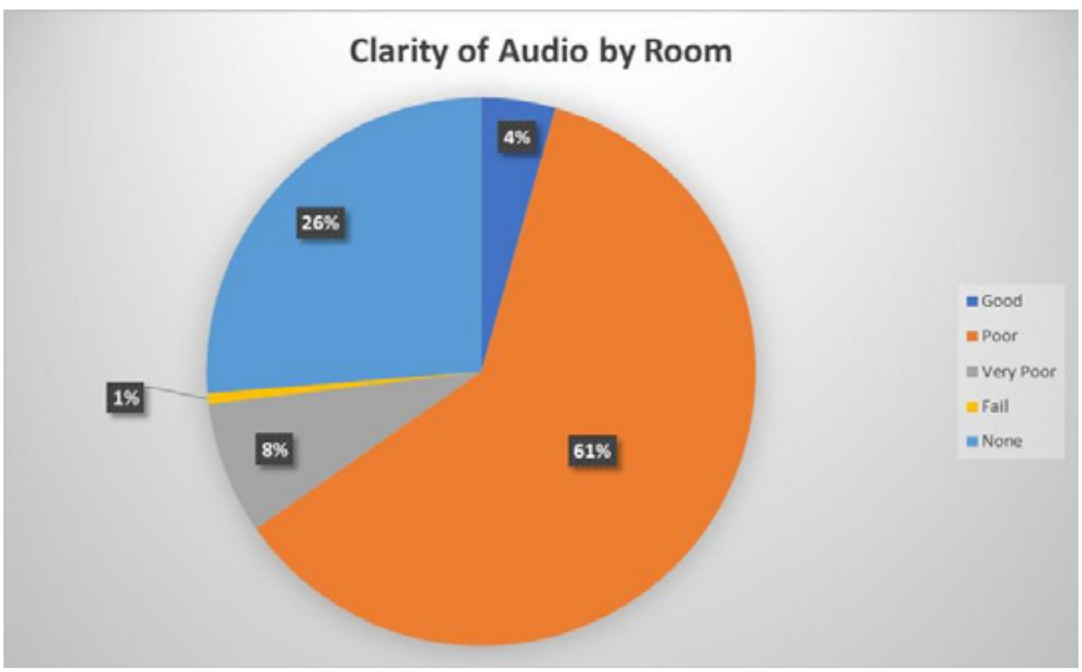
Figure 1

Clarity	# of Rooms	%
Good	14	4%
Poor	195	61%
Very Poor	25	8%
Fail	2	1%
None	84	26%
Total:	**320**	

25 rooms received a Very Poor rating, which typically indicates internal damage of the speaker cone or wiring. These issues were not externally visible during the testing but were clearly audible as either intense humming or active distortion of the audio. In these rooms, speech was somewhat intelligible, but was often unclear.

In 2 rooms, the speakers were given a Fail rating due to intense distortion of the audio which rendered the speech unintelligible.

84 rooms received a None rating due to the absence of paging speakers. These rooms were primarily office spaces, conference rooms, workrooms, and auxiliary spaces (backstage of the auditorium, stairwells, breakrooms, etc.).



Findings – 2/3

Volume:
As seen in Figure 2, 36 spaces were measured as Very Quiet. Since these readings were taken during a period when there were no students or teachers in the building, these rooms can be safely assumed to have inadequate volume for even general-purpose paging.

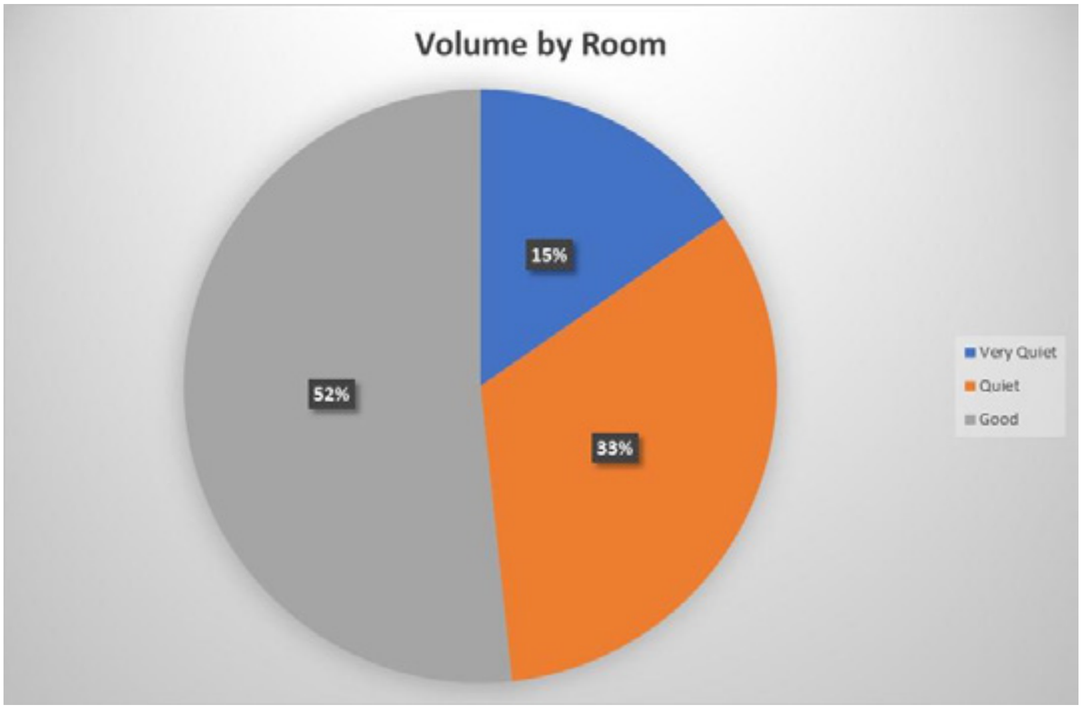
Figure 2

Rating	Db-A Range	# of Rooms
Very Quiet	50-59	36
Quiet	60-69	77
Good	70-79	121
	Total:	234

*Rooms with no speakers not included

77 spaces were measured as Quiet. These rooms would have an acceptable volume for general everyday use but may lack sufficient volume in high-noise situations.

121 rooms were measured as Good. These spaces had an appropriate volume for all situations.



Findings 3/3

Insufficient Coverage:
84 rooms were noted as having no paging endpoints. These rooms included offices, corridors, workspaces, and other miscellaneous areas. While many of these rooms had VoIP phones, they did not appear to be currently integrated into the analog paging system. Restrooms were also noted to have no active paging but were not included in the total tally.

There were four notable spaces which included paging endpoints, but not in sufficient quantities to be effective. These areas included the following:

- Library
- Main Entrance
- Cafeteria
- Room D102

Additionally, on the exterior of the building, only 6 of the 29 exit doors were covered with a paging endpoint.

Recommendations

As noted, the assessment revealed significant issues with audio quality and insufficient coverage, which could impact effective communication during emergencies and compromise the safety of students, staff, and visitors.

To rectify the existing issues and enhance the functionality of the public address system, we propose the following four steps:

System Upgrade: We recommend a complete system upgrade to ensure state-of-the-art audio quality and improved performance. This includes replacing outdated components with modern, high-quality equipment, such as amplifiers, speakers, and audio processors. The additional inclusion of visual elements such as flashers and text displays will ensure that students and staff of all abilities are properly informed at all times. Upgrading to advanced audio-visual technology will significantly enhance sound reproduction, resulting in clear and intelligible announcements throughout the entire school campus.

Upgrades may be performed in multiple phases based on timeframe and resource allocation.

Zoning and Control: We propose implementing a zoning system to divide the campus into distinct audio zones. This will enable targeted announcements specific to certain areas, such as classrooms, administrative offices, or outdoor spaces. Additionally, we would recommend a centralized control interface, allowing authorized personnel to easily manage audio sources, adjust volume levels, and initiate emergency broadcasts from a central location or through a user-friendly mobile application.

Network Integration: To leverage the benefits of modern AV technology, we recommend integrating the public address system with the school's existing network/VoIP infrastructure. This integration will enable centralized control, monitoring, and maintenance of the system, eliminating the need for separate control panels and simplifying system management. It will also facilitate integration with other safety systems, such as fire alarms, gunshot detection systems and security cameras, allowing for synchronized alerts and streamlined emergency response protocols.

Ongoing Support and Maintenance: Upon completion of the system upgrade, our team will provide training to designated school staff, ensuring they are proficient in operating the new system effectively. We will also offer ongoing support and maintenance services to ensure the system remains in optimal condition.

We believe that implementing these steps will address the audio quality and coverage issues in the current public address system at Framingham High School. Our expertise in AV integration, coupled with industry-leading products and technologies, will ensure a seamless and efficient solution that aligns with the school districts' safety objectives.

Pro AV Systems

Data

I/E	Room #	Volume	Clarity	Working	Total	Notes
Internal	A102B			0	0	
Internal	A102D					No Access
Internal	A102E	59	Poor	1	1	
Internal	A102F					No Access
Internal	A106	55	Good	1	1	
Internal	A107B	55	Poor	1	1	
Internal	A107B	60	Poor	1	1	
Internal	A107C			0	0	
Internal	A108	55	Good	1	1	
Internal	A110	54	Good	1	1	
Internal	A112 Corridor	68	Poor	4	4	
Internal	A114	69	Poor	1	1	
Internal	A116			0	0	
Internal	A117	60	Poor	1	1	
Internal	A118	59	Poor	1	1	
Internal	A119	64	Poor	1	1	
Internal	A121 Corridor	65	Poor	4	4	
Internal	A200	71	Poor	1	1	
Internal	A200A	69	Poor	1	1	
Internal	A201	70	Poor	1	1	
Internal	A202	72	Poor	1	1	
Internal	A202A			0	0	
Internal	A203	71	Poor	1	1	
Internal	A204	70	Poor	1	1	
Internal	A205	71	Poor	1	1	
Internal	A206	71	Poor	1	1	
Internal	A207	71	Poor	1	1	
Internal	A208	70	Poor	1	1	
Internal	A209	70	Poor	1	1	
Internal	A210	72	Poor	1	1	
Internal	A212	71	Poor	1	1	
Internal	A213	69	Poor	1	1	
Internal	A214			0	0	
Internal	A215	70	Poor	1	1	
Internal	A216	71	Poor	1	1	
Internal	A217	70	Poor	3	3	
Internal	A217 Corridor	70	Poor	3	3	
Internal	A219 Corridor	71	Poor	4	4	

Internal	Auditorium	58	Very Poor	4	4	
Internal	Auditorium Lobby	59	Poor	4	4	
Internal	B101	59	Poor	1	1	
Internal	B102	63	Poor	1	1	
Internal	B104			0	0	
Internal	B105	57	Poor	1	1	
Internal	B106	62	Poor	1	1	
Internal	B107	61	Poor	1	1	
Internal	B108	57	Poor	1	1	
Internal	B109	55	Poor	1	1	
Internal	B112 Corridor	66	Poor	4	5	
Internal	B115 Corridor	65	Poor	6	6	
Internal	B201			0	0	
Internal	B201B			0	0	
Internal	B202	70	Poor	1	1	
Internal	B203	71	Poor	1	1	
Internal	B204	71	Poor	1	1	
Internal	B205	70	Poor	1	1	
Internal	B206			0	0	
Internal	B207	70	Poor	1	1	
Internal	B208	71	Poor	1	1	
Internal	B209	71	Poor	1	1	
Internal	B210	69	Poor	1	1	
Internal	B211	70	Poor	1	1	
Internal	B212			0	0	
Internal	B213			0	0	
Internal	B214			0	0	
Internal	B215 Corridor	70	Poor	6	6	
Internal	C Corridor	72	Poor	7	7	
Internal	C103	64	Poor	1	1	
Internal	C104					No Access
Internal	C105	64	Poor	1	1	
Internal	C106	65	Poor	1	1	
Internal	C107	63	Poor	1	1	
Internal	C108	62	Poor	1	1	
Internal	C109	68	Poor	1	1	
Internal	C110	61	Poor	1	1	
Internal	C114			0	0	
Internal	C115	56	Good	1	1	
Internal	C116	61	Poor	1	1	
Internal	C117			0	0	
Internal	C118	57	Good	1	1	
Internal	C119	61	Good	1	1	

Internal	C121 Corridor	71	Poor	4	4	
Internal	C200			0	0	
Internal	C201	71	Poor	1	1	
Internal	C202			0	0	
Internal	C203	71	Poor	1	1	
Internal	C204	70	Poor	1	1	
Internal	C205	69	Poor	1	1	
Internal	C206			0	0	
Internal	C207	71	Poor	1	1	
Internal	C208	70	Poor	1	1	
Internal	C209	69	Poor	1	1	
Internal	C212			0	0	
Internal	C212A			0	0	
Internal	C213			0	0	
Internal	C214			0	0	
Internal	C215	71	Poor	1	1	
Internal	C216	70	Poor	1	1	
Internal	C217			0	0	
Internal	C218	71	Poor	1	1	
Internal	C219	70	Poor	1	1	
Internal	C220 Corridor	70	Poor	11	11	
Internal	C221 Corridor	70	Poor	1	1	
Internal	C222B Corridor	70	Poor	9	9	
Internal	Cafeteria	66	Poor	12	12	Insufficient coverage
Internal	Cafeteria Passage #3	62	Poor	4	4	
Internal	Cafeteria Passage #4	65	Poor	6	6	
External	Courtyard 1	66	Very Poor	2	2	
External	Courtyard 2	64	Poor	1	1	
External	Courtyard 3	68	Poor	1	1	
External	Courtyard 4	70	Poor	2	2	
Internal	D102	68	Poor	2	2	Insufficient coverage
Internal	D102A			0	0	
Internal	D102B			0	0	
Internal	D102C			0	0	
Internal	D102D			0	0	
Internal	D102E			0	0	
Internal	D102F			0	0	
Internal	D102H			0	0	
Internal	D102J			0	0	
Internal	D102K			0	0	
Internal	D102L			0	0	
Internal	D105A			0	0	
Internal	D107	52	Good	2	2	

Internal	D108			0	0
Internal	D109	66	Poor	2	2
Internal	D109D			0	0
Internal	D109E			0	0
Internal	D109G			0	0
Internal	D109H			0	0
Internal	D109I			0	0
Internal	D109K			0	0
Internal	D110	61	Poor	1	1
Internal	D110 Office	62	Poor	1	1
Internal	D112	62	Poor	1	1
Internal	D115A Corridor	70	Very Poor	5	5
Internal	D133			0	0
Internal	D145			0	0
Internal	D153			0	0
Internal	D154			0	0
Internal	D156			0	0
Internal	D157			0	0
Internal	D202			0	0
Internal	D204	71	Poor	1	1
Internal	D206	69	Poor	1	1
Internal	D207	70	Poor	1	1
Internal	D208	70	Poor	1	1
Internal	D209	68	Poor	1	1
Internal	D210	68	Poor	1	1
Internal	D211			0	0
Internal	D212	70	Poor	1	1
Internal	D213	69	Poor	1	1
Internal	D215	71	Poor	1	1
External	Door 01	64	Poor	1	1
External	Door 05	0	Fail	0	2
External	Door 11	74	Poor	1	1
External	Door 16	74	Poor	1	1
External	Door 24	65	Very Poor	2	2
External	Door 27	67	Poor	1	1
External	Door 28	60	Very Poor	1	1
Internal	E Corridor	65	Poor	8	8
Internal	E100	67	Very Poor	1	1
Internal	E101	61	Fail	0	1
Internal	E102	68	Very Poor	1	1
Internal	E103	61	Poor	1	1
Internal	E104	65	Very Poor	1	1
Internal	E105	66	Poor	1	1

Internal	E106	69	Very Poor	1	1	
Internal	E107	65	Very Poor	1	1	
Internal	E108	61	Poor	1	1	
Internal	E109	69	Very Poor	1	1	
Internal	E113			0	0	
Internal	E114	62	Poor	1	1	
Internal	E115	73	Poor	1	1	
Internal	E117	63	Poor	1	1	
Internal	E118	68	Poor	1	1	
Internal	E119	58	Poor	1	1	
Internal	E122 Corridor	72	Poor	8	8	
Internal	E200	71	Poor	1	1	
Internal	E200 Corridor	70	Poor	8	8	
Internal	E201	71	Poor	1	1	
Internal	E202	70	Poor	1	1	
Internal	E203	70	Poor	1	1	
Internal	E204	69	Poor	1	1	
Internal	E205	70	Poor	1	1	
Internal	E206	71	Poor	1	1	
Internal	E207	70	Poor	1	1	
Internal	E208	71	Poor	1	1	
Internal	E209	72	Poor	1	1	
Internal	E210	69	Poor	1	1	
Internal	E211	70	Poor	1	1	
Internal	E213	71	Poor	1	1	
Internal	E214	71	Poor	1	1	
Internal	E215	70	Poor	1	1	
Internal	Entrance/Lobby	62	Poor	1	1	Insufficient coverage
Internal	F101	60	Poor	1	1	
Internal	F102	55	Poor	1	1	
Internal	F103	55	Poor	1	1	
Internal	F103	59	Very Poor	1	1	
Internal	F104	53	Very Poor	1	1	
Internal	F107	58	Very Poor	1	1	
Internal	F111	58	Poor	1	1	
Internal	F112	56	Poor	1	1	
Internal	F113	58	Poor	1	1	
Internal	F115	57	Poor	1	1	
Internal	F116 Corridor			0	0	Insufficient coverage
Internal	F118	58	Poor	1	1	
Internal	F120	59	Poor	1	1	
Internal	F120A			0	0	
Internal	F120B			0	0	

Internal	F122	55	Poor	1	1	
Internal	F126B Corridor	66	Very Poor	9	9	
Internal	F201	70	Poor	1	1	
Internal	F202	70	Poor	1	1	
Internal	F203	70	Poor	1	1	
Internal	F204	70	Poor	1	1	
Internal	F205	70	Poor	1	1	
Internal	F206	70	Poor	1	1	
Internal	F207	71	Poor	1	1	
Internal	F208	70	Poor	1	1	
Internal	F209			0	0	
Internal	F210	71	Poor	1	1	
Internal	F211	69	Poor	1	1	
Internal	F212	71	Poor	1	1	
Internal	F213	70	Poor	1	1	
Internal	F214			0	0	
Internal	F215	70	Poor	1	1	
Internal	F216			0	0	
Internal	F217	69	Poor	1	1	
Internal	F218	70	Poor	1	1	
Internal	F219			0	0	
Internal	F220			0	0	
Internal	F221			0	0	
Internal	F222A Corridor	70	Poor	10	10	
Internal	Family Liaison Office	56	Good	1	1	
Internal	G100A Corridor			0	0	Insufficient coverage
Internal	G102	72	Very Poor	2	2	
Internal	G103	64	Good	1	1	
Internal	H100	53	Very Poor	4	4	
Internal	H102	61	Poor	3	9	
Internal	H104	57	Poor	2	6	
Internal	H108			0	0	
Internal	H110			0	0	
Internal	H111	55	Good	1	1	
Internal	H111A			0	0	
Internal	H112			0	0	
Internal	H114	59	Good	1	1	
Internal	H116	57	Poor	1	1	
Internal	H116A			0	0	
Internal	H118	61	Poor	1	1	
Internal	H120B Corridor	69	Very Poor	6	6	
Internal	H121B Corridor	63	Poor	7	7	
Internal	I119 Corridor			0	0	Insufficient coverage

Internal	J001			0	0
Internal	J003			0	0
Internal	J004	70	Poor	1	1
Internal	J006	70	Poor	2	3
Internal	J007	61	Poor	1	1
Internal	J008			0	0
Internal	J009	63	Very Poor	1	1
Internal	J010	71	Very Poor	1	1
Internal	J020	71	Poor	1	1
Internal	J020	71	Poor	1	1
Internal	J020A	70	Poor	0	0
Internal	J022	70	Poor	1	1
Internal	J024	63	Poor	1	1
Internal	J024	69	Poor	1	1
Internal	J026 Breakroom			0	0
Internal	J026 Workshop			0	0
Internal	J028	72	Very Poor	1	1
Internal	J030 Corridor	70	Very Poor	4	4
Internal	J101			0	0
Internal	J102	70	Poor	1	1
Internal	J103A	69	Very Poor	1	1
Internal	J105	70	Poor	1	1
Internal	J106	70	Poor	1	1
Internal	J107	71	Poor	1	1
Internal	J116A Corridor	70	Poor	6	6
Internal	J117 Corridor	70	Poor	5	5
Internal	J118 Corridor	70	Poor	2	2
Internal	J119 Corridor	71	Poor	2	2
Internal	J120	73	Good	2	2
Internal	J121	74	Good	1	2
Internal	K002	70	Poor	1	1
Internal	K005	71	Poor	1	1
Internal	K006	70	Poor	1	1
Internal	K008	71	Poor	1	1
Internal	K009	71	Poor	1	1
Internal	K011	69	Poor	1	1
Internal	K013	70	Poor	1	2
Internal	K015	70	Poor	1	1
Internal	K018			0	0
Internal	K018A	70	Poor	1	1
Internal	K019	70	Poor	2	2
Internal	K024 Corridor	70	Poor	6	6
Internal	K026 Corridor	71	Poor	3	3

Internal	K027 Corridor	71	Poor	5	5	
Internal	K029 Corridor	70	Poor	5	5	
Internal	K101 Lobby	71	Poor	5	5	
Internal	K102			0	0	
Internal	K103			0	0	
Internal	K107			0	0	
Internal	K113	70	Poor	22	22	
Internal	K114			0	0	
Internal	K117			0	0	
Internal	K118	70	Very Poor	1	1	
Internal	K119			0	0	
Internal	K120 Corridor	70	Poor	2	2	
Internal	K121			0	0	
Internal	K124 Corridor	71	Poor	6	6	
Internal	K125 Corridor	70	Poor	1	1	
Internal	K128/Gym	74	Good	4	4	
Internal	K135 Corridor	71	Poor	5	5	
Internal	Kitchen/Food Prep			0	0	Insufficient coverage
Internal	Library	60	Poor	6	6	Insufficient coverage
Internal	Library @ windows	51	Poor	0	0	Insufficient coverage
Internal	Library Classroom	52	Poor	0	0	Insufficient coverage
Internal	Set Building			0	5	
Internal	Stairs F	70	Very Poor	2	2	
Internal	Stairs G	68	Poor	1	1	

Where Technology Means More®

Framingham Public Schools

High School Paging Project

9-15-23

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ePlus Account Team

Gary Hastings – Account Executive

David Lavallee – Solutions Architect

Please Note: *This document is not an official ePlus Statement of Work or a legally binding contract. The purpose of this document is to provide budgetary labor pricing with a high level review of the level of effort for the customer's reference, and is subject to change based on final agreement between ePlus and customer. An official ePlus Statement of Work will need to be signed by both the customer and ePlus to constitute a formal project.*

ePlus Company Information

ePlus offers consultative expertise and services that empower organizations to achieve more success and innovation through sustainable IT solutions. We help customers assess their technology and business needs and advise them on the most effective IT strategy and approach for their organization. We then design, implement, and optimize the cloud, security, data center, networking, collaboration, and emerging solutions to enable that strategy. We back those efforts with local support, long-term service, and flexible financing and consumption models, all with the end result of helping customers thrive in the digital economy and multi-cloud world, drive better business outcomes, and stay ahead of the innovation curve. We are a technology company that takes great pride in designing, implementing, and managing technical solutions for a diverse customer base that spans across multiple market verticals - this includes: Government, Education, Heathcare, Retail, Manufacturing, Finance, Legal, and Mid-Market.

Locations

National Headquarters
ePlus Technology, inc.
13595 Dulles Technology Drive
Herndon, VA 20171
www.eplus.com

List of all ePlus Locations/Offices

Where Technology Means More®

ePlus is a company where technology means more, and it is more than a tagline, it is our way of doing business.

- **Transform More** - smarter integration requires more listening, more inventive engineers, and more imagination. Every day we at ePlus hand craft agile data center and cloud solutions that deliver more.
- **Protect More** - safeguarding today's complex and rapidly changing IT environment demands more. More thinking, insight, and the tenacity to strengthen security posture.
- **Build More** - a solid IT infrastructure is the backbone of any organization's success. We deliver the best the industry has to offer for more performance, reliability, and scalability.
- **Expect More** - envisioning, designing, implementing, and managing—we offer more answers. Then we make it happen. When people ask for more, we deliver.

Our methodology involves working collaboratively with customers to align technology to the business, making it a strategic component of the organization's success.

Executive Summary

This Scope of Work is for installation and configuration of a NEW IP based paging system.

Detailed Description of Services

Project Kick-off

- Stake holders and engineers list
- Scheduling
- Product staging
- Contacts
- Clearance/paperwork

Planning and Design

- Speaker naming
- Speaker extension numbering
- Speaker groupings
- Speaker zoning (class/hall)
- Ip Addressing and vlans
- Fusion Controller placement
- Cabling specifics
- Switch requirements/POE
- UC integration
- Training
- Bell Schedule
- Pre-recorded messages

Cabling

- Network Cabling and Speaker Mounting:
- Eight Hundred and Ninety-Six (896) CAT 6 single to Interior Paging Speakers
- Mount/Install Eight Hundred and Ninety-Six (896) Interior Paging Speakers
- Twenty-Nine (29) CAT 6 single to Exterior Paging Speakers
- Mount/Install Twenty-Nine (29) Exterior Paging Speakers
- Sixteen (16) Cores through Interior Walls
- Twenty (20) Forty-Eight port CAT 6 Patch Panels
- CAT 6 Cabling to be different color than the existing blue and white cabling.
- Space created in existing racks for new patch panels by others.
- Network Cabling to station locations, and MDF/IDF terminations.
- Test and certify all cables.

- Notes:
    - 208,125f CAT 6 Plenum Rated Cable
    - 20 48 Port CAT 6 Patch Panel
    - 925 CAT 6 Jacks – Plug no patch cable.
    - 210 J Hooks
    - Other Miscellaneous Materials: Mounting Hardware, Fire Stop, Velcro strips, etc.

Build

- Singlewire Fusion Appliance
- un-box appliance and record serial number
- Asset tag as needed (customer to supply tag)

- Power up device
- Set IP
- set DNS
- Set gateway.
- Set NTP
- Set username/password and record.
- Attach device to network.
- Update device to latest GA code
- Register device.
- License device
- Add Singlewire device licenses.
- Verify device and licenses.
- Setup vlans and DHCP for paging (with customer)
- Configuration
- Configure device groups.
- Configure device zones.
- Add groups to zones.
- Add speakers to groups.
- Name/ID speakers
- Configure UC/Fusion Integration
- Suggested groups:
- Hallway A/B per floor
- Classrooms A/B per floor
- Gym
- Auditorium
- Cafeteria
- Outdoor
- Main office area

- Suggested Zones:
    - All
    - outdoor
    - auditorium
    - Gym
    - Cafeteria
- Per floor

- There are 950 speakers total:
    - 265 IP-SDM
    - 265 IP-SEST-SD (mount)
    - 49 SD-72W
    - 49 81-8R (Mount)
    - 552 IP-SM
    - 552 IP-STB (mount)
    - 29 IP-APX
    - 30 IP-HVP
    - 30 IP-SEST-HVP (mount)
- Switches

  - twenty (20) switches 2 per IDF
  - IDF are 2 per floor/5 floors.

  - Install switches.
  - Bring switch to IDF and unpack.
  - Record serial number
  - Asset tag as needed (customer to supply tag)
  - Rack switch(es) and power up

- Configure switches.
  - Connect new switch(es) to existing switch via ethernet.
  - Initial switch configuration
- update switch code
- configure vlan for paging.
- patch network speaker cables

Testing of Speakers

Training session with IT

Documentation:
- Cable testing report
- Exports of zones/groups/speakers
- Login credentials

closeout meeting

Place of Performance

115 A Street
Framingham, MA. 01701

Deliverables

Documentation:
- Cable testing report
- Exports of zones/groups/speakers
- Login credentials

Assumptions

General Project Assumptions

- Calls and meetings will be scheduled at a mutually agreeable time between the Customer and ePlus resource. The calls and meetings will be scheduled through ePlus PM.
- No training is included in this project unless otherwise specified in this SOW.
- Services schedule reflects work effort based on non-contiguous Business Days and does not include a full-time ePlus Engineer for staff augmentation during the project.
- All new cabling will utilize pathways as established by others, with the exception of new Cores and cabling supports as installed by Comm-Tract.
- J Hooks/Cabling Supports for the cable routing in the open areas where needed for cabling support.
- Utilize above ceiling grid pathways for routing of rough CAT 6 cable, and/or cable runway or cable trough if installed by others.
- Includes all associated jacks, faceplates for above Locations.
- Includes all terminations on new patch panels in the MDF/IDF's, testing, certification, and 20-year manufacturer's warranty.
- Includes mounting and installation of all speakers.
- Speaker locations to be determined by Framingham IT personnel prior to installation starting.
- Includes other materials, Fire Stop, etc.
- switches will be configured for paging purposes only

Customer Responsibilities

General Project Responsibilities

- Customer shall provide lift as needed.

Budget Pricing Breakdown

Project Kick-Off	1,125.00
Planning and Design	4,500.00
Build	31,875.0 0
Cabling	12,500.0 0
Test	30,000.0 0
Documentation and Closeout	562.50
Switches	39,375.0 0

Assumptions

General Project Assumptions

- Calls and meetings will be scheduled at a mutually agreeable time between the Customer and ePlus resource. The calls and meetings will be scheduled through ePlus PM.
- No training is included in this project unless otherwise specified in this SOW.
- Services schedule reflects work effort based on non-contiguous Business Days and does not include a full-time ePlus Engineer for staff augmentation during the project.

Customer Responsibilities

Advanced Authorizations and Staff Certifications

Strategic alliances with the industry's leading manufacturers keep ePlus engineers and sales professionals at the forefront of technology, enabling them to deliver industry-leading solutions to our clients. With an extensive roster of staff certifications, we also hold the following partnership designations:

Cisco

Cisco Gold Certified Partner
Cisco Master Specializations:

+ Networking
+ Cloud Builder
+ Security
+ Collaboration
+ Managed Services

Cisco Learning Partner
Cisco Lifecycle Advisor Program
AppDynamics Titan Partner
Cisco Powered:

+ Managed Business Communications
+ Managed Security Services

Cisco Advanced Specializations:

+ Data Center Architecture
+ Collaboration Architecture
+ Enterprise Networks Architecture
+ IoT – Connected Safety and Security
+ Security Architecture
+ Unified Computing Technology

Cisco Authorized Technology Provider:

+ Application Centric Infrastructure
+ TelePresence Video Master
+ Energy Management Suite Integrator
+ Telehealth Reseller
+ Unified Contact Center Enterprise

Dell-EMC

Partner Titanium

Hewlett Packard Enterprise

HPE Platinum Partner

HP

HP Partner First Platinum Partner

NetApp

NetApp Star Partner
NetApp Authorized Professional Services Partner
NetApp Solution Specializations

+ Data Center – FlexPod
+ FlexPod Premium Partner
+ Server Virtualization – VMware Professional Services Certifications
+ Storage Infrastructure
+ Data Center

Support Services Certified

VMware

VMware Premier Solution Provider
VMware Authorized Consulting Partner

+ Infrastructure Virtualization Competency
+ Business Continuity / Disaster Recovery Competency
+ Desktop Virtualization (VIEW) Competency

Additional Key Vendors

The ePlus Difference

We bring a keen focus, in-depth knowledge, and an unwavering commitment to the customer experience to every engagement, enabling organizations to navigate challenging situations and achieve results, faster. Positioned squarely at the forefront of today's most transformative technologies, **ePlus helps organizations imagine, implement, and achieve more from technology.**

CLOUD - Create customized roadmaps, then design, implement, service, and support organizations on their journey to adopt private, hybrid, and public cloud services. ePlus helps customers address today's multi-cloud requirements surrounding security, compliance, cost optimization, visibility, and connectivity by helping them build and manage a cloud-enabled enterprise foundation.

SECURITY - Deliver custom cybersecurity programs built upon strong culture and integrated technology, aimed at defining and mitigating business risk, identifying business challenges and creating safer environments to achieve positive business outcomes.

DATA CENTER – Design and support all data center needs, including compute, virtualization, hyper converged, storage, and back up and disaster recovery solutions.

NETWORKING - Fully support automation and modernization of the network by optimizing access, connectivity, and security across on-premise, cloud, and hybrid environments, including multi-cloud/SDN, mobility/wireless, SD-WAN, and service provider networking.

COLLABORATION – Foster effective communication—within internal teams and with customers—through voice and video calling, real-time messaging and meetings, video conferencing, and contact center solutions deployed on-premise or in the cloud.

SERVICES - Apply a lifecycle approach to consult, design, architect, and implement solutions as well as monitor and manage IT environments—to attain the greatest return on technology investments and fuel innovation.

FINANCING AND CONSUMPTION MODELS - Enable technology acquisitions with cost predictability and contract flexibility. Accelerate transformations by aligning costs with demand using custom consumption programs.

PROPOSAL VALIDITY PERIOD

This proposal is valid for sixty (60) days from the date of submission.

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 8

(1) PROJECT NAME: Asbestos Abatement - Districtwide

PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

In an ongoing effort to address the School District's Asbestos Hazard Emergency Response Action (AHERA), in compliance with Department of Environmental Protection requirements (D.E.P.), the District performs routine six-month inspections for all suspected asbestos-containing materials within all school buildings. Additionally, three year reports are filed through a contracted industrial hygienist firm to ensure the District is in full compliance with AHERA and D.E.P. guidelines for Public Schools.

Any item containing asbestos must be monitored on a routine basis. If the item is found to be in poor condition or in a state where asbestos particulates may become airborne, then the District is required to repair and/or remove the item.

Additionally, all asbestos must be removed at some point from all school buildings, regardless of if the building is scheduled to be demolished. However, we take a proactive approach and address large common areas of asbestos-containing floor tile in corridors, classrooms, etc. that show signs of wear or curled edges. Even though there is no imminent danger of the material becoming airborne or "friable", the District attempts to remove it before the material/area poses health risks. Ceilings, floors and pipe coverings above the ceilings are the next area of priority for removing asbestos containing materials. This capital request does include remediation of ACM ceiling tiles and replacements in various district buildings.

During our routine 6-month AHERA inspections, our consultant identifies areas throughout District buildings where asbestos remains and should be remediated. This capital request is to address those locations through remediation design and continue in our efforts to remove asbestos district-wide. It is important to note that while it is important to continue in our remediation efforts, these locations currently pose no health risk to students, staff, or parents.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34

a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction						
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other	561,000			1	1	1
	TOTAL	561,000	-	-	1	1	1

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.		**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION:

District wide

(11) ASSET TYPE:

Building Infrastructure

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

TBD

(9) FINANCE DEPARTMENT NOTES:

8. Asbestos Abatement - Districtwide

FY25

In an ongoing effort to address the School District's Asbestos Hazard Emergency Response Action (AHERA), in compliance with Department of Environmental Protection requirements (D.E.P.), the District performs routine six-month inspections for all suspected asbestos-containing materials within all school buildings. Additionally, three year reports are filed through a contracted industrial hygienist firm to ensure the District is in full compliance with AHERA and D.E.P. guidelines for Public Schools.

Any item containing asbestos must be monitored on a routine basis. If the item is found to be in poor condition or in a state where asbestos particulates may become friable, then the District is required to repair and/or remove the item.

Additionally, all asbestos must be removed at some point from all school buildings, regardless if the building is scheduled to be demolished. However, we take a proactive approach and address large common areas of asbestos-containing floor tile in corridors, classrooms, etc. that show signs of distress. Even though there is no imminent danger of the material becoming or friable, the District attempts to remove it before the material/area poses health risks. Ceilings, floors and pipe coverings above the ceilings are the next area of priority for removing asbestos containing materials. This capital request does include remediation of ACM ceiling tiles and replacements in various district buildings.

During our routine 6-month AHERA inspections, our consultant identifies areas throughout District buildings where asbestos remains and should be remediated. This capital request is to address those locations through remediation design and continue in our efforts to remove asbestos district-wide. It is important to note that while it is important to continue in our remediation efforts, these locations currently pose no health risk to students, staff, or parents.

- Design - $50,000
- Construction - $460,000
- Contingency - $51,000
- **TOTAL - $561,000**

Asbestos Abatement and Design				
Location	**Cost**			
Asbestos Abatement Cost	*$250,000*			
Replacement Cost	*$110,000*			
Ceiling Tile Abatement and Replacement	*$100,000*			
Design, Monitoring and Air Sampling	*$50,000*			
TOTAL	*$510,000*			
Project Contingency	*$51,000*			
PROJECT TOTAL	**$561,000**			

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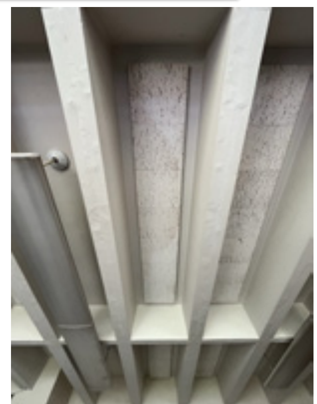
DRAFT CAPITAL BUDGET PROPOSAL

Asbestos Abatement/Replace Floor Tiles - $561,000

Asbestos Abatement Districtwide



Stapleton Asbestos Examples

Walsh Asbestos Examples

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 3

(1) PROJECT NAME: Roof Repairs/Replacements, Design - Juniper Hill and King

PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital budget funding is for design development to facilitate roof replacements at King Elementary and Juniper Hill BLOCKS School's. These roofs are at the end of useful life and rapidly deteriorating. Additionally, the extended warranty for both of these buildings has expired, requiring the district to cover any needed repairs through the operating budget. Currently, both of these roofs are experiencing moisture infiltration and deterioration that is requiring full replacement in order to ensure the continued usage of the school. This funding request would allow the district to undertake design for full replacement with Habeeb & Associates, the District's on-call design firm. The intent would be to undertake design during FY2025, submit a funding request for replacement in the FY2026 budget, and undertake replacements during the summer of 2026, while school is out for the summer.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design	1,251,110					
d.	Construction						
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	1,251,110	-	-	-	-	-

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2) **MSBA**
3)

(10) PROJECT OR EQUIPMENT LOCATION: **Juniper Hill and Stapleton Schools**

(11) ASSET TYPE: **Building Infrastructure**

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

TBD

(9) **FINANCE DEPARTMENT NOTES:**

3 . **Roof Repairs/Replacement Design - Juniper Hill and King School's**

FY25:

This request for capital budget funding is for design development to facilitate roof replacements at King Elementary and Juniper Hill BLOCKS School's. These roofs are at the end of useful life and rapidly deteriorating. Additionally, the extended warranty for both of these buildings has expired, requiring the district to cover any needed repairs through the operating budget. Currently, both of these roofs are experiencing moisture infiltration and deterioration that is requiring full replacement in order to ensure the continued usage of the school. This funding request would allow the district to undertake design for full replacement with Habeeb & Associates, the District's on-call design firm. The intent would be to undertake design during FY2025, submit a funding request for replacement in the FY2026 budget, and undertake replacements during the summer of 2026, while school is out for the summer.

- King Elementary School - $623,433
- Juniper Hill BLOCKS School - $627,677

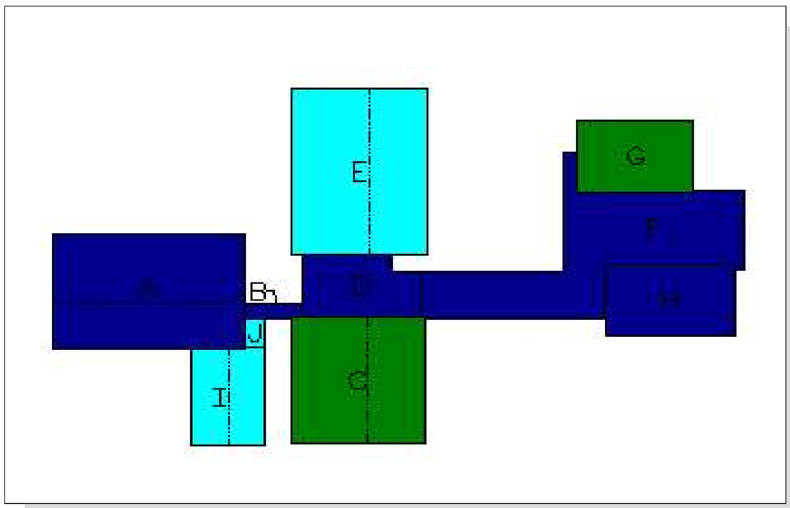
TOTAL - $1,251,110

Framingham Public Schools

Juniper Hill Elementary

Juniper Hill Elementary

29 Upper Joclyn Road
Framingham, MA 01701
10 roof(s) - 47,792 sq. ft.

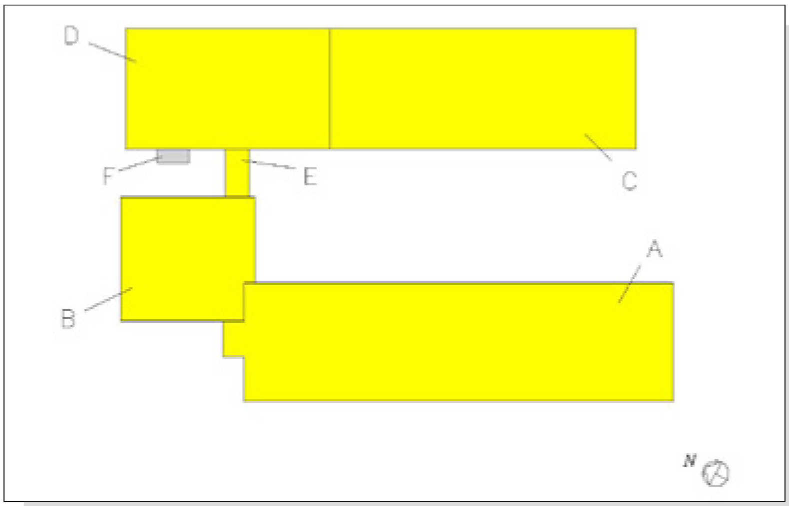


Framingham Public Schools

King Administration Building

King Administration

454 Water Street
Framingham, MA 01701
6 roof(s) - 47,465 sq. ft.



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FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Roof Replacement/Repairs Design - $1,251,110
Juniper HIll and King Elementary School


JUNIPER HILL
EXISTING CONDITIONS



Roof Replacement/Repairs Design - $1,251,110

Juniper HIll and King Elementary School

KING EXISTING CONDITIONS

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: City/Schools | **DEPARTMENT PRIORITY:** 1

(1) PROJECT NAME: Roof Replacement, Construction - Potter Road and Brophy Schools

PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital budget funding is for the replacement of the built-up roofing systems at Potter Road and Barbieri Elementary Schools. These roofs are at the end of useful life, do not meet today's stretch energy code, and are rapidly deteriorating. Additionally, the warranty for Brophy expired on September 6, 2022; and Potter Road expired in August of 2023. Both of these warranties were extended for an additional 5 years through Tremco, our roof warranty contractor.

Currently, both of these roofs are experiencing water intrusion and failure to provide adequate moisture protection. A full replacement is required in order to ensure the school can remain open for its intended use. Funding for the design of these two roofs were allocated during the FY24 capital approval process. Design development is currently underway with Habeeb & Associates, the Department's on-call design firm. Design will include the full replacement of roofing systems at Potter Road and Brophy, which includes replacement of roof top mechanical equipment, increase in insulation to meet new stretch code requirements; fascia replacements and repairs; roof drain replacements and repairs; etc.

In the past, the Department would submit statements of interest to the MSBA for the accelerated repair program for roof replacements to help offset costs. However, MSBA announced last year they were suspending the program. This has put the cost burden solely on the City.

Potter Road Elementary School - $6,550,909
Brophy Elementary School - $6,672,040
TOTAL $13,222,950

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction	13,222,950					
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	13,222,950	-	-	-	-	-

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc

b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**

2)

3)

(10) PROJECT OR EQUIPMENT LOCATION:

Potter Road and Brophy Elementary Schools

(11) ASSET TYPE:

Building Infrastructure

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

TBD

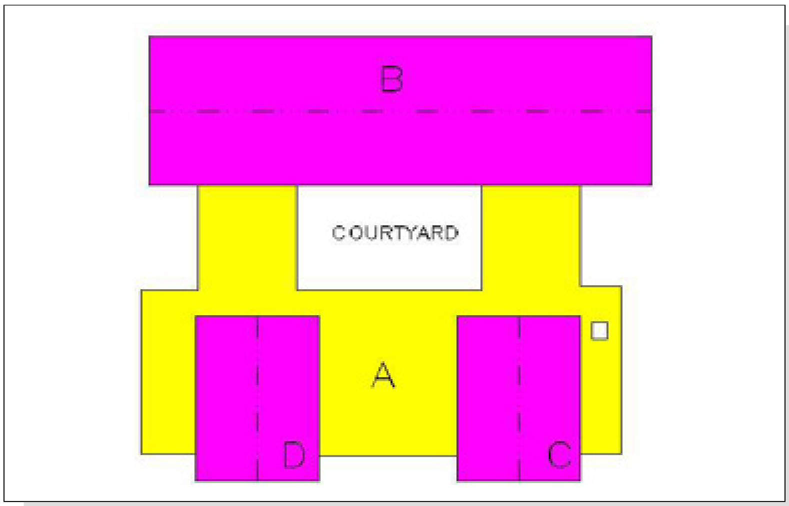
(9) FINANCE DEPARTMENT NOTES:

Framingham Public Schools

Potter Road School

Potter Road School

492 Potter Road
Franingham, MA 01701
4 roof(s) - 49,906 sq. ft.

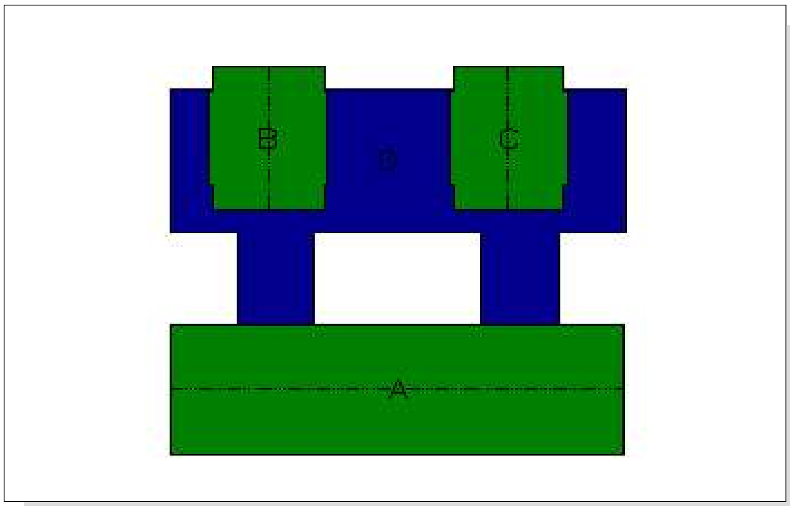


Framingham Public Schools

Brophy Elementary School

Brophy Elementary School

575 Pleasant Street
Framingham, MA 01701
4 roof(s) - 50,840 sq. ft.



1. **<u>Roof Repairs/Replacement Design - Potter Road and Barbieri Schools</u>**

<u>FY25:</u>

This request for capital budget funding is for the replacement of the built-up roofing systems at Potter Road and Barbieri Elementary Schools. These roofs are at the end of useful life, do not meet today's stretch energy code, and are rapidly deteriorating. Additionally, the warranty for Brophy expired on September 6, 2022; and Potter Road expired in August of 2023. Both of these warranties were extended for an additional 5 years through Tremco, our roof warranty contractor.

Currently, both of these roofs are experiencing water intrusion and failure to provide adequate moisture protection. A full replacement is required in order to ensure the school can remain open for its intended use.. Funding for the design of these two roofs were allocated during the FY24 capital approval process. Design development is currently underway with Habeeb & Associates, the Department's on-call design firm. Design will include the full replacement of roofing systems at Potter Road and Brophy, which includes replacement of roof top mechanical equipment, increase in insulation to meet new stretch code requirements; fascia replacements and repairs; roof drain replacements and repairs; etc.

In the past, the Department would submit statements of interest to the MSBA for the accelerated repair program for roof replacements to help offset costs. However, MSBA announced last year they were suspending the program. This has put the cost burden solely on the City.

● Potter Road Elementary School -		$6,550,909
● Brophy Elementary School -		$6,672,040
	TOTAL	**$13,222,950**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FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Roof Repairs/Replacement - $13,222,950
Potter Road and Brophy Elementary School's

BROPHY ELEMENTARY EXISTING CONDITIONS

Roof Repairs/Replacement - $13,222,950 (continued)
Potter Road and Brophy Elementary School's

POTTER ROAD EXISTING CONDITIONS

FRAMINGHAM PUBLIC SCHOOLS - ROOF REPAIRS AND REPLACEMENT
FISCAL YEAR 2023-2024 SNAPSHOT

Priority	Bldg. Name	Construction Date	Installation Date	Roof Age	Warranty Expiration	Consultant Total (Solar, Structural, and Enclosure)	Construction Total (Material, Labor, Bonds, Insurance, Profit, etc.)	FY24 Replacement Cost
1	Potter Road Elementary School	1955	1996	25	Aug 26 2023	**$636,443**	**$5,614,425**	**$6,550,909**
2	Brophy Elementary School	1968	2002	19	Sep 6 2022	**$646,950**	**$5,719,500**	**$6,672,040**
3	King Elementary School	1957	1998	23	Aug 30 2023	**$608,981**	**$5,339,813**	**$6,234,336**
4	Juniper Hill - BLOCKS	1960	2001	20	Sep 12 2021	**$612,660**	**$5,376,600**	**$6,276,744**
5	Barbieri Elementary School	1974	1998	23	Aug 26 2023	**$865,594**	**$7,905,938**	**$9,192,565**
6	Hemenway Elementary	1961	1996	25	Aug 22 2023	**$833,025**	**$7,580,250**	**$8,817,112**
7	Cameron Middle	2001	2001	20	Aug 30 2023	**$870,184**	**$7,951,838**	**$9,245,478**
8	Harmony Grove Elementary School	1998	1998	23	Aug 30 2023	**$742,733**	**$6,677,325**	**$7,776,220**
9	Stapleton Elementary School	1922, 1956, 1976	2007	14	Jan 2 2027	**$411,578**	**$3,365,775**	**$3,958,665**
10	Miriam McCarthy Elementary School Phase II	1952	2007	14	Dec 12 2027	**$348,375**	**$2,733,750**	**$3,230,067**
11	Walsh Middle School	1969	2005	16	May 16 2025	**$1,528,354**	**$14,533,538**	**$16,832,862**

12	Framingham High	1963, 2006	2006	15	May 24 2026	**$2,724,038**	**$26,490,375**	**$30,616,704**
13	New Fuller Middle School	2021	2021	0	Sept 1 2041	**$0**	**$0**	**$0**
14	Farley Middle School	1960??	2023	TBD	TBD	**$0**	**$0**	**$0**
15	Miriam McCarthy Elementary School Phase I	1952	2024	TBD	TBD	**$0**	**$0**	**$0**
16	Charlotte Dunning Elementary School	1965	2024	TBD	TBD	**$0**	**$0**	**$0**

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 4

(1) PROJECT NAME: Building Envelope, Design - Farley

PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital budget funding is for the assessment and design of building envelope repairs to the Farley Administration Building. This facility falls within our long range building envelope repair program and has experienced a number of deficiencies and damage throughout the years.

This funding request of $200,000 would allow the Department to work with on-call envelope design firms to investigate the major areas of concerns including moisture infiltration, identify areas of concern due to years of preventative maintenance, identify the full extent of damage to the infrastructure due to the current condition, and begin developing a plan for repairs. Once this effort is completed, the Department will have a potential phased approach and bidding documents to begin the repair process.

This project will address many issues at Farley, including failing window perimeter sealant systems; deteriorating expansion joints; deteriorating fascia; deteriorated mortar; foundation cracks and failure; spalling concrete; damaged and failing doors/windows; and associated components.

The Farley Administration Building was constructed in 1973 using a replicated floor plan that matched the former Cameron Middle School, and current Barbieri Elementary School. The roof at Farley was recently replaced (summer of 2023), replacing a failed system that was installed in 2005. While the failed roof was not the main driver, it did contribute to the deterioration of the envelope, mainly as a result of the water infiltration experienced during any rain event. The District has recently returned to this facility, utilizing it as a welcome center and central office for administration. The building is currently co-occupied with MassBay Community College, whose lease expires in December of 2023.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design	200,000					
d.	Construction						
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	200,000	-	-	-	-	-

(5) PRIORITY:

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION:

Farley Administration Building

(11) ASSET TYPE:

Building Infrastructure

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

TBD

(9) FINANCE DEPARTMENT NOTES:

4. **Building Envelope Repair Design - Farley**

This request for capital budget funding is for the assessment and design of building envelope repairs to the Farley Administration Building. This facility falls within our long range building envelope repair program and has experienced a number of deficiencies and damage throughout the years.

This funding request of $200,000 would allow the Department to work with on-call envelope design firms to investigate the major areas of concerns including moisture infiltration, identify areas of concern due to years of deferred? maintenance, identify the full extent of damage to the masonry facade? due to the current condition, and begin developing a plan for repairs. Once this effort is completed, the Department will have a potential phased approach and bidding documents to begin the repair process.

This project will address many issues at Farley, including failing window perimeter sealant systems; deteriorating expansion joints;; deteriorated mortar; foundation cracks and failure; spalling concrete; damaged and failing doors/windows; and associated components.

The Farley Administration Building was constructed in 1973 using a replicated floor plan that matched the former Cameron Middle School, and current Barbieri Elementary School. The roof at Farley was recently replaced (summer of 2023), replacing a failed system that was installed in 2005. While the failed roof was not the main driver, it did contribute to the deterioration of the envelope, mainly as a result of the water infiltration experienced during any rain event. The District has recently returned to this facility, utilizing it as a welcome center and central office for administration. The building is currently co-occupied with MassBay Community College, whose lease expires in December of 2023.

- Design - **$200,000**

10/31/23 9:58

PREPARED FOR:
Framingham Public Schools
Framingham, MA

FY 25 COST ESTIMATES

EXTERIOR ENVELOPE 10 YEAR SPREADSHEET

SCHOOL ID	Material and Labor Subtotal	Engineering Fee Construction Contingency 10%	Total	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Recommended Repairs
Framingham High School	$ 1,700,195	$ 170,020	$ 1,870,215	**$ 1,870,215**	$ 1,959,985	$ 2,054,064	$ 2,152,659	$ 2,255,987	$ 2,364,274	$ 2,477,759	$ 2,596,692	$ 2,721,333	$ 2,851,957	Glazing Replacement, Masonry, Sealant, Concrete and Misc. Repairs
King Elementary School	$ 1,175,700	$ 179,647	$ 1,355,347	**$ 1,355,347**	$ 1,420,404	$ 1,488,583	$ 1,560,035	$ 1,634,917	$ 1,713,393	$ 1,795,635	$ 1,881,826	$ 1,972,154	$ 2,066,817	Window and Doors Replacement, Masonry, Sealant, and Misc. Repairs
Dunning Elementary School	$ 1,783,910	$ 272,581	$ 2,056,491	$ 2,056,491	**$ 2,155,203**	$ 2,258,653	$ 2,367,068	$ 2,480,687	$ 2,599,760	$ 2,724,549	$ 2,855,327	$ 2,992,383	$ 3,136,017	Window and Doors Replacement, Concrete Repairs
Thayer Campus of FHS	$ 268,445	$ 41,018	$ 309,463	$ 309,463	**$ 324,318**	$ 339,885	$ 356,199	$ 373,297	$ 391,215	$ 409,994	$ 429,673	$ 450,298	$ 471,912	Window and Doors Replacement, Masonry, Sealant and Concrete Repairs
Juniper Hill Elementary School	$ 575,730	$ 87,972	$ 663,702	$ 663,702	$ 695,559	**$ 728,946**	$ 763,935	$ 800,604	$ 839,033	$ 879,307	$ 921,514	$ 965,746	$ 1,012,102	Window and Doors Replacement, Masonry, Sealant, Concrete and Misc. Repairs
Brophy Elementary School	$ 2,166,730	$ 331,076	$ 2,497,806	$ 2,497,806	$ 2,617,701	$ 2,743,350	**$ 2,875,031**	$ 3,013,033	$ 3,157,658	$ 3,309,226	$ 3,468,069	$ 3,634,536	$ 3,808,994	Window and Doors Replacement, Masonry, Sealant, Concrete, Wood and Misc. Repairs
Potter Road Elementary School	$ 2,155,000	$ 329,284	$ 2,484,284	$ 2,484,284	$ 2,603,530	$ 2,728,499	$ 2,859,467	**$ 2,996,721**	$ 3,140,564	$ 3,291,311	$ 3,449,294	$ 3,614,860	$ 3,788,373	Window and Doors Replacement, Masonry, Sealant, Concrete and Misc. Repairs
TOTAL			$ 11,237,308	$ 11,237,308	$ 11,776,699	$ 12,341,980	$ 12,934,395	$ 13,555,246	$ 14,205,898	$ 14,887,781	$ 15,602,395	$ 16,351,310	$ 17,136,172	
TOTAL PROJECTS BY FISCAL YEAR				$ 3,225,561	$ 2,479,521	$ 2,783,010	$ 2,875,031	$ 2,996,721	TBD	TBD	TBD	TBD	TBD	

***** FY24 thru FY32 are costs with 4.8% escalation

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DRAFT CAPITAL BUDGET PROPOSAL

Building Envelope Repair Assessment and Design - $200,000

Design Repairs to Building Envelope at the Farley Building

KING ELEMENTARY SCHOOL

Deteriorating foundation

Structural cracks, allowing moisture infiltration

Asbestos Window Glazing

FRAMINGHAM HIGH SCHOOL

Crack and spalling foundation

Failing fascia

Deteriorating bricks, allowing moisture infiltration

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools **DEPARTMENT PRIORITY:** 9

(1) **PROJECT NAME:** Farley Generator Installation - Farley Building
PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) **PROJECT DESCRIPTION AND JUSTIFICATION:**

This request for capital budget funding is for the purchase and installation of an appropriately sized generator at the Farley Building. The current generator is greatly undersized for the Districts needs now that the building is occupied by central office staff. This project would allow for the installation of an appropriately sized generator that will provide coverage for the newly relocated offices. Additionally, this generator will be designed to support future operational expansion within the building, allowing for continued operations of the District's Central Office during power outages. The requested funding amount incorporates an increase due to continued inflation and fluctuation in pricing experienced in the market. While this is an estimate, we believe the number will cover all costs associated with this project but understand the continued market fluctuation will result in volatile numbers for the foreseeable future.

Total Requested $610,000

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

This was requested in a previous fiscal year.

(3) **PURPOSE OF PROJECT:**

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) **BUDGET REQUEST BY YEAR:**

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction	610,000					
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	610,000	-	-	-	-	-

(5) **PRIORITY:**

a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) **EFFECTS ON ANNUAL OPERATING BUDGET:**

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) **PROPOSED FUNDING SOURCE(S):**

(10) **PROJECT OR EQUIPMENT LOCATION:**

1)	**Bond**		**Farley Administration Building, 19 Flagg Drive**
2)			(11) ASSET TYPE:
3)			**Building Infrastructure**

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

Thomas Begin, tbegin@framingham.k12.ma.us

(9) FINANCE DEPARTMENT NOTES:

Farley Generator				
Location	**Cost**			
Design	*$40,000*			
Construction	*$318,000*			
Escalation	*$195,000*			
TOTAL	*$553,000*			
Project Contingency	*$55,300*			
PROJECT TOTAL	**$608,300**			

9. Farley Generator Installation

FY25:

This request for capital budget funding is for the purchase and installation of an emergency standby generator at the Farley Building. The existing generator is not sized correctly, nor adequate for the current building operations.. This project would allow for the installation of an appropriately sized generator that will provide coverage for the newly relocated offices. Additionally, this generator will be designed to support future operational expansion within the building, allowing for continued operations of the District's Central Office during power outages. The requested funding amount incorporates an increase due to continued inflation and fluctuation in pricing experienced in the market. While this is an estimate, we believe the number will cover all costs associated with this project but understand the continued market fluctuation will result in volatile numbers for the foreseeable future.

- Design - $40,000
- Construction - $514,700
- Contingency - $55,300
- **TOTAL - $610,000**

SHEPHERD ENGINEERING, INC.

1308 GRAFTON STREET • WORCESTER, MA 01604 • (508) 757 7793 • FAX: (508) 753 2309

Ms. Carol Brodeur
Capital Project Coordinator
Framingham Public Schools
Building and Grounds Dept.
31 Flagg Drive, Suite #6
Framingham, MA 01702

Re: Farley School Generator System Upgrade
31 Flagg Drive
Framingham, MA 01702

Proposed Generator Systems Upgrade Budget:

The project will consist of but not limited to the following to support the electrical systems throughout the entire building:

The overall intent would be to install the new standby generator close to the existing utility padmount transformer. Intercept the existing line-load secondary conductors then connect to a new NEMA 3R service entrance rated automatic transfer switch. This will allow for the majority of the work to be performed outside of the building structure and not interfere with trying to reconnect onto the existing main distribution board currently located within the central portion of the building.

Demolition Phase: **$8,500.00**

- Disconnect and removal of the interior natural gas generator set with a rating of 45kW, 277/480 volt, 3 phase.
- Disconnect, removal and capping of the natural gas piping.
- Disconnect and removal of the interior and exterior exhaust pipe up to the roof line. City of Framingham to be responsible for the equipment removal and all necessary patching.
- Disconnect and removal of the existing wall mounted remote radiator exhaust unit and related piping back to the generator. City of Framingham to be responsible for all the exterior wall section infill.
- Disconnect and removal of the existing automatic transfer switch and related cabling to the generator set.
- Disconnect and removal of the service disconnect switches related to the remote panels – replacement with new distribution panel with reconnection to the existing branch circuits.
- Disconnect and removal of the existing generator/ATS feed from the main distribution board with new branch circuit breaker and related branch circuit feeder to the main electric room.

Note: Excludes demolition work performed by City of Framingham

Proposed Generator Upgrade:

New 400KW Standby Generator in Sound Attenuated Enclosure Diesel: **$190,000.00**

- Purchase a new 400kW diesel base tank style generator within a sound attenuated enclosure with a new 2000 ampere, 3 pole, 480 volt NEMA 3R circuit breaker style automatic transfer switch. Includes tailgate delivery and setting onto the concrete pad.

Generator System Infrastructure: Material and Labor **$120,000.00**

- Preparation of the new generator concrete pad. Pad dimensions to be approximately 12"-0" wide X 26'-0" long. Proposed location along the street side of Flagg Drive adjacent to the end of the maintenance garage.
- New exhaust stack to rise the exterior of the building and rise 10'-0" above the roof structure.
- Intercept the existing secondary electrical feeders as they exit the main utility company padmount transformer. Redirect to the new 2000 ampere, 277/480 volt service entrance rated automatic transfer switch.
- New manhole located in the drive area to intercept the existing line and load secondary feeders.
- New branch circuits from the generator to the new automatic transfer switch (ATS) and related support electrical systems – power to originate from the branch circuit panel currently located within the maintenance garage.
- New branch circuit distribution panel to be located adjacent to the new ATS to support the existing branch lighting circuits.
- Coordination with EVERSOURCE for all required utility power shutdowns to safely transfer the power.
- All necessary connections to the new generator and related controls.

Total Estimated Construction Cost: **$318,500.00**

Note: Excludes overhead and profit contractor costs

Respectfully Submitted John D. Shepherd

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FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Farley Generator Installation - $610,000

Installation of a Generator to Support Entire Building Systems

- Current Building Has a 45kW Generator
  - This Services only Emergency Devices
- Purchase and Installation of 400 kW Generator
  - This Will Provide Service to All Building Systems and Relocated District Offices
  - Ensures Central Office and Support Departments Will Remain in Operations During Power Outages and Ensure Date Operations Are Not Interrupted
- Buildings & Grounds Will Perform Some Work To Help Reduce Expense

CITY OF FRAMINGHAM
CAPITAL PROJECT/EQUIPMENT REQUEST - FY2025-2034 CIP

DEPARTMENT: Schools

DEPARTMENT PRIORITY: 2

(1) PROJECT NAME: Exterior Envelope Construction King and Framingham High School

PROJECT STATUS: In Earlier CIP - Not in Edmunds

(2) PROJECT DESCRIPTION AND JUSTIFICATION:

This request for capital funding is for design development to facilitate masonry repairs to the exterior envelope at King Elementary and Framingham High School. These two facilities fall within our long range exterior envelope repair program and have experienced a number of deficiencies and damage throughout the years.

This funding request of $3,220,000 would allow the Department to move forward with this project in an attempt to continue improving facilities and ensuring they remain “water-tight”. This project will address many issues at King and FHS, including failing window perimeter sealant systems; deteriorating expansion joints; deteriorating fascia; deteriorated mortar; foundation cracks and failure; spalling concrete; and associated components.

King was constructed in 1957 and has undergone numerous improvements throughout the years. However, there have been minimal repairs to the building’s exterior envelope, which has resulted in the deteriorating conditions of today.

Framingham High School was constructed in 1961 and underwent expansion and renovations from 2001 through 2007. While this building has undergone numerous renovations and repairs, the exterior envelope has not been the focus of repairs or renovations for a number of years. This is shown in the current condition and continued moisture infiltration throughout the building.

PROJECT ADDITIONS/CHANGES JUSTIFICATION:

This funding request is for construction as design was funded during FY24

(3) PURPOSE OF PROJECT:

X	Replace existing infrastructure
	Replace existing capital asset
	Replace existing vehicle
	Replace equipment
	New infrastructure
	New capital asset
	New vehicle
	New equipment
	Strategic/Comprehensive/Master plan

(4) BUDGET REQUEST BY YEAR:

		FY 25	FY 26	FY 27	FY 28	FY 29	FY 30-34
a.	Land Acquisition						
b.	Planning / Feasibility						
c.	Design						
d.	Construction	3,225,600					
e.	Equipment/Vehicles						
f.	Contingency						
g.	Other						
	TOTAL	3,225,600	-	-	-	-	-

(5)	PRIORITY:		
a.	X	**health and safety**	safety concern, hazardous condition, agency compliance, non-functional, etc
b.	X	**level service maintenance**	maintains City desired level of service
c.		**economic development**	adds to the City's economic vibrancy
d.		**service improvement**	new or improved service to meet demand

(6) EFFECTS ON ANNUAL OPERATING BUDGET:

	FY 25	FY 26	FY 27	FY 28	FY 29	FY30	YEARS 30-34
Personnel							
Operating							

(7) PROPOSED FUNDING SOURCE(S):

1) **Bond**
2)
3)

(10) PROJECT OR EQUIPMENT LOCATION:

FHS and King School's

(11) ASSET TYPE:

Building

(7a) POTENTIAL GRANT FUNDING SOURCE IF APPLICABLE: (List source and matching requirements)

(8) PROJECT LEAD NAME & CONTACT INFO: (ADDITIONAL PROJECT INFO AS NEEDED)

Thomas Begin, tbegin@framingham.k12.ma.us

(9) FINANCE DEPARTMENT NOTES:

<u>Building Envelope Repair construction - King Elementary and FHS</u>

This request for capital funding is for design development to facilitate masonry repairs to the building envelope at King Elementary and Framingham High School. These two facilities fall within our long range building envelope repair program and have experienced a number of deficiencies and damage throughout the years.

This funding request of $3,220,000 would allow the Department to move forward with this project in an attempt to continue improving facilities and ensuring they remain "water-tight". This project will address many issues at King and FHS, including failing window perimeter sealant systems; deteriorating expansion joints; deteriorating fascia; deteriorated mortar; foundation cracks and failure; spalling concrete; and associated components.

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● King Elementary School -	$1,355,347
● Framingham High School -	$1,870,215
TOTAL	**$3,225,600**

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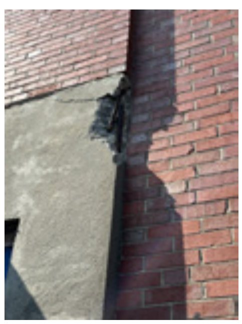
FRAMINGHAM PUBLIC SCHOOLS
DRAFT CAPITAL BUDGET PROPOSAL

Building Envelope Construction - $3,220,000

King Elementary and Framingham High School



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PREPARED FOR:
Framingham Public School
Framingham, MA

FY 25 COST ESTIMATES

EXTERIOR ENVELOPE 10 YEAR SPREADSHEET

SCHOOL ID	Material and Labor Subtotal	Engineering Fee Construction Contingency 10%	Total	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	Recommended Repairs
Framingham High School	**$ 1,700,195**	**$ 170,020**	$ 1,870,215	**$ 1,870,215**	$ 1,959,985	$ 2,054,064	$ 2,152,659	$ 2,255,987	$ 2,364,274	$ 2,477,759	$ 2,596,692	$ 2,721,333	$ 2,851,957	**Glazing Replacement, Masonry, Sealant, Concrete and Misc. Repairs**
King Elementary School	**$ 1,175,700**	**$ 179,647**	$ 1,355,347	**$ 1,355,347**	$ 1,420,404	$ 1,488,583	$ 1,560,035	$ 1,634,917	$ 1,713,393	$ 1,795,635	$ 1,881,826	$ 1,972,154	$ 2,066,817	**Window and Doors Replacement, Masonry, Sealant, and Misc. Repairs**
Dunning Elementary School	**$ 1,783,910**	**$ 272,581**	$ 2,056,491	$ 2,056,491	**$ 2,155,203**	$ 2,258,653	$ 2,367,068	$ 2,480,687	$ 2,599,760	$ 2,724,549	$ 2,855,327	$ 2,992,383	$ 3,136,017	**Window and Doors Replacement, Concrete Repairs**
Thayer Campus of FHS	**$ 268,445**	**$ 41,018**	$ 309,463	$ 309,463	**$ 324,318**	$ 339,885	$ 356,199	$ 373,297	$ 391,215	$ 409,994	$ 429,673	$ 450,298	$ 471,912	**Window and Doors Replacement, Masonry, Sealant and Concrete Repairs**
Juniper Hill Elementary School	**$ 575,730**	**$ 87,972**	$ 663,702	$ 663,702	$ 695,559	**$ 728,946**	$ 763,935	$ 800,604	$ 839,033	$ 879,307	$ 921,514	$ 965,746	$ 1,012,102	**Window and Doors Replacement, Masonry, Sealant, Concrete and Misc. Repairs**
Brophy Elementary School	**$ 2,166,730**	**$ 331,076**	$ 2,497,806	$ 2,497,806	$ 2,617,701	$ 2,743,350	**$ 2,875,031**	$ 3,013,033	$ 3,157,658	$ 3,309,226	$ 3,468,069	$ 3,634,536	$ 3,808,994	**Window and Doors Replacement, Masonry, Sealant, Concrete, Wood and Misc. Repairs**
Potter Road Elementary School	**$ 2,155,000**	**$ 329,284**	$ 2,484,284	$ 2,484,284	$ 2,603,530	$ 2,728,499	$ 2,859,467	**$ 2,996,721**	$ 3,140,564	$ 3,291,311	$ 3,449,294	$ 3,614,860	$ 3,788,373	**Window and Doors Replacement, Masonry, Sealant, Concrete and Misc. Repairs**
TOTAL			**$ 11,237,308**	**$ 11,237,308**	**$ 11,776,699**	**$ 12,341,980**	**$ 12,934,395**	**$ 13,555,246**	**$ 14,205,898**	**$ 14,887,781**	**$ 15,602,395**	**$ 16,351,310**	**$ 17,136,172**	
TOTAL PROJECTS BY FISCAL YEAR				**$ 3,225,561**	**$ 2,479,521**	**$ 2,783,010**	**$ 2,875,031**	**$ 2,996,721**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	

******* FY24 thru FY32 are costs with 4.8% escalation**