

CASINO GOLD

EAST COAST, USA



Photo Credit: Friedmutter Group

4/9/2014

Senior Thesis Spring 2014

Brad Robertson

Penn State Architectural Engineering – Lighting/Electrical Option

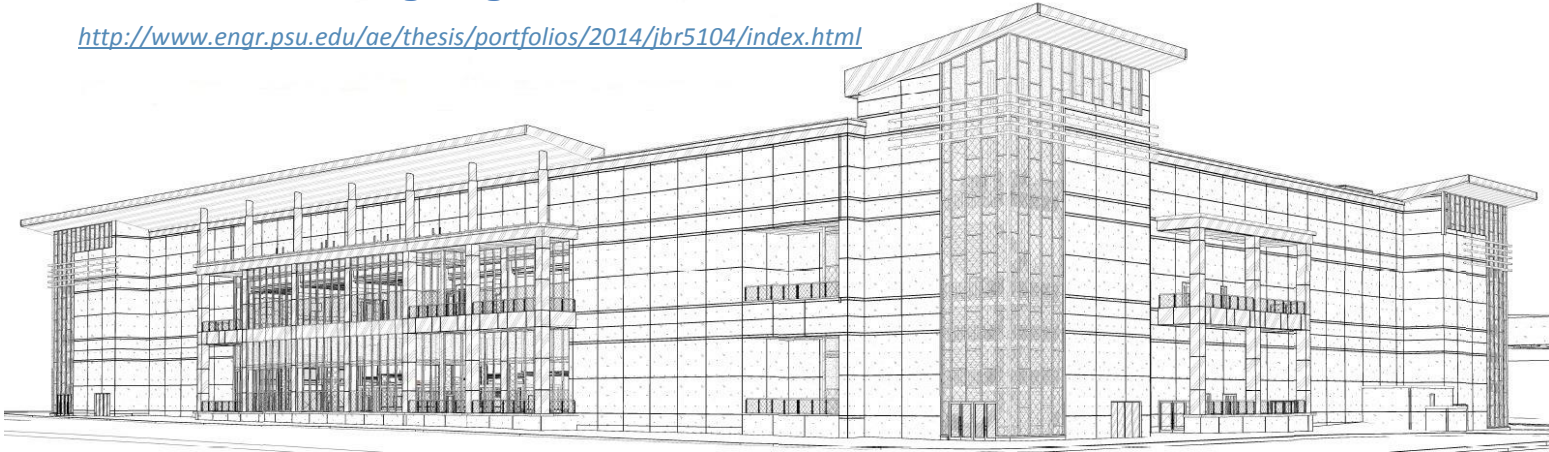
Faculty Advisor – Shawn Good

ABSTRACT

Casino Gold | East Coast, USA

Brad Robertson | Lighting + Electrical

<http://www.engr.psu.edu/ae/thesis/portfolios/2014/jbr5104/index.html>



The Team

Executive Architect: ka
Design/Interiors Architect: Friedmutter Group
Construction Manager: Whiting-Turner
Structural Engineer: Carroll Engineering, Inc.
MEPT Engineer: JBA Consulting Engineers
Lighting Design: The Lighting Practice

The Building

Occupancy Type: A2 Assembly, B, S1
Type of Construction: Type 1B sprinklered, Noncombustible
Size: 309,450 GSF
Levels Above Grade/Total Levels: 3/3
Approximate Cost: \$400 Million
Dates of Construction: June 2013-September 2014



Casino Entrance at Night



Active Outdoor Plaza

The Systems

Lighting: The lighting in Casino Gold is a mix of pendant, recessed, and strip luminaires. The majority of sources are LED and there are multiple custom chandeliers.

Mechanical: A 15,000 sq. ft. central plant adjacent to the building houses the casino's hydronic systems. Rooftop air handling units and exhaust fans service the casino. Due to the nature of the building, special attention is paid to the smoke control system.

Structural: This is a steel structure with metal framed walls and architectural concrete covering the exterior.

Electrical: 480/277V service begins in the Central Plant with Utility Owned transformers. The service is distributed throughout the casino using both 480/277V and 120/208V panels located in defined electrical rooms.

*All images belong to Friedmutter Group and design team

TABLE OF CONTENTS

ABSTRACT	1
TABLE OF CONTENTS	2
EXECUTIVE SUMMARY	5
ACKNOWLEDGEMENTS	6
PROJECT OVERVIEW	7
Project Team	7
Construction and Cost	8
Codes	8
Building	8
Facade	8
Roofing	8
PROPOSAL OVERVIEW	9
LIGHTING DEPTH	9
Concept	9
Outdoor Plaza Lighting Design	9
Recommended Illuminance Values	10
Required Power Density	10
Lighting Plan and Schedule	10
Calculations	12
AGi.32 Rendering	13
Summary	14
Pre-Function Lighting Design	14
Recommended Illuminance Values	15
Required Power Density	15
Lighting Plan and Schedule	15
Calculations	17
AGi.32 Rendering	18
Summary	19
Poker Room Lighting Design	20
Recommended Illuminance Values	21
Required Power Density	22
Lighting Plan and Schedule	22
Calculations	24
AGi.32 Rendering	25
Summary	25
Player's Lounge Lighting Design	26
Recommended Illuminance Values	27
Required Power Density	27

Lighting Plan and Schedule	27
Calculations	29
AGi.32 Rendering	30
Summary	31
ELECTRICAL DEPTH	32
Existing Electrical Information	32
Connected Building Loads	32
Power Company Rate Schedule	32
Building Utilization Voltages	32
Emergency Power Distribution System	33
Changes to Existing Panels	33
Outdoor Plaza	34
Pre-Function	35
Poker Room	36
Player's Lounge	37
Photovoltaic Array	38
Specify a Location	38
Selecting a Solar Module	39
Selecting an Inverter	40
Calculate Array Size	41
Data Output	42
Summary	42
CONSTRUCTION BREADTH	43
Cost	43
RS Means Values	43
Costs Specific to Casino Array	43
Schedule	44
Estimated Construction Times	44
Conclusion	45
STRUCTURAL BREADTH	45
Dead Loads	45
Live Loads	45
Roof Deck	45
Current Roof Joist	45
Evaluation of the Roof Joist	46
Choosing a New Roof Joist	46
Evaluation of Joist Girder	46
Evaluation of a Column	46
Conclusion	46
APPENDIX A – LUMINAIRE DATA SHEETS	47
APPENDIX B – SOLAR EQUIPMENT DATA SHEETS	48

APPENDIX C – STRUCTURAL CALCULATIONS 49

EXECUTIVE SUMMARY

The lighting depth covers the redesign of four spaces within the main casino building: The Outdoor Plaza, Pre-function space, Poker Room, and Player's Lounge. Each space has its own description in the lighting depth for recommended illuminance recommendations, code requirements, lighting equipment schedule, lighting plan, AGi.32 calculations and a summary. The illuminance recommendations are referenced from the IES Lighting Handbook, 10th Edition. ASHRAE 90.1 is used for the code requirements.

The final lighting design for the Outdoor Plaza guides casino guests towards the entrance while creating a safe environment through the use of overhead string lights. The Pre-Function space, adjacent to the multi-purpose room, uses cove lighting in the recessed ceilings areas to create a psychological impression of spaciousness. In the poker room an environment similar to a workspace has been designed through a combination of recessed down lights and large pendants. Finally, in the Player's Lounge an intimate social setting is the result of custom pendant luminaires and unique indirect linear luminaires.

In the electrical depth, four panels were modified to contain the new loads that resulted from the lighting redesign. While most loads fit on one branch circuit, a couple of them were spread across all three phases. Each new load was added so that the current fuses could remain on the panel. The lighting loads were not large enough to change any of the feeder sizes for the panels. Also in the electrical depth is an analysis of a proposed solar array for the roof of the casino. The analysis includes monthly data for the electrical production of the array based on TMY weather data.

With the new solar array comes a new load on the roof of the casino. A structural breadth evaluates the roof decking, roof joists, joist girders, and columns of the casino's third level. The calculations show that the members of the third level are adequate for the new load, except the roof joists. The roof joists had to be increased in size from 39LH09 to 39LH11. The written calculations are included in Appendix C.

A construction breadth is included in the report that details the labor and material costs of installing the new solar array. A 10 day schedule was achieved with the RS Means 2014 release values. The installation is not expected to significantly impact the 18 month construction schedule of the casino.

ACKNOWLEDGEMENTS

I would like to thank each and every individual who has helped me throughout this year long project.

A special thank you:

Mr. Shawn Good – Senior Thesis Advisor

Ms. Leslie Beahm – Senior Thesis Electrical Advisor

Dr. Kevin Houser – AE Lighting Professor

Dr. Richard Mistrick – AE Lighting Professor

Professor Kevin Parfitt – Director of Senior Thesis

JBA Consulting Engineers – Las Vegas, NV

*And of course a big thank you is in order for my family and fiancé. You have helped me the entire way through five years of Architectural Engineering with your love and support.

PROJECT OVERVIEW

Casino Gold is a three level casino located in the eastern United States. The building is 309,450 sf and has three levels. The first two levels house gaming, dining, a multi-function space, a World Series of Poker Room, and even private gaming areas. The third level is mainly offices for the employees of the casino.

The project site contains three structures. They include a main casino building, a large parking garage, and a separate central services plant. The parking structure is connected to the casino with two bridges. One bridge is for the guests while the other is a smaller, service bridge. The site plan seen below shows the layout of the site.

Note: The name of the casino and the location are withheld from this report per the owner's request.

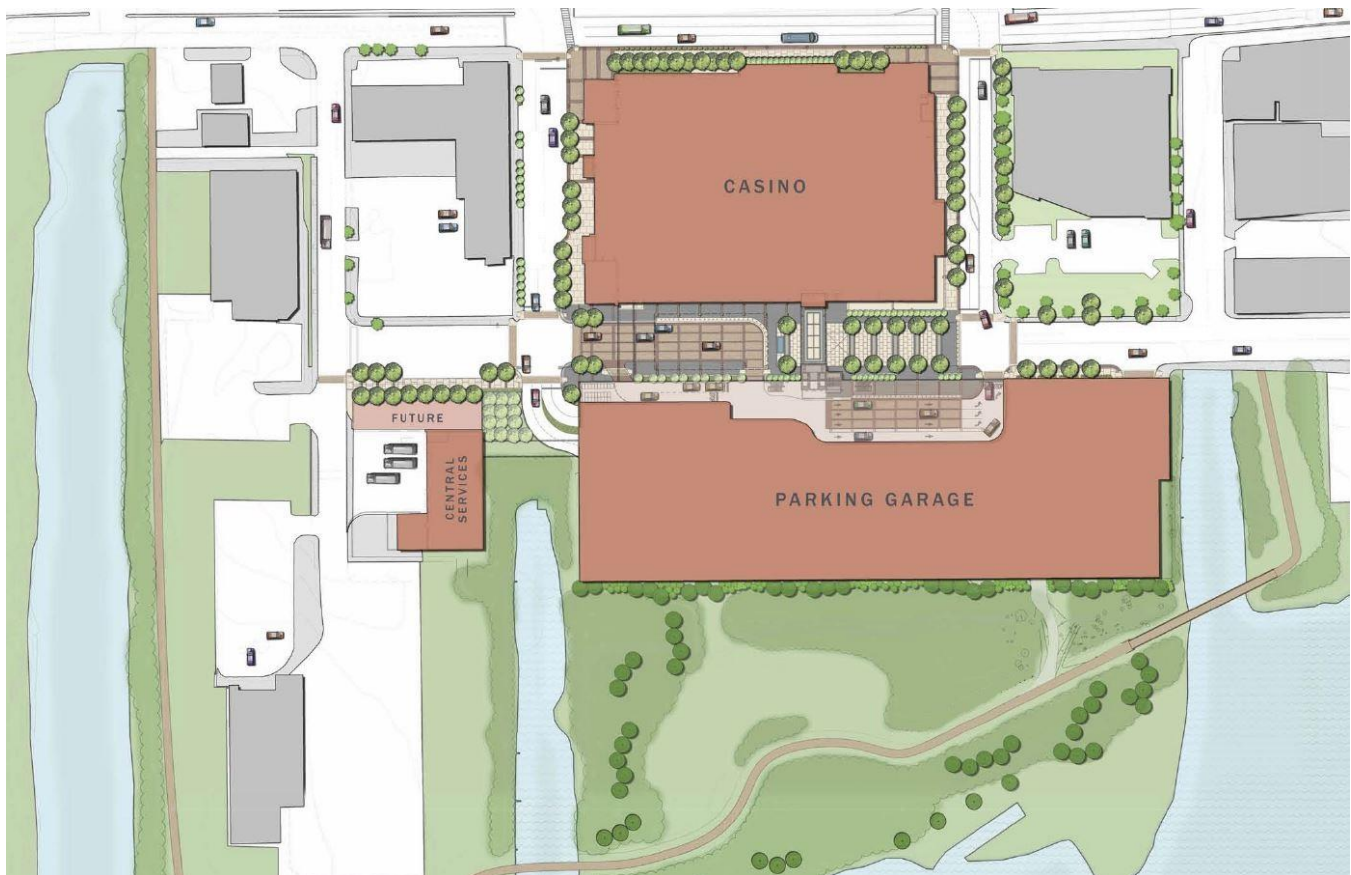


Photo Credit: Friedmutter Group

Project Team

Executive Architect: ka

Design/Interiors Architect: Friedmutter Group

Construction Manager: Whiting-Turner

Structural Engineer: Carroll Engineering, Inc.

MEPT Engineer: JBA Consulting Engineers

Lighting Design: The Lighting Practice

Construction and Cost

Approximate cost: \$400 million

Approximate dates of construction: January 2013 – July 2014

Project delivery method: Design-Bid-Build

Codes

Major national codes: International Building Code

ASHRAE 90.1

International Mechanical Code

National Electric Code

International Plumbing Code

Building

Occupancy type: A2 Assembly, B, S1

Type of construction: Type 1B sprinklered, Noncombustible, Protected

Size: 309,450 sq. ft.

Levels above grade/Total levels: 3/3

Facade

The building façade is a mostly prefabricated architectural concrete on top of a vapor barrier, and metal studs, with batt insulation. The main entranceways of the casino have glass curtain wall systems with metal framing.

Roofing

The majority of the roofing for the casino is type RFA1, with the construction:

Single ply TPO roof membrane

R-25 minimum rigid insulation

Sheathing board

1 ½" Metal Decking on steel structure

The next largest area of roofing is type RFA2, with the construction:

Single ply TPO roof membrane

Protection Board

R-25 Minimum rigid insulation

Vapor Retarder

3 ¼" Concrete

3" Metal decking on steel structure

PROPOSAL OVERVIEW

The focus of my Senior Thesis Project is on the lighting and the electrical systems within the main casino. The following report will include a lighting re-design of four different spaces within the casino as well as changes to the electrical system. Breadth topics such as construction and structural will also be included. The goal of this capstone project is to provide alternative solutions to the great designs already in place, for the academic purpose of individual learning.

LIGHTING DEPTH

Concept

The atmosphere inside of a casino is very much centered on a social experience. Whether you are enjoying a night out with your friends or you end up meeting complete strangers while playing your favorite game, people are always connecting with each other. The concept for Casino Gold's lighting design will be "Connecting with People." During our daily lives we are constantly connected to others through social media, email, and messaging. With all of this technology it can be easy to forget that face-to-face interaction with others is still important. A strong design that focuses on intimacy in certain spaces, and excitement in others, will be able to bring people together.

Outdoor Plaza Lighting Design

The outdoor plaza for Casino Gold is one of the first parts of the casino that guests will encounter. It is important to create a great first impression with arriving guests. This will most likely be a meeting spot for many visitors and it will be used at all hours of the day. Due to the twenty-four hour nature of the casino, safety at night is a top priority for this space. The materials present in the Outdoor Plaza are relatively simple, as it is mostly concrete and stone work. The plaza is lined with tree planters that provide an extra element for the lighting design. The Outdoor Plaza is located between the parking garage and the casino at ground level.

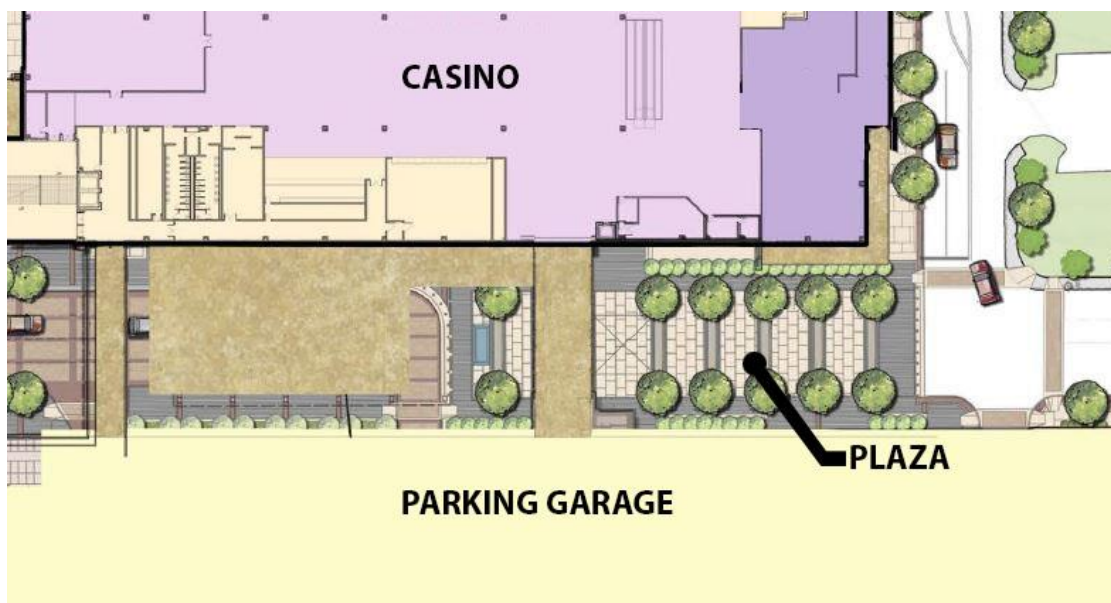


FIGURE 1 - PLAZA LOCATION

Recommended Illuminance Values

The recommended illuminance values are referenced from the Illuminating Engineering Society's *The Lighting Handbook*, 10th Edition. The values for the outdoor plaza can be found in Table 34.2. For an outdoor plaza of a single commercial establishment the recommended illuminance values are taken from the low activity Plaza section.

Horizontal (E_h) Targets	Vertical (E_v) Targets	Average/Minimum Ratio
4 lux	2 lux	5:1

Required Power Density

The code requirements for power density are referenced from ASHRAE 90.1. The table pertaining to exterior lighting is Table 9.4.3B. The plaza is considered a Zone 3 and the lighting power allowance is

Building grounds					
Walkways less than 10 ft wide	No allowance	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
Walkways 10 ft wide or greater Plaza areas Special feature areas	No allowance	0.14 W/ft ²	0.14 W/ft ²	0.16 W/ft ²	0.2 W/ft ²
Stairways	No allowance	0.75 W/ft ²	1.0 W/ft ²	1.0 W/ft ²	1.0 W/ft ²
Pedestrian tunnels	No allowance	0.15 W/ft ²	0.15 W/ft ²	0.2 W/ft ²	0.3 W/ft ²
Landscaping	No allowance	0.04 W/ft ²	0.05 W/ft ²	0.05 W/ft ²	0.05 W/ft ²

0.16 W/ft². The approximate area of the plaza is 17,600 ft².

Lighting Plan and Schedule

As a result of the additional criteria for safety and guidance, the lighting design for the Outdoor Plaza makes use of overhead string lights. This overhead light not only renders the faces of guests for safety, but it also creates an inviting atmosphere for people to gather under. Attracting guests to gather and socialize is a main goal of the overall lighting design for this project and ties into the concept of bringing people together quite well. Ground mounted bollard lighting is also used to line the plaza and create a pathway to the entrance of the main casino building. Manufacturer data sheets for the selected luminaires can be found in Appendix A.

Type	Model	Description	Manufacturer	Lamp Type	Input Volts	Input Watts	No. Used
P1	KBA8	3ft tall, 8" round, LED bollard	Lithonia	LED	120	31	24
P2	ML2000-CA	String Light	Cali	LED	120	2.5	128

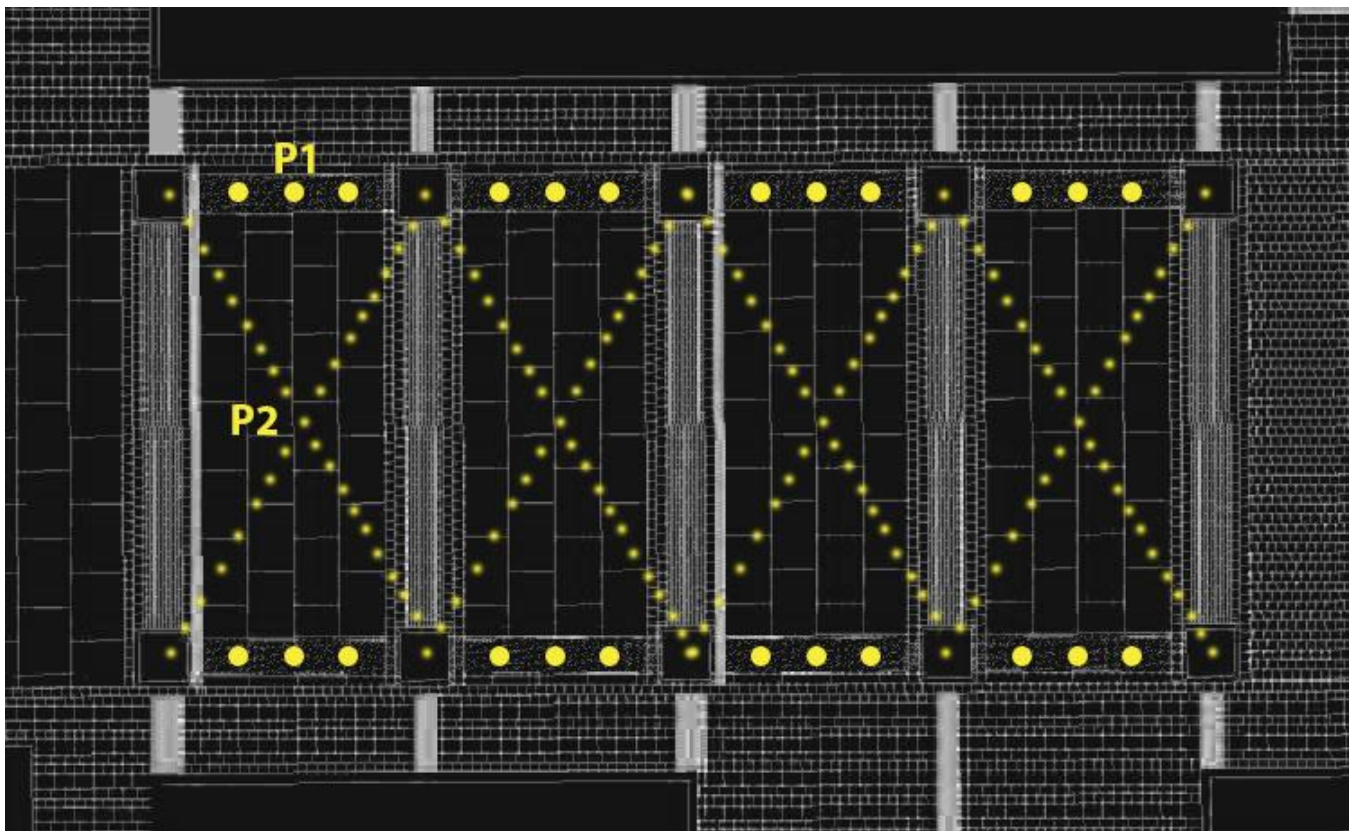
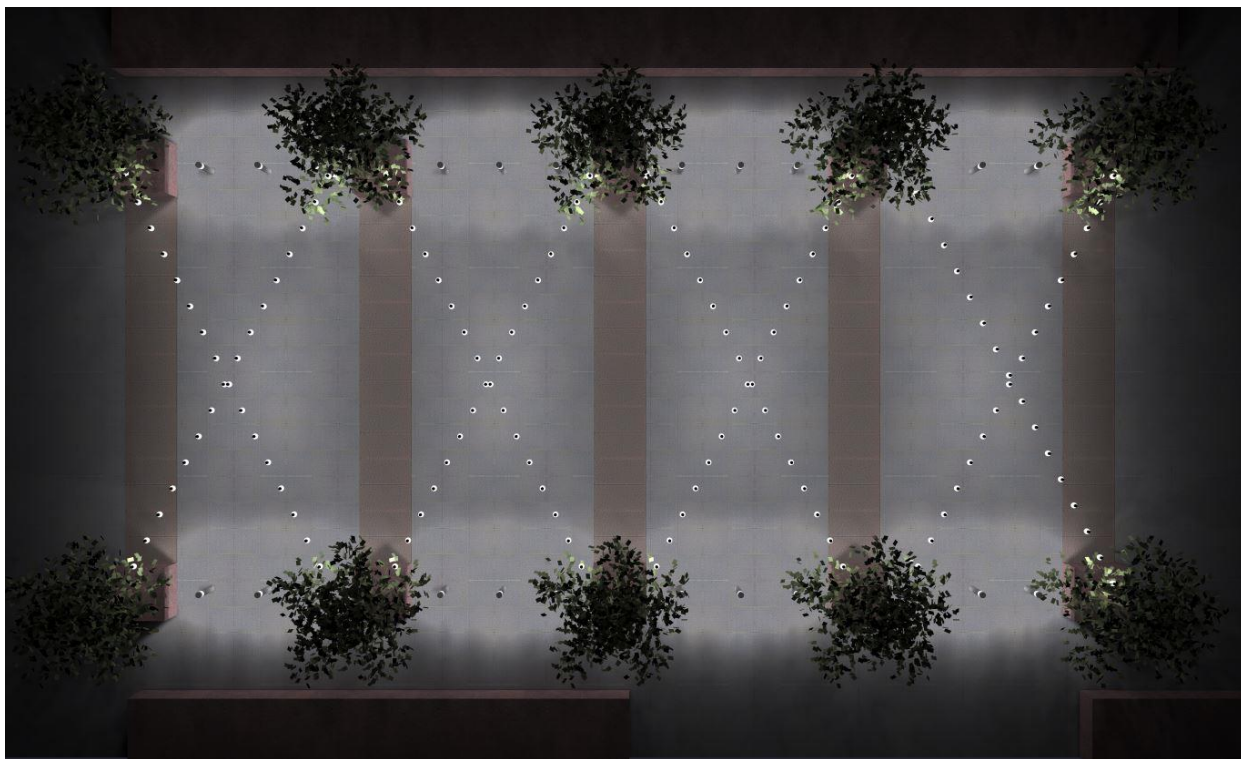


FIGURE 2 - PLAZA LIGHTING PLAN

The bollards have a height of 3ft and line the plaza. The string lights are stretched across the plaza from tree to tree using poles located in the planters. They are 12ft above the ground level in the plaza.



Calculations

AGi.32 was used to analyze the space and calculate the illuminance values of the final design. The following pseudo color rendering shows an even distribution of light across the plaza.

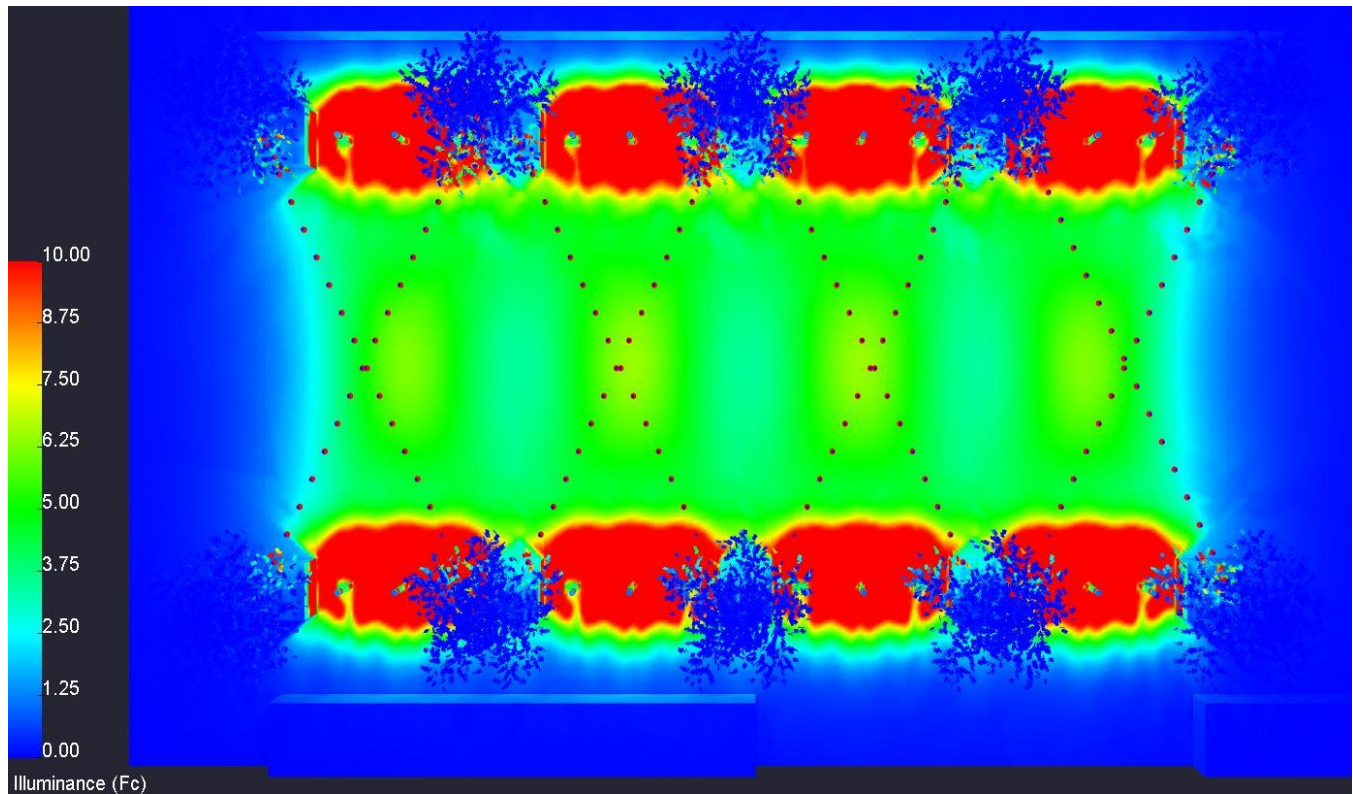


FIGURE 3 - PLAZA PLAN VIEW



The calculated illuminance average of 5fc meets the recommendation level. The average to minimum ratio is less than 5:1, showing that the plaza is appropriately designed. The total consumption of power for the plaza is approximately 1,064W and the area is 17,600ft². This leads to a calculated power density of 0.06 W/ft², well below the ASHRAE 90.1 requirement of 0.16 W/ft².

AGi.32 Rendering



FIGURE 4 - PERSPECTIVE

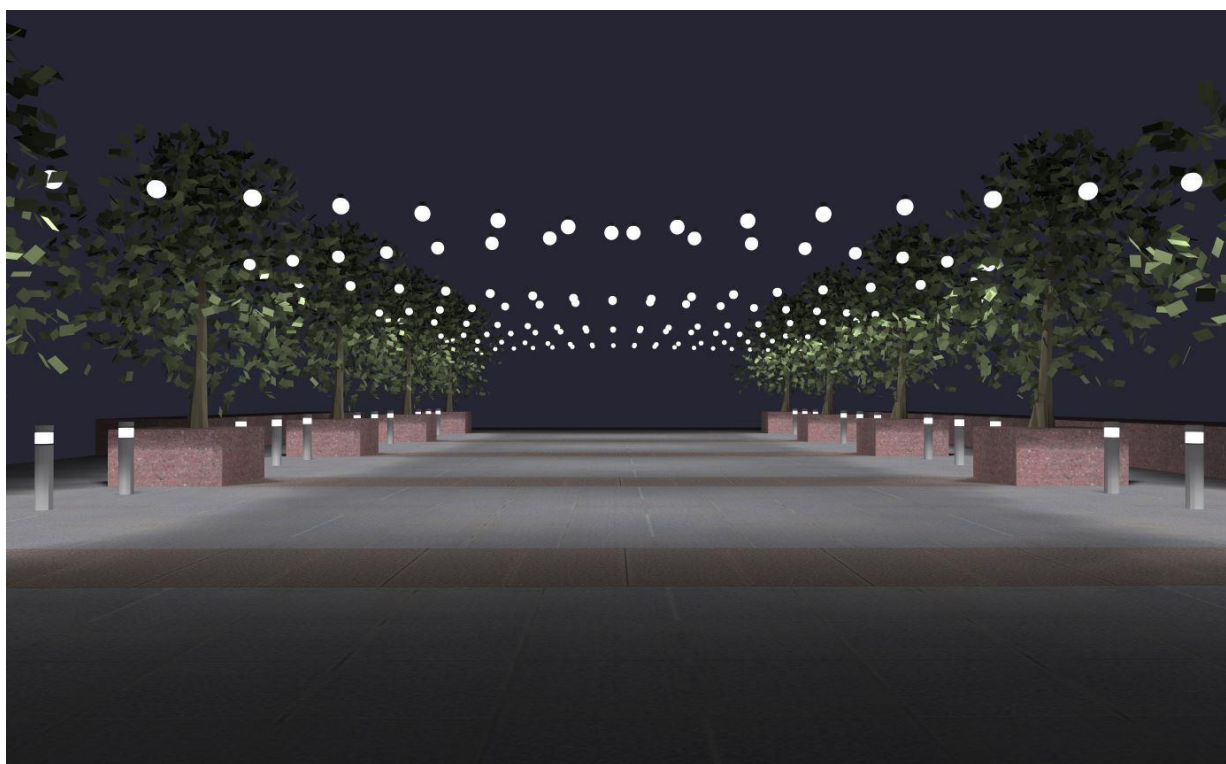


FIGURE 5 - GUEST VIEW

Summary

The final design for the outdoor plaza includes LED bollards as well as string lights. The lighting achieves the main criteria of safety and guidance. With the architectural lighting overhead, guests have an inviting place to meet and socialize with friends outside of the casino. The string lights also serve a functional purpose of helping to render guests faces for safety of others, and the bollards guide guests along the plaza to the main entrance of the casino. The AGi.32 calculations show that the final design meets the IES recommendations with an average horizontal illuminance of 5fc. Finally, the 0.06 W/ft² power density of the plaza is well below the ASHRAE 90.1 code limit of 0.16 W/ft².

Pre-Function Lighting Design

Once guests have entered the first level of the casino, they may need to attend a dinner, meeting, or event in the multi-purpose room. While waiting for these events to begin it is likely that the guests will occupy the pre-function space. The Pre-Function space is located on the first level of the casino and it is adjacent to the multi-purpose room.

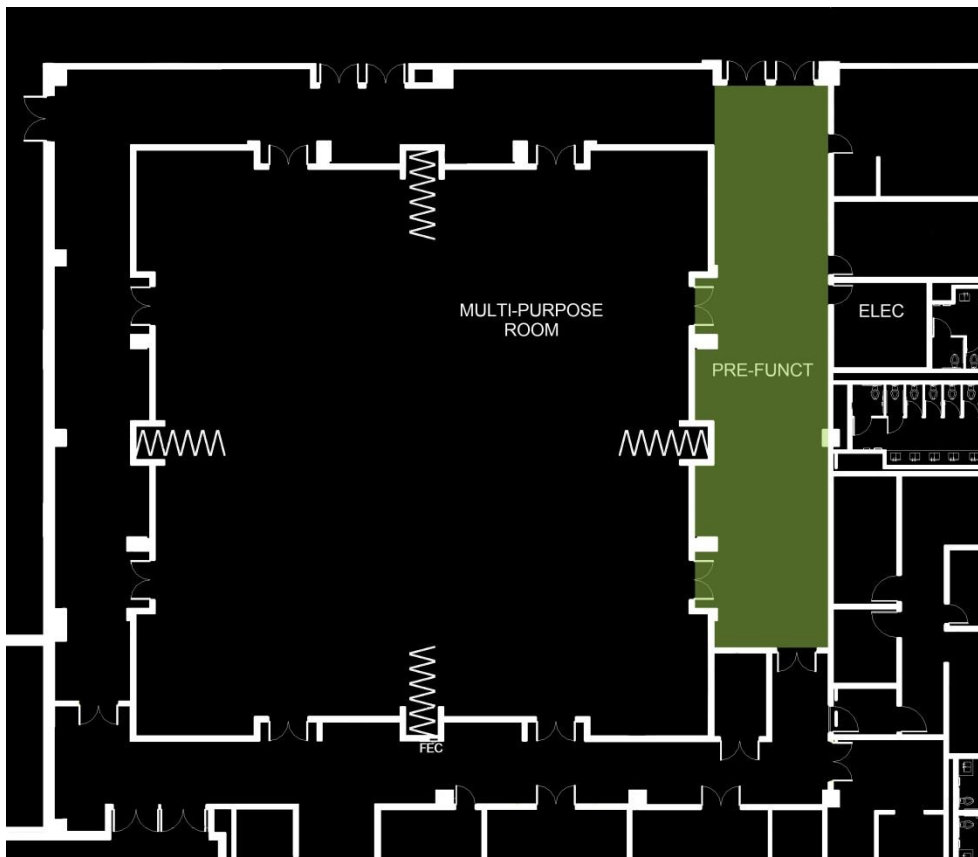


FIGURE 6 PRE-FUNCTION LOCATION

The lighting design in the Pre-Function space makes use of the architectural features present such as ceiling coves and overhangs. The materials include carpet flooring, painted GWB, and dark woodwork around the two entrances into the multipurpose room. The lighting design is meant to create an impression of spaciousness for the guests that will be gathering in the space during events.

Recommended Illuminance Values

The recommended illuminance values are referenced from the Illuminating Engineering Society's *The Lighting Handbook*, 10th Edition. The values for the Pre-Function space can be found in Table 28.2. The recommended values for the space range from 50 lux with general circulation to 200 lux for registration tables. For this particular design the desired illuminance target is for times of high activity before and after functions in the multi-purpose room.

Horizontal (E_h) Targets	Vertical (E_v) Targets	Average/Minimum Ratio
300 lux (max)	2 lux	4:1

Required Power Density

The code requirements for power density are referenced from ASHRAE 90.1. The table pertaining to space-by-space method interior lighting is Table 9.6.1. The Pre-Function space is assumed to be a common space type of Corridor/Transition for this analysis which results in a lighting power allowance of 0.66 W/ft². The approximate area of the Pre-Function space is 1,980 ft².

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types ^a	LPD, W/ft ²	RCR Threshold
Corridor/Transition	0.66	Width < 8 ft

Lighting Plan and Schedule

The lighting design for the Pre-Function space makes use of the given architectural features such as the overhangs above the doorways and the coves surrounding the recessed ceilings. Wall washing luminaires are used to highlight the areas of wall that will contain artwork. Recessed downlights are located above the entrances to the multi-purpose room to create a visual point of interest. Custom pendant luminaires line the middle of the Pre-Function space and add to the overall illumination level in the space without adding glare or significant shadows. Cove luminaires are used in the areas of recessed ceiling surfaces to create a psychological impression of spaciousness for the guests.

Type	Model	Description	Manufacturer	Lamp Type	Input Volts	Input Watts	No. Used
F1	SQHZW	6" square lensed wallwash	Gotham	HID	120	86.6	4
F2	DoM6	6" round recessed downlight	Lithonia	LED	120	15.6	4
F3	107-P	Fabric covered pendant, square cylinder	Shaper	T5	120	93	4
F4	iW Cove MX	4ft cove accent with intelligent white light controls	Philips	LED	120	20.7	22

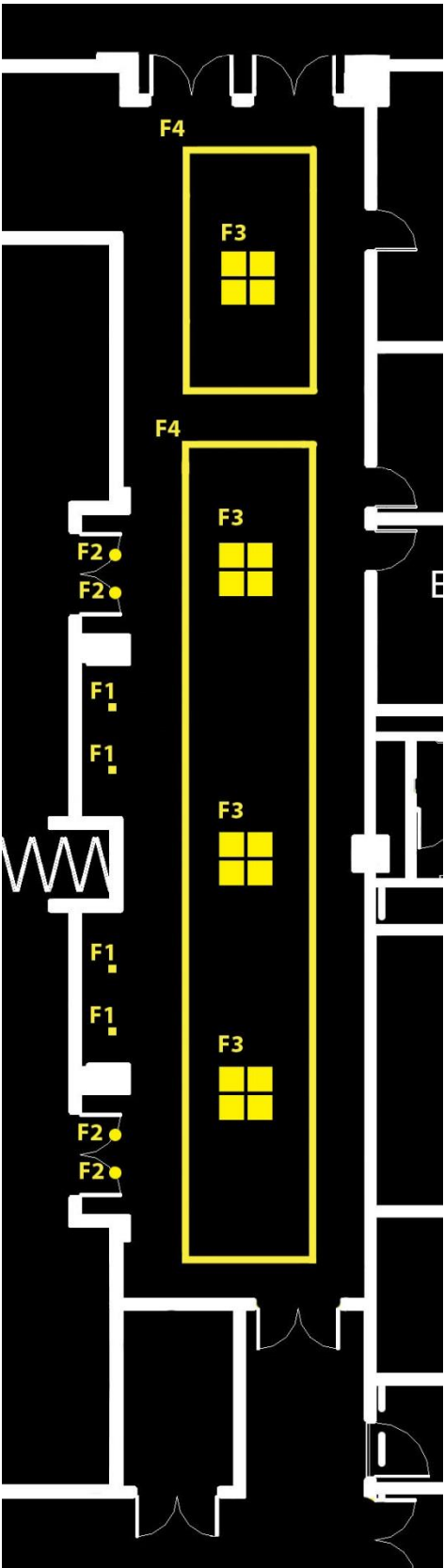


FIGURE 7 PRE-FUNCTION LIGHTING PLAN

Calculations

AGi.32 was used to analyze and calculate the illuminance values of the final design. The following pseudo color rendering shows an even distribution of light across the Pre-Function space.

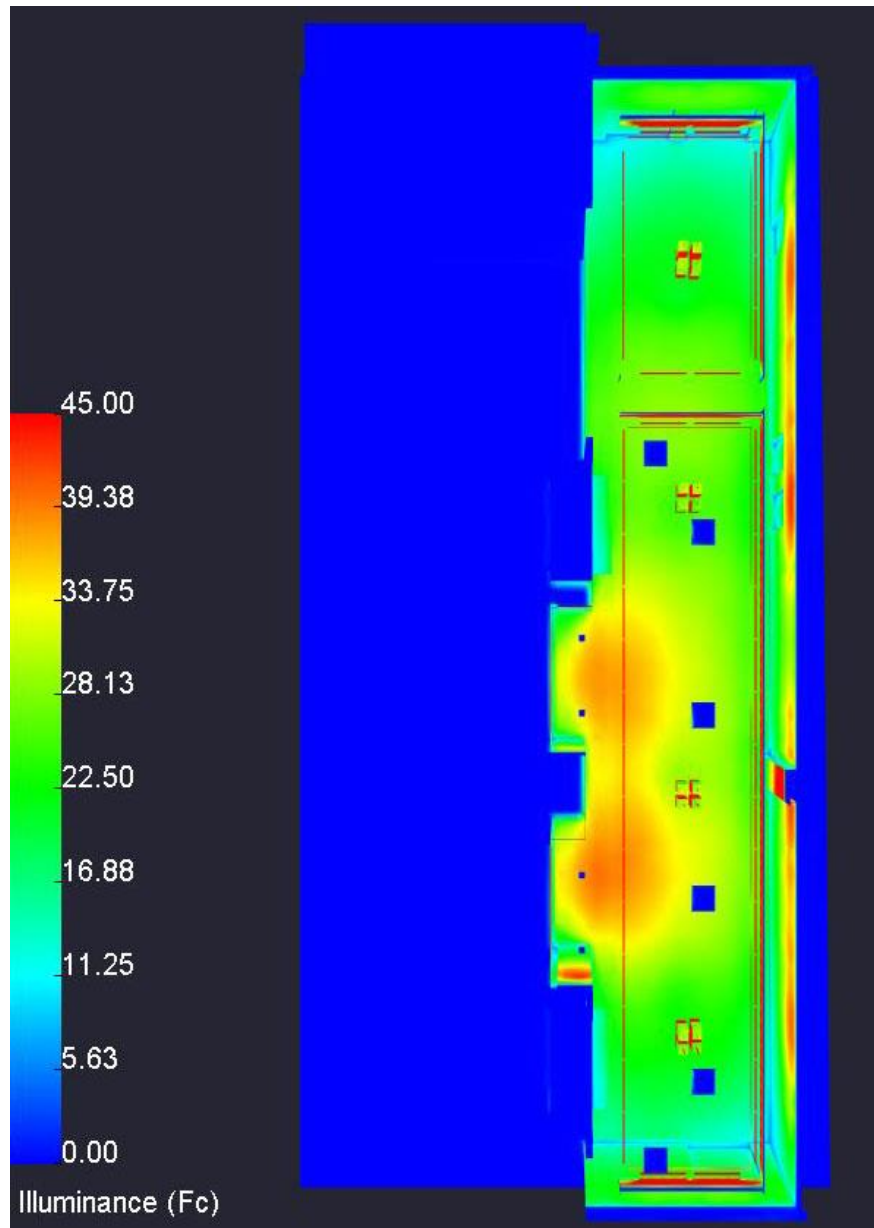


FIGURE 8 PRE-FUNCTION PLAN VIEW



The calculated illuminance average of 30fc meets the selected design criteria for the Pre-Function space. The average to minimum ratio is only 1.95, much less than the recommended 4:1 ratio. The total consumption of power for the Pre-Function space is approximately 1,236W and the area is 1,980ft². This leads to a calculated power density of 0.62 W/ft², which is just below the ASHRAE 90.1 requirement of 0.66 W/ft².

AGi.32 Rendering

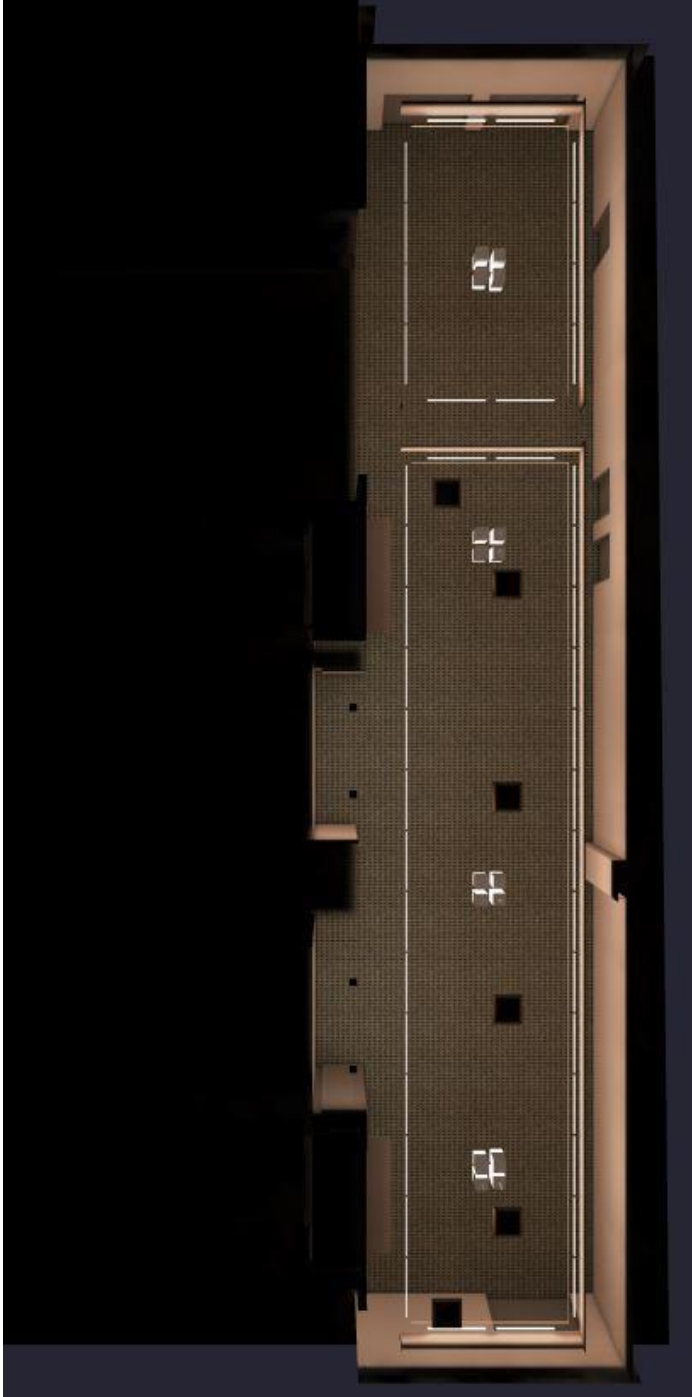


FIGURE 9 PRE-FUNCTION PLAN VIEW

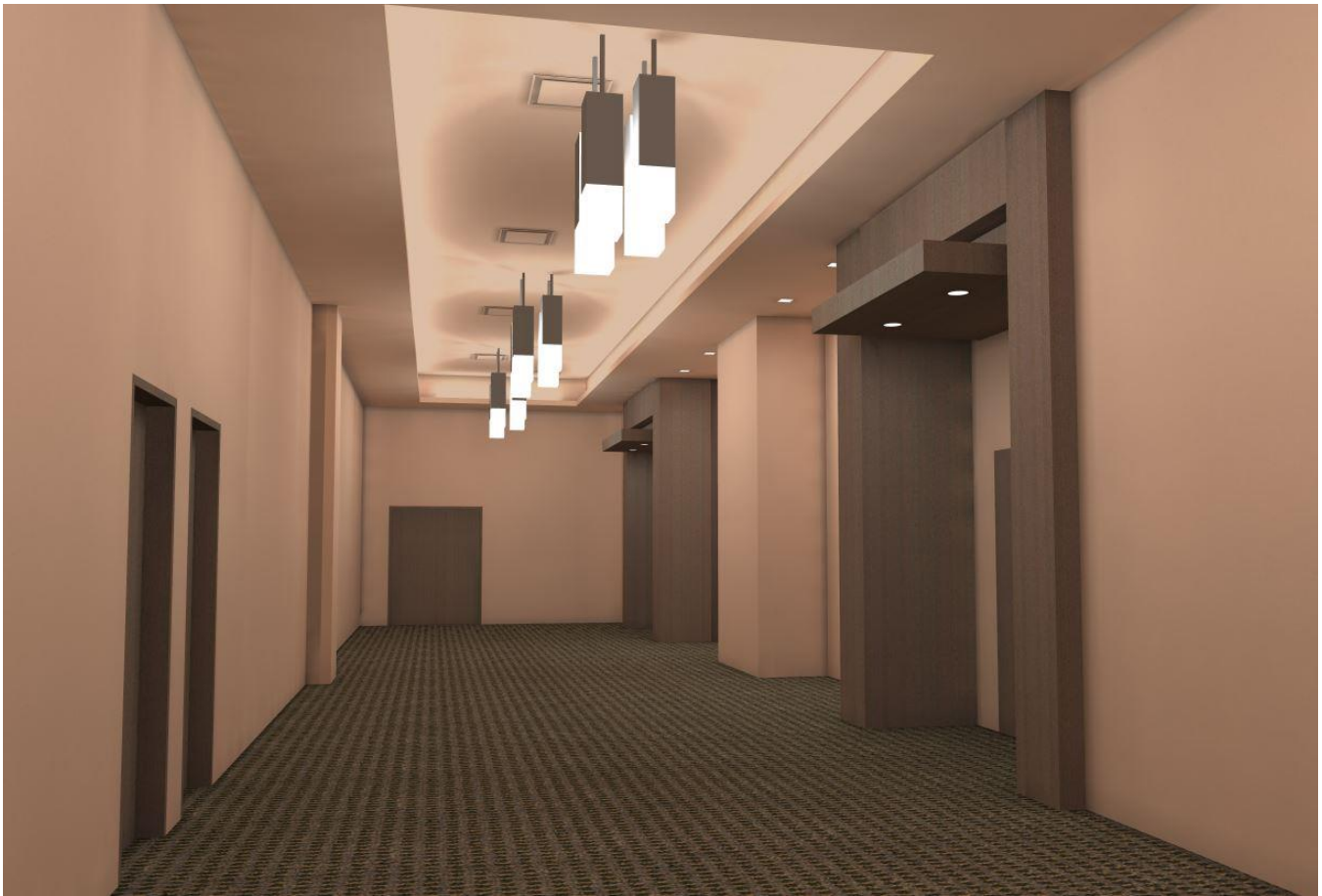


FIGURE 10 PRE-FUNCTION GUEST VIEW

Summary

The final design for the Pre-Function space meets the design goals and criteria. This is a flexible space that can be used for many different functions taking place inside of the adjacent multi-purpose room. The cove lighting for the recessed ceiling creates the feeling of a more spacious area for guests to enjoy their social interaction before events. The pendant luminaires are a great addition to the space with their unique fabric covers and alternating suspension lengths from the ceiling. The AGi.32 calculations show that the final design meets the IES recommendations with an average horizontal illuminance of 30fc. Finally, the 0.62 W/ft² power density of the Pre-Function space is below the ASHRAE 90.1 code limit of 0.66 W/ft².

Poker Room Lighting Design

A poker room is about as close to a workspace as a casino will have. Players grind away at these tables for hours on end, often without leaving their seats. A space this heavily used must be visually comfortable so occupants will stick around for the long haul.

The World Series of Poker Room is located in the southeast quadrant of the second level in the casino. The floor space in the Poker Room is approximately 8,100 sq. ft. and is split into two areas. One area is for general poker games, while the other smaller area is for high-limit games or special events. The high-limit area is raised two steps above the main area and is bordered by a railing as well as an accessible ramp. The bar in the lower right corner of the plan view is not included in this design.

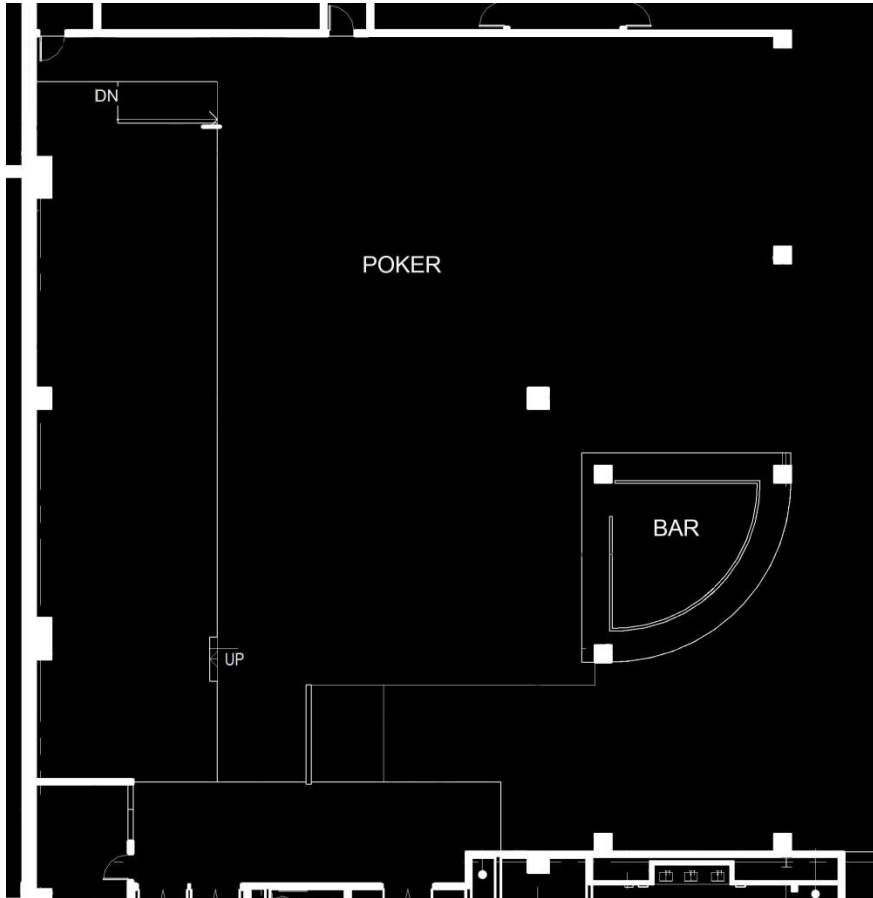


FIGURE 11 - POKER PLAN VIEW

The walls in the poker room use dark colored wood to border painted areas of GWB as well as artwork and televisions. Ceilings in the Poker Room are 15' tall with 16' recessed squares that are bordered with more dark wood trim.

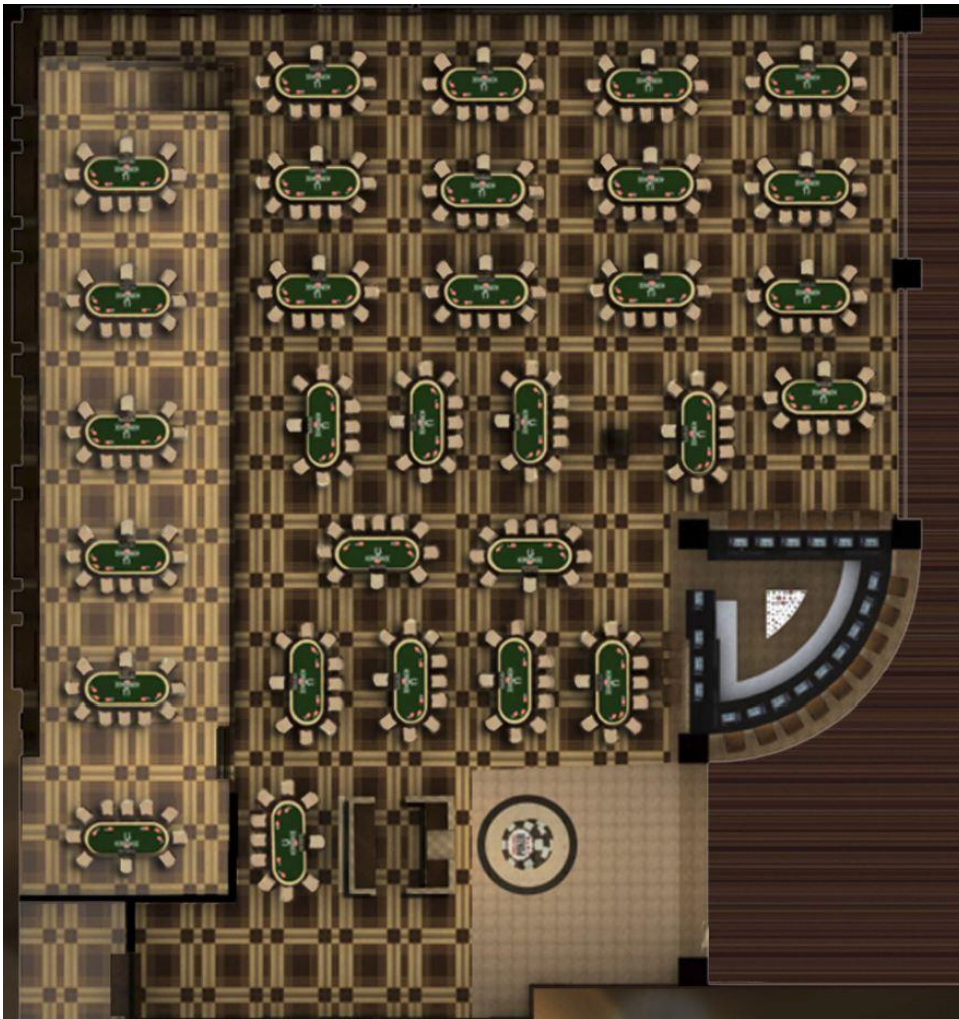


FIGURE 12 - POKER FURNITURE LAYOUT *IMAGE COURTESY OF FRIEDMUTTER GROUP AND DESIGN TEAM

The goal of the lighting design for the Poker Room is to provide a comfortable environment for the players, especially because many players can be there for hours on end. Discipline coordination is important for the construction of this space because the proposed lighting design cannot interfere with the view of security cameras. Mechanical devices such as diffusers have to be accounted for when designing the layout of the downlights and pendants in the space.

Recommended Illuminance Values

The recommended illuminance values are referenced from the Illuminating Engineering Society's *The Lighting Handbook*, 10th Edition. The values for the Poker Room can be found in Table 28.2. The exact recommended values depend on the individual casino and their security specialist. With that in mind, the assumption is made that the Poker Room will follow the recommended illuminance values of lounges containing table games in Table 28.2. The average to minimum ratio is found in Table 12.6.

Horizontal (E_h) Targets	Vertical (E_v) Targets	Average/Minimum Ratio
300 lux	50 lux	5:1

Required Power Density

The code requirements for power density are referenced from ASHRAE 90.1. The table pertaining to space-by-space method interior lighting is Table 9.6.1. A poker room is not a very typical space so it is not listed specifically in the table. For this design it is that the Poker Room has the same power density requirements of a classroom, which results in a lighting power allowance of 1.24 W/ft². The reason why the classroom/lecture/training designation is assumed is because the tasks for the space are similar. Players need appropriate levels of light to read the faces of cards just the same as a student needs to read a book in class. The approximate area of the Poker Room is 8,100 ft².

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types ^a	LPD, W/ft ²	RCR Threshold
Classroom/Lecture/Training	1.24	4

Lighting Plan and Schedule

The lighting design for the Poker Room aims to create a workspace for players. Wall washing luminaires are used to highlight the areas of wall that will contain artwork. Compact fluorescent wall washing luminaires have been chosen for their color rendering qualities of the artwork and woodwork throughout the room. Recessed downlights are located throughout the entire poker room to avoid shadowing or pools of light as best as possible. Pendant luminaires are located in each of the recessed ceiling bays and provide indirect/direct light to the poker tables. Decorative wall drum luminaires are also included on the columns in the high-limits area of the lighting design.

Type	Model	Description	Manufacturer	Lamp Type	Input Volts	Input Watts	No. Used
PK1	SQFW	6" Square Lensed Wallwash	Gotham	CFL	120	32.5	12
PK2	Ortwin	Decorative wall drum	Winona	CFL	120	32.2	3
PK3	DoM8	8" recessed round downlight	Lithonia	LED	120	27.5	123
PK4	Apollo	43" diameter bowl pendant	Winona	CFL	120	186	14

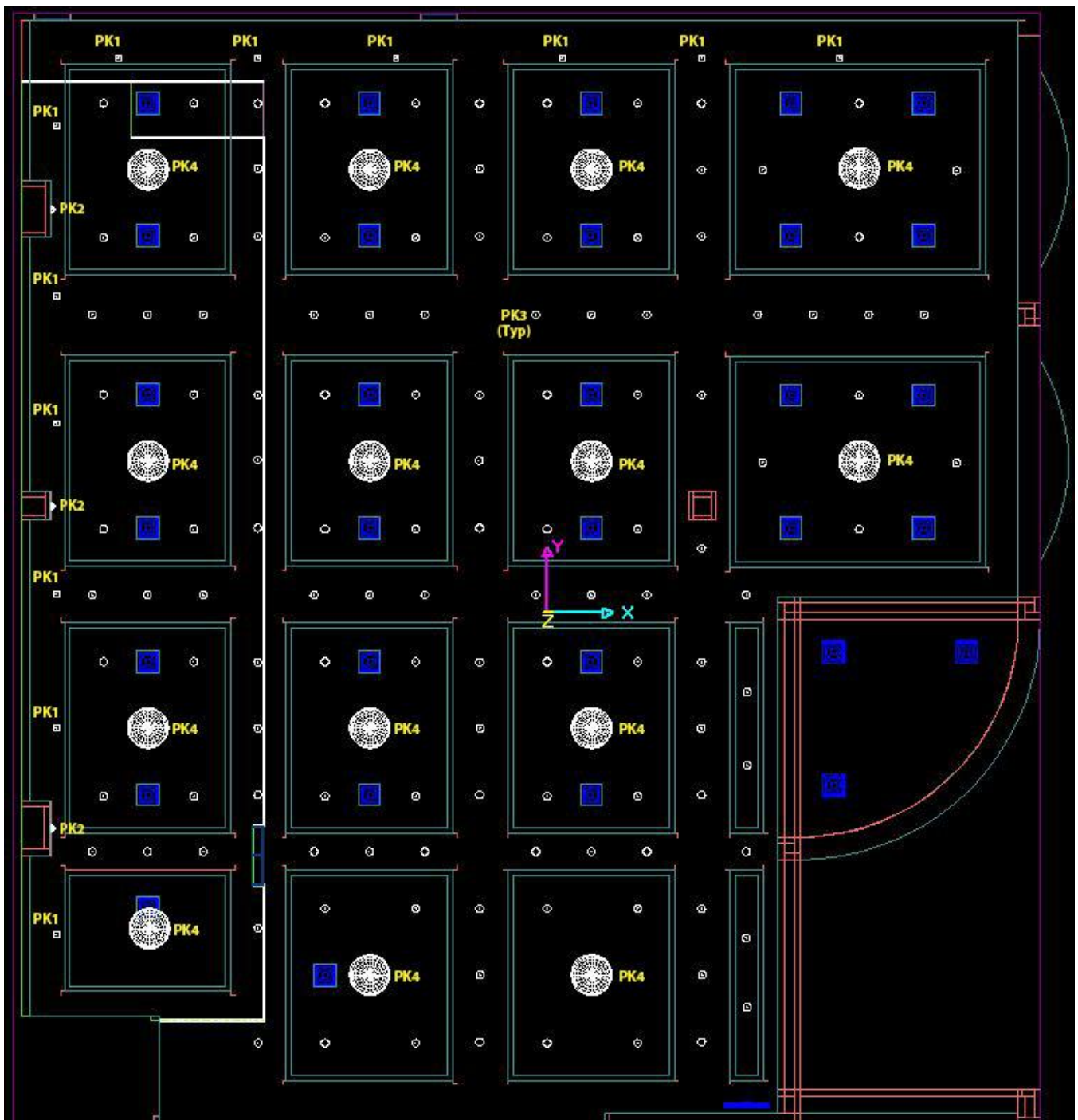


FIGURE 13 - POKER ROOM LIGHTING PLAN

Calculations

AGi.32 was used to analyze and calculate the illuminance values of the final design. The following pseudo color rendering shows an even distribution of light across the Poker Room.

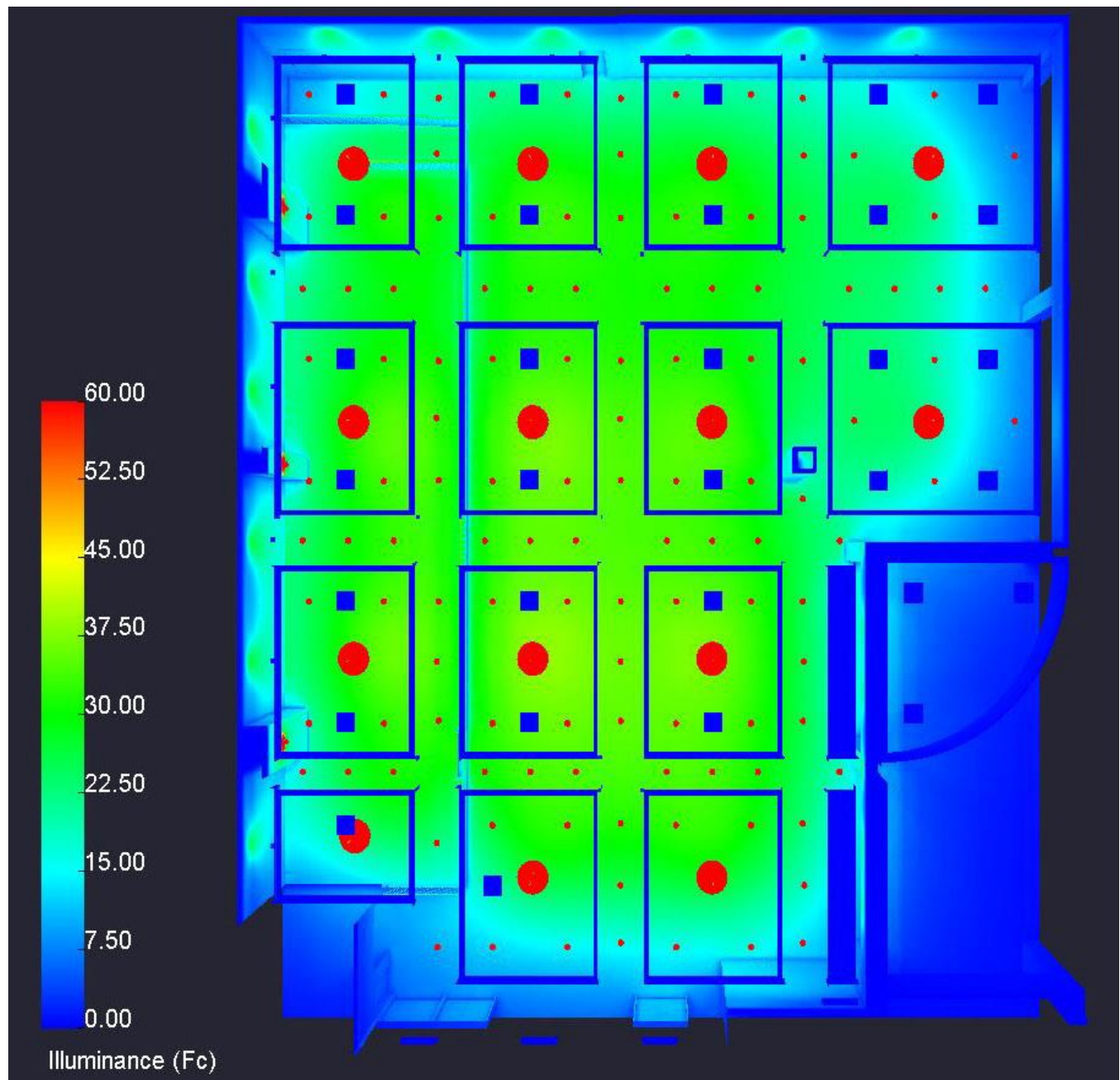


FIGURE 14 - POKER ROOM PLAN VIEW



The calculated illuminance average of 32fc meets the selected design value for the Poker Room. Also, the average to minimum ratio is only 1.85, which is much less than the recommended 5:1 ratio. The total consumption of power for the Poker Room is approximately 6,473W and with an area of 8,100ft² for this design. This leads to a calculated power density of 0.80 W/ft², which is below the ASHRAE 90.1 requirement of 1.24 W/ft².

AGi.32 Rendering



FIGURE 15 - POKER GUEST VIEW

Summary

The final lighting design for the Poker Room creates a workspace for the players. This is a room that will be used constantly by guests and the lighting will hold up to the task. With all of the wood finishes located throughout the Poker Room it was important to include fluorescent luminaires close to those surfaces to best render the wood color and texture. The LED downlights located across the entire ceiling ensure an even distribution of light to minimize shadows on the tables. This lighting design achieved that goal with a low average to minimum illuminance ratio of 1.85. The AGi.32 calculations show that the final design meets the IES recommendations with an average horizontal illuminance of 32fc. Finally, the 0.80

W/ft² power density of the Poker Room is well below the assumed ASHRAE 90.1 code limit of 1.24 W/ft².

Player's Lounge Lighting Design

The Player's Lounge brings the "Connecting with People" concept full circle by creating an intimate setting for the guests to visit and interact with each other. This is one of the few places in the casino that the owner can make a profit from beverage sales, so the lighting design of the bar within the Player's Lounge is used to attract guests from outside of the lounge. It is located in the southwest quadrant of the casino's second level.



FIGURE 16 - PLAYER'S LOUNGE LOCATION

The goal of the lighting design for the Player's Lounge is to provide an inviting setting that draws guests into the space and keeps them there. The bar is the main focus from outside of the space and so is the wall surrounding the entrance. It gives guests a glimpse of the interior and tempts them to enter.

Recommended Illuminance Values

The recommended illuminance values are referenced from the Illuminating Engineering Society's *The Lighting Handbook*, 10th Edition. The values for the Player's Lounge can be found in Table 22.2. A lounge can be found under the section of Food Service for Common Applications.

Horizontal (E_h) Targets	Vertical (E_v) Targets	Average/Minimum Ratio
100 lux (lounge area)	50 lux	3:1
50 lux (back bar)	20 lux	3:1

Required Power Density

The code requirements for power density are referenced from ASHRAE 90.1. The table pertaining to space-by-space method interior lighting is Table 9.6.1. A lounge can be found under Dining Area, which results in a lighting power allowance of 1.31 W/ft². The approximate area of the Player's Lounge is 1,556 ft².

TABLE 9.6.1 Lighting Power Densities Using the Space-by-Space Method

Common Space Types ^a	LPD, W/ft ²	RCR Threshold
Dining Area	0.65	4
For Bar Lounge/Leisure Dining	1.31	4

Lighting Plan and Schedule

The lighting design for the Player's lounge is centered on the guest experience and social interaction. This connection with people is based directly off the casino's lighting concept. Pendant luminaires create intimate seating areas for small groups of guests in the lounge area. Cove lighting provides a soft glow while highlighting the unique architectural features of the ceiling above the guests. Suspended linear luminaires provide an indirect light about the space between the seating and the bar so that glare is not an issue. Behind the bar the coves are illuminated to draw attention to it from people just outside looking in.

Type	Model	Description	Manufacturer	Lamp Type	Input Volts	Input Watts	No. Used
L1	Ortwin	36" drum with custom finish	Winona	CF	120	94	2
L2	iW Cove MX	4ft linear cove with intelligent white light	Philips	LED	120	20.7	8
L3	LL1MA	Indirect/direct linear suspended	Peerless	T8	120	30.5	28

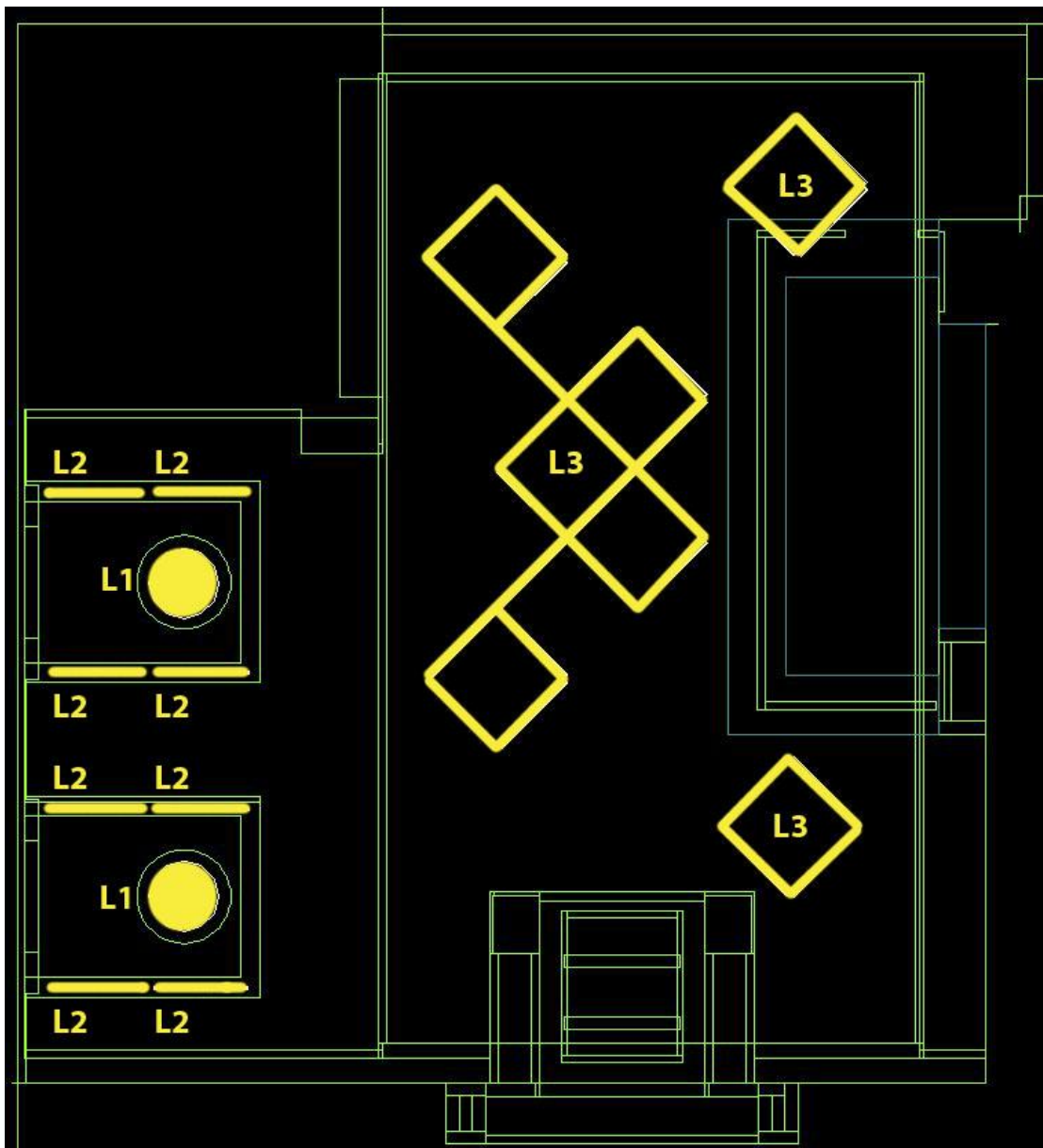


FIGURE 17 - LIGHTING PLAN

Calculations

AGi.32 was used to analyze and calculate the illuminance values of the final design. The following pseudo color rendering shows an even distribution of light across the Player's Lounge.

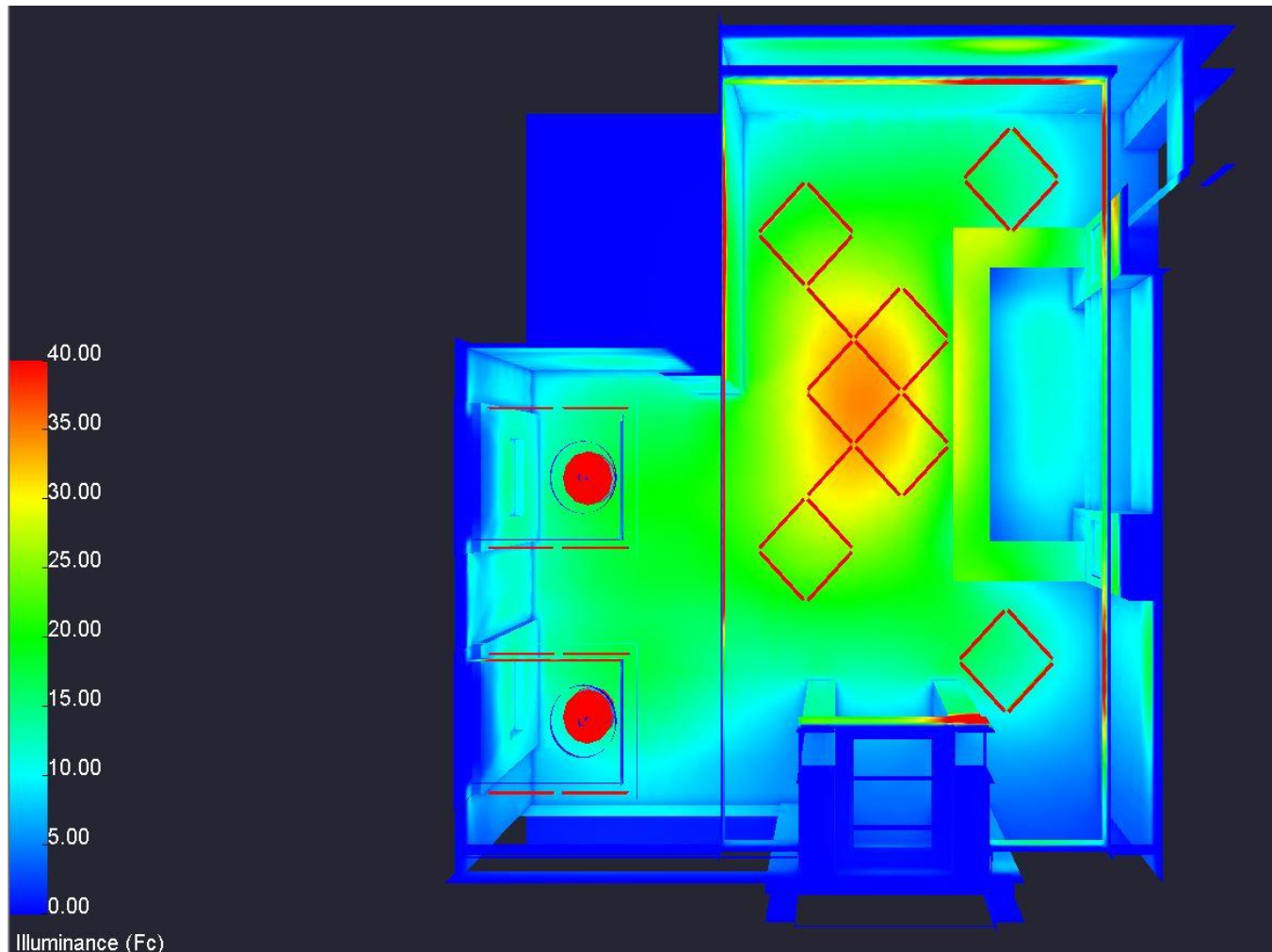


FIGURE 18 - LOUNGE PLAN VIEW



The calculated illuminance average of 21fc exceeds the selected recommended value for the Player's Lounge. The average to minimum ratio is only 2.70 which is just under the ASHRAE 90.1 requirement of 3:1. The total consumption of power for the lounge is approximately 1,208W with an area of 1,556ft². This leads to a calculated power density of 0.78 W/ft², which is below the ASHRAE 90.1 requirement of 1.31 W/ft².

AGi.32 Rendering



FIGURE 19 - PLAN VIEW



FIGURE 20 - FRONT VIEW

Summary

The final lighting design for the Player's Lounge creates a space for guests to interact without gambling. With all of the wood and stone finishes located throughout the lounge it was important to include fluorescent luminaires close to those surfaces to best render the wood color and stone textures. The LED cove lights used have an intelligent white control so that the color temperature can be adjusted by the user on site. The AGi.32 calculations show that the final design meets the IES recommendations with an average horizontal illuminance of 21fc. Finally, the 0.78 W/ft² power density of the Player's Lounge is below the ASHRAE 90.1 code requirement of 1.31 W/ft².

ELECTRICAL DEPTH

The electrical depth for Casino Gold focuses on the redesign of existing panels to meet the new lighting demands that have resulted from the Lighting Depth. The lighting loads were not a large enough change to require the resizing of any feeders.

Also included in the electrical depth is a photovoltaic array that has been added to the main roof of the casino. The evaluation of the solar resource was conducted in a software system known as SAM. SAM is a shortened version of System for Advisor Model. Monthly outputs of electricity produced by the array were calculated and a cost study is included in the Construction Breadth. The structural impacts are also evaluated in the Structural Breadth of this report.

Manufacturer's data sheets for the specified solar module and inverter are located in Appendix B.

Existing Electrical Information

Connected Building Loads

There are numerous distribution boards and panelboards throughout the casino. The distribution system can be somewhat simplified by tracing all of these connected loads back to the five main switchboards that service them. The main switchboards for Casino Gold are: MSA, MSB, MSC, MSD, and GMS1 (the generator switchboard). The loads for each of these are:

- MSA – 723 kVA
- MSB – 2226 kVA
- MSC – 1749 kVA
- MSD – 2482 kVA
- GMS1 – 318 kVA
- Total Building Load – 7498 kVA

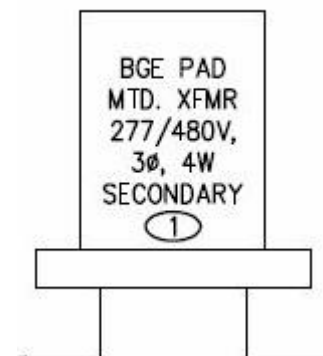
Power Company Rate Schedule

Schedule GL – General Service Large-Electric, 480V Service Voltage

Building Utilization Voltages

The Power Distribution for Casino Gold begins in the Central Plant building located just outside the casino. Service from Baltimore Gas and Electric enters the Central Plant into multiple 480/277V Secondary transformers. These transformers are owned by Baltimore Gas and Electric even though they are inside of casino property. Adjacent to each transformer is a switchboard that begins a branch of the distribution system. Distributions panels are separated for emergency loads, lighting loads, high voltage loads, and low voltage loads.

- Building Utilization Voltage – 480/277 V
- Lighting – 120 volt, plus low voltage LED lighting
- Receptacle – 120 volt
- Mechanical – 480 volt 3 phase



- Special Equipment
 - IT Equipment – 120 volt
 - Fire Pumps – 208 volt
 - Elevators – 480 volt

Emergency Power Distribution System

The emergency power for Casino Gold originates at a diesel generator. This 500kVA generator has the capability to produce 400kw of power and operates on 277/480V. Loads connected to the emergency system include:

- Fire Pump (103kVA load)
- Switchboard GMS1 (318kVA load)
 - Distribution Board 'EDBHA'
 - Distribution Board 'EDBHCP'
 - Distribution Board 'ELEV1'

Each of the distribution boards listed above has a 4-pole automatic transfer switch connected to it that operates in the event of a power loss.

Changes to Existing Panels

Four electrical panels have been changed due to the new lighting loads. There is one modified panelboard for the Plaza, Pre-Function space, Poker Room, and Player's lounge. The lighting loads were not significant enough to change fuse size or feeder size on the panels and branch circuits.

Outdoor Plaza

PANEL: LCCB

JOB: XXXXXX

VOLTAGE: 120/208 Wye
 BUS: 225A
 MAINS: L.O.
 AIC RATING: 10,000

3Ø, 4W
 LOCATION: CORRIDOR C131
 MOUNTING: RECESSED

CIRCUIT CODE: blank or
 N: NON-CONTINUOUS
 L: LONG-CONTINUOUS
 R: DEMANDABLE RECEPTACLES
 K: KITCHEN NO. OF EQUIPMENT:

CKT	CODE	TRIP	POLE	LOAD DESCRIPTION	M	R	L	NOTE	A	B	C	A	B	C	NOTE	L	R	M	LOAD DESCRIPTION	POLE	TRIP	CODE	CKT
1	R	20	1	RECEPTS		2			360			100						1	DDC	1	20	N	2
3	N	20	1	UH-2	1					100			100					1	AHU-1 DDC	1	20	N	4
5	N	20	1	UH-1	1						100			1176				1	EF-1 (1/2HP)	1	20	N	6
7	N	20	1	MOTORIZED DAMPER	1				100			0							SPARE	1	20		8
9	R	20	1	RECEPT		4				720			50					1	TERRACE HEATER	1	20	N	10
11	N	20	1	VAV	6						300			150				3	TERRACE HEATER	1	20	N	12
13	R	20	1	RECEPTS - POLE		1			180			540						3	REC - TERRACE	1	20	R	14
19	R	20	1	RECEPT - POLE		1			180			720						4	RECEPTS	1	20	R	20
21	R	20	1	RECEPT - POLE		1				180			720					4	RECEPTS	1	20	R	22
23	R	20	1	RECEPT - POLE		1					180			100					METERS	1	20	N	24
25	R	20	1	RECEPT - POLE		1			180			100							METERS	1	20	N	26
27	R	20	1	RECEPT - POLE		1				180		100							METERS	1	20	N	28
29	L	20	1	SIGN			1				500			744					PLAZA BOLLARD LTG	1	20		30
31	L	20	1	SIGN			1		500			320							PLAZA STRING LTG	1	20		32
33	L	20	1	SIGN			1			500		0							SPARE	1	20		34
35	L	20	1	SIGN			1				500		0						SPARE	1	20		36
37	L	20	1	SIGN			1		500			0							SPARE	1	20		38
39	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		40
41	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		42
43	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		44
45	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		46
47	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		48
49	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		50
51	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		52
53	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		54
55	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		56
57	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		58
59	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		60
61	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		62
63	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		64
65	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		66
67	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		68
69	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		70
71	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		72
73	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		74
75	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		76
77	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		78
79	--	20	1	SPARE	--	--	--		0			0							SPARE	1	20		80
81	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		82
83	--	20	1	SPARE	--	--	--			0		0							SPARE	1	20		84
PHASE TOTALS									3780 VA	4090 VA	4650 VA	TOTAL CONNECTED VA						12520 VA					

PANEL NOTES:

CONNECTED VA (CODE N)	2476 VA
CONNECTED VA (CODE L)	2500 VA
CONNECTED VA (CODE R)	6480 VA
CONNECTED VA (CODE K)	0 VA
PANEL CONNECTED KVA	12.5 KVA
PANEL DEMAND KVA	13.1 KVA
PANEL DEMAND AMP3	36.5 A

The plaza lighting was added to branch circuits 30 and 32 of Panel LCCB. Using the power consumption data from the luminaire spreadsheets, and the quantity of luminaires from the light depth, a load for each circuit was calculated. The perimeter lighting is calculated to have a load of 733VA, while the string lights have a smaller load of 320VA. This lighting is considered to be a non-continuous load and each branch circuit will keep its 20A fuse.

Pre-Function

PANEL: LCAC

JOB: XXXXXX

VOLTAGE: 120/208 Wye
 BUS: 225A
 MAINS: L.O.
 AIC RATING: 22,000

3Ø, 4W
 LOCATION: ELEC. RM. C105
 MOUNTING: SURFACE

CIRCUIT CODE: blank or N: NON-CONTINUOUS
 L: LONG-CONTINUOUS
 R: DEMANDABLE RECEPTACLES
 K: KITCHEN NO. OF EQUIPMENT:

CKT	CODE	TRIP	POLE	LOAD DESCRIPTION	M	R	L	NOTE	A	B	C	A	B	C	NOTE	L	R	M	LOAD DESCRIPTION	POLE	TRIP	CODE	CKT
1	R	20	1	RECEPTS - IDF		5			900			409			--	--	--		PREFUNCTION PERIMETER	1	20	--	2
3	R	20	1	RECEPTS		2				360			455		--	--	--		PREFUNCTION COVE	1	20	--	4
5	R	20	1	RECEPT - PREFUNCTION		1					180			372	--	--	--		PREFUNCTION PENDANTS	1	20	--	6
7	R	20	1	RECEPT - PREFUNCTION		1			180						--	--	--		SPARE	1	20	--	8
9	R	20	1	RECEPT - PREFUNCTION		1				180			0		--	--	--		SPARE	1	20	--	10
11	R	20	1	RECEPT - PREFUNCTION		1					180		0		--	--	--		SPARE	1	20	--	12
13	R	20	1	RECEPT - PREFUNCTION		1			180				0		--	--	--		SPARE	1	20	--	14
15	R	20	1	RECEPT - PREFUNCTION		1				180			0		--	--	--		SPARE	1	20	--	16
17	R	20	1	RECEPT - PREFUNCTION		1					180		0		--	--	--		SPARE	1	20	--	18
19	R	20	1	RECEPT - JANUS		2			360				0		--	--	--		SPARE	1	20	--	20
21	R	20	1	RECEPT - ARTWORK		1					180		0		--	--	--		SPARE	1	20	--	22
23	R	20	1	RECEPT - ARTWORK		1					180		0		--	--	--		SPARE	1	20	--	24
25	R	20	1	RECEPT - ARTWORK		1			180				0		--	--	--		SPARE	1	20	--	26
27	R	20	1	RECEPT - ARTWORK		1				180			0		--	--	--		SPARE	1	20	--	28
29	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	30
31	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	32
33	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	34
35	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	36
37	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	38
39	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	40
41	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	42
43	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	44
45	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	46
47	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	48
49	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	50
51	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	52
53	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	54
55	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	56
57	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	58
59	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	60
61	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	62
63	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	64
65	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	66
67	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	68
69	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	70
71	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	72
73	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	74
75	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	76
77	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	78
79	--	20	1	SPARE	--	--	--	--	0				0		--	--	--		SPARE	1	20	--	80
81	--	20	1	SPARE	--	--	--	--		0			0		--	--	--		SPARE	1	20	--	82
83	--	20	1	SPARE	--	--	--	--			0		0		--	--	--		SPARE	1	20	--	84
PHASE TOTAL \$									2209 VA	1535 VA	720 VA	TOTAL CONNECTED VA						4464 VA					

PANEL NOTES:

CONNECTED VA (CODE N)	0 VA
CONNECTED VA (CODE L)	0 VA
CONNECTED VA (CODE R)	3600 VA
CONNECTED VA (CODE K)	0 VA
PANEL CONNECTED KVA	4.5 KVA
PANEL DEMAND KVA	4.5 KVA
PANEL DEMAND AMP \$	12.4 A

Three branch circuits were used on Panel LCAC for the lighting in the Pre-Function space. Existing receptacles in the Pre-Function space are already located on the left side of this panel. The perimeter lighting on branch circuit 2 includes the wallwash luminaires as well as the 6" LED downlights, both from the lighting depth report. The new cove lighting in the Pre-Function space is located on branch circuit 4 of this panel and is the largest of the three new loads at 455VA. Finally, the 4 pre-function pendants were

added to branch circuit 6 with a load of 372VA. All three of these loads are under 1920VA, meaning that they are able to stay on the current 20A circuits.

Poker Room

PANEL: LAAC		JOB: XXXXXX		VOLTAGE: 120/208 Wye		3Ø, 4W		CIRCUIT CODE: blank or		N: NON-CONTINUOUS													
				BUS: 100A				L: LONG-CONTINUOUS															
		MAIN S: L.O.		LOCATION: SECURITY B213				R: DEMANDABLE RECEPTACLES															
		AIC RATING: 10,000		MOUNTING: RECESSED				K: KITCHEN		NO. OF EQUIPMENT:													
CKT	CODE	TRIP	POLE	LOAD DESCRIPTION	M	R	L	NOTE	A	B	C	A	B	C	NOTE	L	R	M	LOAD DESCRIPTION	POLE	TRIP	CODE	CKT
1	R	20	1	RECEPTS - CORRIDOR		4			720			720							RECEPTS - CORRIDOR	1	20	R	2
3	R	20	1	RECEPTS - OFFICE		3				540			180				1		RECEPTS - ELEV EQ	1	20	R	4
5	R	20	1	RECEPTS - OFFICES		3					540			180			1		RECEPTS - COND	1	20	R	6
7	R	20	1	RECEPTS - OFFICES		4			720			0							SPARE	1	20		8
9		20	1	Poker Room Perimeter Ltg						457			720				4		RECEPTS - SECURITY	1	20	R	10
11		20	1	Poker Room Down Ltg							1128			200			2		DDC	1	20	N	12
13		20	1	-					1128			300					3		DDC	1	20	N	14
15		20	1	-						1128			100				1		DDC	1	20	N	16
17		20	1	Poker Room Pendants							868			0					SPARE	1	20		18
19		20	1	-					868					0					SPARE	1	20		20
21		20	1	-						868				0					SPARE	1	20		22
23		20	1	SPARE							0			0					SPARE	1	20		24
25		20	1	SPARE					0					0					SPARE	1	20		26
27		20	1	SPARE						0				0					SPARE	1	20		28
29		20	1	SPARE							0			0					SPARE	1	20		30
31		20	1	SPARE					0					0					SPARE	1	20		32
33		20	1	SPARE						0				0					SPARE	1	20		34
35		20	1	SPARE							0			0					SPARE	1	20		36
37		20	1	SPARE					0					0					SPARE	1	20		38
39		20	1	SPARE						0				0					SPARE	1	20		40
41		20	1	SPARE							0			0					SPARE	1	20		42
PHASE TOTAL \$									4456 VA	4023 VA	2916 VA	TOTAL CONNECTED VA						11395 VA					
PANEL NOTES:																		CONNECTED VA (CODE N)		600 VA			
																		CONNECTED VA (CODE L)		0 VA			
																		CONNECTED VA (CODE R)		4320 VA			
																		CONNECTED VA (CODE K)		0 VA			
																		PANEL CONNECTED KVA		11.4 KVA			
																		PANEL DEMAND KVA		11.4 KVA			
																		PANEL DEMAND AMP S		31.6 A			

The additions to Panel LAAC for the Poker Room are different from the previous two panels because some of the loads were spread across 3 phases. The first load that was added to the panel was the Poker Room perimeter lighting, which includes the wallwash luminaires and the wall drum luminaires from the lighting depth. The perimeter lighting has a total load of 457VA. The next load is the 8" LED downlights that are arrayed across the space. These downlights totaled a load of 3383VA so the load was spread across the 3 phases evenly with 1128VA loads. This allows the downlights to be grouped together and stay on the current fuse of 20A. Finally, the Poker Room pendants were added to the panel in the same fashion. The pendants have their load spread across the 3 phases with 868VA on each phase.

Player's Lounge

PANEL: KLDBC																							
JOB: XXXXX				VOLTAGE: 120/208 Wye				3Ø, 4W				CIRCUIT CODE: blank or N: NON-CONTINUOUS											
				BUS: 225A								L: LONG-CONTINUOUS											
				MAINS: L.O.				LOCATION: SERVICE BAR C260				R: DEMANDABLE RECEPTACLES											
				AIC RATING: 10,000				MOUNTING: RECESSED				K: KITCHEN NO. OF EQUIPMENT:											
CKT	CODE	TRIP	POLE	LOAD DESCRIPTION	M	R	L	NOTE	A	B	C	A	B	C	NOTE	L	R	M	LOAD DESCRIPTION	POLE	TRIP	CODE	CKT
1	K	20	1	E23-002 DISPLAY CASE		1			1440			180					1		CONV OUTLET	1	20	R	2
3	K	20	1	E23-018 COFFEE GRINDER		1				1128			180				1		CONV OUTLET	1	20	R	4
5	K	20	1	E23-012 BEV CTR	1						840			1920			1		E23-023 BOD UNIT	1	20	R	6
7	K	20	1	E23-084 LIQUOR GUN					1200			1800					1		E23-078 POS	1	20	R	8
9	K	20	1	E23-067 BLENDER	1	1				1920				1920			1		E23-087 CPU	1	20	R	10
11	K	20	1	E23-007 CARBONATOR		1					1800			1200			1		E23-083 CASH REGISTER	1	20	R	12
13	K	20	1	E23-091/041 CABINET/BAR TOP	2				1200			1800					1		E23-078 POS	1	20	R	14
15	K	20	1	E23-078 CARBONATOR		1				1800			1800				1		E23-083 CASH REGISTER	1	20	R	16
17	K	20	1	E23-070 REACH-IN COOLER		1					1020			1920			1		E23-043 PRINTER	1	20	R	18
19	K	20	1	E23-089 SS CABINET WITH STEPS	1				600				1920				3		E23-086 CPU	1	20	R	20
21	K	20	1	E23-081 REACH IN COOLER		1				1020			1800				1		E23-083 CASH REGISTER	1	20	R	22
23	K	20	1	E23-107/108/109 BCKBR STOR/CLR	5						941			3016			1		E23-015 COFFEE BREWER	2	40	K	24
25	K	20	1	E23-095 BAR TOP AND DIE		1			1200			3016											26
27	K	20	1	E23-064 LIQUOR STEPS		1				1200			3600				1		E23-034 ICE MAKER	3	40	K	28
29	K	20	1	E23-007 CARBONATOR		1					1800			3600									30
31	K	25	1	E23-100 BLENDER STATION	1	1			2400			3600											32
33	K	20	1	E23-084 SOLENOIDS		1				1200			1560				1		E23-063 FROZEN DRINK MACH	2	20	K	34
35	K	20	1	E23-007 CARBONATOR		1					180			1560									36
37	K	20	1	E23-095 BAR TOP AND DIE	1				1200			1560					1		E23-063 FROZEN DRINK MACH	2	20	K	38
39	K	40	1	E23-101 GLASSWASHER	1					3228			1560										40
41	R	20	1	RECEPTS - SERVICE BAR C260		3					540			1560			1		E23-088 GLASSWASHER	2	20	K	42
43	R	20	1	RECEPTS - SERVICE BAR C260		1			700			1560											44
45	--	20	1	BAR COVE LTG	--	--	--	--		166			180				1		CONV OUTLET	1	20	R	46
47	--	20	1	BAR PENDANT	--	--	--	--			188			180			1		CONV OUTLET	1	20	R	48
49	--	20	1	BAR OVERHEAD LTG	--	--	--	--	864				180				1		CONV OUTLET	1	20	R	50
51	--	20	1	SPARE	--	--	--	--	0				180				1		CONV OUTLET	1	20	R	52
53	--	20	1	SPARE	--	--	--	--	0		0			180			1		CONV OUTLET	1	20	R	54
55	--	20	1	SPARE	--	--	--	--	0			180					1		E23-103 CASH REGISTER	1	20	K	56
57	--	20	1	SPARE	--	--	--	--	0				180				1		E23-103 CASH REGISTER	1	20	R	58
59	--	20	1	SPARE	--	--	--	--	0		0			0					SPARE	1	20	--	60
61	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	62
63	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	64
65	--	20	1	SPARE	--	--	--	--	0		0			0					SPARE	1	20	--	66
67	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	68
69	--	20	1	SPARE	--	--	--	--	0				0						SPARE	1	20	--	70
71	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	72
73	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	74
75	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	76
77	--	20	1	SPARE	--	--	--	--	0			0		0					SPARE	1	20	--	78
79	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	80
81	--	20	1	SPARE	--	--	--	--	0			0							SPARE	1	20	--	82
83	--	20	1	SPARE	--	--	--	--	0		0			0					SPARE	1	20	--	84
PHASE TOTAL \$									26610 VA	24622 VA	22445 VA	TOTAL CONNECTED VA									73677 VA		
PANEL NOTES:																							
																				CONNECTED VA (CODE N)	0 VA		
																				CONNECTED VA (CODE L)	0 VA		
																				CONNECTED VA (CODE R)	18780 VA		
																				CONNECTED VA (CODE K)	53689 VA		
																				PANEL CONNECTED KVA	73.7 KVA		
																				PANEL DEMAND KVA	50.5 KVA		
																				PANEL DEMAND AMP \$	140.2 A		

The final panel that was modified due to the new lighting loads is Panel KLDBC. Three branch circuits were used for the new lighting in the Player's lounge. The first load, the Bar Cove Lighting on circuit 45, has a small total of 166VA. Next, a branch circuit was used for the two pendants located in the seating area of the lounge. The pendants were placed on branch circuit 47 with a load of 168VA. Finally, the third load that has been created is on branch circuit 49. This load is the Peerless overhead lighting in the

Player's lounge and is the largest of the three loads at 854VA. All three of these new circuits have loads that will adequately fit on the current 20A branch circuits.

Photovoltaic Array

The proposed photovoltaic array for this project was designed using System Advisor Model, or SAM. SAM is solar design software from the National Renewable Energy Laboratory. The program takes various inputs from the user to determine weather data, size of the array, and financial details. For this electrical depth, a solar module and inverter are chosen based on a balance of cost and . Their manufacturer's data sheets can be found in Appendix B. The monthly energy produced by the array has also been calculated.

The following analysis will go through the beginning steps of setting up a simulation in SAM. This process leads to the chosen equipment and calculates the production data for the array.

Specify a Location

SAM 2014.1.14: C:\Users\Brad\Desktop\Thesis\Solar\solar.zsam

File Case Analysis Tools Script Help

My project X

Select Technology and Market... Flat Plate PV, Commercial

Location and Resource

Location: BALTIMORE, MD
Lat: 39.2 Long: -76.7 Elev: 47.0 m

Module

Suntech Power STP250-20-Wd
Output: 250.2 Wdc

Inverter

Growatt New Energy Technology: GROWATT 20000 TL3-US
Capacity: 20194 Wac

Array

Power: 99.8318 kWdc
Area: 649.2 m²

PV Subarrays

Number of subarrays: 1

Performance Adjustment

Percent of annual output: 100 %
Year-to-year decline: 0.5 % per year

PV System Costs

Total: \$ 255,680.46
Per Capacity: \$ 2.56 per Wdc

Financing

Analysis: 25 years
Debt Fraction: 100.0% percent

Incentives

Fed. ITC
No cash incentives

Depreciation

5-yr MACRS (Federal)
5-yr MACRS (State)

Utility Rate

Net Metering? Yes

Electric Load

Annual Energy: 7.6463e+006 kWh
Annual Peak: 1687.62 kW

Exchange Variables

(For Excel Exchange and custom TRNSYS only.)

Choose Weather Data File

Type a few letters of the location name:

Download weather file...

Folder settings...
Refresh list
Copy to project
Remove from project
Create TMY3 file

SAM/KY Covington.tm2
SAM/KY Lexington.tm2
SAM/KY Louisville.tm2
SAM/LA Baton Rouge.tm2
SAM/LA Lake Charles.tm2
SAM/LA New Orleans.tm2
SAM/LA Shreveport.tm2
SAM/MA Boston.tm2
SAM/MA Worcester.tm2
SAM/MD Baltimore.tm2
SAM/ME Caribou.tm2

Click a file in the list to choose a file from the NREL NSRDB TMY2 dataset, or click Download Weather File to enter an address and download a weather file from the NREL Solar Prospector database. A blue highlight indicates the weather file SAM uses for simulations. SAM lists files in the default weather folder and in any folders you specify in Folder Settings. The prefix "SAM/" indicates a file from the default folder. To embed weather data in your .zsm file for sharing with other people, click Copy to Project: SAM indicates the embedded weather file in the list with the prefix "USER/". See Help for details.

Location Information

City: BALTIMORE Time Zone: GMT -5 Latitude: 39.1833 deg
State: MD Elevation: 47 m Longitude: -76.6667 deg

Weather Data Information (Annual)

Direct Normal: 1429.7 kWh/m² Dry-bulb Temp: 12.6 °C
Global Horizontal: 1482.1 kWh/m² Wind Speed: 4.1 m/s

View hourly data...

Web Links

SAM reads weather files in the TMY3, TMY2, EPW, and SMW file formats. The default weather folder contains copies of the complete NREL NSRDB TMY2 dataset. You can use the links below to visit websites with other weather files. If you download files from the web, click Folder Settings to choose folders where SAM can find your downloaded weather files. See Help for details.

[Best weather data for the U.S. \(1200+ locations in TMY3 format\)](#)
[Best weather data for international locations \(in EPW format\)](#)
[U.S. satellite-derived weather data \(10 km grid cells in TMY2 format\)](#)

FIGURE 21 - SAM LOCATION AND RESOURCE PAGE

Selecting a Solar Module

SAM 2014.1.14: C:\Users\Brad\Desktop\Thesis\Solar\solar.zsam

File Case Analysis Tools Script Help

My project X

Select Technology and Market... Flat Plate PV, Commercial

Location and Resource
 Location: BALTIMORE, MD
 Lat: 39.2 Long: -76.7 Elev: 47.0 m

Module
 Suntech Power STP250-20-Wd
 Output: 250.2 Wdc

Inverter
 Growatt New Energy Technology: GROWATT 20000 TL3-US
 Capacity: 20194 Wac

Array
 Power: 99.8318 kWdc
 Area: 649.2 m²

PV Subarrays
 Number of subarrays: 1

Performance Adjustment
 Percent of annual output: 100 %
 Year-to-year decline: 0.5 % per year

PV System Costs
 Total: \$ 255,680.46
 Per Capacity: \$ 2.56 per Wdc

Financing
 Analysis: 25 years
 Debt Fraction: 100.0% percent

Incentives
 Fed. ITC
 No cash incentives

Depreciation
 5-yr MACRS (Federal)
 5-yr MACRS (State)

Utility Rate
 Net Metering? Yes

Electric Load
 Annual Energy: 7.6463e+006 kWh
 Annual Peak: 1687.62 kW

Exchange Variables
 (For Excel Exchange and custom TRNSYS only.)

CEC Performance Model with Module Database Change...

Search for modules by manufacturer or model name:

SAM/CEC Modules/Suntech Power PLUTO245-Wde
 SAM/CEC Modules/Suntech Power PLUTO245-Wdm
 SAM/CEC Modules/Suntech Power STP245-20-WId
 SAM/CEC Modules/Suntech Power STP245-20-WWb
 SAM/CEC Modules/Suntech Power STP245-20-Wde
 SAM/CEC Modules/Suntech Power STP245S-20-Wd
 SAM/CEC Modules/Suntech Power STP245S-20-Wde
 SAM/CEC Modules/Suntech Power STP245S-20-Wdm
 SAM/CEC Modules/Suntech Power PLUTO250-HWb
 SAM/CEC Modules/Suntech Power PLUTO250-Wde
 SAM/CEC Modules/Suntech Power PLUTO250-Wdm
 SAM/CEC Modules/Suntech Power STP250-20-WId
 SAM/CEC Modules/Suntech Power STP250-20-WWb

Module Characteristics at Reference Conditions
 Reference conditions: Total Irradiance = 1000 W/m², Cell temp = 25 C

Suntech Power STP250-20-Wd

Parameter	Value	Temperature Coefficients
Efficiency	15.38 %	
Maximum Power (Pmp)	250.205 Wdc	-4.500e-001 %/C -1.126e+000 W/C
Max Power Voltage (Vmp)	30.7 Vdc	
Max Power Current (Imp)	8.15 Adc	
Open Circuit Voltage (Voc)	37.4 Vdc	-3.400e-001 %/C -1.272e-001 V/C
Short Circuit Current (Isc)	8.63 Adc	5.650e-002 %/C 4.876e-003 A/C

Temperature Correction
 NOCT cell temp model
 Mounting specific cell temp model
 Refer to Help for more information about CEC cell temperature models.

Nominal operating cell temperature (NOCT) parameters
 Mounting standoff: Ground or rack mounted
 Array height: One story building height or lower

Mounting configuration heat transfer cell temperature model
 Mounting Configuration: Rack
 Heat Transfer Dimensions: Module Dimensions
 Mounting Structure Orientation: Structures do not impede flow underneath module
 Module Width: 1 m
 Module Length: 1.627 m
 Rows of modules in array: 1
 Columns of modules in array: 10
 Temperature behind the module: 20 C
 Gap Spacing: 0.05 m

Physical Characteristics
 Material: Multi-c-Si Module Area: 1.627 m² Number of Cells: 60

Additional Parameters

FIGURE 22 - SAM CHOOSING A SOLAR MODULE

A Suntech STP250 – 20/Wd was chosen as the solar module for the casino. This is a 250Watt, polycrystalline solar module. It has an open circuit voltage of 37.4V and an efficiency of 15.4%. The full specifications for the panel can be found in Appendix B.

Selecting an Inverter

SAM 2014.1.14: C:\Users\Brad\Desktop\Thesis\Solar\solar.zsam

File Case Analysis Tools Script Help

My project x

Select Technology and Market... Flat Plate PV, Commercial

Location and Resource
Location: BALTIMORE, MD
Lat: 39.2 Long: -76.7 Elev: 47.0 m

Module
Suntech Power STP250-20-Wd
Output: 250.2 Wdc

Inverter
Growatt New Energy Technology: GROWATT 20000 TL3-US 277V
Capacity: 20194 Wac

Array
Power: 99.8318 kWdc
Area: 649.2 m²

PV Subarrays
Number of subarrays: 1

Performance Adjustment
Percent of annual output: 100 %
Year-to-year decline: 0.5 % per year

PV System Costs
Total: \$ 255,680.46
Per Capacity: \$ 2.56 per Wdc

Financing
Analysis: 25 years
Debt Fraction: 100.0% percent

Incentives
Fed. ITC
No cash incentives

Depreciation
5-yr MACRS (Federal)
5-yr MACRS (State)

Utility Rate
Net Metering? Yes

Electric Load
Annual Energy: 7.6463e+006 kWh
Annual Peak: 1687.62 kW

Exchange Variables
(For Excel Exchange and custom TRNSYS only.)

Inverter CEC Database Change...

Search for inverters by manufacturer or model name:

SAM/Sandia Inverters/Growatt New Energy: GROWATT 5000MTL-US (208V) 208V [CEC 2011]
SAM/Sandia Inverters/Growatt New Energy: GROWATT 5000MTL-US (240V) 240V [CEC 2011]
SAM/Sandia Inverters/Growatt New Energy: GROWATT 5000MTL-US (277V) 277V [CEC 2011]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 10000 TL3-US 277V [CEC 2012]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 10000TL-US (208V) 208V [CEC 2013]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 11000TL-US (240V) 240V [CEC 2013]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 12000 TL3-US 277V [CEC 2012]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 18000 TL3-US 277V [CEC 2012]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 20000 TL3-US 277V [CEC 2012]
SAM/Sandia Inverters/Growatt New Energy Technology: GROWATT 8000TL-US (208V) 208V [CEC 2013]

Efficiency Curve and Characteristics

Growatt New Energy Technology: GROWATT 20000 TL3-US 277V

Parameter	Value	Unit	Code	Value	Unit
CEC weighted efficiency	96.5274	%			
European weighted efficiency	96.1344	%			
Maximum AC power	20194	Wac	C0	-4.20679e-007	1/Wac
Maximum DC power	20882	Wdc	C1	-6.4611e-005	1/Wdc
Power consumption during operation	91.5823	Wdc	C2	0.0010009	1/Wdc
Power consumption at night	0.2	Wac	C3	0.000720304	1/Wdc
Nominal AC voltage	277	Vac			
Maximum DC voltage	1000	Vdc			
Maximum DC current	25	Adc			
Minimum MPPT DC voltage	400	Vdc			
Nominal DC voltage	418.491	Vdc			
Maximum MPPT DC voltage	800	Vdc			

FIGURE 23 - SAM INVERTER SELECTION

The SAM software has a very large database of DC to AC inverters to choose from. When an inverter is selected the software will notify the user of any conflicts that may arise. It will often take a few tries to find an inverter that matches with the chosen solar module and the characteristics of the array. A Growatt inverter was selected for this study and a corresponding cut sheet is located in Appendix B.

Calculate Array Size

SAM 2014.1.14: C:\Users\Brad\Desktop\Thesis\Solar\solar.zsam

File Case Analysis Tools Script Help

My project X

Select Technology and Market... Flat Plate PV, Commercial

Location and Resource

Location: BALTIMORE, MD
Lat: 39.2 Long: -76.7 Elev: 47.0 m

Module

Suntech Power STP250-20-Wid
Output: 250.2 Wdc

Inverter

Growatt New Energy Technology: GROWATT 20000 TL3-US
Capacity: 20194 Wac

Array

Power: 99.8318 kWdc
Area: 649.2 m²

PV Subarrays

Number of subarrays: 1

Performance Adjustment

Percent of annual output: 100 %
Year-to-year decline: 0.5 % per year

PV System Costs

Total: \$ 255,680.46
Per Capacity: \$ 2.56 per Wdc

Financing

Analysis: 25 years
Debt Fraction: 100.0% percent

Incentives

Fed. ITC
No cash incentives

Depreciation

S-yr MACRS (Federal)
S-yr MACRS (State)

Utility Rate

Net Metering? Yes

Electric Load

Annual Energy: 7.6463e+006 kWh
Annual Peak: 1687.62 kW

Exchange Variables

(For Excel Exchange and custom TRNSYS only.)

Layout

Specify System Size

Specify desired array size Specify modules and inverters

Desired array size: 100 kWdc
DC to AC ratio: 1.1

Modules per string: 21
Strings in parallel: 95
Number of inverters: 50

Sizing messages (see Help for details):
Actual DC to AC Ratio is 0.99. Check for more sizing messages after running simulations.

Actual Layout

Modules		Inverters	
Nameplate capacity	99.8318 kWdc	Total capacity	100.97 kWac
Number of modules	399	Total capacity	104.41 kWdc
Modules per string	19	Number of inverters	5
Strings in parallel	21	Maximum DC voltage	1000 Vdc
Total module area	649.173 m ²	Minimum MPPT voltage	400 Vdc
String Voc	710.6 V	Maximum MPPT voltage	800 Vdc
String Vmp	583.3 V		

Nameplate capacity and string Vmp are at module reference conditions. String Voc is at 1000 W/m² incident irradiance and 25 °C cell temperature.

Interconnection Derates (AC)

AC wiring losses: 0.99 (0..1)
Step-up transformer losses: 1 (0..1)
Total interconnection derate: 0.99 (0..1)

Land Area

Packing factor: 2.5
Total land area: 0.401027 acres

Ground Reflectance

Use albedo in weather file if it is specified
Monthly ground reflectance (albedo)

Tilted Surface Radiation Model (Advanced)

Isotropic HDKR Perez

-Radiation Components
 Beam and diffuse
 Total and beam

Self Shading Calculator for Fixed Tilt Arrays

Enable Self-Shading Calculator

Module

Orientation: Landscape

Length: 2.418 m
Width: 0.673 m
Number of Cells along Length: 10
Number of Cells along Width: 6
Number of Bypass Diodes: 3

Characteristics from Module Page

Area: 1.627 m² Number of cells: 60

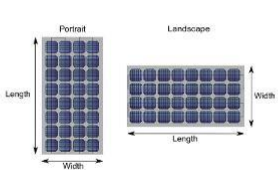


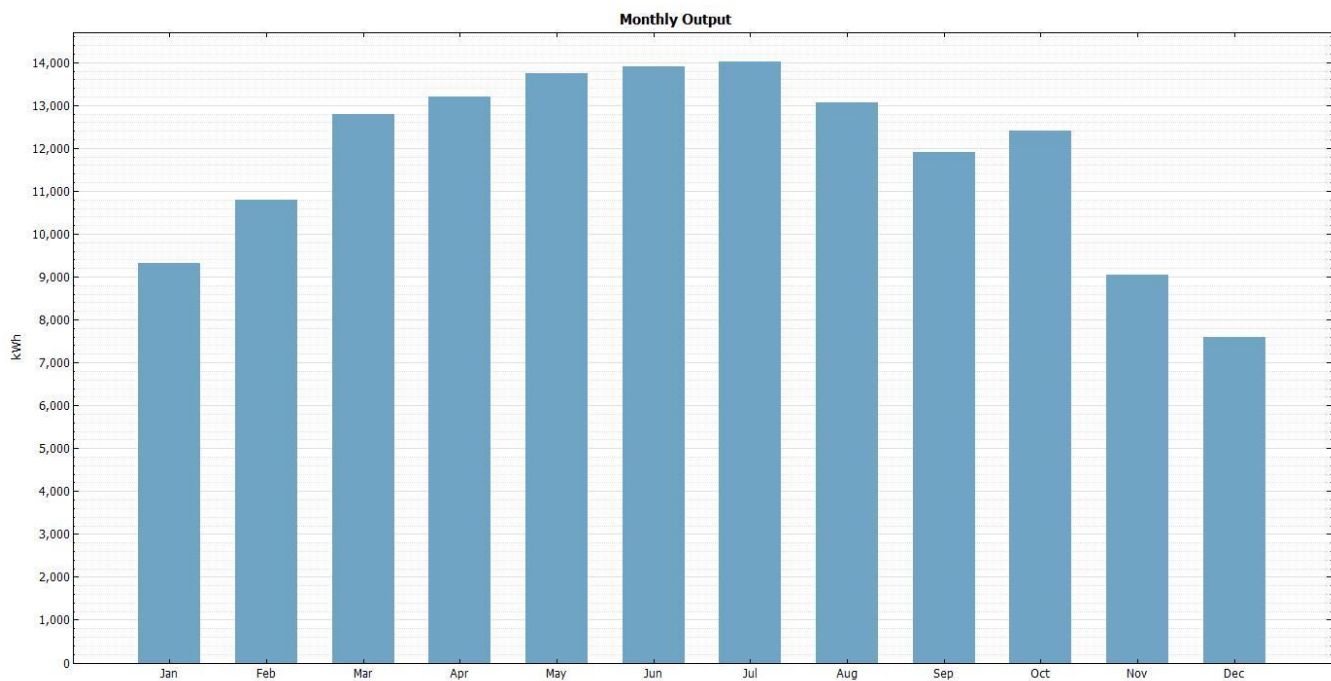
FIGURE 24 - SAM ARRAY SIZE

The section of SAM that works with the size of the array is the most interesting. For this study, an array of 400 panels was chosen based on the dimensions of the main casino roof. A 20 row array, with 20 panels in each row, will fit on the main casino roof. This is also taking into consideration inter-array shading and row spacing across the array. With 400 panels, five inverters will be needed.

Data Output

After loading the meteorological data for the project's location, specifying a solar module, and specifying an AC to DC inverter, SAM will run an annual simulation. The simulation ran for Casino Gold produced the following values. The numbers 1-12 represent the month of the calendar year.

	Monthly Energy (kWh)	Net ac output (kWh)	Net dc output (kWh)
1	9324.69	9324.69	9681.71
2	10785.1	10785.1	11175.7
3	12786	12786	13274.6
4	13206.1	13206.1	13724.6
5	13743.2	13743.2	14303.9
6	13895.6	13895.6	14481.4
7	14008.3	14008.3	14601.6
8	13070	13070	13626.9
9	11916.1	11916.1	12411.9
10	12397.3	12397.3	12885.2
11	9056.27	9056.27	9416.5
12	7594.67	7594.67	7912.91



Summary

The solar resource was analyzed at the location of the project, a solar module and inverter have been selected, and the array has been sized. The specified solar module is a Suntech STP250 – 20/Wd. The specified AC to DC inverter is a Growatt 20000TL3-US. The proposed array will contain a total of 400 panels and produce a peak load of about 14,000kWh in the month of June.

CONSTRUCTION BREADTH

Adding a solar array to the roof of the casino will result in an added cost for the project as well as extra work for the crew. The following analysis provides information related to the cost and schedule impacts of the new array.

Cost

The 2014 release of RS Means was used to find the following values. The Master Format 2010 section used for Photovoltaic Collectors is 263113500. The first table shows the values directly from RS Means, the second table shows the quantities estimated for this project.

RS Means Values

Description	Crew	Daily Output	Labor Hours	Bare Materials	Bare Labor	Bare Total	Total O&P
150W, 33V, PV Panel	1 Elec	8	1	645.00	53.50	698.50	790.00
48V, 5500W DC to AC inverter	1 Elec	2	4	3750.00	213.00	3963.00	4445.00
PV components, combiner box	1 Elec	4	2	189.00	107.00	296.00	368.00
Fuse, 15A for combiner box	1 Elec	40	0.2	16.40	10.65	27.05	34.00
PV Rack system, on steel framing, with standoff	R1A	11.00	1.455	55.00	64.00	119.00	157.50

Costs Specific to Casino Array

The following table uses RS Means values for pricing of materials and labor, except for the Suntech 250W panels. The Suntech STP250 – 20/Wd panel was priced at an average of \$375 from multiple retailers. The data sheet for the Suntech panel can be found in the Appendix B. The number of crew members and corresponding daily output has been modified to finish the installation in 10 days. The breakdown of the construction time is found in the next section titled “Schedule.”

Description	No.	Crew	Daily Output	Labor Hours	Bare Materials	Bare Labor	Bare Total
250W, 37V, Suntech PV Panel	400	6 Elec	48	1	150,000	21,400	171,400
Growatt DC to AC inverter	5	5 Elec	10	4	18,750	1,065	19,815
PV components, combiner box	1	1 Elec	4	2	189.00	107.00	296.00
Fuse, 15A for combiner box	21	1 Elec	40	0.2	344.40	223.65	568.05
PV Rack system, on steel framing, with standoff	400	4 R1A	44	1.455	22,000	25,600	47,600

Schedule

Using the labor information gathered from the 2014 release of RS Means, an estimate for the length of time needed to install the new solar array can be calculated. The table below takes labor hours and daily output directly from the Photovoltaic Collectors section 2631 13500 in RS Means.

Description	No.	Crew	Daily Output	Labor Hours	Total Hours	Days
250W, 37V, Suntech PV Panel	400	1 Elec	8	1	400	50
Growatt DC to AC inverter	5	1 Elec	2	4	20	2.5
PV components, combiner box	1	1 Elec	4	2	2	0.25
Fuse, 15A for combiner box	21	1 Elec	40	0.2	4.2	0.5
PV Rack system, on steel framing, with standoff	400	R1A	11.00	1.455	582	37

The length of installation for each component calculated in the table above would have a significant impact on the schedule of the project. Assuming that the Suntech panels and the racks can be installed simultaneously, an installation of 8 to 10 days would be desirable. This much shorter installation time would not have a significant impact on the overall 18 month construction of the casino.

To achieve an 8-10 installation time for the array, the amount of workers needs to be increased. A 6 man crew, working in teams of two, will be able to handle the installation of the panels. An R1A crew consists of two workers already, so the project will need 4 of these crews totaling 8 workers. The total amount of workers assigned to the installation of the solar array will be 14.

Estimated Construction Times

Description	No.	Crew	Daily Output	Labor Hours	Days
250W, 37V, Suntech PV Panel	400	6 Elec	48	1	8.3
Growatt DC to AC inverter	5	5 Elec	10	4	0.5
PV components, combiner box	1	1 Elec	4	2	0.25
Fuse, 15A for combiner box	21	1 Elec	40	0.2	0.5
PV Rack system, on steel framing, with standoff	400	4 R1A	44	1.455	9.1

The number of days calculated from the Estimated Construction Times table shows that the solar array installation can be completed in less than 10 days. All 6 of the electricians will begin by installing the Suntech panels and that will take just over 8 days. The 9th day of installation will be for the electricians to

finish installing the panels and install the inverters. While the electricians are working, the 4 R1A crews will also be working on the installation of the PV rack system. The PV rack system will take about 9 days for the crew to install.

Conclusion

The total cost estimate for the materials of the proposed solar array is \$191,283. The total cost of labor is estimated to be \$48,396. Adding materials and labor together results in \$239,680 estimated for the entire installation. This estimation does not include profit. The installation will take a total period of 10 days and will not significantly impact the 18 month construction schedule for Casino Gold.

STRUCTURAL BREADTH

The proposed solar array on the casino roof creates a new load and it requires an evaluation of the structural members supporting it. The main roof for the casino is the top of the third level. This roof has a width of 168 feet and a length of 300 feet. The chosen Suntech 250 watt polycrystalline solar module has a width of 3.25 feet and a length of 5.4 feet. With a weight of 40 pounds, the panel exerts a load of 3lbs/ft². The dimensions of both the roof and panel can be found in Appendix C.

The calculations for the following structural analysis can also be found in Appendix C. The structural calculations analyze the roof decking, a roof joist, joist girder, and the supporting column. All of the joists, joist girders, and columns for the roof structure are consistent throughout the third level.

Dead Loads

- 3psf - Suntech panel self-weight
- 1psf - 3-ply ready roofing (AISC Table 17-13, 14th Edition)
- 1.5psf - Rigid insulation, R-25 (AISC Table 17-13, 14th Edition)
- 3psf - ¾" wood sheathing (AISC Table 17-13, 14th Edition)
- 10psf - Superimposed dead load
- 1.78psf - Vulcraft 1.5B x 22 gauge roof decking (Vulcraft Roof Decking Table)

Live Loads

- 30psf – Snow Load

Roof Deck

The roof deck meets the requirements for a 3-span, unshored condition, determined from the Vulcraft Roof Deck table.

Current Roof Joist

- 21plf – 32LH09 Roof Joist (Steel Joist Institute Joist Catalog, LRFD Table)
- Span of 60ft, spacing of 5' 8"
- An LRFD load combination of [1.2D+1.6S] was used in evaluating the current roof joist.
- $W_{ult} = 445\text{plf}$
- $W_{fl} = 310\text{plf}$

Evaluation of the Roof Joist

- Use Steel Joist Institute Long Span Steel Joist LRFD Table
- 32LH09 joist designation and a clear span of 60ft
 - $W_{ult} = 534\text{plf}$ (from table) $> 445\text{plf}$ (from calculations), OK
 - W for $L/360 = 180\text{plf}$ (from table)
 - W for $L/240 = 270\text{plf} < 310\text{plf}$ (from calculations), **current roof joist is not big enough for the new load of the solar array**

Choosing a New Roof Joist

- Increase size of joist to satisfy the deflection criteria that was not met in the previous section
 - Choose a new joist of 32LH11
 - $W_{ult} = 643\text{plf}$ (from table) $> 445\text{plf}$ (from calculations), OK
 - W for $L/360 = 216\text{plf}$ (from table)
 - W for $L/240 = 324\text{plf} > 313\text{plf}$ (from calculations), OK
- **New 32LH11 joist is adequate**
 - Self-weight of 5psf

Evaluation of Joist Girder

The current joist girder for the roof is a 60G10N20K. This notation shows that the joist girder is 60 inches deep, has 10 panels, and has an unfactored point load of 20 kips. The evaluation conducted in the attached calculations shows an actual point load of less than 20 kips, proving that the joist girder is adequate. The girder has a self-weight of 93plf, or 2psf, found in the Steel Joist Institute LRFD joist girder table.

Evaluation of a Column

The casino is designed with W8X48 columns on the third level, supporting the roof structure. The columns have a height of 13 feet. When evaluating the P_u on the column a tributary area of $3,360\text{ft}^2$ is used. This leads to a P_u of 275 kips for the column. Using Table 4-1 in the AISC 14th Edition, a value of $\phi P_u = 421\text{k}$ for a W8X48 column is much larger than the calculated 275k. This proves that the columns in the current design are able to support the new loading condition.

Conclusion

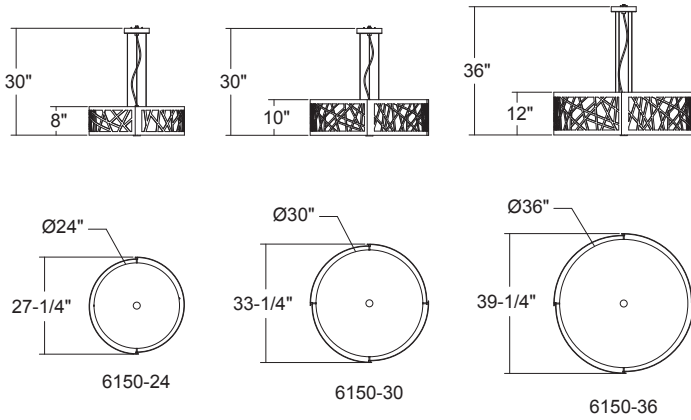
After evaluating the structural members of the third level, the calculations determine that the current roof joists must increase in size. The roof joists must increase from 32LH09 to 32LH11. The current roof decking, joist girders and columns of the third level are adequately designed to support the new load of the solar array.

APPENDIX A – LUMINAIRE DATA SHEETS

Pendant



QUICK FIND #: QF-3231



1. CATALOG # **6150-24**
6150-30
6150-36

2. LAMPING
6150-24
FQ = (4) CFQ26W/G24Q-3
6150-30
FQ = (4) CFQ26W/G24Q-3
6150-36
FM = (4) CFTR42W/GX24Q-4
FX = (8) CFTR42W/GX24Q-4

3. VOLTAGE
120V = 120 VOLT
277V = 277 VOLT

4. **OA**
LENS OPTION **OA = OPAL ACRYLIC (etched)**

5. FINISH
STANDARD
BAL = BRUSHED ALUMINUM
LBP = LIGHT BRONZE PAINT WITH BRUSHED TEXTURE
CUSTOM
CPF = CUSTOM PAINTED FINISH (consult factory)
CMF = CUSTOM METAL FINISH (consult factory)

6. SPECIAL
STD = STANDARD
MOD = MODIFIED

Modification Descriptions: (if needed)

Weight Hanging (lbs.) *

FQ / 6150-24	25 lbs.
FQ / 6150-30	35 lbs.
FM / 6150-36	54 lbs.
FX / 6150-36	60 lbs.

* all pendants over 50 lbs. require additional hanging support.

Notes:

- UL listed and cUL approved
- Winona Lighting products are union made.
- Custom Sizes and Finishes available upon request.
- All Fluorescent fixtures available in 120V and 277V.
- Winona Lighting reserves the right to make design changes without prior notice.
- Lamps not included.

DECORATIVE FINISHES

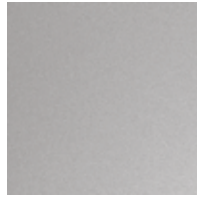
Painted Finishes



AB5 • Antique Brass Paint



ABP • Antique Brass Paint



ALP • Aluminum Paint (Matte)



BBP • Brushed Brass Paint



DABP • Dark Antique Brass Paint



LBP • Light Bronze Paint w/ Brushed Texture



LBPS • Light Bronze Paint Smooth



LGP • Light Gold Iridescent Paint



LSP • Light Silver Paint



MBP • Medium Bronze Paint



MCP • Mediterranean Cherry Powdercoat Paint



PBP • Pale Bronze Paint



PEW • Pewter Paint



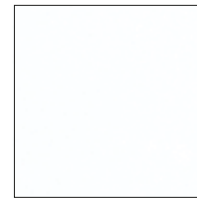
PGP • Pale Gold Paint



RWP • Redwood Powdercoat Paint



SGB • Semi-Gloss Black



SGW • Semi-Gloss White



VCP • Verdi Copper Patina Paint

Custom Paint Finishes

Whether it is matching an existing surface or creating a bold splash of color, the flexibility of the Winona Lighting wet paint system is the easiest way to customize a luminaire or your application.

Our in-house computerized mixing and matching capabilities allow us to accurately provide custom finishes without minimum order quantity, set up fees or additional lead time. There is no need to submit samples to a paint manufacturer for matching purposes causing delay to the production schedule. We can provide custom finishes in either metallic colors to match an actual metal finish or solid colors to match interior or exterior finishes.

Variations in color and luster may be present in these examples due to limitations in the printing process. For accurate color certification samples, please request a Winona Lighting finish chip from your sales representative.

DECORATIVE FINISHES

Metal Finishes



AB3 • Antique Brass
(will darken with time)



BAL • Brushed Aluminum



BB • Brushed Brass



BC • Brushed Chrome



BN • Brushed Nickel



BSS • Brushed Stainless Steel



GAL • Ground Aluminum



PAL • Polished Aluminum



PB • Polished Brass



PC • Polished Chrome



PN • Polished Nickel

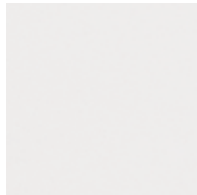


PSS • Polished Stainless Steel



TBR • Tinted Brass Lacquer

Acrylic Lenses



OA • Opal Acrylic



FAH4 • White Vein Faux Alabaster



FAH5 • Antique Vein Faux Alabaster



FAH6 • Gray Vein Faux Alabaster



FAH7 • Beige Vein Faux Alabaster



FAH8 • White Faux Linen



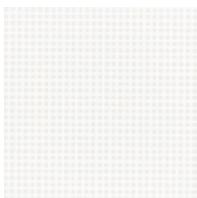
FAH9 • Beige Faux Linen



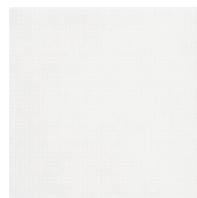
FAH10 • Antique Faux Linen



SA1 • Clear Acrylic w/Vertical Fade Pattern panels series



SA2 • Clear Acrylic w/Grid Pattern panels series



SA3 • Clear Acrylic w/Printed Dot Pattern panels series



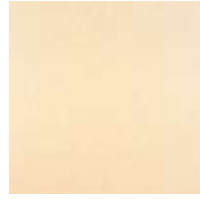
SA4 • Clear Acrylic w/Weave Pattern panels series

DECORATIVE FINISHES

Fabric and Parchment Shades



FAB1 • Linen Cream
textures series



FAB2 • Beige Homespun
textures series



FAB3 • Desert Beige
textures series



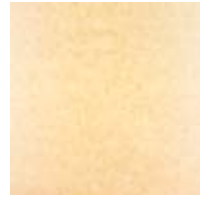
FAB4 • Olive Drab
textures series



FAB5 • Stone Blue
textures series



FAB6 • Linda Red
textures series



FAB7 • Natural Onion Skin
textures series



FAB8 • Kinwashi
textures series



FAB9 • Kozo Natural
textures series

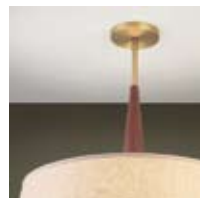
Wood Finishes



NM • Natural Maple
Wood Finish
textures series



WD • Dark Cherry
Wood Finish
textures series



FEATURES & SPECIFICATIONS

INTENDED USE — Recessed downlight that provides volumetric lighting by filling the entire volume of space with light, delivering the ideal amount of light to walls, cubicles, work surfaces and people. Typical applications include corridors, lobbies, conference rooms and private offices. The system maintains 70% lumen output at more than 50,000 hours.

CONSTRUCTION — 16-gauge galvanized steel mounting/plaster frame with torsion springs to mount open conical shape reflector.

Rugged, one-piece, die-cast housing with white interior dome reflector.

LED light source shielded from direct view.

Vertically adjustable mounting brackets that use 16-gauge flat bar hangers (included), 1/2" conduit or C channel T bar fasteners. Provides 3-3/4" total adjustment.

Post installation adjustment possible from above or below the ceiling.

Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination 1/2"-3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors, rated for 90°C.

Fixture height of 5-3/4" allows installation in shallow plenum applications.

Secondary housing adjustment system for precise, final ceiling-to-flange alignment.

Maximum 1-1/2" ceiling thickness.

ELECTRICAL — Utilizes high-brightness LEDs mounted to a metal core circuit board, ensuring cool-running operation, 3500K, CRI > 80.

Thermal control ensures cool running LEDs.

Thermal protection provided against improper insulation use.

High-efficiency, electronic LED driver mounted in the junction box.

Luminaire should be installed in applications where ambient temperatures do not exceed 50°C. Ambient temperatures that exceed 50°C will result in reduced lamp life and will void warranty.

Input wattage for 600L is 15.6W. Input wattage for 900L is 25.0W.

The DOM6 LED with DIM option operates with all 0-10V dimming switches. The following dimming switches have been confirmed to dim to 10% output:

Synergy® model number: [ISD BC 120/277](#)

Leviton® model number: IP710-DLX

Lutron® model number: NTFTV-WH. For on/off control, this switch requires a power pack. Consult Lutron for more information.

LISTINGS — CSA Certified to US and Canadian safety standards. Damp location listed.

WARRANTY — Five-year limited warranty. Complete warranty terms located at:

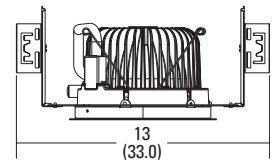
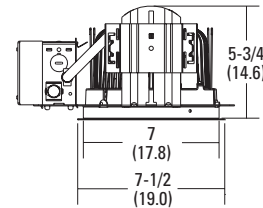
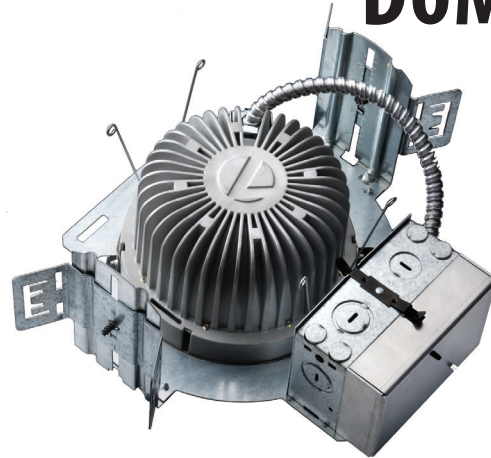
www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Specifications subject to change without notice.

Catalog Number
Notes
Type

DOM6 LED

6" OPEN LED



Specifications

Aperture: 6-3/4 (17.1)

Ceiling opening: 7 (17.8)

Overlap trim: 7-1/2 (19.0)

Height: 5-3/4 (14.6)

Length: 11-1/8 (28.3)

Standard width: 13 (33.0)

All dimensions are inches (centimeters) unless otherwise specified.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: DOM6 LED 900L 35K 120 D06

DOM6 LED		Lumen output ¹		Color temperature	Voltage	Reflector	Options
DOM6 LED	600L	35K	3500K	120	D06	White open ³	TRW White flange with anodized reflectors
	900L	40K	4000K	277	D06A	Clear diffuse open	TRBL Black flange with anodized reflectors
				347 ²	D06AZ	Semi-specular open	DIM 0-10V dimming driver, 10% minimum light output
					D06MW	Matte white ³	ELRB722 Bodine® emergency battery pack with remote test switch provides 86% light output or roughly 770 lumens, for up to 90 minutes (900L only) ⁴
							NSD Sensor Switch® nLight® one 5A relay with one 0-10 VDC dimming output; requires bus power, such as nPP16 power pack. Refer to nSP5-D . ⁵

Accessories: Order as separate catalog number.	
IDS BC 120/277 WH	Synergy white switch
IDS BC 120/277 IV	Synergy ivory switch
NSP5 D ER KIT	Sensor Switch nLight secondary relay and dimming pack device used to switch and dim luminaires powered via an emergency circuit. Refer to NSP5 D ER KIT .

Notes

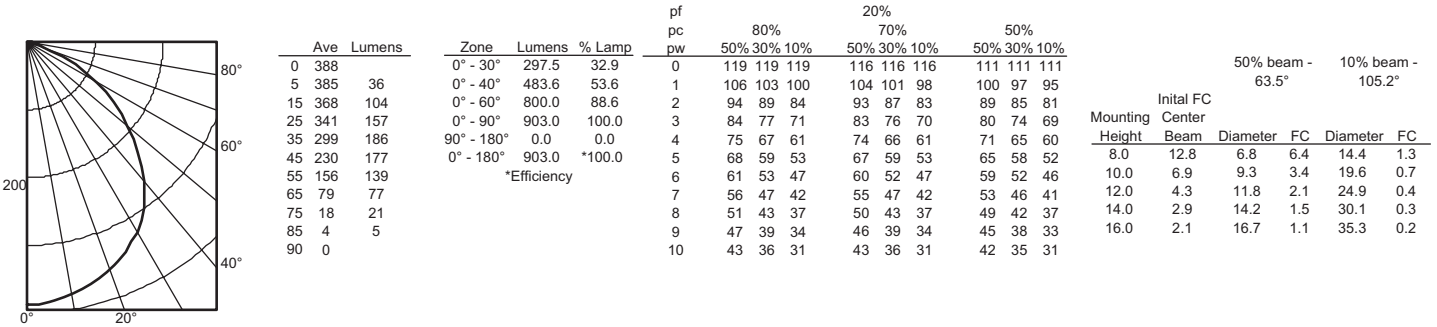
- Total system delivered lumens; power factor > 0.90.
- Not available with ELRB722
- White integral flange.
- ELRB722 available only with 900L.
- For emergency generator/inverter applications order non-nLight-enabled fixture and NSP5 D ER KIT as an accessory. Refer to [NSP5 D ER KIT](#).

DOM6 LED 6" OPEN LED

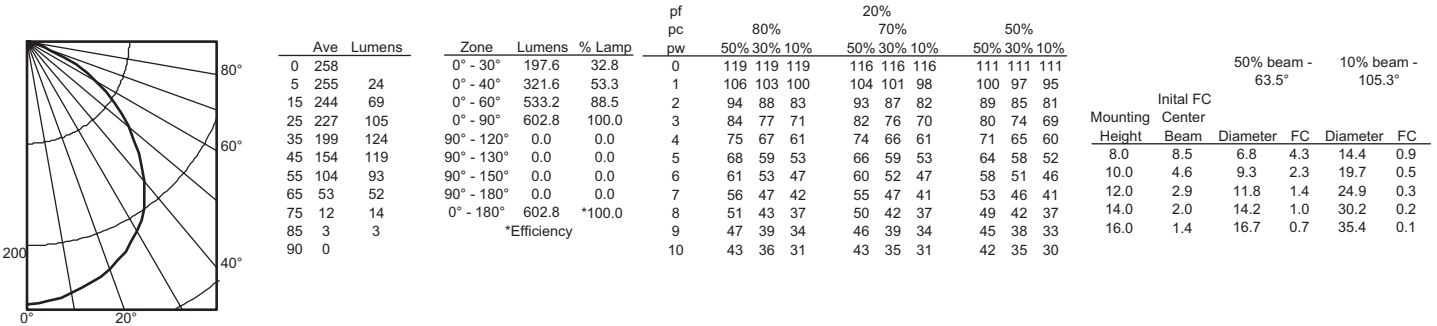
PHOTOMETRICS

Distribution Curve	Distribution Data	Output Data	Coefficient of Utilization	Illuminance Data at 30" Above Floor for a Single Luminaire
--------------------	-------------------	-------------	----------------------------	--

DOM6 900L D06; 903 delivered lumens, input watts: 25.0, Test No. LTL 17007, tested in accordance with IESNA LM-79-2008



DOM6 600L D06; 603 delivered lumens, input watts: 15.6, Test No. LTL 17014, tested in accordance with IESNA LM-79-2008



Notes

- Actual performance may differ as a result of end-user environment and application.
- Actual wattage may differ by +/-5% when operating between 120-347V +/-10%.



DOM6_LED_OPEN

Catalog Number
Notes
Type

FEATURES & SPECIFICATIONS

INTENDED USE — Recessed downlight that provides volumetric lighting by filling the entire volume of space with light, delivering the ideal amount of light to walls, cubicles, work surfaces and people. Typical applications include corridors, lobbies, conference rooms and private offices. The system maintains 70% lumen output at more than 50,000 hours.

CONSTRUCTION — 16-gauge galvanized steel mounting/plaster frame with torsion springs to mount open conical shape reflector.

Rugged, one-piece, die-cast housing with white interior dome reflector.

LED light source shielded from direct view.

Vertically adjustable mounting brackets that use 16-gauge flat bar hangers (included), 1/2" conduit or C channel T bar fasteners. Provides 3-3/4" total adjustment.

Post installation adjustment possible from above or below the ceiling.

Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination 1/2"-3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors, rated for 90°C.

Fixture height of 5-3/4" allows installation in shallow plenum applications.

Secondary housing adjustment system for precise, final ceiling-to-flange alignment.

Maximum 1-1/2" ceiling thickness.

ELECTRICAL — Utilizes high-brightness LEDs mounted to a metal core circuit board, ensuring cool-running operation, 3500K, CRI > 80.

Thermal control ensures cool-running LEDs.

Thermal protection provided against improper insulation use.

High-efficiency, electronic LED driver mounted in the junction box.

Luminaire should be installed in applications where ambient temperatures do not exceed 50°C. Ambient temperatures that exceed 50°C will result in reduced lamp life and will void warranty.

Input wattage for 1200L is 27.5W. Input wattage for 1500L is 35.8W.

The DOM8 LED with DIM option operates with all 0-10V dimming switches. The following dimming switches have been confirmed to dim to 10% output:

Synergy® model number: [ISD BC 120/277](#)

Leviton® model number: IP710-DLX

Lutron® model number: NTFTV-WH. For on/off control, this switch requires a power pack. Consult Lutron for more information.

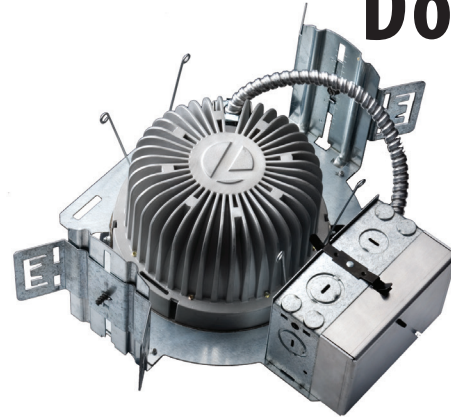
LISTINGS — CSA Certified to US and Canadian safety standards. Damp location listed.

WARRANTY — Five-year limited warranty. Complete warranty terms located at:

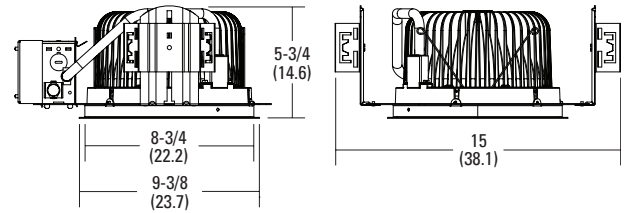
www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Specifications subject to change without notice.

DOM8 LED



8" OPEN LED



Specifications

- Aperture: 8-3/4 (22.2)
- Ceiling opening: 8-3/4 (22.2)
- Overlap trim: 9-3/8 (23.7)
- Height: 5-3/4 (14.6)
- Length: 13 (33.0)
- Standard width: 15 (38.1)

All dimensions are inches (centimeters) unless otherwise specified.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: DOM8 LED 1200L 35K 120 D08

DOM8 LED Series	Lumen output ¹	Color temperature	Voltage	Reflector	Options	
DOM8 LED	1200L	35K	3500K	120	D08 White open ³	TRW White flange with anodized reflectors
		40K	4000K	277	D08A Clear diffuse open	TRBL Black flange with anodized reflectors
	1500L			347 ²	D08AZ Semi-specular open	DIM 0-10V dimming driver, 10% min. light output
					D08MW Matte white ³	ELR Emergency battery pack with remote test switch 100% lumen output at 90 minutes
					NSD Sensor Switch® nLight® one 5A relay with one 0-10 VDC dimming output; requires bus power, such as nPP16 power pack. Refer to nSP5-D . ⁴	

Accessories: Order as separate catalog number.	
IDS BC 120/277 WH	Synergy white switch
IDS BC 120/277 IV	Synergy ivory switch
NSP5 D ER KIT	Sensor Switch nLight secondary relay and dimming pack device used to switch and dim luminaires powered via an emergency circuit. Refer to NSP5 D ER KIT .

Notes

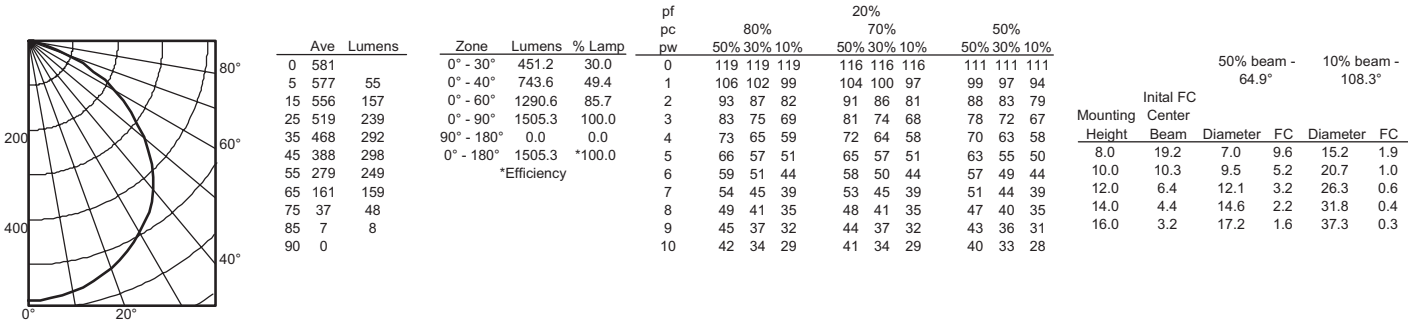
- Total system delivered lumens; power factor > 0.90.
- Not available with ELR and ELR8722
- White integral flange.
- For emergency generator/inverter applications order non-nLight-enabled fixture and NSP5 D ER KIT as an accessory. Refer to [NSP5 D ER KIT](#).

DOM8 LED 8" OPEN LED

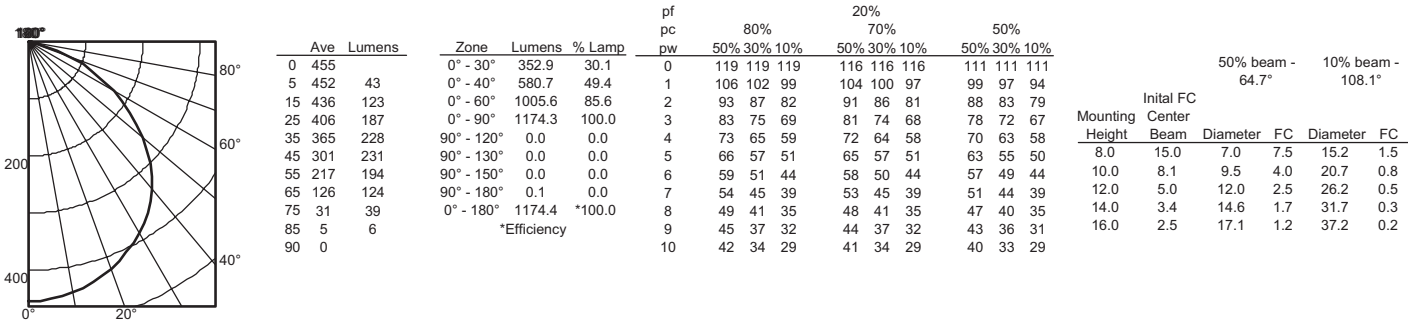
PHOTOMETRICS

Distribution Curve	Distribution Data	Output Data	Coefficient of Utilization	Illuminance Data at 30" Above Floor for a Single Luminaire
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DOM8 1500L D08; 1505 delivered lumens, input watts: 35.8, Test No. LTL 17190, tested in accordance with IESNA LM-79-2008



DOM8 1200L D08; 1174 delivered lumens, input watts: 27.5, Test No. LTL 17214, tested in accordance with IESNA LM-79-2008



Notes

- Actual performance may differ as a result of end-user environment and application.
- Actual wattage may differ by +/-5% when operating between 120-347V +/-10%.



DOM8_LED_OPEN



Date: _____ Type: _____

Firm Name: _____

Project: _____

iW Cove MX Powercore

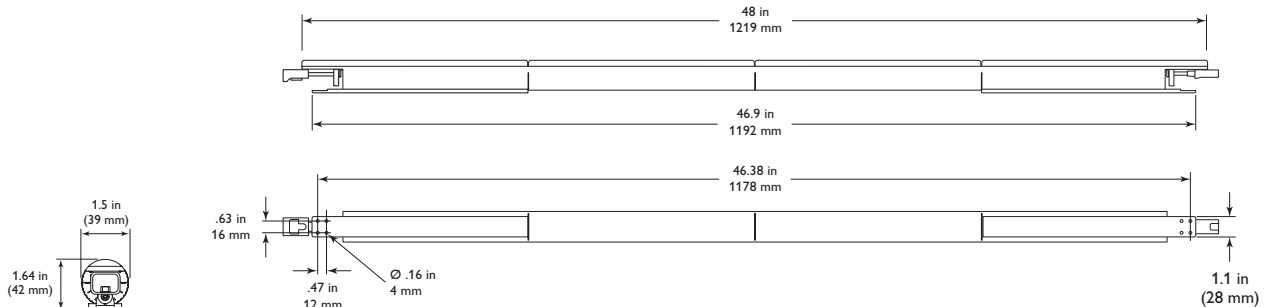
4 ft (1.2 m) 110° x 110° (wide) beam angle

Premium interior linear LED cove and accent fixture with intelligent white light

iW Cove MX Powercore is a high-performance, white-light LED fixture that brilliantly illuminates alcoves and other interior spaces wherever adjustable color temperature is required. With three channels of warm, neutral, and cool LED sources, this compact, versatile fixture offers a color temperature range of 2700 K to 6500 K. With its rotating housing, flexible end-to-end locking power connectors, and wide and medium beam angles, iW Cove MX Powercore is the perfect choice for retail, exhibit, hospitality, and architectural applications.

- Superior beam quality — Available in 1 ft (305 mm) and 4 ft (1.2 m) die-cast aluminum housings with wide (110° x 110°) and medium (50° x 70°) beam angles. Delivers striation-free light within close distance from fixture placement with no visible light scalloping between fixtures.
- High-performance illumination in a wide range of color temperatures — Channels of warm, neutral, and cool white LEDs produce color temperatures ranging from 2700 K to 6500 K. Offers the greatest possible light intensity at all color temperatures. Fixture brightness can be varied while maintaining constant color temperature.
- Superior binning algorithm sets new standard for color consistency — iW Cove MX Powercore exceeds the recognized standards for color quality to guarantee uniformity and consistency of hue and color temperature across LEDs, fixtures, and manufacturing runs.
- Integrates Powercore technology — Powercore technology rapidly, efficiently, and accurately controls power output to fixtures directly from line voltage. The Philips Data Enabler Pro merges line voltage with control and delivers them to the fixture over a single standard cable, dramatically simplifying installation and lowering total system cost.
- Universal power input range — Power input of 100 to 240 VAC for consistent installation anywhere in the world.
- Easy installation — By delivering line voltage directly to the fixtures, Powercore simplifies installation by reducing the number of external power supplies, allowing long product runs and eliminating the need for special wiring. Easy-to-install 4 ft (1.2 m) mounting tracks allow quick project setup in linear applications.
- Flexible mounting and positioning — With end-to-end locking power connectors that can make 180° turns, these compact cove fixtures are easy to position in even the most challenging mounting circumstances. 1 ft (305 mm) and 5 ft (1.5 m) jumper cables can add extra space between fixtures. Optional mounting tracks support vertical and overhead positioning.

For detailed product information, please refer to the iW Cove MX Powercore Product Guide at www.philipscolorkinetics.com/ls/intelliwhite/iwcovemxpc/



PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	4 ft (1.2 m), 110° x 110° beam angle
	Color Temperature*	2700 K – 6500 K
	Lumens†	2471 (all channels full on)
	Efficacy (lm / W)	48.6 (all channels full on)
	CRI	81 (all channels full on)
	Lumen Maintenance‡	50,000 hours L70 @ 25° C 50,000 hours L70 @ 50° C 50,000 hours L50 @ 25° C 50,000 hours L50 @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	50 W maximum at full output, steady state
Control	Interface	Data Enabler Pro (DMX / Ethernet)
	Control System	Philips Color Kinetics full range of controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, or third-party controllers
Physical	Dimensions (Height x Width x Depth)	1.64 x 48 x 1.5 in 42 x 1219 x 38 mm
	Weight	4.1 lb (1.85 kg)
	Housing	Die-cast aluminium, white powder-coated finish.
	Lens	Clear polycarbonate
	Fixture Connections	Integral male / female connectors
	Temperature Ranges	-4° – 122° F (-20° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage
	Humidity	0 – 95%, non-condensing
Certification and Safety	Certification	UL / cUL, FCC Class B, CE, PSE, CCC, SAA, C-Tick
	Environment	Dry / Damp Location, IP20

* Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.



† Lumen measurement complies with IES LM-79-08 testing procedures.

‡ L70 = 70% lumen maintenance (when light output drops below 70% of initial output). L50 = 50% lumen maintenance (when light output drops below 50% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

Fixtures

Item	Type	Item Number	Philips 12NC
iW Cove MX Powercore 1 ft (305 mm)	110° x 110°	UL / cUL / CE	523-000002-02 910503701230
		CCC	523-000002-04 910503701232
	50 x 70°	UL / cUL / CE	523-000002-03 910503701231
		CCC	523-000002-05 910503701992
iW Cove MX Powercore 4 ft (1.2 m)	110° x 110°	UL / cUL / CE	523-000002-06 910503702608
		CCC	523-000002-08 910503703169
	50 x 70°	UL / cUL / CE	523-000002-07 910503702609
		CCC	523-000002-09 910503703170

Use Item Number when ordering in North America.

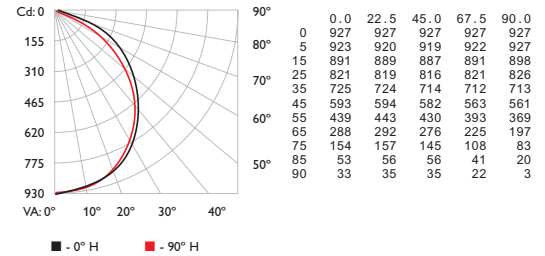


Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.philipscolorkinetics.com

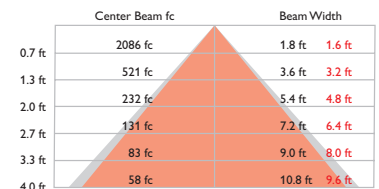
Photometrics

4 ft (1.2 m), 110° x 110° beam angle (all channels full on)

Polar Candela Distribution



Illuminance at Distance



30.5 ft (9.3 m) 1 fc maximum distance
Vert. Spread: 106.9°
Horiz. Spread: 100.4°

Lumens	2471
Efficacy	48.6 lm / W

For lux multiply fc by 10.7

Accessories

Item	Type	Item Number	Philips 12NC
Mounting Track, White	1 @ 4 ft (1219 mm)	120-000124-00	910503701787
Leader Cable with terminator	10 ft (3.1 m)	UL / cUL	108-000050-00 910503701686
		CE / CCC	108-000050-01 910503701687
Jumper Cable	1 ft (305 mm)	UL / cUL	108-000049-01 910503701683
		CE / CCC	108-000049-03 910503701685
	5 ft (1.5 m)	UL / cUL	108-000049-00 910503701682
		CE / CCC	108-000049-02 910503701684
Wiring Compartment with Terminator		120-000077-02	910503701740
Data Enabler Pro	3/4 in / 1/2 in NPT (U.S. trade size conduit)	106-000004-00	910503701210
	PG21 / PG13 (metric size conduit)	106-000004-01	910503701211

Use Item Number when ordering in North America.

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KBA8 LED

LED Specification Bollard

Specifications

8" Round
(20.3 cm)

Height: 42"
(106.7 cm)

Weight (max): 27 lbs
(12.25 kg)



Catalog
Number

Notes

Type

Hit the Tab key or mouse over the page to see all interactive elements.

Introduction

The KBA8 Bollard is a stylish, fully integrated LED solution for walkways. It features a sleek, modern design and is carefully engineered to provide long-lasting, energy-efficient lighting with a variety of optical and control options for customized performance.

With an expected service life of over 20 years of nighttime use and up to 70% in energy savings over comparable 100W metal halide luminaires, the KBA8 Bollard is a reliable, low-maintenance lighting solution that produces sites that are exceptionally illuminated.

Ordering Information

EXAMPLE: KBA8 LED 16C 700 40K SYM MVOLT DDBXD

KBA8 LED																
Series	LEDs	Drive current		Color temperature		Distribution		Voltage	Control options	Other options	Finish (required)					
KBA8 LED	Asymmetric 12C 12 LEDs ¹	350	350 mA	30K	3000K	ASY	Asym- metric ¹	MVOLT ⁵	Shipped installed	Shipped installed	DWHXD	White	Striping⁹			
		530	530 mA	40K	4000K						DNAXD	Natural aluminum		SDDB	Dark bronze	
	Symmetric 16C 16 LEDs ²	700	700 mA	50K	5000K	SYM	Sym- metric ²	208 ⁵	PE	Photoelectric cell, button type	DF	Double fuse (208, 240V) ^{4,7}	SDWH	White		
		Amber 450 450 mA ^{3,4}	Amber AMBLW	Amber limited wavelength ^{3,4}	DMG						0-10V dimming driver (no controls)	H24	24" overall height	DBLXD	Black	SDBL
								240 ⁵	ELCW	Emergency battery backup ⁶	H30	30" overall height	DDBTXD	Textured dark bronze	SDTG	Tennis green
							277 ⁵	H36			36" overall height	DBLBXD	Textured black	SDBR	Bright red	SDBUA
								347 ⁴			FG	Ground-fault festoon outlet	DNATXD	Textured natural aluminum	SDYLB	Yellow
											L/AB	Without anchor bolts (3 bolt base)	DWHGXD	Textured white		
											L/AB4	4 bolt retrofit base without anchor bolts ⁸				

Accessories

Ordered and shipped separately.

MRAB U Anchor bolts for KBA8 LED⁸

NOTES

- 1 Only available in the 12C, ASY version.
- 2 Only available in the 16C, SYM version.
- 3 Only available with 450 AMBLW version.
- 4 Not available with ELCW.
- 5 MVOLT driver operates on any line voltage from 120-277V (50/60 Hz). Specify 120, 208, 240 or 277 options only when ordering with fusing (SF, DF options), or photocontrol (PE option).
- 6 Not available with 347V. Not available with fusing. Not available with 450 AMBLW.
- 7 Single fuse (SF) requires 120, 277, or 347 voltage option. Double fuse (DF) requires 208 or 240 voltage option.
- 8 MRAB U not available with L/AB4 option.
- 9 Striping is available only in the colors listed.



Performance Data

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Actual performance may differ as a result of end-user environment and application. Actual wattage may differ by +/- 8% when operating between 120-480V +/- 10%.

Light Engines	Drive Current	System Watts	3000K					4000K					5000K					Limited Wavelength Amber					
			Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	
Asymmetric 3 Engines (12 LEDs)	350	16	641	40	1	1	1	809	51	1	1	1	870	54	1	1	1						
	530	22	947	43	1	1	1	1,191	54	1	1	1	1,282	58	1	1	1						
	700	31	1,214	40	1	1	1	1,527	51	1	1	1	1,646	55	1	1	1						
	Amber 450	16																324	20	0	1	0	
Symmetric 4 Engines (16 LEDs)	350	20	888	44	1	0	0	1,116	56	1	0	0	1,203	60	1	0	0						
	530	28	1,254	45	1	0	0	1,598	57	1	0	1	1,719	61	1	0	1						
	700	39	1,608	41	1	0	1	2,022	52	1	0	1	2,180	56	2	0	1						
	Amber 450	20																374	19	0	0	0	

Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the platforms noted in a **25°C ambient**, based on 10,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Operating Hours	0	25,000	50,000	100,000
Lumen Maintenance Factor	1.00	0.98	0.97	0.95

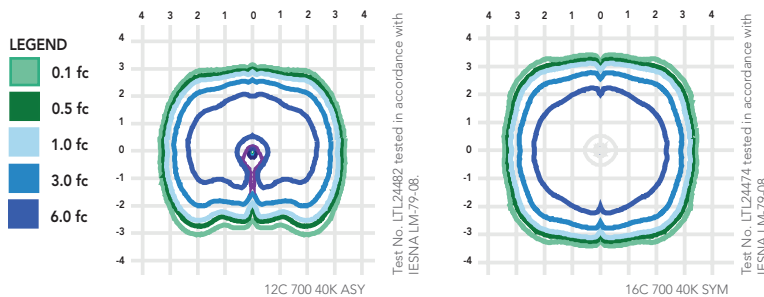
Electrical Load

Light Engines	Drive Current (mA)	System Watts	Current (A)				
			120	208	240	277	347
12C	350	16W	0.158	0.118	0.114	0.109	0.105
	530	22W	0.217	0.146	0.136	0.128	0.118
	700	31W	0.296	0.185	0.168	0.153	0.139
	Amber 450	16W	0.161	0.120	0.115	0.110	0.106
16C	350	20W	0.197	0.137	0.128	0.121	0.114
	530	28W	0.282	0.178	0.162	0.148	0.135
	700	39W	0.385	0.231	0.207	0.185	0.163
	Amber 450	20W	0.199	0.139	0.130	0.123	0.116

Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting's [KBA8 Bollard homepage](#).

Isofootcandle plots for the KB LED Bollards. Distances are in units of mounting height (3').



FEATURES & SPECIFICATIONS

INTENDED USE

The rugged construction and clean lines of the KBA bollard is ideal for illuminating building entryways, walking paths, and pedestrian plazas, as well as any other location requiring a low mounting height light source with fully cutoff illumination.

CONSTRUCTION

One-piece 8-inch round extruded aluminum shaft with thick side walls for extreme durability, a high-impact clear acrylic lens and welded top cap. Die-cast aluminum mounting ring allows for easy leveling even in sloped locations and a full 360-degree rotation for precise alignment during installation. Three 1/2" x 11" anchor bolts with double nuts and washers and 3 3/4" bolt circle template ensure stability. Overall height is 42" standard.

FINISH

Exterior parts are protected by a zinc-infused super durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering for maximum retention of gloss and luster. A tightly controlled multi-stage process ensures a minimum 3-mil thickness for a finish that can withstand the elements without cracking or peeling. Available in both textured and non-textured finishes.

OPTICS

Two fully cutoff optical distributions are available: symmetrical and asymmetrical. IP66 sealed LED light engine provides smoothly graduated illumination without any uplight. Light engines are available in standard 4000K (>70 CRI) or optional 3000K (>80 CRI) or 5000K (67 CRI). Limited-wavelength amber LEDs are also available.

ELECTRICAL

Light engines consist of high-efficacy LEDs mounted to metal-core circuit boards to maximize heat dissipation and promote long life (L95/100,000 hours at 700mA at 25°C). Class 2 electronic drivers are designed for an expected life of 100,000 hours with < 1% failure rate. Electrical components are mounted on a removable power tray.

LISTINGS

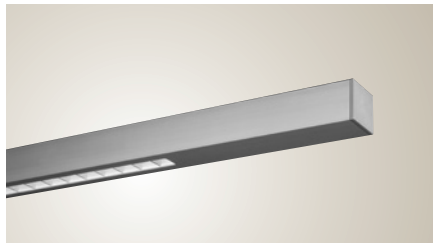
CSA certified to U.S. and Canadian standards. Light engines are IP66 rated. Rated for -40°C minimum ambient. Cold-weather emergency battery backup rated for -20°C minimum ambient.

WARRANTY

Five-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Note: Specifications subject to change without notice.





Lightline® I/D Indirect T8

Type:

Project:

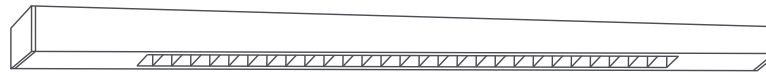
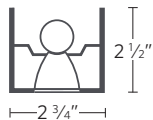
SPECIFICATIONS

Suspended

LL1M4

LAMPING OPTIONS

□ LL1M4



SPECIFICATIONS

Construction

Housing is extruded aluminum forming a 2 3/4" x 2 1/2" rectangular profile. Die-cast end plate mechanically attaches with no exposed fasteners.

Shielding

Long window with soft white aluminum baffle.

Reflectors

Die-formed, pre-finished white reflector with hammertone specular aluminum.

Electrical

Specify 120V, 277V or 347V. Pre-wired with 16AWG fixture wires. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included. UL and C-UL listed.

Finish

Standard colors include satin anodized aluminum, and white white (low gloss).

Luminaire Length

8' and 12' lengths in a single section for suspension spacing of 8' and 12'. For total luminaire length, add 3/4" for each end plate. Using internal joiners, 4', 8', and 12' sections can be joined to form longer rows.

CATALOG NUMBER

Examples: LL1M4 1 32 12FT R12 120 GEB10 SCT LP835 F1/12 C100 — LL1M4 1 32 8FT R8 120 ADZT SCT LP841 F1/24 C041

Luminaire	# of Lamps in Cross Section	Lamp Type	Luminaire Row Length	Maximum Section Length	Voltage	Ballast Type	# of Emergency Modules	Emergency Type ²
LL1M4	1	32 32W T8	X FT (4' increments)	R4 4' section(s) R8 8' section(s) R12 12' section(s)	120 277 347	GEB10 <10% THD Electronic ADEZ ¹ Advance Mark 10 dim ADZT ¹ Advance Mark 7 0-10V dim <i>Reference Ballast Wizard on website or consult factory for other options.</i>	(Blank) None 1SE 1 section 2SE 2 sections XSE X sections	(Blank) None EC Emergency circuit EL ³ Emergency battery pack EN ³ Emergency battery pack w/night light circuit

Switching	Lamp Color	Mounting Type /	Overall Suspension	Finish	Options
SCT Single circuit	L/LP No lamp L/LPE No lamp. Wired for energy saving lamps. LP830 3000K 80+ CRI LP835 3500K 80+ CRI LP841 4100K 80+ CRI <i>Reference Lamp Chart on website or consult factory for other options.</i>	F1/ T-bar ceiling (universal mounting bracket) F1A/ T-bar ceiling (UMB with integrated J-box) F2/ Hard ceiling (horizontal J-box) F3/ Rigid stem	12 12" 15 15" 18 18" 21 21" 24 24" XX XX" <i>Overall suspension is measured from ceiling to bottom of luminaire.</i>	C041 White white (low gloss) C100 Satin anodized finish C099 Custom finish	ACG Adjustable cable grippers BLK Black cord, cord manager and canopy (not available with F3) CP Chicago plenum (available with F1A only) DL Damp location label DU Dust cover ELH Emergency through wiring w/separate feed ELS Emergency through wiring w/single feed, shared neutral ELS2 Emergency through wiring w/single feed, separate neutrals GLR Fusing (fast blow) GMF Fusing (slow blow) MCS Matching feed canopy at support NEPP5D nLight enabled control module per row/zone OJB Offset junction box SLP Sloped ceiling (for 10-45°, must be specified with F2, ACG and OJB options) XXXX Integrated sensor; choose options and obtain code on page 2

Notes:

- Not available in 347V
- Emergency type is installed in last 4' of luminaire sections. Separate feed required unless ELS or ELS2 is specified
- Not available in 4' section

2246 5th Street, Berkeley, CA 94710 • Tel: 510.845.2760 • Fax: 510.845.2776 • Email: techsupport@peerlesslighting.com • PeerlessLighting.com

Lightline® I/D

Indirect T8

Type:

Project:

Suspended

LL1M4

INTEGRATED NLIGHT MICRO SENSOR

Determine the appropriate sensor type, network type and sensor power source for your application. Enter the code in the Options section of the Catalog Number.

EXAMPLE: PDT1

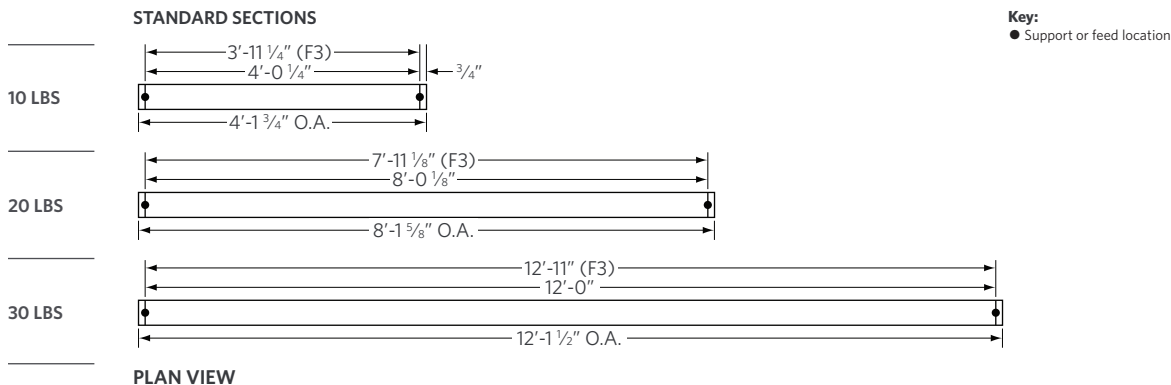
Sensor Type (choose one)	
ADC nLight model nES ADCX	Daylight Dimming Specify 0-10V dimming ballast No occupancy sensing
PDT nLight model nES PDT7 ADCX	Daylight Dimming and/or Occupancy Detection Specify 0-10v dimming ballast for daylight dimming Specify fixed-output ballast for occupancy detection only (daylight dimming disabled)

Network Type & Sensor Power Source (choose one)	
1*	nLight-Enabled (Network-Ready) with Luminaire-Integrated Power Pack 10' Cat-5e cable and splitter provided
2	Standalone Operation (No Networking) with Luminaire Integrated Power Pack No Cat-5e cable provided
3*	nLight-Enabled (Network-Ready) with Remote nLight Power Pack or nPanel 10' Cat-5e cable and splitter provided Order required remote nLight Power Pack or nPanel separately through nLight (Acuity Brands Controls)

For more information about the Integrated nLight Micro Sensor, its capabilities and options, download the PDF guide at: PeerlessLighting.com/nLight-Sensor-Guide
*nLight-Enabled (network-ready) options include one RJ-45 connector on the luminaire and 10' of Cat-5e cable and a splitter to control the entire luminaire row (depending on wattage/voltage limitations). The Cat-5e cable drop is located in the same section as the sensor. For multiple zones, please contact techsupport@peerlesslighting.com.

WEIGHTS & SUPPORT SPACING

Suspension spacing equals section length. Default location shown. Consult factory for stem mounting suspension spacing and alternate locations.

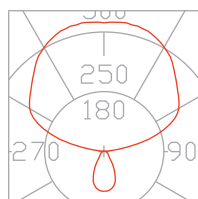


CONFIGURATIONS



Mitered "L", "X" and "T" connectors available for suspended configurations. Reference [Pattern Connector Guide](#) for additional details.

PHOTOMETRICS Actual performance may differ as a result of end-user environment and application.

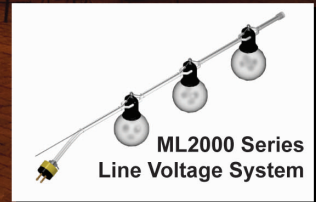


1-LAMP T8
70.8% efficiency
2018 delivered lumens
89.1% up / 10.9% down



MARKETLITE SERIES

Manufactured in the U.S.A.



“Lighting for the Professional Designer”

PRODUCT *Construction*

- Applications: Building Exteriors and Interiors
- Voltage: Line Voltage (120V) System (12V Optional)
- Socket Base: Medium Base Sockets are Permanently Attached in Parallel Wiring
- Lamps: Replaceable LEDs (50,000Hrs Lamp Life) are protected with Shatterproof, Sealed Globes (LEDs Included). Available with Incandescent Line Voltage (120V) or Low Voltage Lamps (12V)
- Spacing: 6", 12", 24", 36", 48", 60" or other Custom Spacing
- Length: Built to Order (Custom Lengths to Fit Application)
- Lead Wire: Standard 6' lengths (Custom Lengths Available)
- Mounting: Surface Mount or Suspended
- Options: Mesh Canopies with Custom Finishes
Canopies and Cages with Custom Finishes

ELECTRICAL *information*

MarketLite is a LINE VOLTAGE (120V) system that can carry up to 1800 Watts in a single run (20 amp - 12 gauge wire). MarketLite is available with low voltage lamps (12V) which will require a 12 volt (secondary side) transformer. Our standard transformers' primary side voltage are 120 or 277 volts. Consult factory for other voltages.

APPLICATION *information*

MarketLite is a LINE VOLTAGE (120V) system available with long life, energy efficient LEDs. MarketLite can be installed using the special hooks on the lamp sockets to an aircraft cable. MarketLite can be field cut for an easy and fast installation not requiring exact field dimensions.

MarketLite is excellent to illuminate areas for accent or decorative lighting. MarketLite creates a warm, pleasant environment in outdoor venues, restaurant interiors, patios and other applications.



ETL Listed Dry or Wet Location
Meets UL and CSA Requirements
Lighting Facts Partner
LM79 Testing Available



CALIFORNIA ACCENT LIGHTING, INC.



2034 E. Lincoln Ave. #431 Anaheim, CA. 92806

P. (714)535-7900 | F. (714)535-7902 | (800) 921-CALI (2254) | info@calilighting.com | www.calilighting.com

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Raphael Series • Apollo • 5000

Pendant



QUICK FIND #: QF-3125

1. CATALOG # 5000-30
5000-42

2. LAMPING
5000-30
I = (4) 60W A-19/MED.
F = (4) CFQ26W/G24Q-3
5000-42
I = (8) 60W A-19/MED.
F = (4) CFTR42W/GX24Q-4
FX = (8) CFTR42W/GX24Q-4

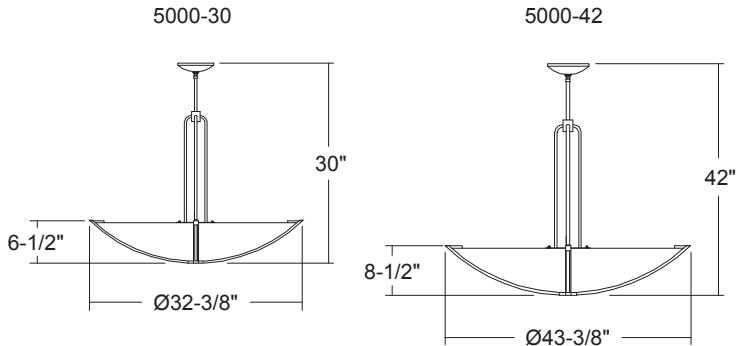
3. VOLTAGE 120V = 120 VOLT (incandescent 120V only)
277V = 277 VOLT

4. LENS OPTION
OA = OPAL ACRYLIC (etched)
FAH4 = WHITE VEIN HAND PAINTED FAUX ALABASTER
FAH5 = ANTIQUE HAND PAINTED FAUX ALABASTER (beige)
FAH6 = GRAY VEIN HAND PAINTED FAUX ALABASTER
FAH7 = BEIGE VEIN HAND PAINTED FAUX ALABASTER

5. FINISH
STANDARD
BAL = BRUSHED ALUMINUM
LBP = LIGHT BRONZE PAINT WITH BRUSHED TEXTURE
CUSTOM
CPF = CUSTOM PAINTED FINISH (consult factory)
CMF = CUSTOM METAL FINISH (consult factory)

6. SPECIAL STD = STANDARD
MOD = MODIFIED

Modification Descriptions: (if needed)




Weight Hanging (lbs.) *

I, F / 5000-30	30 lbs.
I / 5000-42	40 lbs.
F / 5000-42	45 lbs.
FX / 5000-42	46 lbs.

* all pendants over 50 lbs. require additional hanging support.

Notes:

- UL listed and cUL approved 
- Winona Lighting products are union made.
- Custom Sizes and Finishes available upon request.
- All Fluorescent fixtures available in 120V and 277V.
- Winona Lighting reserves the right to make design changes without prior notice.
- Lamps not included.

DESCRIPTION

The 107-P Fabrique Square Cylinder Pendant Luminaire features 26 shade materials, 4 mounting options, 4 Metal Motifs (**Patent Pending**), Metal Panel Frames (**Patent Pending**) and 2 Shade-in-a-Shade options.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Material/Mounting

Cold-rolled steel and aluminum wirebody, painted white. Supplied with white acrylic bottom diffuser with one finial. Optional matte white acrylic top cover.

Single Stem (P1S): 5" canopy with a 1/2" stem self-aligning swivel. One 1/2" stem with a standard hang height of 40" (OA) for 28" Ht., minimum 32" (OA), 54" (OA) for 40" Ht., minimum 44" (OA), and 64" (OA) for 52" Ht., minimum 56" (OA). Maximum overall hang height for one-piece stem assembly is 8' (OA). 9' to 25' (OA) stems are supplied in multiple sections. Supplied with a hang straight swivel canopy which will accommodate up to 34° adjustment. Specify SCA for sloped ceiling applications from 18° to 45°. *Single Stem with Aircraft Cables (P1SAC):* One 1/2" stem and three 3/64" cables with a standard hang height of 40" (OA) for 28" Ht., minimum 32" (OA), 54" (OA) for 40" Ht., minimum 44" (OA), and 64" (OA) for 52" Ht., minimum 56" (OA). Maximum overall hang height is 25' (OA). 8' to 25' stems are supplied in multiple sections. Contact factory for lengths above 25' and multi-cylinders. Supplied with a hang straight swivel canopy which will accommodate up to 34° (total) adjustment.

Three Fixture Pendant Cluster (P3FCL):* 22" Square aluminum canopy with three 1/2" stems with a hang straight swivel canopy with a standard hang height of 92" (OA) for 28" Ht., minimum 76" (OA), 122" (OA) for 40" Ht., minimum 108" (OA), and 152" (OA) for 52" Ht., minimum 140" (OA). Contact factory for SCA and MOD OA.

Four Fixture Pendant Cluster (P4FCL):* 22" Square aluminum canopy with four 1/2" stems with a hang straight swivel canopy with a standard hang height of 112" (OA) for 28" Ht., minimum 96" (OA), 152" (OA) for 40" Ht., minimum 138" (OA), and 192" (OA) for 52" Ht., minimum 180" (OA). Contact factory for SCA and MOD OA.

*Shaper clusters are shown with a standard OA and with a specific quantity of fixtures. They can easily be modified to have more fixtures, a variety of fixture lengths, longer or shorter OA's and larger/different mounting plates to meet the needs of specific projects. Please contact the factory for details.

Shades

10" Square Solid cold-rolled steel construction. Material on heavy translucent white styrene. All shades are "Hand-Tucked" except for paper, vinyl and wood options. Note that Shaper's standard material selection is subject to change based on supplier availability. It is common for material manufacturers to be out of stock for long periods of time, change or discontinue materials without notice, based on market trends and/or raw material availability. We will contact the customer to provide the best alternative solution for orders in house if this situation occurs.

Optional Shade-in-a-Shade (CSQSIS, or TSQSIS): Solid cold-rolled steel frame construction with exposed metal painted white, silver or gold to match specified organza. Organza adhered to a heavy clear vinyl backing.

Optional Metal Motifs-[Patent Pending] (MMSQM, MMSQC, MMSQR or MMSQT): Solid aluminum or steel laser-cut construction with integral mounting tabs.

Optional Metal Panel-[Patent Pending] (MPSQ): Solid aluminum or steel panel construction with integral mounting tabs and flat resin inserts.

Finish (Stem, Motifs, Panel, canopy and finial)

Standard: Natural Aluminum (NA) [Sustainable Design].

Premium: Matte White (MW), Aluminum Paint (ALP), Bronze Metallic Paint (BM), Gold Metallic Paint (GM), Lacquered Satin Aluminum (SAL), Satin Brass (SB), Polished Brass* (PB), Oxidized Brass (OBRS), Satin Chrome (SC), Polished Chrome* (PC), Satin Copper (SCP), Polished Copper* (PCP), Oxidized Copper (OCP), Satin Nickel (SN), Polished Nickel* (PN), Gun Metal (GNM) or Custom Color (CC).

Contact Factory for multi-finishes (i.e. MW finial with SC stems/canopy).

*Note: Plated Polished finishes are not available with Metal Motif options.

Materials

Standard: Silk White (SIW).

Premium: Shantung White - 28" & 40" only (SWH), Shantung Eggshell

(SEG), Chintz Chocolate (CCT), Chintz Onyx (CXH), Shantung Beige (SBG), Apex (APX), Glasgow Flax - 28" & 40" only (GFX), Paper Leaf - 28" & 40" only (PPF), Nutmeg Shimmer (NGS), Bronze Shimmer (BZS), Linen Alabaster - 28" & 40" only (LAT), Linen Biscuit - 28" & 40" only (LBS), Linen Chopsticks - 28" & 40" only (LCK), Grass Cloth - 28" only (GSH), Silk Ivory (SIY), White Krinkle - 28" & 40" only (WHK), White Corona (WCA), Heather Grey (HTG), Aluminium Shimmer (AMS), Golden Honey - Vinyl Coated - 28" & 40" only (GHY), Natural Flax - Vinyl Coated - 28" & 40" only (NFX), Alabaster - Vinyl Coated - 28" & 40" only (ABR), FSC** Natural Bamboo (NLB) [Sustainable Design], FSC** Variegated Bamboo (VDB) [Sustainable Design] or FSC** Amber Bamboo (ABB) [Sustainable Design] or Customer Supplied Fabric (CSCC). Note that the Bamboo is horizontal on the 106 shade.

Optional Shade-in-a-Shade (CSQSIS or TSQSIS): Earth Dust (EDT), White Mist (WMT) or Silver Moon (SMO).

Optional Metal Panel (MP): Earth Dust - Resin (EDTR), White Mist - Resin (WMTR) or Silver Moon - Resin (SMOR).

*Many additional stock fabrics are available as a MOD, contact the factory for details. Shaper can accommodate "Customer Supplied Fabric" (CSCC) orders. Please contact your representative for details and minimum quantities.

**Forest Stewardship Council's (FSC) role is to bring together people, organizations and businesses of the Global South and North to develop consensus-based solutions that promote responsible stewardship of the world's forests. Visit www.fsc.org for more details. Natural materials and textiles are subject to inconsistency in color/pattern, texture, shape and may vary from dye lots. They may also change in appearance over time. Many materials appear differently when illuminated. As an example, the wood appears to be more amber when illuminated. It is recommended to view all samples illuminated prior to making final selection. Please contact your representative for a color sample chip.



107-P SERIES

Pendant Luminaire
Fabrique
Square Cylinder



Fabrique

Shaper now offers a wide variety of architectural fabric luminaires. All of the shades have been designed to have minimal or no visible hardware or structural trim, and are available with the latest in lamp and ballast technology (T5/CFL with dimming ballasts).

SUSTAINABLE DESIGN

Shaper has a long-standing history of offering environmentally-friendly fixtures. The copper and bronze alloys used in our exterior luminaires feature up to 98% recycled content, contribute less undesirable air emissions compared to painted aluminum and are easy to recycle.

ARRA

Shaper Lighting certifies that its products satisfy the requirements of Section 1605 of the American Recovery and Reinvestment Act (also known as the ARRA Buy American provision).

SPECIFICATION FEATURES (CONT'D.)

Optics

Refer to shaperlighting.com for complete photometrics.

Ballast

Integral electronic HPF, multi-volt 120/277V (347V Canada), thermally protected with end-of-life circuitry to accommodate the specified lamp wattage 120/277V DM only. Contact factory for 347V DM.

Standard dimming ballasts: Advance-HO Mark 7 (DMA7), Mark 10 (DMA10) or Lutron (DML).

Lamp/Socket

28": Three (3) 14W or 24W HO T5 linear fluorescents lamps.

40": Three (3) 21W or 39W HO T5 linear fluorescents lamps.

52": Three (3) 28W or 54W HO T5 linear fluorescents lamps.

Note: When specifying the Advance dimming option, only Advance Mark 7 (DMA7) or Mark 10 is available and specify the (3) 54WHO T5 (106-52-WMTA) lamping. T5HO lamps are recommended for use with medium to dark materials.

Lamps furnished by others.

Installation

Supplied with a universal integral mounting strap for a standard 4" J-box or plaster ring. Integral safety cable provided. Contractor to provide appropriate structural support for fixture weight. Refer to shaperlighting.com for installation sheets.

Cleaning recommendation: Use a soft clothes brush or a vacuum brush to dust the outside of the lamp shade and a clean soft white flannel cloth for the inside of the lamp shade.

Options

FL T5 Dimming Ballast: Advance Mark 7 (DMA7) or Mark 10 (DMA10) - Available with (3) 54WHO T5 (107-52-P) only or Lutron (DML). Sloped Ceiling Adaptor (SCA), Matte White Acrylic Top Cover (TC), Remote Emergency Ballast (REM), Top Square Shade-in-a-Shade (TSQSSIS) or Center Square Shade-in-a-Shade (CSQSSIS) + EDT, WMT or SMO, "European Mushroom" Pleat (EMP), "Casual Box" Pleat (CBP), Metal Motif Square Mondrian (MMSQM), Metal Motif Square Curvilinear (MMSQC), Metal Motif Square Rhombus (MMSQR) or Metal Motif Square Tangent (MMSQT). Floating Frame - Metal Panel Square (MPSQ) + EDTR, WMTR or SMOR. (Contact factory for NFP701 Fire Resistent or Stain Guard fabric coating.

Labels

U.L. and C.U.L. approved for interior locations only.

Modifications

Shaper's skilled craftspeople, with their depth of experience, offer the designer the flexibility to modify standard Fabrique pendant luminaires for project-specific solutions. Contact the factory regarding scale options, unique finishes, mounting, additional materials/colors or decorative detailing.

ORDERING INFORMATION

Sample Number (Fixture): 107-40-P1SAC-T5/3/21-277V-OCF-SCA18-TC-52

Series 107 = Square Cylinder Pendant ¹	Mounting Types P1S P1SAC 3FCL 4FCL	Lamp T5/3/14 ² T5/3/24HO ² T5/3/21 ³ T5/3/39HO ³ T5/3/28 ⁴ T5/3/54HO ⁴	Finish Standard NA = Natural Aluminum	Options DMA7 = Dimming Ballast (Advance Mark 7) ⁴ DMA10 = Dimming Ballast (Advance Mark 10) ⁶ DML = Dimming Ballast (Lutron) MMSQM = Metal Motif, Square, Mondrian ^{8, 11} MMSQC = Metal Motif, Square, Curvilinear ^{8, 11} MMSQR = Metal Motif, Square, Rhombus ^{8, 11} MMSQT = Metal Motif, Square, Tangent ^{8, 11} MPSQ-EDTR = Metal Panel Square, Earth Dust Resin ⁸ MPSQ-WMTR = Metal Panel Square, White Mist Resin ⁸ MPSQ-SMOR = Metal Panel Square, Silver Moon Resin ⁸ REM = Remote Emergency Ballast ⁹ SCA = Sloped Ceiling Adaptor ¹⁰ TC = Matte White Acrylic Top Cover TSQIS-EDT = Top Square Shade-in-Shade, Earth Dust ⁷ TSQIS-WMT = Top Square Shade-in-Shade, White Mist ⁷ TSQIS-SMO = Top Square Shade-in-Shade, Silver Moon ⁷ CSQIS-EDT = Center Square Shade-in-Shade, Earth Dust ⁷ CSQIS-WMT = Center Square Shade-in-Shade, White Mist ⁷ CSQIS-SMO = Center Square Shade-in-Shade, Silver Moon ⁷
Size 28" 40" 52"	Voltage 120V 277V 347V	Premium ALP = Aluminum Paint BM = Bronze Metallic Paint CC = Custom Color GM = Gold Metallic Paint GNM = Gun Metal MW = Matte White OBRS = Oxidized Brass OCP = Oxidized Copper	Polished PB = Polished Brass ⁵ PC = Polished Chrome ⁵ PCP = Polished Copper ⁵ PN = Polished Nickel ⁵ SAL = Lacquered Satin Aluminum SB = Satin Brass SC = Satin Chrome SCP = Satin Copper SN = Satin Nickel	OA (P1S & P1SAC) (P3FCL) (P4CL) 28" Ht. = 40"OA 28" Ht. = 92"OA 28" Ht. = 112"OA 40" Ht. = 52"OA 40" Ht. = 122"OA 40" Ht. = 152"OA 52" Ht. = 64"OA 52" Ht. = 152"OA 52" Ht. = 192"OA or specify or specify or specify

- Notes:
- Fabric Kit is not included. Please specify Fabric Kit (below) to complete specification.
 - Available in 28".
 - Available in 40".
 - Available in 52".
 - Not available with Metal Motif options.
 - Available in T5/3/54HO (107-52-P) lamping only.
 - Shade-in-Shade (SIS) is not available with Vinyl Coated or Bamboo materials.
 - Patent Pending.
 - Supplied by others. Please specify REM Ballast.
 - Specify for sloped ceiling applications from 18° to 45°.
 - Not available in polished metal finishes.

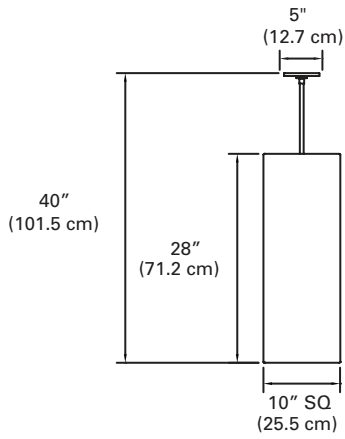
Sample Number (Fabric Kit): 107-40-SHD-SWH-CBP

Series 107 = Square Cylinder Pendant ¹	Size 28" 40" 52"	SHD	Options EMP = European "Mushroom Pleat" ⁹ CBP = "Casual" Box Pleat ⁹
Materials Standard SIW = Silk White	Premium ABB = FSC Amber Bamboo ^{5, 6} ABR = Alabaster - Vinyl Coated ^{2, 3} AMS = Aluminium Shimmer APX = Apex BZS = Bronze Shimmer CCT = Chintz Chocolate CSF = Customer Supplied Fabric ⁴ CXH = Chintz Onyx GFX = Glasgow Flax ^{2, 3} GHY = Golden Honey - Vinyl Coated ^{2, 3} GSH = Grass Cloth ² HTG = Heather Grey ⁶ LAT = Linen Alabaster ^{2, 3}	Options MMSQM = Metal Motif, Square, Mondrian ^{8, 10} MMSQC = Metal Motif, Square, Curvilinear ^{8, 10} MMSQR = Metal Motif, Square, Rhombus ^{8, 10} MMSQT = Metal Motif, Square, Tangent ^{8, 10} MPSQ-EDTR = Metal Panel Square, Earth Dust Resin ⁸ MPSQ-WMTR = Metal Panel Square, White Mist Resin ⁸ MPSQ-SMOR = Metal Panel Square, Silver Moon Resin ⁸ TSQIS-EDT = Top Square Shade-in-Shade, Earth Dust ⁷ TSQIS-WMT = Top Square Shade-in-Shade, White Mist ⁷ TSQIS-SMO = Top Square Shade-in-Shade, Silver Moon ⁷ CSQIS-EDT = Center Square Shade-in-Shade, Earth Dust ⁷ CSQIS-WMT = Center Square Shade-in-Shade, White Mist ⁷ CSQIS-SMO = Center Square Shade-in-Shade, Silver Moon ⁷	Polished LBS = Linen Biscuit ^{2, 3} LCK = Linen Chopsticks ^{2, 3} NFX = Natural Flax - Vinyl Coated ^{2, 3} NGS = Nutmeg Shimmer NLB = FSC Natural Bamboo ^{5, 6} PPF = Paper Leaf ^{2, 3} SBG = Shantung Beige SEG = Shantung Eggshell SIY = Silk Ivory SWH = Shantung White ^{2, 3} VDB = FSC Variegated Bamboo ^{5, 6} WCA = White Corona WHK = White Krinkle ^{2, 3}

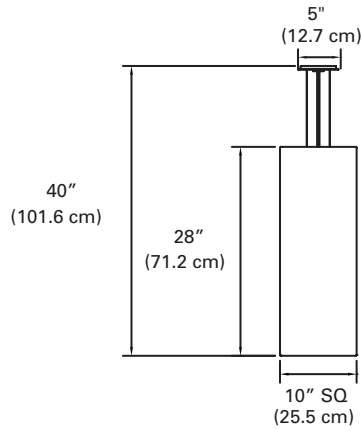
- Notes:
- Fixture is not included. Please specify Fixture (above) to complete specification.
 - Available in 28".
 - Available in 40".
 - Shaper can accommodate "Customer Supplied Fabric" orders. Please contact your representative for details and minimum quantities.
 - Forest Stewardship Council's (FSC) role is to bring together people, organizations and businesses of the Global South and North to develop consensus-based solutions that promote responsible stewardship of the world's forest. Visit www.fsc.org for more details.
 - Many materials appear differently when illuminated. As an example, the wood appears to be more amber when illuminated. It is recommended to view all samples illuminated prior to making final selection.
 - Shade-in-Shade (SIS) is not available with Vinyl Coated or Bamboo materials.
 - Patent Pending.
 - Please note: Cannot be added to bamboo, vinyl-coated fabric, or paper options.
 - Not available in polished metal finishes.

107-P FABRIQUE SQUARE CYLINDER PENDANT LUMINAIRE

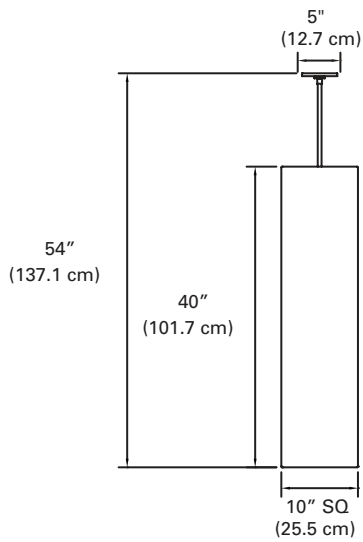
MOUNTING TYPES



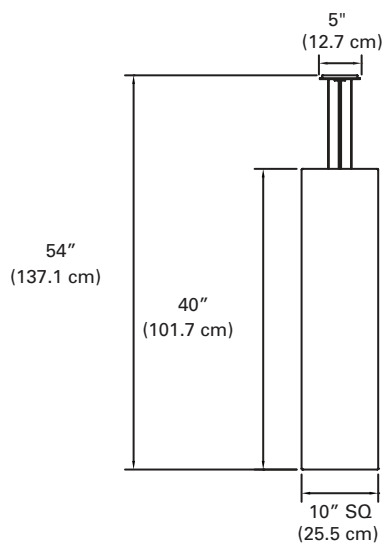
**107-28-P1S
(SINGLE STEM)**



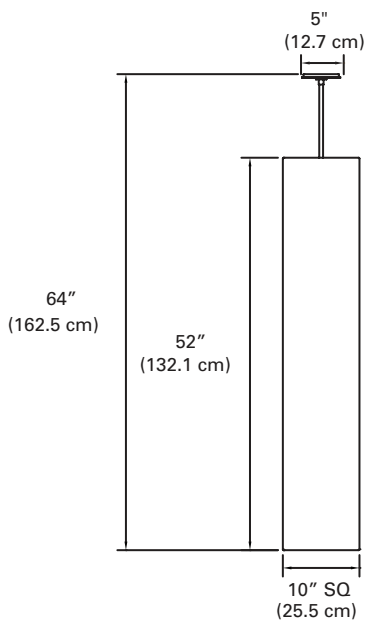
**107-28-P1SAC (SINGLE STEM
WITH AIRCRAFT CABLES)**



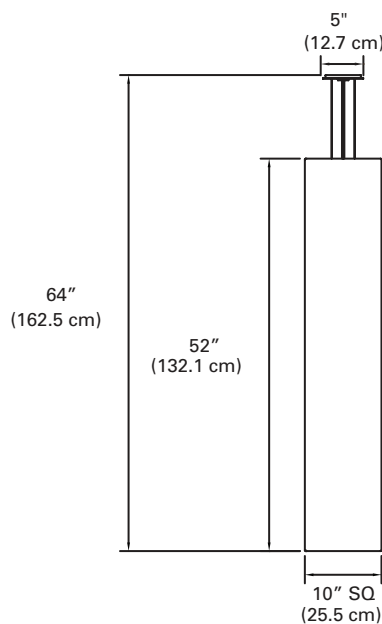
**107-40-P1S
(SINGLE STEM)**



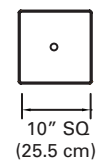
**107-40-P1SAC (SINGLE STEM
WITH AIRCRAFT CABLES)**



**107-52-P1S
(SINGLE STEM)**

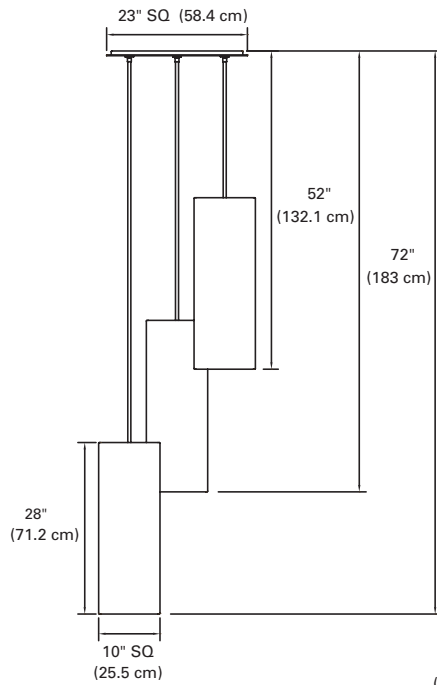


**107-52-P1SAC (SINGLE STEM
WITH AIRCRAFT CABLES)**

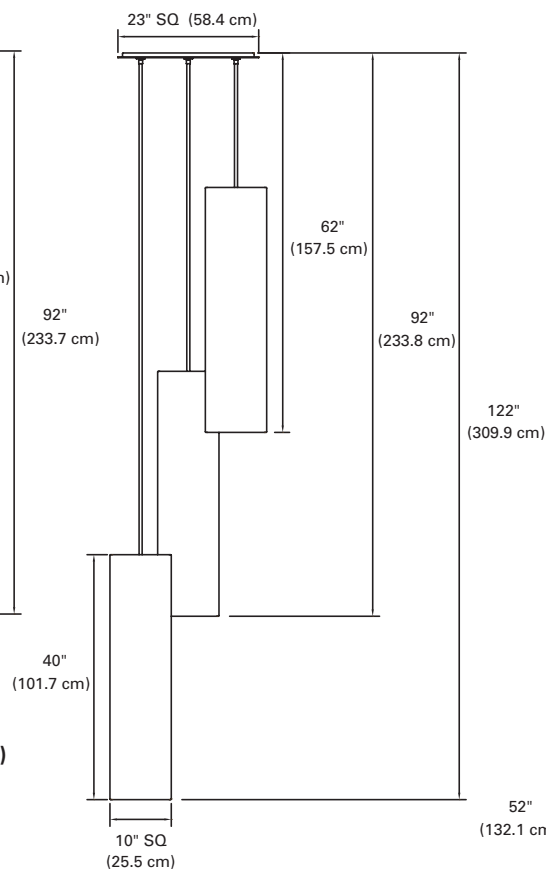


**107-P
PLAN VIEW**

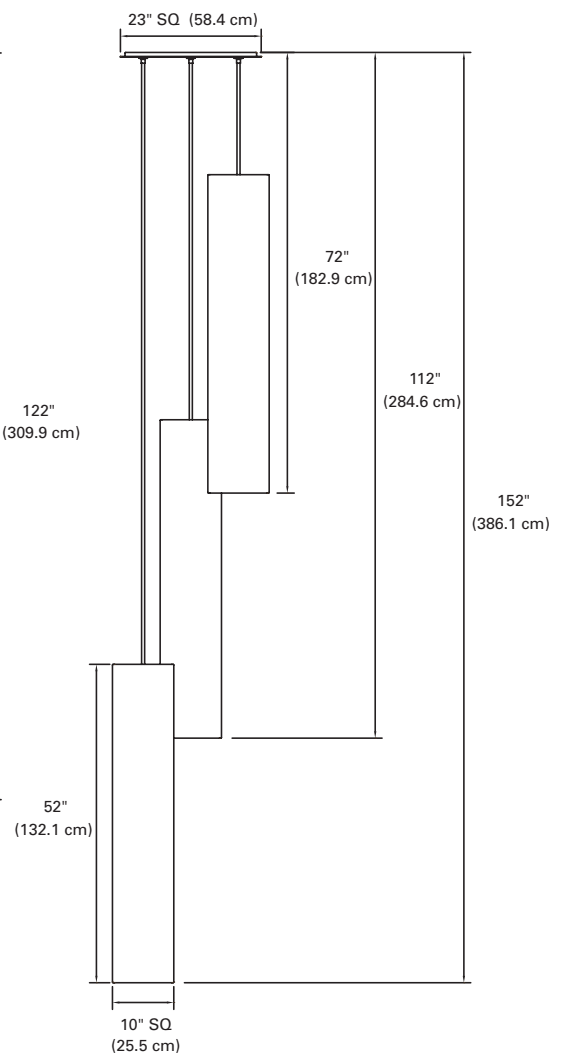
MOUNTING TYPES (CONT'D.)



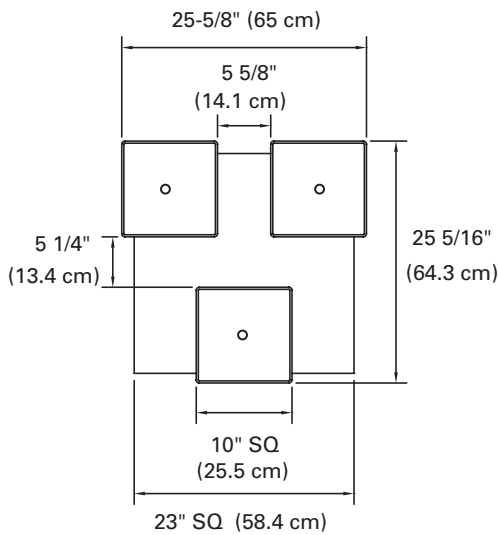
107-28-3FCL
(MULTI-HEAD CYLINDER PENDANT)



107-40-3FCL
(MULTI-HEAD CYLINDER PENDANT)

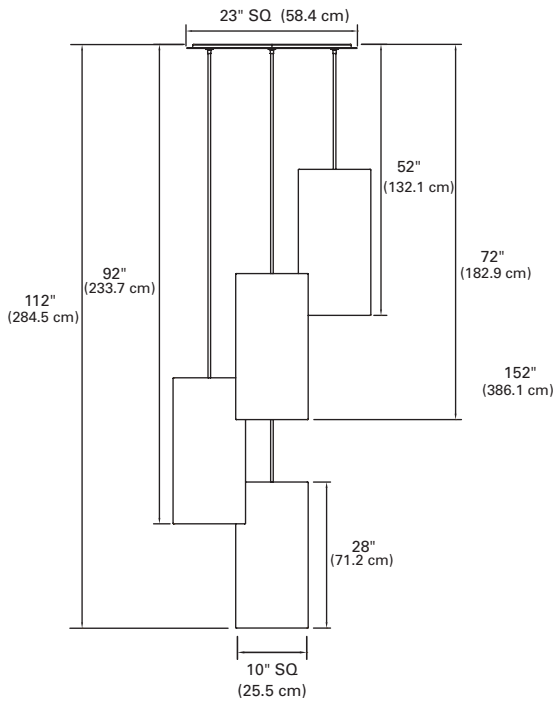


107-52-3FCL
(MULTI-HEAD CYLINDER PENDANT)

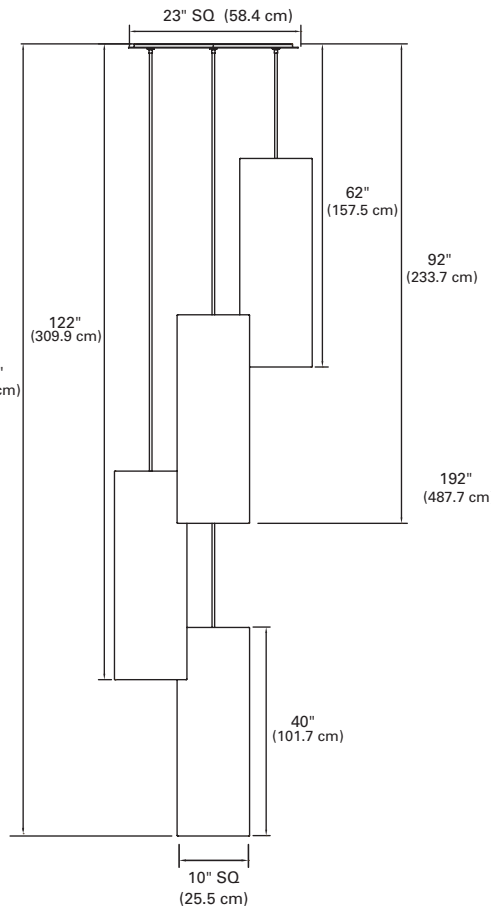


107-3FCL-PLAN VIEW
(MULTI-HEAD CYLINDER PENDANT)

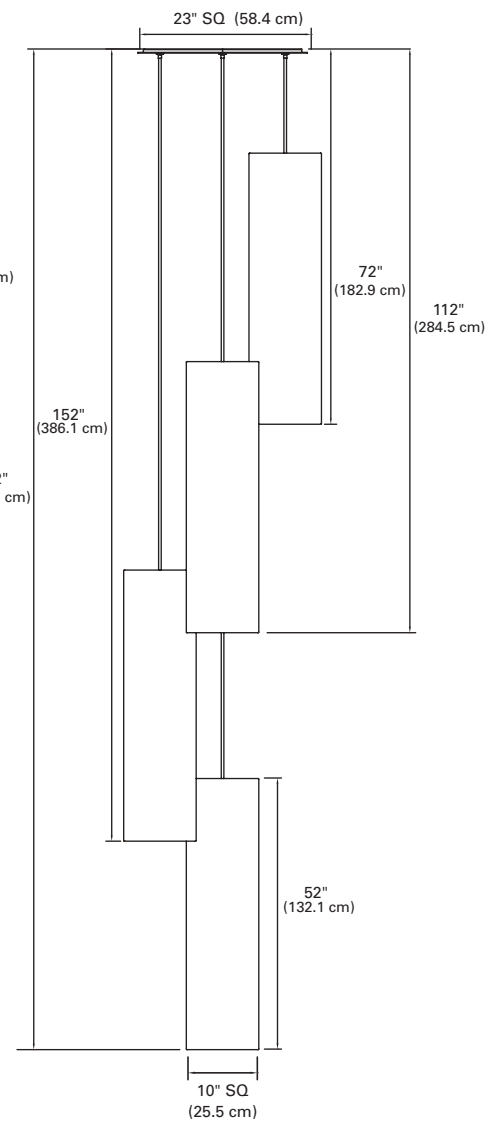
MOUNTING TYPES (CONT'D.)



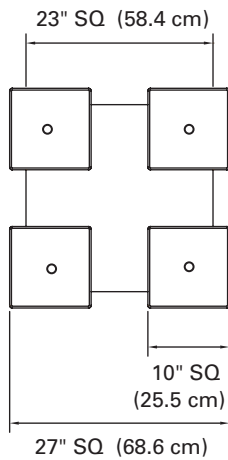
107-28-4FCL
(MULTI-HEAD CYLINDER PENDANT)



107-40-4FCL
(MULTI-HEAD CYLINDER PENDANT)



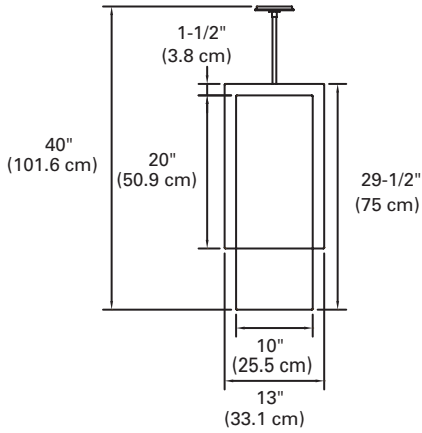
107-52-4FCL
(MULTI-HEAD CYLINDER PENDANT)



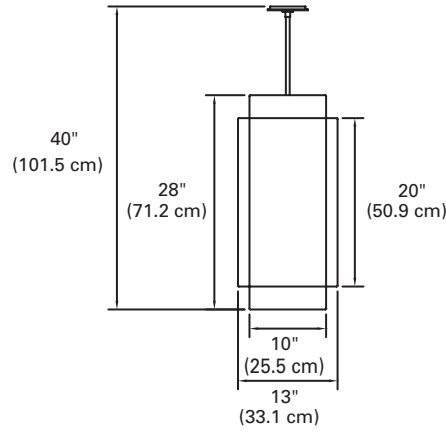
107-4FCL-PLAN VIEW
(MULTI-HEAD CYLINDER PENDANT)

107-P FABRIQUE SQUARE CYLINDER PENDANT LUMINAIRE

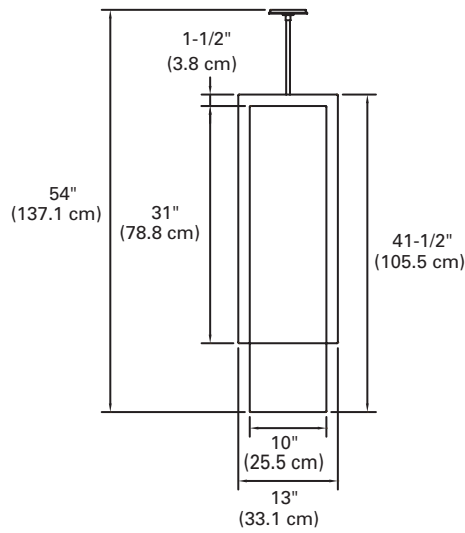
OPTIONS



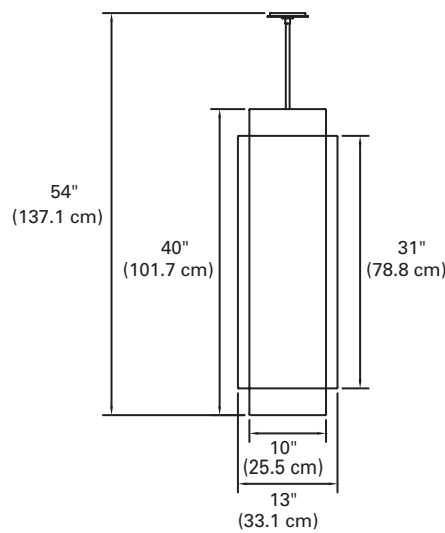
107-28-P1S-TSQSIS (TOP SQUARE SHADE-IN-SHADE)



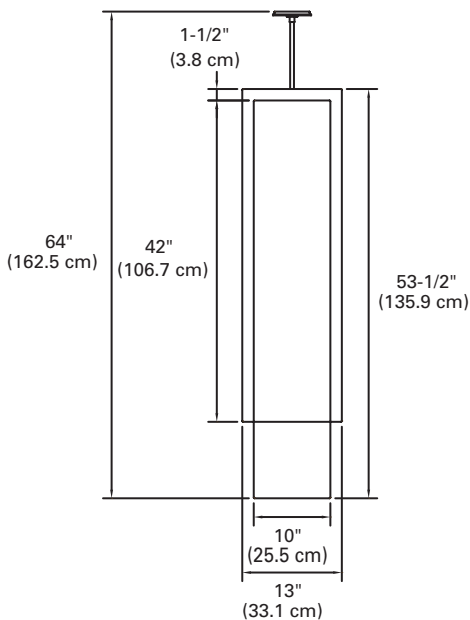
107-28-P1S-CSQSIS (CENTER SQUARE SHADE-IN-SHADE)



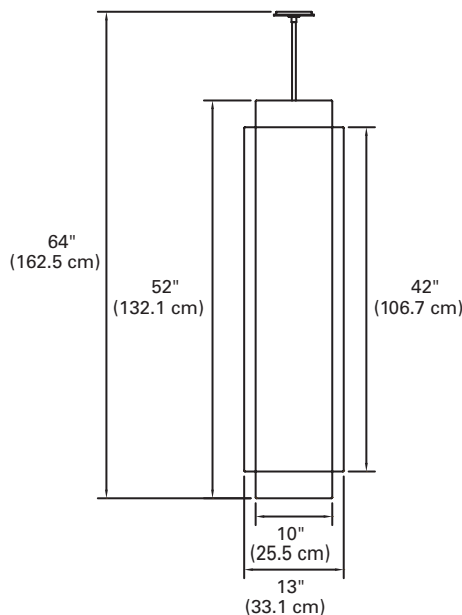
107-40-P1S-TSQSIS (TOP SQUARE SHADE-IN-SHADE)



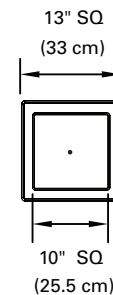
107-40-P1S-CSQSIS (CENTER SQUARE SHADE-IN-SHADE)



107-52-P1S-TSQSIS (TOP SQUARE SHADE-IN-SHADE)

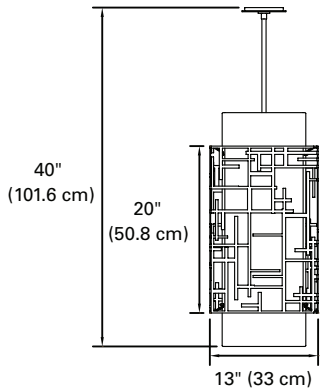


107-52-P1S-CSQSIS (CENTER SQUARE SHADE-IN-SHADE)

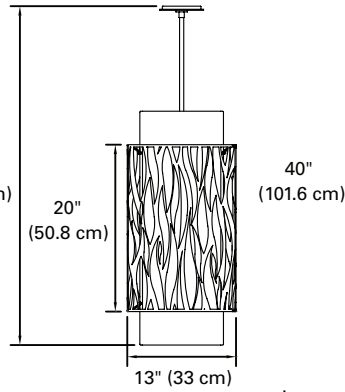


107-P-SIS
PLAN VIEW

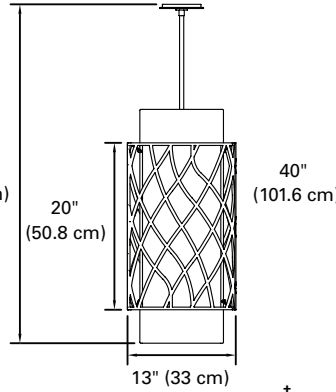
OPTIONS (CONT'D)



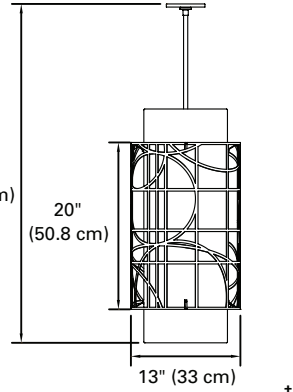
107-28-P1S-MMSQM
(METAL MOTIF
SQUARE MONDRIAN)



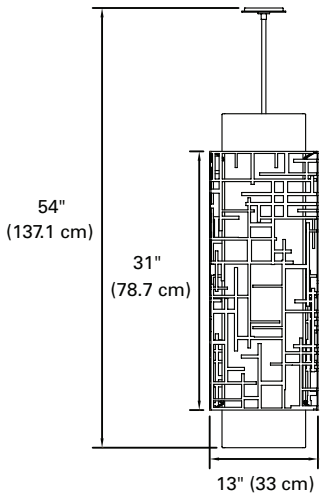
107-28-P1S-MMSQC[†]
(METAL MOTIF
SQUARE CURVILINEAR)



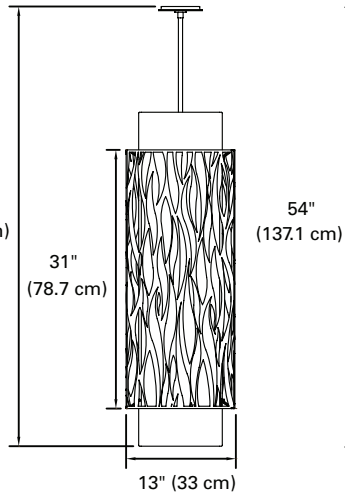
107-28-P1S-MMSQR[†]
(METAL MOTIF
SQUARE RHOMBUS)



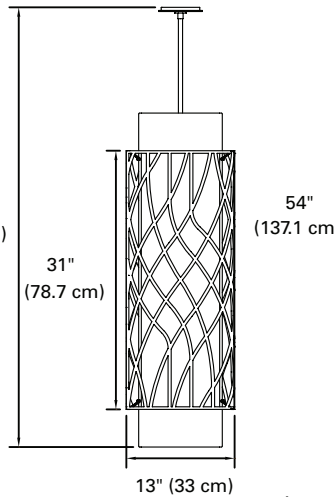
107-28-P1S-MMSQT[†]
(METAL MOTIF
SQUARE TANGENT)



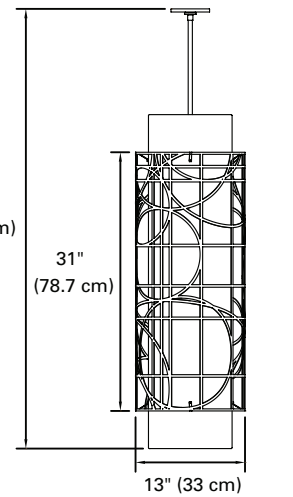
107-40-P1S-MMSQM[†]
(METAL MOTIF
SQUARE MONDRIAN)



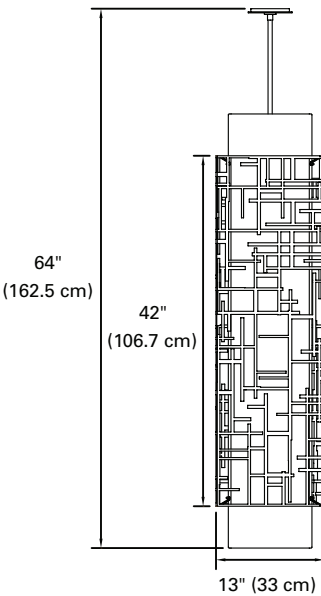
107-40-P1S-MMSQC[†]
(METAL MOTIF
SQUARE CURVILINEAR)



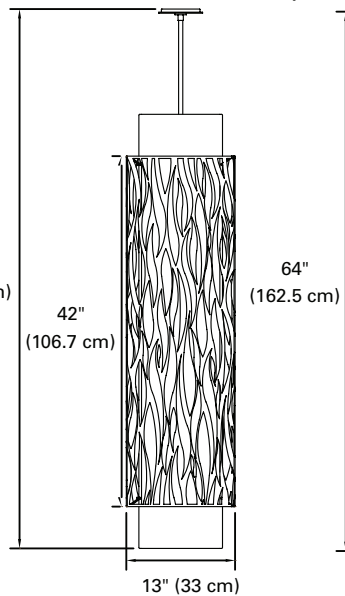
107-40-P1S-MMSQR[†]
(METAL MOTIF
SQUARE RHOMBUS)



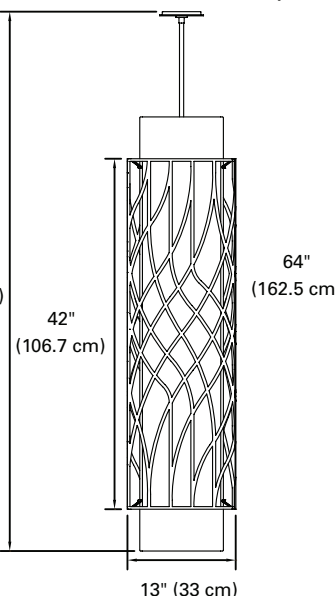
107-40-P1S-MMSQT[†]
(METAL MOTIF
SQUARE TANGENT)



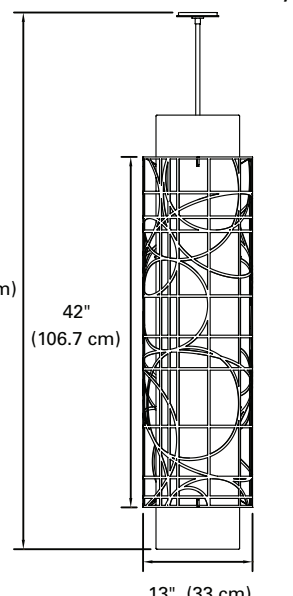
107-52-P1S-MMSQM[†]
(METAL MOTIF
SQUARE MONDRIAN)



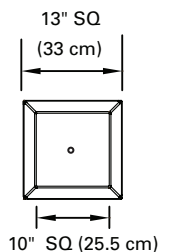
107-52-P1S-MMSQC[†]
(METAL MOTIF
SQUARE CURVILINEAR)



107-52-P1S-MMSQR[†]
(METAL MOTIF
SQUARE RHOMBUS)



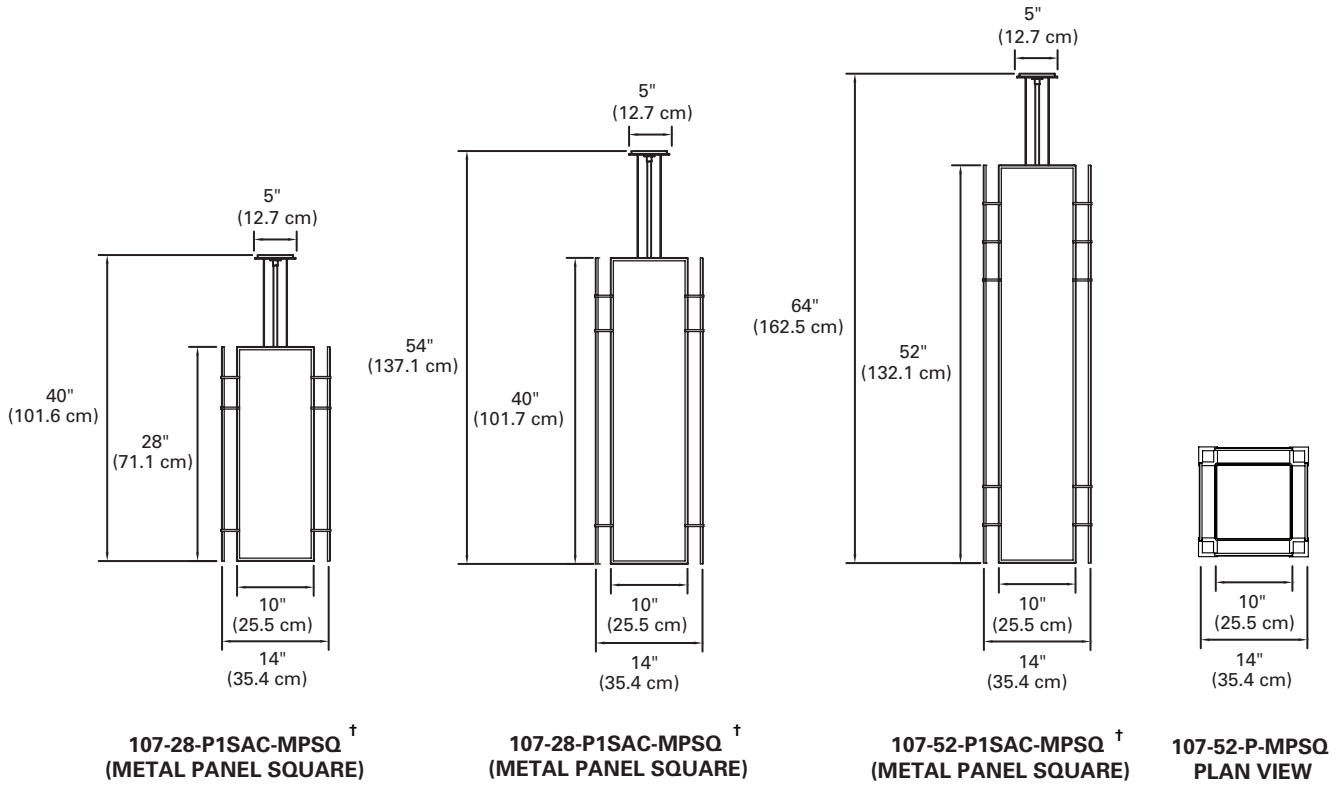
107-52-P1S-MMSQT[†]
(METAL MOTIF
SQUARE TANGENT)



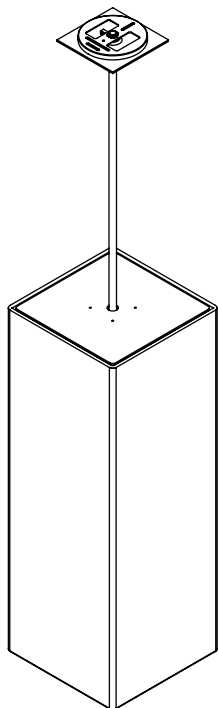
107-MMSQT
PLAN VIEW

[†] PATENT PENDING

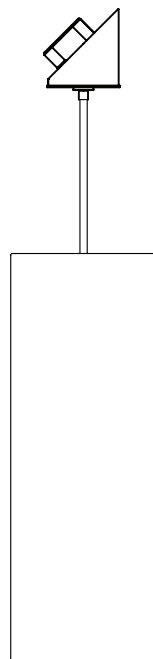
OPTIONS (CONT'D.)



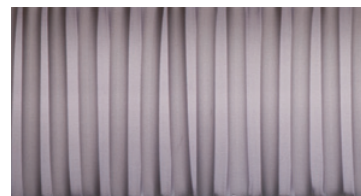
[†] PATENT PENDING



107-P-TC
(TOP COVER)



107-P-SCA (SLOPED
CEILING ADAPTOR)

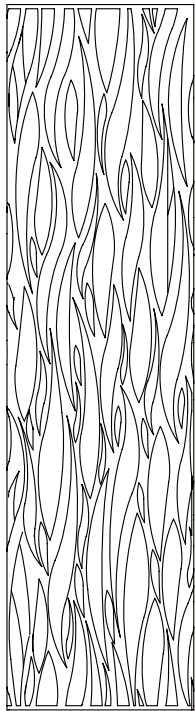


CASUAL "BOX" PLEAT (CBP)

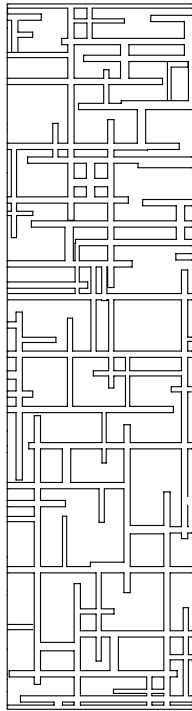


EUROPEAN "MUSHROOM"
PLEAT (EMP)

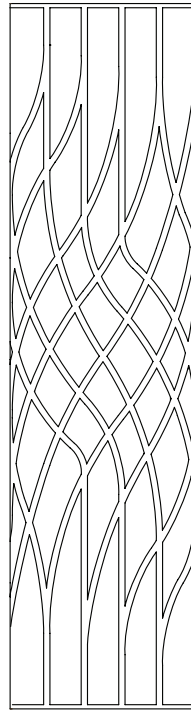
OPTIONAL METAL MOTIFS (CLOSE-UP - PATENT PENDING)



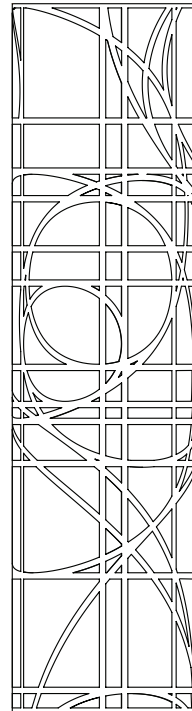
CURVILINEAR † - 52"



MONDRIAN † - 52"



RHOMBUS † - 52"



TANGENT † - 52"

† PATENT PENDING

COMPANION PRODUCTS



101-S



103



104-SRT



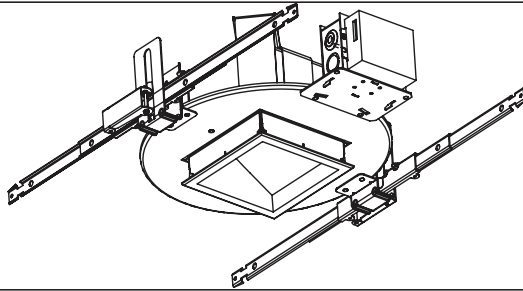
105



109-S



111



Gotham Architectural Downlighting
Compact Fluorescent Downlights

6" SQFW
Square Lensed Wallwash

Double Twin-Tube or Triple-Tube lamp

FEATURES

OPTICAL SYSTEM

- Self-flanged, matte-diffuse high-impact polymer finishing trim with a durable, proprietary vapor deposition finish.
- Patented Bounding Ray™ Optical Principle design (U.S. Patent No. 5,800,050) provides lamp before lamp image and smooth transition from top of the reflector to bottom.
- One piece trim eliminates mitered flange corners and inside corner gaps.
- Upper reflector is painted a highly reflective matte white providing diffuse, even light with high efficiency.
- Dual kicker design along with proprietary Gotham spread lens delivers a uniform distribution of light to the wall.

MECHANICAL SYSTEM

- 16-gauge painted steel mounting/plaster frame accommodates up to 1-1/2" thick ceiling materials.
- Patented adjustable aperture allows 1/4" adjustments in all directions and up to 5° of rotation allowing post-installation adjustments to ensure trim-to-trim alignment.
- 16-gauge galvanized steel mounting bars with continuous 4" vertical adjustments are shipped pre-installed. Post-installation adjustment possible without the use of tools from above or below ceiling.

- Secondary housing adjustment system for precise, final ceiling to flange alignment.
- Galvanized steel junction box with hinged access covers and spring latch. Three combination 1/2"-3/4" and two 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

ELECTRICAL SYSTEM

- Horizontally-mounted, four-pin, positive-latch, thermoplastic socket.
- Class P, thermally protected, high power factor electronic ballast mounted to the junction box.

LISTING

- Fixtures are UL Listed for thru-branch wiring, Non-IC recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards.

WARRANTY

- 1-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

ORDERING INFORMATION

EXAMPLE: SQFW 1/32TRT 6AR MVOLT

Series	Wattage/Lamp	Aperture/Trim color	Finish	Voltage	Ballast ⁵
SQFW	1/18DTT ¹	6AR Clear	(blank) ³ Semi-specular	MVOLT ⁴	(blank) Electronic ballast (standard)
	1/26DTT ¹	6PR Pewter	LD Matte-diffuse	120	ECOS EcoSystem™ electronic dimming ballast. Minimum dimming level 5%.
	1/18TRT	6WTR Wheat		277	ADEZ ⁶ Advance Mark 10® electronic dimming ballast. Minimum dimming level 5%
	1/26TRT	6DSR Stepped		347	ADZT Advance Mark 7 electronic dimming ballast. Minimum dimming level 5%
	1/32TRT	6PDSR Pewter stepped			
	1/42TRT	6WDSR Wheat stepped			
		6WR ² White			
	6BR ² Black				

Options

ELR ⁷	Emergency battery pack. Remote test switch	WLP	With 3500 K lamp (shipped separately)
ELRSD ⁷	Emergency battery pack with self-diagnostics. Remote test switch provided	NEPP ¹²	Interface for Sensor Switch® nLight® network provided with integral power supply. Refer to TN-623-01 .
GMF ⁸	Single, slow-blow fuse	RRL	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature.
GLR ⁸	Single, fast-blow fuse	TRW ¹³	White painted flange
CP	Chicago plenum	TRBL ¹⁴	Black painted flange
BDP ⁹	Ballast disconnect plug		
MFLG ¹⁰	Microflange trim		
SQMT ¹¹	Square metal trim		

ACCESSORIES order as separate catalog numbers (shipped separately)

NSP5 D ER KIT Sensor Switch nLight secondary relay and dimming pack device used to switch and dim luminaires powered via an emergency circuit. Refer to [NSP5 D ER KIT](#).

6" SQFW

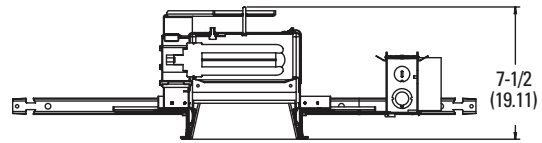
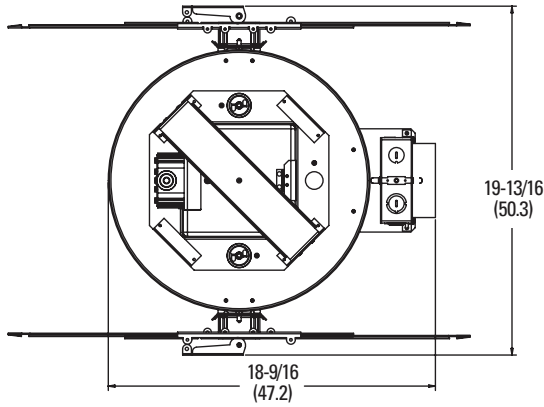
Square Lensed Wallwash

Double Twin-Tube or Triple-Tube lamp



DIMENSIONAL DATA

All dimensions are inches (centimeters) unless otherwise noted.



- Aperture: 6 (15.2)
- Ceiling Opening: 6-5/8 (16.8)
- Overlap Trim: 7-3/16 (18.3)

NOTES

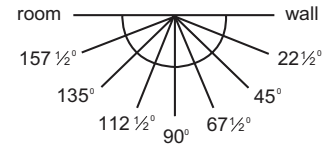
ORDERING NOTES

1. Requires 4-pin lamp. Ships as TRT fixture.
2. Not available with matte-diffuse finishes.
3. Available with WR and BR trim colors and SQMT metal trim option.
4. Multi-volt electronic ballast capable of operating on any line voltage from 120V through 277V, 50 or 60HZ.
5. For additional ballast types, refer to [Technical Bulletins](#).
6. Available in 120V or 277V only.
7. For dimensional changes, refer to [TECH-140](#).
8. Not available with MVOLT. Must specify voltage.
9. Meets codes that require in-fixture disconnect.
10. Order ships as 3 components: housing, trim and microflange gypsum board.
11. Not available with stepped reflector or MFLG option.
12. For emergency generator/inverter applications order non-nLight enabled fixture and NSP5 D ER KIT as an accessory. Refer to [NSP5 D ER KIT](#).
13. Not available with white reflector.
14. Not available with black reflector.



TECHNICAL INFORMATION

Footcandle values are initial and tables are based on minimum of six units. For fixture-to-wall distance other than those shown, use maximum of one-to-one spacing (distance between fixtures not more than distance to wall) for best results.



Fixture/Lamp	Candlepower Data	Footcandle values
--------------	------------------	-------------------

SQFW 1/32TRT 6AR

Vertical Angle	Plane Angle															
	Room Side				Wall Side											
	Room	157.5°	135°	112.5°	90°	67.5°	45°	22.5°	Wall	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers			
0°	638	638	638	638	638	638	638	638	638	1	13	7	13	12	4	12
5°	612	615	623	633	645	663	678	686	684	2	23	18	23	20	11	20
15°	569	576	576	589	616	665	718	755	752	3	23	22	23	20	15	20
25°	468	492	516	488	491	557	669	741	731	4	21	21	21	17	15	17
35°	342	367	369	336	315	363	501	613	591	5	18	19	18	14	14	14
45°	215	233	218	186	171	185	308	412	423	6	15	15	15	11	11	11
55°	126	125	102	80	74	95	146	270	302	7	12	12	12	9	9	9
65°	71	47	29	26	27	43	67	149	201	8	10	10	10	7	7	7
75°	4	5	5	4	6	11	22	50	74	9	8	8	8	6	6	6
85°	1	1	1	1	1	1	1	0	0	10	6	6	6	5	5	5
90°	0	0	0	0	0	0	0	0	0							

SQFW 1/42TRT 6AR

Vertical Angle	Plane Angle															
	Room Side				Wall Side											
	Room	157.5°	135°	112.5°	90°	67.5°	45°	22.5°	Wall	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers			
0°	718	718	718	718	718	718	718	718	718	1	14	8	14	13	4	13
5°	684	693	700	709	721	739	751	759	757	2	25	20	25	23	12	23
15°	639	649	637	627	642	688	758	823	828	3	25	23	25	22	16	21
25°	534	553	538	495	488	542	660	784	808	4	23	23	23	19	16	19
35°	385	398	378	339	310	352	481	611	647	5	20	20	20	16	15	16
45°	249	248	222	189	177	186	288	395	468	6	16	16	16	13	12	13
55°	148	136	107	85	81	100	137	256	340	7	13	13	13	10	10	10
65°	83	52	33	29	30	48	71	146	232	8	11	11	11	8	8	8
75°	4	5	5	5	7	12	24	47	84	9	9	9	9	7	7	7
85°	1	1	1	1	1	1	1	0	0	10	7	7	7	5	5	5
90°	0	0	0	0	0	0	0	0	0							

SQFW 1/32TRT 6DSR

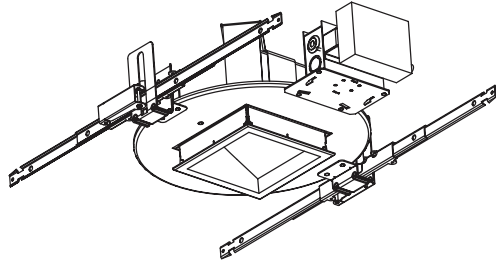
Vertical Angle	Plane Angle															
	Room Side				Wall Side											
	Room	157.5°	135°	112.5°	90°	67.5°	45°	22.5°	Wall	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers			
0°	522	522	522	522	522	522	522	522	522	1	14	9	14	13	5	13
5°	490	493	505	520	536	555	570	580	578	2	24	20	24	21	13	21
15°	430	446	468	500	543	607	658	677	662	3	24	23	24	20	16	20
25°	365	389	413	415	444	534	641	695	656	4	21	21	21	17	15	17
35°	320	343	319	289	292	363	490	595	543	5	18	18	18	14	13	14
45°	237	268	220	171	167	190	310	422	410	6	14	14	14	11	11	11
55°	123	147	121	88	86	103	159	287	304	7	11	11	11	9	9	9
65°	73	70	46	36	39	58	79	162	202	8	9	9	9	7	7	7
75°	58	38	20	12	13	23	33	61	82	9	7	7	7	6	6	6
85°	9	7	5	4	3	4	4	4	6	10	6	6	6	5	5	5
90°	0	0	0	0	0	0	0	0	0							

SQFW 1/42TRT 6DSR

Vertical Angle	Plane Angle															
	Room Side				Wall Side											
	Room	157.5°	135°	112.5°	90°	67.5°	45°	22.5°	Wall	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers			
0°	608	608	608	608	608	608	608	608	608	1	16	10	16	15	6	15
5°	570	572	581	595	613	633	653	665	667	2	27	23	27	24	14	24
15°	504	510	521	538	569	637	707	755	758	3	27	25	27	22	17	22
25°	441	450	435	418	441	522	640	751	756	4	24	24	24	19	17	19
35°	376	381	330	292	290	355	479	602	618	5	20	20	20	15	15	15
45°	273	276	224	180	179	197	302	412	470	6	16	16	16	12	12	12
55°	136	143	125	97	97	115	159	279	351	7	13	13	13	10	10	10
65°	85	70	51	41	44	66	89	165	241	8	10	10	10	8	8	8
75°	68	39	23	13	14	25	39	62	97	9	8	8	8	6	6	6
85°	9	7	5	4	3	4	4	5	7	10	7	7	7	5	5	5
90°	0	0	0	0	0	0	0	0	0							

PHOTOMETRY NOTES

- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- Actual performance may differ as a result of end-user environment and application.
- Consult factory or IES file for microgroove baffle, black cone or other photometric reports.



Gotham Architectural Downlighting
HID Downlights

6" SQHZW
Square Lensed Wallwash

ED17 Lamp

FEATURES

OPTICAL SYSTEM

- Self-flanged, matte-diffuse high-impact polymer finishing trim with a durable, proprietary vapor deposition finish.
- Patented Bounding Ray™ Optical Principle design (U.S. Patent No. 5,800,050) provides lamp before lamp image and smooth transition from top of the reflector to bottom.
- One piece trim eliminates mitered flange corners and inside corner gaps.
- Upper reflector is painted a highly reflective matte white providing diffuse, even light with high efficiency.
- Dual kicker design along with proprietary Gotham spread lens delivers a uniform distribution of light to the wall.

MECHANICAL SYSTEM

- 16-gauge painted steel mounting/plaster frame accommodates up to 1-1/2" thick ceiling materials.
- Patent pending adjustable aperture allows 1/4" adjustments in all directions and up to 5° of rotation allowing post-installation adjustments to ensure trim to trim alignment.
- 16-gauge galvanized steel mounting bars with continuous 4" vertical adjustments are shipped pre-installed.

- Post-installation adjustment possible without the use of tools from above or below ceiling.
- Secondary housing adjustment system for precise, final ceiling to flange alignment.
- Galvanized steel junction box with hinged access covers and spring latch. Three combination 1/2"-3/4" and two 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

ELECTRICAL SYSTEM

- Medium-base porcelain socket with nickel-plated screw shell.
- Pre-wired, electronic, 120 or 277V ballast module is standard. Module can be attached before or after mounting of mounting/plaster frame.
- Thermally-activated insulation detector.

LISTING

- Fixtures are UL Listed for thru-branch wiring, Non-IC recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards.

WARRANTY

- 1-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

ORDERING INFORMATION

EXAMPLE: SQHZW 70M 6AR 120

Series	Wattage/Lamp ¹	Aperture/Trim	Finish	Voltage	Ballast	Options		
SQHZW	<u>Metal halide (ED17)</u>	6AR Clear	(blank) ³ Semi-specular	120	(blank) Electronic ballast	SF Single fuse		
	50M	6PR Pewter	LD Matte-diffuse	277	EMB Electro-magnetic ballast	LRC⁵ Provides compatibility with Lithonia Reloc® System. Lithonia Reloc System can be installed less this option with connectors provided by others. Access above ceiling required.		
	70M	6WTR Wheat		347⁴				
	100M	6WR² White						
	<u>Color-corrected metal halide (ED17)</u>	6BR² Black						
	50MHC	6DSR Stepped						
	70MHC	6PDSR Pewter stepped						
	100MHC	6WDSR Wheat stepped						
								MFLG⁶ Microflange trim
								SQMT⁷ Square metal trim
							CP Chicago plenum approved	
					WLP 3000 K lamp (shipped separately)			

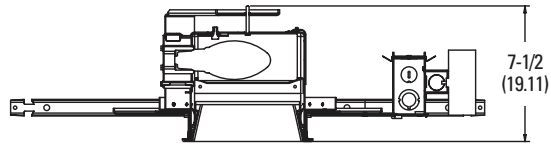
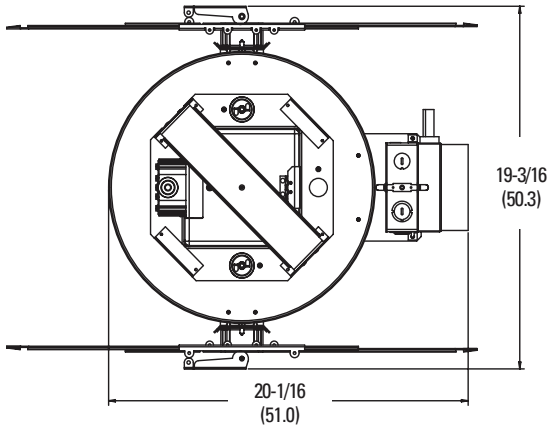
NOTES

ORDERING NOTES

1. Recommended for use with coated lamps. Open rated lamps required.
2. Not available with matte-diffuse finish.
3. Available with WR and BR trim colors and SQMT metal trim option.
4. Available with 70W & 100W electromagnetic ballast only.
5. For compatible Reloc systems, refer to [TECH-110](#).
6. Order ships as 3 components: housing, trim and microflange gypsum board.
7. Not available with stepped reflector or MFLG option.

DIMENSIONAL DATA

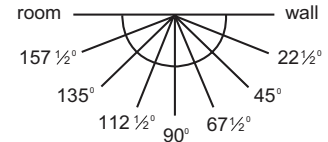
All dimensions are inches (centimeters) unless otherwise noted.



- Aperture: 6 (15.2)
- Ceiling opening: 6-5/8 (16.8)
- Overlap trim: 7-3/16 (18.3)

TECHNICAL INFORMATION

Footcandle values are initial and tables are based on minimum of six units. For fixture-to-wall distance other than those shown, use maximum of one-to-one spacing (distance between fixtures not more than distance to wall) for best results.



Fixture/Lamp	Candlepower Data	Footcandle values
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SQHZW 70M 6AR

70W MHC70/C/U lamp

5800 rated lumens

Test No. LTL16111

Vertical Angle	Plane Angle				Wall
	Room Side	90°	67.5°	45°	
0°	1616	1616	1616	1616	1616
5°	1596	1623	1647	1665	1675
15°	1435	1517	1637	1749	1775
25°	1006	1127	1448	1608	1625
35°	580	653	975	1255	1269
45°	348	369	524	814	855
55°	179	221	283	500	614
65°	62	103	161	270	408
75°	13	24	51	77	164
85°	3	2	2	1	1
90°	0	0	0	0	0

	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers		
	1	27	14	27	25	8
2	48	40	48	42	25	42
3	48	48	48	40	31	40
4	45	48	45	37	33	37
5	40	42	40	31	31	31
6	33	34	33	25	26	25
7	27	28	27	21	21	21
8	22	22	22	17	17	17
9	18	18	18	14	14	14
10	15	15	15	12	12	12

SQHZW 100M 6AR

100W MHC100/C/U lamp

8800 rated lumens

Test No. LTL16115

Vertical Angle	Plane Angle				Wall
	Room Side	90°	67.5°	45°	
0°	2419	2419	2419	2419	2419
5°	2380	2421	2474	2496	2518
15°	2123	2247	2452	2636	2701
25°	1483	1662	2161	2446	2504
35°	860	973	1453	1899	1970
45°	513	545	787	1245	1361
55°	261	322	420	762	976
65°	92	151	238	418	647
75°	20	36	76	117	255
85°	4	4	3	2	1
90°	0	0	0	0	0

	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers		
	1	42	22	42	39	12
2	75	61	75	66	38	66
3	74	72	74	63	47	63
4	70	72	70	57	50	57
5	60	63	60	47	46	47
6	50	51	50	38	39	38
7	41	41	41	31	32	31
8	34	34	34	26	26	26
9	27	27	27	21	21	21
10	22	22	22	17	17	17

SQHZW 70M 6DSR

70W MHC70/C/U lamp

5800 rated lumens

Test No. LTL16112

Vertical Angle	Plane Angle				Wall
	Room Side	90°	67.5°	45°	
0°	1292	1292	1292	1292	1292
5°	1294	1322	1342	1361	1369
15°	1230	1337	1443	1504	1506
25°	902	1059	1334	1482	1446
35°	546	656	941	1198	1160
45°	352	389	542	838	841
55°	211	248	317	531	624
65°	95	144	193	297	428
75°	31	55	83	109	193
85°	7	10	10	11	16
90°	0	0	0	0	0

	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers		
	1	31	19	31	28	12
2	51	44	51	44	28	44
3	49	51	49	41	34	41
4	44	48	44	36	34	36
5	38	40	38	29	30	29
6	31	33	31	24	25	24
7	26	26	26	19	20	19
8	21	21	21	16	16	16
9	17	17	17	13	13	13
10	14	14	14	11	11	11

SQHZW 100M 6DSR

100W MHC100/C/U lamp

8800 rated lumens

Test No. LTL16116

Vertical Angle	Plane Angle				Wall
	Room Side	90°	67.5°	45°	
0°	1944	1944	1944	1944	1944
5°	1942	1991	2028	2055	2067
15°	1830	1998	2173	2280	2297
25°	1331	1570	2005	2253	2226
35°	813	975	1407	1824	1799
45°	520	575	810	1290	1334
55°	310	363	468	818	983
65°	141	211	284	456	670
75°	47	82	120	164	293
85°	11	14	15	15	22
90°	0	0	0	0	0

	3 ft. from wall on 3 ft. centers			3 ft. from wall on 4 ft. centers		
	1	48	29	48	43	18
2	79	67	79	69	43	69
3	76	78	76	64	51	64
4	68	73	68	55	51	55
5	57	61	57	44	45	44
6	48	49	48	36	37	36
7	39	39	39	29	30	29
8	31	31	31	24	24	24
9	25	25	25	19	20	19
10	20	20	20	16	16	16

PHOTOMETRY NOTES

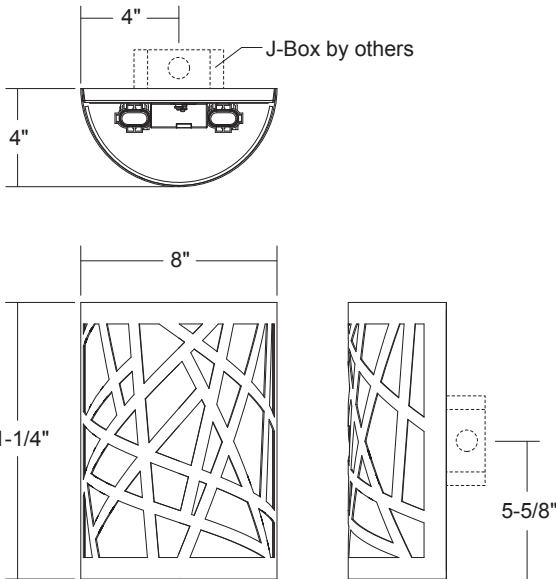
- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- Actual performance may differ as a result of end-user environment and application.
- Consult factory or IES file for microgroove baffle, black cone or other photometric reports.

Wall Sconce



QUICK FIND #: QF-3243

ADA



1. **6152**
CATALOG #
2. **F**
LAMPING
3. **VOLTAGE**
4. **OA**
LENS OPTION
5. **FINISH**

STANDARD

BAL = BRUSHED ALUMINUM

LBP = LIGHT BRONZE PAINT WITH BRUSHED TEXTURE

CUSTOM

CPF = CUSTOM PAINTED FINISH (*consult factory*)

CMF = CUSTOM METAL FINISH (*consult factory*)
6. **SPECIAL**

Modification Descriptions: (if needed)

Weight Hanging (lbs.)

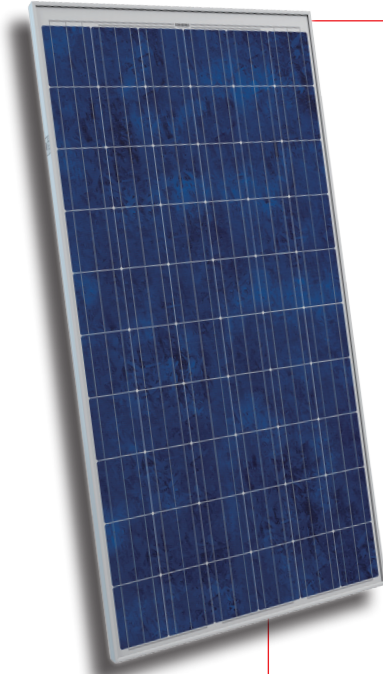
F / 6152 8 lbs.

Notes:

- UL listed and cUL approved _{us}
- Winona Lighting products are union made.
- Custom Sizes and Finishes available upon request.
- All Fluorescent fixtures available in 120V and 277V.
- Winona Lighting reserves the right to make design changes without prior notice.
- Lamps not included.

APPENDIX B – SOLAR EQUIPMENT DATA SHEETS

250 Watt POLYCRYSTALLINE SOLAR MODULE



Features



High module conversion efficiency

15.4%

Module efficiency up to 15.4% achieved through advanced cell technology and manufacturing capabilities



Excellent weak light performance

Weak light

Excellent performance under low light conditions



Positive tolerance

0/+5%

Positive tolerance of up to 5% delivers higher outputs reliability



Suntech current sorting process

2%

System output maximized by reducing mismatch losses up to 2% with modules sorted & packaged by amperage



Extended wind and snow load tests

3800Pa
5400Pa

Module certified to withstand extreme wind (3800 Pascal) and snow loads (5400 Pascal) *



Withstanding harsh environment

Harsh environment

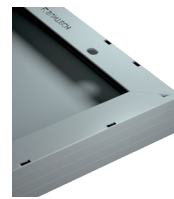
Reliable quality leads to a better sustainability even in harsh environment like desert, farm and coastline

Certifications and standards: UL1703



Trust Suntech to Deliver Reliable Performance Over Time

- World-class manufacturer of crystalline silicon photovoltaic modules
- Unrivaled manufacturing capacity and world-class technology
- Rigorous quality control meeting the highest international standards: ISO 9001: 2008, ISO 14001: 2004 and ISO17025: 2005
- Tested for harsh environments (salt mist, ammonia corrosion and sand blowing testing: IEC 61701, DIN 50916:1985 T2, DIN EN 60068-2-68)***



Compact and Durable Frame Design

Suntech's new compact frame design is light-weight (3.5 lbs lighter) and easier to handle during installation. The rigid and durable hollow chamber guarantees the same long-term and reliable performance.

Industry-leading Warranty based on nominal power



- 97% in the first year, thereafter, for years two (2) through twenty-five (25), 0.7% maximum decrease from MODULE's nominal power output per year, ending with the 80.2% in the 25th year after the defined WARRANTY STARTING DATE.****
- 10-year material and workmanship warranty



Reliable IP67 Rated Junction Box

Supports installations in multiple orientations. High performance, low resistance connectors ensure maximum output for the highest energy production.

* Please refer to Suntech Standard Module Installation Manual for details. **PV Cycle only for EU market.

*** Please refer to Suntech Product Near-coast Installation Manual for details. **** Please refer to Suntech Product Warranty for details.

Electrical Characteristics

STC	STP250-20/Wd
Maximum Power at STC (Pmax)	250 W
Optimum Operating Voltage (Vmp)	30.7 V
Optimum Operating Current (Imp)	8.15 A
Open Circuit Voltage (Voc)	37.4 V
Short Circuit Current (Isc)	8.63 A
Module Efficiency	15.4%
Operating Module Temperature	-40 °C to +85 °C
Maximum System Voltage	600 V DC (UL)
Maximum Series Fuse Rating	20 A
Power Tolerance	0/+5 %

STC: Irradiance 1000 W/m², module temperature 25 °C, AM=1.5;
Best in Class AAA solar simulator (IEC 60904-9) used, power measurement uncertainty is within +/- 3%

NOCT	STP250-20/Wd
Maximum Power at NOCT (Pmax)	185 W
Optimum Operating Voltage (Vmp)	28.0 V
Optimum Operating Current (Imp)	6.59 A
Open Circuit Voltage (Voc)	34.5 V
Short Circuit Current (Isc)	7.01 A

NOCT: Irradiance 800 W/m², ambient temperature 20 °C, AM=1.5, wind speed 1 m/s;
Best in Class AAA solar simulator (IEC 60904-9) used, power measurement uncertainty is within +/- 3%

Temperature Characteristics

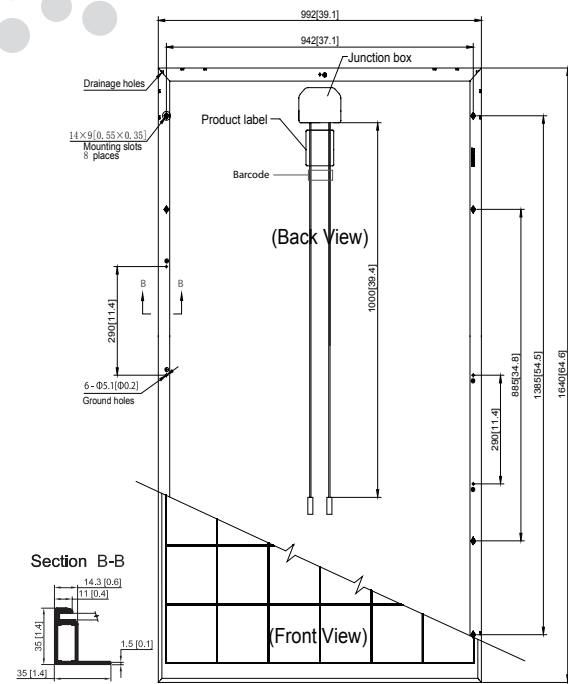
Nominal Operating Cell Temperature (NOCT)	45±2°C
Temperature Coefficient of Pmax	-0.43 %/°C
Temperature Coefficient of Voc	-0.33 %/°C
Temperature Coefficient of Isc	0.067 %/°C

Mechanical Characteristics

Solar Cell	Polycrystalline silicon 156 × 156 mm (6 inches)
No. of Cells	60 (6 × 10)
Dimensions	1640 × 992 × 35mm (64.6 × 39.1 × 1.4 inches)
Weight	18.2 kgs (40.1 lbs.)
Front Glass	3.2 mm (0.13 inches) tempered glass
Frame	Anodized aluminium alloy
Junction Box	IP67 rated (3 bypass diodes)
Output Cables	UL 4703, UL44 4.0 mm ² (0.006 inches ²), symmetrical lengths (-) 1000mm (39.4 inches) and (+) 1000 mm (39.4 inches)
Connectors	MC4 connectors

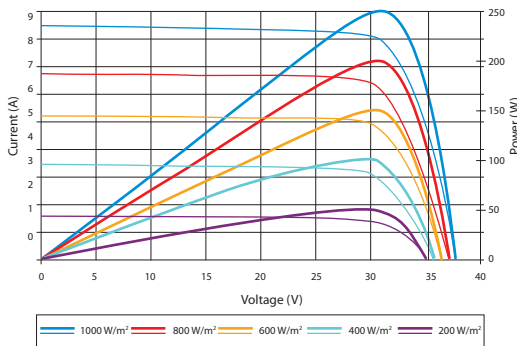
Packing Configuration

Container	20' GP	40' HC
Pieces per pallet	30	30
Pallets per container	6	28
Pieces per container	180	840



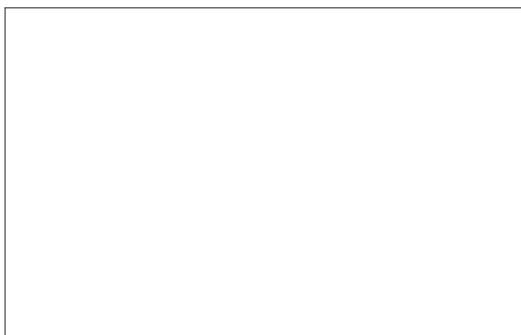
Note: mm [inch]

Current-Voltage & Power-Voltage Curve(250-20)



Excellent performance under weak light conditions: at an irradiation intensity of 200 W/m² (AM 1.5, 25 °C), 95.5% or higher of the STC efficiency (1000 W/m²) is achieved

Dealer information



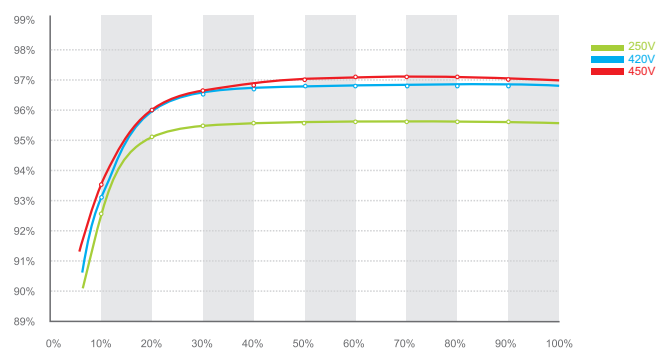
Information on how to install and operate this product is available in the installation instruction. All values indicated in this data sheet are subject to change without prior announcement. The specifications may vary slightly. All specifications are in accordance with standard EN 50380. Color differences of the modules relative to the figures as well as discolorations of/in the modules which do not impair their proper functioning are possible and do not constitute a deviation from the specification.



Leading - edge Technology

- ▶ High efficiency of 97.5% delivery more energy
- ▶ Dual independent MPP tracking lead to optimal energy harvesting
- ▶ Integrated DC disconnect switch
- ▶ Consistent and stable performance across entire input voltage and output power range
- ▶ True three-phase transformerless GT topology
- ▶ Bluetooth / RF technology / Wi-Fi
- ▶ Sound control, easy installation maintenance procedure
- ▶ Newest generation IGBTs and advanced MPPT algorithms
- ▶ Comprehensive protection for IGBTs, overvoltage, islanding, short-circuit, overload, overheat, etc
- ▶ Flexible system design with safety fuse module and lightning proof module

20k efficiency



GROWATT NEW ENERGY TECHNOLOGY Co.,LTD

A: Building B, Jiayu Industrial Zone, #28 Guanghui Road, Longteng Community, Shiyan, Baoan District, Shenzhen, P.R.China.

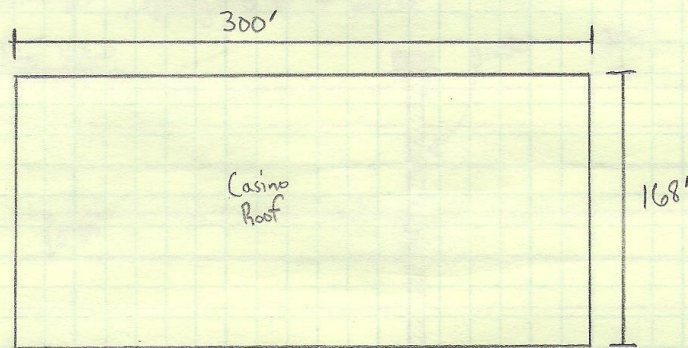
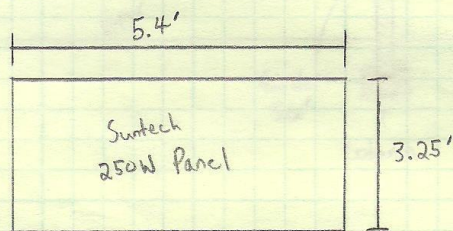
T: + 86 755 2747 1900 F: + 86 755 2749 1460 E: info@ginverter.com

	Growatt 10000TL3-US	Growatt 12000TL3-US	Growatt 18000TL3-US	Growatt 20000TL3-US
Input Data				
Max. DC power	10500W	12500W	18750W	20850W
Max. DC voltage	600V	600V	600V	600V
Start voltage	120V	120V	120V	120V
DC nominal voltage	375V	375V	375V	375V
PV voltage range	80V - 600V	80V - 600V	80V - 600V	80V - 600V
MPP voltage range (Full load)	250V - 600V	250V - 600V	250V - 600V	250V - 600V
Max. input current of the MPP trackers A / trackers B	21A / 21A	25A / 25A	38A / 38A	42A / 42A
Max. input short circuit current	32A / 32A	32A / 32A	50A / 50A	50A / 50A
Number of independent MPP trackers/strings per MPP tracker	2 / 3	2 / 3	2 / 6	2 / 6
Output (AC)				
Rated AC output power	10000W	12000W	18000W	20000W
Rated AC voltage	480V	480V	480V	480V
AC voltage range	422-528VAC	422-528VAC	422-528VAC	422-528VAC
AC grid frequency; range	60 Hz;59.3-60.5 Hz	60 Hz;59.3-60.5 Hz	60 Hz;59.3-60.5 Hz	60 Hz;59.3-60.5 Hz
Max. output current(cos φ=1)	12A	14.5A	21.5A	24A
Power factor (cos φ)	>0.99(0.9Leading - 0.9Lagging)	>0.99(0.9Leading - 0.9Lagging)	>0.99(0.9Leading - 0.9Lagging)	>0.99(0.9Leading - 0.9Lagging)
Harmonics	<3%	<3%	<3%	<3%
Grid connection type	3/NE	3/NE	3/NE	3/NE
Efficiency				
Max. efficiency	97%	97%	97.5%	97.5%
CEC-Weighted Efficiency	95.5%	95.5%	96%	96.5%
MPPT efficiency	99.5%	99.5%	99.5%	99.5%
Protectopm devices				
DC switch for each MPP tracker	yes	yes	yes	yes
DC reverse-polarity protection	yes	yes	yes	yes
DC/AC over voltage protection-Varistor	yes	yes	yes	yes
DC/AC over voltage protection-DIN rail surge arrester(Optional)	Class II	Class II	Class II	Class II
DC insulation measure	yes	yes	yes	yes
AC short circuit protection	yes	yes	yes	yes
General Data				
Diemensions(W/H/D) in mm	530/705/247	530/705/247	650/740/247	650/740/247
Weight	46KG	46KG	63KG	63KG
Operation temperature range	-25 °C ... +60 °C	-25 °C ... +60 °C	-25 °C ... +60 °C	-25 °C ... +60 °C
Noise emission	≤50dB(A)	≤50dB(A)	≤50dB(A)	≤50dB(A)
Self Consumption night	< 3 W	< 3 W	< 3 W	< 3 W
Topology	Transformerless	Transformerless	Transformerless	Transformerless
Cooling concept	Fan Cool	Fan Cool	Fan Cool	Fan Cool
Electronics protection rating/connection area	NEMA 3R	NEMA 3R	NEMA 3R	NEMA 3R
Altitude	2000m without derating	2000m without derating	2000m without derating	2000m without derating
Relative Humidity	0~95%	0~95%	0~95%	0~95%
Features				
Display	Graphic	Graphic	Graphic	Graphic
Interfaces: RS232/RS485/Bluetooth/RF/Wi-Fi	yes / yes / opt / opt / opt	yes / yes / opt / opt / opt	yes / yes / opt / opt / opt	yes / yes / opt / opt / opt
Warranty: 10 years / 15 years	yes / opt	yes / opt	yes / opt	yes / opt
Certificates and Approvals				
UL1741,UL1998,IEEE1547,FCC part 15(class B),CSA C22.2 No.107.1				

APPENDIX C – STRUCTURAL CALCULATIONS

Structural Calculations

Brad Robertson

Roof DimensionsPanel Dimensions

$$\begin{aligned} \text{Panel Weight: } & 40 \text{ lbs} \\ \text{Dead Load: } & \frac{40 \text{ lbs}}{17.55 \text{ ft}^2} = 2.3 \text{ psf} \end{aligned}$$

Dead Loads

- 3 psf \rightarrow Panel
 - 1 psf \rightarrow 3-ply ready roofing
 - 1.5 psf \rightarrow R-25 rigid insulation
 - 3 psf \rightarrow 3/4" wood sheathing
 - 10 psf \rightarrow Superimposed dead load
 - 1.78 psf \rightarrow 1.5B x 22 gauge roof decking (Vulcraft Roof Deck Table)
- } AISC Table 17-3, 14th Edition

Live Load

30 psf \rightarrow snow load

Total Loads

21 psf \rightarrow Dead load
30 psf \rightarrow Live load

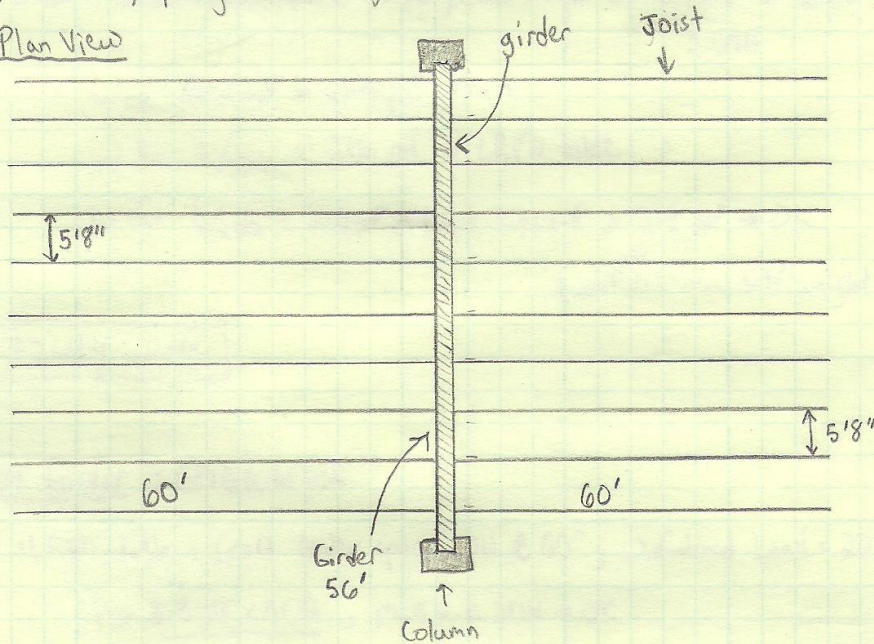
Structural Calculations

Brad Robertson

Load Combination: $1.2D + 1.6S$, assume no uplift or other live loads, LRFD

Span = 60', Spacing = 5'8" \Rightarrow joists

Plan View



Joist

32LH09 \Rightarrow 21 plf \Rightarrow Steel Joist Institute LRFD Table

$$[1.2D + 1.6S] \times \text{joist self wt} = [(1.2)(21\text{psf}) + (1.6)(30\text{psf})] \times 5.67\text{ft} = 420\text{ plf}$$

$$W_{\text{tot}} = 420\text{ plf} + (1.2 \times \text{joist weight}) = 420\text{ plf} + (1.2 \times 21\text{plf}) = 445\text{ plf}$$

$$W_{\text{H}} = (21\text{psf} + 30\text{psf})(5.67\text{ft}) = 290\text{plf} + \text{joist wt} = 290\text{plf} + 21\text{plf} = 310\text{plf}$$

- Use SJI Long-Span Steel Joist LRFD Table
- 32LH09 Joist designation and a clear span of 60'

$$W_{\text{tot}} = 534\text{ plf} > 445\text{ plf} \Rightarrow \text{OK}$$

$$w \text{ for } L/360 = 180\text{ plf} \Rightarrow \text{from table}$$

$$w \text{ for } L/240 = 180\text{plf} \times 1.5 = 270\text{ plf} < 310\text{ plf} \Rightarrow \text{Joist does not work}$$

• 32LH09 does not meet deflection criteria

Structural Calculations

Brad Robertson

New Joist

- Choose 32LH11 from LRFD table, self weight of $\frac{24 \text{ plf}}{5.67 \text{ ft}} \Rightarrow 5 \text{ psf}$

$$W_{\text{uti}} = 643 \text{ plf} > 445 \text{ plf} \rightarrow \text{OK}$$

$$W \text{ for } L/360 = 216 \text{ plf} \rightarrow \text{LRFD table}$$

$$W \text{ for } L/240 = 216 \text{ plf} \times 1.5 = 324 \text{ plf} > 313 \text{ plf} \rightarrow \text{OK}$$

(includes new self weight of joist)

• 32LH11 works

Joist Girder : 60G10N20K

- LRFD Table : 60ft Girder span, 10N @ 60", Unfactored Load = 20k

$$P_u = \frac{313 \text{ plf} \times 56 \text{ ft}}{1000} = 17.5 \text{ k} < 20 \text{ k} \rightarrow \text{OK}$$

- LRFD Table : $93 \text{ plf} / 60 \text{ ft} = 2 \text{ psf}$

• Girder 60G10N20K works

Column

- W8X48, height 13ft

- Tributary Area of 60' x 56' = 3,360 ft²

$$P_u = [1.2D + 1.6S] \times \text{area} = [1.2(21 \text{ psf} + 5 \text{ psf} + 2 \text{ psf}) + 1.6(30)] \times 3360 \text{ ft}^2$$

$$P_u = \frac{274,176}{1000} = 275 \text{ k}$$

- Table 4-1 in AISC, 14th Edition : $\phi P_n = 421 \text{ k} > 275 \text{ k} \rightarrow \text{OK}$

• Column W8X48 works