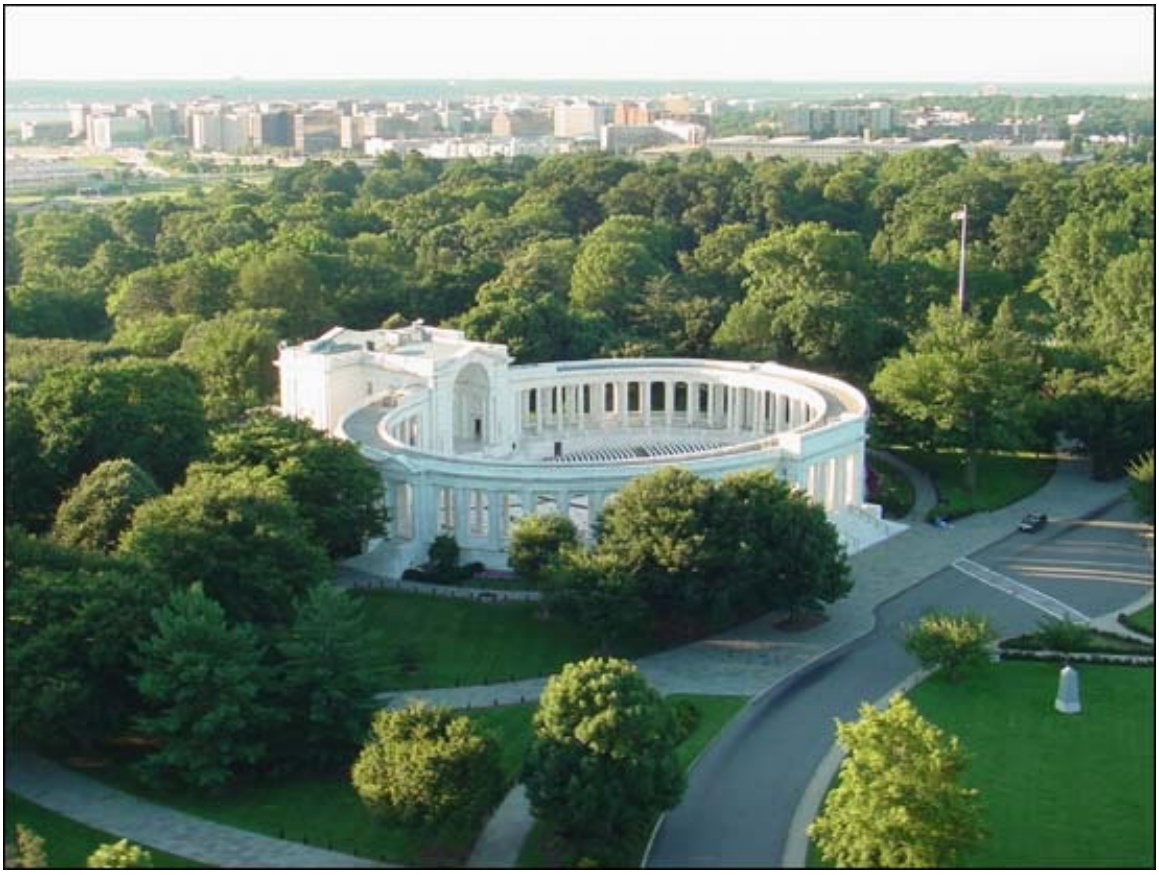
The Memorial Reception Building
Arlington National Cemetery



Final Thesis Report

Lighting/Electrical: Dr. Mistrick & Ted Dannerth

April 12, 2007

Jennifer Sanborn

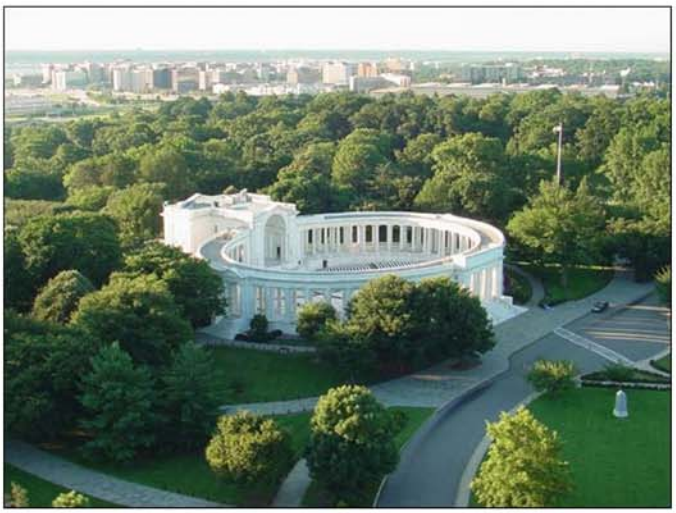
The Memorial Reception Building
Arlington National Cemetery
Arlington, Virginia

General Building Data

Building Area: 49,000-50,000 sq. ft.
Cost: $6,000,000 for the Renevation
3 Stories above grade
Occupancies: A-3 Assembly
B Business
S-2 Storage

Electrical

Utilities: Main incoming power is a 15kv 3 ph service connected to the building through an H.V. switch board.
Exterior: There are two transformers for the exterior electrical distribution with the capacity of 150 KVA and 300 KVA. Both of these transformers are 3 phase, 4-wire type with secondary voltage of 208Y/120V and are connected to the primary service switch board.
Interior: There are two panel boards that provide electrical power to the interior of the building, both of which are 3-phase, 4-wire and are 208Y/120V with the capacity of 1600A and 1200A.



Mechanical

Cooling system: Two 12.5 ton rooftop units and a 4000 CFM cooling unit.
Heating: Hot water system heated. Water circulates through unit heaters, convectors, finned tube radiators, and hot water coils in the ducts.
Exhaust fans: One 1500 CFM and one 900 CFM.

Project Team

Owner: Government
General Contractor: William V. Walsh Construction Co.
Arch: Vitetta
Civil: Burgess & Niple
MPE: Weigand Associates
Lighting: The Lighting Practice
Elevator Engineers: Lerch Bates
Landscape: Hord Coplan Macht

Lighting

Exterior lighting: 5 exterior light fixtures.
Interior lighting: The existing building before the renovation, was using all pcb ballasts for the fluorescent lighting fixtures. The the foot-candle levels did not comply with the newest IES standards.

Structural

Roof: Poured in place reinforced concrete roof deck and concrete encased steel beams which are supported on load baring walls.
Floor: Poured in place reinforced concrete slabs and concrete encased steel beams which are supported on interior and exterior load bearing masonry walls and interior load bearing masonry piers.
Exterior walls: 21" thick load bearing masonry walls.
Interior walls: Some are load bearing masonry walls and others are either clay tile or stud partitions.
Construction type: 2A, protected noncombustible.

Jennifer Sanborn
Lighting/Electrical

The Pennsylvania State University
Senior Thesis 2006-2007
www.arche.psu.edu/thesis/2006/jls747

Table of Contents

Executive Summary

The Memorial Reception Building was first built in the early 20th century. The most recent renovation was completed in the spring of 2006. The buildings architecture is based off of Roman and Greek architecture giving the building an old but unique feel. This building is considered to be a historical building which creates new requirements to be followed. The main restriction that was followed for this lighting design was to place fixtures out of site of the visitors as much as possible. In the event of being unable to discreetly hide the fixtures, it is suggested to pick out fixtures that match the buildings time period and architecture as close as possible.

The lighting design consists of four spaces; the tomb guards work area, the reception room, the crypt chapel, and finally the amphitheater which currently has no light fixtures since the building and the cemetery grounds are only open between dawn and dusk. These lighting concepts keep the historical aspect in mind while creating a design that introduces points of interest and flow through each space. The light fixtures were either hidden in the architecture or chosen to help demonstrate it. By adding and subtracting loads to the building, the lighting electrical coordination was completed to ensure correct sizing for circuit breakers, wires, and transformers.

To ensure the protective device units will behave correctly in the event of a short circuiting or over loading, a typical line from a branch circuit back to the switch gear was chosen to analyze. This analysis proves the electrical system will work correctly in the event of short circuiting. Next, since all the emergency lighting, security cameras, and fire protection was being fed by battery packs during the event of a power outage, an emergency system was design with a new emergency panel board and generator. After the design was completed, it is noted that since this building is so small, battery packs would indeed be the most cost efficient method. To save energy, new power saving and environmentally friendly transformers were investigated to cut back on annual utility costs. By using these new energy efficient transformers, the owner saves almost $5,000 in annual operating costs and saves 50,000kWh per year.

By adding a cove bump up into the plenum space in the work area of the tomb guard quarters, the diffusers and return grill needed to be moved to a lower part of the dropdown ceiling. To get the correct air distribution for the space, new diffusers were chosen based on throw, CFM rating, and NC value. Also, because of a new dead load being added to the ceiling and less room allotted in the plenum space, the mechanical duct work layout as well as the drop down ceiling layout needed to be redesigned. Structurally, the new ceiling can hold the dead load of the cove and the new duct layout decrease pressure drop into the adjacent kitchen resulting in having to add a damper in the duct.

The lighting design requires many different coordination issues to be solved. All these issues including structural/architectural, mechanical, and electrical are solved through investigation and calculation. The design ends up being a well rounded engineering solution for all the coordination issues that are frequently found in construction today.

Acknowledgements

Professionals

Michael Weigand
Jason Kramer
Joshua Lutton
William Bowers
Message board participants

Professors

Dr. Rick Mistrick
Ted Dannerth
Professor Kevin Parfitt
Professor Robert Holland
Dr. James Freihaut
Professor Paul Bowers
The rest of the AE faculty

Piers

Devin Maurizio
Clement Fung
Katie Jenkins
Dave Rosenberger
Angela Nudy
Kate Feato
Yena Han
Michael Lombardi
Patrick Murphy
Justin Beam
Justin Schultz
Ben Burgoyne

A special thanks to my family and friends who supported me throughout the year.

Introduction

The memorial reception building is located Arlington Virginia's National Cemetery. It was first built in the early 20th century, but since then, it has been renovated several times with the most recent one being completed in 2006. The occupant of the building is the Platoon called "The Old Guard", which consists of a select group of members from the 3rd US Infantry reside here during their shift to watch over The Tomb of the Unknowns. The building is a mixed use space including but not limited to the tomb guard quarters, office and storage spaces, and museum areas. The building consists of 3 floors, one of which is a basement where the gaurds spend most off their off time. The 2 floors above grade are open to the public for viewing the honorary awards and medals.

The United States Government owns this building and is considered to be a well known monument in Washington D.C. The architecture and MEP firms who worked on the most recent renovation were Vitetta and Weigand Associates. The construction of the renovation started in December of 2004 and continued for another year and a half. The total estimated cost of the renovation was over $6,000,000 and was bid out as a design-build project. The buildings overall square footage is just about 50,000sf.

The Memorial Reception Building's architecture is based off of ancient Roman and Greek architecture with the marble finishes and stone columns in both the amphitheater and some of the interior spaces of the building. Some of the spaces are decorated with grand staircases or open to above ceilings. Overall, the building is a magnificent piece of architecture giving a blank pallet to the lighting designer and potentially allowing them to design something spectacular.

Background

The existing primary service is a 15KV, 3-PH service which is connected to the building through an H.V. switch board. There are two transformers for the exterior electrical distribution with the capacity of 150 KVA and 300 KVA, both of which are connected to the primary service switch board. These transformers are 3 phase, 4-wire type with secondary a voltage of 208Y/120V. There are two panel boards, with the capacity of 1600A and 1200A, which distribute power throughout the rest of the building.

Compact fluorescent and fluorescent sources were being used in the majority of the building's basement level's general spaces except for some halogen track lighting fixtures used in the tomb guard's practice room. Incandescent, halogen, and low voltage lamps are also being used in the crypt chapel which is also located on the basement level. The first floor is equipped with new incandescent candelabra or incandescent globe lamps in the sconces and chandeliers which were re-lamped and the second floor lighting consists of just halogen track lighting. All lighting in building is operating off of 120V.

The cooling system for The Main Reception Building consists of two separate 12.5 ton rooftop units located on the amphitheater roof. There is also a 4000 CFM cooling unit which serves the Tomb Guard's Quarters and the VIP room located in the North mechanical room. Heating for the building in its entirety is provided by a hot water system heated by a boiler. There are unit heaters, convectors, finned tube radiators, and hot water coils in the ductwork witch all circulate the hot water through the building. There are two existing exhaust fans, one is a 1500 CFM and the other is a 900 CFM, to serve the building.

The plumbing design analysis states that the design-build team performed a detailed code analysis which indicated that fire sprinklers are not required to be provided by code. After reviewing the existing municipal domestic water system and finding it lacks both sufficient flow and pressure and also knowing smoke detector coverage was being provided throughout the building, the owner decided to not place a sprinkler system in the building. So currently there is no sprinkler system in the building.

The fire alarm system is a zoned, non-coded, addressable, microprocessor based system. It is located in the electrical closet on the basement level. The system includes: a fire alarm control panel, graphic enunciator panel, pull stations, visual devices audio/visual devices, smoke detectors, heat detectors, dust detectors, and tamper switches and flow switches on sprinkler piping system.

The roof of the existing structure is constructed with poured in place reinforced concrete roof deck and concrete encased steel beams which are supported on load baring walls. The floor is constructed with poured in place reinforced concrete floor slabs and concrete encased steel beams. It is supported on interior and exterior load bearing masonry walls and interior load bearing masonry piers. The exterior walls are all 21" thick load bearing masonry walls. Some of the interior walls are load bearing masonry walls and some others are either clay tile or stud partitions. The construction type for the Memorial Reception Building is type 2A, protected noncombustible.

The telephone system is a typical system where the telephone cable; which is a category 3, 4 pair telephone cable; is distributed throughout the building from a 66 clip connecting block located in the telephone closet on the basement level. Eleven cables service the basement level, while three cables service the first floor level. The data system is also a typical system where the data cable; which is a category 5e, 4 pair data cable; is distributed through the building from the LAN terminal, which is a 16 port category 5 patch panel, located in the LAN closet on the basement level. Nine cables service the basement level, while four cables service the first floor level.

The security system is made up of fiber optic cabling connected to two site cameras, four cameras located around the amphitheater, and one camera located on the roof. The terminal cabinet for the security cameras is located in the telephone room, while the fiber optic termination by Arlington National Cemetery is located in the LAN closet, and the TV that is used to view these security cameras in located in the Sergeant of Guard's office. All three of which are located on the basement level.

Lighting Depth

Introduction

The buildings architecture allows for a unique lighting design concept. The four spaces that were designed for include the work area in the tomb guards' quarters, the reception room at the main entrance of the first floor, the crypt chapel for the guards in the basement, and the exterior amphitheater. Each of these spaces has at least one unique architectural piece which connects them together.

Each spaces lighting design had its own criterion that was compiled. Using these guidelines, a one of a kind lighting design was developed. Whether it is up lighting a cove to achieve a Flynn mode, or adding fixtures to display cases to create interest, each space is unique but connected at the same time through the main concept of architectural lighting.

Designing a lighting layout for architectural lighting requires much thought into placement of fixtures. Most of the fixtures that were chosen are in grade, recessed, or hidden out of sight to the occupant through lips on ledges or display cases. If a fixture would be seen by the occupant, a great deal of discretion was taken when picking out the fixture.

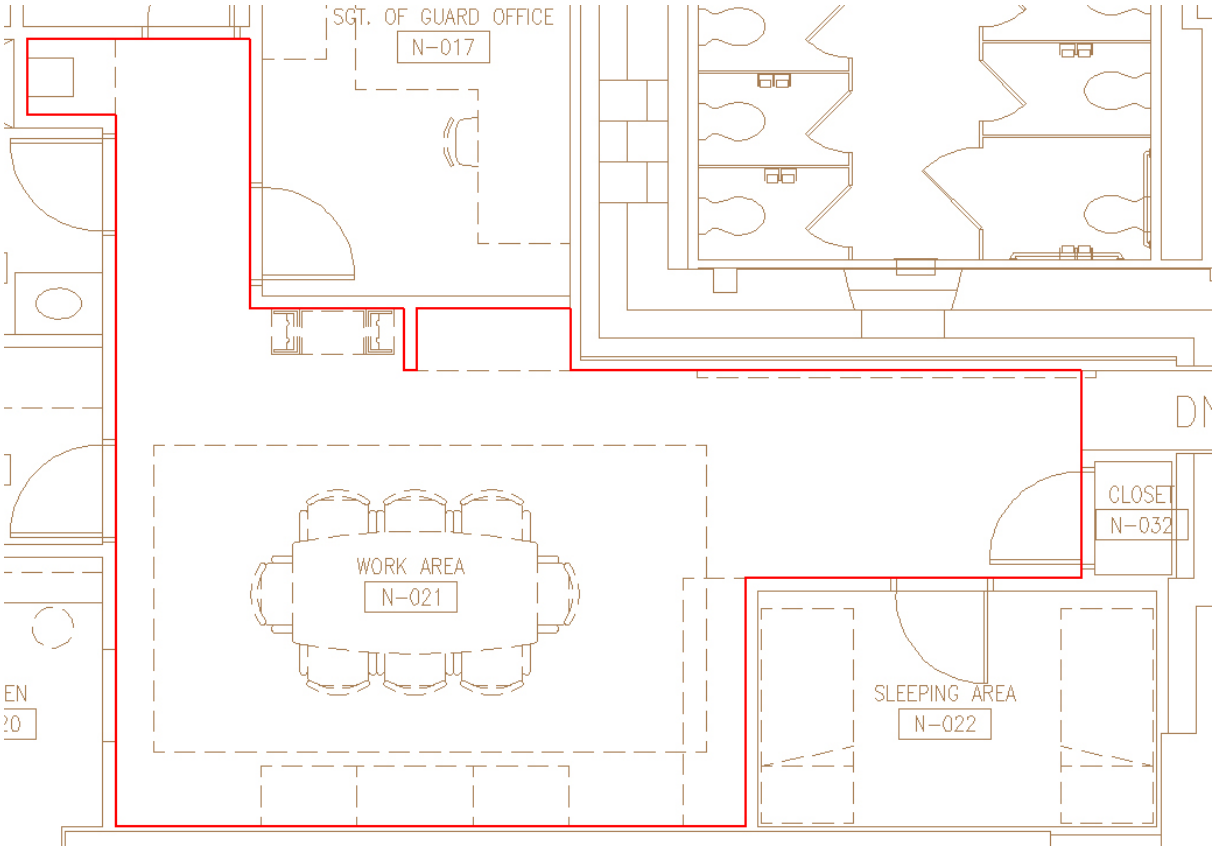
Overall, the light fixture selection, placement, and concept were very critical for designing a lighting scheme for this building. The final design was developed by taking each separate space into consideration but also keeping the building in mind as a whole.

Work Area

The work area is located in the tomb guards' quarters in the basement of the building. This area is used 24 hours a day, 5 days a week by the tomb guards. These guards are required to watch over the tomb of the Unknown Soldier in 30 minute to 2 hour shifts. When they are in between shifts, the tomb guards' quarter is where they go to relax, sleep, or eat until their next shift. The work area is used for meetings, watching videos, working, and eating. The design for the space incorporates the idea of creating a relaxing atmosphere without taking away the versatility of the space through controls.

Existing Conditions

Floor Plan:



Space Properties:

Floor:

Material: Carpet

Color: Atlas Carpet Mills Inc. Chart well #CE 21 Sunflower

Reflectance: 0.3

Walls:

Material: Gypsum Wall Board

Paint Color: Benjamin Moore Color #HC-39 Putman Ivory with Eggshell Finish

Reflectance: 0.75

Ceiling:

Material: Gypsum Board
Paint Color: Benjamin Moore Color #White Satin 2067-70 with Egg Shell Finish
Reflectance: 0.9

Material: 2x2 Acoustical Tiles
Color: Standard White
Reflectance: 0.9

Furnishings:

- Mirror located at entrance corridor on West wall.
- Entertainment center located on East wall.
- Workstation located on North wall.
- Conference room table located in center of space.
- Display case and telephone stand located on West wall.

Design Criteria:

Tasks:

- Reading
- Writing
- Conversing
- Presenting

Illuminances:

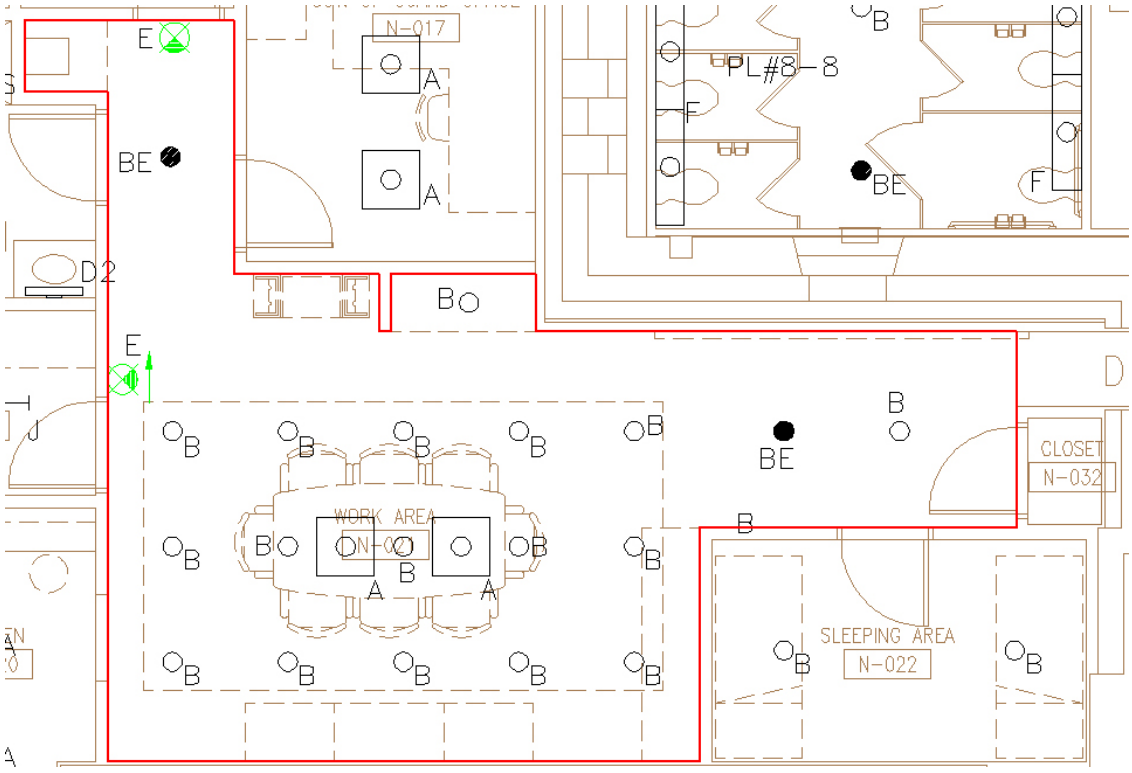
- $E_{H\ (table)}$ Category D-30fc
- $E_{V\ (face)}$ Category B-5fc

Criteria:

- Appearance of Space and Luminaires: Luminaires should not be distracting in this space. Concentration should be on the tasks at hand; either the presenter or the material on the table.
- Direct Glare: Direct glare should be avoided since it causes the decrease in visibility and discomfort. The lamps in the luminaires should not be seen by the presenter of the audience.
- Light Distribution on Surfaces: All surfaces should be uniformly lit to ensure identification of objects in the space and to decrease distractions.
- Light Distribution on Task Plane: The surface of the conference room table should have an even distribution of light to allow for the flexibility in use of the whole table and to increase the task visibility.
- Luminances of Room Surfaces: Luminance on room surfaces should create a comfortable atmosphere for the occupants.

- Modeling of Faces and Objects: Modeling of faces is very important as the occupants around the table will be conversing with each other. They need to be able to recognize the people in which they are talking to and interpret what they are saying.
- Reflected Glare: It is important to not allow reflected glare in this type of space. Reflected glare off the work plane will decrease the visibility of materials and cause eye fatigue.
- Surface Characteristics: Surfaces in this space should not be a glossy finish to avoid reflected glare.

Lighting Layout:



Luminaires:

LIGHTING FIXTURE SCHEDULE

TYPE	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	LAMP NO.	LAMP TYPE	LAMP WATT	VOLT	LAMP COLOR TEMP	LAMP CRI	LAMP AVE. LIFE HRS	LAMP APPROX. INITIAL LUMENS	FINISH	MOUNTING	NOTES
A	CEILING MOUNTED FIXTURE	LITHONIA LIGHTING	2PM3 G B 2 U316 SLD GED	2	T8U	31	120	3000	85	20,000	2800	–	CEILING RECESSED	–
AE	CEILING MOUNTED FIXTURE	LITHONIA LIGHTING	2PM3 G B 2 U316 SLD GED EL – EM	2	CF	26	120	3000	82	20,000	2800	–	CEILING RECESSED	–
B	RECESSED COMP. FL. DOWNLIGHT	EDISON PRICE	DPX 226/B	2	CF	26	120	3000	82	10,000	1800	SEMI-SPECULAR CLEAR WITH WHITE FLANGE	CEILING RECESSED	–
BE	RECESSED COMP. FL. DOWNLIGHT	EDISON PRICE	DPX 226/B-EM	2	CF	26	120	3000	82	10,000	1800	SEMI-SPECULAR CLEAR WITH WHITE FLANGE	CEILING RECESSED	WITH EMERGENCY BALLAST
BD	RECESSED COMP. FL. DOWNLIGHT	EDISON PRICE	DPX 226/B-DM	2	CF	26	120	3000	82	10,000	1800	SEMI-SPECULAR CLEAR WITH WHITE FLANGE	CEILING RECESSED	WITH DIMMING BALLAST
BS	RECESSED SHOWER DOWNLIGHT	LITHONIA LIGHTING	LGF-226DTT-FFL-120 GED	2	CF	26	120	3000	82	10,000	1800	REGRESSED WHITE SPLAY	CEILING RECESSED	WITH ROUND LENS
C	RECESSED MOUNTED FLUORESCENT	LIGHTOLIER LIGHTING	QVS 2 G PF LG 3 32 120 SR	3	T8	32	120	3000	86	24,000	3100	WHITE WITH WHITE SHIELD	CEILING RECESSED	–

Light Loss Factors:

Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
A	IV	0.94	0.89	0.88	0.97	0.71
B	IV	0.84	0.89	0.88	0.97	0.64
BE	IV	0.84	0.89	0.88	0.97	0.64

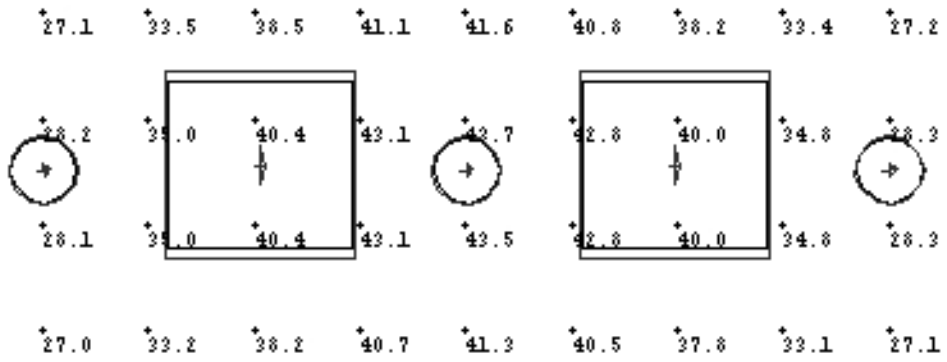
Assumptions:

- 12 month cleaning cycle
- Clean environment
- Work plane at 2'-5"

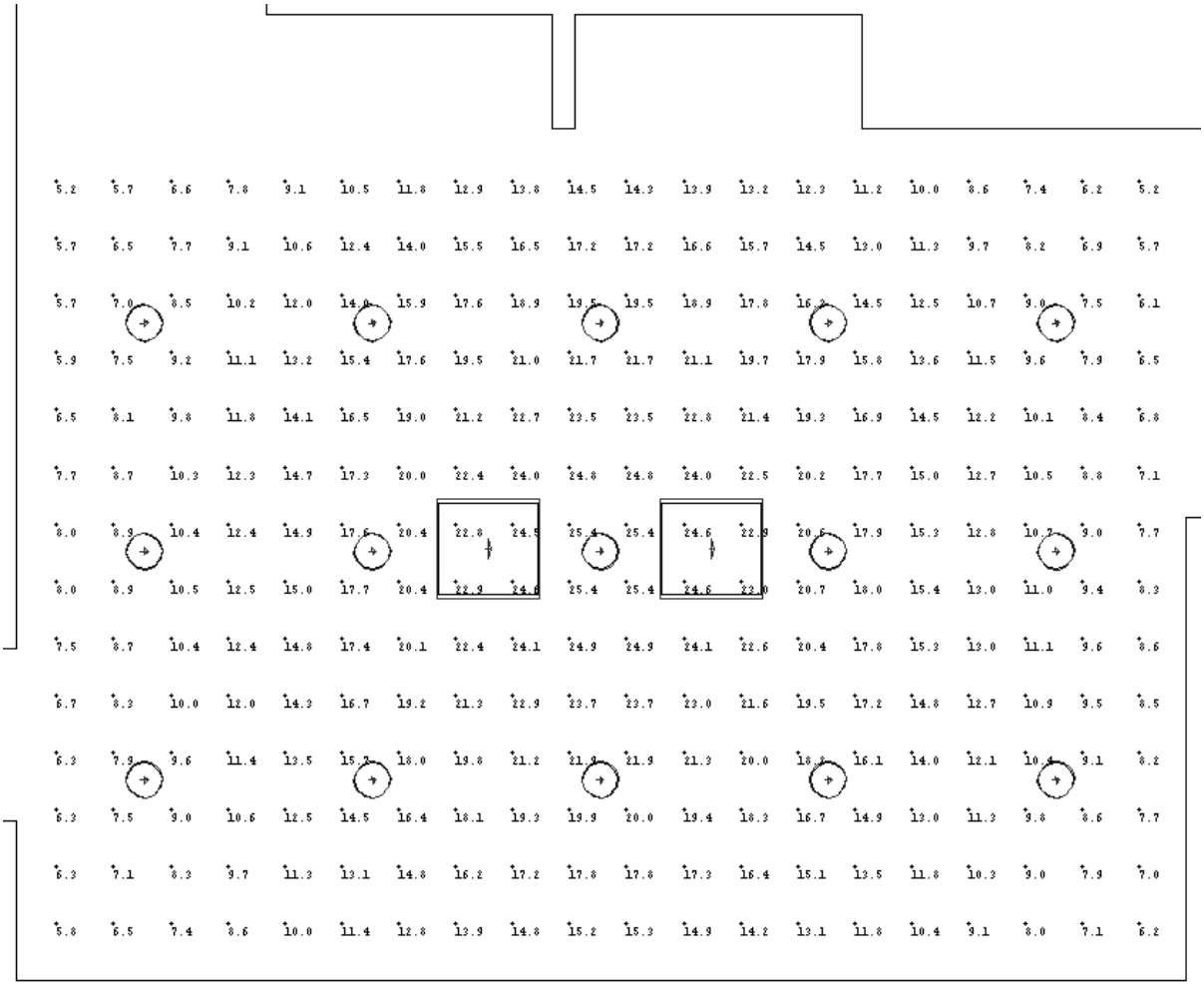
AGI Foot Candle Levels Calculated:

Average Horizontal Illuminance on table (2'-6"): 36.5 fc
Average Horizontal Illuminance on floor: 14 fc

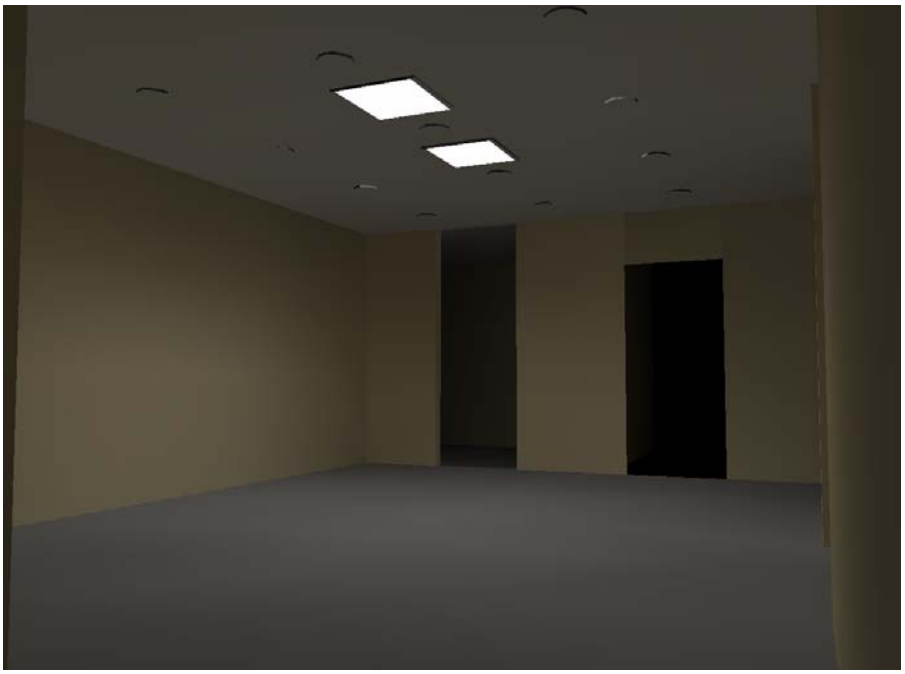
Table Calculation Grid:

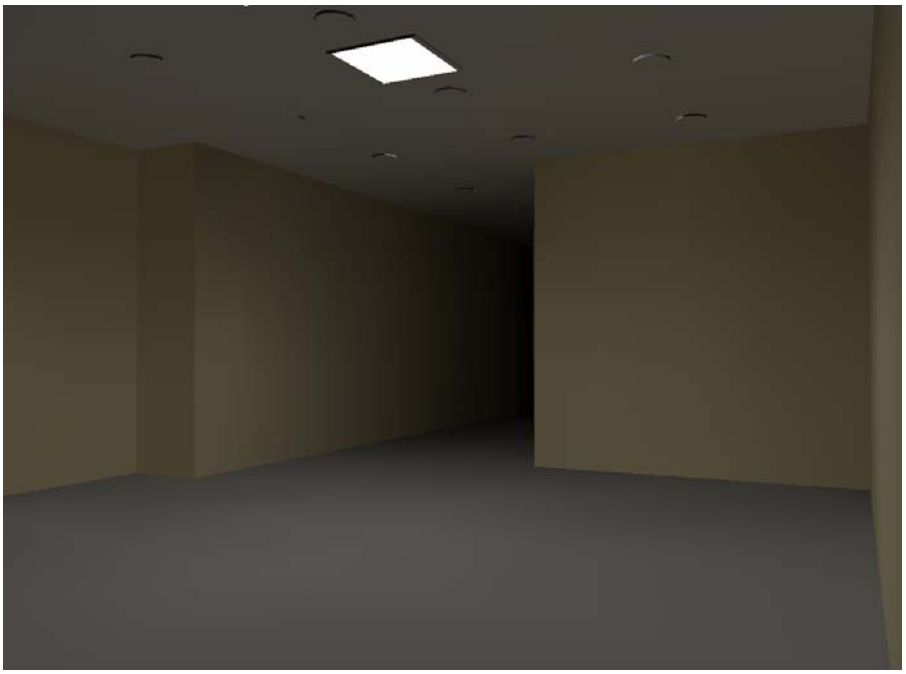


Floor Calculation Grid:

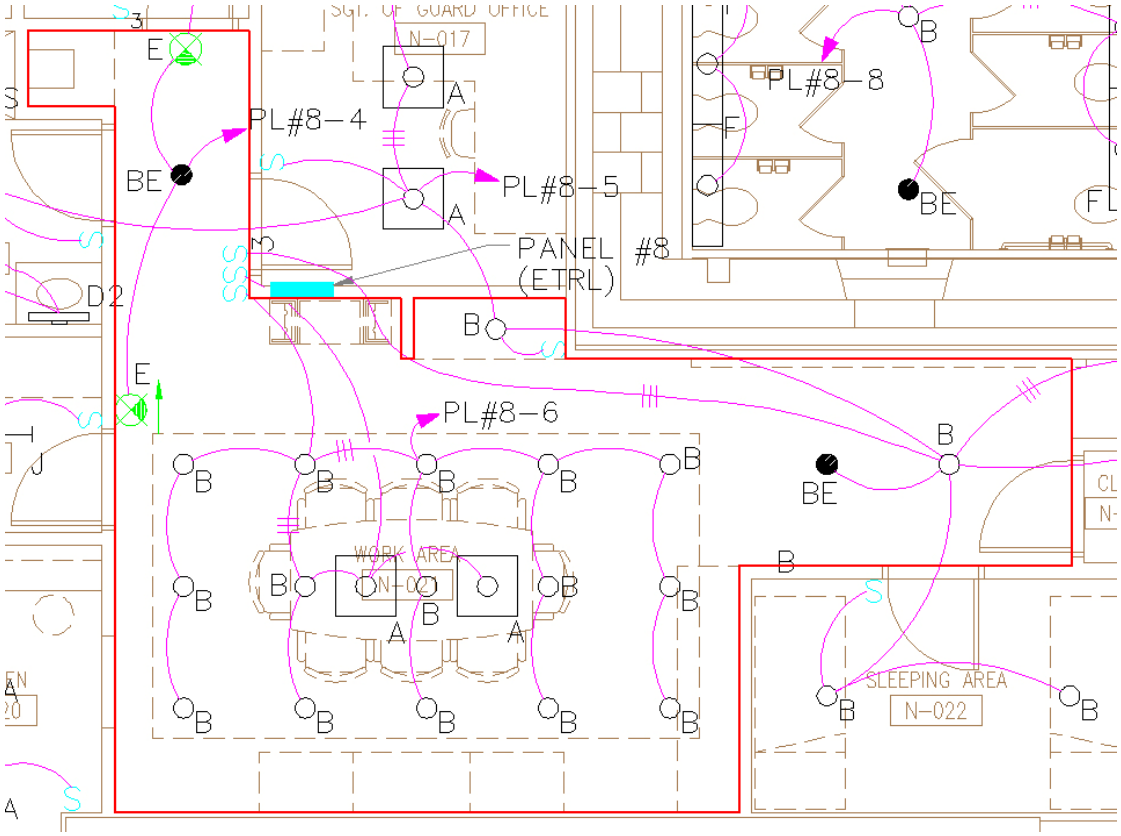


Renderings:





Wiring/Switching Diagram:



Controls:

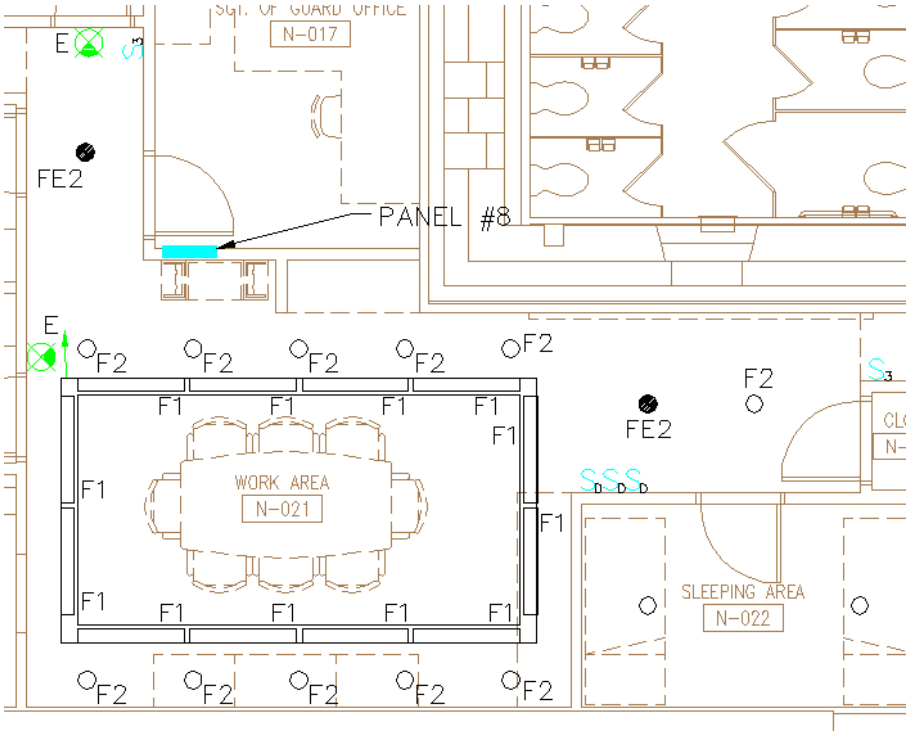
All the lights in this space are controlled be regular switches. The down light at the entrance of the space is controlled by a 3 way switch with one switch located at the entrance, and the other located at the far end of the space. Both the down lights and the 2x2 recessed fixtures located over the conference room table are each controlled by their own single pole switch located at the far end of the space.

Schematic Concept

For this space, the main goal is to make the space comfortable to be in. The guards who use this space are here for quite a long time, so creating a space where they would want to be is very beneficial. For this space the Flynn mode of hazy and quiet was chosen to achieve the goal of relaxing. Creating interest in the display case was added to increase the feel of relaxation by putting the attention on something else in the room than the occupants.

To achieve hazy and quiet, the ceiling was lit indirectly with fluorescent cove fixtures. Prior to this redesign, there was no cove in this space, just a drop down ceiling. To create the cove, a portion of the dropdown ceiling above the conference room table was removed and a lip was placed in around the perimeter of the bump up. By having this over the conference room table, it creates a perfect opportunity to light the table indirectly. The design also included downlights around the outside perimeter of the remaining dropdown ceiling to allow for flexibility in the space and help enforce the Fylnn mode of relaxation.

Lighting Layout:



Luminaire Schedule:

Fixture Schedule													
Type	Description	Catalog Number	Manufacturer	Lamp								Finishes	Mounting
				No.	Type	Watt	Voltage	Color Temp.	CRI	Ave. Life Hrs.	Initial Lumens		
F1	Linear Cove	SC-1T8-04'-120-DM-10THD	Prudential Lighting	1	FL	32	120	3000	85	20,000	3,100	white enamel	Surface
F2	Downlight	DPLX 113/6-119	Edison Price	1	CF	13	120	4000	82	12,000	900	Aluminum	Recessed
FE2	Downlight	DPLX 113/6-120	Edison Price	1	CF	13	120	4000	82	12,000	900	Aluminum	Recessed

Light Loss Factors:

Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
Cove (F1)	VI	0.92	0.86	1.0	0.87	0.68
Downlights (F2, FE2)	IV	0.85	0.89	1.0	0.97	0.73

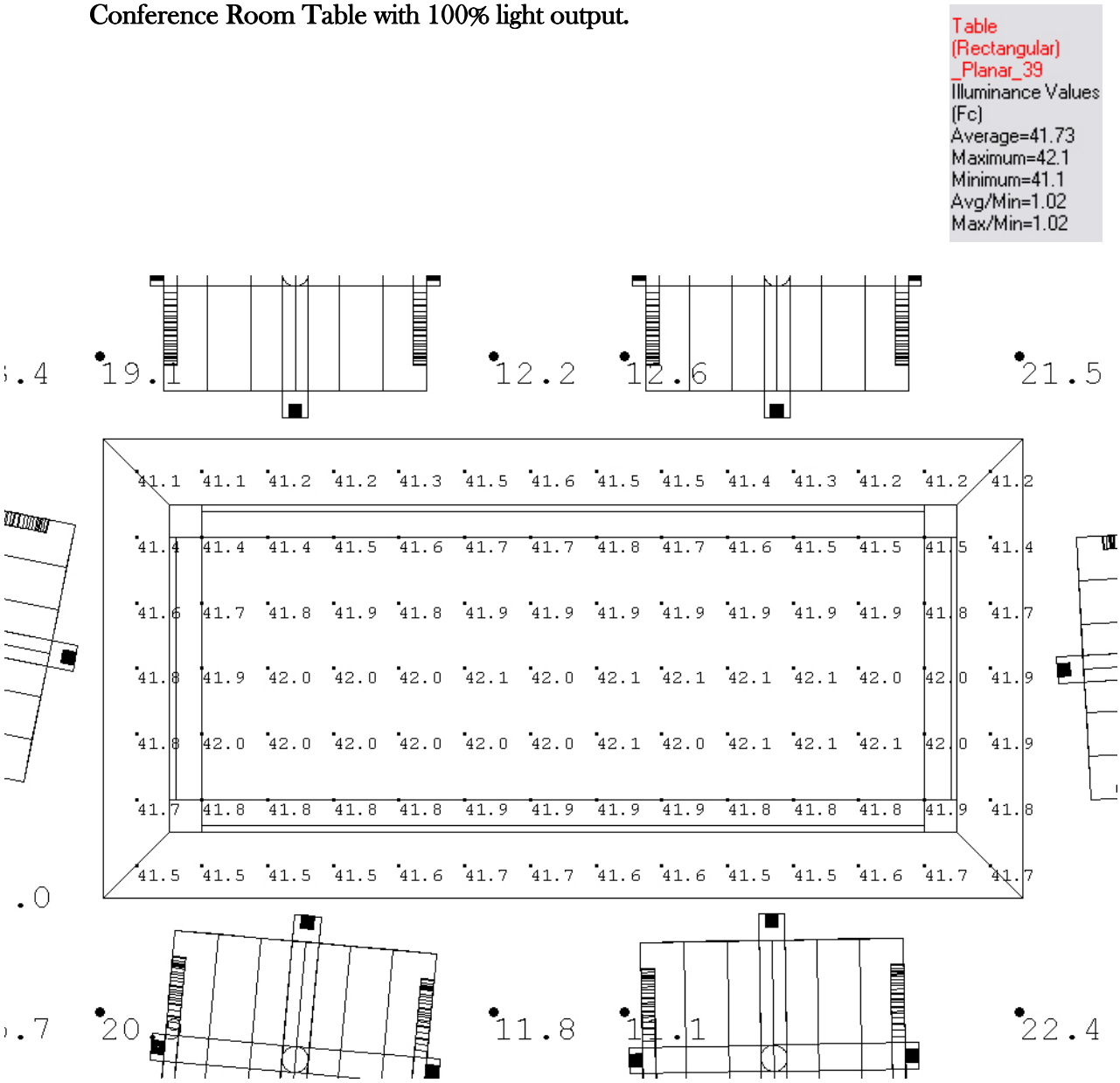
Assumptions: Clean, 12 month cleaning cycle, RCR: 3.35

Power Density:

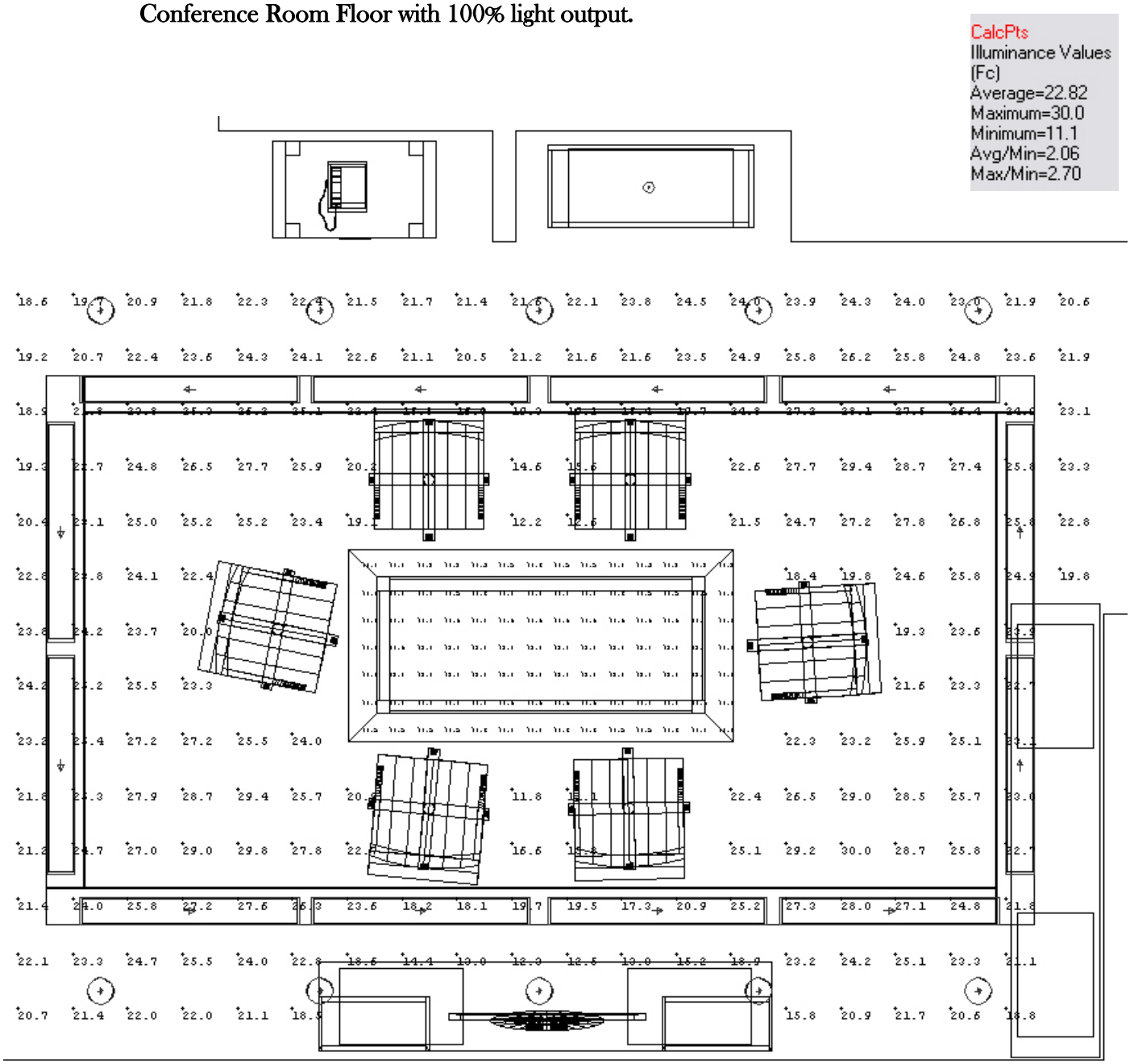
Luminaire	Watts	Lamp Qty	Total Watts	Room Sq.Ft.	Watts/Sq.Ft.	Allowed
Cove (F1)	30	12	360	455	0.79	1.3 + 1.0 Accent
Downlights (F2, FE2)	18	13	234	455	0.52	
				Total	1.31	2.3

Calculation Points:

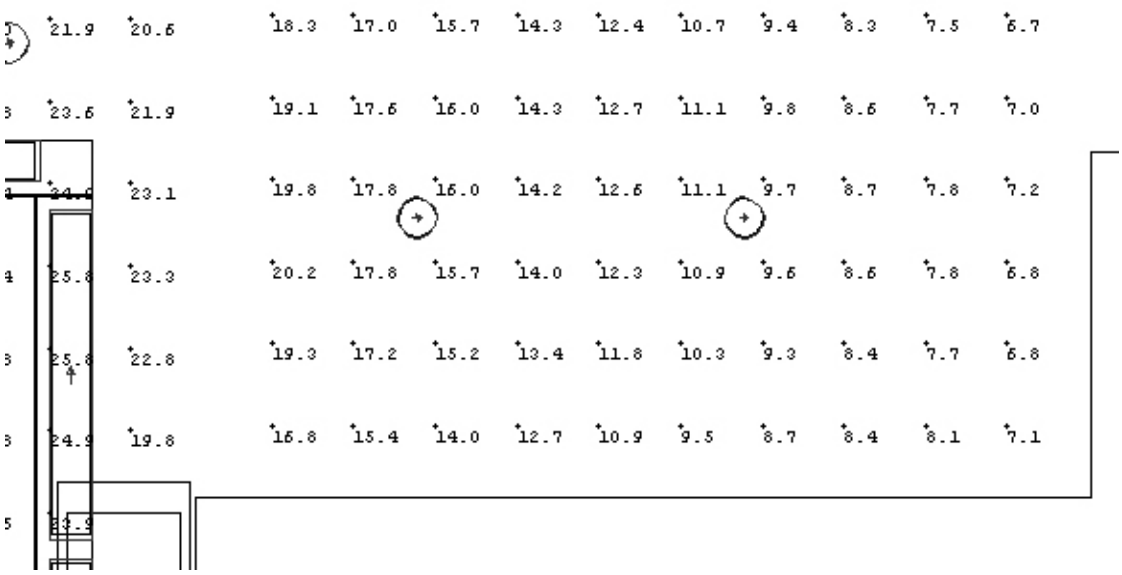
Conference Room Table with 100% light output.



Conference Room Floor with 100% light output.



Conference Room Entrance Floor with 100% light output.

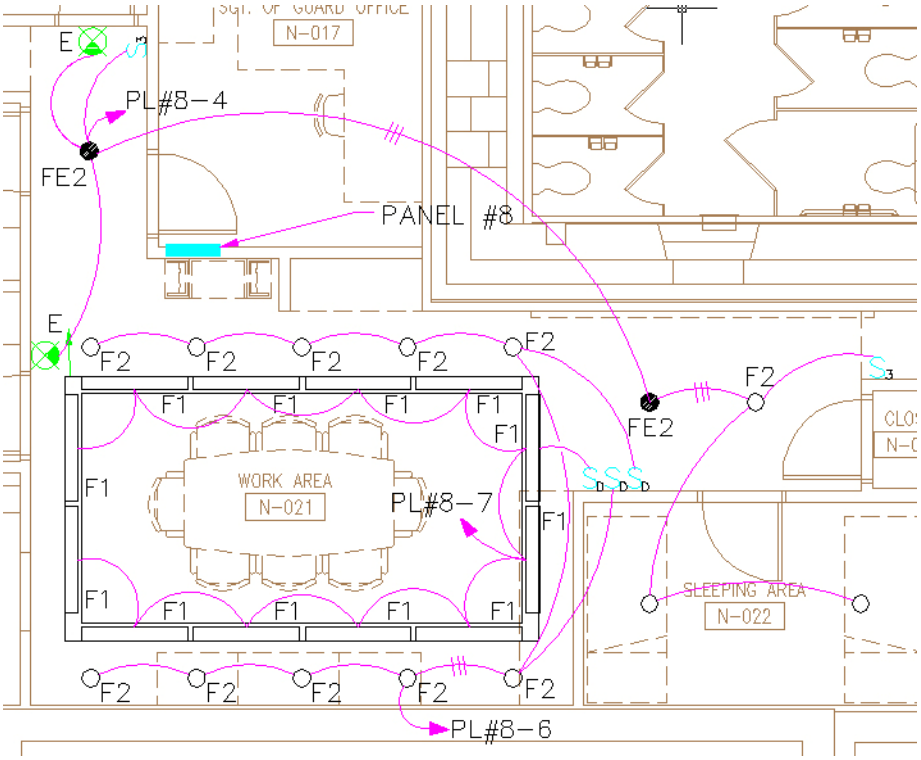


Project_1
Calc Pts

CalcPts_1
Illuminance Values (Fc)
Average=12.06
Maximum=20.2
Minimum=6.7
Avg/Min=1.80
Max/Min=3.01

Renderings:

Wiring/Switching Diagram:



Controls:

The controls for the light fixtures in this space allow for great versatility. Each set of downlights are controlled by their own dimmer slide wall switch. This allows for the set of downlights directly above the television screen to be dimmed or turned off separately from the other set on the opposite side of the room. There is also a 3-way switch which controls the three hallway lights at each of the entrances to increases safety in the space. The linear cove lights are also connected to a dimmer slide wall switch which allows for the overall light level on the conference room table to be dimmed down.

Conclusion

Overall, this lighting design worked well with this space. The required footcandle levels were met as well as the overall design concept. The renderings show how the scallops on the walls as well as the interest created in the display case both create a relaxed feel. On the other hand, the renderings also show that the cove lighting might cause the space to not be relaxing, but this is accepted since the design includes a way to dim them down to an acceptable intensity.

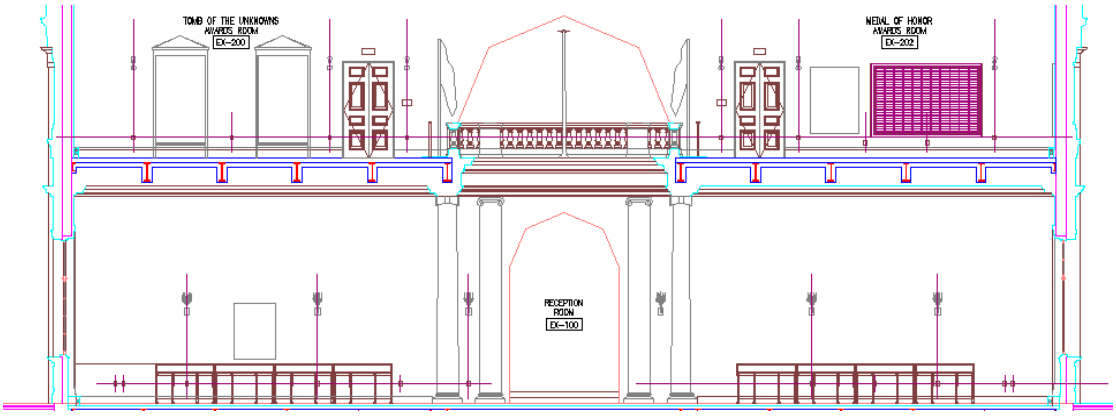
Reception Room

The reception room is located just inside the entrance of the building. It is essentially made up of a corridor with two museum like spaces on either side. These spaces consist of a number of display cases which hold honorary medals and awards. This space is open to the public 11 hours a day, 365 days a year. The overall goals of this space are to draw the visitors into the side rooms with the display cases and to emphasize the architecture to create a grand entrance into the building.

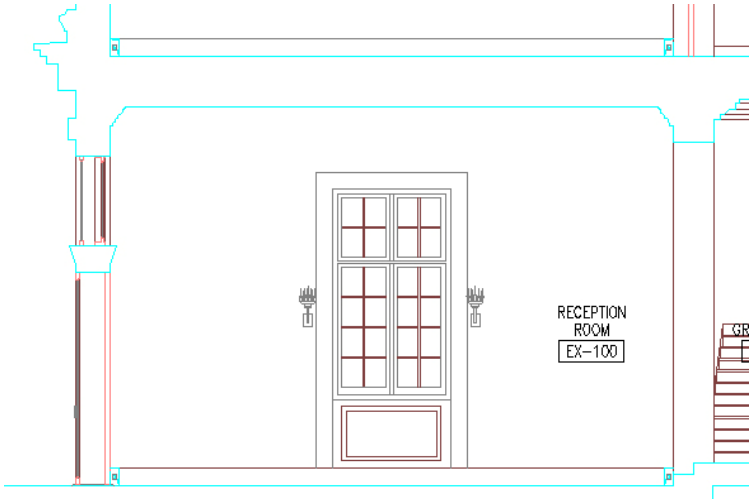
Existing Conditions

Section Looking West:

Section Looking East:

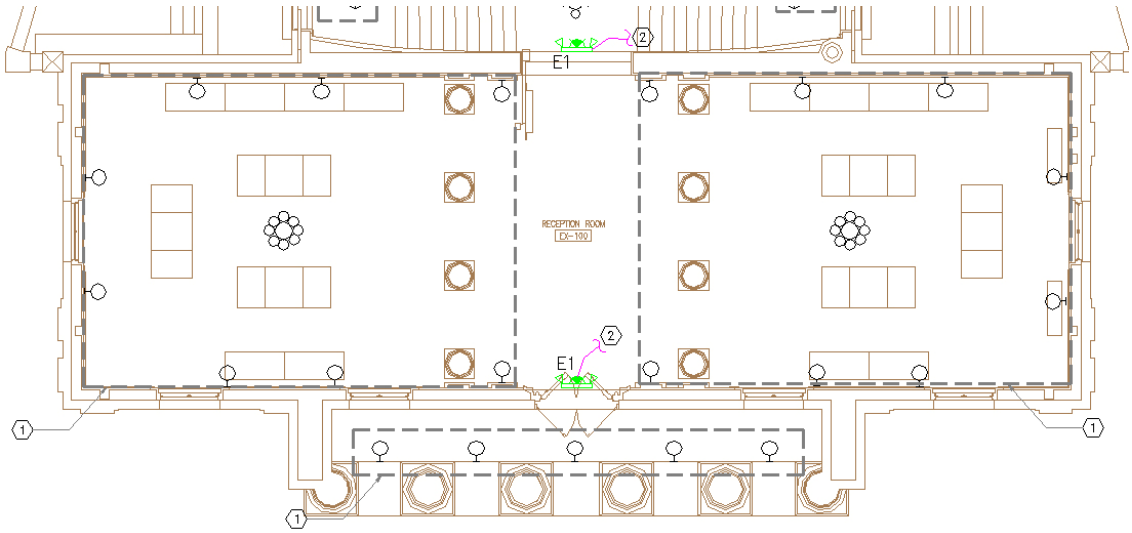


Section Looking South:



Section Looking North:

Floor Plan:



Space Properties:

Floor:
- Material: Marble
- Color: Dirty White
- Reflectance: 0.61

Walls:
- Material: Plaster
- Paint color: Orange-Yellow
- Reflectance: 0.71

Ceiling:
- Material: Plaster
- Paint Color: White
- Reflectance: 0.9

Furnishings:

- Display cases located in adjacent rooms containing honorary medals and plaques.

Design Criteria:

Tasks:

- Viewing
- Conversing
- Reading
- Writing
- Meandering

Illuminance:

- E_H (display cases) Category D-30fc
- E_V (face) Category B-5fc

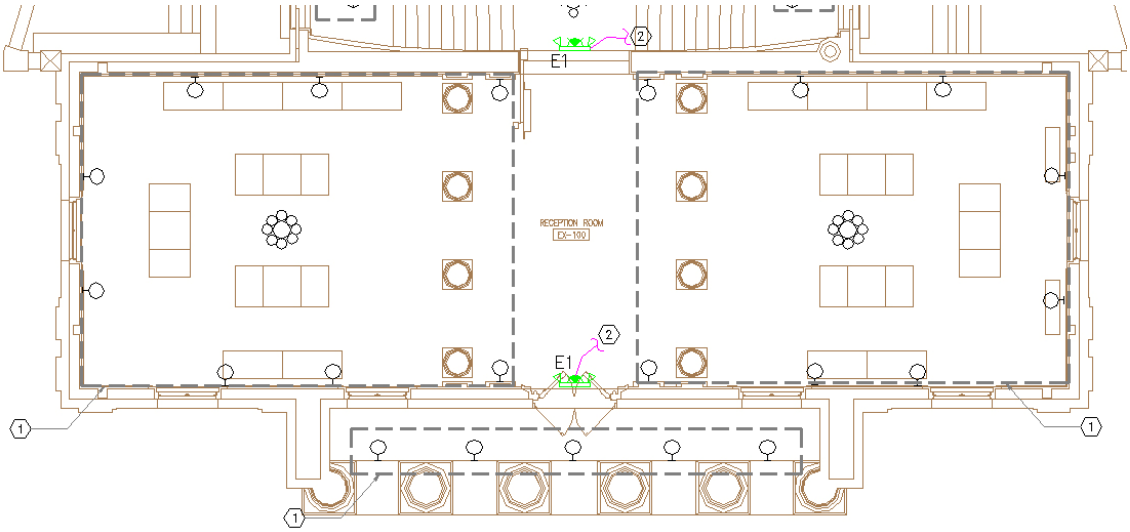
Criteria:

This space is assumed to be categorized as a museum with a subcategory as exhibit cases since the two adjacent rooms which are open to the reception room contain display cases. There also isn't an actual receptionist or a reception desk which would require a different set of design criteria.

- Appearance of spaces and Luminaires: The luminaires should not detract from this space; only emphasize the points of interest in the room.
- Color Appearance: The color rendering should be accurate in this space in order to model the objects in the display cases accurately.
- Daylight Integrations and Control: It is important to design a space with controllable day lighting so the sunlight does not discolor or destroy the objects in the display cases.
- Direct Glare: Direct glare should be avoided in this space so it does not create discomfort or reduce visibility from viewing the objects in the display cases.
- Light Distributions of Surfaces and Task Plane: A uniform distribution of light is required on the surfaces of this space to allow for adequate viewing of the objects on display.
- Luminances of Room Surfaces: Room surfaces should have an appropriate luminance level so they do not distract from the points of interest which are located through out the room.
- Modeling of Faces or Objects: Faces and objects should be modeled realistically in this space so the occupants can identify the object they are looking at or the person they are talking to.

- Points of Interest: This space is filled with points of interest which all need to be illuminated to a point where they stand out from the room and are emphasized.
- Reflected glare: It is important to make sure there is a minimal amount of reflected glare in this space since display cases with glass are used. Having a reflection of the fixtures where in the glass, this would cause a decrease in visibility to the objects inside the glass.
- Shadows: Shadows should be minimized in this space so they do not cause a distraction and take away from the pieces in the display cases.
- Source/Task/Eye Geometry: This should be considered and should play a part in locating and aiming fixtures. If they are aimed in such a way they may be reflected directly into the eye and decrease visibility.
- Sparkle/Desired Reflected Highlights: Reflected highlights may be desired in this space depending on the objects in the cases. In this case, they are honorary medals which would look great if they gleamed in the light. It would increase their eye catching ability and make them stand out even more from the rest of the room.
- Surface Characteristics: Surfaces behind the objects in the cases and the room surfaces should not be of a glossy finish since this would detract from points of interests in the room and create reflected glare causing discomfort while viewing the objects.
- System Control and Flexibility: Control over the lighting system in the space would be very beneficial since each display case could be lit at its own intensity level depending on the types of objects it contains.

Lighting Plan:



Luminaires: Original sconces and chandeliers are being used in this space.

Light Loss Factors:

Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
Chandelier	I	0.9	0.93	1.0	0.92	0.77
Sconce	I	0.9	0.93	1.0	0.92	0.77

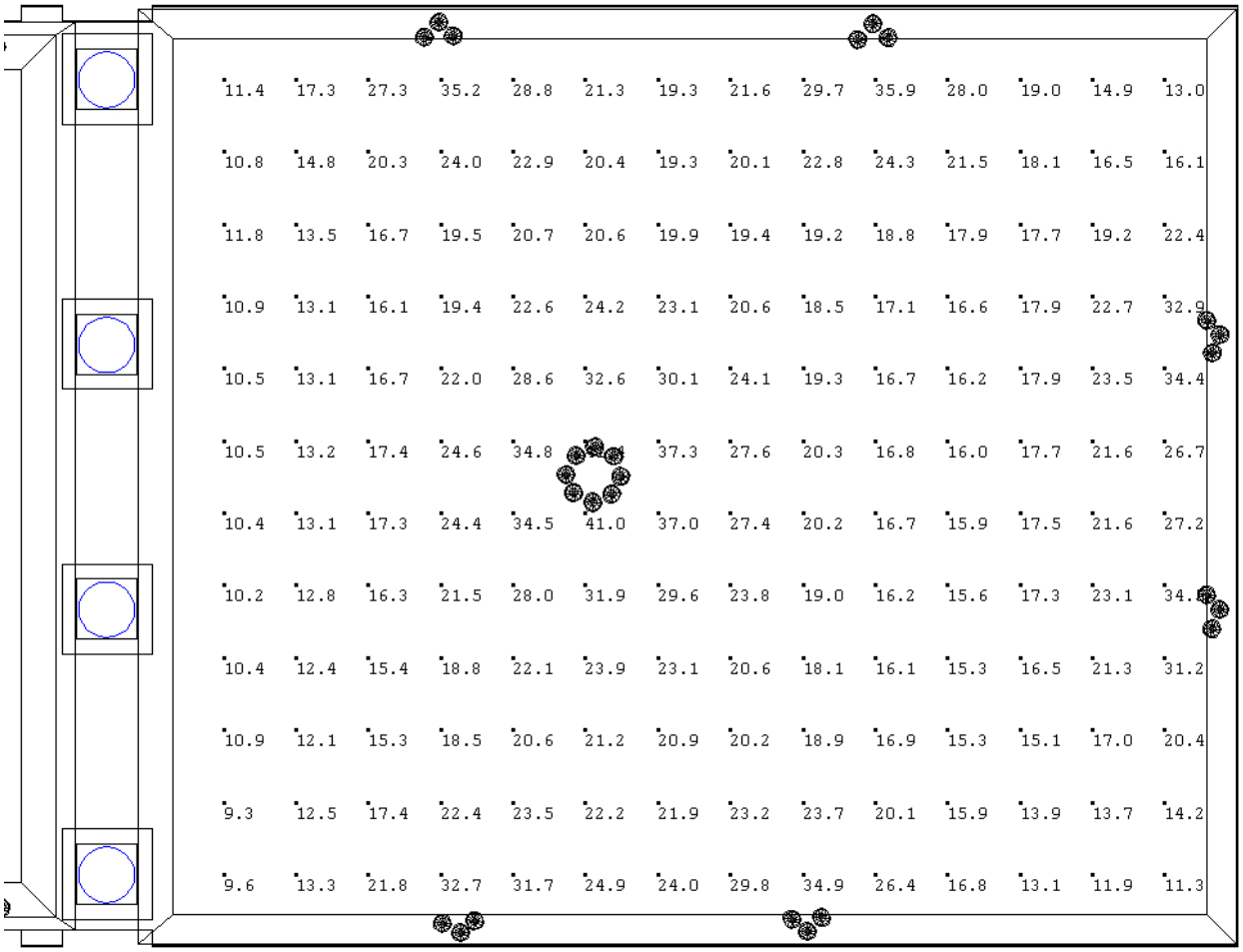
Assumptions:

- 12 month cleaning cycle
- Clean environment
- Work plane at 3'-0"

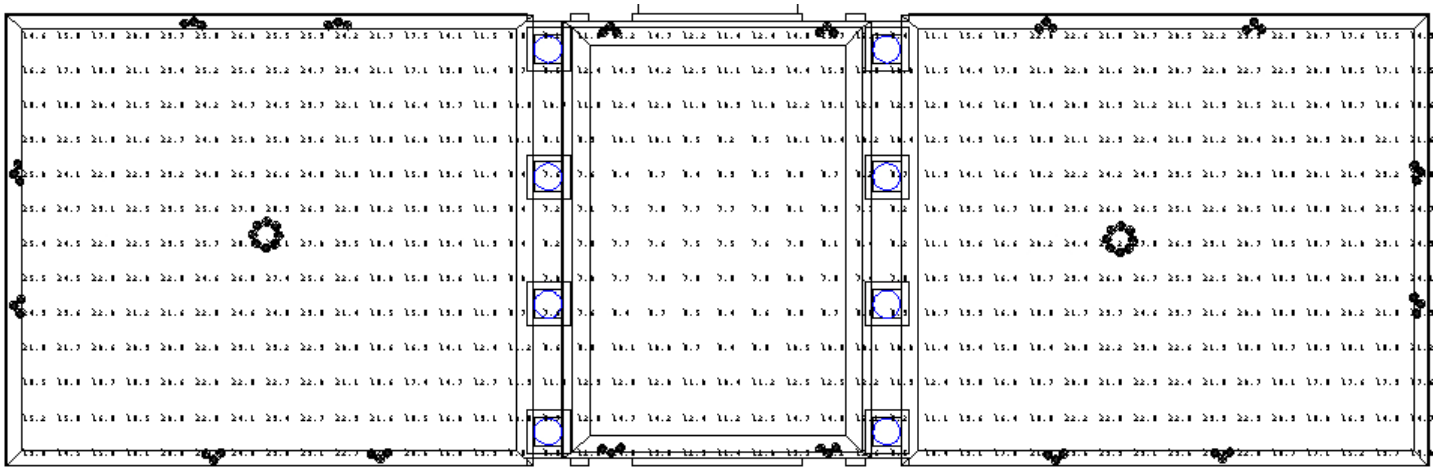
AGI Foot Candle Levels Calculated:

Average Horizontal Illuminance at task plane (3'-0"): 21 fc
Average Horizontal Illuminance on floor: 17 fc

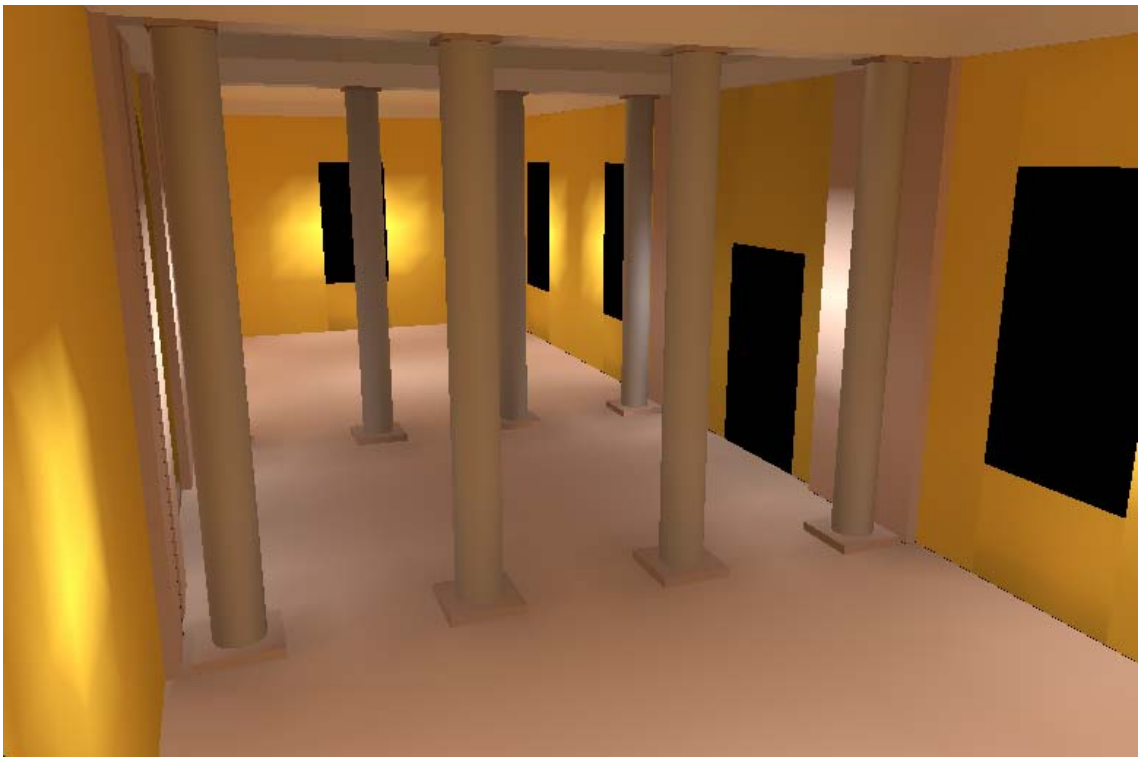
Task Plane Calculation Grid:



Floor Level Calculation Grid:



Renderings:



Wiring/Switching Diagram:

There weren't any wiring or switching diagrams for the reception room since the lighting renovation did not include this space.

Controls:

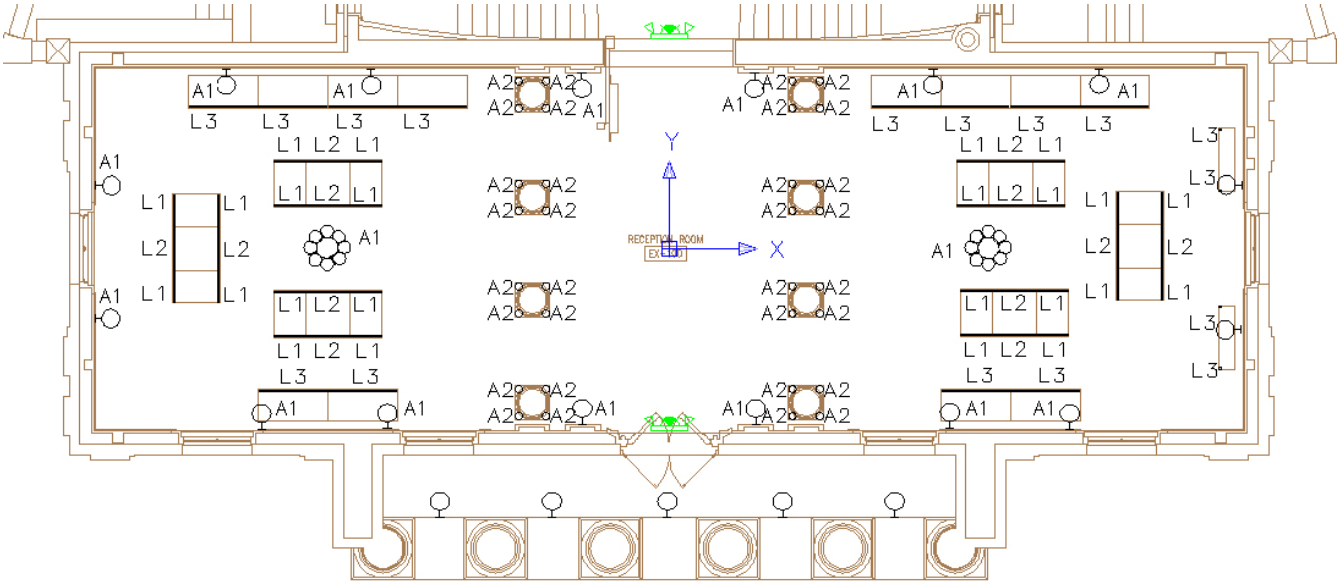
Assuming light switches since the original lighting system is being used in this space.

Schematic Concept

The main design goal for this space is to create hierarchy between the architecture, display cases, and their adjacent surfaces. By adding light fixtures into the display cases, this generates the brightness needed to create interest, thus flowing traffic into the side rooms of the space. Although the artifacts in the display cases, consisting of plaques and medals, are considered to be the least susceptible type of material to be damages by light, LEDs are used in this design since they have a low amount of ultra violet and infrared output. Fiber optics are also known to have a low level of ultra violet and infrared output, so a second design was investigated to see which one would work best for this type of application.

Another goal is to create a more grand entrance. The architecture in this space, in itself, is an artifact on display, with its Roman columns framing the central corridor and the Greek like banister outlining the opening to the above spaces. To emphasize the height of the space, in grade uplights are placed in the footing of the columns creating appoint of interest as the visitors enter into the room. To help increase the noticeable difference between the display cases and their surrounding surfaces but also reinforcing the idea of ancient time, the original chandeliers and sconces were kept and re-lamped with flickering candelabra lamps to mimic a flame.

Lighting Layout:



Luminaire Schedule:

Fixture Schedule													
Type	Description	Catalog Number	Manufacturer	Lamp								Finishes	Mounting
				No.	Type	Watt	Voltage	Color Temp.	CRI	Ave. Life Hrs.	Initial Lumens		
A1	Sconce/Chandalier	Existing Fixture	Philips	1	CandelOb.	3	120	----	----	2,000	50	----	Suface/Pendant
A2	Ingrade	636-75MR16-12-NBR-TP-EYF	Cooper Lighting	1	MR16	71	12	3050	----	6,000	2,000	Brass	Recessed
L1	Display Case (2ft)	O-09-I-3K-NG-1-24-3-1-I	ioLighting	----	LED	12	24/120	3000	----	50,000	254	Aluminum	Surface
L2	Display Case (3ft)	O-09-I-3K-NG-1-24-3-1-I	ioLighting	----	LED	18	24/120	3000	----	50,000	381	Aluminum	Surface
L3	Display Case (4ft)	O-09-I-3K-NG-1-24-3-1-I	ioLighting	----	LED	24	24/120	3000	----	50,000	508	Aluminum	Surface

Light Loss Factors:

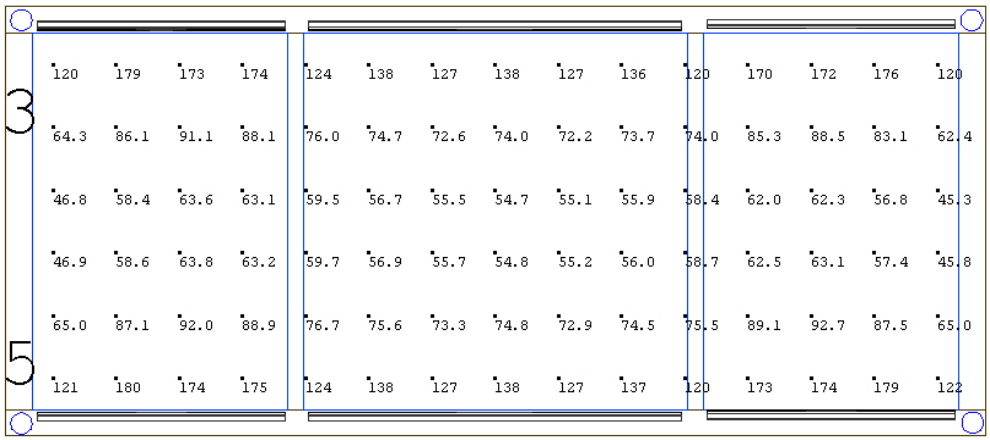
Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
Chandelier (A1)	I	0.9	0.93	1.0	0.92	0.77
Sconce (A1)	I	0.9	0.93	1.0	0.92	0.77
Display Case (L1, L2, L3)	I	0.8	0.93	1.0	0.92	0.68

Assumptions: Clean, 12 month cleaning cycle, RCR: 4.5

Power Density:

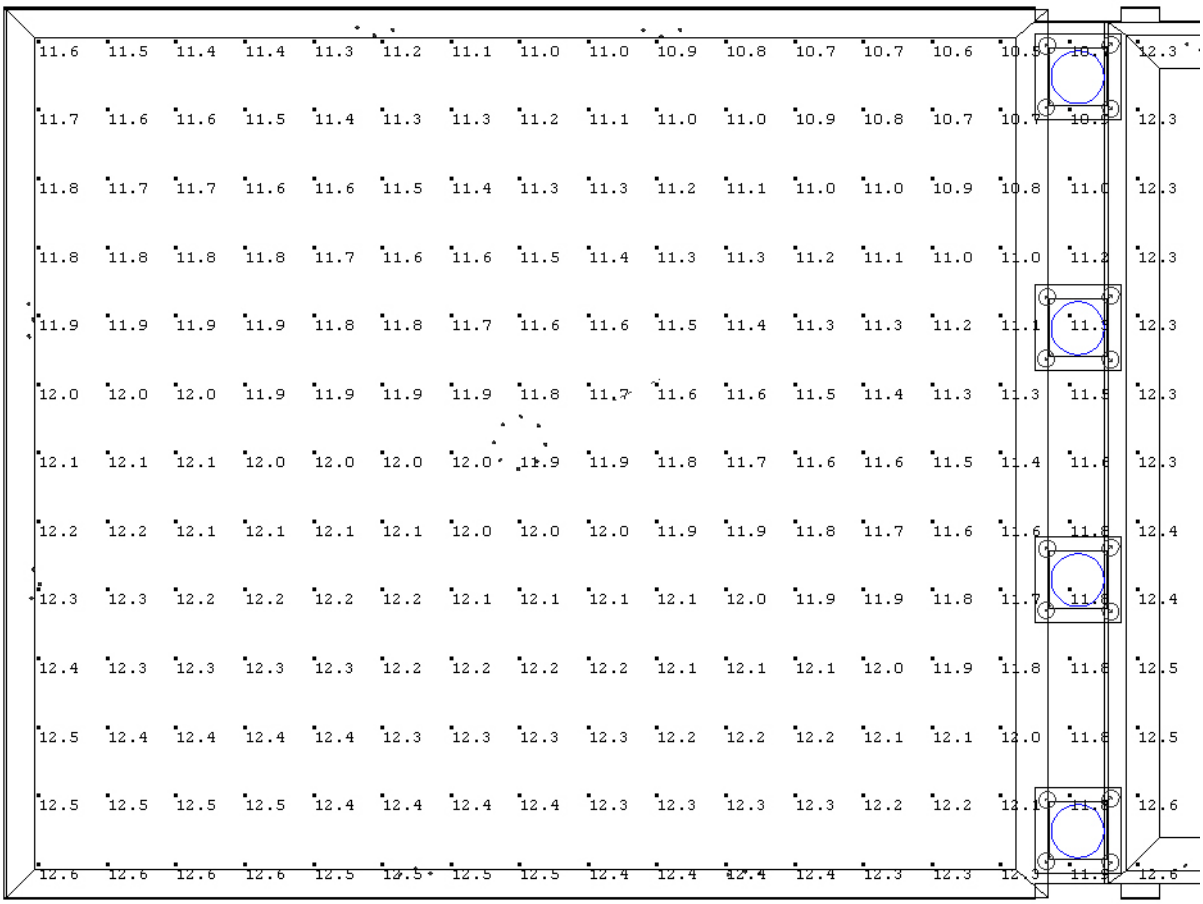
Luminaire	Watts	Lamp Qty	Total Watts	Room Sq.Ft.	Watts/Sq.Ft.	Allowed
Candelabra (A1)	3	106	318	2168.9	0.15	1.3 + 1.0 Accent
Uplight (A2)	75	26	1950		0.90	
Diplay Case (L1, L2, L3)	150	16	2400		1.1	
				Total	2.15	2.3

Typical Display Case Calculation Grid:



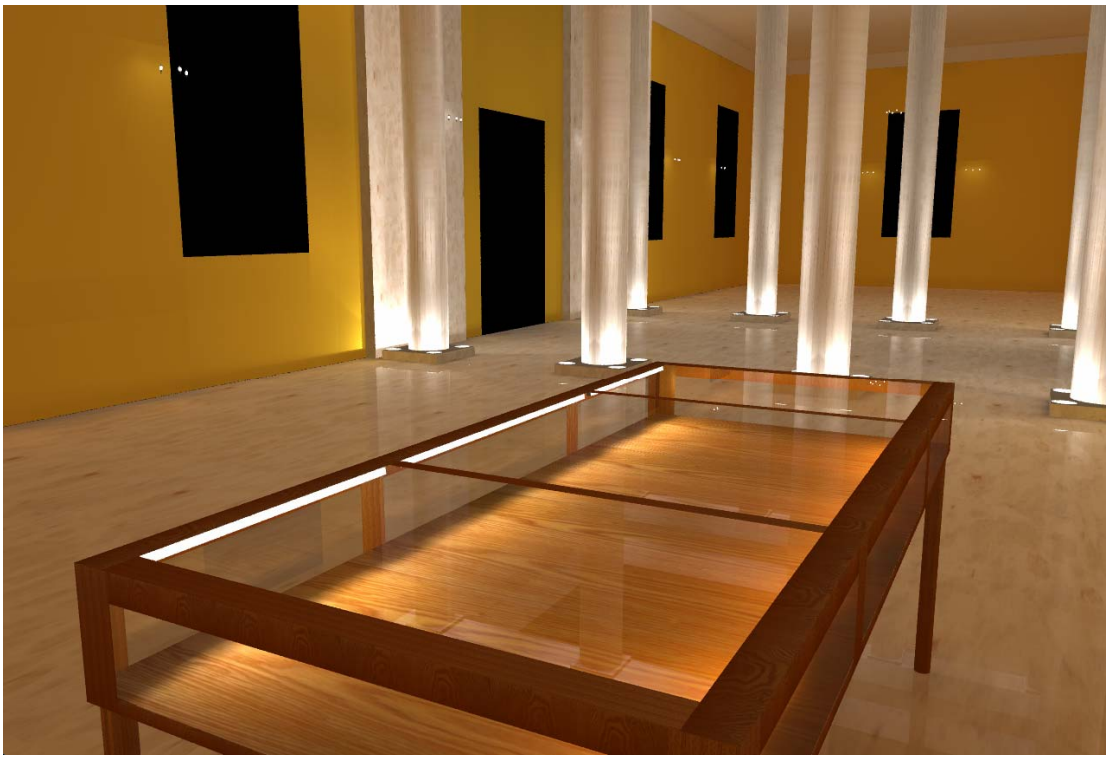
CalcPts
Illuminance Values (Fc)
Average=94.14
Maximum=180
Minimum=45.3
Avg/Min=2.08
Max/Min=3.97

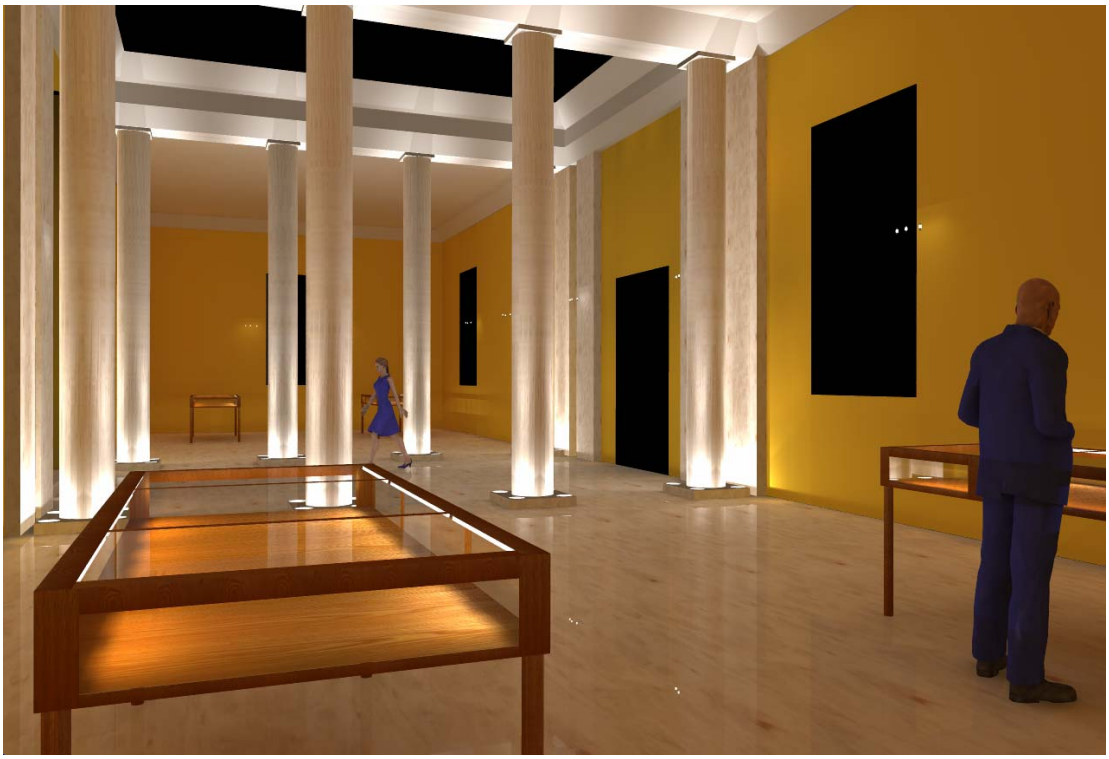
Main Floor Calculation Grid:

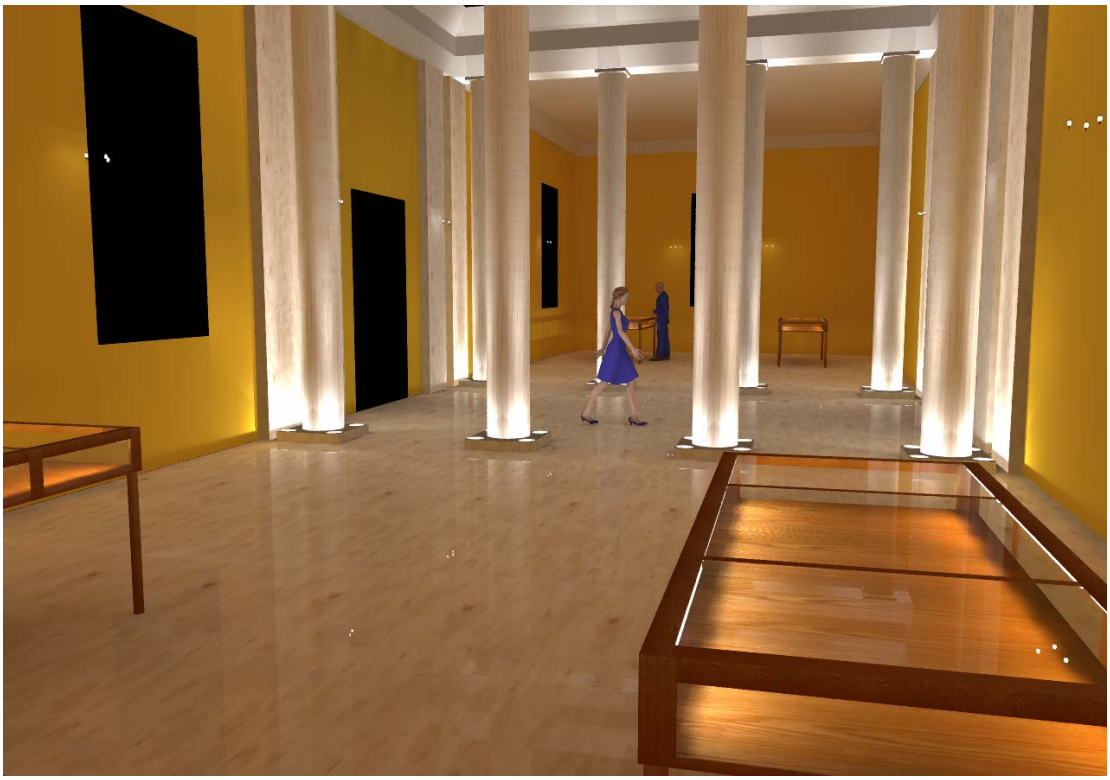


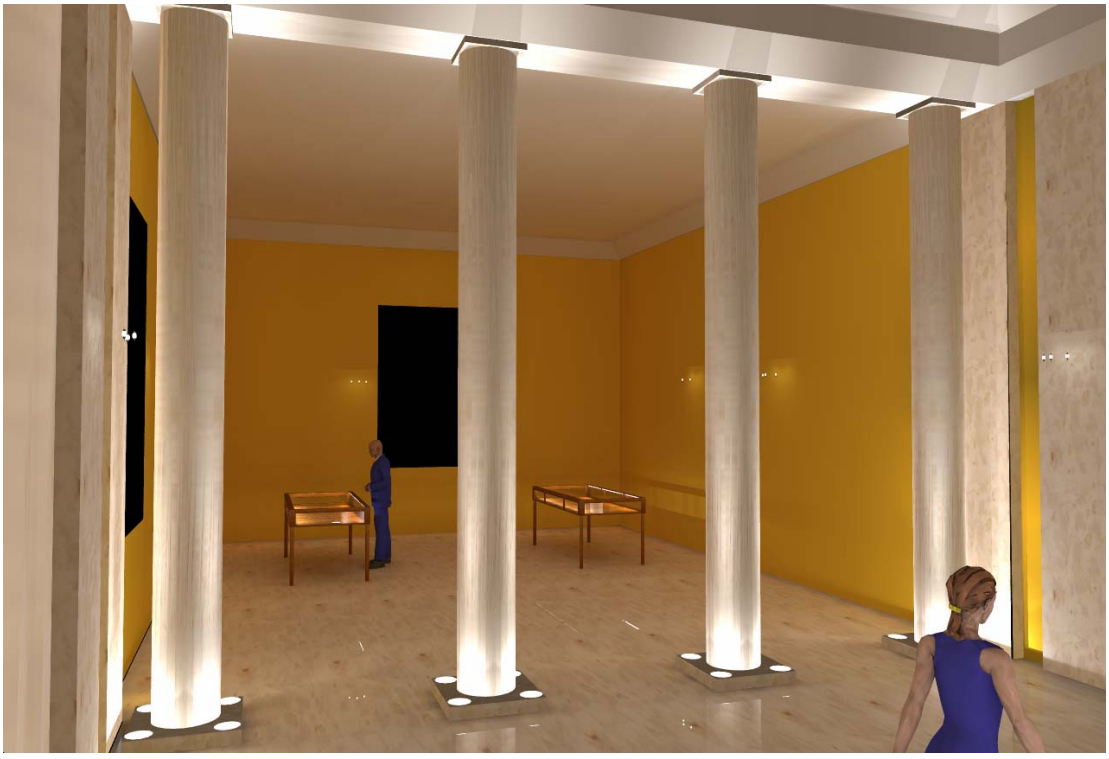
Entrance Floor Calculation Grid:

Renderings:

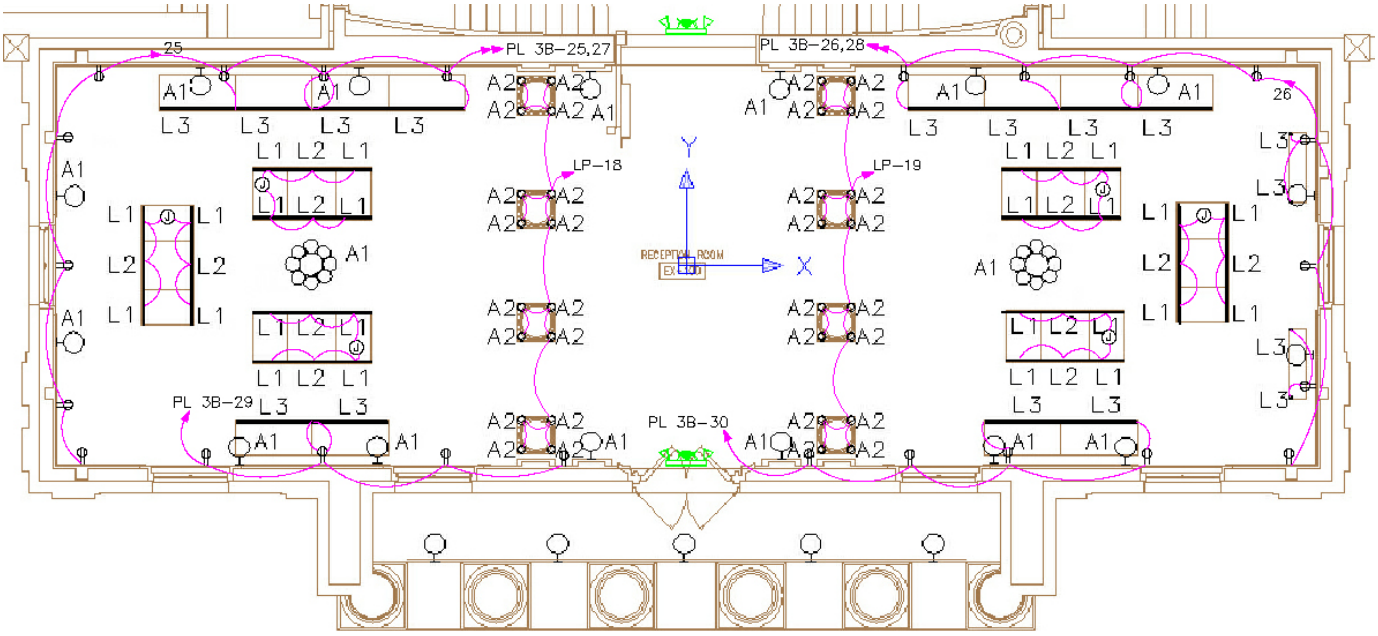








Wiring/Switching Diagram:



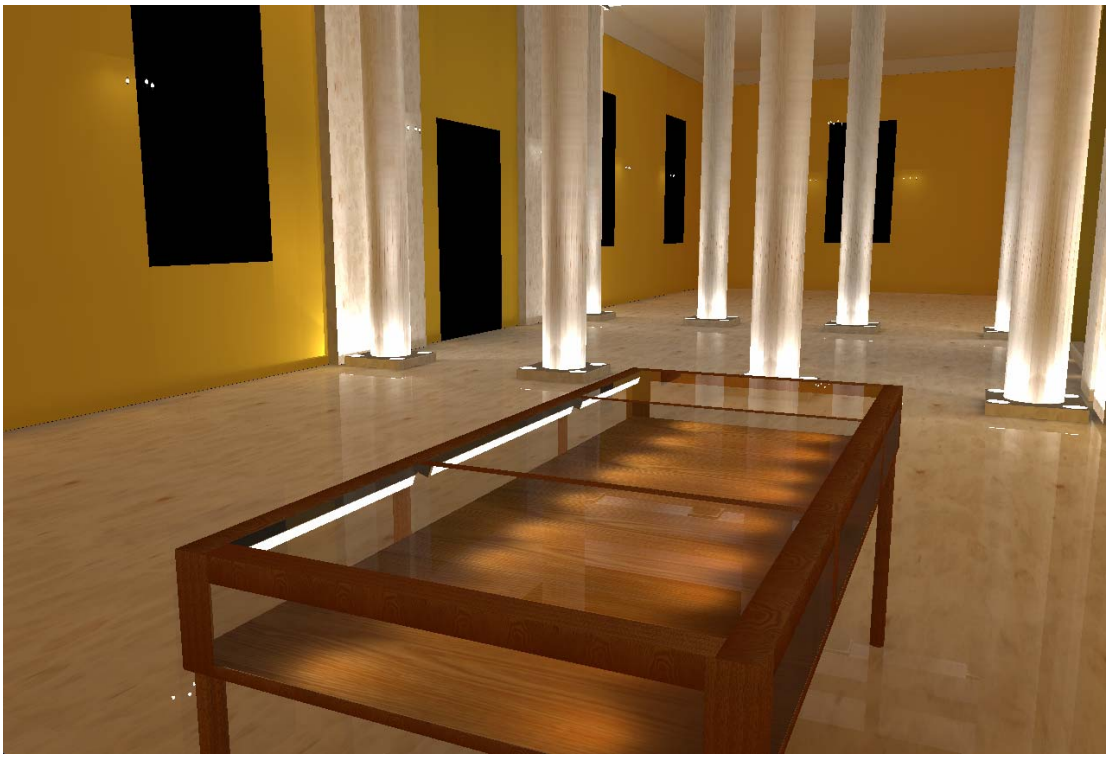
Controls:

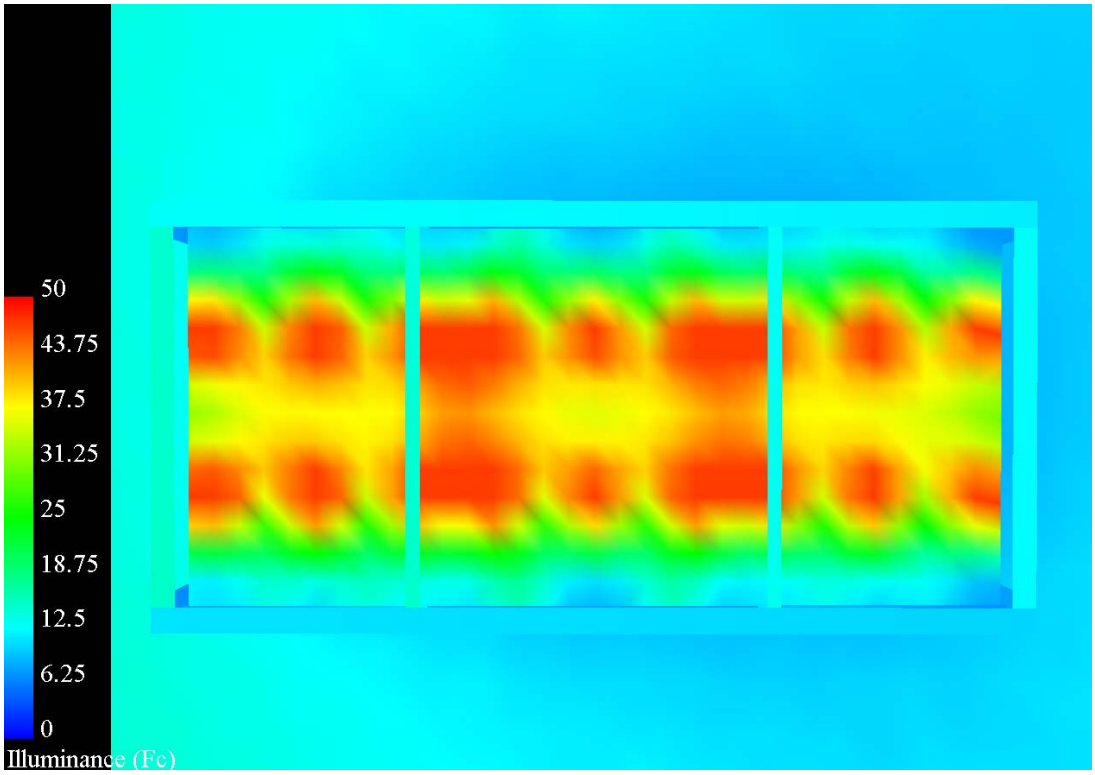
The display case lighting are all plugged into either a wall or floor receptacle. These fixtures are connected to 4 keyed wall switches to eliminate tampering as well as a localized switch located on the underside of each display case to have the ability to turn of individual cases. The chandeliers and sconces are also controlled by keyed wall switches, one for each side room. The uplights on the columns are controlled by a keyed dimmer wall switch to allow for the uplight to be dimmed down in the case of a special event being held in these spaces where lower light levels are desired.

Secondary Lighting Design:

As a second option for lighting the display cases, a fiber optic source was investigated. Fiber optics are also well known for their low ultra violet, infrared, and heat output levels which are a frequent concern when completing a lighting design that incorporates historical artifacts. Required correction factors based on type of illuminator, cable length, intensity level, and fixture length were included in this calculation. The fixture cut sheet is included at the end of the lighting appendix as well as the correction factors that were used.

Renderings:





As shown in the above pseudo rendering, the light output for the fiber optic fixture is much lower than the LED fixture. Although the output creates interest by not being uniform, the ratio level between the bottom of the display case and its surroundings is too small. Ultimately, this would cause the main attraction in the space to be the columns located at the entrance, thus not creating flow into the two side rooms which was the overall main for this space.

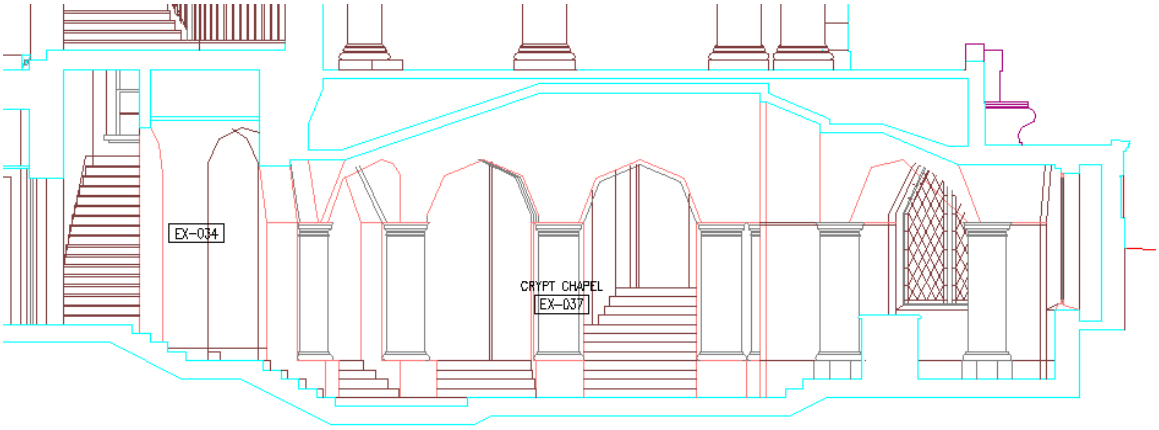
Summary:

The overall lighting design created for this space achieves all design goals. By using the flicker flame candelabra, this decrease the light output as well as decreases the power density in the space. Most importantly, it allows for the display cases to be more prominent. The display cases are at a 5:1 ratio to the ambient lighting in the space, thus creating an interest as well as an attraction to the side rooms which is desired for the space. By selecting the product that was used in this design, it delivers excellent white light output without the damaging ultra violet, infrared, and heat, the traditional light sources, such as halogen and fluorescent, produce. The addition of the uplights on the columns enforces the idea of making the architecture grander. As visitors walk into the space, it automatically draws the occupant's eye up the columns towards the open space above. Then the occupant sees the brightly lit display cases and approaches them through the grand columns. Ultimately, the architecture is on display as well as the honorary awards and medals.

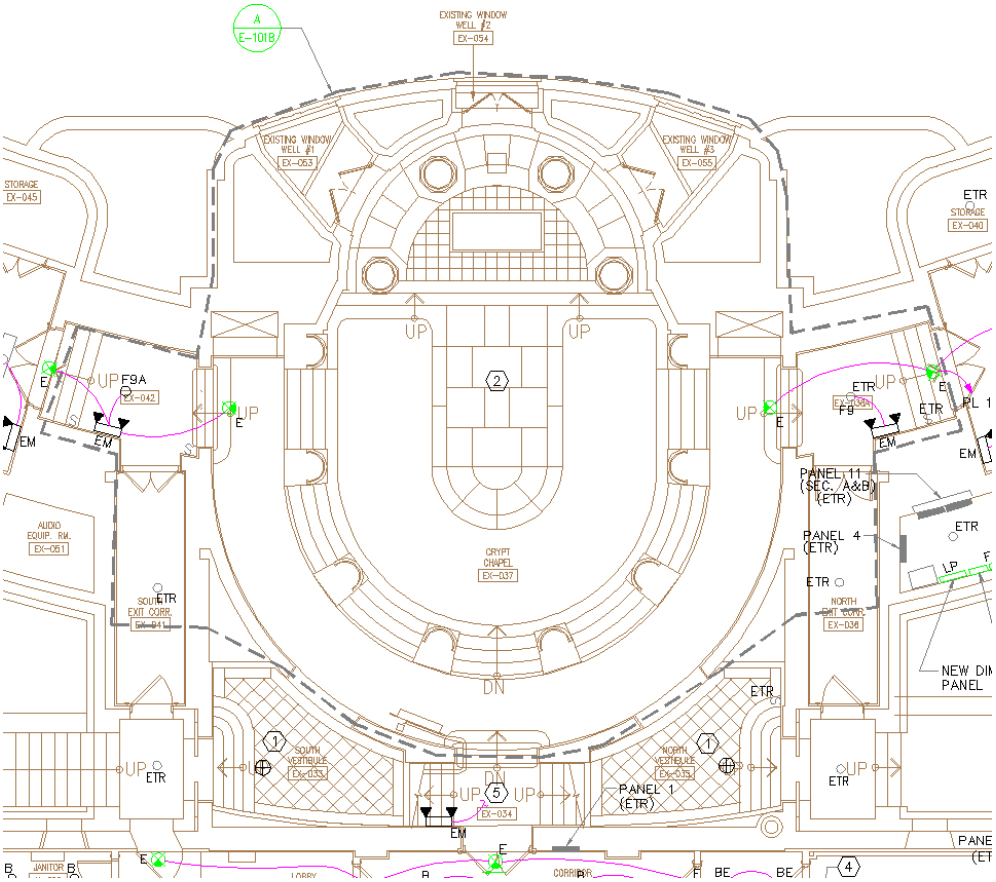
Crypt Chapel

The crypt chapel is located in the basement just down the hall from the tomb guards' quarters. This space is used by the guards during their shift breaks. The space is broken up into three different spaces: the entrances, the chapel perimeter corridor, and the crypt chapel itself. This space is not used for congregational settings, but for intimate and quiet occasions with God. The overall design concept for this space is to create a place to be one with God.

Section Looking West:



Floor Plan:



Space Properties:

Floor:

Material: Marble
Color: Dirty White
Reflectance: 0.61

Material: Carpet
Color: Atlas Carpet Mills Inc. Sorbonne 38 #BN26 Gold Maize
Reflectance: 0.1

Walls:

Material: Plaster
Paint color: White
Reflectance: 0.50

Ceiling:

Material: Cork
Paint color: White
Reflectance: 0.70

Furnishings:

- Stone alter located at the front of the chapel.

Design Criteria:

Tasks:

- Praying
- Conversing
- Reading

Illuminances:

- $E_{v(face)}$ Category D-30fc

Criteria:

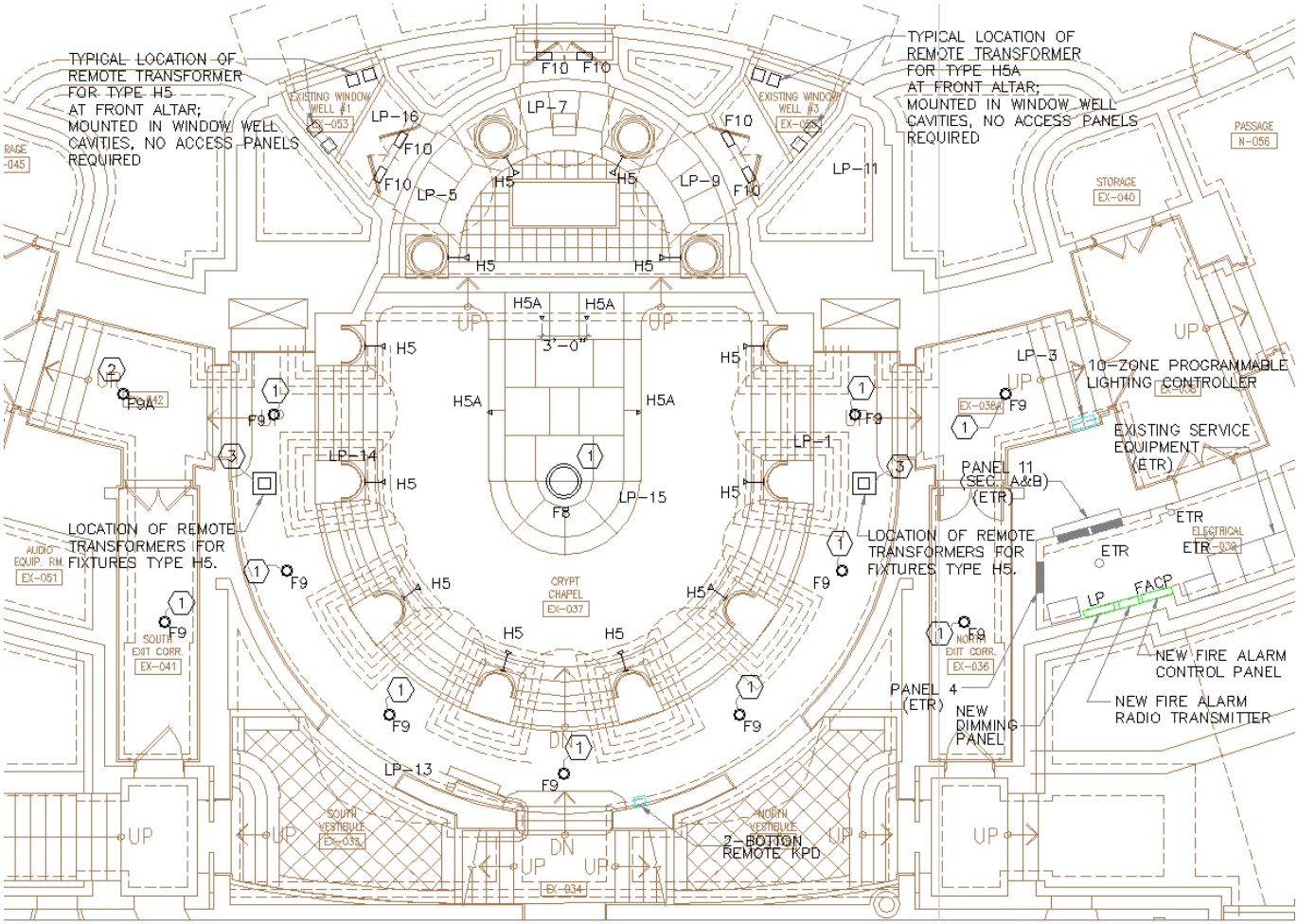
This area is characterized as a House of Worship with a subcategory of Highlighted Items since there is no congregational seating.

- Appearance of Space and Luminaires: In this case where the space is a chapel, the appearance of the space and luminaires is important. The space needs to create a certain mode for its occupants and highlights need to be given to the important objects in the room.

- Color Appearance: Again, this space is trying to create a certain mood, so the color rendering needs to be accurate so the space is portrayed correctly.
- Direct Glare: Direct glare from the light fixtures should be avoided because it decreases the visibility rate, distracts from the space, and creates discomfort.
- Flicker: It is important in this space not have flickering lights because the flickering will distract the occupants from what they came to do and will take away from the ambiance of the space.
- Modeling of Faces or Objects: This criterion is important because depending on the mood of this space, the modeling of faces or objects could be good or bad. This space might want to create a dark and secluded atmosphere which would require a darker feeling with shadows. On another hand, the space might have a welcoming and comfortable atmosphere which would require more light and less shadows.
- Points of interest: The most important criteria would be points of interest. This space requires a lot of emphasis on certain features and details which create the spaces atmosphere.

Existing Conditions

Lighting Plan:



Luminaries:

LIGHTING FIXTURE SCHEDULE (CRYPT CHAPEL)

LIGHTING FIXTURE SCHEDULE

TYPE	MTG	DESCRIPTION	LAMPING	WATT	VOLT	MFR.	CATALOGUE NO.
F8	PEND	REFER TO RESTORATION NOTES	(12) 60B10 ½ 14M	760	120	WINONA (WINONA, MN) CRENSHAW LIGHTING (FLOYD, VA) CUSTOM METALCRAFT, INC. (CHARLESTOWN, MA)	CLEAN AND RELAMP EXISTING CHANDELIER
F9	SURF	REFER TO RESTORATION NOTES	(4) 40G16 ½ C/4M	160	120	WINONA (WINONA, MN) CRENSHAW LIGHTING (FLOYD, VA) CUSTOM METALCRAFT, INC. (CHARLESTOWN, MA)	CLEAN AND RELAMP EXISTING CHANDELIER
F9A	SURF	CONTRACTOR TO MATCH NEW ROSETTE TO EXISTING TYPE F9	(4) 40G16 ½ C/4M	160	120	WINONA ALGER UNILIGHT	NEW ROSETTE TO MATCH EXISTING TYPE F9
F10	SURF	HALOGEN UPLIGHT LUMINAIRE, NOMINAL 12 INCH WIDE X 5 INCH HIGH ALUMINUM HOUSING WITH 7 INCH PROJECTION FROM WALL, SOLID ALUMINUM VISOR, ALUMINUM CANOPY NOMINAL 5 INCH DIAMETER, EXTRUDED CLEAR ANODIZED ALUMINUM REFLECTOR WITH ASYMMETRICAL DISTRIBUTION, TEMPERED GLASS LENS, OVERALL WHITE PAINT FINISH.	1-250Q/CL/DC	250	120	ELLIPTIPAR WINONA SPI	T102-0250-E-02-A-VO
H5	SURF	LOW VOLTAGE ACCENT LIGHT, NOMINAL 12 INCH LONG METAL STEM WITH LAMPHOLDER, BACKLIGHT SHIELD WITH LOUVER ACCESSORY HOLDER, SOFT FOCUS SPREAD LENS AND EGGCRATE LOUVER, STEM MOUNTS DIRECTLY TO NOMINAL 2 INCH SQUARE WALL CANOPY, OVERALL CHROME FINISH, REMOTE TRANSFORMER, 3 ½ INCH DEEP ELECTRICAL BACK BOX, CANOPY MOUNTING DETAIL AND EXACT LOCATION OF CANOPY TO BE COORDINATED WITH DESIGN PROFESSIONAL.	1-50MRC16/CC/ NFL24°	50	120	TECH LIGHTING	700DJWAL12C-700DJ2SQ6-REMOTE TRANSFORMER- STANDARD 3-1/2 INCH DEEP ELECTRICAL BACK BOX - 700A02BK;140MR16SF;700MR16SCH
H5A	SURF	LOW VOLTAGE ACCENT LIGHT, NOMINAL 6 INCH LONG METAL STEM WITH LAMPHOLDER, BACKLIGHT SHIELD WITH LOUVER ACCESSORY HOLDER, SOFT FOCUS SPREAD LENS AND EGGCRATE LOUVER, STEM MOUNTS DIRECTLY TO NOMINAL 2 INCH SQUARE CEILING CANOPY, OVERALL CHROME FINISH, REMOTE TRANSFORMER, 3 ½ INCH DEEP ELECTRICAL BACK BOX, CANOPY MOUNTING DETAIL AND EXACT LOCATION OF CANOPY TO BE COORDINATED WITH DESIGN PROFESSIONAL.	1-50MRC16/CC/ NFL24°	50	120	TECH LIGHTING	700JS2C-067C-700FJ2SQ67-C-REMOTE TRANSFORMER - STANDARD 3-1/2 INCH DEEP ELECTRICAL BACK BOX - 700A02BK;140MR16SF;700MR16SCH

Lumen Method Calculation

Job Name	Arlington National Cemetary	**Initials**	tad
Room Description	Crypt Chapel - Scheme A+B - Window Lighting	**Date**	25-Aug-04

♦ **Fixture & Lamp Information**

A. Manufacturer & Catalog No.		Elliptipar	T102	
B. Lamp Identification		250Q/CL/DC	250	Watts
C. Initial Lumens per lamp		5000		
D. No. of lamps per fixture		1		
E. Total per Fixture	Lumens	5000	250	Watts
F. Total Lighting System	Fixture Qty	6	1500	Watts

♦ **Room Data**

Length (ft.)	48	Ceiling Reflectance:	70%
Width (ft.)	43	Walls Reflectance:	50%
Room Area	2064	Floor Reflectance:	10%

Mounting Ht:	4		
Work Plane Ht:	2.5	Room Cavity Ht:	1.5

♦ **Room Cavity Ratio:**	0.3
♦ **Coefficient of Utilization:**	0.50
♦ **Light Loss Factor:**	65%
♦ **Watts per Square Foot:**	0.7
♦ **Footcandles:**	**4.72**

Lumen Method Calculation

Job Name	Arlington National Cemetary	**Initials**	tad
Room Description	Crypt Chapel - Scheme A	**Date**	25-Aug-04

♦ **Fixture & Lamp Information**

A.	Manufacturer & Catalog No.		Tech Lighting	700DJGRGC	
B.	Lamp Identification		GE 50W MR/C/FL	50	Watts
C.	Initial Lumens per lamp		1080		
D.	No. of lamps per fixture		1		
E.	Total per Fixture	Lumens	1080	50	Watts
F.	Total Lighting System	Fixture Qty	16	800	Watts

♦ **Room Data**

Length (ft.)	48	Ceiling Reflectance:	70%
Width (ft.)	43	Walls Reflectance:	50%
Room Area	2064	Floor Reflectance:	10%
Mounting Ht:	16		
Work Plane Ht:	2.5	Room Cavity Ht:	13.5

♦ **Room Cavity Ratio:** 3.0

♦ **Coefficient of Utilization:** 0.60

d

♦ **Light Loss Factor:** 80%

♦ **Watts per Square Foot:** 0.4

♦ **Footcandles:** **4.02**

Lumen Method Calculation

Job Name	Arlington National Cemetary	**Initials**	tad
Room Description	Crypt Chapel - Scheme B	**Date**	25-Aug-04

♦ **Fixture & Lamp Information**

A. Manufacturer & Catalog No.		Fiberstars	FS11/MBF	
B. Lamp Identification		71W MR16	70	Watts
C. Initial Lumens per lamp		1200		
D. No. of lamps per fixture		1		
E. Total per Fixture	Lumens	1200	70	Watts
F. Total Lighting System	Fixture Qty	16	1120	Watts

♦ **Room Data**

Length (ft.)	48	Ceiling Reflectance:	70%
Width (ft.)	43	Walls Reflectance:	50%
Room Area	2064	Floor Reflectance:	10%
Mounting Ht:	16		
Work Plane Ht:	2.5	Room Cavity Ht:	13.5

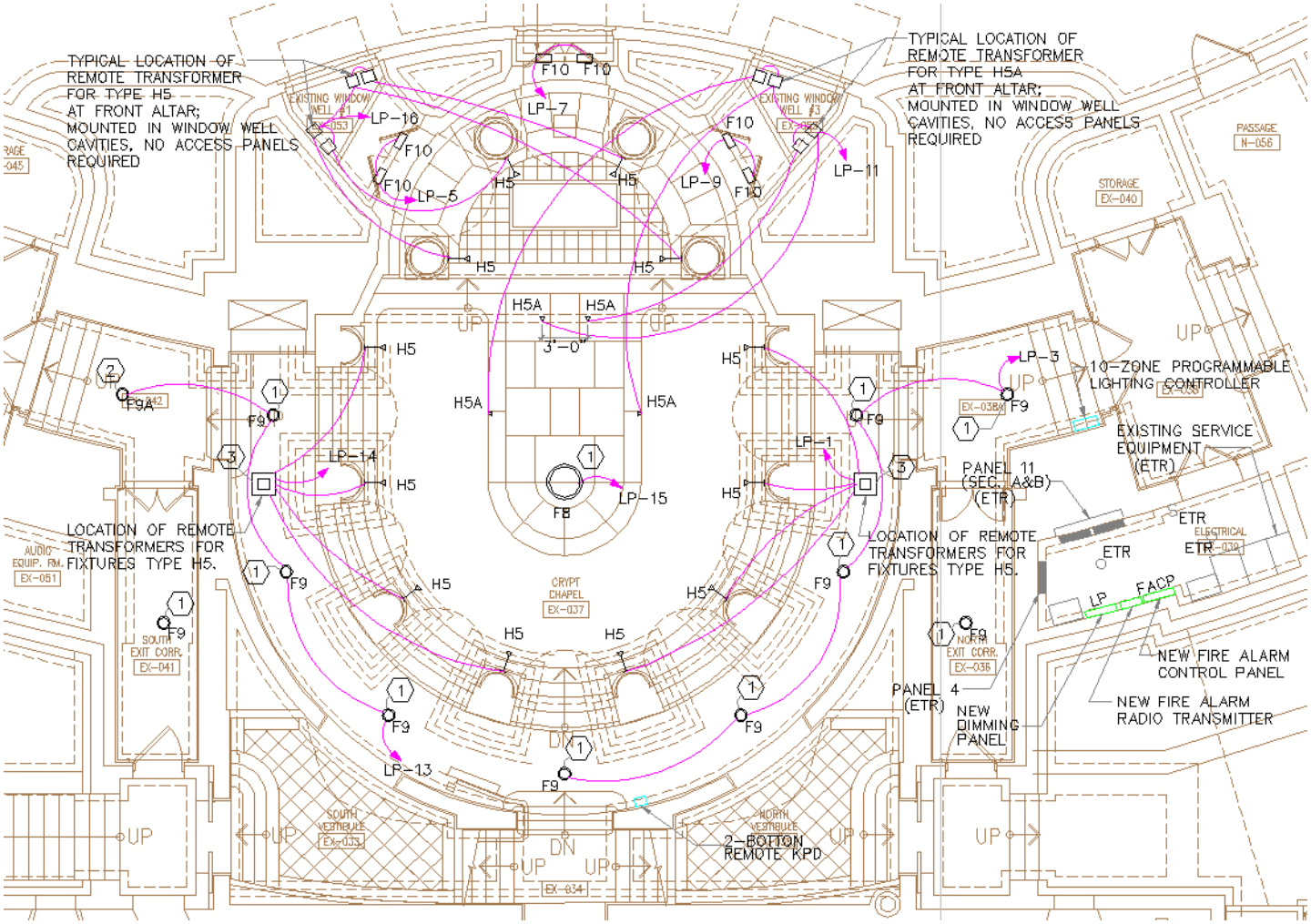
♦ **Room Cavity Ratio:** 3.0

♦ **Coefficient of Utilization:** 0.40

♦ **Light Loss Factor:** 70%

♦ **Watts per Square Foot:** 0.5

♦ **Footcandles:** **2.60**



Controls:

The lights in this space are controlled by a Lutron Grafik Eye 4000 system which is wired through a 24 circuit dimming panel located in the electrical room. This Grafik Eye system is located in the front right stair well of the chapel and has the option for 10 zones. There is an on/off remote control station which is also located at the rear of the chapel near the stairs from the 1st floor.

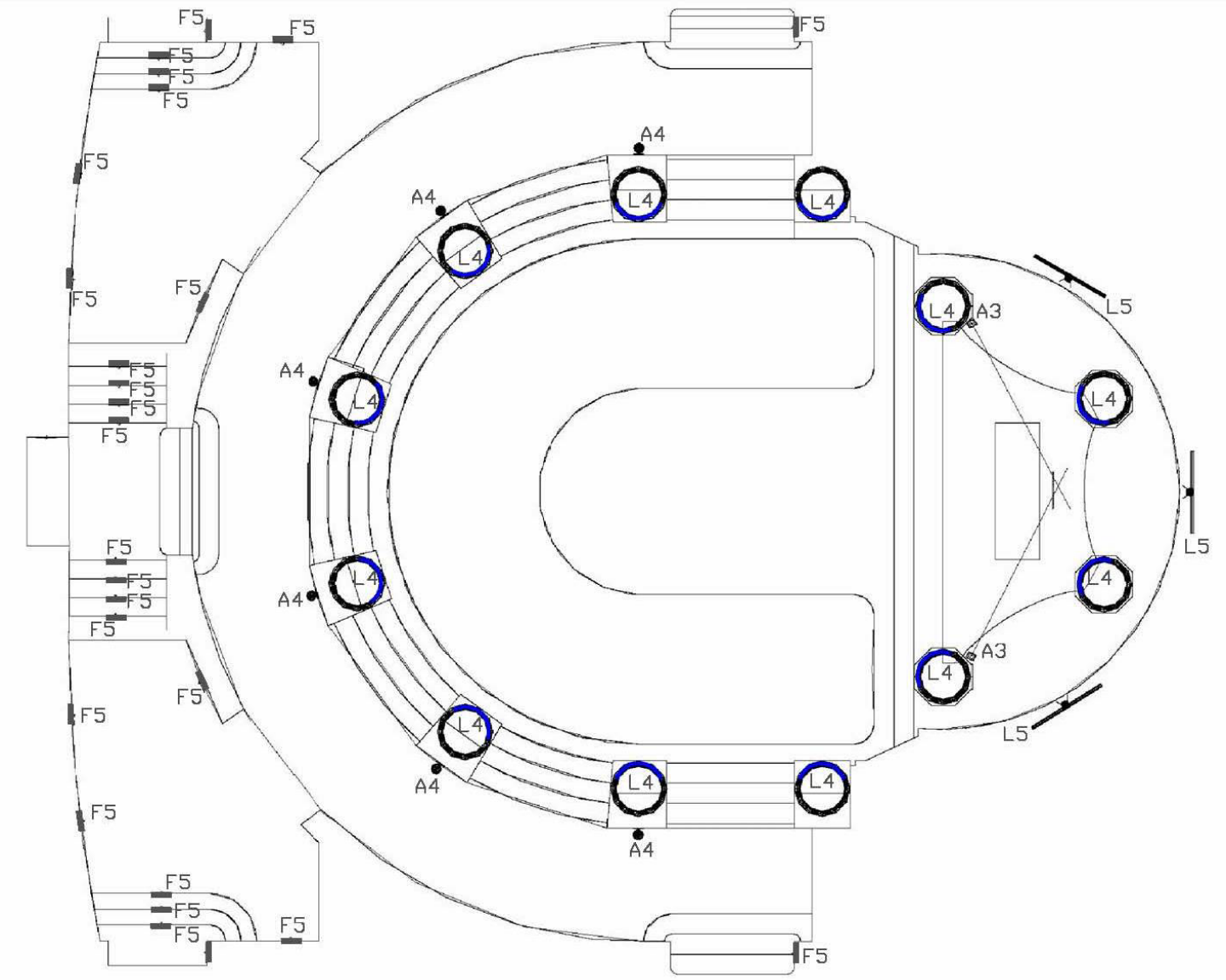
Schematic Design

The overall design idea that was developed for this space was to create a breath taking experience for the occupants as they enter the chapel area. To do this, the entrance floors were illuminated only, then the corridor around the chapel area was illuminated by direct sconces, then the chapel area was indirectly illuminated to create a grand ceiling.

By lighting the floors only in the entrance areas, this causes the people entering the space to become quiet and directs their attention to the floor. Then by lighting the lower half of the wall only in the corridor around the chapel, this draws the attention to eye level. Finally, as they enter the main chapel space, their eyes continue to move upward for them to take in the masterpiece of the ceiling's architecture. By having the eye flow from low to high, it creates a even grander appearance of the ceiling in the chapel. By lighting the ceiling, it creates the feeling of the sky being directly above and causes the occupants to forget they are in the basement of a building, thus making feeling as if they can make more of a connection with God.

After the first breath taking site, the eye is then drawn down to the front of the space. To draw the occupant's attention to the front of the space, where an angel statue and alter reside, spot lights were aimed at the angels face and wall mounted uplights were placed outside the stain glass to back light the glass.

Lighting Layout:



Lighting Fixture Schedule:

Fixture Schedule													
Type	Description	Catalog Number	Manufacturer	Lamp								Finishes	Mounting
				No.	Type	Watt	Voltage	Color Temp.	CRI	Ave. Life Hrs.	Initial Lumens		
A3	Spot	US49314	Targetti	1	MR16	50	12	3050	----	6,000	3200	Die cast aluminum	Mono Point
A4	Sconce	700TDECS-C-S	2 Thousand Degrees	1	A19	75	120	2700	100	750	1180	Satin nickel	Surface
F5	Step Light	2216P	Bega	1	CF	13	120	2700	82	10,000	810	Stainless steel	Recessed
L4	Click Strip	AV-2.4-LWW-MC-AR	Tokistar Lighting	10	LED	7.2	24	2400	----	30,000	80	White plastic	Surface
L5	Projector	ML6-41-0-1-10SD-1-4	Exterieur Vert	48	LED	70.84	24	2400	----	50,000	1800	Grey	Surface

Light Loss Factors:

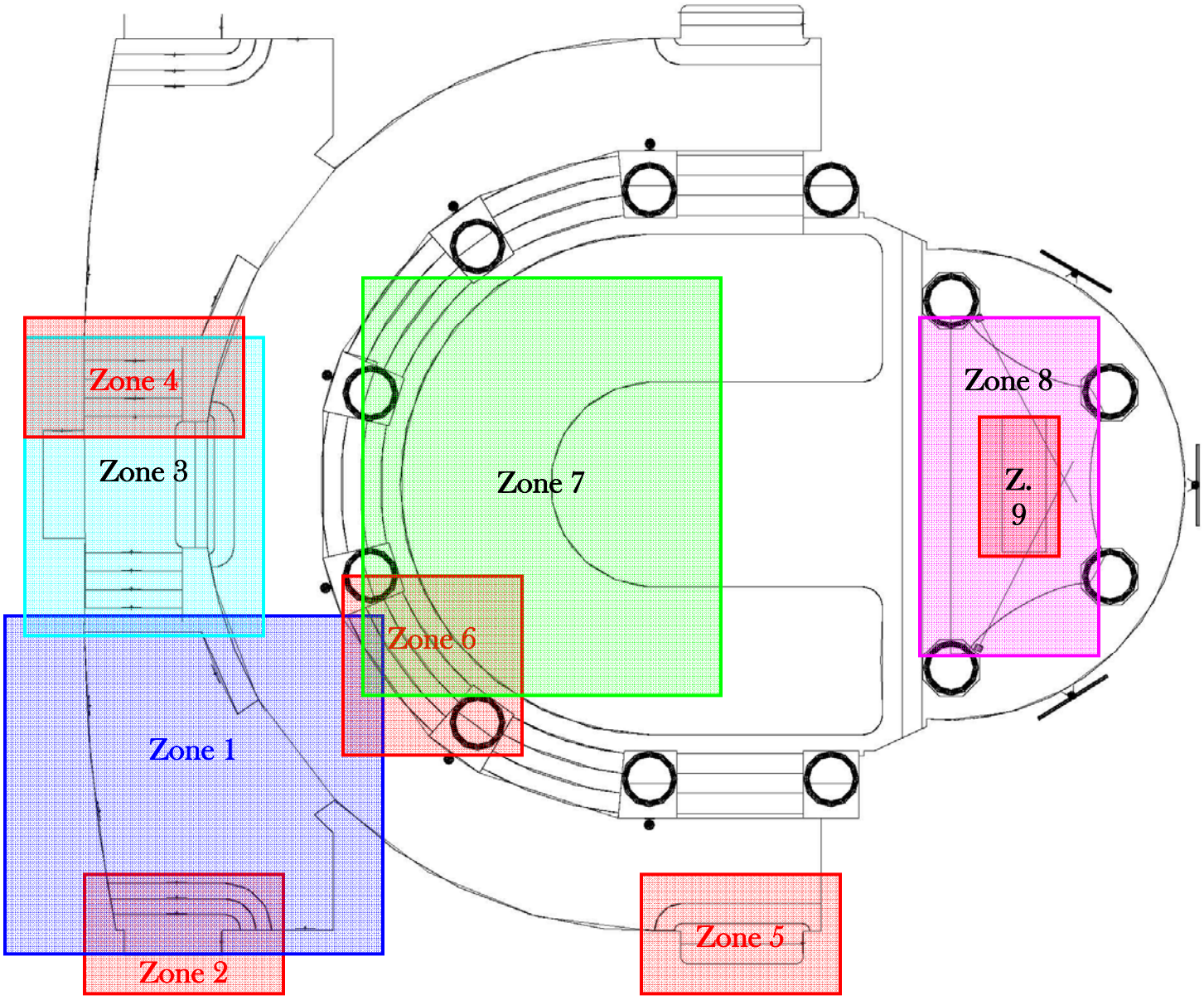
Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
Spot (A3)	VI	0.93	0.85	1.0	0.92	0.73
Sconce (A4)	I	0.95	0.93	1.0	0.92	0.81
Step Light (L6)	VI	0.8	0.85	1.0	0.92	.63
Click Strip (L4)	I	0.8	0.93	1.0	0.98	0.73
Projector (L5)	VI	0.8	0.85	1.0	0.98	0.66

Assumptions: Clean, 12 month cleaning cycle, **RCR:** 3.5

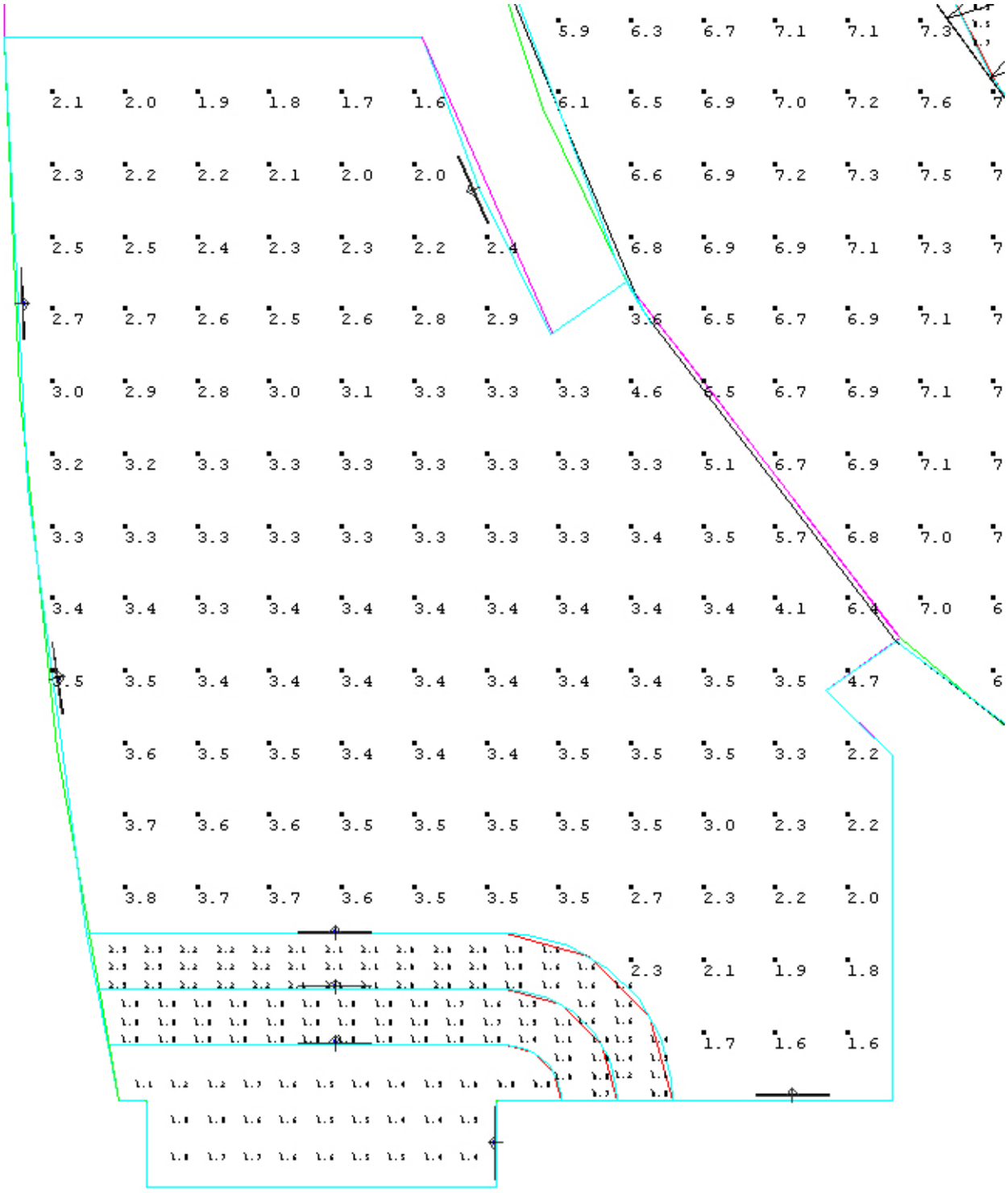
Power Density:

Luminaire	Watts	Lamp Qty	Total Watts	Room Sq.Ft.	Watts/Sq.Ft.	Allowed
Spot (A3)	50	2	100	2400.75	0.04	1.3 + 1.0 Accent
Sconce (A4)	75	6	450		0.187	
Step Light (L6)	13	27	351		0.146	
Click Strip (L4)	7.2	12	86.4		0.036	
Projector (L5)	70.84	3	212.5		0.089	
				Total	0.5	2.3

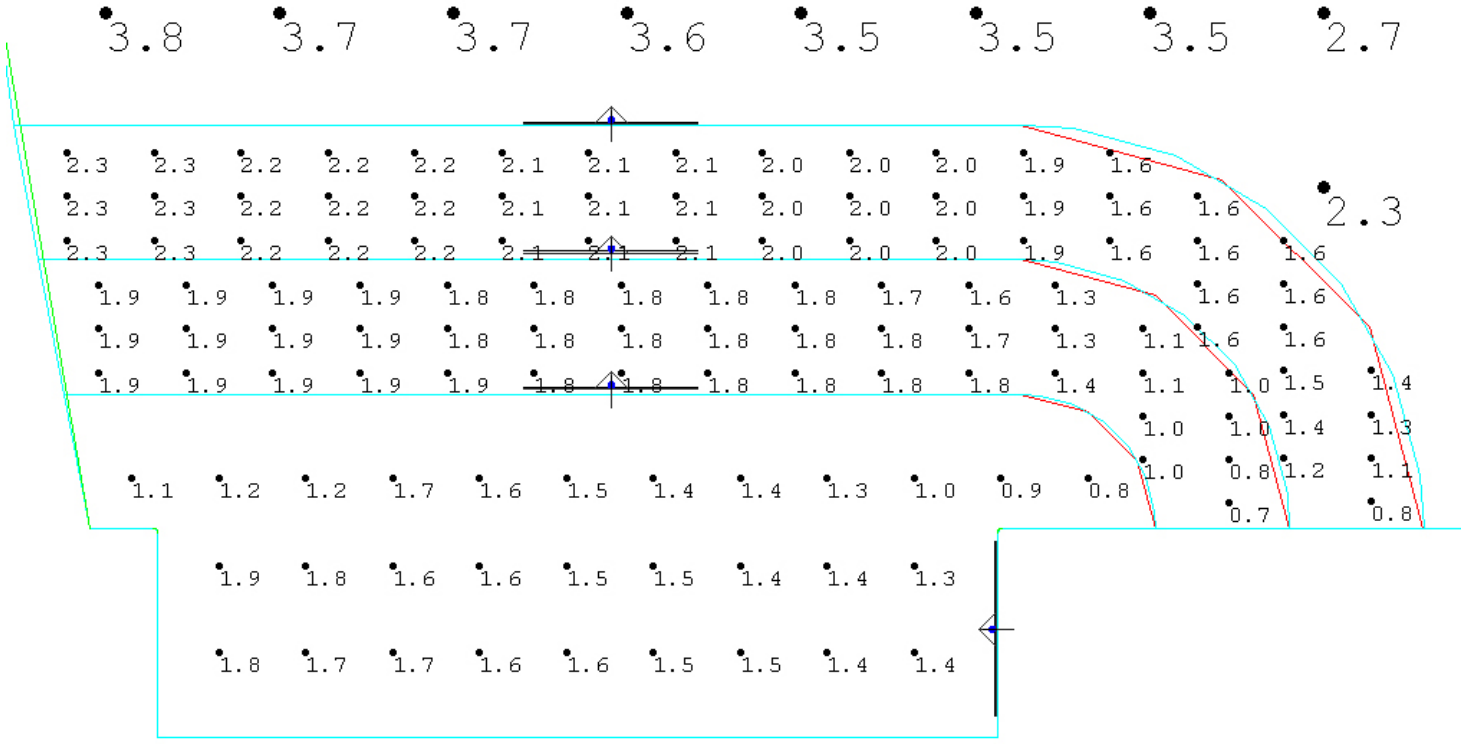
Calculation Points:



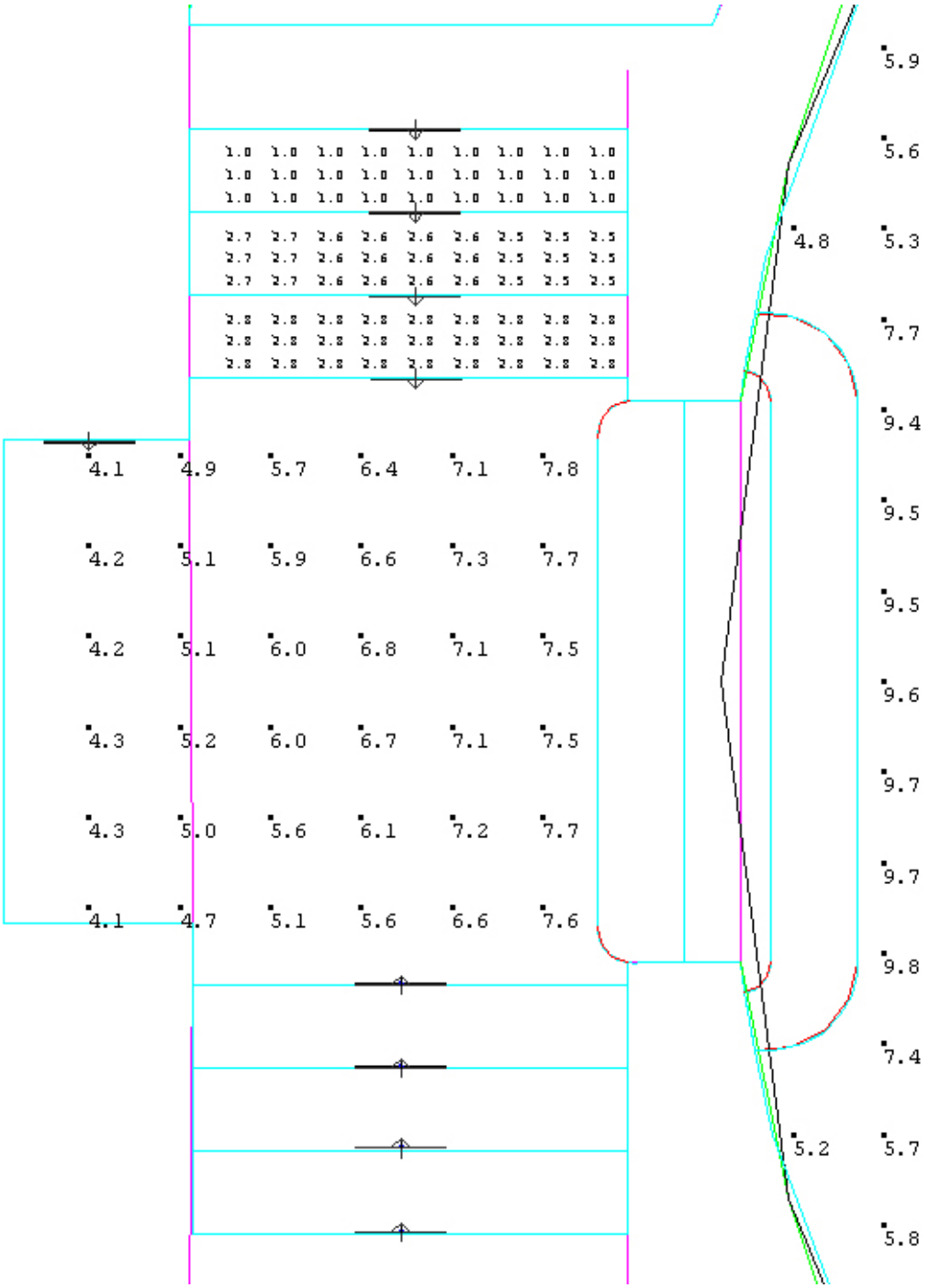
Zone 1


5.9 6.3 6.7 7.1 7.1 7.3
2.1 2.0 1.9 1.8 1.7 1.6 6.1 6.5 6.9 7.0 7.2 7.6 7
2.3 2.2 2.2 2.1 2.0 2.0 6.6 6.9 7.2 7.3 7.5 7
2.5 2.5 2.4 2.3 2.3 2.2 2.4 6.8 6.9 6.9 7.1 7.3 7
2.7 2.7 2.6 2.5 2.6 2.8 2.9 3.6 6.5 6.7 6.9 7.1 7
3.0 2.9 2.8 3.0 3.1 3.3 3.3 3.3 4.6 6.5 6.7 6.9 7.1 7
3.2 3.2 3.3 3.3 3.3 3.3 3.3 3.3 3.3 5.1 6.7 6.9 7.1 7
3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.4 3.5 5.7 6.8 7.0 7
3.4 3.4 3.3 3.4 3.4 3.4 3.4 3.4 3.4 3.4 4.1 6.4 7.0 6
3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4 3.4 3.5 3.5 4.7 6
3.6 3.5 3.5 3.4 3.4 3.4 3.5 3.5 3.5 3.3 2.2
3.7 3.6 3.6 3.5 3.5 3.5 3.5 3.5 3.0 2.3 2.2
3.8 3.7 3.7 3.6 3.5 3.5 3.5 2.7 2.3 2.2 2.0
2.3 2.1 1.9 1.8
1.7 1.6 1.6

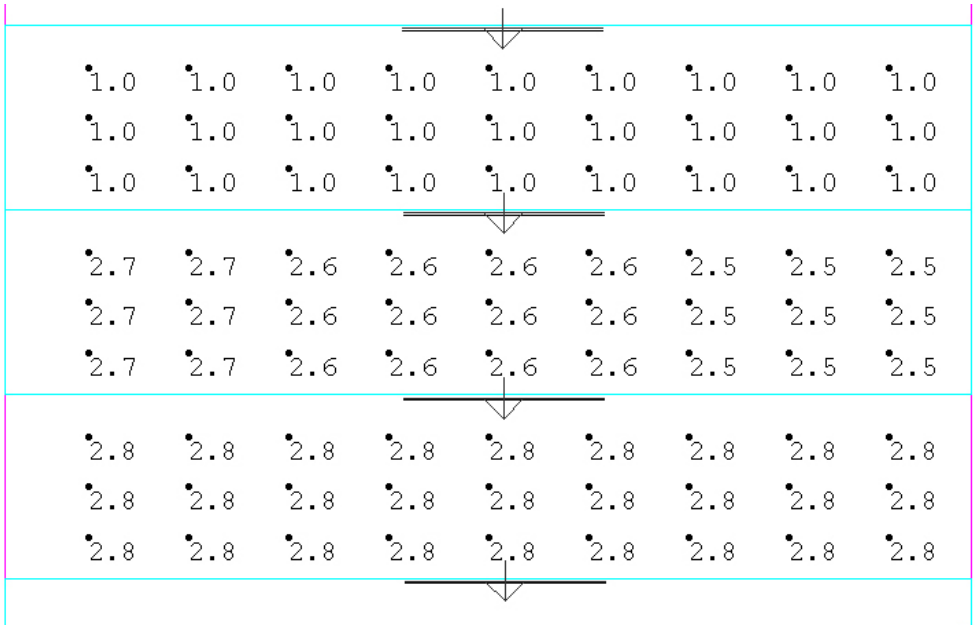
Zone 2


3.8 3.7 3.7 3.6 3.5 3.5 3.5 2.7
2.3 2.3 2.2 2.2 2.2 2.1 2.1 2.1 2.0 2.0 2.0 1.9 1.6
2.3 2.3 2.2 2.2 2.2 2.1 2.1 2.1 2.0 2.0 2.0 1.9 1.6 1.6
2.3
2.3 2.3 2.2 2.2 2.2 2.1 2.1 2.0 2.0 2.0 1.9 1.6 1.6 1.6
1.9 1.9 1.9 1.9 1.8 1.8 1.8 1.8 1.8 1.7 1.6 1.3 1.6 1.6
1.9 1.9 1.9 1.9 1.8 1.8 1.8 1.8 1.8 1.8 1.7 1.3 1.1 1.6 1.6
1.9 1.9 1.9 1.9 1.9 1.8 1.8 1.8 1.8 1.8 1.8 1.4 1.1 1.0 1.5 1.4
1.0 1.0 1.4 1.3
1.1 1.2 1.2 1.7 1.6 1.5 1.4 1.4 1.3 1.0 0.9 0.8 1.0 0.8 1.2 1.1
0.7 0.8
1.9 1.8 1.6 1.6 1.5 1.5 1.4 1.4 1.3
1.8 1.7 1.7 1.6 1.6 1.5 1.5 1.4 1.4

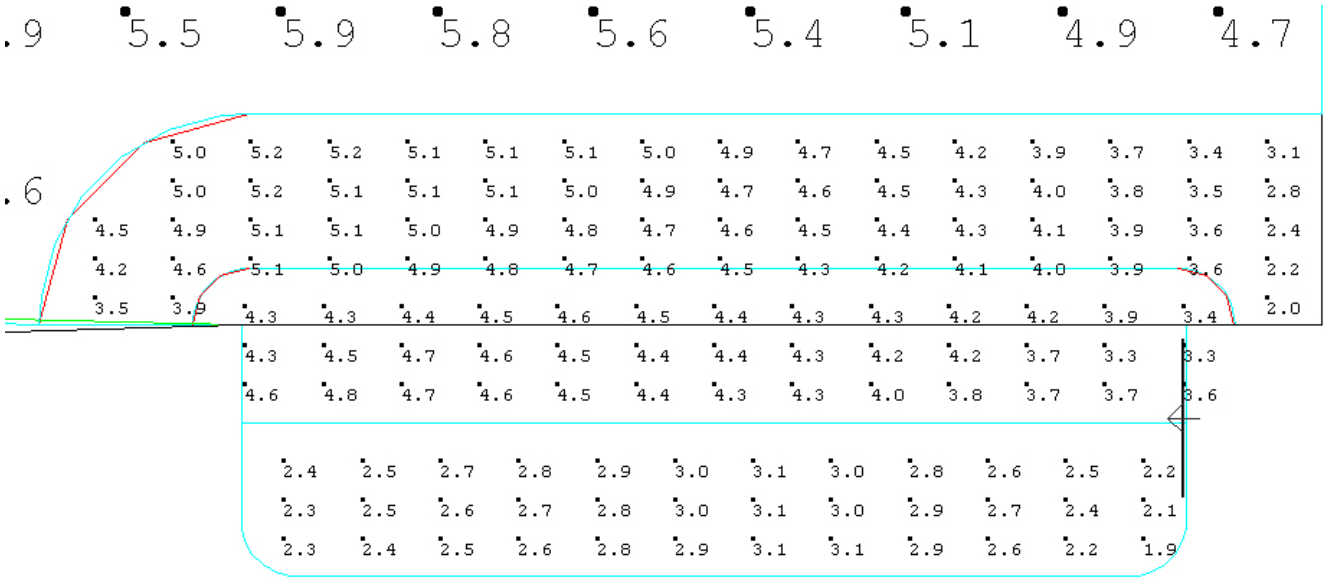
Zone 3


1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8
4.1 4.9 5.7 6.4 7.1 7.8
4.2 5.1 5.9 6.6 7.3 7.7
4.2 5.1 6.0 6.8 7.1 7.5
4.3 5.2 6.0 6.7 7.1 7.5
4.3 5.0 5.6 6.1 7.2 7.7
4.1 4.7 5.1 5.6 6.6 7.6
5.9
5.6
4.8
5.3
7.7
9.4
9.5
9.5
9.6
9.7
9.7
9.8
7.4
5.2
5.7
5.8

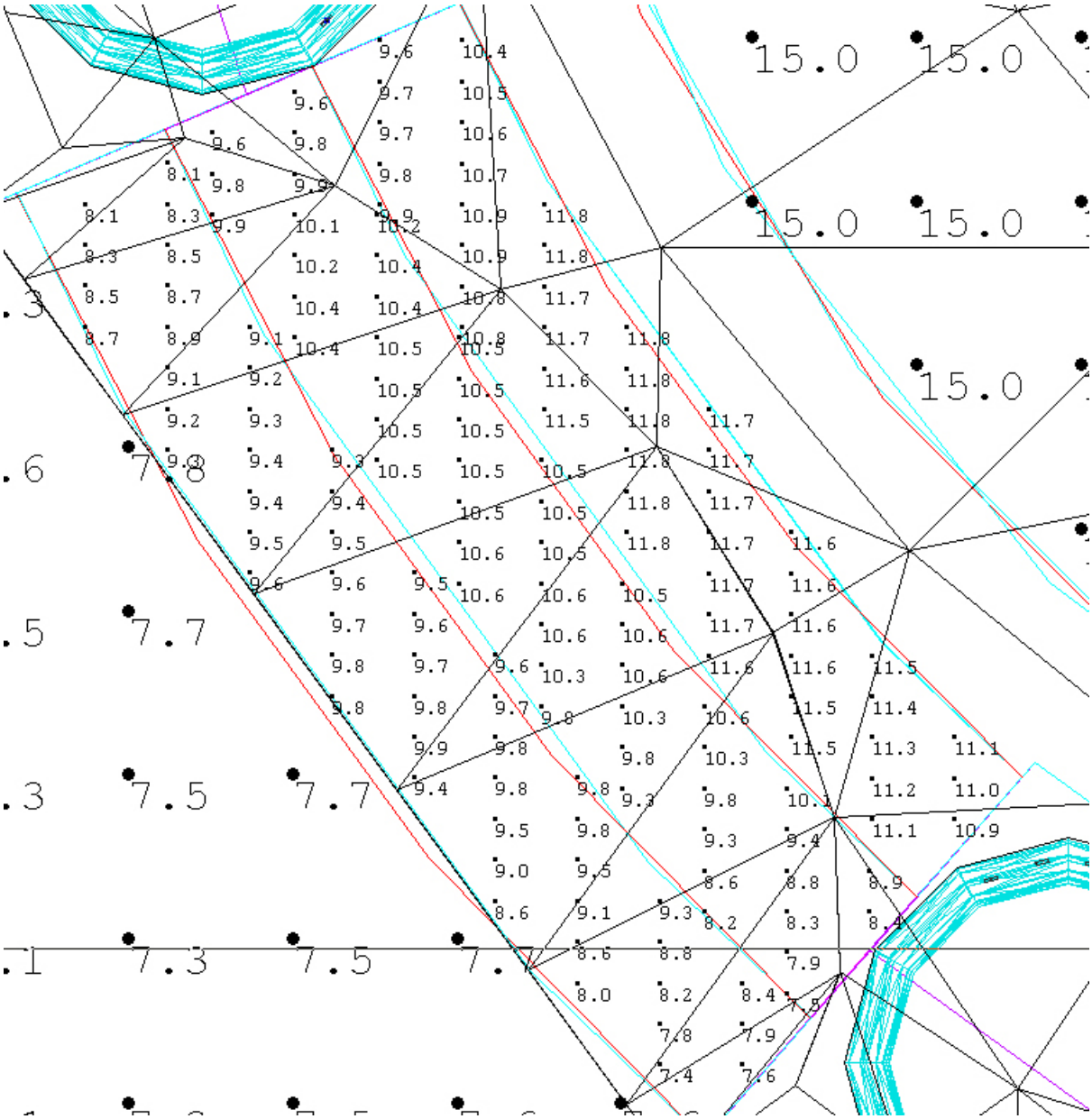
Zone 4


1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.7 2.7 2.6 2.6 2.6 2.6 2.5 2.5 2.5
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8
2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8 2.8

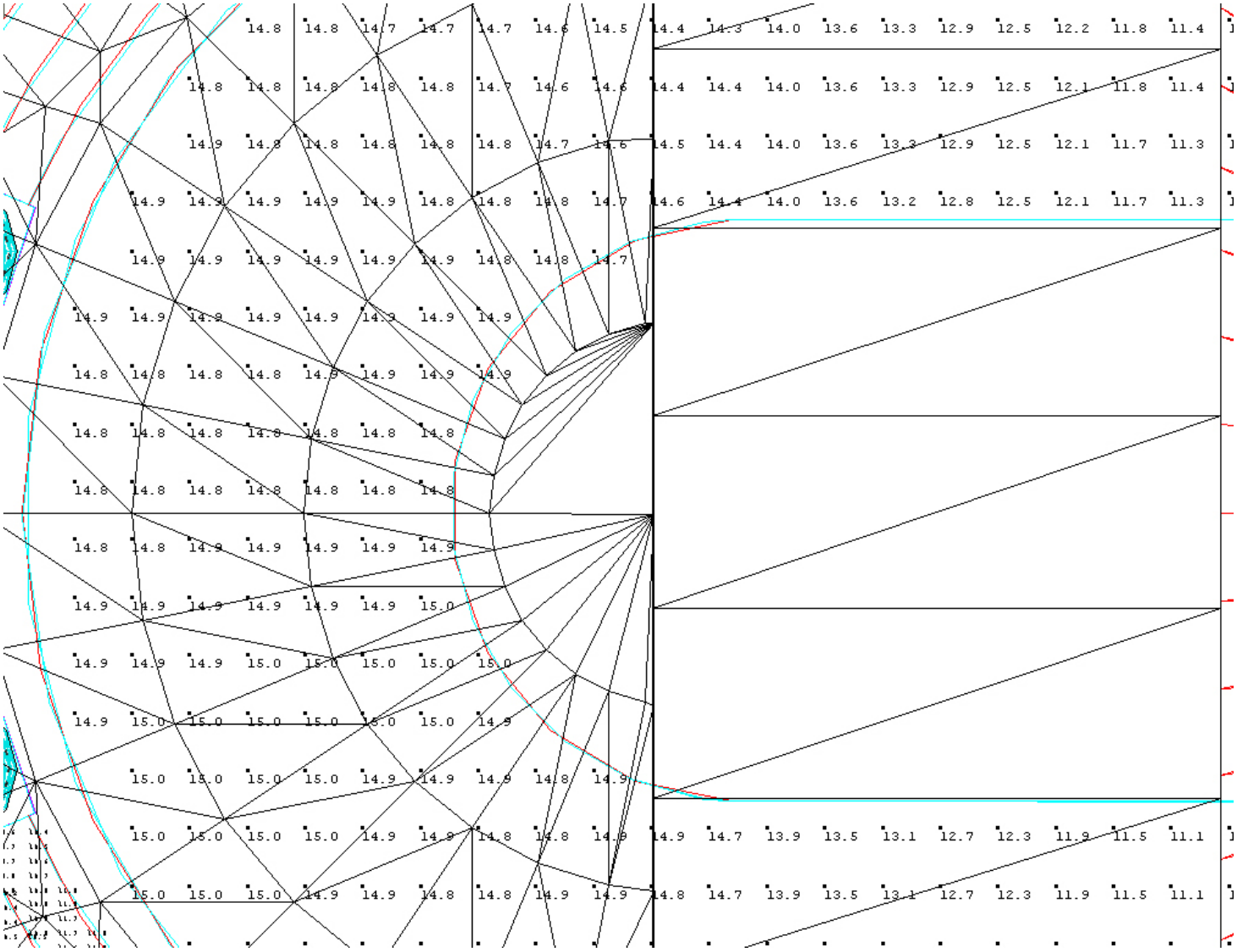
Zone 5


.9 5.5 5.9 5.8 5.6 5.4 5.1 4.9 4.7
.6
5.0 5.2 5.2 5.1 5.1 5.1 5.0 4.9 4.7 4.5 4.2 3.9 3.7 3.4 3.1
5.0 5.2 5.1 5.1 5.1 5.0 4.9 4.7 4.6 4.5 4.3 4.0 3.8 3.5 2.8
4.5 4.9 5.1 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.1 3.9 3.6 2.4
4.2 4.6 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.3 4.2 4.1 4.0 3.9 3.6 2.2
3.5 3.9 4.3 4.3 4.4 4.5 4.6 4.5 4.4 4.3 4.3 4.2 4.2 3.9 3.4 2.0
4.3 4.5 4.7 4.6 4.5 4.4 4.4 4.3 4.2 4.2 3.7 3.3 3.3
4.6 4.8 4.7 4.6 4.5 4.4 4.3 4.3 4.0 3.8 3.7 3.7 3.6
2.4 2.5 2.7 2.8 2.9 3.0 3.1 3.0 2.8 2.6 2.5 2.2
2.3 2.5 2.6 2.7 2.8 3.0 3.1 3.0 2.9 2.7 2.4 2.1
2.3 2.4 2.5 2.6 2.8 2.9 3.1 3.1 2.9 2.6 2.2 1.9

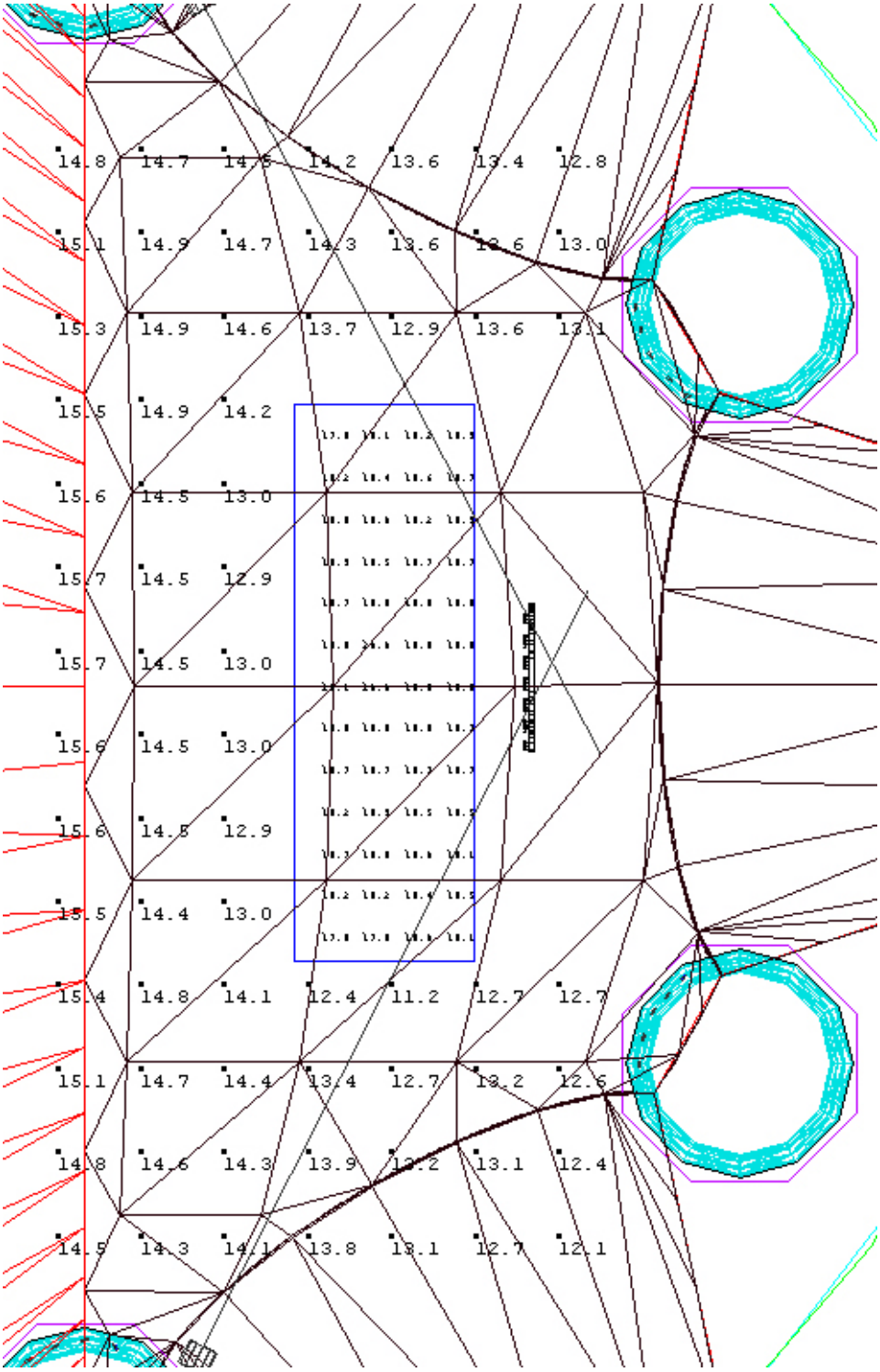
Zone 6



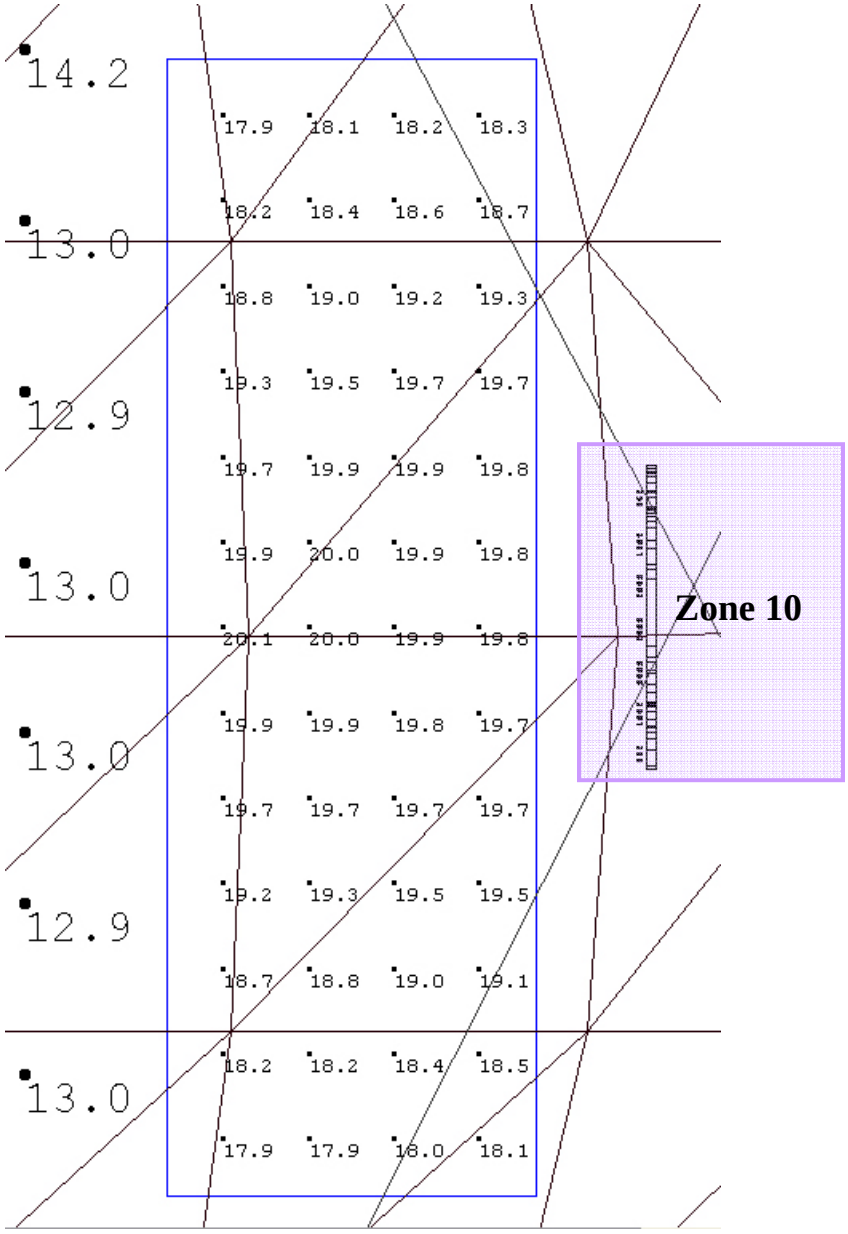
Zone 7


14.8 14.8 14.7 14.7 14.7 14.6 14.5 14.4 14.3 14.0 13.6 13.3 12.9 12.5 12.2 11.8 11.4
14.8 14.8 14.8 14.8 14.8 14.7 14.6 14.6 14.4 14.4 14.0 13.6 13.3 12.9 12.5 12.1 11.8 11.4
14.9 14.8 14.8 14.8 14.8 14.8 14.7 14.6 14.5 14.4 14.0 13.6 13.3 12.9 12.5 12.1 11.7 11.3
14.9 14.9 14.9 14.9 14.9 14.8 14.8 14.8 14.7 14.6 14.4 14.0 13.6 13.2 12.8 12.5 12.1 11.7 11.3
14.9 14.9 14.9 14.9 14.9 14.9 14.8 14.8 14.7
14.9 14.9 14.8 14.9 14.9 14.9 14.9 14.9
14.8 14.8 14.8 14.8 14.8 14.9 14.9 14.9
14.8 14.8 14.8 14.8 14.8 14.8 14.8
14.8 14.8 14.8 14.8 14.8 14.8 14.8
14.8 14.8 14.8 14.9 14.9 14.9 14.9
14.9 14.9 14.9 14.9 14.9 14.9 15.0
14.9 14.9 14.9 15.0 15.0 15.0 15.0 15.0
14.9 15.0 15.0 15.0 15.0 15.0 15.0 14.9
15.0 15.0 15.0 15.0 14.9 14.9 14.9 14.8 14.9
15.0 15.0 15.0 15.0 14.9 14.9 14.8 14.8 14.9 14.9 14.7 13.9 13.5 13.1 12.7 12.3 11.9 11.5 11.1
15.0 15.0 15.0 14.9 14.9 14.8 14.8 14.9 14.9 14.8 14.7 13.9 13.5 13.1 12.7 12.3 11.9 11.5 11.1

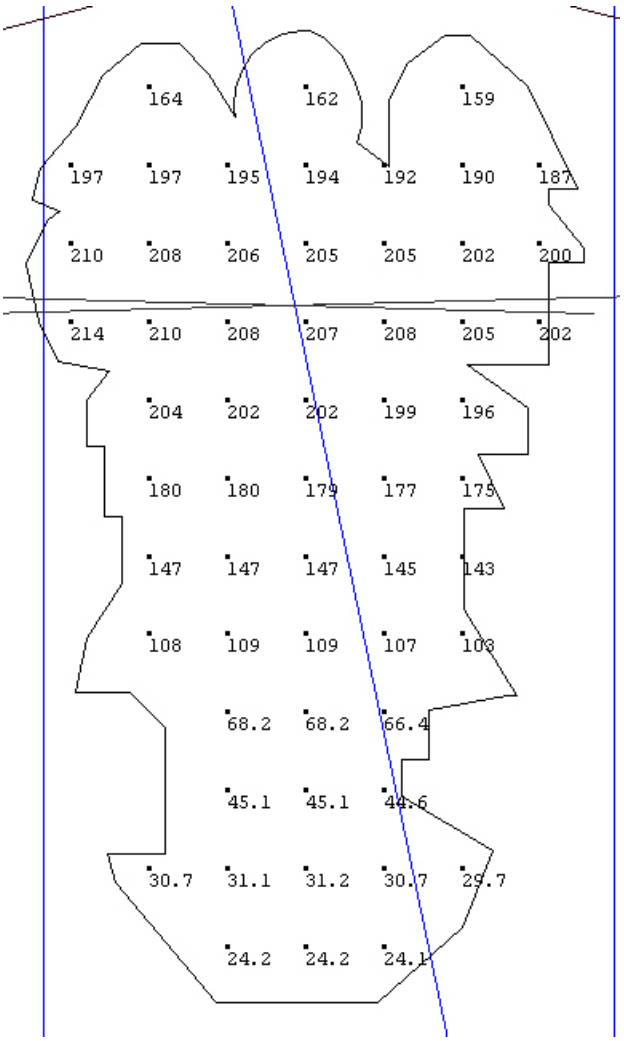
Zone 8


14.8 14.7 14.6 14.2 13.6 13.4 12.8
15.1 14.9 14.7 14.3 13.6 13.6 13.0
15.3 14.9 14.6 13.7 12.9 13.6 13.1
15.5 14.9 14.2
15.6 14.5 13.0
15.7 14.5 12.9
15.7 14.5 13.0
15.6 14.5 13.0
15.6 14.5 12.9
15.5 14.4 13.0
15.4 14.8 14.1 12.4 11.2 12.7 12.7
15.1 14.7 14.4 13.4 12.7 13.2 12.6
14.8 14.6 14.3 13.9 13.2 13.1 12.4
14.5 14.3 14.1 13.8 13.1 12.7 12.1

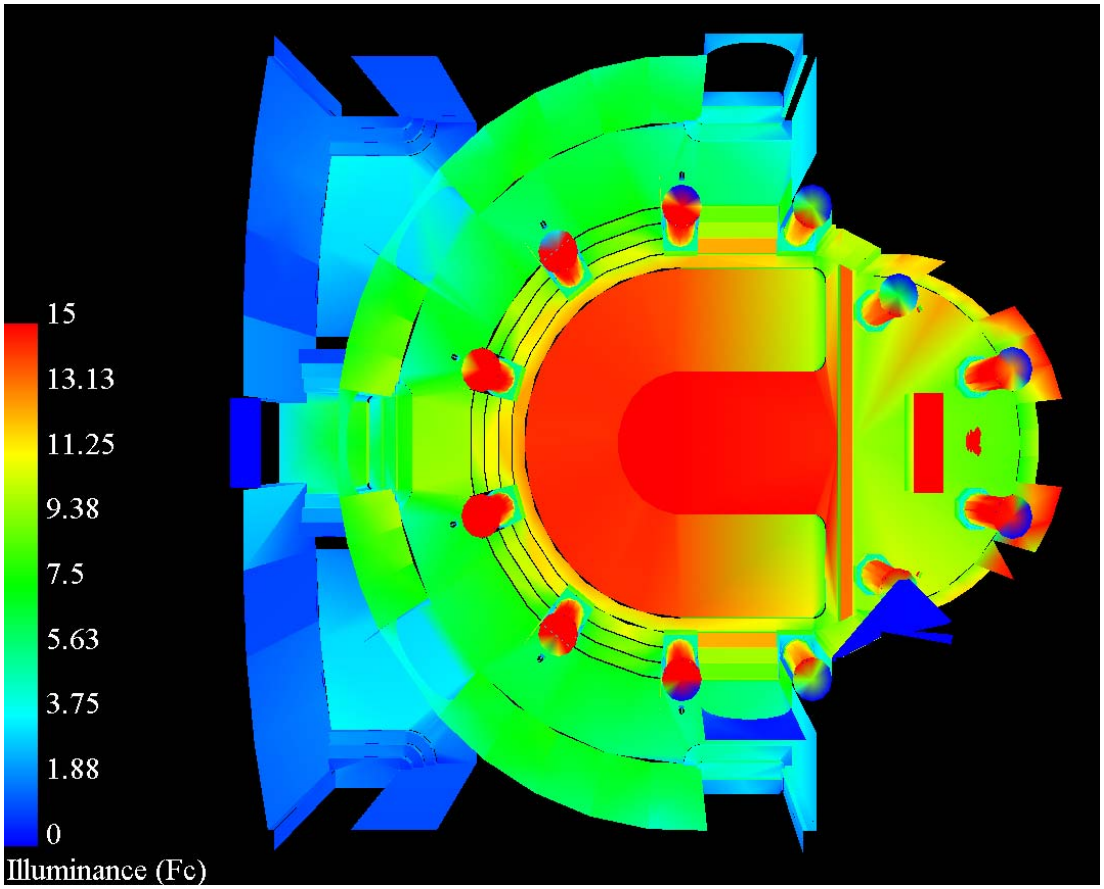
Zone 9

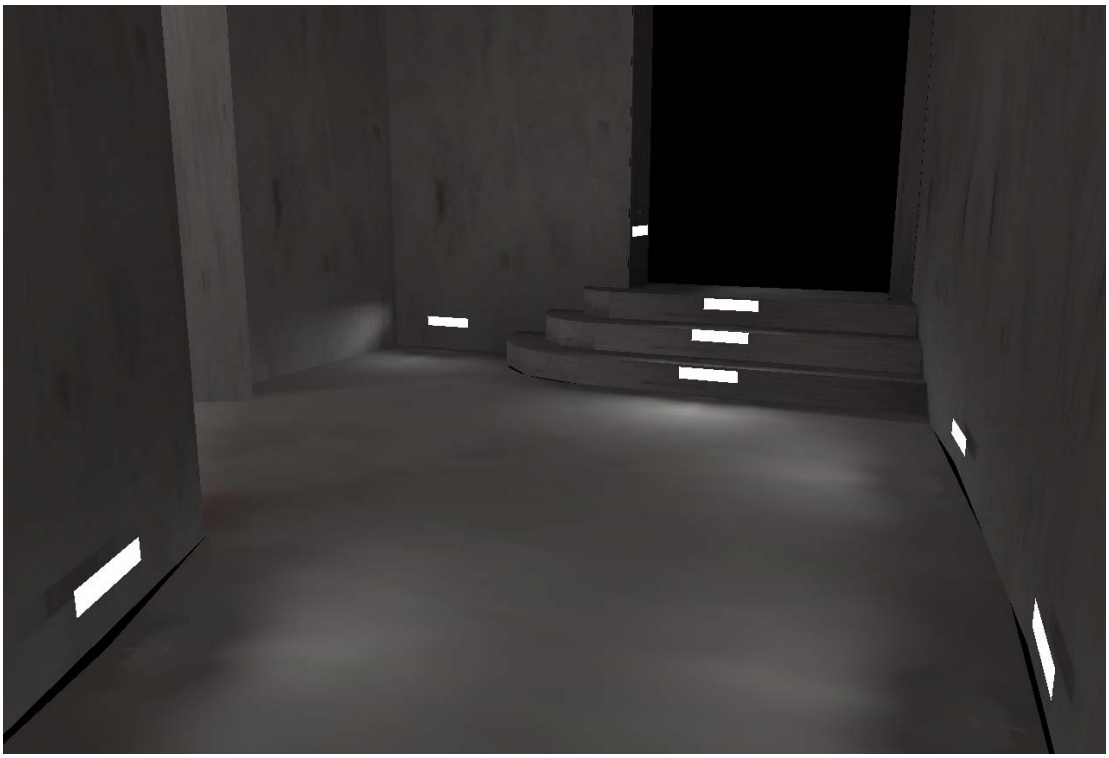

14.2
13.0
12.9
13.0
13.0
12.9
13.0
17.9 18.1 18.2 18.3
18.2 18.4 18.6 18.7
18.8 19.0 19.2 19.3
19.3 19.5 19.7 19.7
19.7 19.9 19.9 19.8
19.9 20.0 19.9 19.8
20.1 20.0 19.9 19.8
19.9 19.9 19.8 19.7
19.7 19.7 19.7 19.7
19.2 19.3 19.5 19.5
18.7 18.8 19.0 19.1
18.2 18.2 18.4 18.5
17.9 17.9 18.0 18.1
Zone 10

Zone 10 – Angel Statue

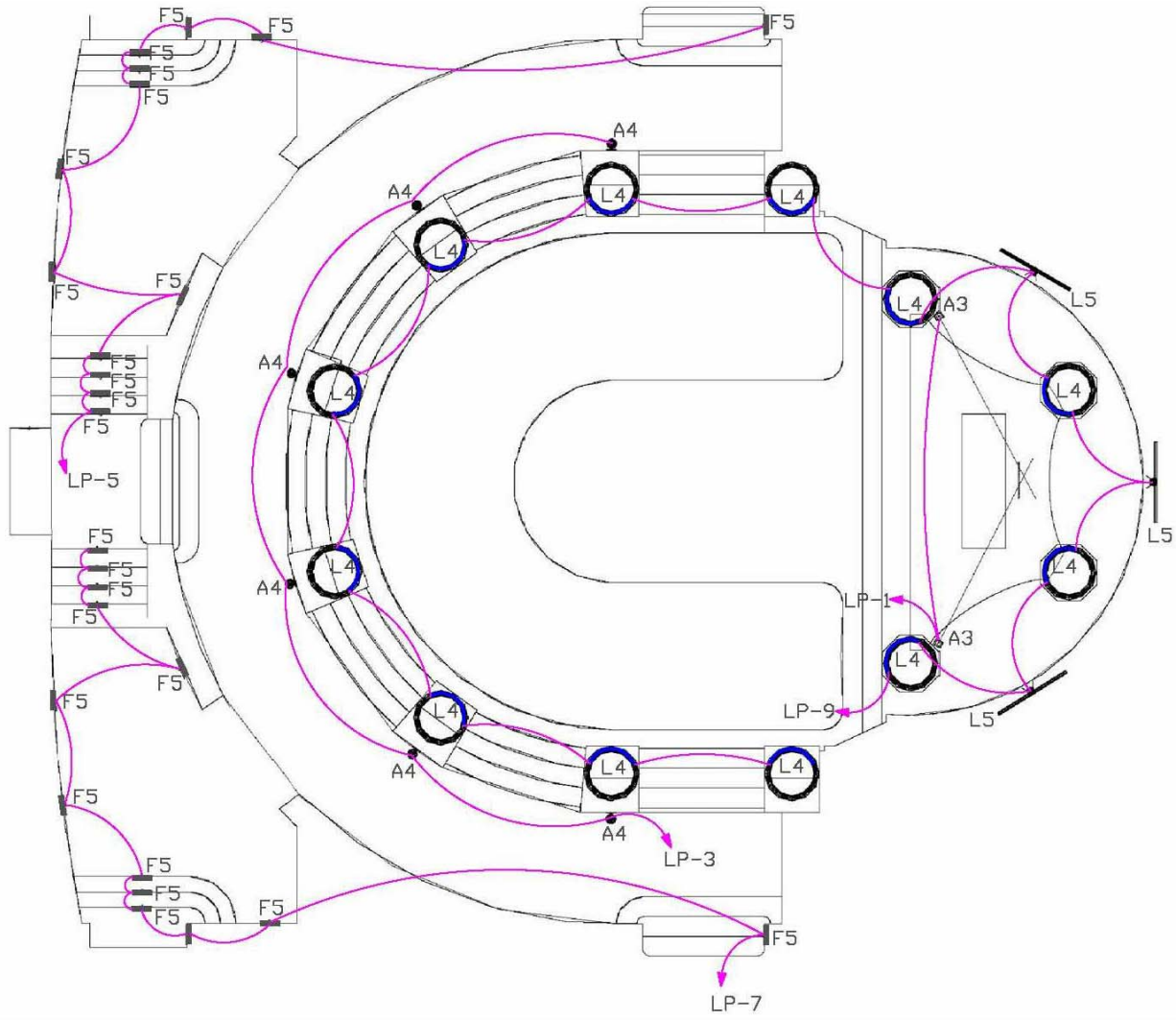


Renderings:





Wiring Switching Diagram:



Controls:

DIMMING CONTROL SYSTEM:

ARCHITECTURAL PRESET DIMMING CONTROL SYSTEM
TO CONSIST OF:

- LUTRON 24-CIRCUIT DIMMING PANEL (TYPE GP)
  QTY. (1) - LOCATED IN MAIN ELECTRIC ROOM
- LUTRON GRAFIK EYE 4000 SERIES (10-ZONE)
  QTY. (1) - LOCATED IN CRYPT CHAPEL (BASEMENT)
- LUTRON GRAFIK EYE 4000 SERIES (6-ZONE)
  QTY. (2) - LOCATED IN AWDRD ROOMS (2ND FLOOR)
- ON/OFF REMOTE CONTROL STATION
  QTY. (1) - LOCATED AT REAR OF CHAPEL NEAR STAIR FROM 1ST FLOOR
- WIRING AND NECESSARY DEVICE & ACCESSORIES PER MANUFACTURER'S INSTRUCTIONS.

CONTROL ZONES:

ZONE 1: TYPE L4
ZONE 2: TYPE L5
ZONE 3: TYPE A3
ZONE 4: TYPE F5
ZONE 5: TYPE F5
ZONE 6: TYPE F5
ZONE 7: TYPE F5

Summary:

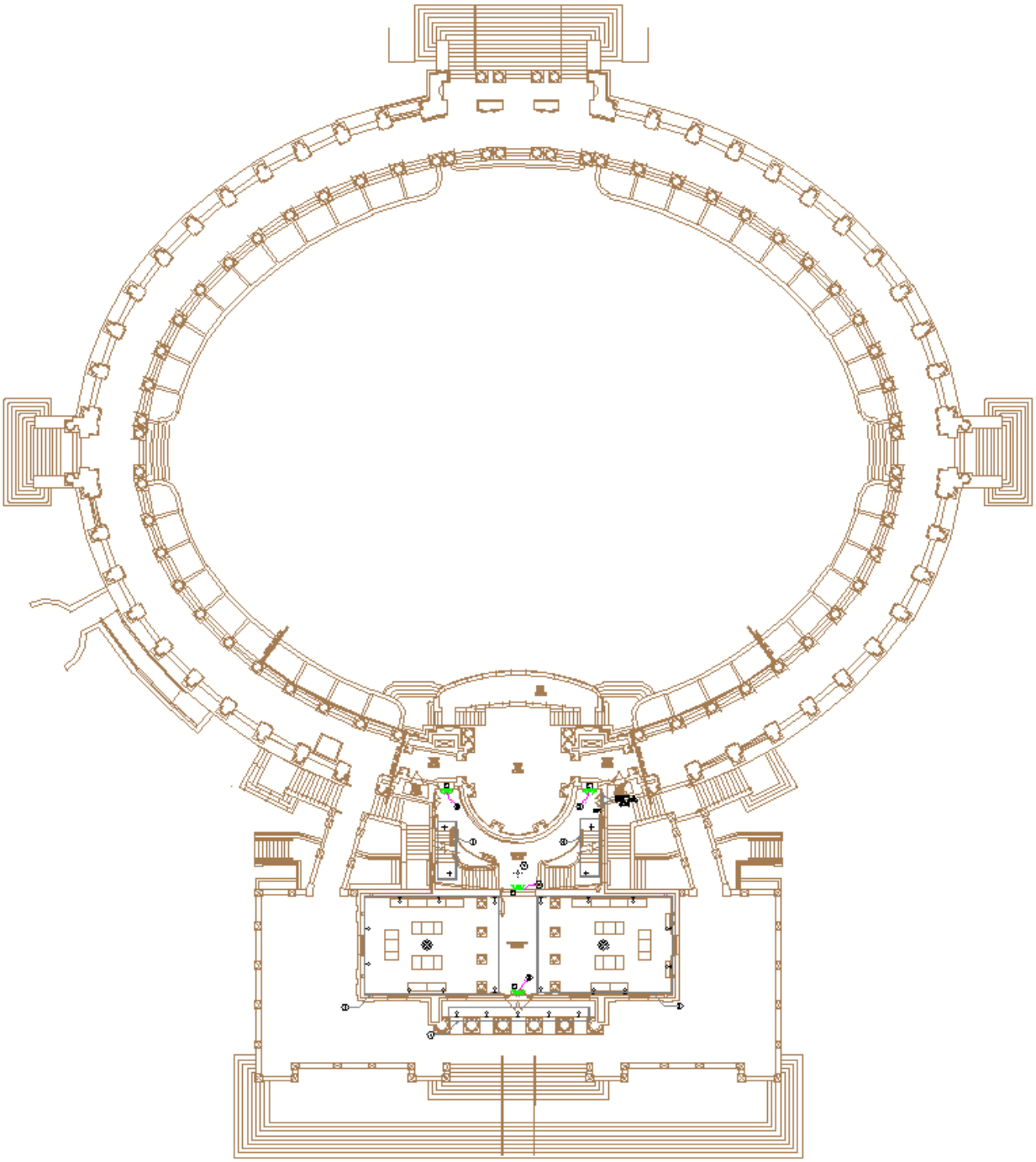
Overall the lighting design worked well with this space. As can be seen in the pseudo rendering, the footcandle levels were achieved with the entrances having a lowest level, the perimeter corridor having the middle level, and the chapel area having the highest level. This creates the desired concept of creating flow vertically and horizontally through the space. The ceiling uplight design was a good concept idea, but the model was unable to demonstrate the desired effect due to model difficulties. The spot lighting and window wash lighting create a nice point of interest that draws the occupants through the space to the front of the chapel. The goals of creating flow and emphasizing the architecture are eloquently achieved.

Amphitheater

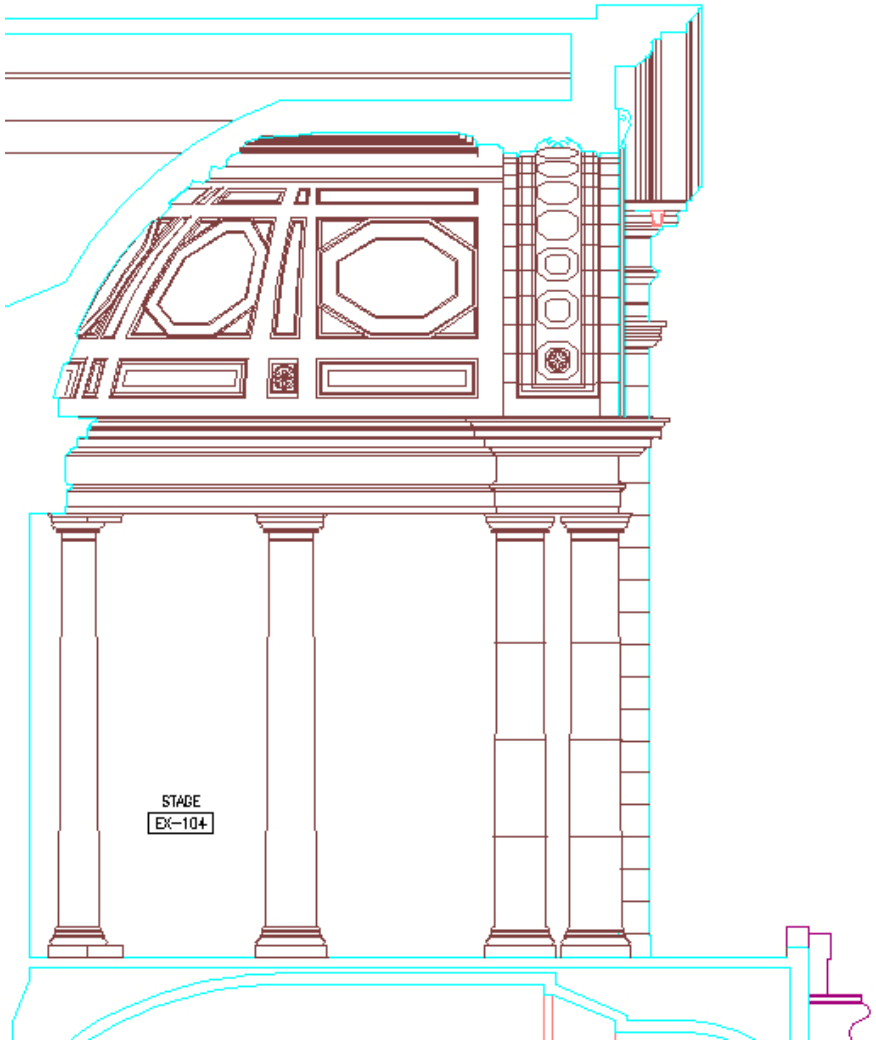
The exterior amphitheater is located on the back side of the building. On the opposite side of the building is where the tomb of the Unknown Soldier is located which is lit by torches. The architecture of this building resembles Greek and Roman architecture from ancient times. This is a big piece of the space and what makes it grand. The space is currently open to the public during daylight hours, but the lighting design being proposed is for the rare chance they might want to open this space at night. The design is like the other monument located in the Washington DC area.

Existing Conditions

Floor Plan:



Stage Section Looking South:



Note: Currently there are only 5 exterior fixtures on this building located at the front entrance into the reception room. There is no need for exterior fixtures since the cemetery grounds close at dusk and the building is located with in the boundaries of these grounds. I will be designing a lighting theme for this space in case the event arises where the need for a night time presentation or speech is necessary.

Space Properties:

Floor:
Material: Marble
Color: Dirty White
Reflectance: 0.61

Walls:
Material: Marble
Color: Dirty White
Reflectance: 0.61

Furnishings:

- Podium

Design Criteria:

Tasks:

- Reading
- Writing
- Conversing
- Speaking
- Video Broadcasting

Illuminances:

- $E_{H(podium)}$ Category D-30fc
- $E_{V(face)}$ Category B-5fc

Criteria:

I am assuming this area would be characterized as a House of Worship subcategorized as Highlighted Items since there is no congregational seating.

- Appearance of Space and Luminaires: Space should be appealing to the occupant to create interest and a comfortable atmosphere. Luminaires should enhance the grandness of the architecture while also being recessed or hidden from view as much as possible to not detract from the space's features.
- Color Appearance: This criterion is particularly important since the presentations occurring in the space have the capability of being broadcasted.

- Direct Glare: Direct glare should be avoided through out the space, whether it is for the presenter, audience, or visitors taking a tour. Direct glare can cause the lack of visibility and cause distraction.
- Light Distribution on Surfaces: A uniform distribution of light on the surfaces should be archived particularly on the floor and steps leading to the aisles and seats.
- Light Pollution: Depending on county requirements, there might be a no tolerance policy for light pollution since it detracts from the surrounding buildings and areas.
- Modeling of Faces or Objects: Faces and objects should be well lit in this space to allow for correct identification.
- Peripheral Detection: Considering this space in located outside, a increase in peripheral detection is required to in crease the feeling of safeness through out the space.
- Points of Interest: Certain parts of the architecture might want to be lit at a greater illuminance level to create importance and significance throughout the space.
- Reflected Glare: To maintain a high level of visibility for the speaker and audience, reflected glare should be avoided.
- Shadows: Again, due to this space being outside, shadows should be avoided to increase the feeling of safety throughout the space.
- Source/Task/Eye Geometry: Also should be noted since the speaker will be reading from either a screen or papers on the podium. No fixtures should be placed in an orientation where direct light bounces into the speakers eyes.
- Surface Characteristics: Keeping a lower gloss level on the marble will ensure the possibility of glare at a minimal thus increasing the visibility level of the space.

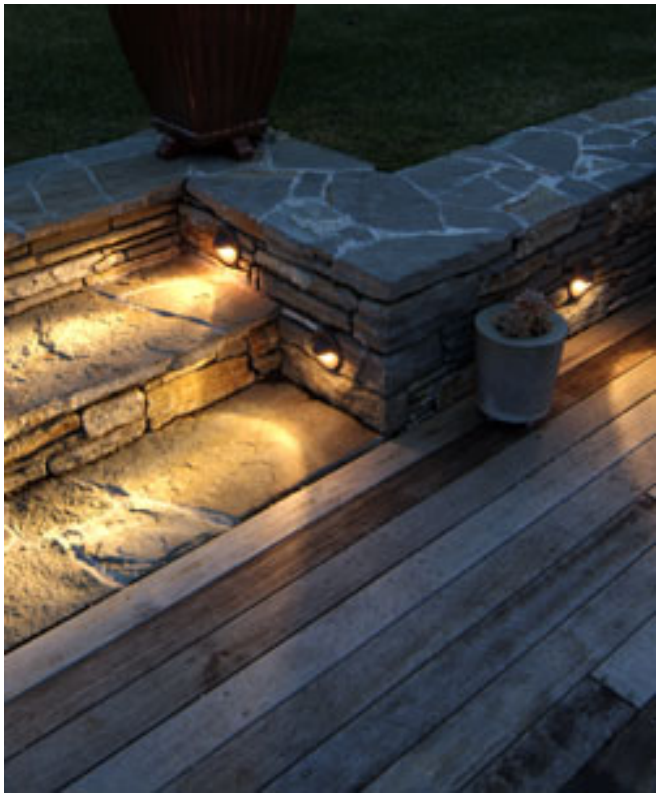
Luminaires: None

Controls: None

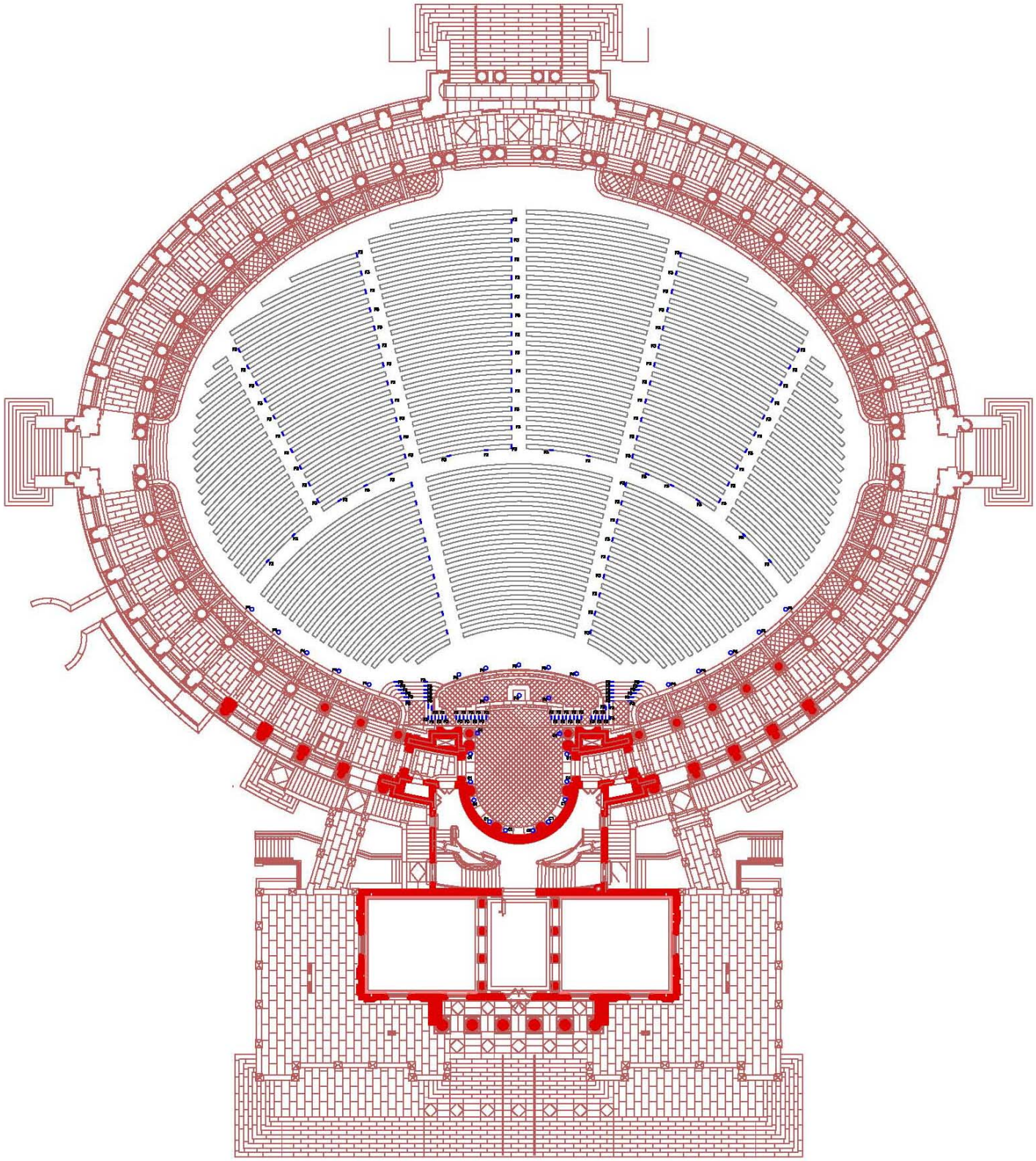
Schematic Design

Since the space is all about the architecture the main goal for this space is to emphasize it as much as possible without over lighting the space. The second goal is to create flow through the space to draw visitors through. Some main features of this space are the seats, the stage area, the dome above the stage, and the columns which surround the perimeter of the space.

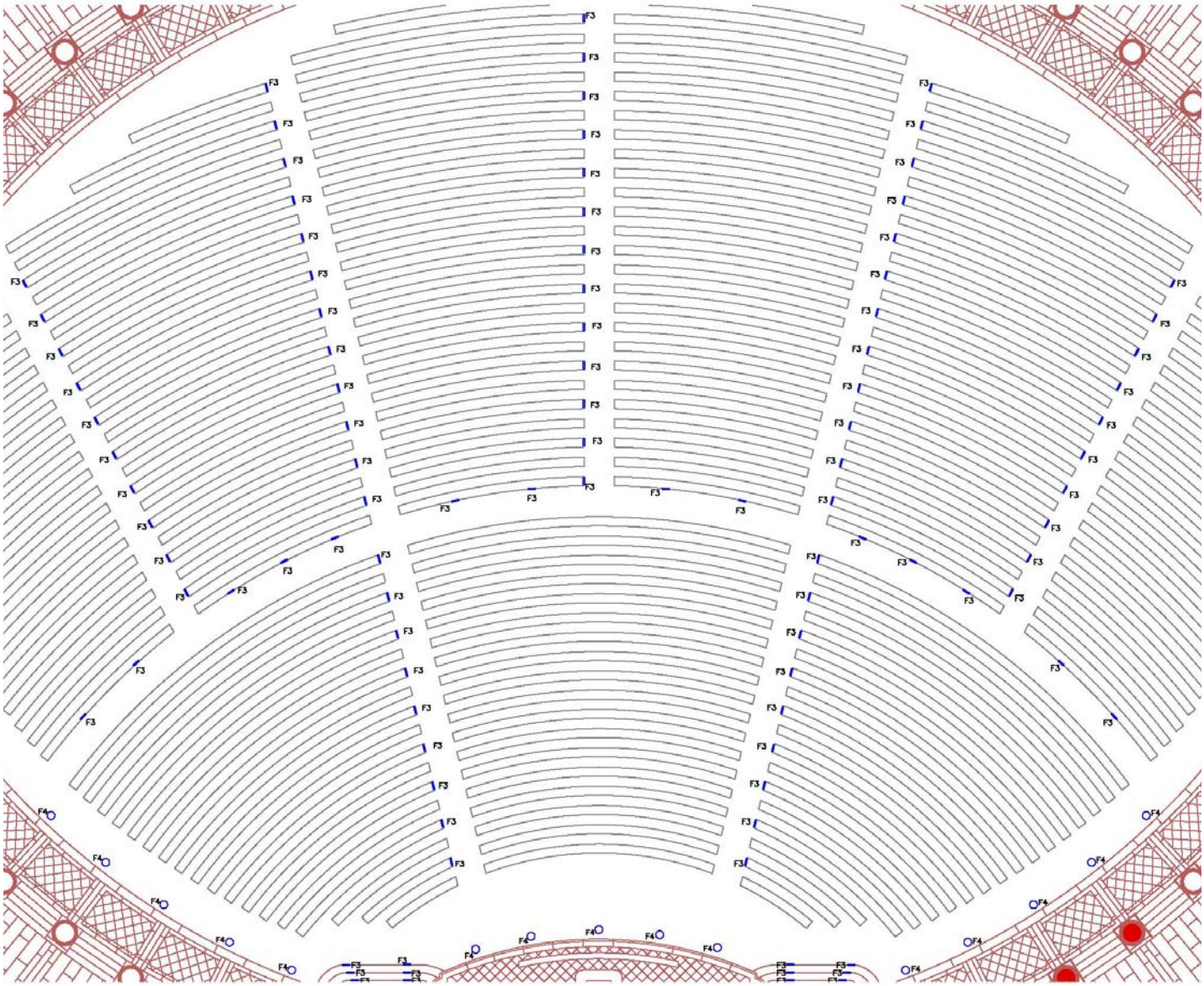
To light the aisles in the seating area, step lights are used to create flow to the front of the space. The front is lit with in grade wall washers to spill light onto the 10 foot wall joining the ground level to the stage level. This also creates spill light onto the ground to acceptable light levels. The steps to get onto the stage are lit by the same light fixture as the aisles. This helps create flow from the ground level to the stage level. The dome spanning the stage is lit by directional spot lights to create interest and show off the details in the architecture. Finally the columns on the stage and around the perimeter of the space are lit by uplights to emphasize the column grandness and height of the space. One thing that needed to be kept in mind was light pollution. By placing the column uplights under the dome, all the spill light was kept inside the space instead of leaking out to the front of the building where the tomb of the Unknown Soldier is located or to the surrounding area causing.



Lighting Layouts:

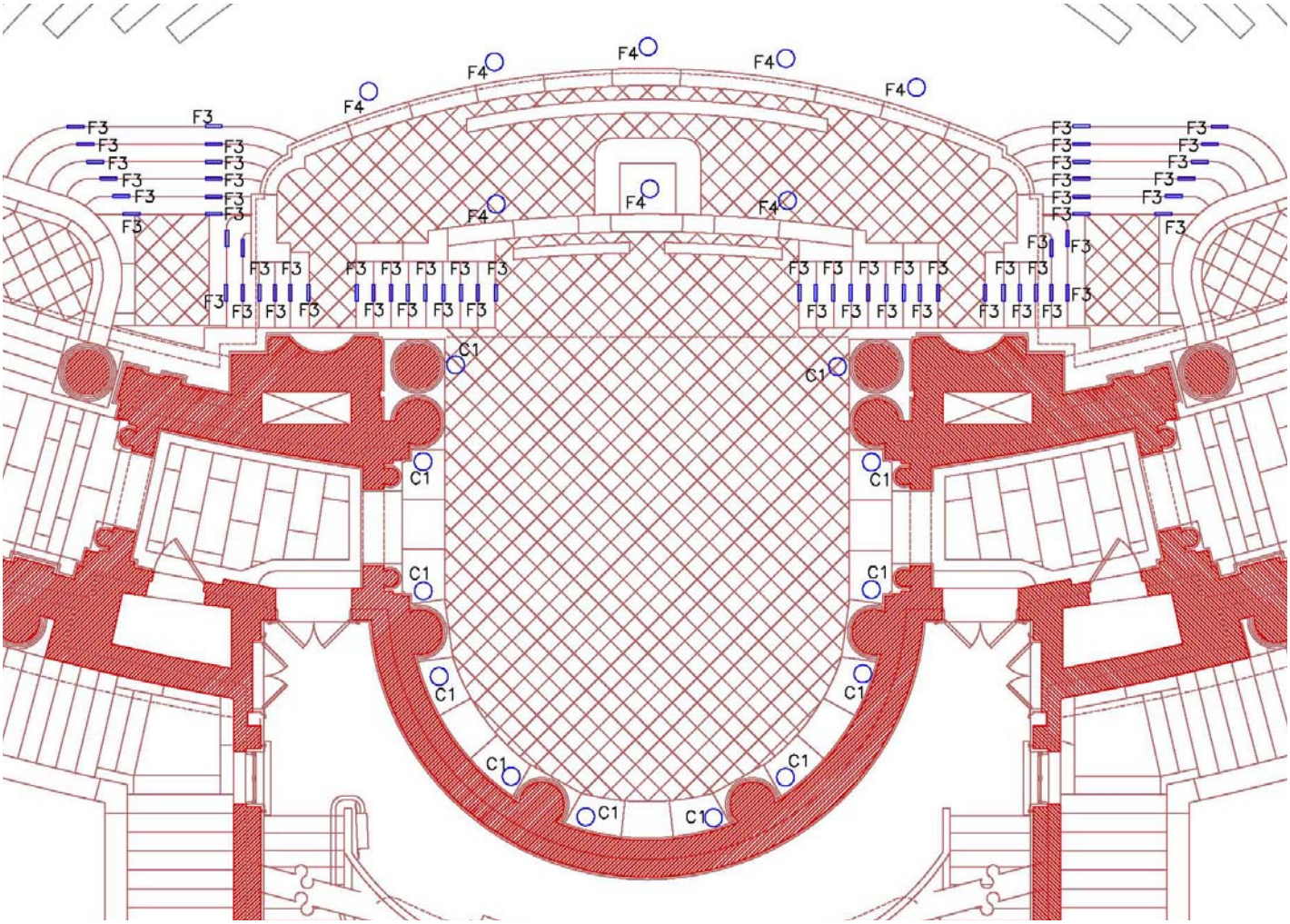


Seating Area:

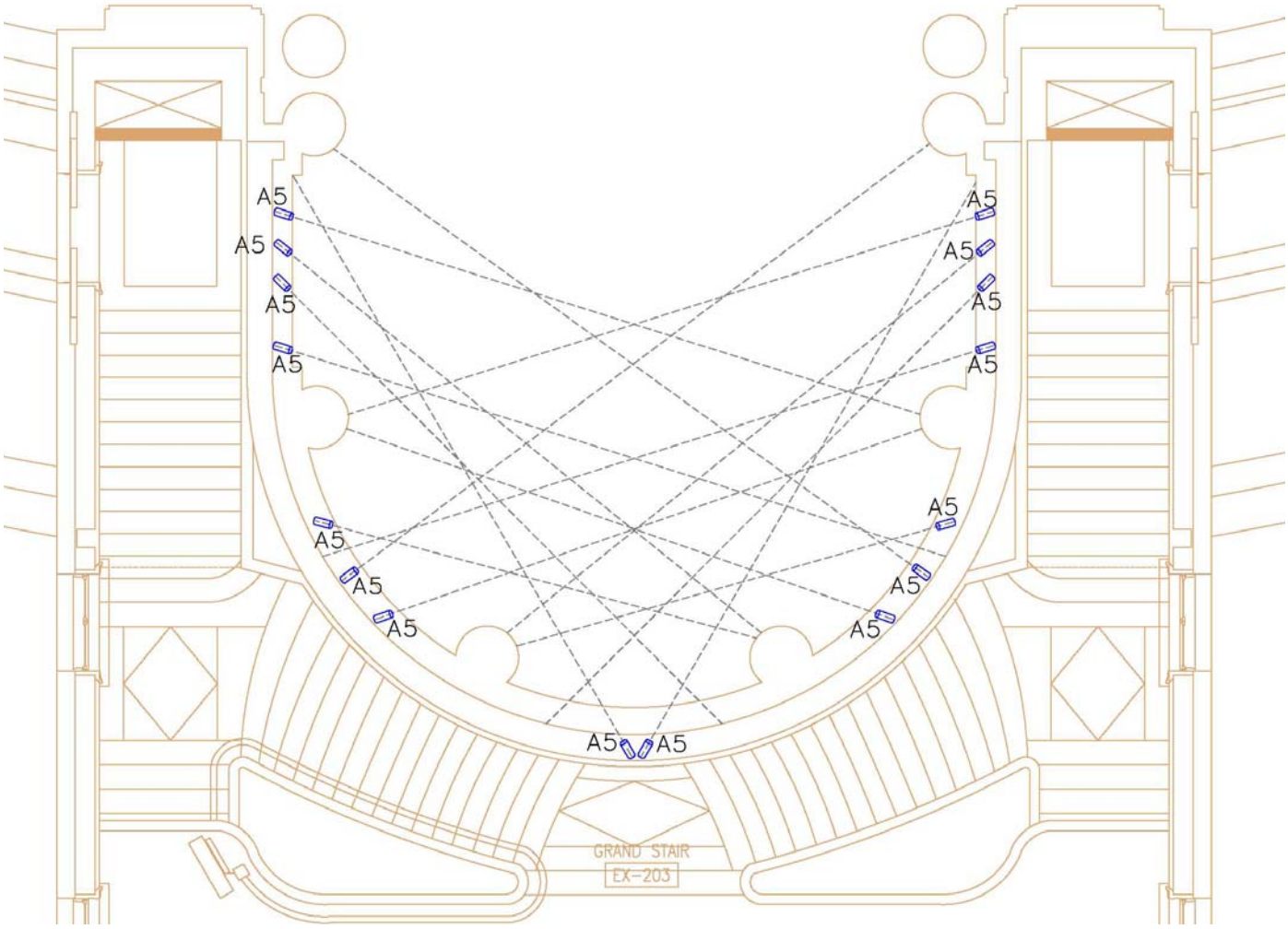


Note: All fixtures in seating area are F3.

First Floor of Stage:



Second Floor of Stage:



Luminaire Schedule:

Fixture Schedule

Type	Description	Catalog Number	Manufacturer	Lamp								Finishes	Mounting
				No.	Type	Watt	Voltage	Color Temp.	CRI	Ave. Life Hrs.	Initial Lumens		
A5	Spot	7319-120-15	Sistemalux	1	Hal	50	12	3000	100	3,000	935	Die cast aluminum	Surface
F3	Step Light	2217P	Bega	1	CF	13	120	2700	82	10,000	810	Die cast aluminum	Recessed
F4	In grade	I.B010-120	Sistemalux	1	CF	42	120	4000	82	12,000	3200	Stainless Steel	Recessed
C1	In grade	I.B007-120-13	Sistemalux	1	MH	35	120	3000	80	10,000	3400	Stainless Steel	Recessed

Light Loss Factors:

Luminaire	Maintenance Category	LLD	LDD	BF	RSDD	Total
Spot (A5)	VI	0.87	0.8	1.0	1.0	0.7
Step Light (F3)	III	0.84	0.87	1.0	1.0	0.73
In Grade (F4)	VI	0.84	0.8	1.0	1.0	0.67
In Grade (C1)	VI	0.87	0.8	1.0	1.0	0.7

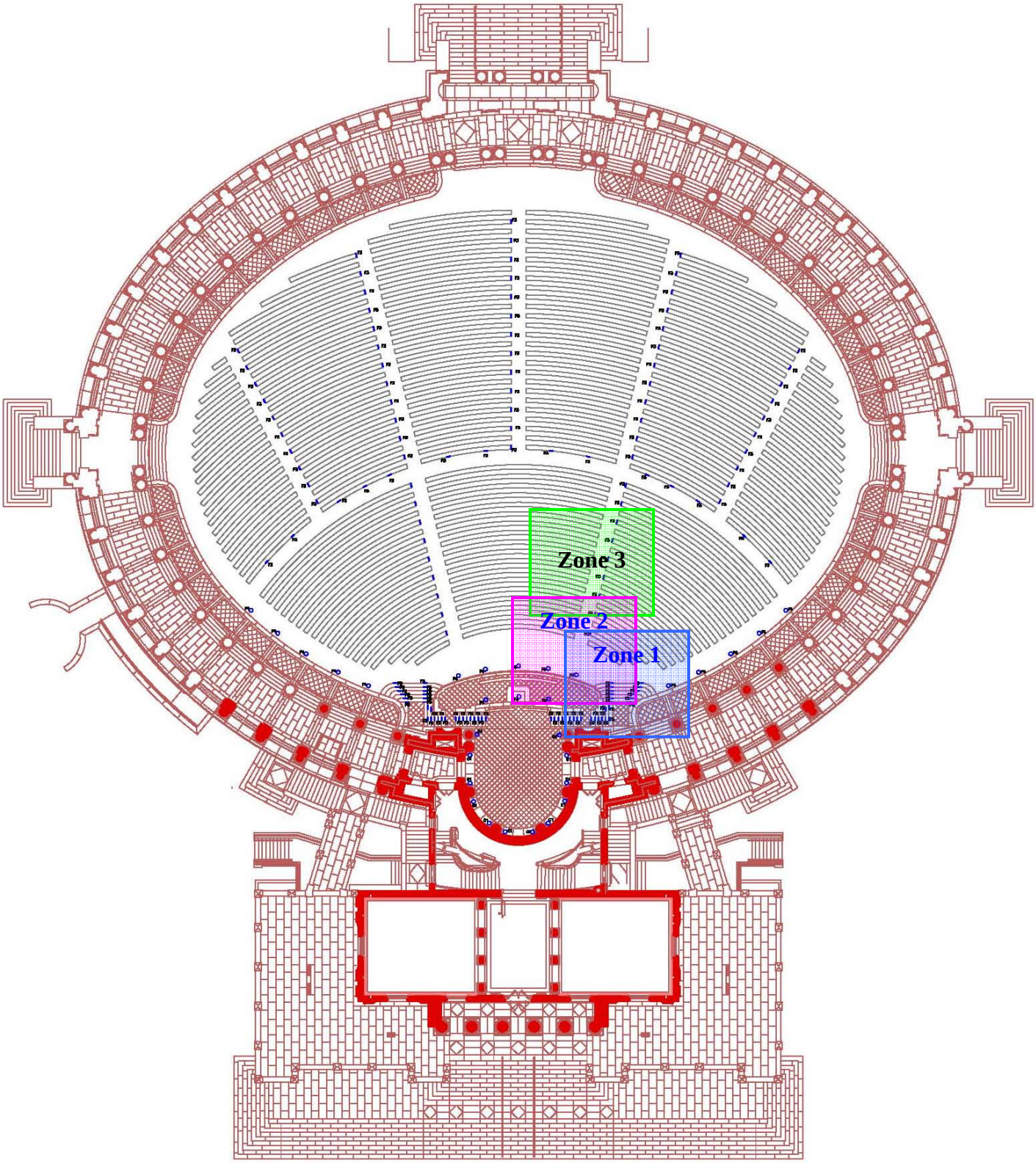
Assumptions: The RSDD is assumed to be 1.0 since the cavity ratio is nonexistent for exterior spaces. To correct for this in the above light loss factors calculation, the space was considered to be of a medium cleanliness and have a cleaning cycle of 12 months.

Power Density:

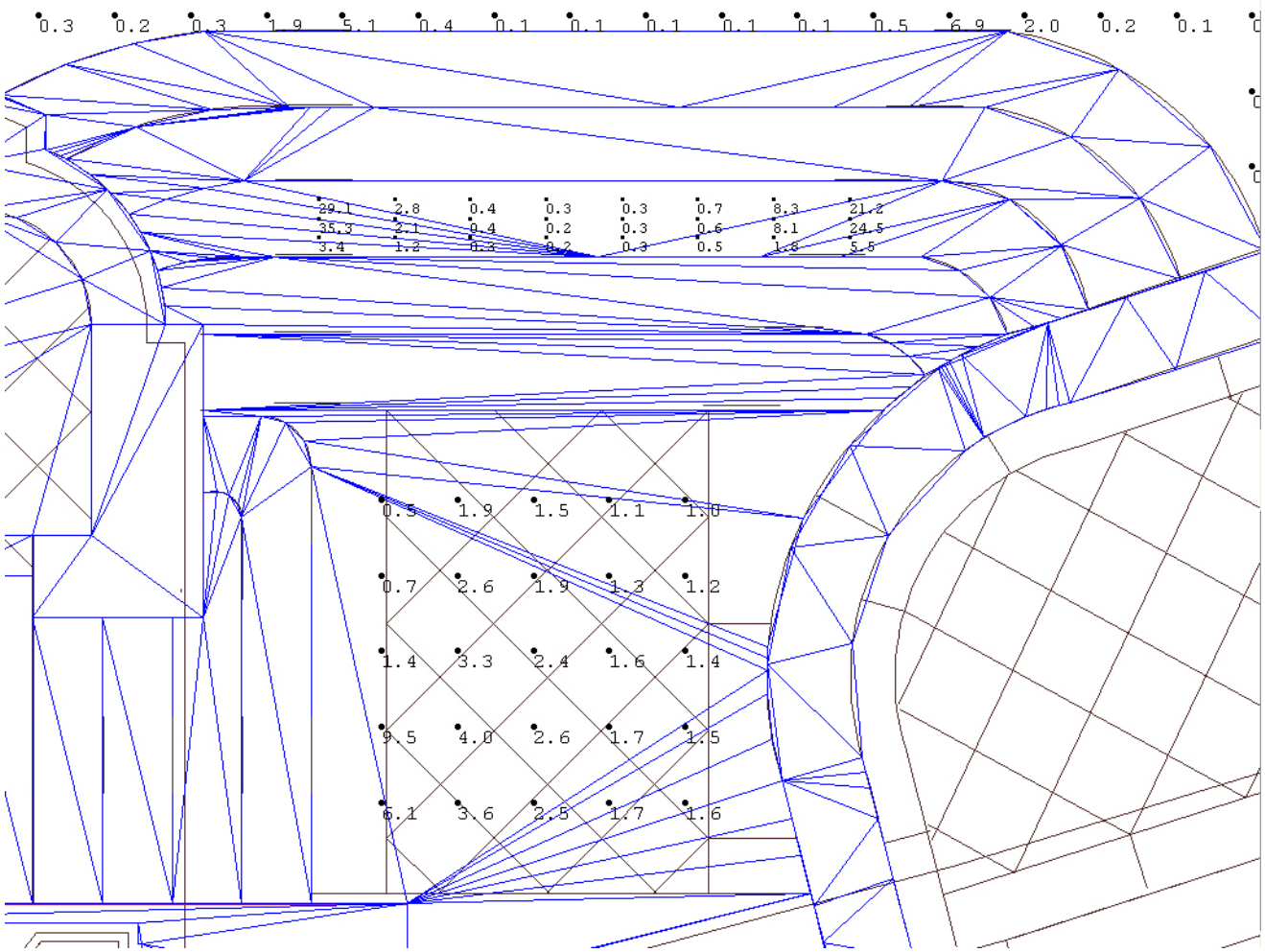
Luminaire	Watts	Lamp Qty	Total Watts	Room Sq.Ft.	Watts/Sq.Ft.	Allowed
Spot (A5)	50	16	800	22920	0.035	1.3 + 1.0 Accent
Step Light (F3)	13	146	1898		0.083	
In grade (F4)	42	18	756		0.033	
In grade (C1)	35	12	420		0.018	
				Total	0.169	2.3

Note: The power density is so low because the lighting design was only for a portion of the space. There would be more wall wash luminaires and column up lights than what were included in this scope of the design.

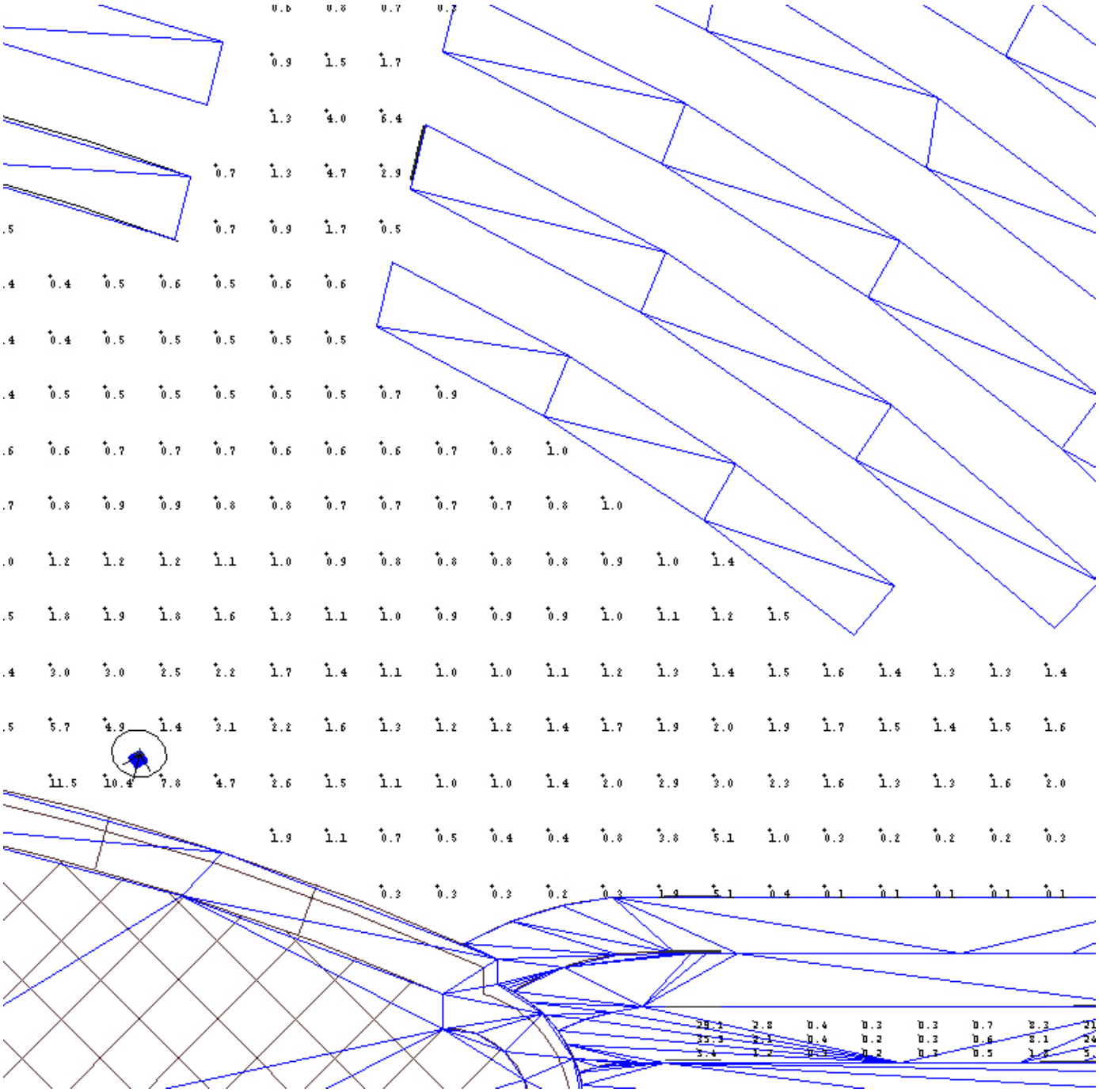
Calculation Grids:



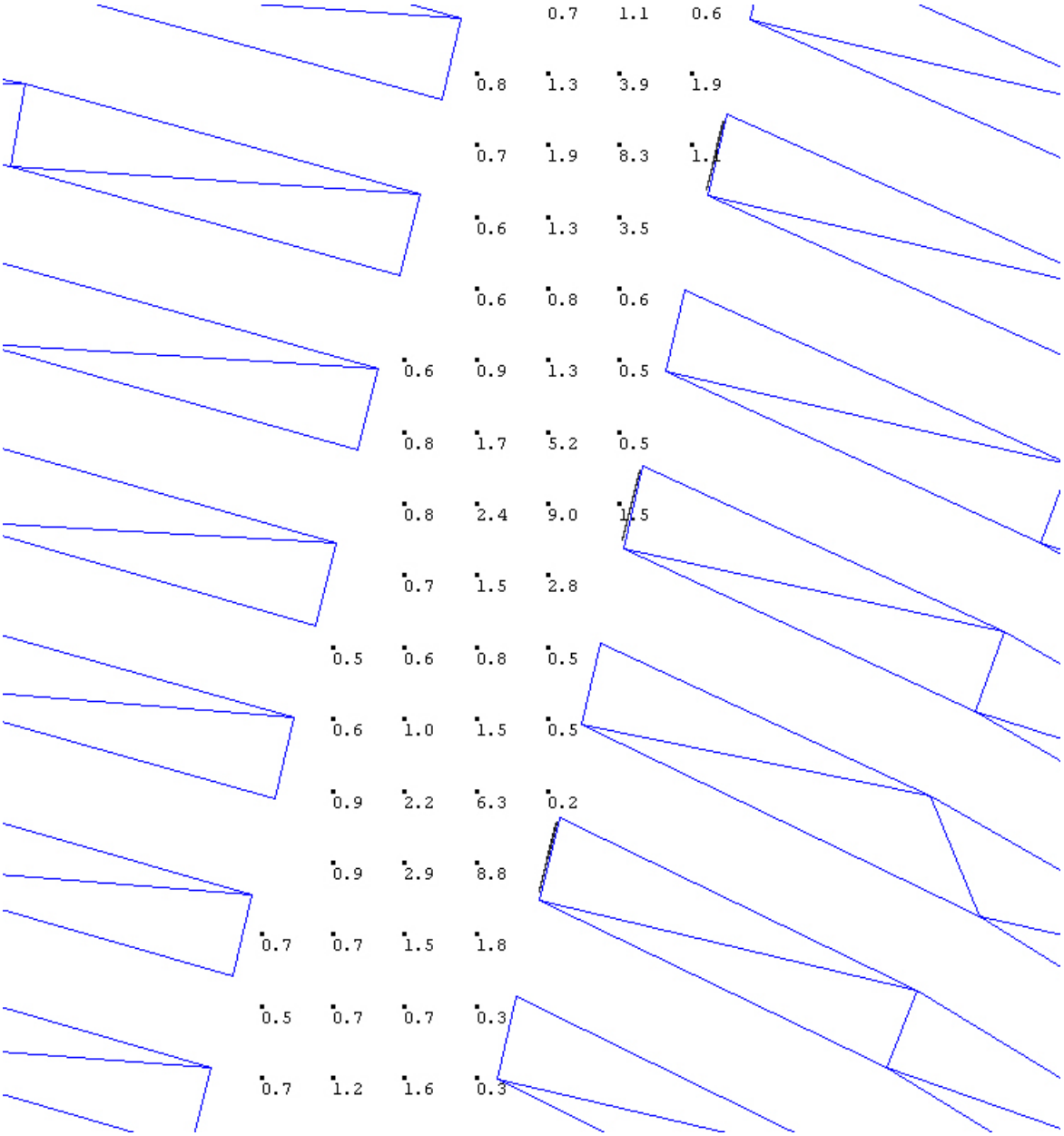
Zone 1:


0.3 0.2 0.3 1.9 5.1 0.4 0.1 0.1 0.1 0.1 0.1 0.5 6.9 2.0 0.2 0.1
29.1 2.8 0.4 0.3 0.3 0.7 8.3 21.2
35.3 2.1 0.4 0.2 0.3 0.6 8.1 24.5
3.4 1.2 0.3 0.2 0.3 0.5 1.8 5.5
0.5 1.9 1.5 1.1 1.0
0.7 2.6 1.9 1.3 1.2
1.4 3.3 2.4 1.6 1.4
9.5 4.0 2.6 1.7 1.5
6.1 3.6 2.5 1.7 1.6

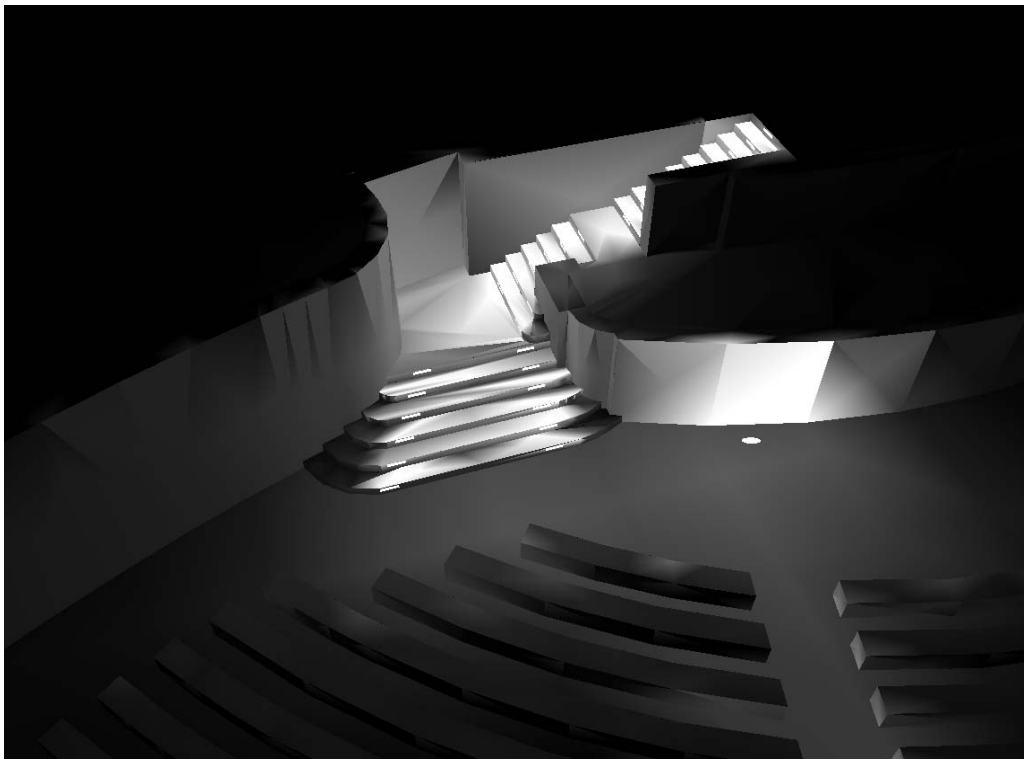
Zone 2:

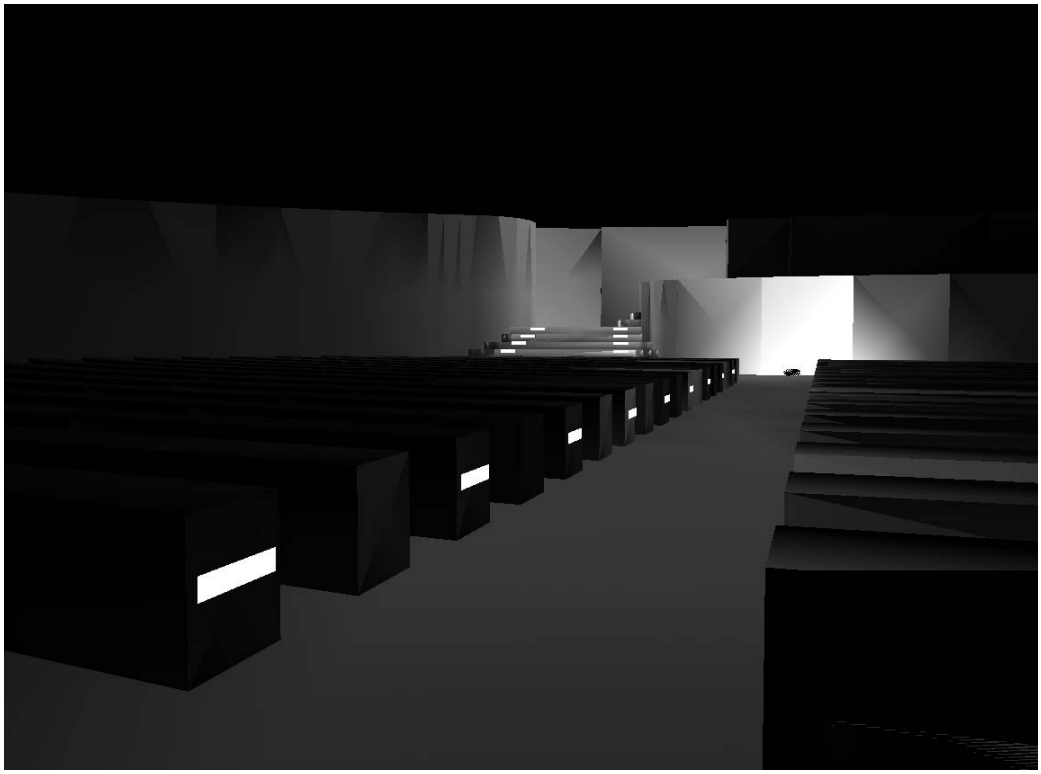


Zone 3:

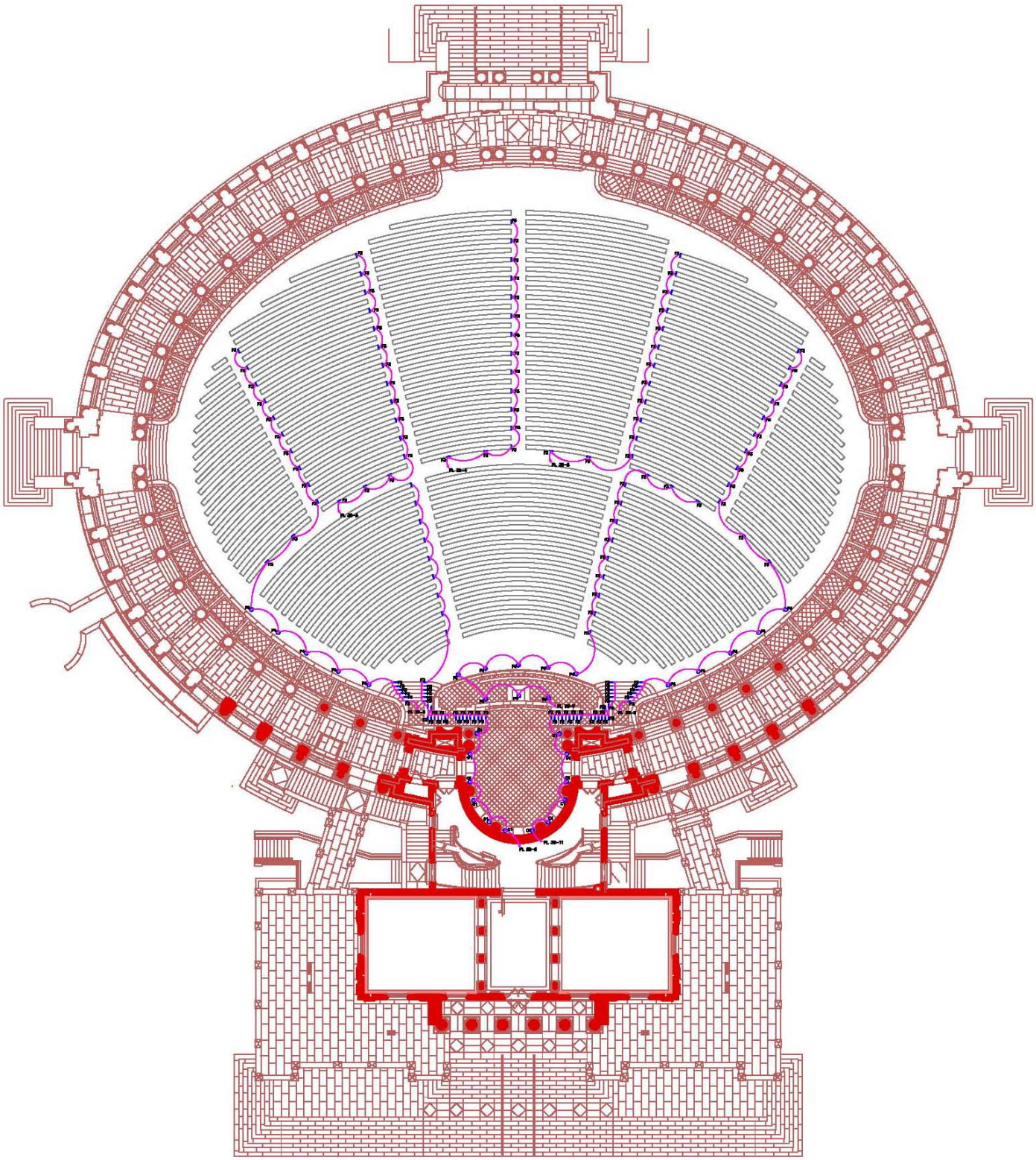

0.7 1.1 0.6
0.8 1.3 3.9 1.9
0.7 1.9 8.3
0.6 1.3 3.5
0.6 0.8 0.6
0.6 0.9 1.3 0.5
0.8 1.7 5.2 0.5
0.8 2.4 9.0
0.7 1.5 2.8
0.5 0.6 0.8 0.5
0.6 1.0 1.5 0.5
0.9 2.2 6.3 0.2
0.9 2.9 8.8
0.7 0.7 1.5 1.8
0.5 0.7 0.7 0.3
0.7 1.2 1.6 0.3

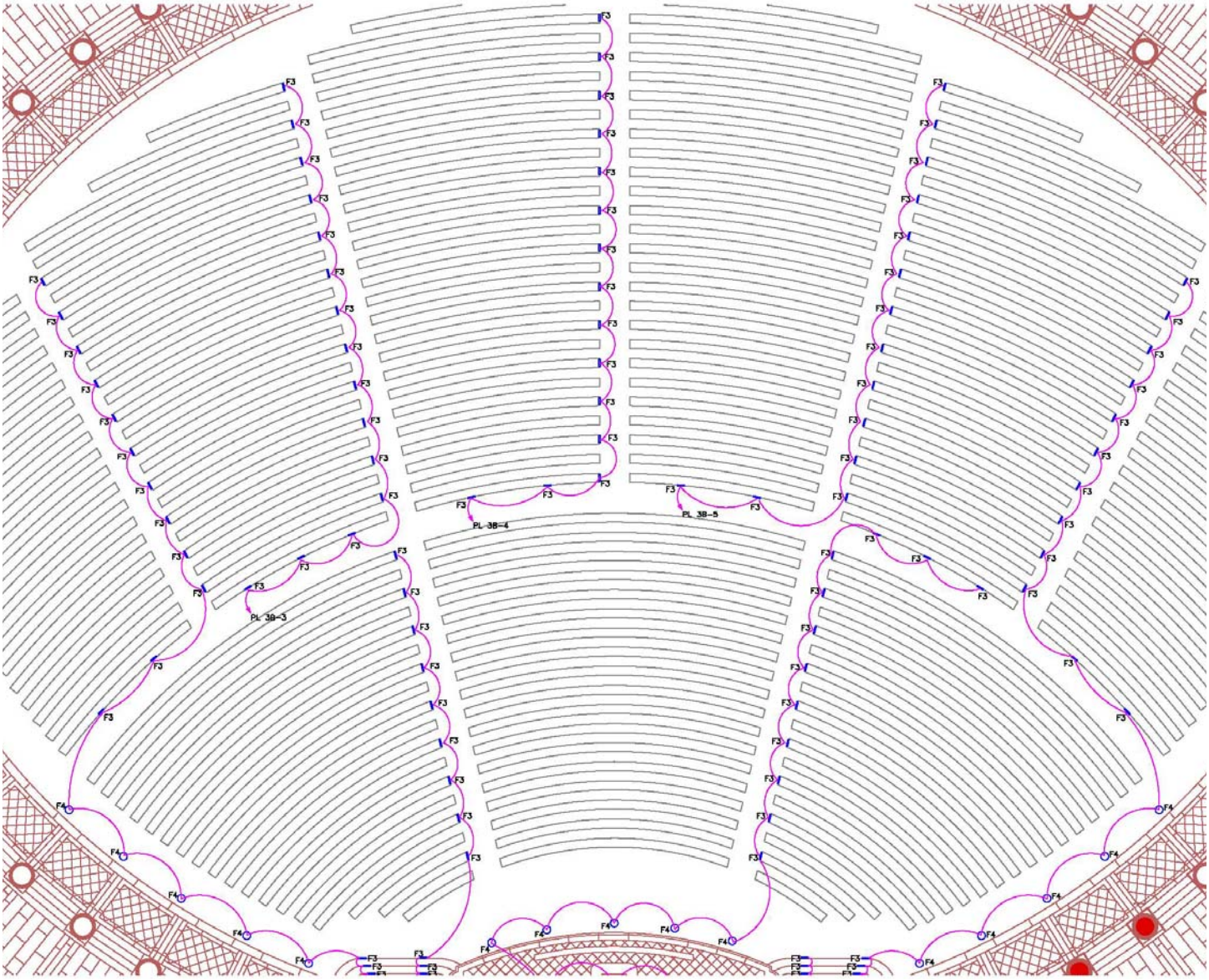
Renderings:



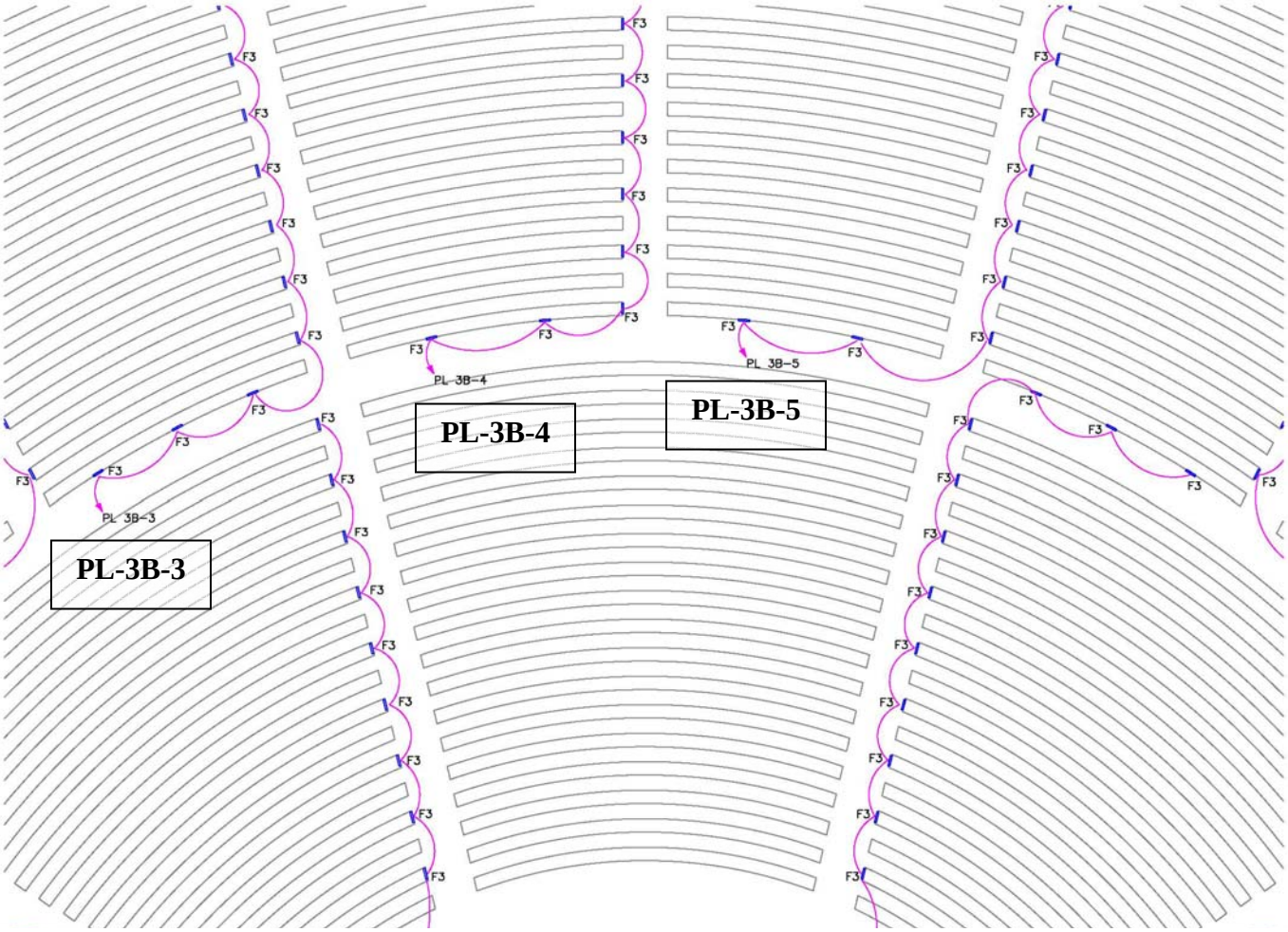


Wiring/Switching Diagrams:

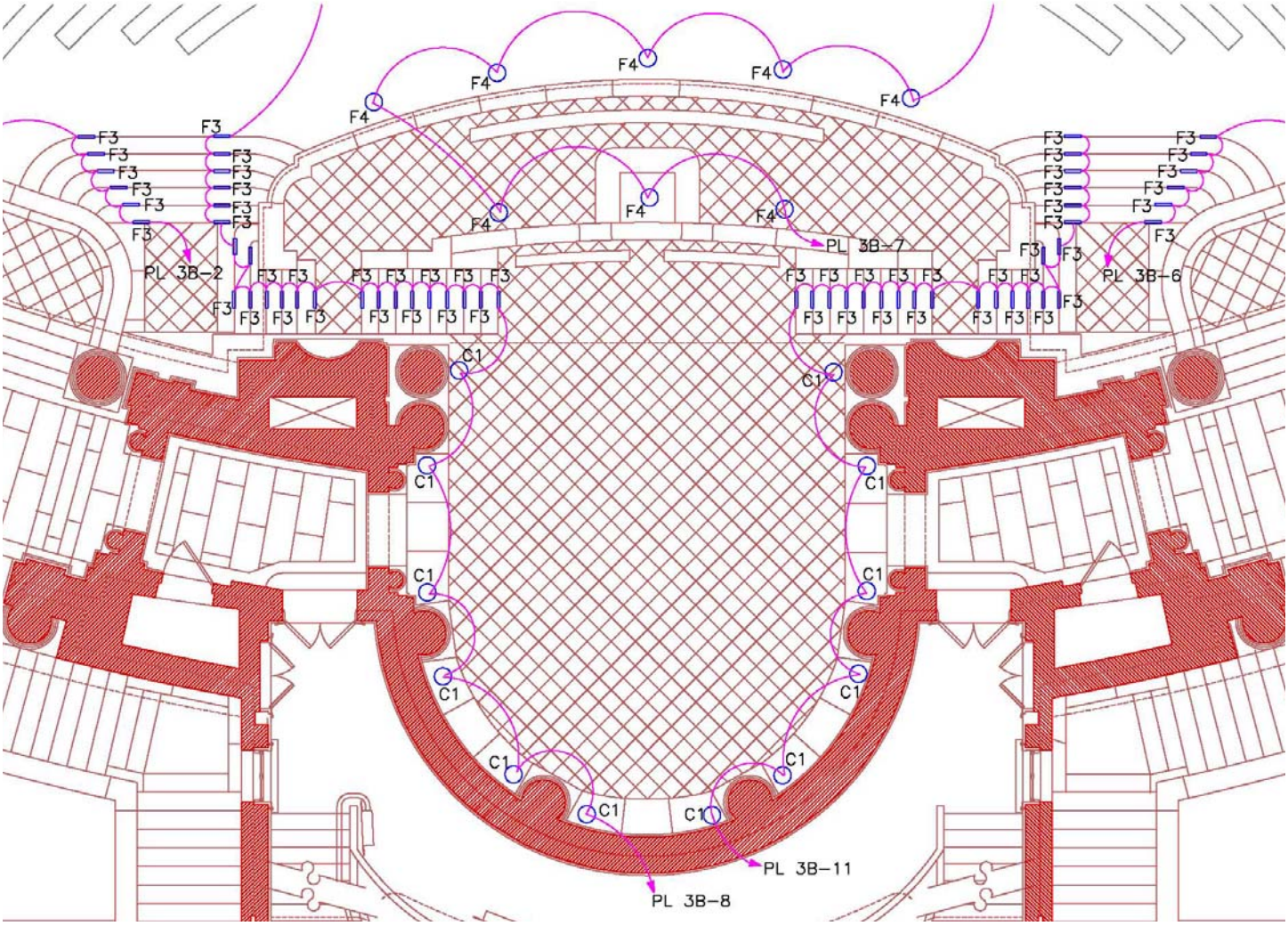




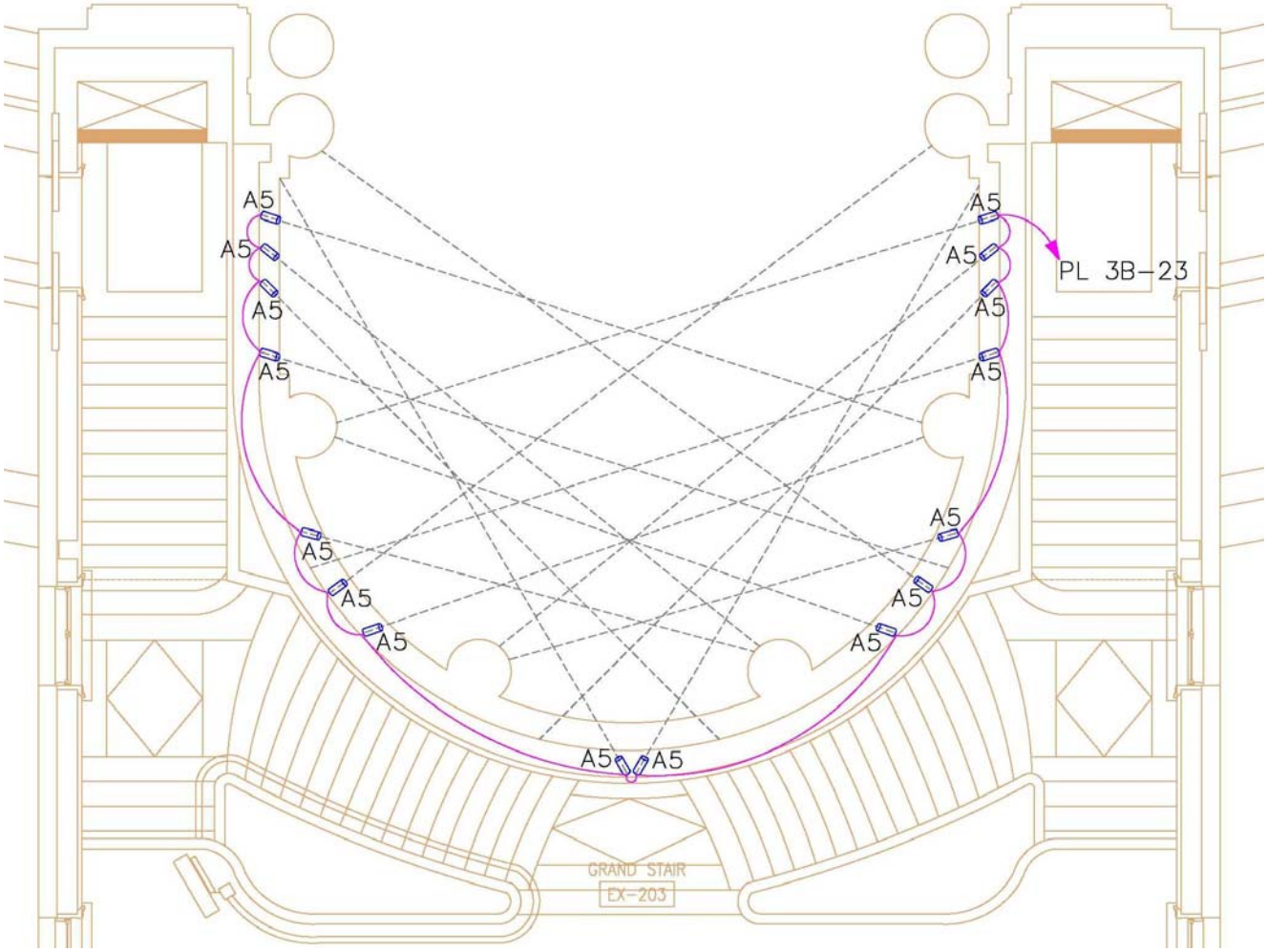
Note: All fixtures in seating area are F3.


PL-3B-3
PL-3B-4
PL-3B-5
PL 3B-3
PL 3B-4
PL 3B-5
F3

First Floor of Stage:



Second Floor of Stage:



Controls:

This space is controlled by a time clock with an override switch. It will be set to turn on at dusk and turn off at dawn.

Summary:

Overall the lighting system worked well. It lit what was designed to be lit as well as keeping the controlled guidelines such as no light pollution in mind. The controls allow the owner the ability to turn off the fixtures if they are not desired to be on as well as eliminating the hassle of turning them on every night. This design works well with this space.

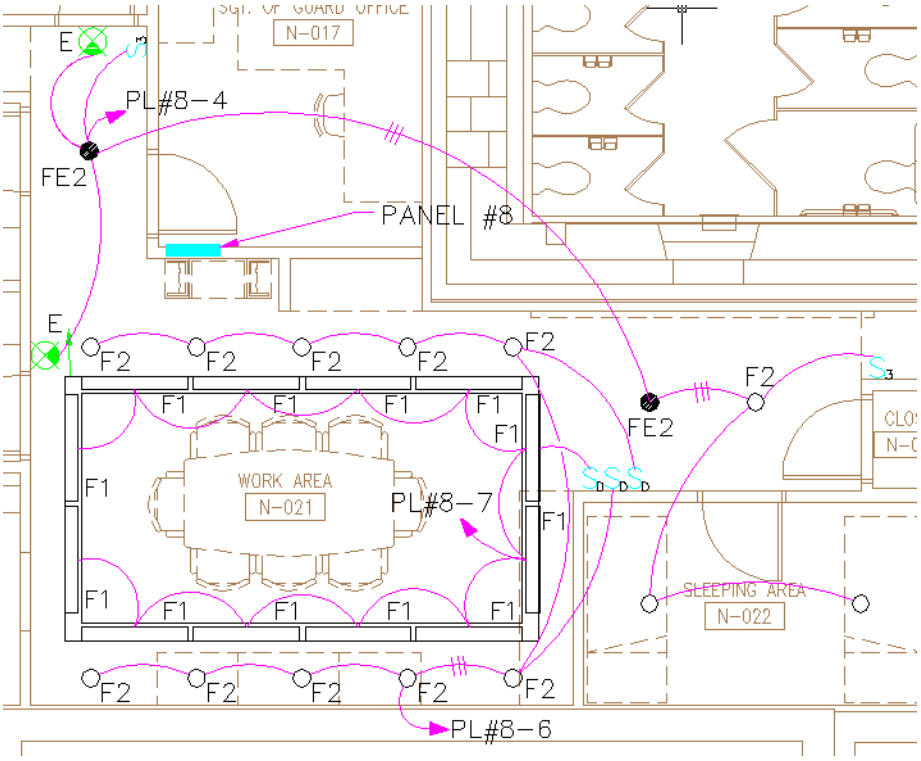
Electrical Depth

Lighting Electrical Coordination

With all the new lighting placed in the building, an electrical coordination needed to be completed to check to see if any equipment, such as wires and circuit breakers, needed to be resized. Wiring diagrams were designed to indicate which lights were going to which circuit. Existing and new panel boards were compiled to compare the two loads and main circuit breaker sizes at the panel board that directly changed from the new load all the way back to the main distribution panel. Finally, riser diagrams were completed to show and indicate new placement of equipment or wire sizing.

Work Area

Wiring/Switching Diagram:



Panel Board Schedules:

Existing 8:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W | PANEL TAG: 8 | MIN. C/B AIC: 10K
SIZE/TYPE BUS: 225A Copper | PANEL LOCATION: Tomb Gaurds Quarters | OPTIONS: 4#4/0 + 1#4G, 2 1/2"C
SIZE/TYPE MAIN: 225A/3P MLO | PANEL MOUNTING: SURFACE

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Receptacles	Room 1	600	20A/1P	1	*			2	20A/1P	1800	Practice Rm	Ex. Lights
Microwave		1000	20A/1P	3		*		4	20A/1P	300		Ex. Emergency Lts
Ex. Lights		800	20A/1P	5			*	6	20A/1P	900	Conf. Area	Ex. Lights
Spare		0	20A/1P	7	*			8	20A/1P	1500	Restroom	Ex. Lights
Ex. Lights		1400	20A/1P	9		*		10	20A/1P	0		Spare
Ex. Receptacles		800	20A/1P	11			*	12	20A/1P	1400	Practice Rm	Ex. Lights
Exhaust Fan (EF-2)	0	200	20A/1P	13	*			14	20A/1P	600	0	Ex. Receptacles
Ex. Receptacles	0	1600	20A/1P	15		*		16	20A/1P	1200	0	Ex. Receptacles
Ex. Receptacles	0	1000	20A/1P	17			*	18	20A/1P	400	0	Ex. Receptacles
Ex. Receptacles	0	200	20A/1P	19	*			20	20A/1P	1000	0	Ex. Receptacles
Ex. Receptacles	0	800	20A/1P	21		*		22	20A/1P	400	0	Ex. Receptacles
Dishwasher	0	1100	20A/1P	23			*	24	20A/1P	1200	0	Garbage Disposal
Existing Load	0	0	20A/1P	25	*			26	20A/1P	800	0	Refrigerator
Existing Load	0	0	20A/1P	27		*		28	20A/1P	0	0	Spare
Ex. Receptacles	0	1000	20A/1P	29			*	30	20A/1P	200		Ex. Receptacles
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	6.70	TOTAL DESIGN LOAD (KW)	23.11
CONNECTED LOAD (KW) - B	6.70	POWER FACTOR	0.92
CONNECTED LOAD (KW) - C	8.80	TOTAL DESIGN LOAD (AMPS)	70

New 8:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W | PANEL TAG: 8 | MIN. C/B AIC: 10K
SIZE/TYPE BUS: 100A Copper | PANEL LOCATION: Tomb Gaurds Quarters | OPTIONS: 4#3 + 1#8G, 1 1/4"C
SIZE/TYPE MAIN: 100A/3P MLO | PANEL MOUNTING: SURFACE

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Receptacles	Room 1	480	20A/1P	1	*			2	20A/1P	1764	Practice Rm	Ex. Lights
Ex. Microwave		1000	20A/1P	3		*		4	20A/1P	294	Conf. Area	New Lights
New Lights	Conf. Area	294	20A/1P	5			*	6	20A/1P	588	Conf. Area	Ex. Lights
New Lights	Conf. Area	800	20A/1P	7	*			8	20A/1P	1470	Restroom	Ex. Lights
Ex. Lights		1372	20A/1P	9		*		10	20A/1P	0		Spare
Ex. Receptacles		800	20A/1P	11			*	12	20A/1P	1400	Practice Rm	Ex. Lights
Ex. Exhaust Fan (EF-2)		200	20A/1P	13	*			14	20A/1P	480		Ex. Receptacles
Ex. Receptacles		1280	20A/1P	15		*		16	20A/1P	960		Ex. Receptacles
Ex. Receptacles		800	20A/1P	17			*	18	20A/1P	320		Ex. Receptacles
Ex. Receptacles		160	20A/1P	19	*			20	20A/1P	800		Ex. Receptacles
Ex. Receptacles		640	20A/1P	21		*		22	20A/1P	320		Ex. Receptacles
Ex. Dishwasher		1100	20A/1P	23			*	24	20A/1P	1200		Ex. Garbage Disposal
Existing Load		0	20A/1P	25	*			26	20A/1P	800		Ex. Refrigerator
Existing Load		0	20A/1P	27		*		28	20A/1P	0		Spare
Ex. Receptacles		800	20A/1P	29			*	30	20A/1P	160		Ex. Receptacles
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	6.95	TOTAL DESIGN LOAD (KW)	21.46
CONNECTED LOAD (KW) - B	5.87	POWER FACTOR	0.93
CONNECTED LOAD (KW) - C	7.46	TOTAL DESIGN LOAD (AMPS)	64

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					8	Panel Location:			Tomb Gaurds Quarters			
Nominal Phase to Neutral Voltage------->					120	Phase:			3			
Nominal Phase to Phase Voltage-------->					208	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks		
1	A	Ex. Receptacles	1	Room 1	0.6	kva	0.80	480	600			
2	A	Ex. Lights	3	Practice Rm	1.8	kva	0.98	1764	1800			
3	B	Ex. Microwave	8		1	kva	1.00	1000	1000			
4	B	New Lights	3	Conf. Area	0.3	kva	0.98	294	300			
5	C	New Lights	3	Conf. Area	0.3	kva	0.98	294	300			
6	C	Ex. Lights	3	Conf. Area	0.6	kva	0.98	588	600			
7	A	New Lights	3	Conf. Area	0.8	kva	1.00	800	800			
8	A	Ex. Lights	3	Restroom	1.5	kva	0.98	1470	1500			
9	B	Ex. Lights	3		1.4	kva	0.98	1372	1400			
10	B	Spare			0	kva	1.00	0	0			
11	C	Ex. Receptacles	1		0.8	kva	1.00	800	800			
12	C	Ex. Lights	5	Practice Rm	1.4	kva	1.00	1400	1400			
13	A	Ex. Exhaust Fan (EF-2)	6		0.2	kva	1.00	200	200			
14	A	Ex. Receptacles	1		0.6	kva	0.80	480	600			
15	B	Ex. Receptacles	1		1.6	kva	0.80	1280	1600			
16	B	Ex. Receptacles	1		1.2	kva	0.80	960	1200			
17	C	Ex. Receptacles	1		1	kva	0.80	800	1000			
18	C	Ex. Receptacles	1		0.4	kva	0.80	320	400			
19	A	Ex. Receptacles	1		0.2	kva	0.80	160	200			
20	A	Ex. Receptacles	1		1	kva	0.80	800	1000			
21	B	Ex. Receptacles	1		0.8	kva	0.80	640	800			
22	B	Ex. Receptacles	1		0.4	kva	0.80	320	400			
23	C	Ex. Dishwasher	8		1.1	kva	1.00	1100	1100			
24	C	Ex. Garbage Disposal	8		1.2	kva	1.00	1200	1200			
25	A	Existing Load			0	kva	1.00	0	0			
26	A	Ex. Refrigerator	8		0.8	kva	1.00	800	800			
27	B	Existing Load			0	kva	1.00	0	0			
28	B	Spare			0	kva	1.00	0	0			
29	C	Ex. Receptacles	1		1	kva	0.80	800	1000			
30	C	Ex. Receptacles	1		0.2	kva	0.80	160	200			
31	A				0	w		0	0			
32	A				0	w		0	0			
33	B				0	w		0	0			
34	B				0	w		0	0			
35	C				0	w		0	0			
36	C				0	w		0	0			
37	A				0	w		0	0			
38	A				0	w		0	0			
39	B				0	w		0	0			
40	B				0	w		0	0			
41	C				0	w		0	0			
42	C				0	w		0	0			
PANEL TOTAL								20.3	22.2	Amps=	61.7	

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					7.0	7.5	34%	62.5
PHASE TOTAL	B					5.9	6.7	30%	55.8
PHASE TOTAL	C					7.5	8.0	36%	66.7

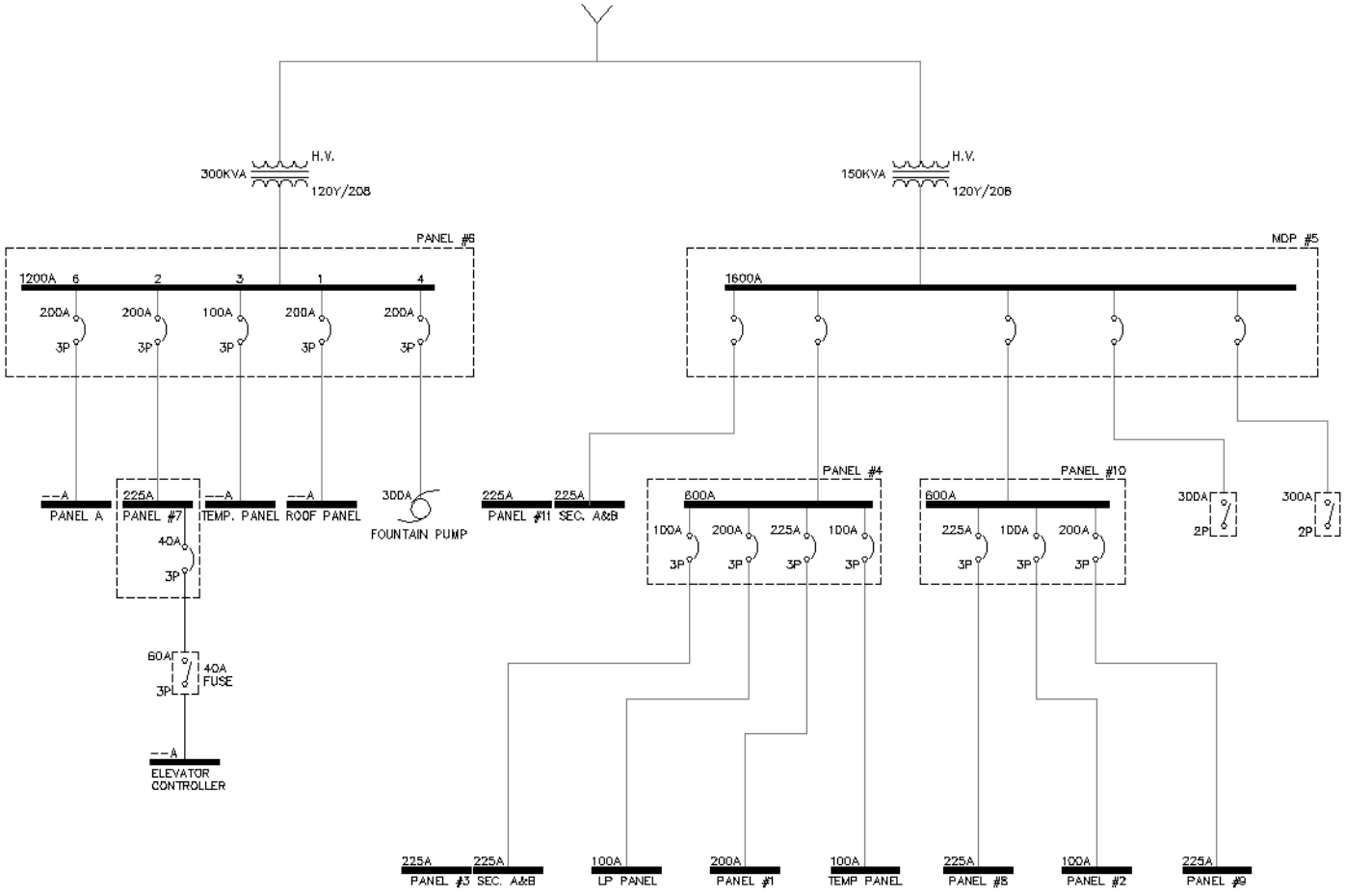
LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		8.0	9.8	0.70	5.6	6.9	0.82		
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		6.6	6.7	1.00	6.6	6.7	0.98		
4	HID lighting		0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting		1.4	1.4	1.00	1.4	1.4	1.00		
6	HVAC fans		0.2	0.2	1.00	0.2	0.2	1.00		
7	heating		0.0	0.0	1.00	0.0	0.0			
8	kitchen equipment		4.1	4.1	1.00	4.1	4.1	1.00		
Total Demand Loads						17.9	19.3			
Spare Capacity			20%			3.6	3.9			
Total Design Loads						21.5	23.1	0.93	Amps=	64.2

Main Circuit Breaker Sizing: 64Amps/0.8 = 80Amps/0.8 = 100Amps
(80% of max load per code, then 80% for good design practice)

Note: Panel 8 is being fed by panel 10 which is ultimately being fed by the main distribution panel number 5. This decrease in load is not enough to require the main circuit breaker on panel 10 to be resized, thus not requiring the MDP #5 main circuit breaker to be resized as well. The single line drawing does not change for this section.

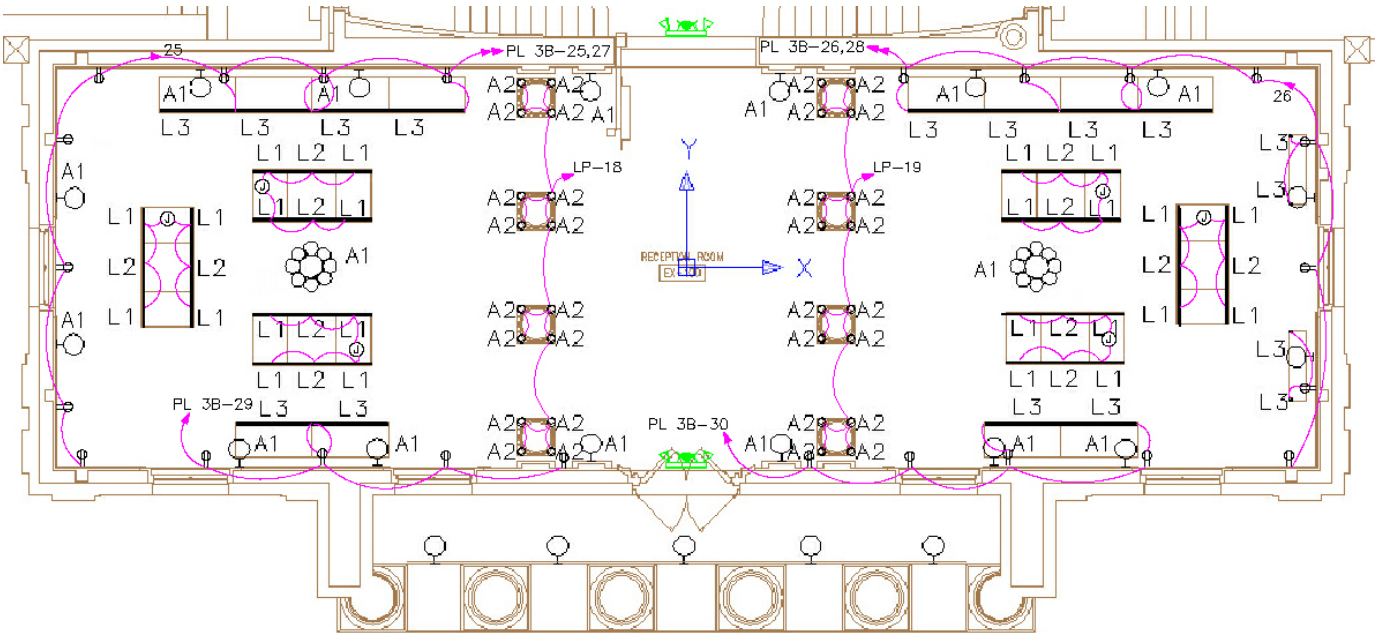
80% of max loading was assumed on all branches without loads listed on the drawings.

Riser Diagram:



Reception Room

Wiring/Switching Diagram:



Panel Board Schedules:

Existing 3 section A:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 A
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: Provide feed through lugs to section B
4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Spare	0	0	20A/1P	1	*			2	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Outside Wall Lts.	Outside	1920	20A/1P	3		*		4	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Inside Wall Doorway	First Floor	1920	20A/1P	5			*	6	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	7	*			8	20A/1P	1920	Second Fl.	Ex. Stairway Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	9		*		10	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	11			*	12	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Ex. Flag Spot Lights	Outside	1920	20A/1P	13	*			14	20A/1P	1920	Outside	Ex. Outside Wall Lts.
Ex. Track Lights	Second Fl.	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	17			*	18	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	19	*			20	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
New Security System	Basement	1000	20A/1P	21		*		22	20A/1P	1920	Second Fl.	Ex. Stairwas Ceiling Lts.
Ex. Recep. Under Panel	First Floor	1920	20A/1P	23			*	24	20A/1P	0		Spare
Ex. Recep. Under Panel	First Floor	1920	20A/1P	25	*			26	20A/1P	0		Spare
New Snow Melt	Outside	1100	20A/1P	27		*		28		0		Space Only
New Snow Melt	Outside	1100	20A/1P	29			*	30		0		Space Only
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	13.44	TOTAL DESIGN LOAD (KW)	46.23
CONNECTED LOAD (KW) - B	15.54	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	10.70	TOTAL DESIGN LOAD (AMPS)	128

New 3 section A:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 A
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Spare	0	1920	20A/1P	1	*			2	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Outside Wall Lts.	Outside	1920	20A/1P	3		*		4	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Inside Wall Doorway	First Floor	1920	20A/1P	5			*	6	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	7	*			8	20A/1P	1920	Second Fl.	Ex. Stairway Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	9		*		10	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	11			*	12	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Ex. Flag Spot Lights	Outside	1920	20A/1P	13	*			14	20A/1P	1920	Outside	Ex. Outside Wall Lts.
Ex. Track Lights	Second Fl.	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	17			*	18	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		1920	20A/1P	19	*			20	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Spare	0	0	20A/1P	21		*		22	20A/1P	1920	Second Fl.	Ex. Stairwas Ceiling Lts.
Ex. Recep. Under Panel	First Floor	1920	20A/1P	23			*	24	20A/1P	0		Spare
Ex. Recep. Under Panel	First Floor	1920	20A/1P	25	*			26	20A/1P	0		Spare
Ex. Snow Melt	Outside	1100	20A/1P	27		*		28		0		Space Only
Ex. Snow Melt	Outside	1100	20A/1P	29			*	30		0		Space Only
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	17.28	TOTAL DESIGN LOAD (KW)	49.64
CONNECTED LOAD (KW) - B	14.54	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	10.70	TOTAL DESIGN LOAD (AMPS)	138

Existing 3 section B:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 B
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	1	*			2	20A/1P	0	0	Spare
Spare	0	0	20A/1P	3		*		4	20A/1P	0	0	Spare
Spare	0	0	20A/1P	5			*	6	20A/1P	0	0	Spare
Spare	0	0	20A/1P	7	*			8	20A/1P	0	0	Spare
Ex. End Wall Light	First Floor	1920	20A/1P	9		*		10	20A/1P	1920	First Floor	Ex. Wheel Chair Lift
Ex. Outside Door	Outside	1920	20A/1P	11			*	12	20A/1P	1920	Second Fl.	Ex. Wheel Chair Lift
Ex. Back Wall Light	First Floor	1920	20A/1P	13	*			14	20A/1P	1920	Second Fl.	Ex. Recep. Navy Air
Ex. End Wall Light	First Floor	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	L-Stairwell Lights
Ex. Stairwell Light	Second Fl.	1920	20A/1P	17			*	18	20A/1P	1920	First Floor	Ex. Above Panel
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	19	*			20	20A/1P	1920	Second Fl.	Ex. Stairwell Lights
Ex. Inside Wall Light	First Floor	1920	20A/1P	21		*		22	20A/1P	1920	First Floor	Ex. Center Hall Lights
Ex. Outside Door Lights	Outside	1920	20A/1P	23			*	24	20A/1P	1920	First Floor	Ex. Inside Wall Lights
New Receptacle	First Floor	800	20A/1P	25	*			26	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	27		*		28	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	29			*	30	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	31	*			32	20A/1P	800	Second Fl.	New Receptacle
New Receptacle	Second Fl.	800	20A/1P	33		*		34	20A/1P	800	Second Fl.	New Receptacle
New Receptacle (Grave)	Second Fl.	2	20A/1P	35			*	36	20A/1P	1	Second Fl.	New J. Boxes
Space Only	Second Fl.	0		37	*			38	20A/1P	1	Second Fl.	New J. Boxes
Space Only	Second Fl.	0		39		*		40		0		Space Only
Space Only	First Floor	0		41			*	42		0		Space Only
CONNECTED LOAD (KW) - A		12.80								TOTAL DESIGN LOAD (KW)		45.20
CONNECTED LOAD (KW) - B		14.72								POWER FACTOR		1.00
CONNECTED LOAD (KW) - C		13.12								TOTAL DESIGN LOAD (AMPS)		126

New 3 section B:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 250A Copper
SIZE/TYPE MAIN: 250A/3P MLO

PANEL TAG: 3 B
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#250 MCM + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	1	*			2	20A/1P	444	Amphitheater	New Lights
New Lights	Amphitheater	195	20A/1P	3		*		4	20A/1P	195	Amphitheater	New Lights
New Lights	Amphitheater	182	20A/1P	5			*	6	20A/1P	444	Amphitheater	New Lights
New Lights	Amphitheater	492	20A/1P	7	*			8	20A/1P	626	Amphitheater	New Lights
Ex. End Wall Light	First Floor	1920	20A/1P	9		*		10	20A/1P	1920	First Floor	Ex. Wheel Chair Lift
New Lights	Amphitheater	626	20A/1P	11			*	12	20A/1P	1920	Second Fl.	Ex. Wheel Chair Lift
Ex. Back Wall Light	First Floor	1920	20A/1P	13	*			14	20A/1P	1920	Second Fl.	Ex. Recep. Navy Air
Ex. End Wall Light	First Floor	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. L-Stairwell Lights
Ex. Stairwell Light	Second Fl.	1920	20A/1P	17			*	18	20A/1P	1920	First Floor	Ex. Above Panel
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	19	*			20	20A/1P	1920	Second Fl.	Ex. Stairwell Lights
Ex. Inside Wall Light	First Floor	1920	20A/1P	21		*		22	20A/1P	1920	First Floor	Ex. Center Hall Lights
New Lights	Amphitheater	800	20A/1P	23			*	24	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Receptacle	First Floor	1920	20A/1P	25	*			26	20A/1P	1920	First Floor	Receptacle
Receptacle	First Floor	1920	20A/1P	27		*		28	20A/1P	1920	First Floor	Receptacle
Receptacle	First Floor	1920	20A/1P	29			*	30	20A/1P	1920	First Floor	Receptacle
Ex. Receptacle	Second Fl.	800	20A/1P	31	*			32	20A/1P	800	Second Fl.	Ex. Receptacle
Ex. Receptacle	Second Fl.	800	20A/1P	33		*		34	20A/1P	800	Second Fl.	Ex. Receptacle
Ex. Receptacle (Grave)	First Floor	1800	20A/1P	35			*	36	20A/1P	1000	Second Fl.	Ex. J. Boxes
New Fl. Recessed Recept.	First Floor	1920	20A/1P	37	*			38	20A/1P	1000	Second Fl.	Ex. J. Boxes
New Fl. Recessed Recept.	First Floor	1920	20A/1P	39		*		40		0		Space Only
Space Only		0		41			*	42		0		Space Only
CONNECTED LOAD (KW) - A		19.52								TOTAL DESIGN LOAD (KW)		57.46
CONNECTED LOAD (KW) - B		19.27								POWER FACTOR		1.00
CONNECTED LOAD (KW) - C		16.37								TOTAL DESIGN LOAD (AMPS)		160

Existing LP:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A Copper
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: LP
PANEL LOCATION: Electical Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#1 + 1#8G, 1 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Fixture Type H5	Chapel	200	20A/1P	1	*			2	20A/1P	1800	Award R.	Fixture Type G
Fixture Type F9 &9A	Chapel	300	20A/1P	3		*		4	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	5			*	6	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	7	*			8	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	9		*		10	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type H5A	Chapel	200	20A/1P	11			*	12	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F9 &9A	Chapel	300	20A/1P	13	*			14	20A/1P	200	Chapel	Fixture Type H5
Fixture Type F8	Chapel	800	20A/1P	15		*		16	20A/1P	200	Chapel	Fixture Type H5
Fixture Type K	Recep. Rm.	200	20A/1P	17			*	18	20A/1P	0		Spare
Spare		0	20A/1P	19	*			20	20A/1P	0		Spare
Spare		0	20A/1P	21		*		22	20A/1P	500	Award Rm.	Ex. Wall Sconce
Spare		0	20A/1P	23			*	24	20A/1P	500	Award Rm.	Ex. Wall Sconce
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	4.80	TOTAL DESIGN LOAD (KW)	18.84
CONNECTED LOAD (KW) - B	5.90	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	5.00	TOTAL DESIGN LOAD (AMPS)	52

New LP:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A Copper
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: LP
PANEL LOCATION: Electical Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#3 + 1#8G, 1 1/4"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
New Lighting 'A3'	Chapel	100	20A/1P	1	*			2	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'A4'	Chapel	450	20A/1P	3		*		4	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'F5'	Chapel	169	20A/1P	5			*	6	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'F5'	Chapel	169	20A/1P	7	*			8	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'L4, L5'	Chapel	300	20A/1P	9		*		10	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
Spare	0	0	20A/1P	11			*	12	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
Spare	0	0	20A/1P	13	*			14	20A/1P	0	0	Spare
Spare	0	0	20A/1P	15		*		16	20A/1P	0	0	Spare
Ex. Fixt. 'K'	Recept Rm	200	20A/1P	17			*	18	20A/1P	1200	Recept Rm	New Fixture 'A2'
New Fixture 'A2'	Recept Rm	1200	20A/1P	19	*			20	20A/1P	0	Recept Rm	Spare
Spare		0	20A/1P	21		*		22	20A/1P	500	Award Rm	Ex. Wall Sconce
Spare		0	20A/1P	23			*	24	20A/1P	500	Award Rm	Ex. Wall Sconce
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	5.07	TOTAL DESIGN LOAD (KW)	18.71
CONNECTED LOAD (KW) - B	4.85	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	5.67	TOTAL DESIGN LOAD (AMPS)	52

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					3 A	Panel Location:			First Floor Electrical Closet		
Nominal Phase to Neutral Voltage------->					120	Phase:			3		
Nominal Phase to Phase Voltage-------->					208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Spare	8		1920	w	1.00	1920	1920		
2	A	Ex. Track Lights U.L.	5	Second Fl.	1920	w	1.00	1920	1920		
3	B	Ex. Outside Wall Lts.	5	Outside	1920	w	1.00	1920	1920		
4	B	Ex. Track Lights U.L.	5	Second Fl.	1920	w	1.00	1920	1920		
5	C	Ex. Inside Wall Doorway	5	First Floor	1920	w	1.00	1920	1920		
6	C	Ex. Inside Wall Lights	5	First Floor	1920	w	1.00	1920	1920		
7	A	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
8	A	Ex. Stairway Lights	5	Second Fl.	1920	w	1.00	1920	1920		
9	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
10	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
11	C	Spare	8			w	1.00	0	0		
12	C	Ex. Inside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
13	A	Ex. Flag Spot Lights	4	Outside	1920	w	1.00	1920	1920		
14	A	Ex. Outside Wall Lts.	5	Outside	1920	w	1.00	1920	1920		
15	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
16	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
17	C	Spare	8			w	1.00	0	0		
18	C	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
19	A	Spare	8		1920	w	1.00	1920	1920		
20	A	Ex. Inside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
21	B	Spare	8			w	1.00	0	0		
22	B	Ex. Stairwas Ceiling Lts.	5	Second Fl.	1920	w	1.00	1920	1920		
23	C	Ex. Recep. Under Panel	1	First Floor	1920	w	1.00	1920	1920		
24	C	Spare	8			w	1.00	0	0		
25	A	Ex. Recep. Under Panel	1	First Floor	1920	w	1.00	1920	1920		
26	A	Spare	8			w	1.00	0	0		
27	B	Ex. Snow Melt	8	Outside	1100	w	1.00	1100	1100		
28	B	Space Only	8			w	1.00	0	0		
29	C	Ex. Snow Melt	8	Outside	1100	w	1.00	1100	1100		
30	C	Space Only	8			w	1.00	0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								42.5	42.5	Amps=	118.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					17.3	17.3	41%	144.0
PHASE TOTAL	B					14.5	14.5	34%	121.2
PHASE TOTAL	C					10.7	10.7	25%	89.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		3.8	3.8	0.70	2.7	2.7	1.00		
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		0.0	0.0	1.00	0.0	0.0			
4	HID lighting		1.9	1.9	1.00	1.9	1.9	1.00		
5	incandescent lighting		30.7	30.7	1.00	30.7	30.7	1.00		
6	HVAC fans		0.0	0.0	1.00	0.0	0.0			
7	heating		0.0	0.0	1.00	0.0	0.0			
8	other		6.0	6.0	1.00	6.0	6.0	1.00		
Total Demand Loads						41.4	41.4			
Spare Capacity			20%			8.3	8.3			
Total Design Loads						49.6	49.6	1.00	Amps=	137.9

Main Circuit Breaker Sizing: 138Amps/0.8 = 172.5Amps/0.8 = 216Amps
(80% of max load per code, then 80% for good design practice)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					3 B	Panel Location:			First Floor Electrical Closet		
Nominal Phase to Neutral Voltage------->					120	Phase:			3		
Nominal Phase to Phase Voltage-------->					208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Ex. Outside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
2	A	New Lights	3	Amphitheater	444	w	1.00	444	444		
3	B	New Lights	3	Amphitheater	195	w	1.00	195	195		
4	B	New Lights	3	Amphitheater	195	w	1.00	195	195		
5	C	New Lights	3	Amphitheater	182	w	1.00	182	182		
6	C	New Lights	3	Amphitheater	444	w	1.00	444	444		
7	A	New Lights	3	Amphitheater	492	w	1.00	492	492		
8	A	New Lights	3	Amphitheater	626	w	1.00	626	626		
9	B	Ex. End Wall Light	5	First Floor	1920	w	1.00	1920	1920		
10	B	Ex. Wheel Chair Lift	8	First Floor	1920	w	1.00	1920	1920		
11	C	New Lights	3	Amphitheater	626	w	1.00	626	626		
12	C	Ex. Wheel Chair Lift	8	Second Fl.	1920	w	1.00	1920	1920		
13	A	Ex. Back Wall Light	5	First Floor	1920	w	1.00	1920	1920		
14	A	Ex. Recep. Navy Air	1	Second Fl.	1920	w	1.00	1920	1920		
15	B	Ex. End Wall Light	5	First Floor	1920	w	1.00	1920	1920		
16	B	Ex. L-Stairwell Lights	5	Second Fl.	1920	w	1.00	1920	1920		
17	C	Ex. Stairwell Light	5	Second Fl.	1920	w	1.00	1920	1920		
18	C	Ex. Above Panel	5	First Floor	1920	w	1.00	1920	1920		
19	A	Ex. Outside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
20	A	Ex. Stairwell Lights	5	Second Fl.	1920	w	1.00	1920	1920		
21	B	Ex. Inside Wall Light	5	First Floor	1920	w	1.00	1920	1920		
22	B	Ex. Center Hall Lights	5	First Floor	1920	w	1.00	1920	1920		
23	C	New Lights	5	Amphitheater	800	w	1.00	800	800		
24	C	Ex. Inside Wall Lights	5	First Floor	1920	w	1.00	1920	1920		
25	A	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
26	A	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
27	B	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
28	B	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
29	C	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
30	C	Receptacle	1	First Floor	1920	w	1.00	1920	1920		
31	A	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800		
32	A	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800		
33	B	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800		
34	B	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800		
35	C	Ex. Receptacle (Grave)	1	First Floor	1800	w	1.00	1800	1800		
36	C	Ex. J. Boxes	1	Second Fl.	1000	w	1.00	1000	1000		
37	A	New Fl. Recessed Recept.	1	First Floor	1920	w	1.00	1920	1920		
38	A	Ex. J. Boxes	1	Second Fl.	1000	w	1.00	1000	1000		
39	B	New Fl. Recessed Recept.	1	First Floor	1920	w	1.00	1920	1920		
40	B	Space Only				w		0	0		
41	C	Space Only				w		0	0		
42	C	Space Only				w		0	0		
PANEL TOTAL								55.2	55.2	Amps=	153.2

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					19.5	19.5	35%	162.7
PHASE TOTAL	B					19.3	19.3	35%	160.6
PHASE TOTAL	C					16.4	16.4	30%	136.4

LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		24.3	24.3	0.70	17.0	17.0	1.00		
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		3.2	3.2	1.00	3.2	3.2	1.00		
4	HID lighting		0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting		23.8	23.8	1.00	23.8	23.8	1.00		
6	HVAC fans		0.0	0.0	1.00	0.0	0.0			
7	heating		0.0	0.0	1.00	0.0	0.0			
8	other		3.8	3.8	1.00	3.8	3.8	1.00		
Total Demand Loads						47.9	47.9			
Spare Capacity			20%			9.6	9.6			
Total Design Loads						57.5	57.5	1.00	Amps=	159.6

Main Circuit Breaker Sizing: 160mps/0.8 = 200Amps/0.8 = 250Amps
(80% of max load per code, then 80% for good design practice)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP	Panel Location:			Electical Room		
Nominal Phase to Neutral Voltage------->					120	Phase:			3		
Nominal Phase to Phase Voltage-------->					208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	New Lighting 'A3'	5	Chapel	0.1	kva	1.00	100	100		
2	A	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
3	B	New Lighting 'A4'	5	Chapel	0.45	kva	1.00	450	450		
4	B	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
5	C	New Lighting 'F5'	3	Chapel	0.169	kva	1.00	169	169		
6	C	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
7	A	New Lighting 'F5'	5	Chapel	0.169	kva	1.00	169	169		
8	A	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
9	B	New Lighting 'L4, L5'	5	Chapel	0.3	kva	1.00	300	300		
10	B	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
11	C	Spare	5			kva	1.00	0	0		
12	C	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800		
13	A	Spare	5			kva	1.00	0	0		
14	A	Spare	5			kva	1.00	0	0		
15	B	Spare	5			kva	1.00	0	0		
16	B	Spare	5			kva	1.00	0	0		
17	C	Ex. Fixt. 'K'	5	Recept Rm	0.2	kva	1.00	200	200		
18	C	New Fixture 'A2'	5	Recept Rm	1.2	kva	1.00	1200	1200		
19	A	New Fixture 'A2'	5	Recept Rm	1.2	kva	1.00	1200	1200		
20	A	Spare	5	Recept Rm		kva	1.00	0	0		
21	B	Spare			0	kva	1.00	0	0		
22	B	Ex. Wall Sconce	5	Award Rm	0.5	kva	1.00	500	500		
23	C	Spare			0	kva	1.00	0	0		
24	C	Ex. Wall Sconce	5	Award Rm	0.5	kva	1.00	500	500		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								15.6	15.6	Amps=	43.3

PHASE LOADING					kW	kVA	%	Amps
PHASE TOTAL	A				5.1	5.1	33%	42.2
PHASE TOTAL	B				4.9	4.9	31%	40.4
PHASE TOTAL	C				5.7	5.7	36%	47.2

LOAD CATAGORIES		Connected			Demand				Ver. 1.01
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	0.0	0.0	0.70	0.0	0.0			
2	computers	0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting	0.2	0.2	1.00	0.2	0.2	1.00		
4	HID lighting	0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting	15.4	15.4	1.00	15.4	15.4	1.00		
6	HVAC fans	0.0	0.0	1.00	0.0	0.0			
7	heating	0.0	0.0	1.00	0.0	0.0			
8	kitchen equipment	0.0	0.0	1.00	0.0	0.0			
Total Demand Loads					15.6	15.6			
Spare Capacity		20%			3.1	3.1			
Total Design Loads					18.7	18.7	1.00	Amps=	52.0

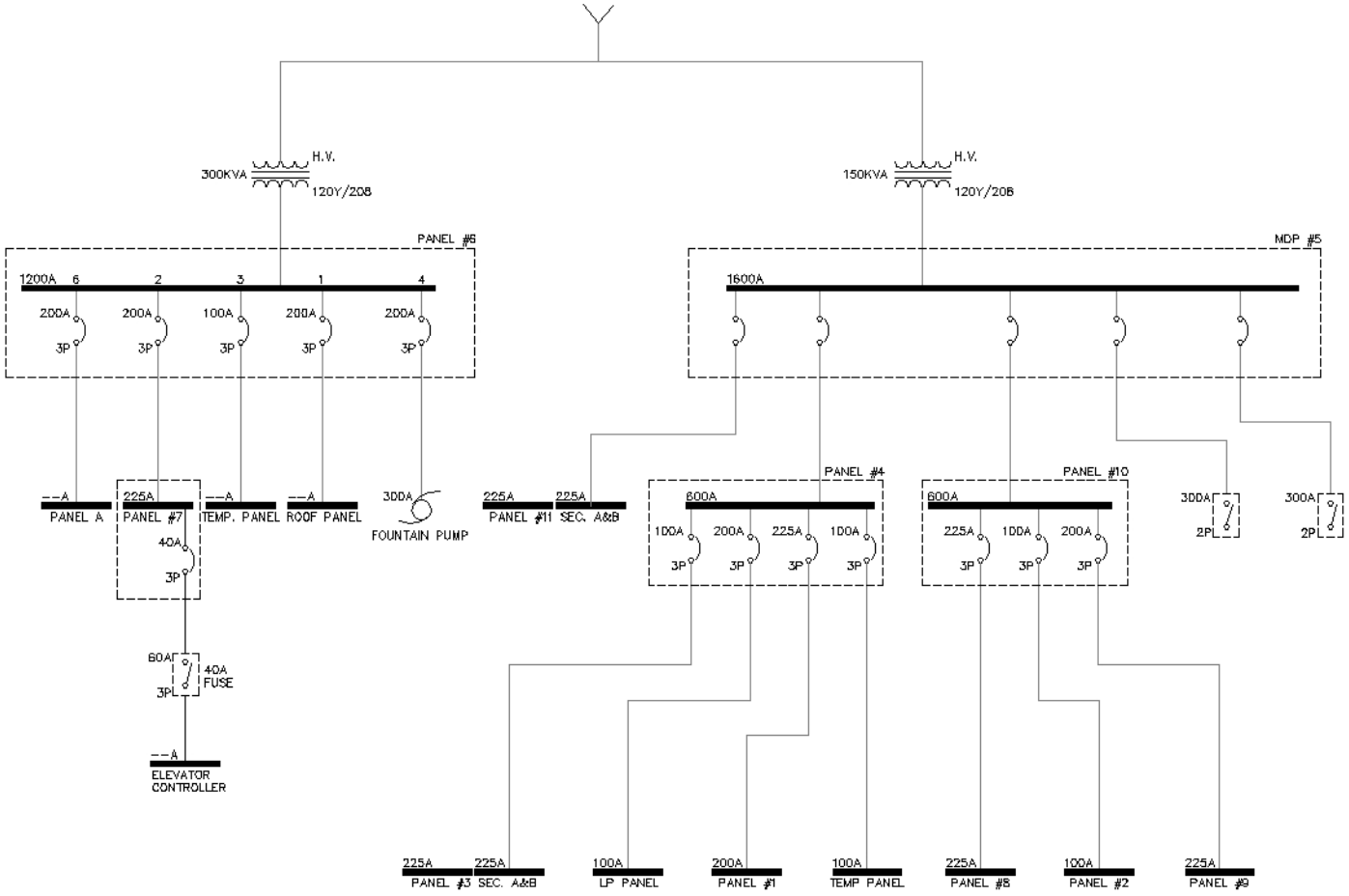
Main Circuit Breaker Sizing: 52Amps/0.8 = 65Amps/0.8 = 82Amps
(80% of max load per code, then 80% for good design practice)

Note: Both panel 3 and the LP panels are being fed by panel 4 which is being fed by the main distribution panel #5. All the final loads for these panel boards in this space did not change dramatically enough to resize the main circuit breaker in panel 4 or MDP #5. The single line drawing does not change for this section.

80% of max loading was assumed on all branches without loads listed on the drawings.

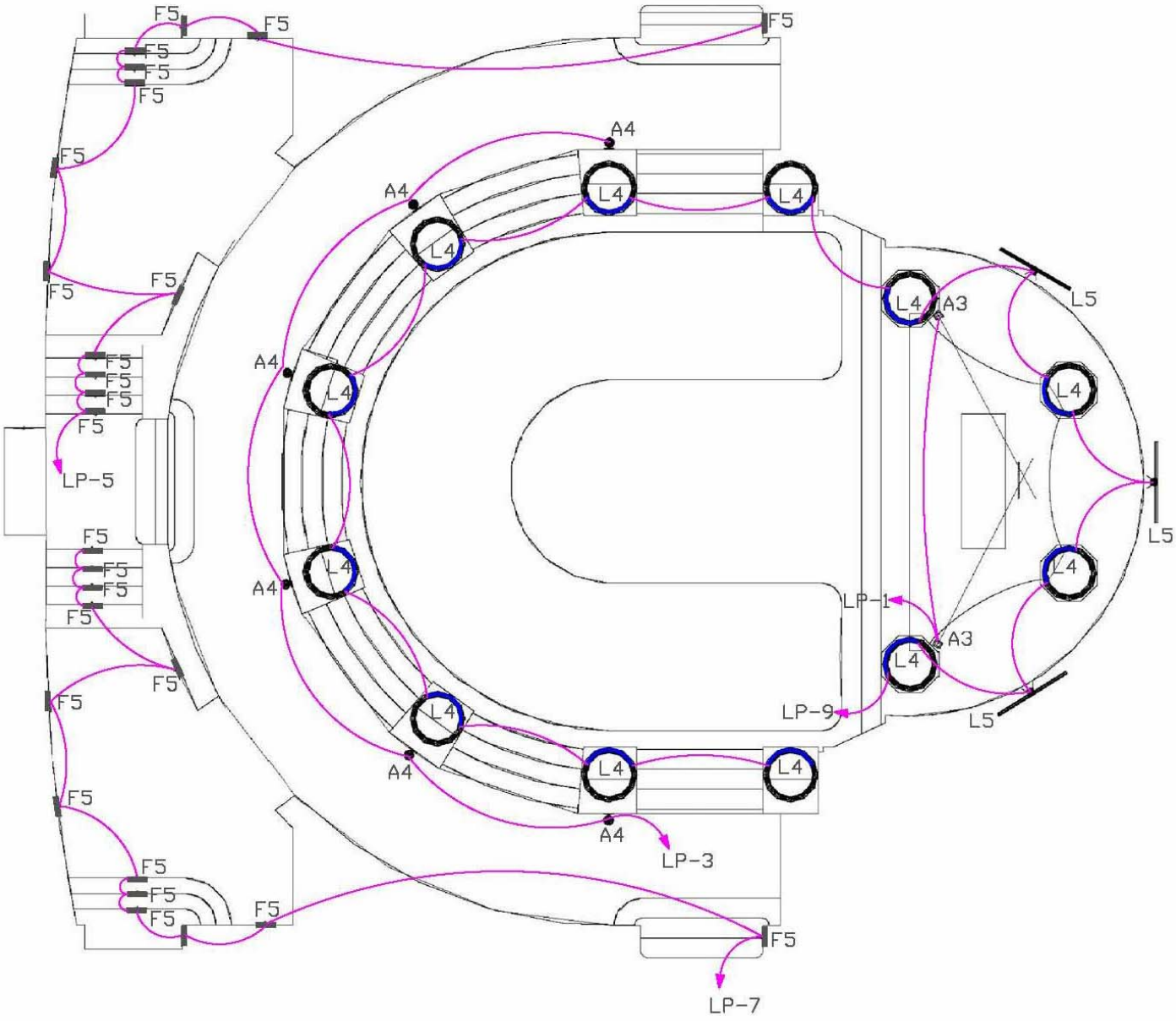
There were no changes required for Panel 3 Section A since no new loads were added and the MLO only size for section B did not increase.

Riser Diagram:



Crypt Chapel

Wiring/Switching Diagram:



Panel Board Schedules:

Existing LP:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A Copper
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: LP
PANEL LOCATION: Electical Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#1 + 1#8G, 1 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Fixture Type H5	Chapel	200	20A/1P	1	*			2	20A/1P	1800	Award R.	Fixture Type G
Fixture Type F9 &9A	Chapel	300	20A/1P	3		*		4	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	5			*	6	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	7	*			8	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F10	Chapel	500	20A/1P	9		*		10	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type H5A	Chapel	200	20A/1P	11			*	12	20A/1P	1800	Award Rm.	Fixture Type G
Fixture Type F9 &9A	Chapel	300	20A/1P	13	*			14	20A/1P	200	Chapel	Fixture Type H5
Fixture Type F8	Chapel	800	20A/1P	15		*		16	20A/1P	200	Chapel	Fixture Type H5
Fixture Type K	Recep. Rm.	200	20A/1P	17			*	18	20A/1P	0		Spare
Spare		0	20A/1P	19	*			20	20A/1P	0		Spare
Spare		0	20A/1P	21		*		22	20A/1P	500	Award Rm.	Ex. Wall Sconce
Spare		0	20A/1P	23			*	24	20A/1P	500	Award Rm.	Ex. Wall Sconce
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	4.80	TOTAL DESIGN LOAD (KW)	18.84
CONNECTED LOAD (KW) - B	5.90	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	5.00	TOTAL DESIGN LOAD (AMPS)	52

New LP:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A Copper
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: LP
PANEL LOCATION: Electical Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#3 + 1#8G, 1 1/4"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
New Lighting 'A3'	Chapel	100	20A/1P	1	*			2	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'A4'	Chapel	450	20A/1P	3		*		4	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'F5'	Chapel	169	20A/1P	5			*	6	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'F5'	Chapel	169	20A/1P	7	*			8	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
New Lighting 'L4, L5'	Chapel	300	20A/1P	9		*		10	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
Spare	0	0	20A/1P	11			*	12	20A/1P	1800	Award Rm	Ex. Fixt. 'G'
Spare	0	0	20A/1P	13	*			14	20A/1P	0	0	Spare
Spare	0	0	20A/1P	15		*		16	20A/1P	0	0	Spare
Ex. Fixt. 'K'	Recept Rm	200	20A/1P	17			*	18	20A/1P	1200	Recept Rm	New Fixture 'A2'
New Fixture 'A2'	Recept Rm	1200	20A/1P	19	*			20	20A/1P	0	Recept Rm	Spare
Spare		0	20A/1P	21		*		22	20A/1P	500	Award Rm	Ex. Wall Sconce
Spare		0	20A/1P	23			*	24	20A/1P	500	Award Rm	Ex. Wall Sconce
		0		25	*			26		0		
		0		27		*		28		0		
		0		29			*	30		0		
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	5.07	TOTAL DESIGN LOAD (KW)	18.71
CONNECTED LOAD (KW) - B	4.85	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	5.67	TOTAL DESIGN LOAD (AMPS)	52

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP	Panel Location:			Electical Room			
Nominal Phase to Neutral Voltage------->					120	Phase:			3			
Nominal Phase to Phase Voltage-------->					208	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks		
1	A	New Lighting 'A3'	5	Chapel	0.1	kva	1.00	100	100			
2	A	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
3	B	New Lighting 'A4'	5	Chapel	0.45	kva	1.00	450	450			
4	B	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
5	C	New Lighting 'F5'	3	Chapel	0.169	kva	1.00	169	169			
6	C	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
7	A	New Lighting 'F5'	5	Chapel	0.169	kva	1.00	169	169			
8	A	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
9	B	New Lighting 'L4, L5'	5	Chapel	0.3	kva	1.00	300	300			
10	B	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
11	C	Spare	5			kva	1.00	0	0			
12	C	Ex. Fixt. 'G'	5	Award Rm	1.8	kva	1.00	1800	1800			
13	A	Spare	5			kva	1.00	0	0			
14	A	Spare	5			kva	1.00	0	0			
15	B	Spare	5			kva	1.00	0	0			
16	B	Spare	5			kva	1.00	0	0			
17	C	Ex. Fixt. 'K'	5	Recept Rm	0.2	kva	1.00	200	200			
18	C	New Fixture 'A2'	5	Recept Rm	1.2	kva	1.00	1200	1200			
19	A	New Fixture 'A2'	5	Recept Rm	1.2	kva	1.00	1200	1200			
20	A	Spare	5	Recept Rm		kva	1.00	0	0			
21	B	Spare			0	kva	1.00	0	0			
22	B	Ex. Wall Sconce	5	Award Rm	0.5	kva	1.00	500	500			
23	C	Spare			0	kva	1.00	0	0			
24	C	Ex. Wall Sconce	5	Award Rm	0.5	kva	1.00	500	500			
25	A				0	w		0	0			
26	A				0	w		0	0			
27	B				0	w		0	0			
28	B				0	w		0	0			
29	C				0	w		0	0			
30	C				0	w		0	0			
31	A				0	w		0	0			
32	A				0	w		0	0			
33	B				0	w		0	0			
34	B				0	w		0	0			
35	C				0	w		0	0			
36	C				0	w		0	0			
37	A				0	w		0	0			
38	A				0	w		0	0			
39	B				0	w		0	0			
40	B				0	w		0	0			
41	C				0	w		0	0			
42	C				0	w		0	0			
PANEL TOTAL								15.6	15.6	Amps=	43.3	

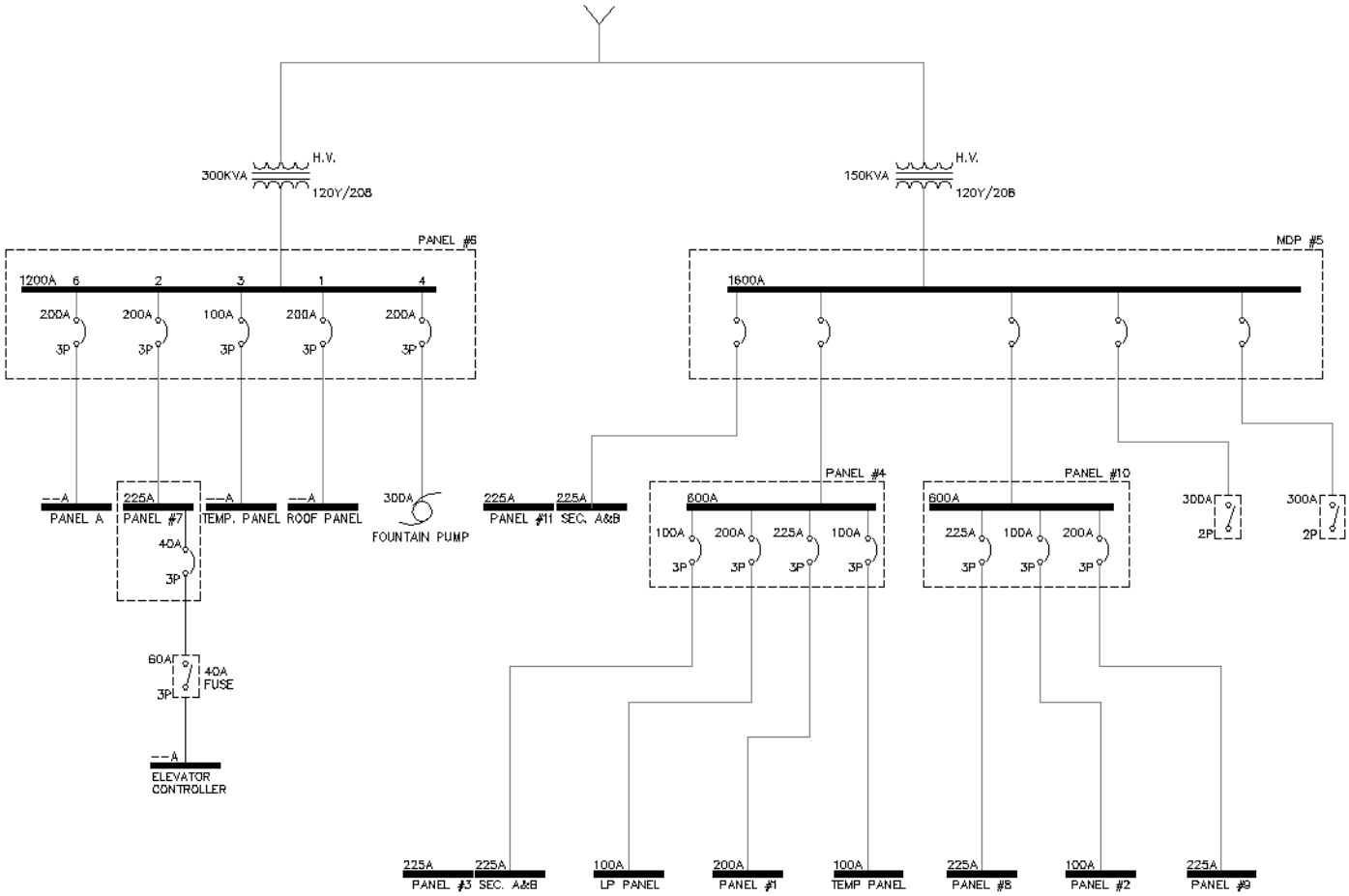
PHASE LOADING					kW	kVA	%	Amps
PHASE TOTAL	A				5.1	5.1	33%	42.2
PHASE TOTAL	B				4.9	4.9	31%	40.4
PHASE TOTAL	C				5.7	5.7	36%	47.2

LOAD CATAGORIES		Connected			Demand				Ver. 1.01
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	0.0	0.0	0.70	0.0	0.0			
2	computers	0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting	0.2	0.2	1.00	0.2	0.2	1.00		
4	HID lighting	0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting	15.4	15.4	1.00	15.4	15.4	1.00		
6	HVAC fans	0.0	0.0	1.00	0.0	0.0			
7	heating	0.0	0.0	1.00	0.0	0.0			
8	kitchen equipment	0.0	0.0	1.00	0.0	0.0			
Total Demand Loads					15.6	15.6			
Spare Capacity		20%			3.1	3.1			
Total Design Loads					18.7	18.7	1.00	Amps=	52.0

Main Circuit Breaker Sizing: 52Amps/0.8 = 65Amps/0.8 = 82Amps
(80% of max load per code, then 80% for good design practice)

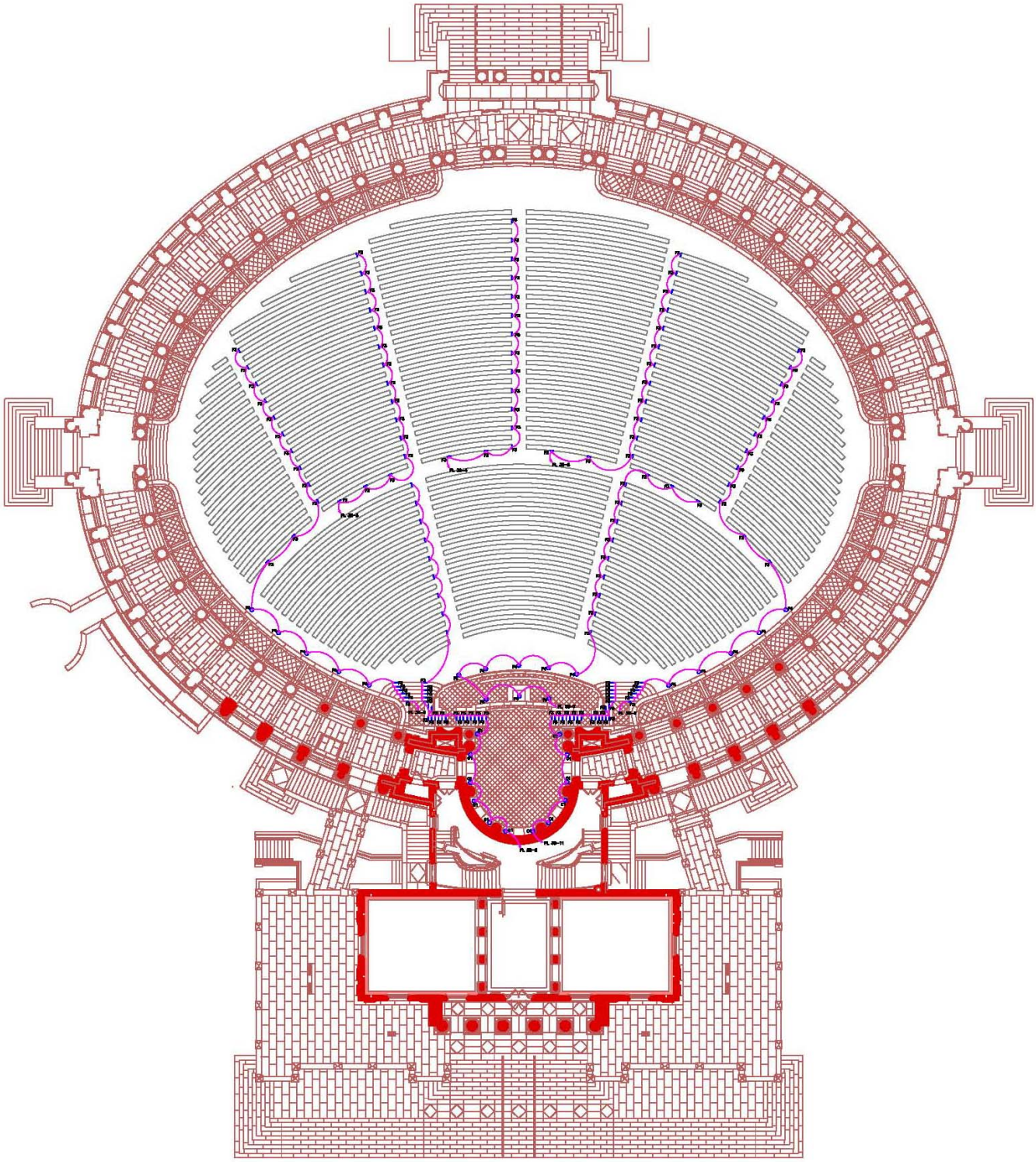
Note: Panel LP is being fed by panel 4 which is being fed by the main distribution panel #5. The final load for panel LP in this space did not change dramatically enough to resize the main circuit breaker in panel 4 or MDP #5. The single line drawing does not change for this section.

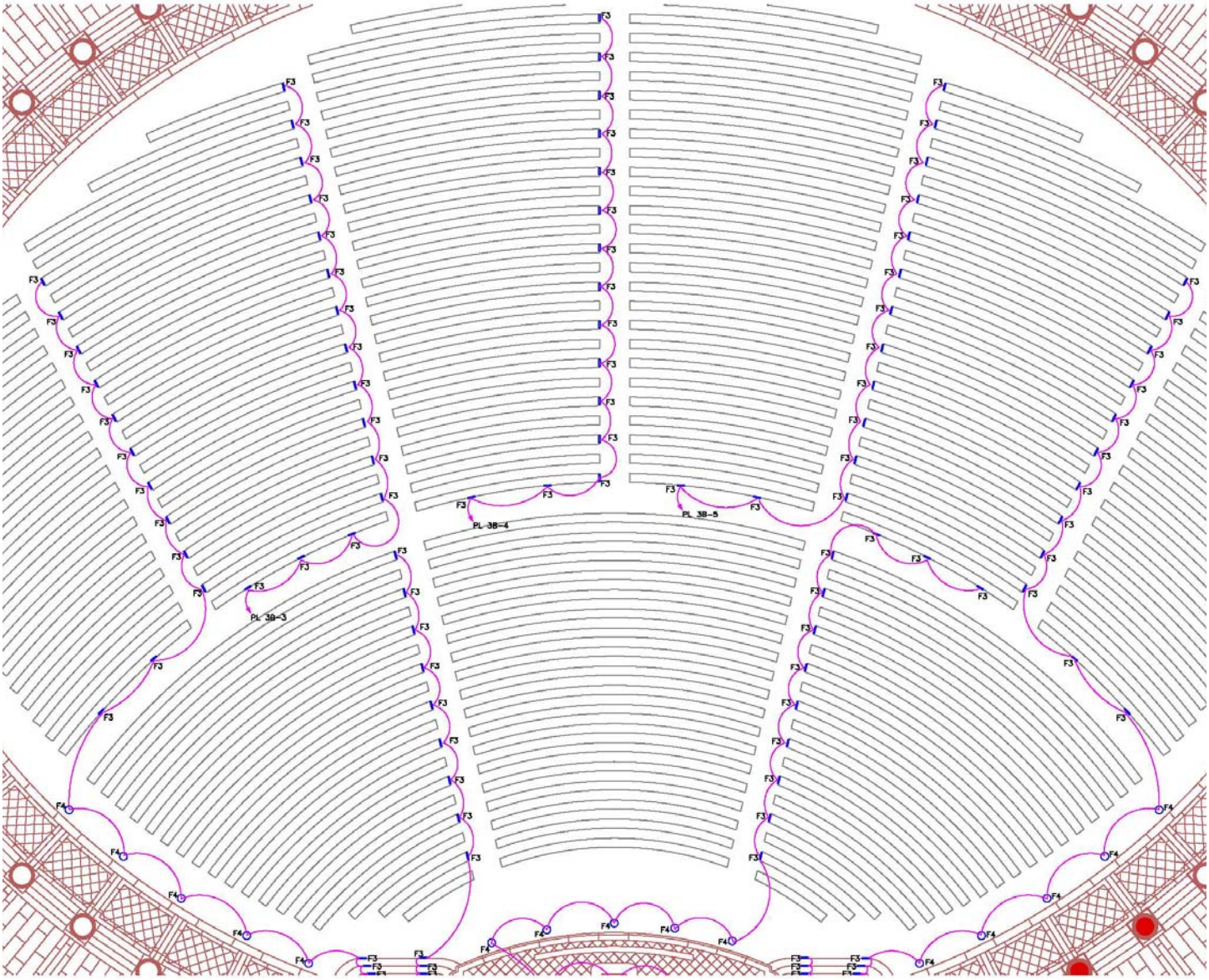
Riser Diagram:



Amphitheater

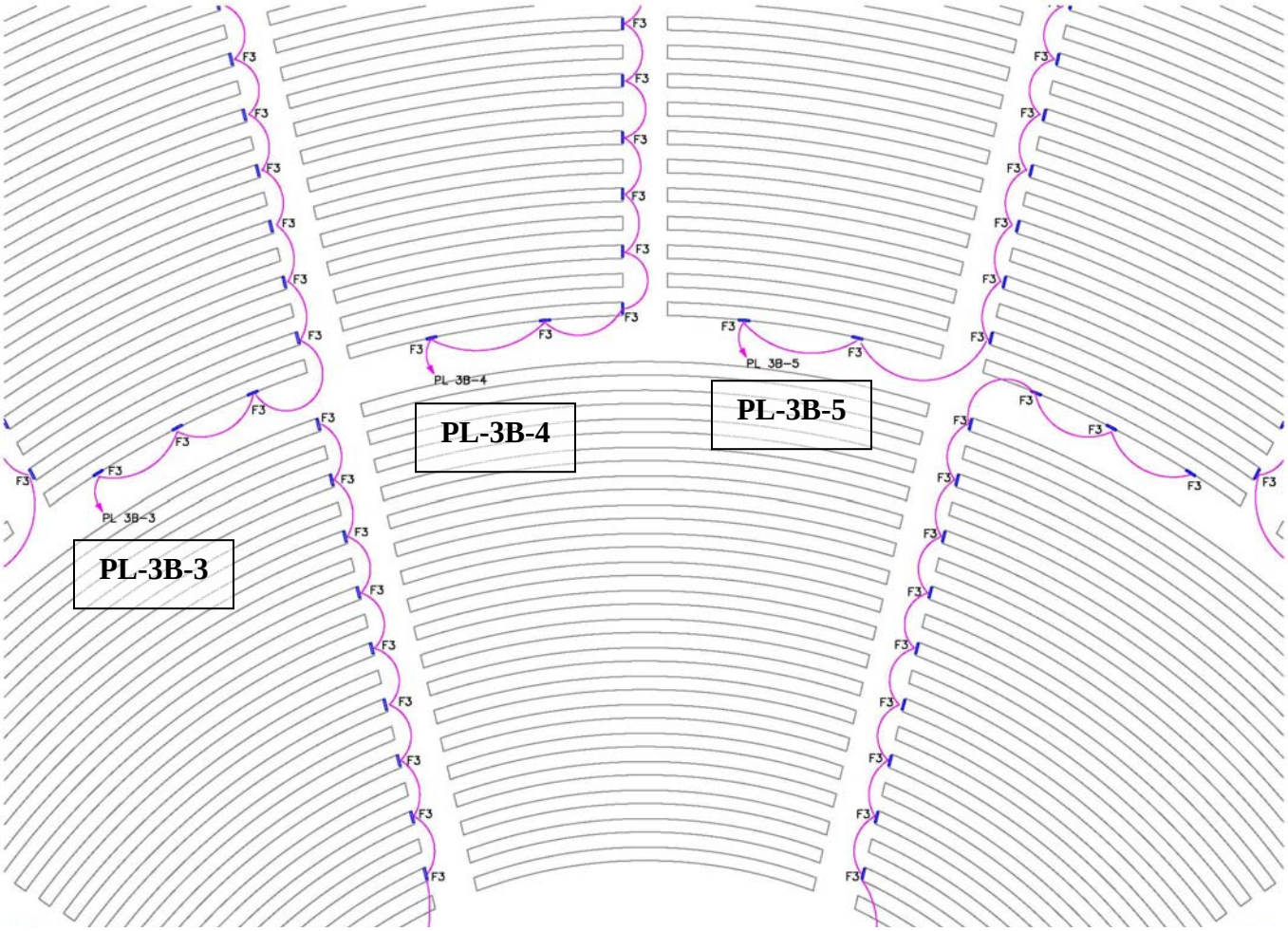
Wiring/Switching Diagram:



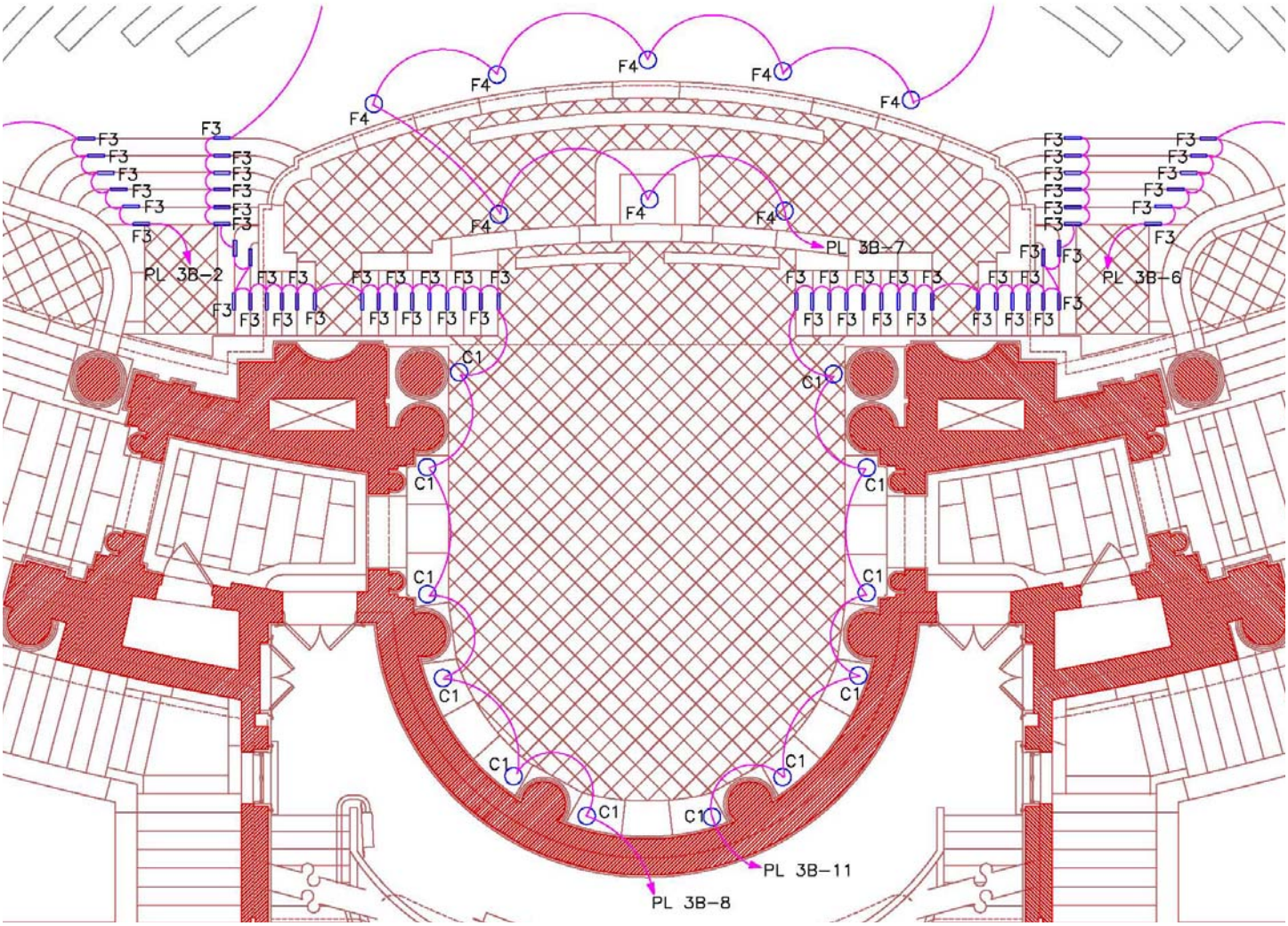


Note: All fixtures in seating area are F3.

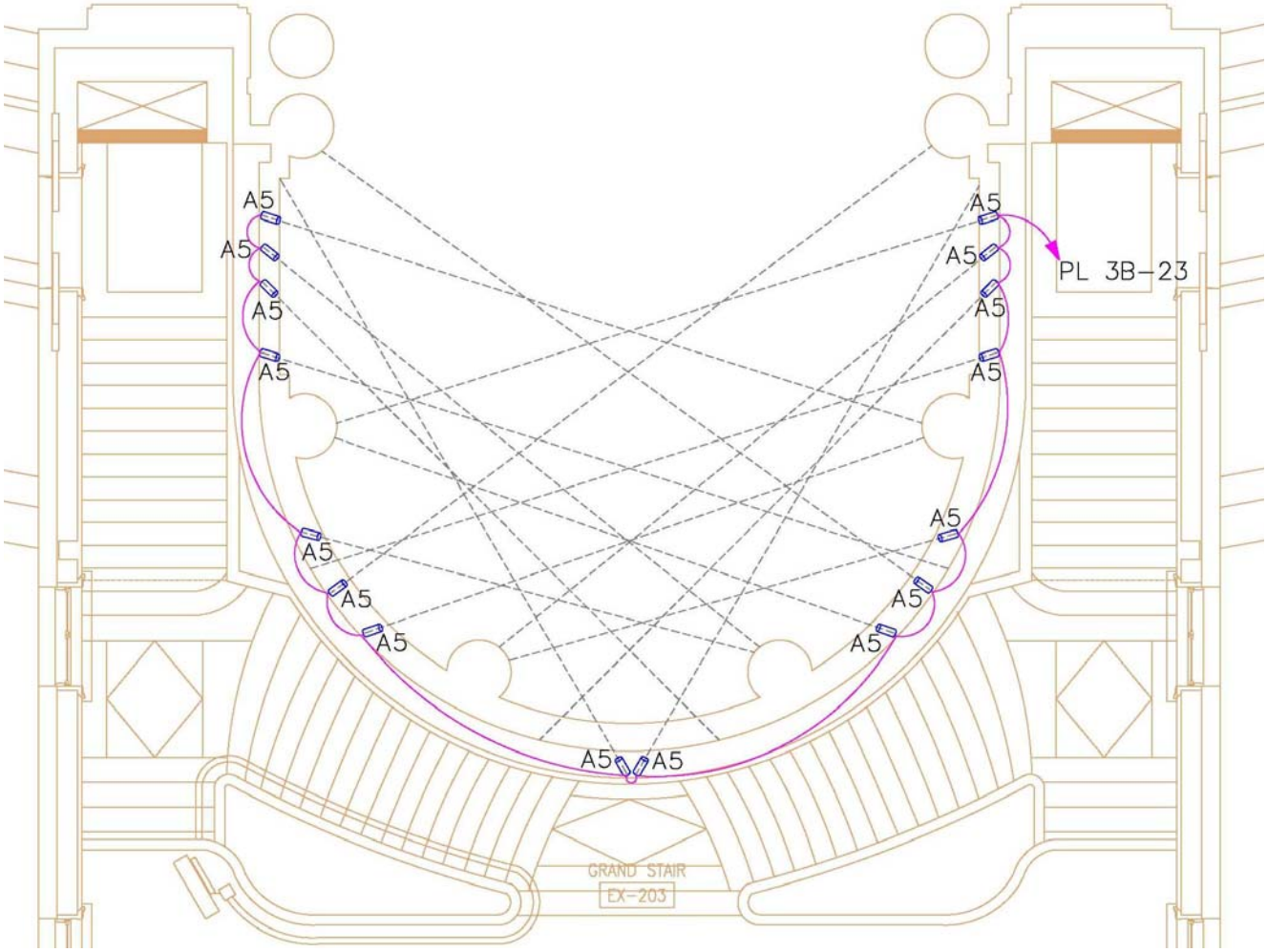
Seating Area:



First Floor of Stage:



Second Floor of Stage:



Panel Board Schedules:

Existing 3 section A:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 A
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Spare	0	1920	20A/1P	1	*			2	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Outside Wall Lts.	Outside	1920	20A/1P	3		*		4	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Inside Wall Doorway	First Floor	1920	20A/1P	5			*	6	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	7	*			8	20A/1P	1920	Second Fl.	Ex. Stairway Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	9		*		10	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	11			*	12	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Ex. Flag Spot Lights	Outside	1920	20A/1P	13	*			14	20A/1P	1920	Outside	Ex. Outside Wall Lts.
Ex. Track Lights	Second Fl.	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	17			*	18	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		1920	20A/1P	19	*			20	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Spare	0	0	20A/1P	21		*		22	20A/1P	1920	Second Fl.	Ex. Stairwas Ceiling Lts.
Ex. Recep. Under Panel	First Floor	1920	20A/1P	23			*	24	20A/1P	0		Spare
Ex. Recep. Under Panel	First Floor	1920	20A/1P	25	*			26	20A/1P	0		Spare
Ex. Snow Melt	Outside	1100	20A/1P	27		*		28		0		Space Only
Ex. Snow Melt	Outside	1100	20A/1P	29			*	30		0		Space Only
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	17.28	TOTAL DESIGN LOAD (KW)	49.64
CONNECTED LOAD (KW) - B	14.54	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	10.70	TOTAL DESIGN LOAD (AMPS)	138

New 3 section A:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 A
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Spare	0	1920	20A/1P	1	*			2	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Outside Wall Lts.	Outside	1920	20A/1P	3		*		4	20A/1P	1920	Second Fl.	Ex. Track Lights U.L.
Ex. Inside Wall Doorway	First Floor	1920	20A/1P	5			*	6	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	7	*			8	20A/1P	1920	Second Fl.	Ex. Stairway Lights
Ex. Track Lights	Second Fl.	1920	20A/1P	9		*		10	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	11			*	12	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Ex. Flag Spot Lights	Outside	1920	20A/1P	13	*			14	20A/1P	1920	Outside	Ex. Outside Wall Lts.
Ex. Track Lights	Second Fl.	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		0	20A/1P	17			*	18	20A/1P	1920	Second Fl.	Ex. Track Lights
Spare		1920	20A/1P	19	*			20	20A/1P	1920	First Floor	Ex. Inside Wall Lts.
Spare	0	0	20A/1P	21		*		22	20A/1P	1920	Second Fl.	Ex. Stairwas Ceiling Lts.
Ex. Recep. Under Panel	First Floor	1920	20A/1P	23			*	24	20A/1P	0		Spare
Ex. Recep. Under Panel	First Floor	1920	20A/1P	25	*			26	20A/1P	0		Spare
Ex. Snow Melt	Outside	1100	20A/1P	27		*		28		0		Space Only
Ex. Snow Melt	Outside	1100	20A/1P	29			*	30		0		Space Only
		0		31	*			32		0		
		0		33		*		34		0		
		0		35			*	36		0		
		0		37	*			38		0		
		0		39		*		40		0		
		0		41			*	42		0		

CONNECTED LOAD (KW) - A	17.28	TOTAL DESIGN LOAD (KW)	49.64
CONNECTED LOAD (KW) - B	14.54	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	10.70	TOTAL DESIGN LOAD (AMPS)	138

Existing 3 section B:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 B
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	1	*			2	20A/1P	0	0	Spare
Spare	0	0	20A/1P	3		*		4	20A/1P	0	0	Spare
Spare	0	0	20A/1P	5			*	6	20A/1P	0	0	Spare
Spare	0	0	20A/1P	7	*			8	20A/1P	0	0	Spare
Ex. End Wall Light	First Floor	1920	20A/1P	9		*		10	20A/1P	1920	First Floor	Ex. Wheel Chair Lift
Ex. Outside Door	Outside	1920	20A/1P	11			*	12	20A/1P	1920	Second Fl.	Ex. Wheel Chair Lift
Ex. Back Wall Light	First Floor	1920	20A/1P	13	*			14	20A/1P	1920	Second Fl.	Ex. Recep. Navy Air
Ex. End Wall Light	First Floor	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	L-Stairwell Lights
Ex. Stairwell Light	Second Fl.	1920	20A/1P	17			*	18	20A/1P	1920	First Floor	Ex. Above Panel
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	19	*			20	20A/1P	1920	Second Fl.	Ex. Stairwell Lights
Ex. Inside Wall Light	First Floor	1920	20A/1P	21		*		22	20A/1P	1920	First Floor	Ex. Center Hall Lights
Ex. Outside Door Lights	Outside	1920	20A/1P	23			*	24	20A/1P	1920	First Floor	Ex. Inside Wall Lights
New Receptacle	First Floor	800	20A/1P	25	*			26	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	27		*		28	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	29			*	30	20A/1P	800	First Floor	New Receptacle
New Receptacle	First Floor	800	20A/1P	31	*			32	20A/1P	800	Second Fl.	New Receptacle
New Receptacle	Second Fl.	800	20A/1P	33		*		34	20A/1P	800	Second Fl.	New Receptacle
New Receptacle (Grave)	Second Fl.	2	20A/1P	35			*	36	20A/1P	1	Second Fl.	New J. Boxes
Space Only	Second Fl.	0		37	*			38	20A/1P	1	Second Fl.	New J. Boxes
Space Only	Second Fl.	0		39		*		40		0		Space Only
Space Only	First Floor	0		41			*	42		0		Space Only

CONNECTED LOAD (KW) - A	12.80	TOTAL DESIGN LOAD (KW)	45.20
CONNECTED LOAD (KW) - B	14.72	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	13.12	TOTAL DESIGN LOAD (AMPS)	126

New 3 section B:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 200A Copper
SIZE/TYPE MAIN: 225A/3P MLO

PANEL TAG: 3 B
PANEL LOCATION: First Floor Electrical Closet
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: 4#4/0 + 1#4G, 2 1/2"C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	1	*			2	20A/1P	444	Amphitheater	New Lights
New Lights	Amphitheater	195	20A/1P	3		*		4	20A/1P	195	Amphitheater	New Lights
New Lights	Amphitheater	182	20A/1P	5			*	6	20A/1P	444	Amphitheater	New Lights
New Lights	Amphitheater	492	20A/1P	7	*			8	20A/1P	626	Amphitheater	New Lights
Ex. End Wall Light	First Floor	1920	20A/1P	9		*		10	20A/1P	1920	First Floor	Ex. Wheel Chair Lift
New Lights	Amphitheater	0	20A/1P	11			*	12	20A/1P	1920	Second Fl.	Ex. Wheel Chair Lift
Ex. Back Wall Light	First Floor	1920	20A/1P	13	*			14	20A/1P	1920	Second Fl.	Ex. Recep. Navy Air
Ex. End Wall Light	First Floor	1920	20A/1P	15		*		16	20A/1P	1920	Second Fl.	Ex. L-Stairwell Lights
Ex. Stairwell Light	Second Fl.	1920	20A/1P	17			*	18	20A/1P	1920	First Floor	Ex. Above Panel
Ex. Outside Wall Lts.	First Floor	1920	20A/1P	19	*			20	20A/1P	1920	Second Fl.	Ex. Stairwell Lights
Ex. Inside Wall Light	First Floor	1920	20A/1P	21		*		22	20A/1P	1920	First Floor	Ex. Center Hall Lights
New Lights	Amphitheater	800	20A/1P	23			*	24	20A/1P	1920	First Floor	Ex. Inside Wall Lights
Receptacle	First Floor	0	20A/1P	25	*			26	20A/1P	0	First Floor	Receptacle
Receptacle	First Floor	0	20A/1P	27		*		28	20A/1P	0	First Floor	Receptacle
Receptacle	First Floor	0	20A/1P	29			*	30	20A/1P	0	First Floor	Receptacle
Ex. Receptacle	Second Fl.	800	20A/1P	31	*			32	20A/1P	800	Second Fl.	Ex. Receptacle
Ex. Receptacle	Second Fl.	800	20A/1P	33		*		34	20A/1P	800	Second Fl.	Ex. Receptacle
Ex. Receptacle (Grave)	First Floor	1800	20A/1P	35			*	36	20A/1P	1000	Second Fl.	Ex. J. Boxes
New Fl. Recessed Recept.	First Floor	0	20A/1P	37	*			38	20A/1P	1000	Second Fl.	Ex. J. Boxes
New Fl. Recessed Recept.	First Floor	0	20A/1P	39		*		40		0		Space Only
Space Only		0		41			*	42		0		Space Only

CONNECTED LOAD (KW) - A	13.76	TOTAL DESIGN LOAD (KW)	43.80
CONNECTED LOAD (KW) - B	13.51	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	11.91	TOTAL DESIGN LOAD (AMPS)	122

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					3 A	Panel Location:			First Floor Electrical Closet		
Nominal Phase to Neutral Voltage------->					120	Phase:			3		
Nominal Phase to Phase Voltage-------->					208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Spare	8		1920	w	1.00	1920	1920		
2	A	Ex. Track Lights U.L.	5	Second Fl.	1920	w	1.00	1920	1920		
3	B	Ex. Outside Wall Lts.	5	Outside	1920	w	1.00	1920	1920		
4	B	Ex. Track Lights U.L.	5	Second Fl.	1920	w	1.00	1920	1920		
5	C	Ex. Inside Wall Doorway	5	First Floor	1920	w	1.00	1920	1920		
6	C	Ex. Inside Wall Lights	5	First Floor	1920	w	1.00	1920	1920		
7	A	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
8	A	Ex. Stairway Lights	5	Second Fl.	1920	w	1.00	1920	1920		
9	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
10	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
11	C	Spare	8			w	1.00	0	0		
12	C	Ex. Inside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
13	A	Ex. Flag Spot Lights	4	Outside	1920	w	1.00	1920	1920		
14	A	Ex. Outside Wall Lts.	5	Outside	1920	w	1.00	1920	1920		
15	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
16	B	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
17	C	Spare	8			w	1.00	0	0		
18	C	Ex. Track Lights	5	Second Fl.	1920	w	1.00	1920	1920		
19	A	Spare	8		1920	w	1.00	1920	1920		
20	A	Ex. Inside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920		
21	B	Spare	8			w	1.00	0	0		
22	B	Ex. Stairwas Ceiling Lts.	5	Second Fl.	1920	w	1.00	1920	1920		
23	C	Ex. Recep. Under Panel	1	First Floor	1920	w	1.00	1920	1920		
24	C	Spare	8			w	1.00	0	0		
25	A	Ex. Recep. Under Panel	1	First Floor	1920	w	1.00	1920	1920		
26	A	Spare	8			w	1.00	0	0		
27	B	Ex. Snow Melt	8	Outside	1100	w	1.00	1100	1100		
28	B	Space Only	8			w	1.00	0	0		
29	C	Ex. Snow Melt	8	Outside	1100	w	1.00	1100	1100		
30	C	Space Only	8			w	1.00	0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								42.5	42.5	Amps=	118.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					17.3	17.3	41%	144.0
PHASE TOTAL	B					14.5	14.5	34%	121.2
PHASE TOTAL	C					10.7	10.7	25%	89.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		3.8	3.8	0.70	2.7	2.7	1.00		
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		0.0	0.0	1.00	0.0	0.0			
4	HID lighting		1.9	1.9	1.00	1.9	1.9	1.00		
5	incandescent lighting		30.7	30.7	1.00	30.7	30.7	1.00		
6	HVAC fans		0.0	0.0	1.00	0.0	0.0			
7	heating		0.0	0.0	1.00	0.0	0.0			
8	other		6.0	6.0	1.00	6.0	6.0	1.00		
Total Demand Loads						41.4	41.4			
Spare Capacity			20%			8.3	8.3			
Total Design Loads						49.6	49.6	1.00	Amps=	137.9

Main Circuit Breaker Sizing: 138Amps/0.8 = 172.5Amps/0.8 = 216Amps
(80% of max load per code, then 80% for good design practice)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->					3 B	Panel Location:			First Floor Electrical Closet			
Nominal Phase to Neutral Voltage------->					120	Phase:			3			
Nominal Phase to Phase Voltage-------->					208	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks		
1	A	Ex. Outside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920			
2	A	New Lights	3	Amphitheater	444	w	1.00	444	444			
3	B	New Lights	3	Amphitheater	195	w	1.00	195	195			
4	B	New Lights	3	Amphitheater	195	w	1.00	195	195			
5	C	New Lights	3	Amphitheater	182	w	1.00	182	182			
6	C	New Lights	3	Amphitheater	444	w	1.00	444	444			
7	A	New Lights	3	Amphitheater	492	w	1.00	492	492			
8	A	New Lights	3	Amphitheater	626	w	1.00	626	626			
9	B	Ex. End Wall Light	5	First Floor	1920	w	1.00	1920	1920			
10	B	Ex. Wheel Chair Lift	8	First Floor	1920	w	1.00	1920	1920			
11	C	New Lights	3	Amphitheater		w	1.00	0	0			
12	C	Ex. Wheel Chair Lift	8	Second Fl.	1920	w	1.00	1920	1920			
13	A	Ex. Back Wall Light	5	First Floor	1920	w	1.00	1920	1920			
14	A	Ex. Recep. Navy Air	1	Second Fl.	1920	w	1.00	1920	1920			
15	B	Ex. End Wall Light	5	First Floor	1920	w	1.00	1920	1920			
16	B	Ex. L-Stairwell Lights	5	Second Fl.	1920	w	1.00	1920	1920			
17	C	Ex. Stairwell Light	5	Second Fl.	1920	w	1.00	1920	1920			
18	C	Ex. Above Panel	5	First Floor	1920	w	1.00	1920	1920			
19	A	Ex. Outside Wall Lts.	5	First Floor	1920	w	1.00	1920	1920			
20	A	Ex. Stairwell Lights	5	Second Fl.	1920	w	1.00	1920	1920			
21	B	Ex. Inside Wall Light	5	First Floor	1920	w	1.00	1920	1920			
22	B	Ex. Center Hall Lights	5	First Floor	1920	w	1.00	1920	1920			
23	C	New Lights	5	Amphitheater	800	w	1.00	800	800			
24	C	Ex. Inside Wall Lights	5	First Floor	1920	w	1.00	1920	1920			
25	A	Receptacle	1	First Floor		w	1.00	0	0			
26	A	Receptacle	1	First Floor		w	1.00	0	0			
27	B	Receptacle	1	First Floor		w	1.00	0	0			
28	B	Receptacle	1	First Floor		w	1.00	0	0			
29	C	Receptacle	1	First Floor		w	1.00	0	0			
30	C	Receptacle	1	First Floor		w	1.00	0	0			
31	A	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800			
32	A	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800			
33	B	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800			
34	B	Ex. Receptacle	1	Second Fl.	800	w	1.00	800	800			
35	C	Ex. Receptacle (Grave)	1	First Floor	1800	w	1.00	1800	1800			
36	C	Ex. J. Boxes	1	Second Fl.	1000	w	1.00	1000	1000			
37	A	New Fl. Recessed Recept.	1	First Floor		w	1.00	0	0			
38	A	Ex. J. Boxes	1	Second Fl.	1000	w	1.00	1000	1000			
39	B	New Fl. Recessed Recept.	1	First Floor		w	1.00	0	0			
40	B	Space Only				w		0	0			
41	C	Space Only				w		0	0			
42	C	Space Only				w		0	0			
PANEL TOTAL								39.2	39.2	Amps=	108.8	

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					13.8	13.8	35%	114.7
PHASE TOTAL	B					13.5	13.5	34%	112.6
PHASE TOTAL	C					11.9	11.9	30%	99.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		8.9	8.9	0.70	6.2	6.2	1.00		
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		2.6	2.6	1.00	2.6	2.6	1.00		
4	HID lighting		0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting		23.8	23.8	1.00	23.8	23.8	1.00		
6	HVAC fans		0.0	0.0	1.00	0.0	0.0			
7	heating		0.0	0.0	1.00	0.0	0.0			
8	other		3.8	3.8	1.00	3.8	3.8	1.00		
Total Demand Loads						36.5	36.5			
Spare Capacity			20%			7.3	7.3			
Total Design Loads						43.8	43.8	1.00	Amps=	121.7

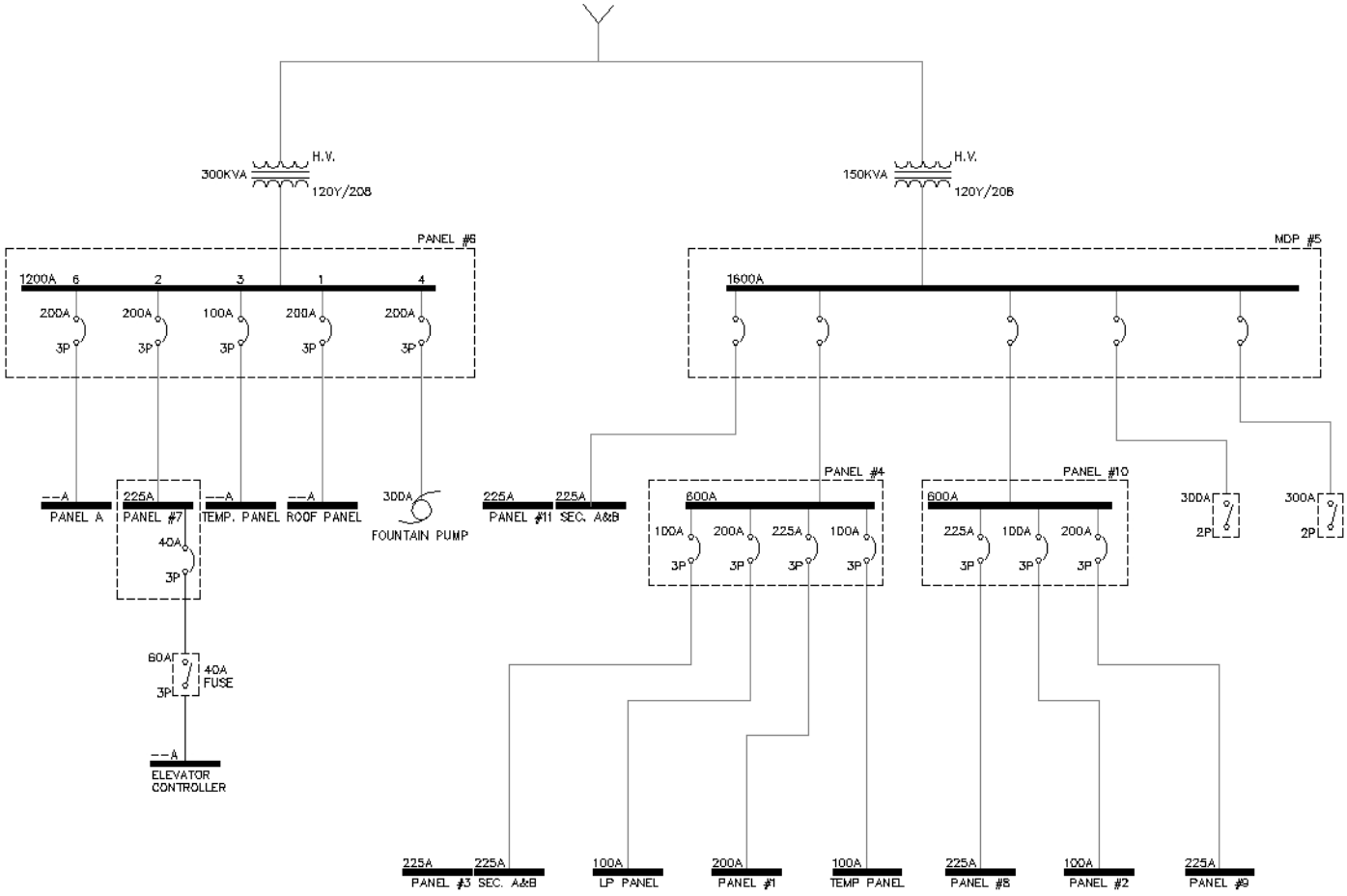
Main Circuit Breaker Sizing: 122Amps/0.8 = 152.5Amps/0.8 = 191Amps
(80% of max load per code, then 80% for good design practice)

Note: Panel 3 is being fed by panel 4 which is being fed by the main distribution panel #5. All the final loads for this panel board did not change dramatically enough to resize the main circuit breaker in panel 4 or MDP #5. The single line drawing does not change for this section.

80% of max loading was assumed on all branches without loads listed on the drawings.

There were no changes required for Panel 3 Section A since no new loads were added and the MLO only size for section B did not increase.

Riser Diagram:



Protective Device Coordination Study

A single path through the buildings distribution system was chosen to check for correct sizing in the event of a short circuit or an over current. A branch circuit was chosen off of panel 11 and this breaker plus two prior devices on this path were analyzed. The path begins with a 20 Amp single pole circuit breaker and continues on to a 125 Amp circuit breaker which is the main circuit breaker for panel 11. The path then finally ends with the 1600 Amp main circuit breaker on the main distribution panel. There was no mention of switch gear equipment in the riser diagram or specifications book so it is assumed that this buildings main distribution panel is its switchgear.

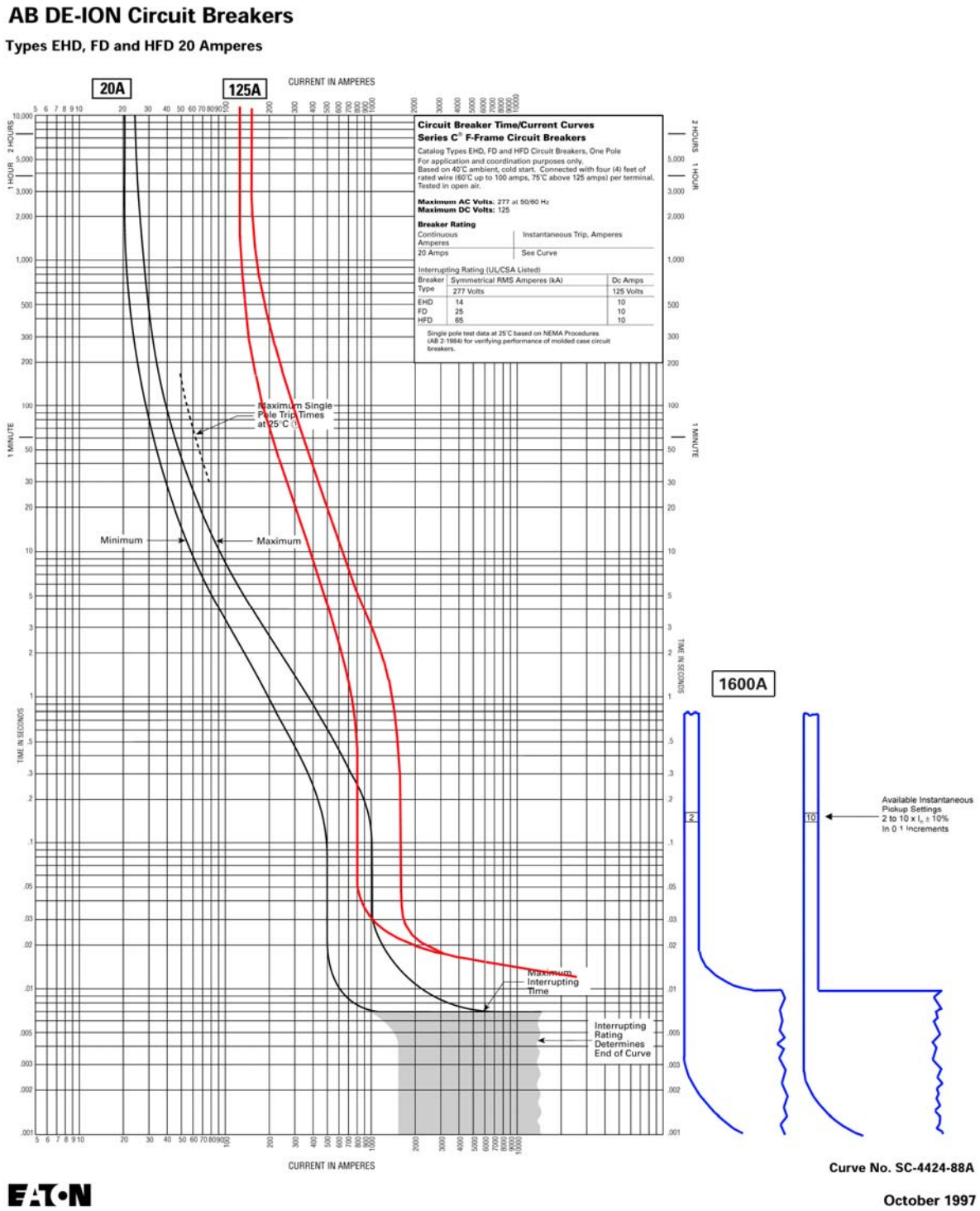


Figure 1 – The time current curve for the three devices mentioned above. From this figure, it is shown that the devices were sized accurately and in the event of an overload/short circuit, the smaller circuit breaker will trip first not allowing the load to continue back through the path.

Emergency Generator

Currently all the emergency lighting, fire protection, and security equipment were powered by battery packs during a power outage. Although a generator in a building this size might not be a cost effective way to power the building in an outage, it does allow for a safer environment for the occupants in the space. By having battery packs in each light fixture and battery back up systems for the security or fire protection, this increases the chance for a battery to die and the unit no to work during a power outage. By using a generator, it also allows for less maintenance time and hassle spent testing each battery.

The loads that are placed on the new emergency panel include:

1. All the indoor emergency lighting to allow for safe egress out of the building. Wiring diagram shown in Figure 2.

2. All outdoor lighting mounted on the building that was considered emergency lighting.

3. The security system which consisted of video cameras and equipment.
4. The Fire Alarm Control Panel.

5. The ADT security system.

6. A radio transmitter.

7. Pump 1 and Pump 2 so the water in the pipes will be able to continue to flow and thus in the winter not freeze the pipes.

8. AHU #1 to allow for cooling in the tomb guards' quarters section of the building since they are required to be there 24 hours a day, 7 days a week no matter what.

The tables below show the loading information for each of these items and calculates the total design load to be 158.6 amps which includes the demand factor for each type of load. One thing to note in the new EM panel board schedule is that each phase, A, B and C, are all loaded with in 7% of each other.

Mechanical Equipment							
Designation	Equipment Type	Phase	Voltage	HP	FLA	PF	KW
EVAP-1/CU-1	Condensing Unit	3	208	2, 3	15.40	0.9	4.99
CU-2	Condensing Unit	3	208	1/2	2.10	0.9	0.68
EVAP-2	Evaporator	3	208	1.5	4.80	0.9	1.56
EF-1	Exhaust Fan	1	120	1/20	0.90	0.8	0.09
EF-2	Exhaust Fan	1	120	1/10	1.40	0.85	0.14
EF-3	Exhaust Fan	1	120	1/2	7.50	0.85	0.77
EF-4	Exhaust Fan	1	120	1/2	9.80	0.85	1.00
EF-5	Exhaust Fan	1	120	1/20	1.00	0.8	0.10
PF-1	Propeller Fan	1	120	1/30	0.72	0.8	0.07
P-1	Pump	3	208	2	7.50	0.9	2.43
P-2	Pump	3	208	2	7.50	0.9	2.43
SUP-1	Sump Pump	1	115	1/2	9.80	0.85	0.96
WH-1	Water Heater	3	208				0.00
CP-1	Circulation Pump	1	115	1/20	0.98	0.8	0.09
EWC	Electric Water Cooler	1	120	1/20	0.98	0.8	0.09
EWC	Electric Water Cooler	1	120	1/2	9.80	0.85	1.00

Table 1 – Mechanical Equipment – The loads for EVAP-1/CU-1 and Pumps 1 and 2 are taken from the existing panel boards since they used a higher full load amps then this schedule shows.

New EM:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 400A Copper
SIZE/TYPE MAIN: 250A/3P C/B

PANEL TAG: EM
PANEL LOCATION: Electric Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Basement	359	20A/1P	1	*			2	20A/1P	333	Basement	Lighting
Lighting	Basement	555	20A/1P	3		*		4	20A/1P	24	1st & 2nd Fl	Lighting
Lighting	Outside	1920	20A/1P	5			*	6	20A/1P	1920	Outside	Lighting
Spare	----	0	20A/1P	7	*			8	20A/1P	0	----	Spare
Spare	----	0	20A/3P	9		*		10	20A/3P	0	----	Spare
Spare	----	0	20A/1P	11			*	12	20A/1P	0	----	Spare
ADT	----	1920	20A/1P	13	*			14	20A/1P	1000	Electrical	Radio Transmitter
ADT	----	1920	20A/1P	15		*		16	20A/1P	1000	Electrical	Security System
Spare	----	0	20A/1P	17			*	18	20A/1P	0	----	Spare
Spare	----	0	20A/1P	19	*			20	20A/1P	0	----	Spare
Spare	----	0	20A/1P	21		*		22	20A/1P	1000	Electrical	FACP
Spare	----	0	20A/1P	23			*	24	20A/1P	0	----	Spare
AC Unit #1	Mechanical	10500	125A/3P	25	*			26	30A/3P	917	Boiler	Pump P-1
		10500		27		*		28		917		
		10500		29			*	30		917		
Spare	-----	0	20A/1P	31	*			32	30A/3P	917	Boiler	Pump P-2
Spare	----	0	20A/1P	33		*		34		917		
Spare	----	0	20A/1P	35			*	36		917		
Spare	-----	0	20A/1P	37	*			38	20A/1P	0	-----	Spare
Spare	-----	0	20A/1P	39		*		40	20A/1P	0	-----	Spare
Spare	-----	0	20A/1P	41			*	42	20A/1P	0	-----	Spare

CONNECTED LOAD (KW) - A	15.95	TOTAL DESIGN LOAD (KW)	56.34
CONNECTED LOAD (KW) - B	16.83	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C	16.17	TOTAL DESIGN LOAD (AMPS)	159

Existing MDP #5:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 1600A Copper
SIZE/TYPE MAIN: 1600A/3P C/B

PANEL TAG: MDP #5
PANEL LOCATION: Electrical Room
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Panel 11	Elec. Rm.	7200	225A/3P	1	*			2	200A/3P	6400	Elec. Rm.	Disconnect Switch
		7200		3		*		4		6400		
		7200		5			*	6		6400		
Panel 4	Elec. Rm.	19200	600A/3P	7	*			8	200A/3P	6400	Elec. Rm.	Disconnect Switch
		19200		9		*		10		6400		
		19200		11			*	12		6400		
Panel 1 0	Base. Coor.	19200	225A/3P	13	*			14	200A/3P	0		Spare
		19200		15		*		16		0		
		19200		17			*	18		0		

CONNECTED LOAD (KW) - A	58.40	TOTAL DESIGN LOAD (KW)	210.24
CONNECTED LOAD (KW) - B	58.40	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	58.40	TOTAL DESIGN LOAD (AMPS)	584

New MDP #5:

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W	PANEL TAG: MDP #5	MIN. C/B AIC: 10K
SIZE/TYPE BUS: 2000A Copper	PANEL LOCATION: Electrical Room	OPTIONS:
SIZE/TYPE MAIN: 2000A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Panel 11	Elec. Rm.	7200	225A/3P	1	*			2	200A/3P	6400	Elec. Rm.	Disconnect Switch
		7200		3		*		4		6400		
		7200		5			*	6		6400		
Panel 4	Elec. Rm.	19200	600A/3P	7	*			8	200A/3P	6400	Elec. Rm.	Disconnect Switch
		19200		9		*		10		6400		
		19200		11			*	12		6400		
Panel 10	Base. Coor.	19200	600A/3P	13	*			14	250A/3P	55700	Electrical	New EM Panel
		19200		15		*		16		55700		
		19200		17			*	18		55700		

CONNECTED LOAD (KW) - A	114.10	TOTAL DESIGN LOAD (KW)	410.76
CONNECTED LOAD (KW) - B	114.10	POWER FACTOR	1.00

Note: The panel boards that these loads came off of would in reality need to be recalculated and possibly resized. If resizing occurs, the feeders would then need to be checked and resized. This was not in the scope of work for this depth topic so these panels boards were not included. These panels consist of: Panel 2, 3A, 3B, 4, 8, 10, and 11. Panels 3A and 3B where used in the lighting electrical coordination section of this book. The loads on these panel boards that were moved onto the new EM panel were actually removed when they were recalculated.

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag---------->				EM	Panel Location:			Electric Room			
Nominal Phase to Neutral Voltage------->				120	Phase:			3			
Nominal Phase to Phase Voltage-------->				208	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	Basement	359	w	0.97	359	370		
2	A	Lighting	3	Basement	333	w	0.98	333	340		
3	B	Lighting	3	Basement	555	w	0.98	555	566		
4	B	Lighting	3	1st & 2nd Fl	24	w	1.00	24	24		
5	C	Lighting	5	Outside	1920	w	1.00	1920	1920		
6	C	Lighting	5	Outside	1920	w	1.00	1920	1920		
7	A	Spare		----		w	1.00	0	0		
8	A	Spare		----		w	1.00	0	0		
9	B	Spare		----		w	1.00	0	0		
10	B	Spare		----		w	1.00	0	0		
11	C	Spare		----		w	1.00	0	0		
12	C	Spare		----		w	1.00	0	0		
13	A	ADT	8	----	1920	w	1.00	1920	1920		
14	A	Radio Transmitter	9	Electrical	1000	w	1.00	1000	1000		
15	B	ADT	8	----	1920	w	1.00	1920	1920		
16	B	Security System	9	Electrical	1000	w	1.00	1000	1000		
17	C	Spare		----		w	1.00	0	0		
18	C	Spare		----		w	1.00	0	0		
19	A	Spare		----		w	1.00	0	0		
20	A	Spare		----		w	1.00	0	0		
21	B	Spare		----		w	1.00	0	0		
22	B	FACP	7	Electrical	1000	w	1.00	1000	1000		
23	C	Spare		----		w	1.00	0	0		
24	C	Spare		----	0	w	1.00	0	0		
25	A	AC Unit #1	6	Mechanical	10500	w	1.00	10500	10500		
26	A	Pump P-1	8	Boiler	917	w	0.90	917	1019		
27	B	-----	6	-----	10500	w	1.00	10500	10500		
28	B	-----	8	-----	917	w	0.90	917	1019		
29	C	-----	6	-----	10500	w	1.00	10500	10500		
30	C	-----	8	-----	917	w	0.90	917	1019		
31	A	Spare		-----		w	1.00	0	0		
32	A	Pump P-2	8	Boiler	917	w	0.90	917	1019		
33	B	Spare		----		w	1.00	0	0		
34	B	-----	8	-----	917	w	0.90	917	1019		
35	C	Spare		----		w	1.00	0	0		
36	C	-----	8	-----	917	w	0.90	917	1019		
37	A	Spare		-----	0	w	1.00	0	0		
38	A	Spare		-----	0	w	1.00	0	0		
39	B	Spare		-----	0	w	1.00	0	0		
40	B	Spare		-----	0	w	1.00	0	0		
41	C	Spare		-----	0	w	1.00	0	0		
42	C	Spare		-----	0	w	1.00	0	0		
PANEL TOTAL								49.0	49.6	Amps=	137.8

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	15.9	16.2	33%	134.7	
PHASE TOTAL	B	16.8	17.0	34%	142.1	
PHASE TOTAL	C	16.2	16.4	33%	136.5	

LOAD CATAGORIES		Connected			Demand				Ver. 1.01
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	0.0	0.0	0.70	0.0	0.0			
2	computers	0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting	1.3	1.3	1.00	1.3	1.3	0.98		
4	HID lighting	0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting	3.8	3.8	1.00	3.8	3.8	1.00		
6	HVAC fans	31.5	31.5	1.00	31.5	31.5	1.00		
7	heating	1.0	1.0	1.00	1.0	1.0	1.00		
8	Other	9.3	10.0	1.00	9.3	10.0	0.94		
Total Demand Loads					47.0	47.6			
Spare Capacity		20%			9.4	9.5			
Total Design Loads					56.3	57.1	0.99	Amps=	158.6

Main Circuit Breaker Sizing: 158.6Amps/0.8 = 198Amps/0.8 = 248Amps
(80% of max load per code, then 80% for good design practice)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

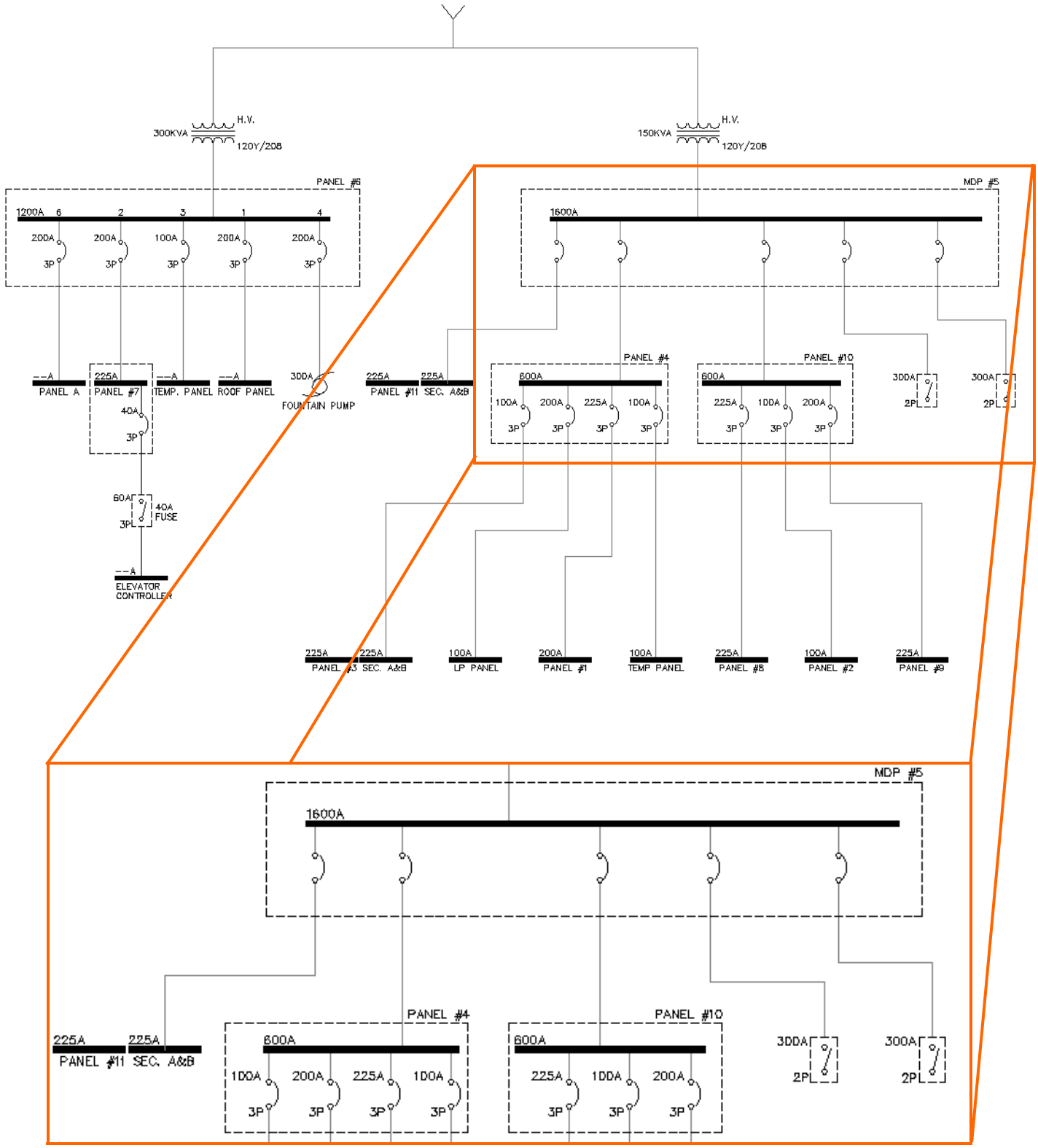
Panel Tag---------->					MDP #5	Panel Location:			Electrical Room		
Nominal Phase to Neutral Voltage------->					120	Phase:			3		
Nominal Phase to Phase Voltage-------->					208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Panel 11	8	Elec. Rm.	7.2	kw	1.00	7200	7200		
2	A	Disconnect Switch	8	Elec. Rm.	6.4	kw	1.00	6400	6400		
3	B		8		7.2	kw	1.00	7200	7200		
4	B		8		6.4	kw	1.00	6400	6400		
5	C		8		7.2	kw	1.00	7200	7200		
6	C		8		6.4	kw	1.00	6400	6400		
7	A	Panel 4	8	Elec. Rm.	19.2	kw	1.00	19200	19200		
8	A	Disconnect Switch	8	Elec. Rm.	6.4	kw	1.00	6400	6400		
9	B		8		19.2	kw	1.00	19200	19200		
10	B		8		6.4	kw	1.00	6400	6400		
11	C		8		19.2	kw	1.00	19200	19200		
12	C		8		6.4	kw	1.00	6400	6400		
13	A	Panel 1 0	8	Base. Coor.	19.2	kw	1.00	19200	19200		
14	A	New EM Panel	8	Electrical	55.7	kw	1.00	55700	55700		
15	B		8		19.2	kw	1.00	19200	19200		
16	B		8		55.7	kw	1.00	55700	55700		
17	C		8		19.2	kw	1.00	19200	19200		
18	C		8		55.7	kw	1.00	55700	55700		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								342.3	342.3	Amps=	950.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					114.1	114.1	33%	950.8
PHASE TOTAL	B					114.1	114.1	33%	950.8
PHASE TOTAL	C					114.1	114.1	33%	950.8

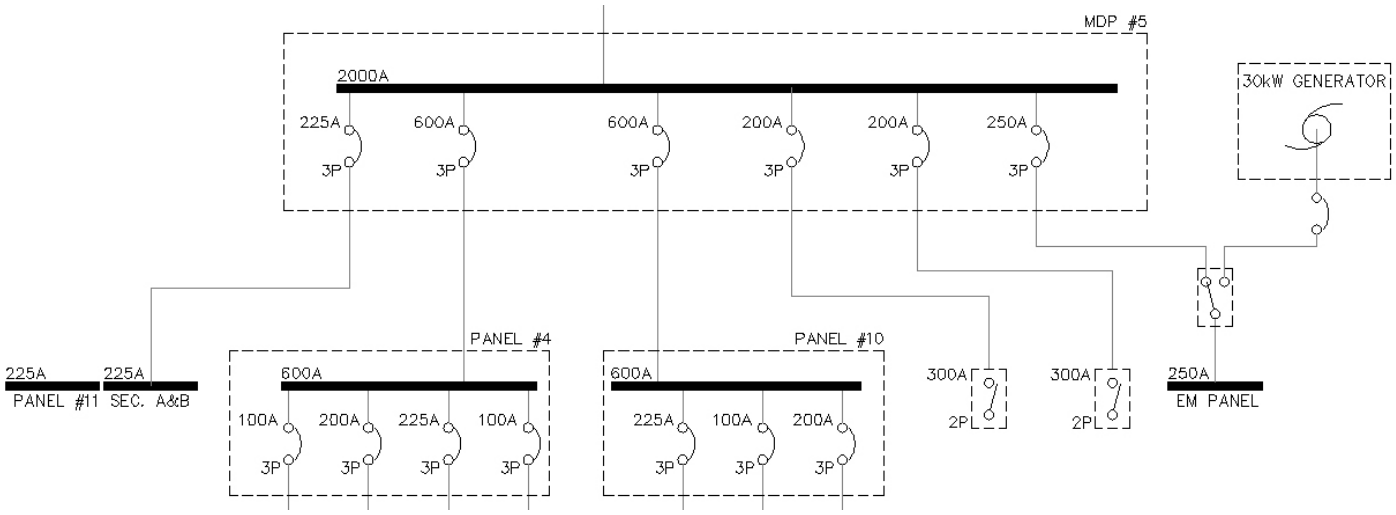
LOAD CATAGORIES			Connected			Demand				Ver. 1.01
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0	0.70	0.0	0.0			
2	computers		0.0	0.0	0.80	0.0	0.0			
3	fluorescent lighting		0.0	0.0	1.00	0.0	0.0			
4	HID lighting		0.0	0.0	1.00	0.0	0.0			
5	incandescent lighting		0.0	0.0	1.00	0.0	0.0			
6	HVAC fans		0.0	0.0	1.00	0.0	0.0			
7	heating		0.0	0.0	1.00	0.0	0.0			
8	other		342.3	342.3	1.00	342.3	342.3	1.00		
Total Demand Loads						342.3	342.3			
Spare Capacity			20%			68.5	68.5			
Total Design Loads						410.8	410.8	1.00	Amps=	1141.0

Main Circuit Breaker Sizing: 1141Amps/0.8 = 1426Amps/0.8 = 1783Amps
(80% of max load per code, then 80% for good design practice)

Existing Single Line Diagram:



New Single Line Diagram:



Sizing the Generator:

To size and select a generator, Kohler's QuickSize program was used. Below, in Figure 3, is the performance summary for the 30RZGB generator that was chosen. The loads were stepped based on safety and security, and then on size. The emergency lighting and security cameras are the first step and would turn on first for occupant safety and then the larger equipment would each turn on separately, starting with the AHU and then each pump. Then finally, the smaller and less important equipment such as the radio transmitter and the security alarm would be stepped together and turn on. Figure 4 shows how the generator is stepped and how much load each step is required to produce.

QuickSize
Generator Set Sizing

Project Memorial Reception Building, Arlington National Cemetery
Customer United States Government

Generator Set

Model No. 30RZGB **Gensets** 1
Engine Vortec 3.0 (Nat. Gas)
Alternator 4P5

Performance Summary

LN / LL Voltage	120/208	volts	**Altitude**	500	feet
Frequency	60	hertz	**Ambient Temp.**	70	F
Phase(s)	3	phase			

Genset Rating @ 130C Rise	30.00 kW
Genset Derated Rating	30.00 kW
Total Running Power	20.35 kW
Percent of Available kW Used	67.84 %
Alternator Starting kVA	69.14 kVA @ 20% dip
Peak Starting kVA	38.38 kVA
Maximum Voltage Dip	13.73 %
Maximum Frequency Dip	9.82 % (est.)(no restriction)
Voltage THD	1.97 % (no restriction)

Informational

Program Version	8.6.0
Database Version	1.32
Project Created	April 2, 2007; 03:14:29 PM
Project Last Saved	April 2, 2007; 03:14:29 PM
Report Created	April 2, 2007; 09:00:09 PM
Project Created By	Jennifer Sanborn

Figure 2 – Generator Sizing

QuickSize
Generator Load Profile

Project Memorial Reception Building, Arlington National Cemetery
Customer United States Government

Generator Set

Model No. 30RZGB **Gensets** 1
Engine Vortec 3.0 (Nat. Gas)
Alternator 4P5

Load Profile

	Qty	Run kW	Run kVA	Run pF	Start kW	Start kVA	Volt Dip	Freq Dip	Volt (L-N) THD
Step #1 Priority #1									
EM-1 Emergency Lighting (Fluorescent lighting with electronic ballast)	1	0.36	0.37	0.97	0.36	0.37			
EM-2 Emergency Lighting (Fluorescent lighting with electronic ballast)	1	0.33	0.34	0.98	0.33	0.34			
EM-3 Emergency Lighting (Fluorescent lighting with electronic ballast)	1	0.56	0.57	0.98	0.56	0.57			
EM-4 Emergency Lighting (Fluorescent lighting with electronic ballast)	1	0.02	0.02	1.00	0.02	0.02			
EM-5 Outside Lighting (Incandescent lighting)	1	1.92	1.92	1.00	1.92	1.92			
EM-6 Outside Lighting (Incandescent lighting)	1	1.92	1.92	1.00	1.92	1.92			
EM-15 Security System (1.00 kW misc. load)	1	1.00	1.00	1.00	1.00	1.00			
Em-23 FACP (1.00 kW misc. load)	1	1.00	1.00	1.00	1.00	1.00			
Step Totals		7.11	7.12	1.00	7.11	7.12	4.40	5.84	2.0%/1.7%/0.0%
Cum. Totals		7.11	7.12	1.00					
Step #2 Priority #2									
EM-25/27/29 ACU #1 (3 phase air conditioner)	1	4.80	5.40	0.89	20.10	33.50			
Step Totals		4.80	5.40	0.89	20.10	33.50	13.73	9.82	2.0%/1.7%/0.0%
Cum. Totals		11.91	12.52	0.95					
Step #3 Priority #3									
EM-26/28/30 Pump 1 (2.00 HP, 3 phase, code K, loaded motor, w/ A.T.L. starting) Rated motor torque from full voltage starting = 84.6%	1	1.80	2.60	0.69	11.56	17.00			
Step Totals		1.80	2.60	0.69	11.56	17.00	8.00	7.45	2.0%/1.7%/0.0%
Cum. Totals		13.71	15.12	0.91					
Step #4 Priority #4									
EM-32/34/36 Pump 2 (2.00 HP, 3 phase, code K, loaded motor, w/ A.T.L. starting) Rated motor torque from full voltage starting = 84.6%	1	1.80	2.60	0.69	11.56	17.00			
Step Totals		1.80	2.60	0.69	11.56	17.00	8.02	7.45	2.0%/1.7%/0.0%
Cum. Totals		15.51	17.72	0.88					
Step #5 Priority #5									

EM-17 ADT (1.92 kW misc. load)								
1	1.92	1.92	1.00	1.92	1.92			
EM-19 ADT (1.92 kW misc. load)								
1	1.92	1.92	1.00	1.92	1.92			
EM-21 Radio Transmitter (1.00 kW misc. load)								
1	1.00	1.00	1.00	1.00	1.00			
Step Totals	4.84	4.84	1.00	4.84	4.84	3.37	4.82	2.0%/1.7%/0.0%
Cum. Totals	20.35	22.56	0.90					
Grand Totals	20.35	22.56	0.90					2.0%/1.7%/0.0%

Informational

Program Version	8.6.0
Database Version	1.32
Project Created	April 2, 2007; 03:14:29 PM
Project Last Saved	April 2, 2007; 10:53:03 PM
Report Created	April 5, 2007; 02:19:02 AM
Project Created By	Jennifer Sanborn

Figure 3 – Generator Load Profile

Note: The cut sheet for the 30RZGB generator is located in the back of this document in the Electrical Appendix section.

This new emergency panel board will be located in the basement electrical room. The new generator will be located in the North catacombs, which is close to the electrical closet where the emergency panel would be located and is also enclosed by masonry walls in the basement where sound transmission is low.

Summary:

Overall the generator sized didn't end up being to big. The overall cost would not be worth the money unless maintenance is an issue. With battery back up systems, the initial cost is low, but having to check to make sure the batteries are working might become a hassle. By using a generator, the initial cost will be high and since the system is so small, the owner might never be paid back because the payback period is longer than the estimated life of the generator. Finally, this ultimately would not be recommended in real practice, the owner would just want batteries backups in all the fixtures that need to be specified as emergency.

Short Circuit Analysis

The memorial reception building's utility is connected to the rest of the cemetery's power creating a campus like power distribution. The utility information was unavailable to do a short circuit calculation.

Powersmiths Transformers

To save energy in this building and to be more environmentally friendly, the use of Powersmiths Transformers was investigated. These Powersmiths transformers are the next generation technology by setting new benchmarks for efficient, reliable and environmentally friendly electrical power distribution systems. Unlike standard transformers which are over designed, Powersmiths transformers are designed to handle harmonic loads resulting in higher efficiency. Powersmiths calculating program was used to calculate the energy savings if these new transformers were used for this building.

Transformer Schedule:

INDIVIDUAL TRANSFORMER SCHEDULE							
TAG	PRIMARY VOLTAGE	SECONDARY VOLTAGE	SIZE	TYPE	TEMP. RISE	TAPS	MOUNTING
T-1	15,000 V	208Y/120V,3PH,4W	300 KVA	DRY TYPE	150 DEGREE C	(6) 2.5%	PAD MOUNTED ON FLOOR
T-2	15,000 V	208Y/120V,3PH,4W	150 KVA	DRY TYPE	150 DEGREE C	(6) 2.5%	PAD MOUNTED ON FLOOR

NOTES:
1. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS

POWERSMITHS

Toll Free : 1-800-747-9627 or (905) 791-1493

The ESP Calculator™

Energy Savings Payback Calculator

Project Description **National Reception Building**

Date **1-Apr-07**

Transformers on Project

Data Entry

QTY	kVA
	15
	30
	45
	75
	112.5
1	150
	225
1	300
	500
	750
	1000
	1500
	2000
	7.5

Available Full Load kW	**450**		
Average kVA (calc)	**225**		
equipment operating hrs/ day	11		
equipment operating days/yr	365	Calc Load kW	Calc Annual kWh
Load during normal operating hours	60%	270	1,084,050
Load outside operating hours	10%	45	213,525
		Total Annual Load kWh:	**1,297,575**

Annual Cost to Operate Load Only

kWh rate	$ 0.080	Annual Consumption:	$	103,806
demand rate ($/kW/mo) ex. $10.00	$12.00	Annual Demand:	$	38,880
		Total Cost to run load	**$**	**142,686**

Annual Cost of Status Quo Transformer Losses & Associated Air Conditioning (A/C) burden

Nameplate Linear efficiency (normal op hrs)		97.7%	% electronics or current THD	30.0%
Calculated operating efficiency		96.5%		
Transformer kW Losses (Normal Operation)		9.7	kW	
Status quo Efficiency (Outside op. hrs)		91.0%		
Transformer kW Losses (Outside op. hrs)		4.5	kW	
Annual addititional kWh from transformers		60,122	kWh	
Annual Cost of Transformer Losses	$	6,209		
A/C System Performance (kW/ton)		1.50		
Additional Tons of Cooling (on peak)		2.76	tons	
Annual addititional kWh from A/C		25,620	kWh	
Annual Cost of Associated A/C	$	2,646		

Summary with Status Quo Transformer

Annual Cost of feeding Building Load	$	142,686
Annual Cost of Transformer Losses	$	6,209
Annual Cost of Associated A/C	$	2,646
Electrical Bill (Status Quo Transformer)	**$**	**151,540**

POWERSMITHS
Toll Free : 1-800-747-9627 or (905) 791-1493

Page 2

The ESP Calculator™
Energy Savings Payback Calculator

Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)		98.2%	
Powersmiths kW Losses (Normal Operation)		4.9	kW
Powersmiths Efficiency (Outside op. hrs)		97.6%	
Transformer kW Losses (Outside op. hrs)		1.1	kW
Annual addititional kWh from transformers		25,121	kWh
Annual Cost of Powersmiths Losses	$	2,722	
Additional Tons of Cooling (on peak)		1.41	tons
Annual addititional kWh from A/C		10,705	kWh
Annual Cost of Associated A/C	$	1,160	

Comparing Status Quo & Powersmiths

	Status Quo		Powersmiths		
Annual Cost of feeding Building Load	$	142,686	$	142,686	
Annual Cost of Transformer Losses	$	6,209	$	2,722	
Annual Cost of Associated A/C	$	2,646	$	1,160	**Reduction**
Annual estimated Electrical Bill	$	151,540	$	146,568	**3%**

Peak kW reduction (normal op hours)	**4.8**	**kW**
Annual kWh reduction	**49,915**	**kWh**
Reduction in Air Conditioning Load (on peak)	**1.35**	**tons**

Cost Analysis (calc)

Energy Cost Escalation (above inflation)	3.0%
Annual Power Quality Benefit	$ -

	Annual Operating Cost	Life Cycle Operating Cost & Savings	
		20 years	32 years
Status Quo Transformers	$8,854	$319,838	$729,619
Powersmiths Transformers	$3,882	$140,243	$319,925
Savings with Powersmiths	**$4,972**	**$179,595**	**$409,694**

Cost	Cost
Powersmiths Transformers	$53,000
Status Quo Transformers	$27,400

Payback on total cost	5.15	years	current kWh rate:
Cost of Energy Savings	$ 0.016	/kWh	$0.080
Cost - Benefit Ratio	5.0	times less to save a kWh than to buy a kWh	

Leasing Option	60 Month Term	48 Month Term	36 Month Term
Total Annual Leasing Payments	**$6,928**	**$8,450**	**$10,752**
Net Annual Cost with savings	$1,956	$3,478	$5,780

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
37 tons of CO2	7 Acres trees planted
119 tons of Coal	5 Car Emissions
289 kgs of SO2	5 homes heated
124 kgs of NOx	

Summary:

By using these Powersmiths transformers instead of regular transformers, the peak kW is reduced by 4.8kW, almost 50,000kWh are saved annually, the air conditioning load is reduced by 1.5tons, and they save the owner almost $5,000 in annual operating costs. The overall payback period is as little as 5.15 years. This design would greatly benefit the owner, building, and environment.

Mechanical Breadth

Since the drop down ceiling wall eliminated in the center of the tomb guards' work space and a cove was inserted into the ceiling, some of the duct work needed to be moved resulting in having to redesign and resize the diffusers as well as redesigning the duct layout in the plenum space. After changing the duct's equivalent length, thee pressure drop had to be calculated to see if the duct needed to be altered in any way.

Duct Sizing

With the new lighting design in the work area, a cove was placed in the ceiling above the conference room table. Prior to this cove insert, the ceiling was made up of a T-bar ceiling with a particle board drop down ceiling around its perimeter, see figure 1. To implement the cove, the T-bar ceiling would be taken out and a bump up would be placed into the plenum area, figure 2. With this bump up into the plenum space, only a 6in plenum would be left for the 12 x12 flexible ducts that supply the diffusers in this space. By moving the diffusers, this required the diffusers to be resized and redesigned. Figure 3 shows the new layout and the shape and size of the new diffusers. Calculations to show how these diffusers were chosen are below.

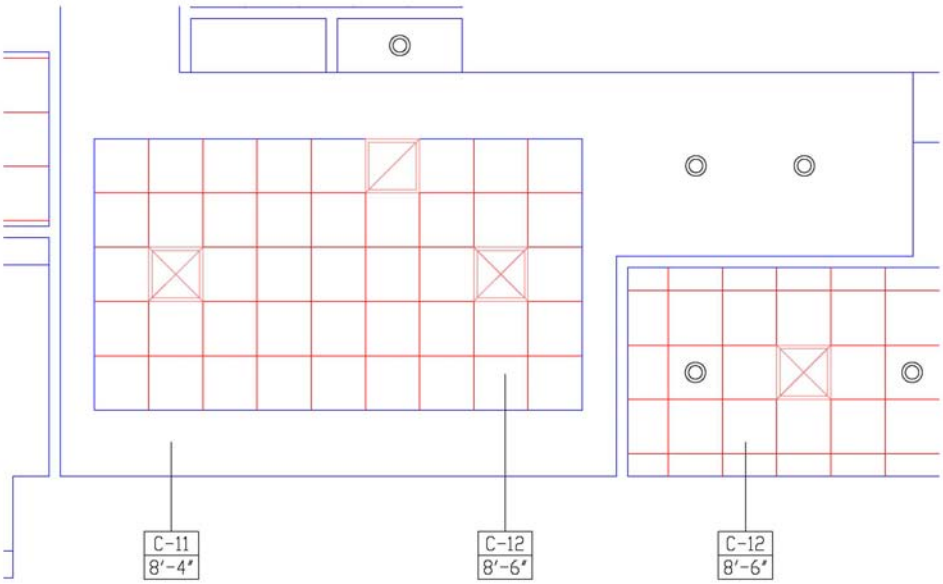


Figure 1 – Reflected Ceiling plan.

C-11: Suspended gypsum board ceiling system on concealed suspension system, paint.
C-12: Suspended 2 x 2 acoustical tile ceiling system, acoustical tile type "ACP-1", suspension type "SS-1".

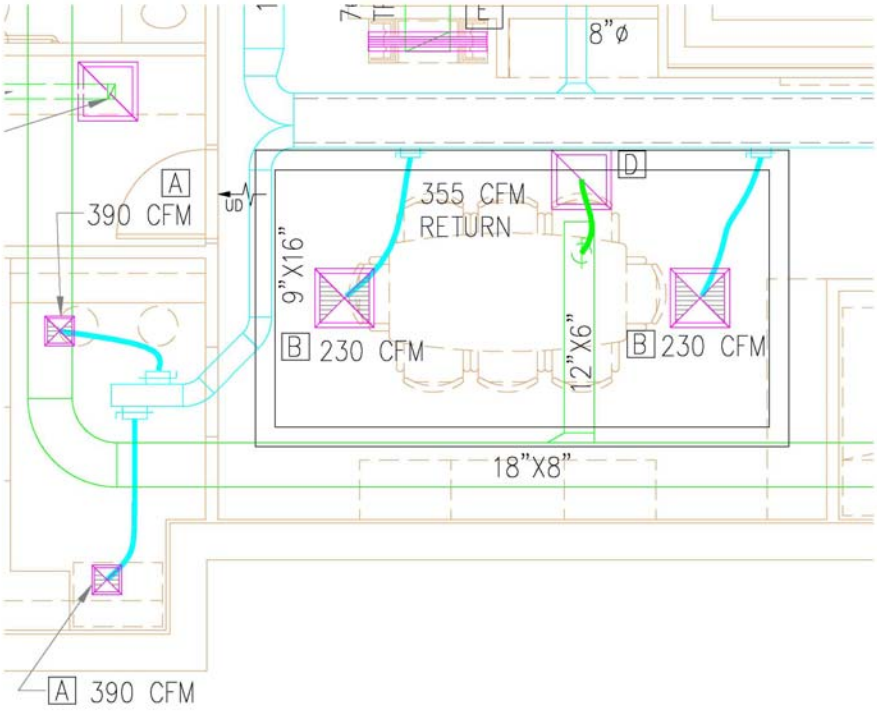


Figure 2 – Original Duct and Diffuser Layout

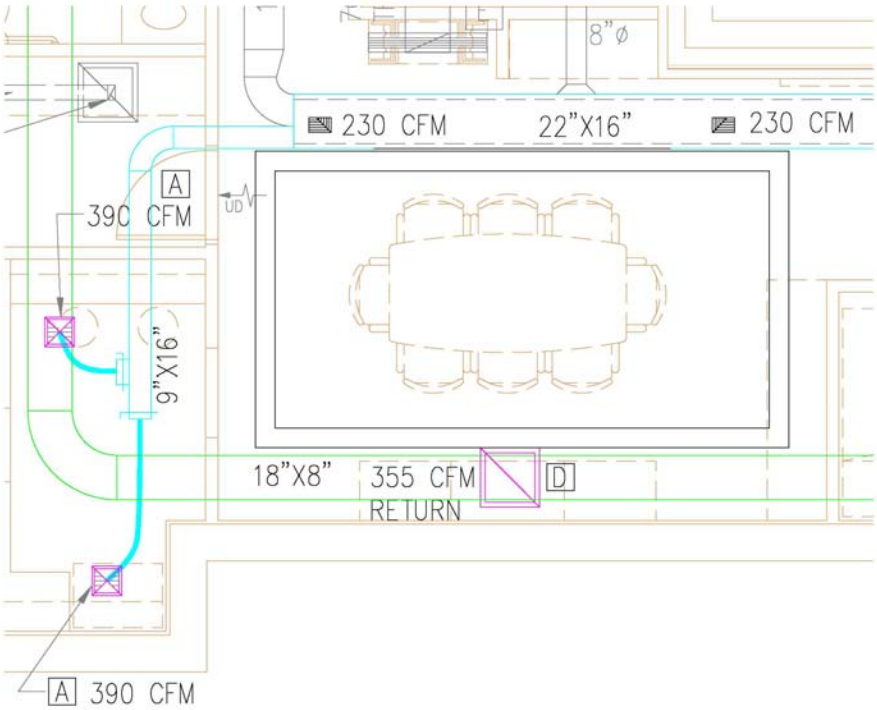


Figure 3 – New Duct and Diffuser Layout

Supply Diffuser Calculations

Design Criteria:

NC: <30
2 diffusers
Each 230 CFM

New Design:

Perforated and louvered ceiling diffusers

X_{50}/L for max ADPI: 2.0 (Table 2)

Max ADPI: 96>80 good

X_{50}/L=2.0 L=13feet (Table 1)

X_{50} = 12 x 2.0 = 24 feet (throw)

Key Characteristic Room Length of Various Diffusers (Table 11-1 MPS)

Diffuser Type	Characteristic Length
High sidewall grille	Distance to wall perpendicular to jet
Circular ceiling diffuser	Distance to closest wall or intersecting jet
Sill grille	Length of room in direction of jet flow
Ceiling slot diffuser	Distance to wall or mid-pane between outlets
Litgh troffer diffusers	Distance to mid-plane between outlets plus distance from ceiling to top of occupied zone
Perforated, louvered ceiling diffusers	Distance to wall or mid-plane between outlets

Table 1 – McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 376. Table 11-1.

Chapter 11 Space Air Diffusion

Table 11-3 Air Diffusion Performance Index (ADPI)

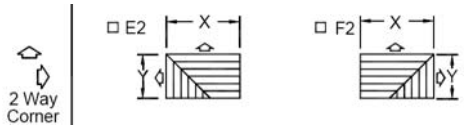
Terminal Device	Room Load, Btu/h-ft^2	x_{50}/L for Maximum ADPI	Maximum ADPI	For ADPI Greater Than	Range of x_{50}/L
High sidewall grilles	80	1.8	68	—	—
	60	1.8	72	70	1.5–2.2
	40	1.6	78	70	1.2–2.3
	20	1.5	85	80	1.0–1.9
Circular ceiling diffusers	80	0.8	76	70	0.7–1.3
	60	0.8	83	80	0.7–1.2
	40	0.8	88	80	0.5–1.5
	20	0.8	93	90	0.7–1.3
Sill grille, Straight vanes	80	1.7	61	60	1.5–1.7
	60	1.7	72	70	1.4–1.7
	40	1.3	86	80	1.2–1.8
	20	0.9	95	90	0.8–1.3
Sill grille, Spread vanes	80	0.7	94	90	0.6–1.5
	60	0.7	94	80	0.6–1.7
	40	0.7	94	—	—
	20	0.7	94	—	—
Ceiling slot diffusers (for T_{100}/L)	80	0.3	85	80	03.–0.7
	60	0.3	88	80	0.3–0.8
	40	0.3	91	80	0.3–1.1
	20	0.3	92	80	0.3–1.5
Light troffer diffusers	60	2.5	86	80	<3.8
	40	1.0	92	90	<3.0
	20	1.0	95	90	<4.5
Perforated and louvered ceiling diffusers	11–51	2.0	96	90	1.4–2.7
				80	1.0–3.4

Source: Reprinted by permission from *ASHRAE Handbook, Fundamentals Volume*, 1997.

Table 2 – McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 378. Table 11-3.

Selection:

NC: 29
Throw: 22 feet
Corner Diffuser



Titus Diffusers • Square and Rectangular, Louvered Face • Performance

Performance Data • Rectangular Neck

TDC • Louvered Face • Supply • Horizontal Blow Pattern

		Neck Vel.	300		400		500		600		700		800		900	
		Vel. Pressure	0.006		0.010		0.016		0.022		0.031		0.040		0.050	
		Total Pressure	0.042		0.075		0.117		0.169		0.229		0.300		0.379	
Return Factors -SP = 1.1 TP NC + 1		Total cfm	113		150		188		225		263		300		338	
		NC	-		14		20		25		29		32		35	
		Side	cfm	Throw	cfm	Throw	cfm	Throw	cfm	Throw	cfm	Throw	cfm	Throw	cfm	Throw
6 x 9 0.38 ft²	A1&B1	X	113	11-13-18	150	12-15-21	188	14-17-24	225	15-18-26	263	16-20-28	300	17-21-30	338	18-22-32
	A2&B2	X & Y	56	6-9-15	75	8-12-17	94	10-14-19	113	10-14-19	131	13-16-23	150	14-17-25	169	15-18-26
	E2&F2	X	75	7-10-14	100	9-12-16	125	11-13-18	150	12-14-20	175	13-15-22	200	13-16-23	225	14-17-25
		Y	38	4-7-12	50	6-9-14	63	7-11-15	75	9-12-17	88	10-13-18	100	11-14-19	113	12-14-20
	A3	X	47	6-10-14	63	9-11-16	78	10-12-18	94	11-14-19	109	12-15-21	125	13-16-22	141	14-17-23
		Y	19	4-7-11	25	6-9-12	31	7-10-14	38	9-11-15	44	9-11-16	50	10-12-17	56	11-13-18
	A3-2	X	42	6-9-15	56	8-12-17	70	10-14-19	84	12-15-21	98	13-16-23	113	14-17-24	127	15-18-26
		Y	35	4-7-12	47	6-9-14	59	7-11-15	70	9-12-17	82	10-13-18	94	11-14-19	105	12-14-20
	B4	X	38	6-10-14	50	9-11-16	63	10-12-18	75	11-14-19	88	12-15-21	100	13-16-22	113	14-17-23
		Y	19	4-7-11	25	6-9-12	31	7-10-14	38	9-11-15	44	9-11-16	50	10-12-17	56	11-13-18

Although a duct with a throw of 24 feet would have been ideal, a duct with a throw of 22 feet is acceptable since there is no furniture with the depth of 2 feet is located against the far wall and no occupants would be occupying this space.

Return Grill

Figure 3 also shows that the return grill was moved to the other side of the room. This was done since the duct would not fit in the plenum space above the cove with the pipe work that is located in their now. It was also done to allow for correct air movement through the room. Air movement for a typical ceiling diffuser is shown in Figure 4. The new location of the return grill is located in the stagnant air area to the right of the diffuser, outlined in red in Figure 4. The return duct and grille is assumed to stay the same size since the air in the space is drawn out by a fan contained in the system.

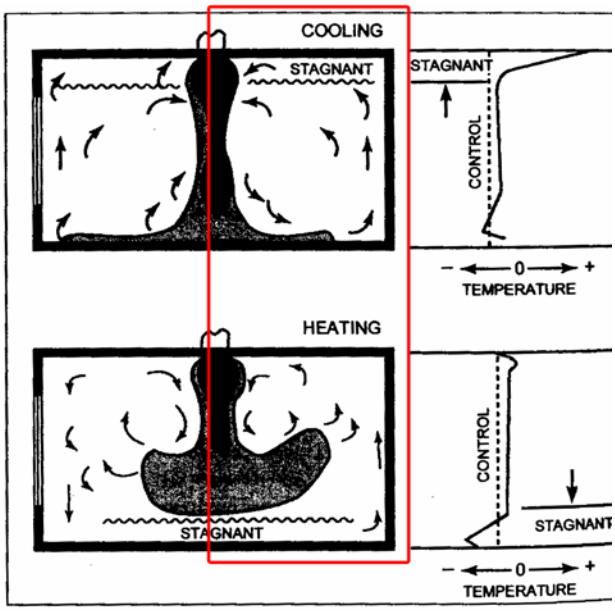


Fig. 8 Air Motion Characteristics of Group E Outlets
(Straub et al. 1956)

Figure 4 - Ceiling Diffuser – McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 373. Figure 11-7.

Duct Coordination

By taking out the T-bar drop down ceiling and inserting a cove, some of the mechanical duct work above this space needed to be moved. Figure 2 shows the original layout of the mechanical ducts above the ceiling with the new cove outline. The 9 x 16 supply duct serving the lower left adjacent room was re-routed to avoid the bump up in the ceiling plenum and the (2) 45 degree elbows were removed. Both walls are not fire rated, so it was possible to be penetrate through these walls. The over all length of the straight duct increased slightly by 3 ft, but by taking out the (2) 45 degree elbows, it subtracted an equivalent length of 16'-8". The pressure drop for this over all length subtraction of 13'-3" is shown below.

Pressure Drop Calculation

Rectangular duct: D = 2HW / (H+W) = (2 x 9 x 16) / (9 + 16) = 11.52 ≅ 12”

Equivalent Length:

Co = 0.16 (45 degree elbow) (see note 1 below)

Co = 0.26 (90 degree elbow) (see note 1 below)

f = 0.019 (see note 2 below)

$$\frac{L}{D} = \frac{C}{f}$$ (see note 3 below)

$$L = \frac{0.16}{0.019}\left(12" x \frac{1'}{12"}\right) = 8.4 \text{ ft}$$ per pleated 45 degree elbow

$$L = \frac{0.26}{0.019}\left(12" x \frac{1'}{12"}\right) = 14 \text{ ft}$$ per pleated 90 degree elbow

Existing pressure drop:

$L_{eq.} = L_{straight} + L_{90} + 2\,L_{45}$

= 9.5’ + 14’ + 2(8.4’) = 40.3’

Flow rate = 780 cfm

$$\frac{\Delta P_{(in.wg.)}}{100\,ft} = 0.14 in.wg.$$ (see note 4 below)

$$\frac{0.14_{in.wg.}}{100\,ft} = \frac{x}{40.3'} \qquad x = 0.056\,in.wg.$$

New pressure drop:

$L_{eq.} = L_{straight} + L_{90}$

= 12.5’ + 14’ = 26.5’

Flow rate = 780 cfm

$$\frac{\Delta P_{(in.wg.)}}{100\,ft} = 0.14 in.wg.$$ (see note 4 below)

$$\frac{0.14_{in.wg.}}{100\,ft} = \frac{x}{26.5'} \qquad x = 0.037\,in.wg.$$

Difference:

$$\frac{0.037_{\,in.wg.}}{0.056_{\,in.wg.}} = 0.66 \qquad 1 - 0.66 = 0.34 \text{ or } 34\% \text{ smaller } \Delta P$$

The pressure drop is about 34% smaller now that the (2) 45 degree elbows were removed and 3 feet was added to the straight duct length. A damper located in the duct is suggested for this decrease in pressure to avoid too much air coming out of the duct or the air coming out to fast.

Note 1: Table values taken from: McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 426. Table 12-8.

Note 2: Table values taken from: McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 434. Table 12-13.

Note 3: Equation taken from: McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 434. Eq. 12-20.

Note 4: Values taken from: McQuiston, Faye; Parker, Jerald; Spitler, Jeffrey; Heating Ventilating, and Air Conditioning, "Analysis and Design". Sixth Edition, 2005. Pg. 420. Figure 12-21.

Summary:

The overall design completes the need of the space. The new cove in the work area does not cause an unsolvable problem. The new diffusers throw the air as far as the occupied space and the return grills new location works well with the new diffuser's air distribution. All of the coordination issues in the plenum that were caused by this new cove design were solved as well as the decrease in pressure drop caused by this new layout can be fixed by a simple damper. It is recommended that the cove be placed in and this new mechanical design be implemented.

Architectural Breadth

By adding the cove into the tomb guards' work area, the dropdown ceiling needed to be analyzed to design the spacing between the main beams and cross tees to make sure these members and cables could hold the extra dead load and gypsum board. The downlights, ducts, diffusers, and return grills were all coordinated with each other to ensure there wouldn't be any coordination issues in the plenum or in the ceiling itself.

Drop Down Ceiling Reconstruction

With the new cove placed in the work area ceiling, the dropdown ceiling needed to be reconstructed by re-spacing the beams and cross tees as well as figuring out their max spans. The weight from the cove also had to be calculated to make sure the members and hangers could hold it. Below are the steps that were taken in figuring out this new ceiling construction based on a few typical main beams and cross tees as well as the beams located around the edge of the cove carrying the coves weight.

Step 1: The weight of the gypsum board used for the cove's construction was calculated.

Cove's Gypsum Board Weight

	3/4" Gypsum Board Weight (Lbs./SF)	Length (ft)	Height (in)	Weight (Lbs.)	Cable Spacing (ft)	Cable Quantity	Lbs/LF	Cove Load per Cable (Lbs)
Piece 1	4.2	18	3.5	22.05	2	9	1.225	2.45
Piece 2	4.2	18	8	50.4	2	9	2.8	5.6
Piece 3	4.2	18	20.5	129.15	2	9	7.175	14.35
						Total	11.2	22.4

Step 2: The gypsum board weight distributed on a few typical cross tees were calculated.

Cross Tees

	Typical Upper Cove (TU1)	Typical Lower Ceiling (TL1)	Typical Lower Ceiling (TL2)
Manufactured Length (in)	48	36	48
Fire Rated	Yes	No	Yes
Span (ft)	3	3	2.0
Deflection L/360 (in.)	0.10	0.10	0.07
Spacing (ft)	2	3	3
Cross Tee Weight (Lbs./LF)	0.75	0.75	0.75

Gypsum Board

3/4" Gypsum Board Weight (Lbs./SF)	4.2	4.2	4.2
Supported Gypsen Board Width (ft)	2.0	3.0	3.0
Support Gypsum Board Length (ft)	3.0	3.0	2.0
Gypsen Board Area (SF)	6.0	9.0	6.0
Weight (Lbs.)	25.2	37.8	25.2
Loading on Cross Tee (Lbs./LF)	8.4	12.6	12.6
Beam Intersections	2.0	2.0	----
Load on each Beam (Lbs.)	12.6	18.9	----
Total Lbs./LF	9.15	13.35	13.35
Allowed Lbs./LF	33.30	33.30	>33.30

The span and spacing for the cross tees was picked based on the gypsum board load calculation. As shown above, each cross tee is carrying a Lbs./LF less than what they are designed for.

Step 3: The load on a few main beams were calculated including the beams holding the weight from the cove. Light fixture weight, cove bracing, and materials were added to make the calculation more accurate.

Main Beams

	Upper Ceiling Long Side Cove Support (BU1)	Typical Upper Ceiling (BU2)	Typical Lower Ceiling (BL1)
Manufacture Length (in.)	144	144	144
Duty Load	Heavy Duty	Heavy Duty	Heavy Duty
Fire Rated	Yes	Yes	Yes
Span (ft)	3	3	3.5
Spacing (ft)	3	3	3
Deflection L/360 (in.)	0.10	0.10	0.12
Main Beam Weight (Lbs./LF)	0.75	0.75	0.75

Other Loading

Cove Lbs./LF	11.20	----	----
Light Fixture Lbs./LF	0.67	----	----
Cove Bracing Lbs./LF	1.31	----	----
Cross Tee Lbs./LF	6.30	12.6	10.8
Total Lbs./LF	19.5	12.6	10.8
Allowed Lbs./LF	33.3	33.3	18.76

The span and spacing for the beams was picked based on the over all weight they would have to support. As shown above, each beam is carrying a Lbs./LF less than what they are designed for.

Step 4: The loads on a few typical hanger wires were calculated.

12 gauge Wire Loading

	BU1	BU2	BL1	Tl2
Lbs./LF on Support	19.5	12.6	10.8	13.35
Span (ft)	3	3	3.5	2
Wire Loading (Lbs.)	58.5	37.8	37.8	26.7
Allowalbe Loading (Lbs.)	375	375	375	375

The hanger wires were calculated based on the overall loading of this system it would be supporting. Based on this calculation, a 12 gauge wire was specified for the construction. As shown above, the amount of load on each 12 gauge wire is significantly smaller than what the wire is designed for. Figure 1 displays the layout for the dropdown ceiling as well as points out these typical beams and cross tees that were used in the calculations.

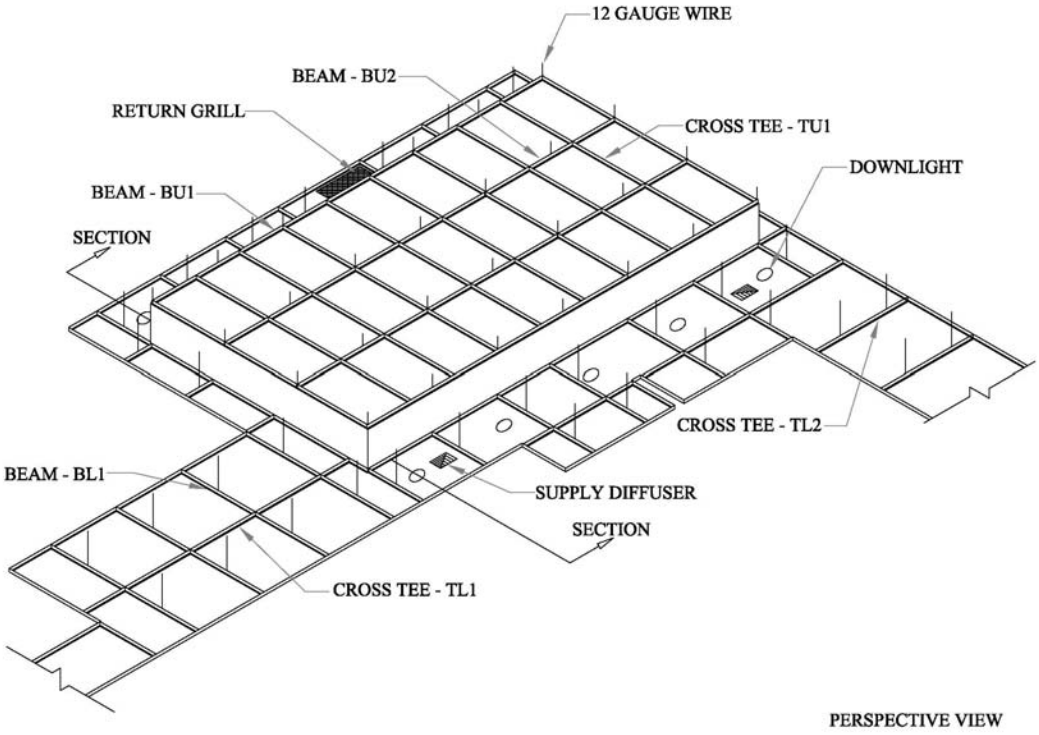


Figure 1

Ceiling Coordination

As seen in Figure 1, there were a number of things that the ceiling needed to be designed around. After the calculations were completed and the span and spacing were decided, the ceiling needed to be coordinated with the downlights, diffusers, grills, and duct work. Figure 2 shows a detailed section of the room and how the supply and return ducts fit into the plenum. Both Figure 2 and 3 show how the diffusers and return grills are centered together with the downlights so when seen from the space, they wont look randomly placed.

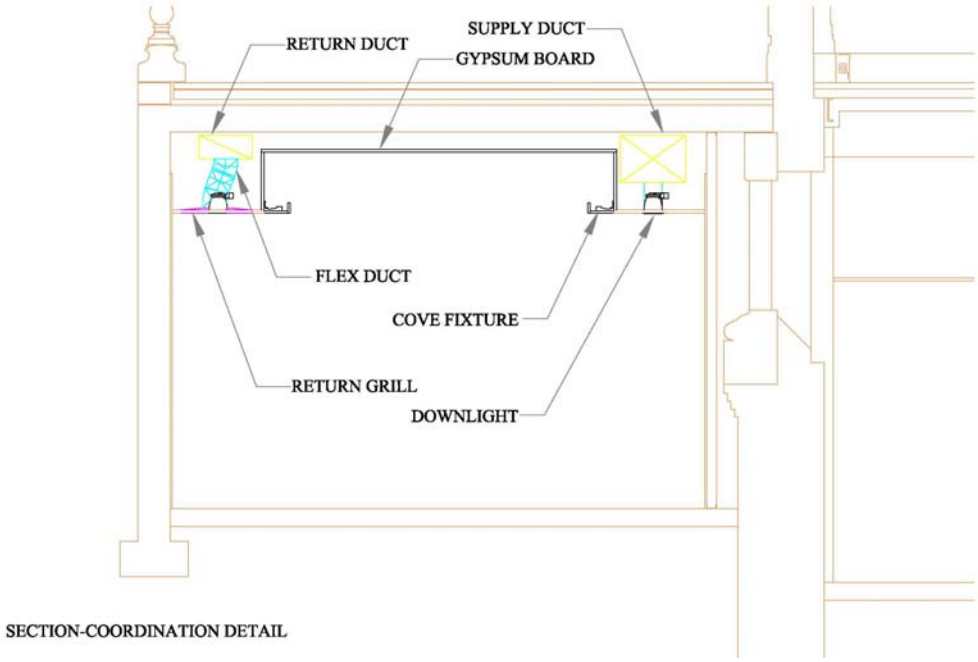


Figure 2

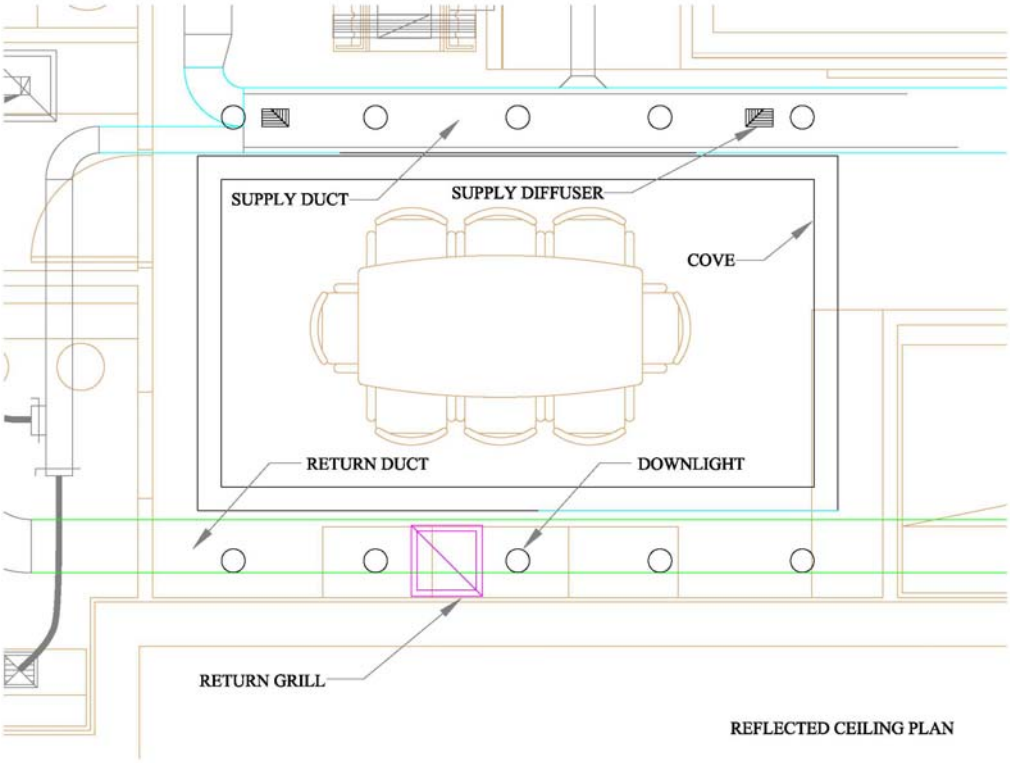


Figure 3

Since there the supply and return duct take up most of the space above either side of the cove, a trapeze system would have to be used. Figure 4 demonstrates how this trapeze system would be set up.

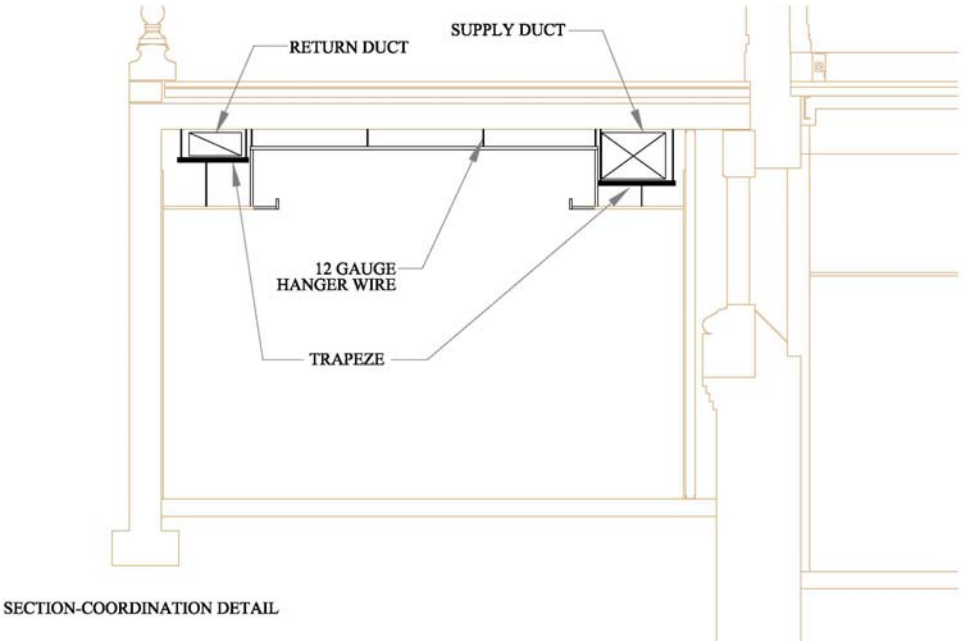


Figure 4

Summary:

All coordination issues were solved by either moving the diffusers or the members of the dropdown ceiling. The new dropdown ceiling spacing is capable of holding the new cove dead load as well as the gypsum board load. Overall, this new design works for the space above and below the plenum. The ceiling from the occupants view looks evenly spaced with is a big concern for the owner and architect.

Conclusion

By using the buildings architecture, a very unique lighting design was implemented. Each space has some kind of point of interest associated with is while keeping the criterion in mind. The Flynn mode for creating a relaxed atmosphere in the work area was accomplished by using indirect lighting and perimeter lighting through downlights and display case lighting. The flow through the reception room, crypt chapel, and the amphitheater was accomplished by playing with light levels in the spaces. Ultimately, the lighting design achieved all the goals that were set for each space while creating a common denominator of architectural lighting.

The electrical design was able to coordinate all the new lighting loads onto the panel boards as well as size the wiring for these devices. New energy efficient transformers saved a large amount of money for the owner, but the cost of the generator system would probably offset these savings. The investigation of the protective devices in the building prove that in the event of a short circuit or over load, the circuit breaker protecting the load would trip first ultimately protecting the rest of the equipment in the run.

The coordination issues the cove design creates in the guards' work area were all solved. The downlights, diffusers, members of the drop down ceiling, cables, and duct work all fit into the plenum without interfering with each other. Also, the new dead load that was added by this cove system is able to be held up by the beams and cables in the plenum thus ensuring the ceiling is structurally sound.

Overall, the systems designed for the Memorial Reception Building achieve all goals set out for it except for the emergency back up system. These designs are recommended for this building.

Appendix

The Memorial Reception Building
Arlington National Cemetery

Lighting

5/4/2007

DuraMax Deco 3W Cand 120V CA10 CL 1BC

Product family description
DuraMax Decorative Petite Bent Tip light bulbs.

Features/Benefits

- Ideal for chandeliers and other decorative light fixtures.
- Lasts 1.5 years.

Applications

- Ideal for chandeliers and other decorative light fixtures.

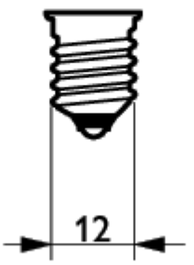
Notes

- Rated average life is the length of operation (in hours) at which point an average of 50% of the lamps will still be operational and 50% will not.

Product data	
Product Number	166982
Full product name	DuraMax Deco 3W Cand 120V CA10 CL 1BC
Ordering Code	BC3CA10C/CL/LL
Pack type	1 Lamp in a Blister Card
Pieces per Sku	1
Skus/Case	6
Pack UPC	046677166984
EAN2US	
Case Bar Code	50046677166989
Successor Product number	
Base	Candelabra [Candelabra Screw]
Base Information	Aluminum [Aluminum Base]
Bulb	CA10
Bulb Finish	Clear
Filament Shape	C-7A [Ring]
Operating Position	Base Down +/- 90D [Standing +/-90D or Base Down (BDH)]
Packing Type	1BC [1 Lamp in a Blister Card]
Packing Configuration	6

Product data	
Atmosphere	Vacuum [Vacuum]
Rated Avg. Life	2000 hr
Ordering Code	BC3CA10C/CL/LL
Pack UPC	046677166984
Case Bar Code	50046677166989
Watts	3W
Voltage	120V
Max Overall Length (MOL) - C	4.12 in
Diameter D	1.25 in
Product Number	166982

DuraMax Deco CA10 CL



Base Candelabra

DESCRIPTION

The Boca 636 is a 6-1/4" diameter inground fixture with rotatable, slotted aperture for use with an MR16 lamp source. The adjustable lamp assembly provides up to 22° vertical tilt and 360° horizontal rotation for precision uplighting, wall washing or general illumination in constricted areas. Designed for recess mounting in concrete, brick, stone or dirt it is suitable for drive-over applications. Fixture is also suitable for recessed mounting in indoor or outdoor wood flooring (non-IC) when equipped with option T.

		Type
Catalog #		FIXTURE 'A2'
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Material
Recessed housing is constructed from corrosion-resistant stainless steel. Trim ring, trim collar and slotted aperture are die-cast from corrosion-resistant solid brass.

B ... Finish
Solid brass trim ring, trim collar and slotted aperture are unpainted to reveal the natural beauty of the material and will patina naturally over time.

C ... Gasket
Recessed housing and trim ring are sealed with a high temperature silicone o-ring gasket to prevent water intrusion.

D ... Lens
Minimum 1/4" thick tempered glass lens, factory sealed with high temperature adhesive to prevent water intrusion and breakage due to thermal shock. Suitable for drive-over applications.

E ... Hardware
Stainless steel hardware is standard to provide maximum corrosion-resistance.

F ... Socket
Ceramic socket with 250° C Teflon® coated lead wires and GU5.3 bi-pin base.

G ... Electrical
Remote 12V transformer required (not included). Available from Lumière as an accessory - see the Accessories & Technical Data section of this catalog for details. 4' 16-2 cord with Lumière's exclusive Siphon Protection System (S.P.S.) is standard. Two 1/2-14 NPSM brass female conduit fittings for through wiring is available (specify option -2C).

H ... Thermal Cutoff Protection (Optional)
Fixture is suitable for recessed mounting in indoor or outdoor wood flooring (non-IC) when equipped with option T (changes UL/cUL wet label to damp label). Fixture is not suitable for inground or concrete pour applications when equiped with option T. Includes two 1/2-14 NPSM brass female conduit fittings for through wiring (option -2C) in lieu of standard 4' 16-2 cord.

I ... Lamp
Not included. Available from Lumière as an accessory - see reverse side of this page.

J ... Labels & Approvals
UL and cUL listed, standard wet label. Fixtures equipped with option T (thermal cutoff protection) are UL/cUL listed, damp label. Manufactured to ISO 9001-2000 Quality Systems Standard. IBEW union made.

K ... Warranty
Lumière warrants its fixtures against defects in materials & workmanship for three (3) years. Auxiliary equipment such as transformers, ballasts and lamps carry the original manufacturer's warranty.

L ... Recessed Housing
Recessed housing is available to ship in advance of complete fixture for rough-in purposes. Specify option -LBB and order separately accompanying recessed housing from below:

636-NBR-BB
recessed housing;

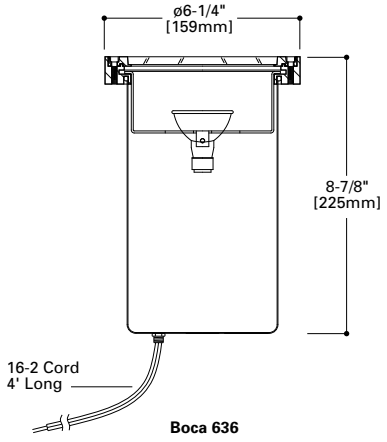
636-NBR-2C-BB
recessed housing w/2C option;

636-NBR-T-BB
recessed housing w/T option;

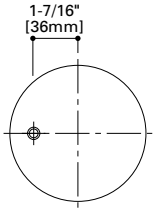
636-NBR-TP-BB
recessed housing w/TP option;

636-NBR-2C-TP-BB
recessed housing w/2C & TP option;

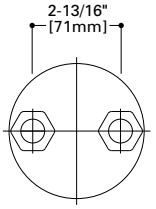
636-NBR-T-TP-BB
recessed housing w/T & TP option



Boca 636



Cord Entry Detail - standard



Conduit Entry Detail - optional (specify –2C)
NOTE: provided as standard when thermal cutoff option (–T) is specified

BOCA

636

75W (max.) MR16
Halogen
Low Voltage

Inground

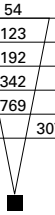
Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

Boca 636
Lamp=75MR16/NSP (EYF)
CBCP=12,300

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
15'0"	54	4'0"
10'0"	123	3'0"
8'0"	192	2'0"
6'0"	342	1'6"
4'0"	769	1'0"
2'0"	3075	0'6"

Lamp Wattage Multiplier
50W x 0.83
20W x 0.29

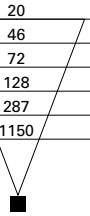


Boca 636
Lamp=75MR16/NFL (EYJ)
CBCP=4600

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
15'0"	20	9'0"
10'0"	46	6'0"
8'0"	72	4'6"
6'0"	128	3'6"
4'0"	287	2'0"
2'0"	1150	1'0"

Lamp Wattage Multiplier
50W x 0.63

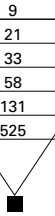


Boca 636
Lamp=75MR16/FL (EYC)
CBCP=2100

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
15'0"	9	4'0"
10'0"	21	3'0"
8'0"	33	2'0"
6'0"	58	1'6"
4'0"	131	1'0"
2'0"	525	0'6"

Lamp Wattage Multiplier
50W x 0.82
35W x 0.48
20W x 0.25



LAMP INFORMATION

Lamp	ANSI Code	Watts	Beam Spread	CBCP	°K	Life (hrs.)	Base	Volts
75MR16/NSP	EYF	75	14°	12,300	3050	4000	GU5.3 bi-pin	12
75MR16/NFL	EYJ	75	25°	4600	3050	4000	GU5.3 bi-pin	12
75MR16/FL	EYC	75	42°	2100	3050	4000	GU5.3 bi-pin	12

NOTE: Inferior quality lamps may adversely affect the performance of this product. Use only name brand lamps from reputable lamp manufacturers.

NOTES AND FORMULAS

- Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
- Footcandle values are initial. Apply appropriate light loss factors where necessary.
- Bare lamp data shown. Consult lamp manufacturers to obtain detailed specifications for their lamps.

ORDERING INFORMATION

Sample Number: 636-75MR16-12-NBR

Series
636: Slotted Aperture, 6-1/4" Dia, Adjustable 22° Vertical Tilt 360° Horizontal Rotation Boca Inground

Source
Halogen
75MR16: 75W Max Halogen MR16, GU5.3 Base

Voltage
12: 12V

Finish
Metal
NBR: Brass

Options
2C: Two 1/2" Conduit Entries (in lieu of 4" cord)
T: Thermally rated for use in non-IC [1] wood flooring (changes UL/cUL wet label to damp label)
TP: Tamper-Resistant Hardware
LBB: Housing Shipped in Advance (select LBB option and order recessed housing separately)

Recessed Housing (order separately)
Select housing from Recessed Housing section on previous page

Accessories [2]

Filters
F71: Peach Dichroic Filter, 2.00" Dia
F73: Green Dichroic Filter, 2.00" Dia
F75: Yellow Dichroic Filter, 2.00" Dia
F77: Dark Blue Dichroic Filter, 2.00" Dia
F79: Neutral Density Dichroic Filter, 2.00" Dia
F22: Red Color Filter, 2.00" Dia
F44: Green Color Filter, 2.00" Dia
F66: Mercury Vapor Color Filter, 2.00" Dia
F72: Amber Dichroic Filter, 2.00" Dia
F74: Medium Blue Dichroic Filter, 2.00" Dia
F76: Red Dichroic Filter, 2.00" Dia
F78: Light Blue Dichroic Filter, 2.00" Dia
F80: Magenta Dichroic Filter, 2.00" Dia
F33: Blue Color Filter, 2.00" Dia
F55: Yellow Color Filter, 2.00" Dia

Filter Holder
LH16: MR16 Size Filter Holder with Hex Cell Louver

Lamps
EZX: 20W MR16 GU5.3 Bi-Pin Very Narrow Spot
BAB: 20W MR16 GU5.3 Bi-Pin Flood
FRA: 35W MR16 GU5.3 Bi-Pin Spot
EXT: 50W MR16 GU5.3 Bi-Pin Narrow Spot
EXN: 50W MR16 GU5.3 Bi-Pin Flood
EYF: 75W MR16 GU5.3 Bi-Pin Narrow Spot
EYC: 75W MR16 GU5.3 Bi-Pin Flood
ESX: 20W MR16 GU5.3 Bi-Pin Narrow Spot
FRB: 35W MR16 GU5.3 Bi-Pin Narrow Spot
FMW: 35W MR16 GU5.3 Bi-Pin Flood
EXZ: 50W MR16 GU5.3 Bi-Pin Narrow Flood
FNV: 50W MR16 GU5.3 Bi-Pin Very Wide Flood
EYJ: 75W MR16 GU5.3 Bi-Pin Narrow Flood

Notes: 1 Two conduit entries (2C) standard with T option.
2 Filters require filter holder accessory.
* Lamp not included.
* 12V remote transformer required - not included.
* See ACCESSORIES & TECHNICAL DATA section of the Lumière catalog for Low Voltage Cable & Transformers.
* Consult your Cooper Lighting representative for additional options and finishes.

20835 – Q50MR16/C/NFL25

GE MR16

PRINT

GENERAL CHARACTERISTICS

Lamp type	Halogen - MR
Bulb	MR16
Base	2-Pin (GX5.3)
Filament	C-6
Wattage	50
Voltage	12
Rated Life	6000 hrs
Lamp Enclosure Type (LET)	Open or enclosed fixtures

PHOTOMETRIC CHARACTERISTICS

Center Beam Candlepower (CBCP)	3200
Color Temperature	3050 K

DIMENSIONS

Maximum Overall Length (MOL)	1.8750 in (47.6 mm)
Bulb Diameter (DIA)	2.000 in (50.8 mm)

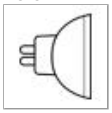
PRODUCT INFORMATION

Product Code	20835
Description	Q50MR16/C/NFL25
ANSI Code	EXZ
Standard Package	BUNDLE
Standard Package GTIN	00043168208352
Standard Package Quantity	20
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	20
UPC	043168994279

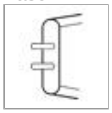
⚠ CAUTIONS & WARNINGS

See list of cautions & warnings.

Bulb



Base



Filament

View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Application/Segment Brochures

- Beauty Salon Lighting
- Restaurant Lighting
- Specialty Store Lighting

Product Brochures

- Color
- XL Brochure

Sell Sheets

- GE ConstantColor® Precise™ MR16 Lamps

IES/Photometric Download

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

Return To Top

TARGETTI

ELITE

QR-CB 51 max 50W

N. Lamps: 1
Weight kg : 0.1
Watt : 50W

DESCRIPTION

Adjustable projector for max 50W Ø51mm 12V dichroic halogen QR-CB 51 lamps. Painted die-cast aluminium body. Metal stem. Frontal ring designed for use with multi-layered dielectric filters, safety glass, frontal anti-glare louvre, with painted metal and translucent polycarbonate screens. Without adapter.

ACCESSORIES

Power supply
Ready for Unix System

Multilayered chromatic dichroic Filters Ø50 mm
49881 Red
49882 Green
49886 Blue
49887 Yellow
49959 Magenta
49880 UV Filter

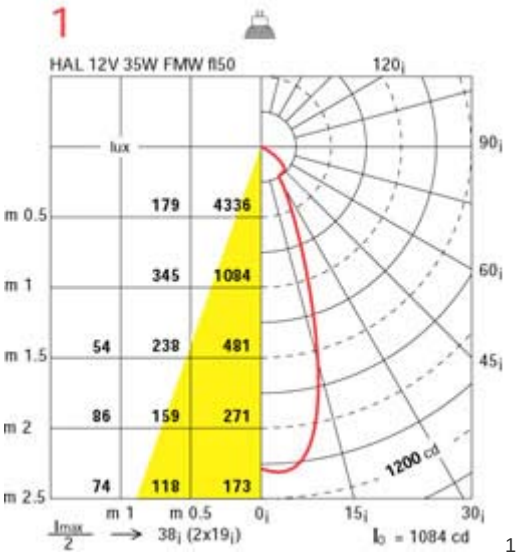
Metal anti-glare louvre
49395 Black

Metal anti-glare screen
49396 Black
49394 White

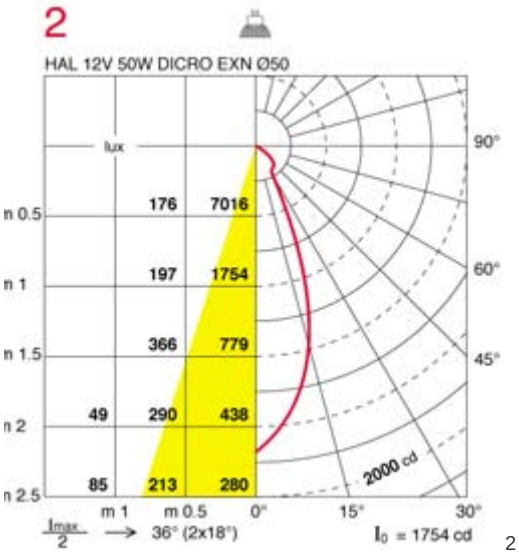
Anti-glare translucent polycarbonate screen
49425 Black
49424 White

Safety glass
42199

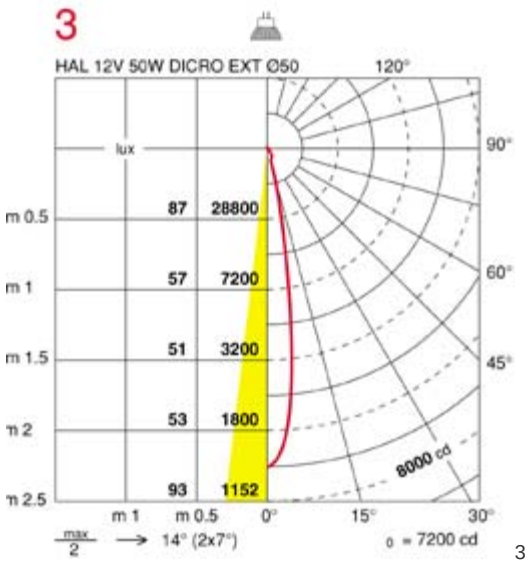
PHOTOMETRIC FILE



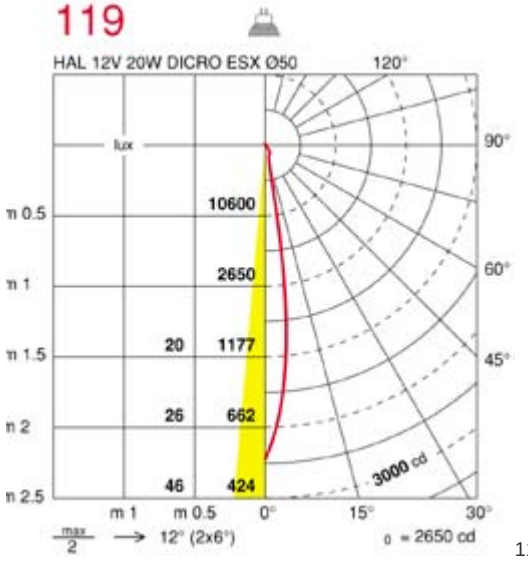
1



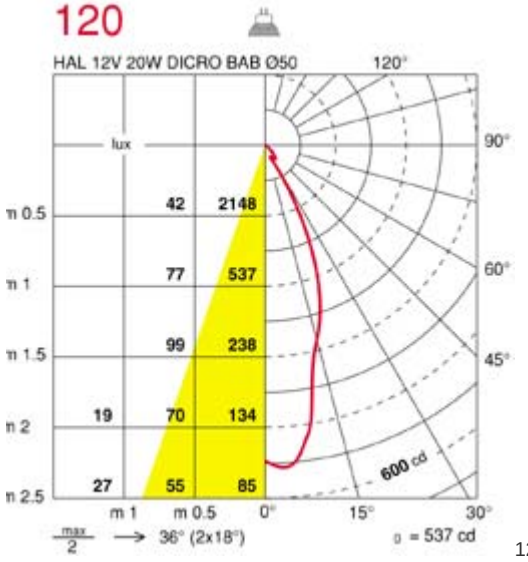
2


3
HAL 12V 50W DICRO EXT Ø50
120°
lux
90°
m 0.5
87
28800
m 1
57
7200
60°
m 1.5
51
3200
45°
m 2
53
1800
8000 cd
m 2.5
93
1152
m 1
m 0.5
0°
15°
30°
max/2 → 14° (2x7°)
0 = 7200 cd

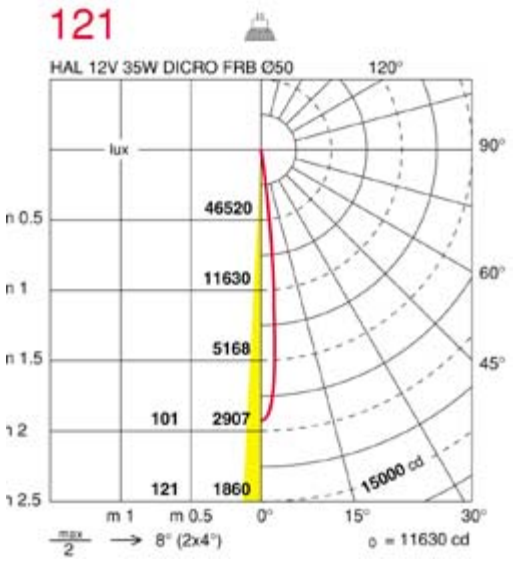
3


119
HAL 12V 20W DICRO ESX Ø50
120°
lux
90°
m 0.5
10600
m 1
2650
60°
m 1.5
20
1177
45°
m 2
26
662
3000 cd
m 2.5
46
424
m 1
m 0.5
0°
15°
30°
max/2 → 12° (2x6°)
0 = 2650 cd

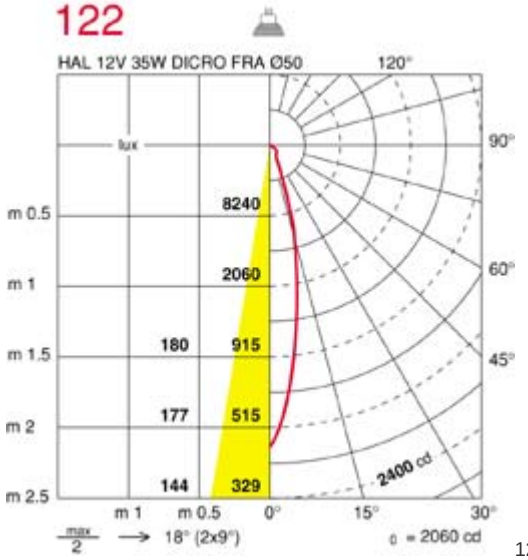
119


120
HAL 12V 20W DICRO BAB Ø50
120°
lux
90°
m 0.5
42
2148
m 1
77
537
60°
m 1.5
99
238
45°
m 2
19
70
134
600 cd
m 2.5
27
55
85
m 1
m 0.5
0°
15°
30°
max/2 → 36° (2x18°)
0 = 537 cd

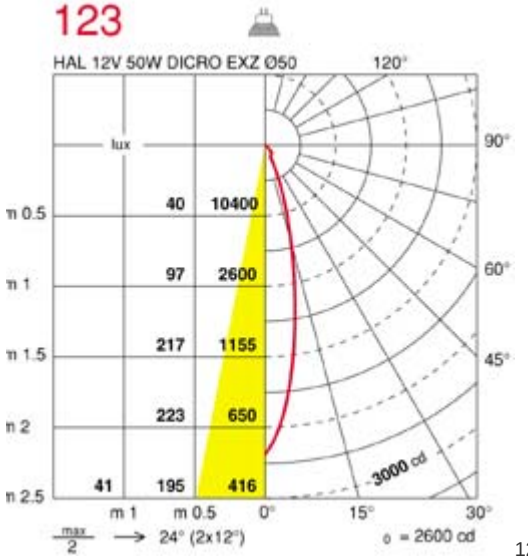
120


121
HAL 12V 35W DICRO FRB Ø50
120°
lux
90°
46520
11630
60°
5168
45°
101
2907
121
1860
15000 cd
m 1
m 0.5
0°
15°
30°
8° (2x4°)
= 11630 cd

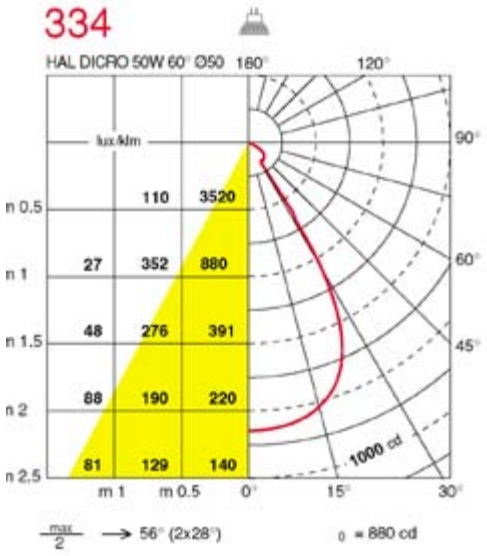
121


122
HAL 12V 35W DICRO FRA Ø50
120°
lux
90°
8240
2060
60°
180
915
45°
177
515
144
329
2400 cd
m 0.5
m 1
m 1.5
m 2
m 2.5
m 1
m 0.5
0°
15°
30°
18° (2x9°)
= 2060 cd

122

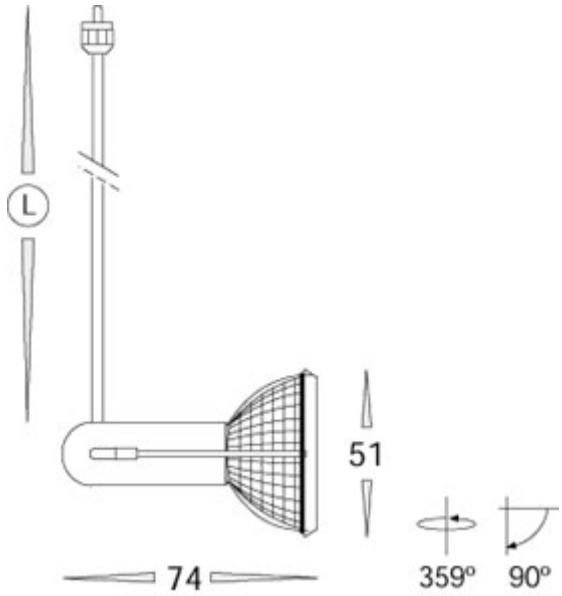

123
HAL 12V 50W DICRO EXZ Ø50
120°
lux
90°
40
10400
60°
97
2600
217
1155
45°
223
650
41
195
416
3000 cd
m 0.5
m 1
m 1.5
m 2
m 2.5
m 1
m 0.5
0°
15°
30°
24° (2x12°)
= 2600 cd

123



334

DRAWING



VERSIONS OF OF QR-CB 51 MAX 50W

▶	**49315**	Elite Dicro Black L=300 mm	0.1 kg	50W
	49330	Elite Dicro Chrome L=300 mm	0.1 kg	50W
	49334	Elite Dicro White L=300 mm	0.1 kg	50W
	49335	Elite Dicro Black L=300 mm	0.1 kg	50W
	49350	Elite Dicro Chrome L=500 mm	0.1 kg	50W
	49354	Elite Dicro White L=500 mm	0.1 kg	50W
	49355	Elite Dicro Black L=500 mm	0.1 kg	50W
	49370	Elite Dicro Chrome L=700 mm	0.1 kg	50W
	49374	Elite Dicro White L=700 mm	0.1 kg	50W

49375	Elite Dicro Black L=700 mm	0.1 kg	50W
49324	Elite Flex White L=500 mm	0.2 kg	50W
49325	Elite Flex Black L=500 mm	0.2 kg	50W
49329	Elite Flex Aluminium L=500 mm	0.2 kg	50W
49310	Elite Dicro Chrome L=100 mm	0.1 kg	50W
49314	Elite Dicro White L=100 mm	0.1 kg	50W

Tel.:+39 055 37 91 1 - Fax: +39 37 91 266 - www.targetti.com - targetti@targetti.it

20835 – Q50MR16/C/NFL25

GE MR16

PRINT

GENERAL CHARACTERISTICS

Lamp type	Halogen - MR
Bulb	MR16
Base	2-Pin (GX5.3)
Filament	C-6
Wattage	50
Voltage	12
Voltage (MIN)	50
Rated Life	6000 hrs
Rated Life (Vert)	6000 hrs
Lamp Enclosure Type (LET)	Open or enclosed fixtures

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3200
Initial Lumens (Hor)	3200
Initial Lumens (Vert)	3200
Center Beam Candlepower (CBCP)	3200
Color Temperature	3050 K
Nominal Initial Lumens per Watt	64

DIMENSIONS

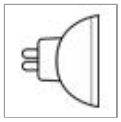
Maximum Overall Length (MOL)	1.8750 in (47.6 mm)
Bulb Diameter (DIA)	2.000 in (50.8 mm)

PRODUCT INFORMATION

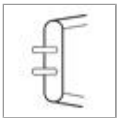
Product Code	20835
Description	Q50MR16/C/NFL25
ANSI Code	EXZ
Standard Package	BUNDLE
Standard Package GTIN	00043168208352
Standard Package Quantity	20
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	20
UPC	043168994279

⚠ CAUTIONS & WARNINGS

Bulb



Base



Filament

View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Application/Segment Brochures

- Beauty Salon Lighting
- Restaurant Lighting
- Specialty Store Lighting

Product Brochures

- Color
- XL Brochure

Sell Sheets

- GE ConstantColor® Precise™ MR16 Lamps

IES/Photometric Download

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

Echo Sconce

Clear
Shown approx. 20% actual size.

Amber

Aquamarine

Havana Brown

Smoke

DESCRIPTION

Vivid glass shade over a white case glass inner cylinder suspended from a round base and highlighted with three satin nickel cylinder details. Provides ambient, up- and down-light.

INSTALLATION

This product can mount to either a 4" square electrical box with round plaster ring or an octagon electrical box. Dimmable with a standard incandescent dimmer.

COLOR

Amber, aquamarine, clear, havana brown, smoke.

FINISH

Satin nickel only.

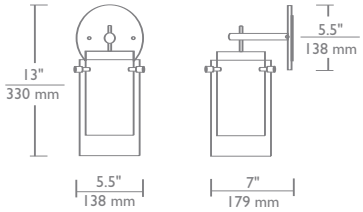
LAMP

Includes 120 volt, 75 watt, medium base-A19 lamp. Maximum lamp wattage that can be used with this fixture is 75 watts.

WEIGHT

3.50 lb./1.58 kg. ±

Echo Sconce



700TDECS	Color	Finish
	A Amber	**S** Satin Nickel
	Q Aquamarine	
	C Clear	
	B Havana Brown	
	S Smoke	

700TDECS _____ _____

FIXTURE TYPE: _____

JOB NAME: _____

2thousand degrees™
7400 Linder Avenue
Skokie, IL 60077
P 847.410.4400
F 847.410.4500
www.2thousanddegrees.com

22364 – 75A/COMM 24PK

GE A19

PRINT

GENERAL CHARACTERISTICS

Lamp type	Incandescent - A-line
Bulb	A19
Base	Medium Screw (E26)
Filament	CC-6
Bulb Finish	Inside frost
Wattage	75
Voltage	120
Rated Life	750 hrs
Bulb Material	Soft glass
Primary Application	Standard

PHOTOMETRIC CHARACTERISTICS

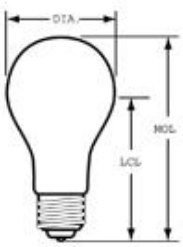
Initial Lumens	1180
Nominal Initial Lumens per Watt	15

DIMENSIONS

Maximum Overall Length (MOL)	4.4300 in (112.5 mm)
Bulb Diameter (DIA)	2.375 in (60.3 mm)
Light Center Length (LCL)	3.120 in (79.2 mm)

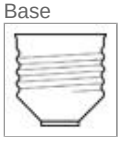
PRODUCT INFORMATION

Product Code	22364
Description	75A/COMM 24PK
Standard Package	Case
Standard Package GTIN	00043168223645
Standard Package Quantity	24
Sales Unit	Unit
No Of Items Per Sales Unit	2
No Of Items Per Standard Package	24
UPC	043168950183

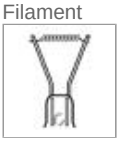


Bulb

Base



Filament



View Larger

ADDITIONAL RESOURCES

Catalogs
MSDS (Material Safety Data Sheets)
Disposal Policies & Recycling Information

Return To Top

FIXTURE 'A5'

SISTEMALUX iGuzzini

SPECIFICATION SHEET

MINIWOODY
FLOODLIGHT WITH BASE

#731 - ____ - 15
OPTIC VOLTAGE FINISH

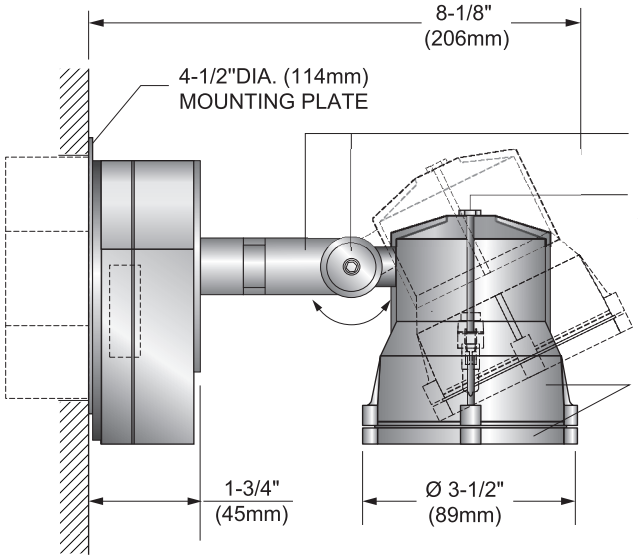
The Miniwoody floodlight series is designed for outdoor use with an adjustable base that can be locked in position. The fixture is adjustable for angle of illumination required and provides two types of optics: Flood and Spot.

LAMPING: 1 X 50W T4 HALOGEN LOW VOLTAGE GY6.35 BASE

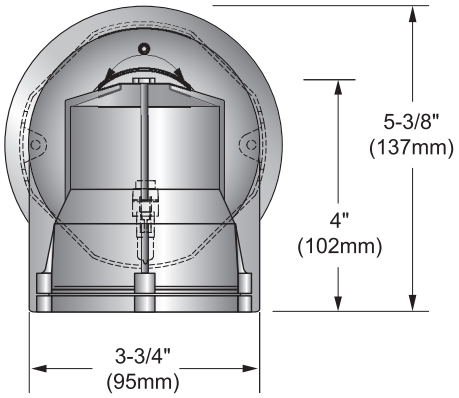
PROJECT NAME: _____

TYPE: _____

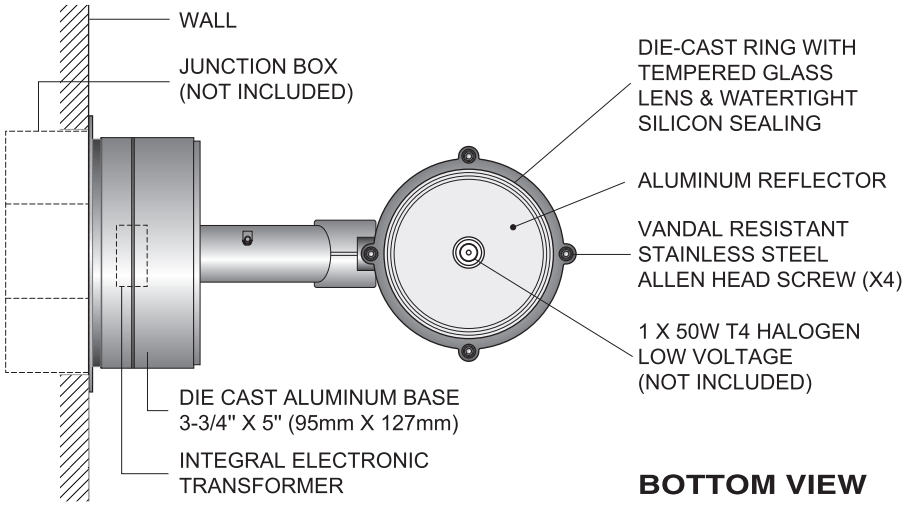
LAST UPDATE: MARCH 25, 2004



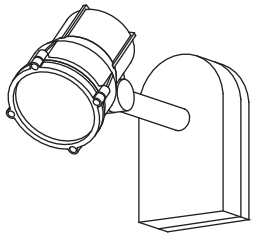
SIDE VIEW



FRONT VIEW



BOTTOM VIEW



ISOMETRIC VIEW

ACCESSORIES

◯ **I.1185** - LINEAR SPREAD LENS FOR ELLIPTICAL DISTRIBUTION

◯ **I.1182** - VISOR

◯ **I.1183** - STRAP LANDSCAPE ATTACHEMENT

◯ 24- CLEAR TRANSPARENT

OPTIC
I.7318 - SPOT (S) **I.7319** - FLOOD (F)

VOLTAGE ◯ 120V ◯ 277V

METAL FINISH ◯ **15** - GREY

c UL us

CANADA - 5455 De Gaspé, suite #100,
Montréal (Quebec), H2T 3B3
Phone: 514.523.1339
Fax: 514.525.6107

USA - 1310 Blue Oaks Blvd.,
Roseville, CA 95678
Phone: 916.772.7800
Fax: 916.772.7825

MINIWOODY
FLOODLIGHT WITH BASE

LV Capsule 50W GY6.35 12V T4 CL 1CT

Product family description
Single-ended low-voltage halogen capsule lamp giving crisp white halogen light.

Features/Benefits

- Low pressure burner .
- UV Block glass.
- Lifetime 4000 hours.
- Universal burning position.
- Variety of wattages.

Applications

- Ideal for accent lighting.

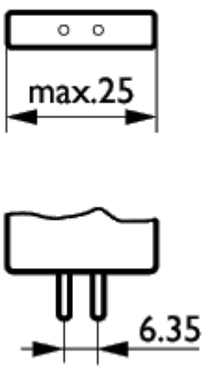
Notes

- NOTICE: Do not touch bulb with bare hands. Fingerprints may result in shorter life. Remove fingerprints with alcohol.CAUTION: THIS LAMP IS PRESSURIZED AND COULD SHATTER so to avoid injury and to avoid exposure to ultraviolet radiation, use only in fixures that provide a protective shield of tempered glass. Provide adequate ventilation to ensure that seal tempreature does not exceed 350 degrees C and use only in fixtures rated for the wattage stated on this package. To avoid risks of burns or other injury, turn power off and allow lamp to fully cool before attempting to replace. Socket condition may affect lamp life. Inspect and replace socket if deterioration has occured. (95)
- Rated average life is the length of operation (in hours) at which point an average of 50% of the lamps will still be operational and 50% will not. (93)

Product data	
Product Number	232652
Full product name	LV Capsule 50W GY6.35 12V T4 CL 1CT
Ordering Code	50W/T4/12V
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	100
Pack UPC	046677232658
EAN2US	
Case Bar Code	50046677232653

Product data	
Successor Product number	
Base	GY6.35
Base Information	15
Bulb	T4 [Diameter: .5 inch]
Bulb Finish	Clear
Operating Position	Universal [Any or Universal (U)]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	10X10F
Rated Avg. Life	3000 hr
Ordering Code	50W/T4/12V
Pack UPC	046677232658
Case Bar Code	50046677232653
Watts	50W
Voltage	12V
Dimmable	Yes
Color Rendering Index	100 Ra8
Color Temperature	3000 K
Initial Lumens	935 Lm
Overall Length C	44 mm
Diameter D	12.5 mm
Product Number	232652

CAP ST GY6.35



Base GY6.35

FIXTURE 'C1'

SISTEMALUX iGuzzini

SPECIFICATION SHEET

LIGHT UP WALK PROFESSIONEL

#I.B007-____-13
VOLTAGE FINISH

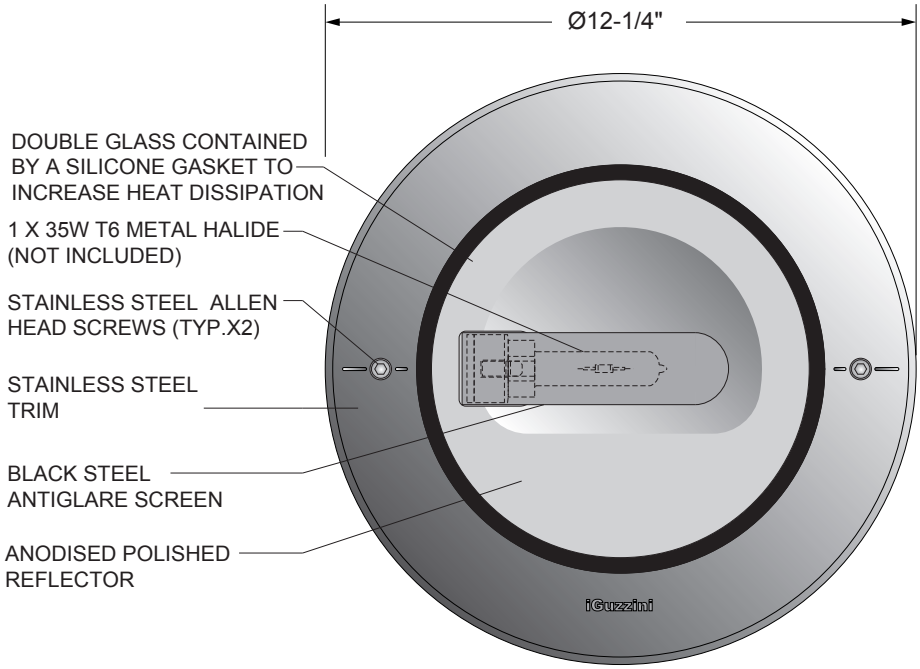
In-ground recessed luminaire with wall washer optic. Cast aluminum body and outer casing. Trim and vandal resistant screws are made of stainless steel. The double layer of tempered glass reduces the surface temperature. The total assembly can whithstand a load of 5000 Kg (11 000 lbs) at a maximum speed of 50 Km/h (31 mph).

LAMPING: 1 X 35W T6 METAL HALIDE
G12 BASE

PROJECT NAME: _____

TYPE: _____

LAST UPDATE: JUNE 06, 2006



TOP VIEW

ACCESSORIES
TO BE ORDERED SEPERATELY

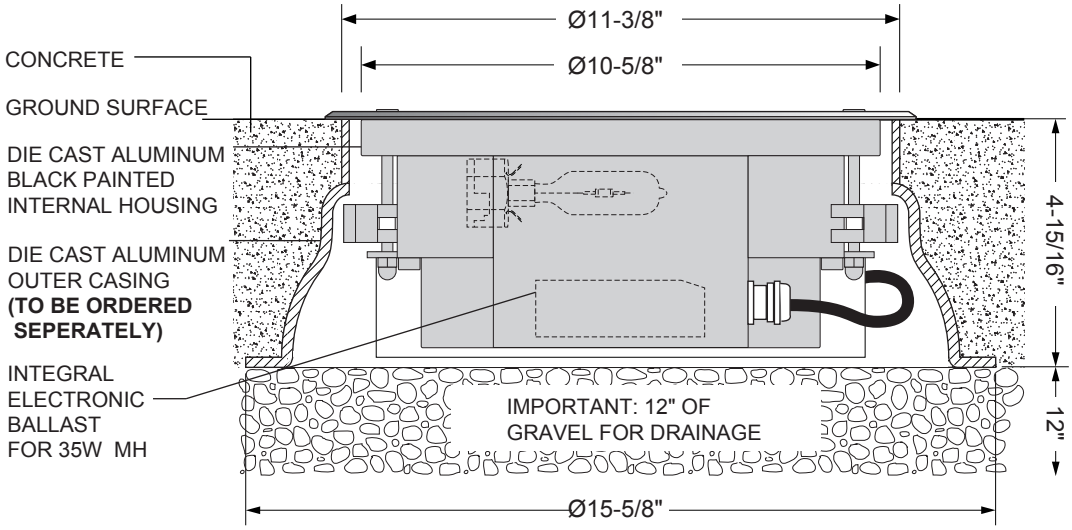

◯ I-B901 - CASING
04 - BLACK


◯ I-B918 - COLORED FILTERS
00 - FROSTED
05 - RED
06 - YELLOW
09 - BLUE


◯ I-B916 - SUCTION CUP

VOLTAGE ◯ 120V ◯ 277V

METAL FINISH
◯ 13 - STAINLESS STEEL



SECTION VIEW

c UL us

CANADA - 5455 De Gaspé, suite #100,
Montréal (Quebec), H2T 3B3
Phone: 514.523.1339
Fax: 514.525.6107

USA - 1310 Blue Oaks Blvd.,
Roseville, CA 95678
Phone: 916.772.7800
Fax: 916.772.7825

LIGHT UP WALK PROFESSIONEL

38696 – CMH35/T/UVC/U/830/G12

GE PulseArc® Showbiz® Ceramic Metal Halide T6 - Stage & Studio

PRINT

GENERAL CHARACTERISTICS

Lamp type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T6
Base	Bi-Pin (G12)
Wattage	35
Rated Life (Vert)	10000 hrs
Primary Application	Stage & Studio

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3400
Nominal Initial Lumens per Watt	97
Color Temperature	3000 K

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position

DIMENSIONS

Light Center Length (LCL)	2.170 in (55.1 mm)

PRODUCT INFORMATION

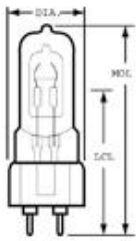
Product Code	38696
Description	CMH35/T/UVC/U/830/G12
ANSI Code	No CMH35 ANSI code
Standard Package Quantity	12
Sales Unit	Unit

CAUTIONS & WARNINGS

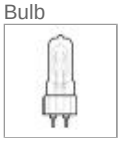
See list of cautions & warnings.

NOTES

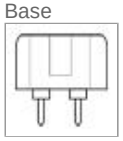
- Enclosed fixture only, per UL Standard 1572. In accordance to Federal Regulations 21 CFR 1040.30 the following notice applies: WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if the outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamp that will automatically extinguish when



Bulb



Base



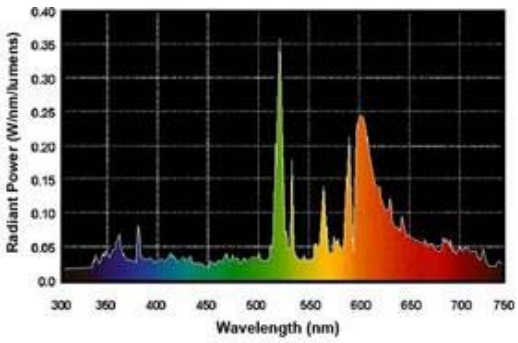
View Larger

ADDITIONAL RESOURCES

Catalogs
Testimonials
MSDS (Material Safety Data Sheets)
Disposal Policies & Recycling Information

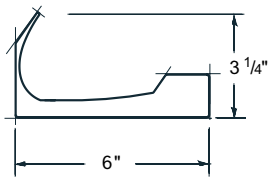
GRAPHS & CHARTS

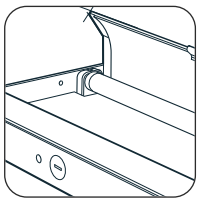
Spectral Power Distribution

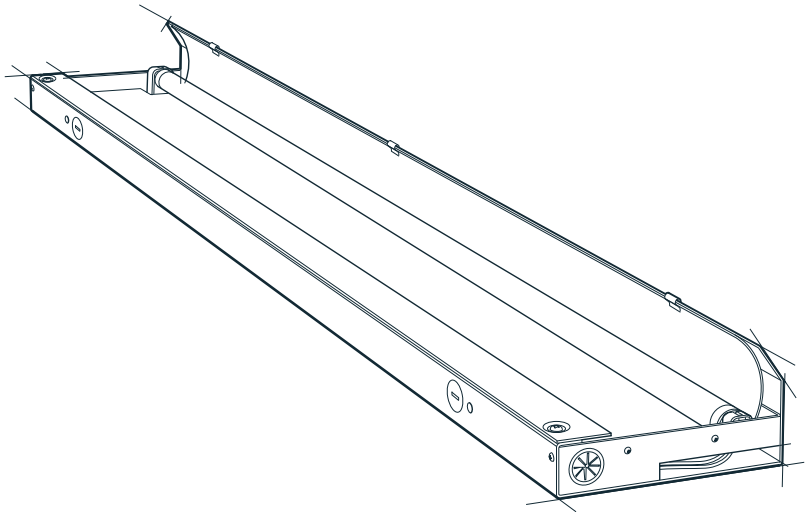


Cove & Perimeter

SUPER COVE







ordering

series	lamp rows	nominal length	voltage	options
SC				
	1T8	02'	120	PAF
	1T5	03'	277	EML*
	1T5HO	04'	347*	EMH*
		06'	*T8 & T5HO only	DM
		08'		RSE*†
		R__*		10THD†
		*row length		B__
				FH
				QC
				*consult factory for fixture lengths < 4'
				†T8 only

Applications Coves, retail, lobbies, small offices, conference rooms.

Features A low-profile cove lighting system designed for T5/HO or T8 lamps with a unique 3-piece optical system. Formed 95 percent reflective specular aluminum reflector throws light at low angles. Galvanized steel bottom reflector directs and diffuses light on ceiling to eliminate striations while limiting uplight. White backlight reflector fills the cove cavity with light, limiting socket shadow.

Construction The housing, available in 2-, 3-, 4-, 6- or 8-foot standard lengths, and end plates are made of die-formed, 20-gauge steel. The three part reflector system is die-formed from 95 percent reflective specular aluminum, 20-gauge steel and galvanized steel.

Finish The standard exterior body color is white enamel.

Electrical T8 fixtures have instant-start electronic ballasts with less than 20% THD. T5/HO fixtures have programmed-start electronic ballasts with less than 10% THD. Fixtures are U.L. Damp labeled (non-emergency) and I.B.E.W. manufactured. Maximum ballasts size available: 1 5/8" width x 1 1/4" height.

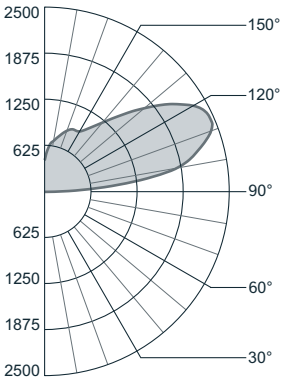
Mounting Fixture is to be surface-mounted within concealed coves.

Options **PAF**: painted after fabrication; **EML**: emergency battery (T5/HO=700 lumens; T8=600 lumens); **EMH**: emergency battery (T5/HO=1200 lumens; T8=1200 lumens); **DM**: dimming (consult factory); **RSE**: rapid-start electronic (T8 only); **10THD**: ballast with < 10% total harmonic distortion; (T8 only); **B_**: specific ballast, specify manufacturer and catalog number (consult factory); **FH**: fixture fusing (slow blow); **QC**: quick-connect circuit assemblies.

photometric data

SC-1T5HO-04

Report # LSI16391 D=0.0% I=100.0%
Lamp Lumens: 4500 Input Watts: 58



Candlepower Summary

Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Output Lumens
90	0	48	35	79	39	
95	10	584	840	1069	911	385
100	37	821	1350	1858	1802	
105	74	753	1615	2064	2149	723
110	111	633	1686	2253	2400	
115	147	567	1557	2225	2455	694
120	183	543	1356	2027	2335	
125	222	564	1154	1759	2076	519
130	256	616	1001	1492	1764	
135	290	646	892	1257	1473	359
140	323	660	835	1082	1230	
145	349	652	838	938	1056	249
150	374	652	848	916	946	
155	395	644	810	905	933	174
160	413	646	761	838	881	
165	427	616	707	756	788	96
170	439	564	671	690	701	
175	446	499	564	575	603	28
180	429	429	429	429	429	

Zonal Lumen Summary

Zone	% Lamp	% Luminaire
0-90	0.00	0.00
0-180	75.74	100.00

Efficiency = 75.7%

Peak Candela = 2458 @ 112.5°
Peak : Zenith Ratio = 5.7 : 1

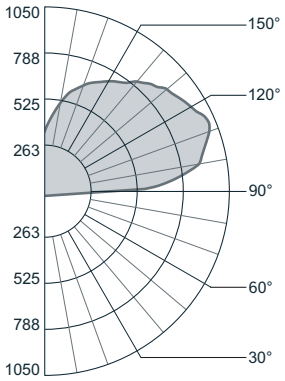
Coefficients of Utilization (%)

Floor	effective floor cavity reflectance = .20										
Ceiling	80				70				50		
Wall	70	50	30	10	70	50	30	10	50	30	10
RCR **0**	72	72	72	72	62	62	62	62	42	42	42
1	66	63	60	57	56	53	51	49	37	35	34
2	60	54	50	47	51	47	43	40	32	30	28
3	54	48	43	39	46	41	37	34	28	26	24
4	50	42	37	33	42	36	32	28	25	22	20
5	45	37	32	28	39	32	27	24	22	19	17
6	42	33	28	24	35	28	24	21	20	17	15
7	38	30	24	20	32	25	21	18	18	15	12
8	35	27	21	18	30	23	18	15	16	13	11
9	32	24	19	15	28	21	16	13	14	12	09

photometric data

SC-1T8-04

Report # LSI16088 D=0.0% I=100.0%
Lamp Lumens: 2950 Input Watts: 31



Candlepower Summary

Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Output Lumens
90	2	138	316	518	556	
95	17	258	493	704	757	248
100	44	360	605	855	917	
105	81	373	695	903	974	328
110	118	382	717	959	1042	
115	156	399	699	934	1044	325
120	192	422	685	887	986	
125	227	451	672	852	937	287
130	260	481	669	820	897	
135	292	509	653	798	857	245
140	319	530	660	756	827	
145	349	547	663	739	778	197
150	373	545	664	725	759	
155	393	536	652	709	734	142
160	410	520	637	679	703	
165	424	502	592	635	660	90
170	434	483	538	560	584	
175	440	460	485	486	500	24
180	430	430	430	430	430	

Zonal Lumen Summary

Zone	% Lamp	% Luminaire
0-90	0.00	0.00
0-180	71.58	100.00

Efficiency = 71.6%

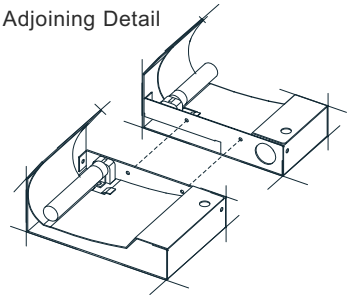
Peak Candela = 1053 @ 112.5°
Peak : Zenith Ratio = 2.4 : 1

Coefficients of Utilization (%)

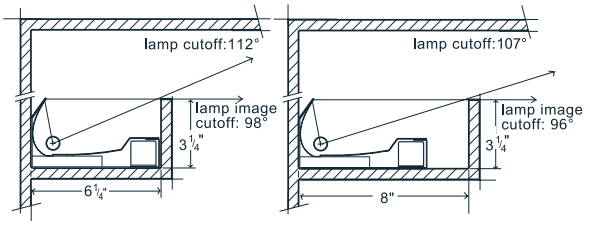
Floor	effective floor cavity reflectance = .20										
Ceiling	80				70				50		
Wall	70	50	30	10	70	50	30	10	50	30	10
RCR **0**	68	68	68	68	58	58	58	58	40	40	40
1	62	59	57	54	53	51	49	46	35	33	32
2	56	51	47	44	48	44	41	38	30	28	26
3	51	45	41	37	44	39	35	32	27	24	22
4	47	40	35	31	41	34	30	27	23	21	19
5	43	35	30	26	36	30	26	23	21	18	16
6	39	31	26	22	33	27	23	19	19	16	14
7	36	28	23	19	31	24	20	17	17	14	12
8	33	25	20	17	28	22	17	14	15	12	10
9	31	23	18	14	26	20	15	13	14	11	09

installation

Adjoining Detail



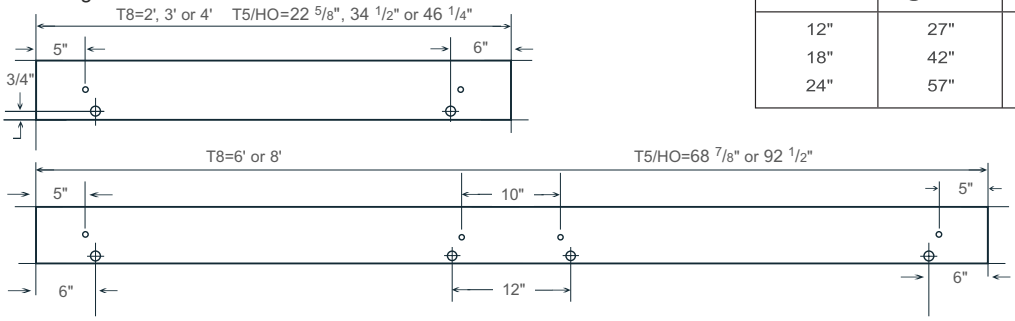
Mounting Details



Distance from wall along ceiling

cove to ceiling	Peak Candela @ 112.5°	6 1/4" cove		8" cove	
		lamp	lamp image	lamp	lamp image
12"	27"	27"	70"	37"	91"
18"	42"	42"	112"	57"	148"
24"	57"	57"	155"	77"	205"

Mounting Locations



In an effort to continually provide the highest quality products, Prudential reserves the right to change design specifications and/or materials, without notice.

F32T8 TL835 48 XLL ALTO

Product family description
Long life, environmentally-responsible lamps

Features/Benefits

- 36,000 hours rated average life
- Low mercury: TCLP* compliant
- Energy efficient
- Extra long life
- Sustainable lighting solutions; Less mercury and fewer lamps in landfills,combined with energy efficiency and long life reduces the impact on the environment.
- Our Green End-Caps mean you are using environmentally-responsible lamps.
- HI-VISION Phosphor combined with Philips exclusive cathode guard delivers: 95% lumen maintenance; reduced lamp-end blackening.
- 85 CRI

Applications

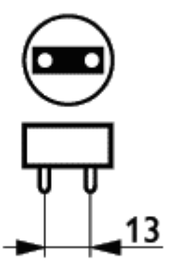
- Ideal for applications requiring long life.

Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Average life under engineering data with lamps turned off and restarted once every 12 operating hours.(241)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- For expected lamp lumen output, commercial ballast manufacturers can advise the appropriate Ballast Factor for each of their ballasts when they are informed of the designated lamp. The Ballast Factor is a multiplier applied to the designated lamp lumen output. (204)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)
- Design lumens rated at 3 hours per start on Instant Start ballast. (239)

Product data	
Product Number	152033
Full product name	F32T8 TL835 48 XLL ALTO
Ordering Code	F32T8/TL835/XLL/ALTO 25PK
Pack type	1 Lamp
Pieces per Sku	1
Skus/Case	25
Pack UPC	046677152031
EAN2US	
Case Bar Code	50046677152036
Successor Product number	
Base	Medium Bi-Pin [Medium Bi-Pin Fluorescent]
Base Information	Green Base
Bulb	T8
Packing Type	1LP [1 Lamp]
Packing Configuration	25
Name Type	F32T8
Feature	Extra Long Life ALTO®
Ordering Code	F32T8/TL835/XLL/ALTO 25PK
Pack UPC	046677152031
Case Bar Code	50046677152036
Energy Saving Product	Energy Saving
Watts	32W
Mercury (Hg) Content	3.5 mg
Color Code	TL835 [CCT of 3500K]
Color Rendering Index	85 Ra8
Color Designation	TL835
Color Temperature	3500 K
Initial Lumens	2950 Lm
Design Mean Lumens	2800 Lm
Nominal Length [inch]	48
Product Number	152033

F-T8-ELL Med Bipin/GB



Base Medium Bi-Pin

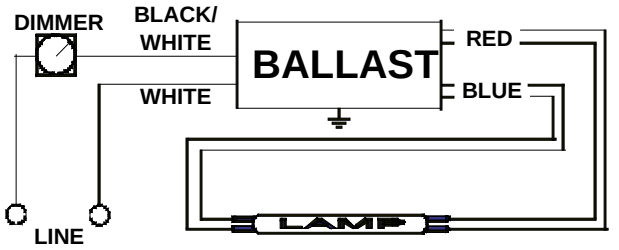
REZ-132-SC

Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
F17T8	1	17	50/10	0.20	07/24	0.05/1.05	10	0.99	1.6	4.38
F25T8	1	25	50/10	0.26	07/30	0.05/1.05	10	0.99	1.6	3.50
* F32T8	1	32	50/10	0.29	09/35	0.05/1.00	10	0.99	1.6	2.86

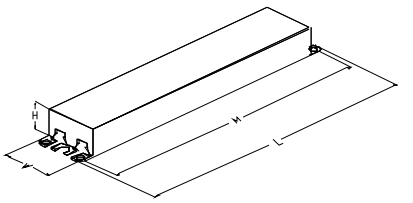
Wiring Diagram



The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 06/13/2003

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

DUPLUX® 113/6 213/6

recessed compact fluorescent downlight/wallwashers

04/06/0 | Spec Sheet | FIXTURE 'F2'

COMPACT FLUORESCENT
1-304

FEATURES

Duplux 113/6 and Duplux 213/6 are highly efficient 6" aperture low brightness downlights, for use with one or two 13-watt compact fluorescent lamps. Duplux 213/6 provides shielding angles of 40° parallel to and 42° perpendicular to the lamps. Recess depth is only 6".

One housing allows interchangeable use of downlight and wallwash reflectors, permitting housings to be installed first and reflectors to be installed or changed at any time.

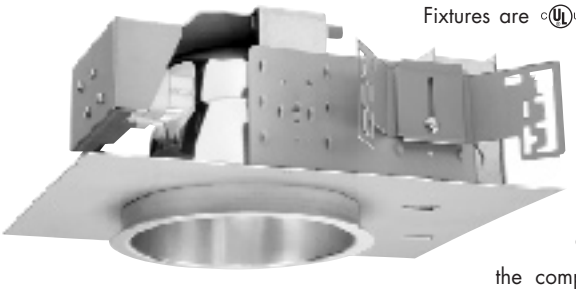
Duplux 213/6 uses two 13-watt, 4-pin lamps providing 1800 lumens (the same as a 100-watt incandescent), a 10,000-hour life, a color rendering index (CRI) of 85, and color temperatures as warm as 2700°K (nearly duplicating the color qualities of incandescent).

Reflectors are available in clear, natural aluminum in three finishes: **EvenTone**, our standard clear finish, partially diffuse, anti-iridescent and gently luminous in appearance; **OptiTone**, specular and anti-iridescent, with minimum brightness and maximum efficiency; and **EasyTone**, diffuse and luminous. Additionally, reflectors are available in champagne gold, wheat, pewter, and bronze. Wallwash (120°) and double wallwash (2x120°) reflectors are also available.

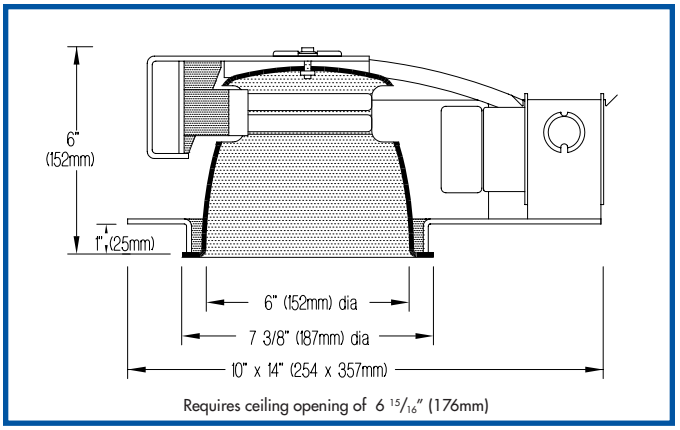
Duplux 113/6 and Duplux 213/6 include pairs of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are available as accessories.

APPLICATIONS

Fixtures are recommended for downlighting or wallwashing in offices, stores, banks, schools, hospitals and airports, as well as lobbies and public areas. The shallow recess depth allows mounting in constricted plenum situations.



Fixtures are c UL us listed for Damp Location (may not be suitable for some outdoor environments). Fixtures are in compliance with the component based efficiency standards of the 1995 New York State Energy Conservation Code. Fixtures are prewired with high power factor Class P electronic ballast and approved for eight #12 wire 75°C branch circuit pull-through wiring. Removal of the reflector allows access to the ballast and junction box.



Requires ceiling opening of 6 15/16" (176mm)

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit	DPLX 113/6 or DPLX 213/6

Reflector Type	
Downlight	no suffix
Wallwash	WW
Double Wallwash	DWW

Voltage			
120 volt service	120	277 volt service	277

Reflector and Flange Color	*Overlap*	*Flush*
EvenTone Clear	VOL	VFL
OptiTone Clear	COL	CFL
EasyTone Clear	ECOL	ECFL
Champagne Gold	GOL	GFL
Wheat	WHOL	WHFL
Pewter	POL	PFL
Bronze	ZOL	ZFL

Other reflector finishes are available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

OPTIONS

Specify by adding to the basic unit.

Emergency battery pack operates one lamp in event of power outage. Not available with DWW reflector. Fixture footprint increases to 10 x 16 ¾" (254 x 425mm). Additional 3" (76mm) is required to remove EM pack through aperture. Not for outdoor application ..... – EM

⅛" (3mm) thick **clear acrylic shield**, spring-mounted within reflector ..... – PS

- Dimming ballast not available.
- A modified fixture suitable for 2" maximum ceiling thickness is available on special order. Contact factory.
- A modified fixture suitable for 347-volt service is available on special order. Contact factory.
- Decorative reflector rings are available on special order. Contact factory.

EDISON PRICE LIGHTING

41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

 12-05

DUPLUX 213/6

PHOTOMETRIC REPORT

Report No. 45204. Original Independent Testing Laboratories, Inc. (ITL) test report furnished upon request.

Luminaire	recessed compact fluorescent downlight with spun aluminum reflector
Lamps	two 13-watt quad, 4-pin, G24q-1 base, 900 lumens each
Efficiency	50.5%
Spacing Criteria	0°- 1.5, 90°-1.6, 180°-1.5
Axis orientation	0° plane is parallel to lamps, opposite sockets

Photometric Report for Duplux 113/6 available on request.

BALLAST INFORMATION

Voltage	*120*	*277*
Input Watts	32	32
Line Current (A)	.27	.12
Power Factor (%)	>98	>98
THD (%)	<10	<10
Min. Starting Temp* (°F)	0	0

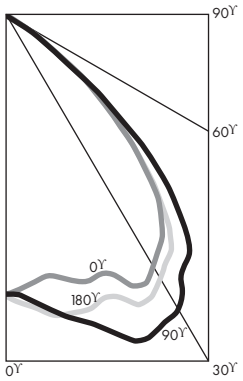
**Consult lamp manufacturers for specific temperatures.*

ZONAL LUMEN SUMMARY

Zone	*Lumens*	*% Lamp*	*% Fixture*
0 - 30°	380	21.1	41.8
0 - 40°	645	35.8	71.0
0 - 60°	908	50.4	99.9
0 - 90°	909	50.5	100.0

CANDLEPOWER DISTRIBUTION *(Candela)*

Vertical Angle	*Horizontal Angle*				
	0	*45*	*90*	*135*	*180*
0	401	401	401	401	401
5	392	394	408	414	418
15	397	418	455	469	440
25	430	450	504	490	458
35	394	425	444	449	413
45	247	283	306	280	250
55	61	58	51	42	40
65	1	1	1	1	1
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



LUMINANCE DATA *(Candela/m²)*

Vertical Angle	*Average 0° Longitude*	*Average 90° Longitude*	*Average 180° Longitude*
45	18370	22758	18593
55	5593	4676	3667
65	124	124	124
75	0	0	0
85	0	0	0

To convert cd/m² to footlamberts, multiply by 0.2919.

COEFFICIENTS OF UTILIZATION – ZONAL CAVITY METHOD

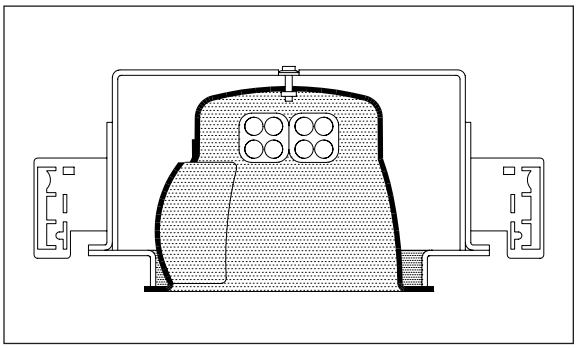
Effective Floor Cavity Reflectance 20%

Ceiling Reflectance (%)	*80*				*70*				*50*			*30*			*10*			*0*
Wall Reflectance (%)	*70*	*50*	*30*	*10*	*70*	*50*	*30*	*10*	*50*	*30*	*10*	*50*	*30*	*10*	*50*	*30*	*10*	*0*
Room Cavity Ratio																		
0	60	60	60	60	59	59	59	59	56	56	56	54	54	54	51	51	51	50
1	57	55	54	52	55	54	53	51	52	51	50	50	49	48	48	48	47	46
2	53	50	48	46	52	49	47	45	48	46	44	46	44	43	45	43	42	41
3	50	46	43	40	48	45	42	40	43	41	39	42	40	38	41	39	38	37
4	46	42	38	35	45	41	38	35	40	37	35	39	36	34	38	36	34	33
5	43	38	34	32	42	37	34	31	36	33	31	35	33	31	35	32	31	30
6	40	35	31	28	39	34	31	28	33	30	28	33	30	28	32	29	28	27
7	37	32	28	25	37	31	28	25	31	27	25	30	27	25	29	27	25	24
8	35	29	25	23	34	29	25	23	28	25	23	28	25	23	27	25	23	22
9	33	27	23	21	32	27	23	21	26	23	21	26	23	21	25	22	21	20
10	31	25	21	19	30	25	21	19	24	21	19	24	21	19	23	21	19	18

DUPLUX 213/6 WW

WALLWASH INFORMATION

Distance From Ceiling (Feet)	*2'6" From Wall; 2'6" O.C.*		*3' From Wall; 3' O.C.*	
	Below Fixture	*Between Fixtures*	*Below Fixture*	*Between Fixtures*
1	9	9	6	6
2	12	12	8	7
3	16	16	10	10
4	16	16	12	12
5	13	13	11	11
6	11	10	9	9
7	8	8	8	8
8	6	6	6	6
9	5	5	5	5
10	4	4	4	4



All vertical footcandles are initial values with no contribution from ceiling or floor reflectances. Computation performed with a total of five wallwashers.

PL-C ALTO 13W/ 841 G24q-1 /4P 1CT

Product family description
Environmentally-responsible lamps.

Features/Benefits

- The only T8 lamps to deliver full rated average life on all T8 ballasts types (Instant Start, Rapid Start, Programmed Start, and Hybrid ballasts).
- Low mercury: TCLP* compliant.
- Energy efficient.
- Sustainable lighting solutions; Less mercury and fewer lamps in landfills, combined with energy efficiency and long life reduces the impact on the environment.
- Our Green End-Caps mean you are using environmentally-responsble lamps.
- HI-VISION® Phosphor combined with Philips exclusive cathode guard delivers: 95% lumen maintenance; reduced lamp-end blackening.
- 85 CRI for TL80 lamps; 78 CRI for TL70 lamps.

Applications

- Ideal for any lighting application requiring maximum quality of light and maintained light output.

Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Average life under engineering data with lamps turned off and restarted once every 12 operating hours.(241)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- For expected lamp lumen output, commercial ballast manufacturers can advise the appropriate Ballast Factor for each of their ballasts when they are informed of the designated lamp. The Ballast Factor is a multiplier applied to the designated lamp lumen output. (204)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

Product data	
Product Number	383281

Product data	
Full product name	PL-C ALTO 13W/841 G24q-1 /4P 1CT
Ordering Code	PL-C 13W/841/4P/ALTO
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	50
Pack UPC	046677240004
EAN2US	
Case Bar Code	60046677240006
Successor Product number	
Base	G24q-1
Base Information	4P
Execution	/4P [4 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	5X10BOX
Avg. Life	10000 hr
Rated Avg. Life	12000 hr
Ordering Code	PL-C 13W/841/4P/ALTO
Pack UPC	046677240004
Case Bar Code	60046677240006
Watts	13W
Dimmable	Yes
Mercury (Hg) Content	- mg
Color Code	840 [CCT of 4000K]
Color Rendering Index	82 Ra8
Color Designation	Cool White
Color Description	840 Cool White
Color Temperature	4000 K
Initial Lumens	900 Lm
Initial Lumens	900 Lm
Overall Length C	142.9 mm
Diameter D	27.1 mm
Diameter D1	27.1 mm
Product Number	383281

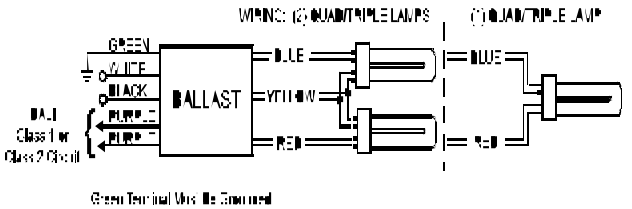
IDL-2S26-M5-BS@277

Brand Name	ROVR
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
* CFQ13W/G24Q	1	13	50/10	0.07	06/18	0.03/1.00	10	0.99	1.6	5.56
CFQ13W/G24Q	2	13	50/10	0.12	19/32	0.03/1.00	10	0.99	1.6	3.13

Wiring Diagram



Diag. 165

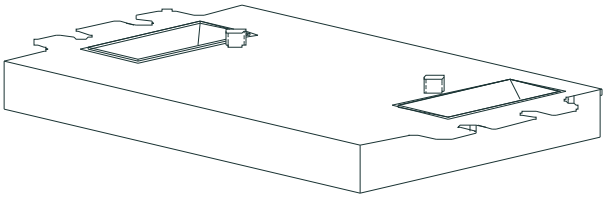
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.18 "	2.00 "
4 49/50	3	1 9/50	2
12.6 cm	7.6 cm	3 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

IDL-2S26-M5-BS@277	
Brand Name	ROVR
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall be provided with integral protection circuitry to withstand connection of low voltage control leads to mains power supply. In this event, ballast shall default to maximum light output.

2.3 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.4 Ballast shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.6 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.7 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.03 at minimum light output for primary lamp application.

2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less throughout the dimming range in accordance with lamp manufacturer recommendations.

2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.10 Ballast shall have a Class A sound rating.

2.11 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.12 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, CFL lamps, and T8 lamps operating on 4-lamp ballast.

2.13 Ballast shall control lamp light output from 100% - 3% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.14 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.15 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

DUPLUX® 113/6 213/6

recessed compact fluorescent downlight/wallwashers

FEATURES

Duplux 113/6 and Duplux 213/6 are highly efficient 6" aperture low brightness downlights, for use with one or two 13-watt compact fluorescent lamps. Duplux 213/6 provides shielding angles of 40° parallel to and 42° perpendicular to the lamps. Recess depth is only 6".

One housing allows interchangeable use of downlight and wallwash reflectors, permitting housings to be installed first and reflectors to be installed or changed at any time.

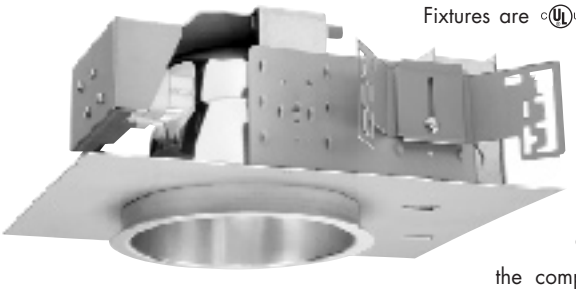
Duplux 213/6 uses two 13-watt, 4-pin lamps providing 1800 lumens (the same as a 100-watt incandescent), a 10,000-hour life, a color rendering index (CRI) of 85, and color temperatures as warm as 2700°K (nearly duplicating the color qualities of incandescent).

Reflectors are available in clear, natural aluminum in three finishes: **EvenTone**, our standard clear finish, partially diffuse, anti-iridescent and gently luminous in appearance; **OptiTone**, specular and anti-iridescent, with minimum brightness and maximum efficiency; and **EasyTone**, diffuse and luminous. Additionally, reflectors are available in champagne gold, wheat, pewter, and bronze. Wallwash (120°) and double wallwash (2x120°) reflectors are also available.

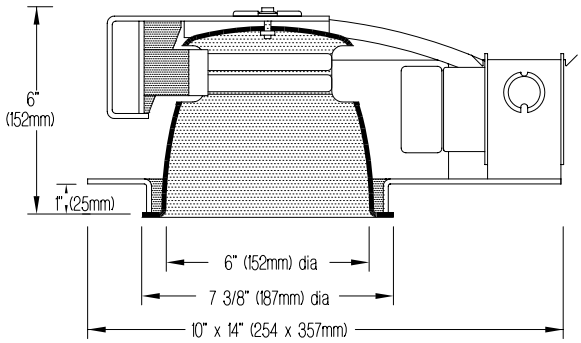
Duplux 113/6 and Duplux 213/6 include pairs of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are available as accessories.

APPLICATIONS

Fixtures are recommended for downlighting or wallwashing in offices, stores, banks, schools, hospitals and airports, as well as lobbies and public areas. The shallow recess depth allows mounting in constricted plenum situations.



Fixtures are c UL us listed for Damp Location (may not be suitable for some outdoor environments). Fixtures are in compliance with the component based efficiency standards of the 1995 New York State Energy Conservation Code. Fixtures are prewired with high power factor Class P electronic ballast and approved for eight #12 wire 75°C branch circuit pull-through wiring. Removal of the reflector allows access to the ballast and junction box.



Requires ceiling opening of 6 15/16" (176mm)

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit	DPLX 113/6 or DPLX 213/6

Reflector Type	
Downlight	no suffix
Wallwash	WW
Double Wallwash	DWW

Voltage			
120 volt service	120	277 volt service	277

Reflector and Flange Color	*Overlap*	*Flush*
EvenTone Clear	VOL	VFL
OptiTone Clear	COL	CFL
EasyTone Clear	ECOL	ECFL
Champagne Gold	GOL	GFL
Wheat	WHOL	WHFL
Pewter	POL	PFL
Bronze	ZOL	ZFL

Other reflector finishes are available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

OPTIONS

Specify by adding to the basic unit.

Emergency battery pack operates one lamp in event of power outage. Not available with DWW reflector. Fixture footprint increases to 10 x 16 ¾" (254 x 425mm). Additional 3" (76mm) is required to remove EM pack through aperture. Not for outdoor application ..... – EM

⅛" (3mm) thick **clear acrylic shield**, spring-mounted within reflector ..... – PS

- Dimming ballast not available.
- A modified fixture suitable for 2" maximum ceiling thickness is available on special order. Contact factory.
- A modified fixture suitable for 347-volt service is available on special order. Contact factory.
- Decorative reflector rings are available on special order. Contact factory.

EDISON PRICE LIGHTING
41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

DUPLUX 213/6

PHOTOMETRIC REPORT

Report No. 45204. Original Independent Testing Laboratories, Inc. (ITL) test report furnished upon request.

Luminaire	recessed compact fluorescent downlight with spun aluminum reflector
Lamps	two 13-watt quad, 4-pin, G24q-1 base, 900 lumens each
Efficiency	50.5%
Spacing Criteria	0°- 1.5, 90°-1.6, 180°-1.5
Axis orientation	0° plane is parallel to lamps, opposite sockets

Photometric Report for Duplux 113/6 available on request.

BALLAST INFORMATION

Voltage	*120*	*277*
Input Watts	32	32
Line Current (A)	.27	.12
Power Factor (%)	>98	>98
THD (%)	<10	<10
Min. Starting Temp* (°F)	0	0

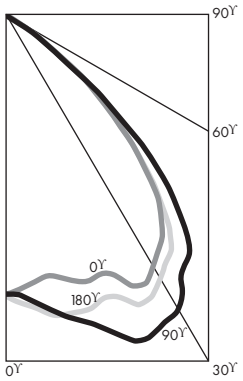
**Consult lamp manufacturers for specific temperatures.*

ZONAL LUMEN SUMMARY

Zone	*Lumens*	*% Lamp*	*% Fixture*
0 - 30°	380	21.1	41.8
0 - 40°	645	35.8	71.0
0 - 60°	908	50.4	99.9
0 - 90°	909	50.5	100.0

CANDLEPOWER DISTRIBUTION *(Candela)*

Vertical Angle	*Horizontal Angle*				
	0	*45*	*90*	*135*	*180*
0	401	401	401	401	401
5	392	394	408	414	418
15	397	418	455	469	440
25	430	450	504	490	458
35	394	425	444	449	413
45	247	283	306	280	250
55	61	58	51	42	40
65	1	1	1	1	1
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0



LUMINANCE DATA *(Candela/m²)*

Vertical Angle	*Average 0° Longitude*	*Average 90° Longitude*	*Average 180° Longitude*
45	18370	22758	18593
55	5593	4676	3667
65	124	124	124
75	0	0	0
85	0	0	0

To convert cd/m² to footlamberts, multiply by 0.2919.

COEFFICIENTS OF UTILIZATION – ZONAL CAVITY METHOD

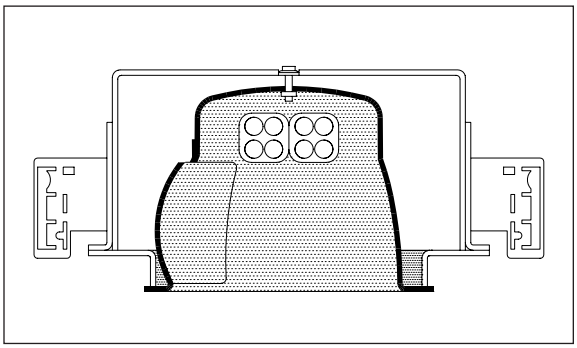
Effective Floor Cavity Reflectance 20%

Ceiling Reflectance (%)	*80*				*70*				*50*			*30*			*10*			*0*
Wall Reflectance (%)	*70*	*50*	*30*	*10*	*70*	*50*	*30*	*10*	*50*	*30*	*10*	*50*	*30*	*10*	*50*	*30*	*10*	*0*
Room Cavity Ratio																		
0	60	60	60	60	59	59	59	59	56	56	56	54	54	54	51	51	51	50
1	57	55	54	52	55	54	53	51	52	51	50	50	49	48	48	48	47	46
2	53	50	48	46	52	49	47	45	48	46	44	46	44	43	45	43	42	41
3	50	46	43	40	48	45	42	40	43	41	39	42	40	38	41	39	38	37
4	46	42	38	35	45	41	38	35	40	37	35	39	36	34	38	36	34	33
5	43	38	34	32	42	37	34	31	36	33	31	35	33	31	35	32	31	30
6	40	35	31	28	39	34	31	28	33	30	28	33	30	28	32	29	28	27
7	37	32	28	25	37	31	28	25	31	27	25	30	27	25	29	27	25	24
8	35	29	25	23	34	29	25	23	28	25	23	28	25	23	27	25	23	22
9	33	27	23	21	32	27	23	21	26	23	21	26	23	21	25	22	21	20
10	31	25	21	19	30	25	21	19	24	21	19	24	21	19	23	21	19	18

DUPLUX 213/6 WW

WALLWASH INFORMATION

Distance From Ceiling (Feet)	*2'6" From Wall; 2'6" O.C.*		*3' From Wall; 3' O.C.*	
	Below Fixture	*Between Fixtures*	*Below Fixture*	*Between Fixtures*
1	9	9	6	6
2	12	12	8	7
3	16	16	10	10
4	16	16	12	12
5	13	13	11	11
6	11	10	9	9
7	8	8	8	8
8	6	6	6	6
9	5	5	5	5
10	4	4	4	4



All vertical footcandles are initial values with no contribution from ceiling or floor reflectances. Computation performed with a total of five wallwashers.

PL-C ALTO 13W/ 841 G24q-1 /4P 1CT

Product family description
Environmentally-responsible lamps.

Features/Benefits

- The only T8 lamps to deliver full rated average life on all T8 ballasts types (Instant Start, Rapid Start, Programmed Start, and Hybrid ballasts).
- Low mercury: TCLP* compliant.
- Energy efficient.
- Sustainable lighting solutions; Less mercury and fewer lamps in landfills, combined with energy efficiency and long life reduces the impact on the environment.
- Our Green End-Caps mean you are using environmentally-responsble lamps.
- HI-VISION® Phosphor combined with Philips exclusive cathode guard delivers: 95% lumen maintenance; reduced lamp-end blackening.
- 85 CRI for TL80 lamps; 78 CRI for TL70 lamps.

Applications

- Ideal for any lighting application requiring maximum quality of light and maintained light output.

Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Average life under engineering data with lamps turned off and restarted once every 12 operating hours.(241)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- For expected lamp lumen output, commercial ballast manufacturers can advise the appropriate Ballast Factor for each of their ballasts when they are informed of the designated lamp. The Ballast Factor is a multiplier applied to the designated lamp lumen output. (204)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

Product data	
Product Number	383281

Product data	
Full product name	PL-C ALTO 13W/841 G24q-1 /4P 1CT
Ordering Code	PL-C 13W/841/4P/ALTO
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	50
Pack UPC	046677240004
EAN2US	
Case Bar Code	60046677240006
Successor Product number	
Base	G24q-1
Base Information	4P
Execution	/4P [4 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	5X10BOX
Avg. Life	10000 hr
Rated Avg. Life	12000 hr
Ordering Code	PL-C 13W/841/4P/ALTO
Pack UPC	046677240004
Case Bar Code	60046677240006
Watts	13W
Dimmable	Yes
Mercury (Hg) Content	- mg
Color Code	840 [CCT of 4000K]
Color Rendering Index	82 Ra8
Color Designation	Cool White
Color Description	840 Cool White
Color Temperature	4000 K
Initial Lumens	900 Lm
Initial Lumens	900 Lm
Overall Length C	142.9 mm
Diameter D	27.1 mm
Diameter D1	27.1 mm
Product Number	383281

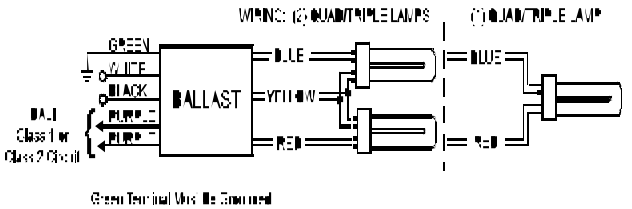
IDL-2S26-M5-BS@277

Brand Name	ROVR
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
* CFQ13W/G24Q	1	13	50/10	0.07	06/18	0.03/1.00	10	0.99	1.6	5.56
CFQ13W/G24Q	2	13	50/10	0.12	19/32	0.03/1.00	10	0.99	1.6	3.13

Wiring Diagram



Diag. 165

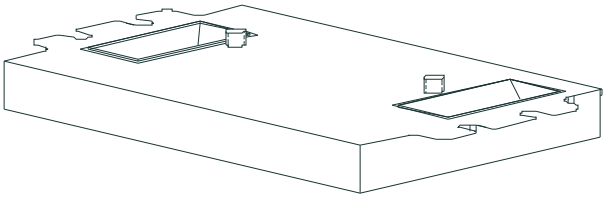
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.18 "	2.00 "
4 49/50	3	1 9/50	2
12.6 cm	7.6 cm	3 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

IDL-2S26-M5-BS@277	
Brand Name	ROVR
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall be provided with integral protection circuitry to withstand connection of low voltage control leads to mains power supply. In this event, ballast shall default to maximum light output.

2.3 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.4 Ballast shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.6 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.7 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.03 at minimum light output for primary lamp application.

2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less throughout the dimming range in accordance with lamp manufacturer recommendations.

2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.10 Ballast shall have a Class A sound rating.

2.11 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.12 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, CFL lamps, and T8 lamps operating on 4-lamp ballast.

2.13 Ballast shall control lamp light output from 100% - 3% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.14 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.15 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.

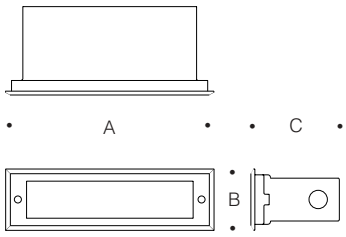
4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

FIXTURE 'F3'

Recessed wall luminaires - stainless steel

Type:
BEGA Product #:
Project:
Voltage:
Color:
Options:
Modified:

Housing: Constructed of die cast and extruded aluminum with integral wiring compartment. Mounting tabs provided.
Enclosure: All stainless steel faceplate, 3⁄16" thick. "Micro-louver" film providing 30° cutoff is laminated between two layers of clear tempered glass and edge sealed in black to prevent light leak. Faceplate is secured by two (2) flat socket head, stainless steel, captive screws threaded into stainless steel inserts in the housing casting. Continuous high temperature O-ring gasket for weather tight operation.
Electrical (Fluorescent): Lampholder: type GX23 (13W), rated 75W, 600V. Ballast is magnetic, HPF, available in 120V or 277V - specify. Through Wiring: suitable for a maximum of four (4) No. 12 AWG conductors (plus ground) suitable for 75°C. Two 7⁄8" knockouts provided for ½" conduit.
Finish: #4, brushed stainless steel. Stainless steel requires regular cleaning and maintenance, much like household appliances, to maintain its luster and to prevent tarnishing or the appearance of rust like stains.
U.L. listed, suitable for wet locations and for installation within 3 feet of ground. Suitable for all types of construction including poured concrete. Type non-IC. Protection class: IP 64.



Clear tempered glass with 30° “micro-louver” behind "single window" solid .375" thick stainless steel faceplate.
U.L. listed, suitable for wet locations. IP 64.
Finish: #4 brushed stainless steel.

		Lamp	Lumen	A	B	C
2217P w/ Micro-louver	ADA	1 13W CF twin-2p	825	12⅛	2⅞	4

BEGA/US 1000 BEGA Way, Carpinteria, CA 93013 [P] 805·684·0533 [F] 805·684·6682

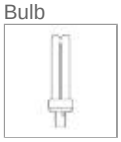
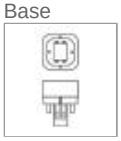
97585 – F13DBX/827/CD

PRINT

GE Soft White Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

• Use original GE's Soft White when you need a light without glare and harsh shadows.

High Color Rendering
Energy Savings

Bulb 
Base 
Package 

View Larger

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX23-2
Wattage	13
Voltage	120
Rated Life	10000 hrs
Starting Temperature (MIN)	-4 °C (25 °F)
Cathode Resistance	10.500 Ohm
Additional Info	TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	810
Mean Lumens	685
Nominal Initial Lumens per Watt	62
Color Temperature	2700 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.285 A
Current Crest Factor (MAX)	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	4.8400 in (122.9 mm)
Nominal Length	4.700 in (119.3 mm)
Base Face to Top of Lamp	3.900 in (99.0 mm)

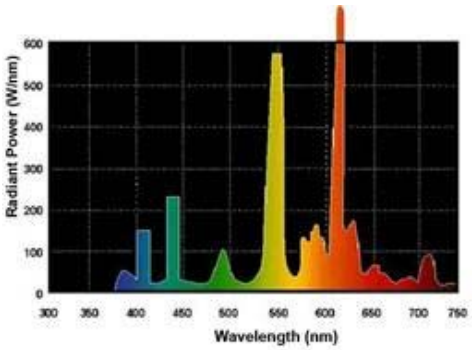
PRODUCT INFORMATION

ADDITIONAL RESOURCES

Catalogs
Testimonials
Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Product Code	97585
Description	F13DBX/827/CD
Standard Package	Case
Standard Package GTIN	10043168975855
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168975858

COMPATIBLE GE BALLASTS

Product Code	Description	# of Bulbs	Power Factor	Ballast Factor
87655	GEM2CF13PH277	2	95.0	0.9
87533	GEM1CF13PH120	1	50.0	0.9

⚠ CAUTIONS & WARNINGS

See list of cautions & warnings.

NOTES

- Based on 60Hz reference circuit.
- Fluorescent lamp lumens decline during life

Return To Top

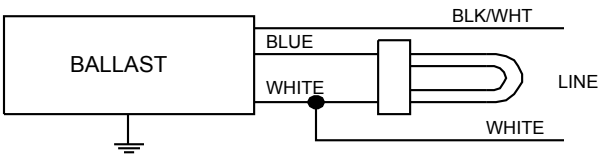
XTH-1B13-TP-W

Brand Name	COMPACT-HPF
Ballast Type	Magnetic
Starting Method	Pre-Heat
Lamp Connection	Series
Input Voltage	220
Input Frequency	50 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Starting Current (Amps)	Open Circuit (Amps)	Input Power (Watts)	Ballast Factor	MAX THD %	Power Factor
CFQ13W/GX23	1	13	0/-18	0.10	0.25	0.24	20	0.99	15	0.92
* CFT13W/GX23	1	13	0/-18	0.10	0.25	0.24	21	0.98	15	0.94

Wiring Diagram



Diag. 47

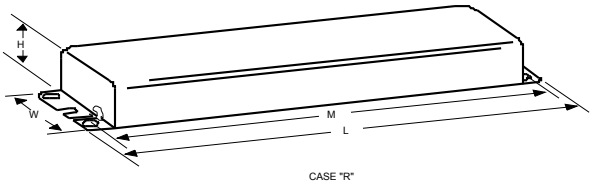
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		
White	15	
Blue	15	
Red		
Yellow		
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White	15	
Red/White		

Enclosure

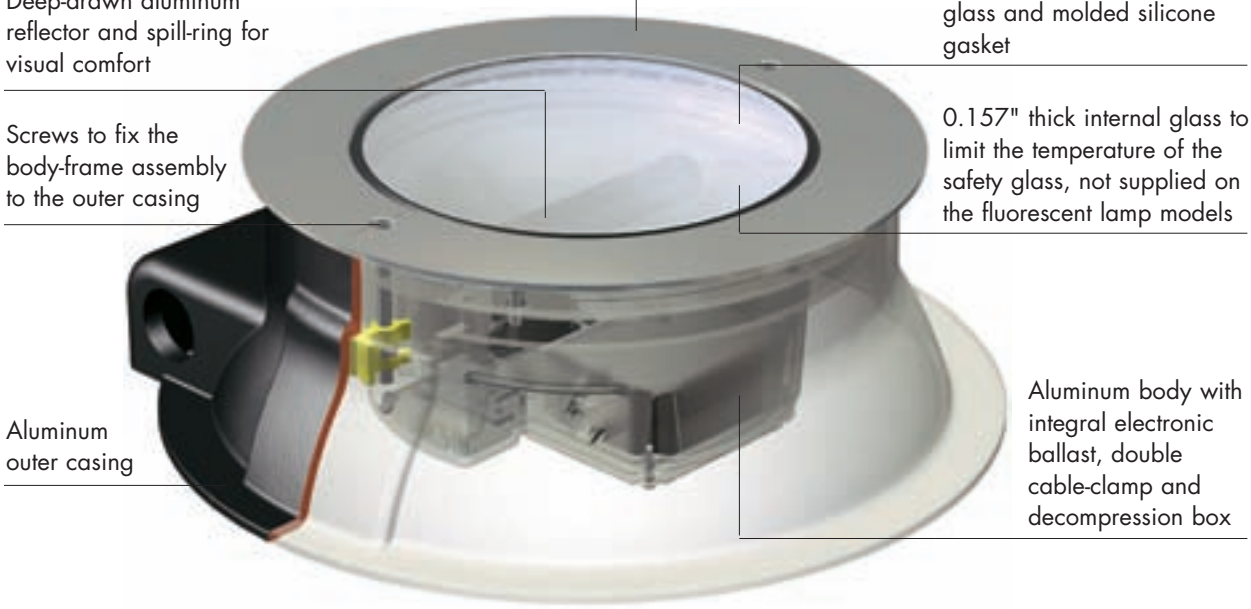


Enclosure Dimensions

OverAll (L)	Width (std)/(TP)	Height (H)	Mounting (M)
4.75 "	2.21875 "/0 "	1.625 "	4.375 "
4 3/4	2 7/32 / 0	1 5/8	4 3/8
12.1 cm	5.6 cm / 0 cm	4.1 cm	11.1 cm

Revised 07/01/1999

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086



Recessed luminaires made with cast aluminum body and outer casing, stainless steel frame and screws. They are designed to use discharge, fluorescent, halogen lamps and lamps with symmetrical, asymmetrical and adjustable optics and spots, medium and flood light cones. Acrylic paint on body, optical assembly and on outer casing guarantees protection against UV rays and outdoor conditions. Coupling of frame, glass, optical assembly and outer casing guarantees resistance to a load of 11,000 lbs at a maximum speed of 31 mph.

Square luminaire

Square models have asymmetrical optics. The outer casing can be ordered separately from the optical bodies. Spill-rings ensure visual comfort in all models. The optical assembly is sealed with hardened sodium-lime glass equipped with a silicone gasket compressed by a stainless steel frame. The locking system is comprised of two stainless steel screws.

Circular luminaire

The high circular recessed fittings house intermediate hardened soda-lime glass with white silkscreen printing. The lower section houses a decompression box with cascade connection, a 6-pole terminal block and a stainless steel double cable clamp. Body and optical assembly are equipped with a locking system comprised of two stainless steel captive screws on which two extruded aluminum supports can slide. The locking system ensures positioning and anchoring of the optical assembly to the outer casing.

Small-body luminaire

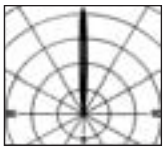
Small-body models have two terminal blocks and a cable clamp. The lower section is connected to the upper section by a stainless steel cable clamp. Models equipped with anti-slip glass are available upon request. Various accessories complement the series: ribbed glass, colored or diffusing filters, suction cup, anti-theft screw kit and outer casing closing plug.

This fixture rated
IP67
UL Listing "suitable for wet location"

Metal halide with adjustable optic spot 0°-25°

I.B009-120	35 W	T6	G12	140° F
I.B009-277	35 W	T6	G12	140° F

Integral electronic ballast

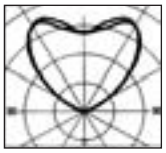


6°

Compact fluorescent with adjustable optic 0°-25°

I.B010-120	26 W	T4 Triple	Gx24q-3	149° F
	32 W	T4 Triple	Gx24q-3	
	42 W	T4 Triple	Gx24q-4	
I.B010-277	26 W	T4 Triple	Gx24q-3	149° F
	32 W	T4 Triple	Gx24q-3	
	42 W	T4 Triple	Gx24q-4	

Integral electronic ballast

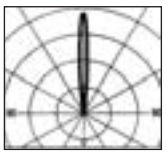


102°

Metal halide with adjustable optic spot 0°-25°

I.B011-120	35 W PAR 20	MH	E26 MED	158° F
I.B011-277	35 W PAR 20	MH	E26 MED	158° F

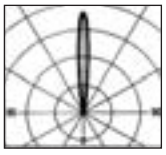
Integral electronic ballast



10°

Halogen with adjustable optic spot 0°-25°

I.B013	50 W PAR 20		E26 MED	149° F



30°

INSTALLATION SYSTEMS AND ACCESSORIES

Casing
I.B902
for I.B009-I.B010-I.B011-I.B013

Available in color 04

Cover plate
I.B910
for I.B902

Available in color 04

Refractor for elliptical distribution of light flow
I.B922
for I.B009-I.B010-I.B011-I.B013

Available in color 24

Colored filters
I.B918
for I.B009-I.B010-I.B011-I.B013

Available in colors 05-06-09-00

Suction cup
I.B916
for I.B009-I.B010-I.B011-I.B013

Photometric files are available at: ***www.sistemalux.com/photometric***

PL-T 42W/841 GX24q-4 /4P ALTO 1CT

Product family description
PL-T Triple 4pin Fluorescent Lamp with Amalgam.

Features/Benefits

- ALTO® Lamp Technology - Passes EPA's TCLP test for non-hazardous waste.
- Utilizes amalgam technology to provide > 90% of rated lumens in ambient temperatures from 23F to 130F.
- Triple tube design available in 18, 26, 32, and 42W.
- Excellent Color Rendering - 82 Color Rendering Index (CRI).
- Broad Range of Color Temperature - Available in 2700, 3000, 3500 and 4100K.
- Dimmable - PL-T 4-pin lamps may be used with electronic dimming ballasts.
- Long Life - 12,000 hours.
- Energy Saving - Designed for use with electronic ballasts for lower operating costs and flicker-free starting.

Applications

- Ideal for downlights and medium bay multi-lamp fixtures for general lighting.

Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

Product data	
Product Number	268763
Full product name	PL-T 42W/841 GX24q-4 /4P ALTO 1CT
Ordering Code	PL-T 42W/841/4P/ALTO
Pack type	1 Lamp in a Folding Carton
Pieces per Sku	1
Skus/Case	12
Pack UPC	046677268763

PHILIPS

Product data	
EAN2US	
Case Bar Code	50046677268768
Successor Product number	
Base	GX24q-4
Base Information	4P
Execution	/4P [4 Pins]
Packing Type	1CT [1 Lamp in a Folding Carton]
Packing Configuration	12
Avg. Hrs. Life	12000 hr
Ordering Code	PL-T 42W/841/4P/ALTO
Pack UPC	046677268763
Case Bar Code	50046677268768
Watts	42W
Lamp Voltage	- V
Dimmable	Yes
Color Code	840 [CCT of 4000K]
Color Rendering Index	82 Ra8
Color Designation	Cool White
Color Description	840 Cool White
Color Temperature	4000 K
Initial Lumens	- Lm
Initial Lumens	3200 Lm
Overall Length C	158.4 mm
Diameter D	39.85 mm
Diameter D1	39.65 mm
Special packing	ALTO
Product Number	268763

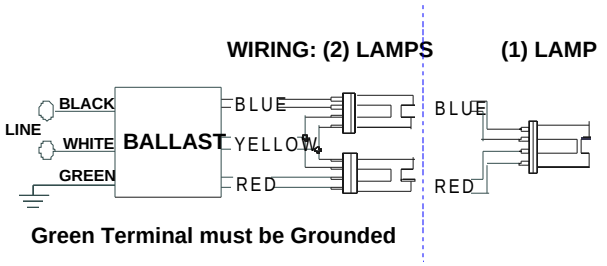
ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
* CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

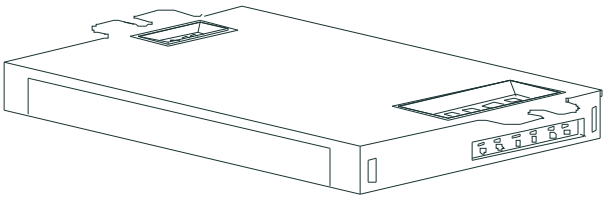
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

ICF-2S26-H1-LD@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____ or approved equal.

Revised 09/02/2004

ADVANCE TRANSFORMER CO.
O'HARE INTERNATIONAL CENTER - 10275 WEST HIGGINS ROAD
ROSEMONT, ILLINOIS 60018
TELEPHONE: (847) 390-5000 FAX: (847) 390-5109

FIXTURE 'F5'

Recessed wall luminaires - stainless steel

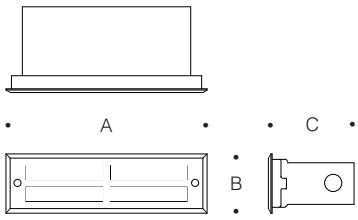
Type:
BEGA Product #:
Project:
Voltage:
Color:
Options:
Modified:

Housing: Constructed of die cast and extruded aluminum with integral wiring compartment. Mounting tabs provided.
Enclosure: All stainless steel faceplate, 3⁄16" thick. "Micro-louver" film providing 30° cutoff is laminated between two layers of clear tempered glass and edge sealed in black to prevent light leak. Faceplate is secured by two (2) flat socket head, stainless steel, captive screws threaded into stainless steel inserts in the housing casting. Continuous high temperature O-ring gasket for weather tight operation.

Electrical (Fluorescent): Lampholder: type GX23 (13W), rated 75W, 600V. Ballast is magnetic, HPF available in 120V or 277V - specify. Through Wiring: suitable for a maximum of four (4) No. 12 AWG conductors (plus ground) suitable for 75°C. Two 7⁄8" knockouts provided for 1⁄2" conduit.

Finish: #4, brushed stainless steel. Stainless steel requires regular cleaning and maintenance, much like household appliances, to maintain its luster and to prevent tarnishing or the appearance of rust like stains.

U.L. listed, suitable for wet locations and for installation within 3 feet of ground. Suitable for all types of construction including poured concrete. Type non-IC. Protection class: IP 64.



Clear tempered glass with 30° "micro-louver" behind "four window" solid .375" thick stainless steel faceplate.
U.L. listed, suitable for wet locations. IP 64.
Finish: #4 brushed stainless steel.

		Lamp	Lumen	A	B	C
2216P w/ Micro-louver	ADA	1 13W CF twin-2p	825	12 1⁄8	2 7⁄8	4

BEGA/US 1000 BEGA Way, Carpinteria, CA 93013 [P] 805·684·0533 [F] 805·684·6682

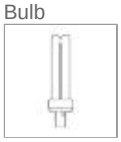
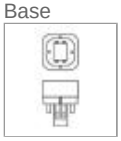
97585 – F13DBX/827/CD

PRINT

GE Soft White Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

• Use original GE's Soft White when you need a light without glare and harsh shadows.

High Color Rendering
Energy Savings

Bulb 
Base 
Package 

View Larger

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX23-2
Wattage	13
Voltage	120
Rated Life	10000 hrs
Starting Temperature (MIN)	-4 °C (25 °F)
Cathode Resistance	10.500 Ohm
Additional Info	TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	810
Mean Lumens	685
Nominal Initial Lumens per Watt	62
Color Temperature	2700 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.285 A
Current Crest Factor (MAX)	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	4.8400 in (122.9 mm)
Nominal Length	4.700 in (119.3 mm)
Base Face to Top of Lamp	3.900 in (99.0 mm)

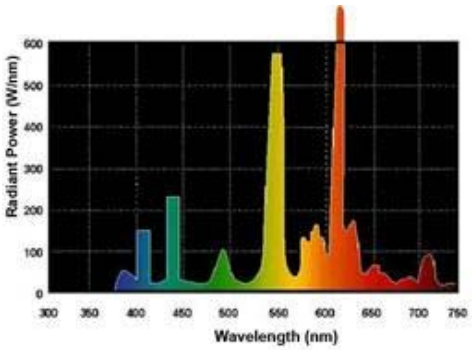
PRODUCT INFORMATION

ADDITIONAL RESOURCES

Catalogs
Testimonials
Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Product Code	97585
Description	F13DBX/827/CD
Standard Package	Case
Standard Package GTIN	10043168975855
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168975858

COMPATIBLE GE BALLASTS

Product Code	Description	# of Bulbs	Power Factor	Ballast Factor
87655	GEM2CF13PH277	2	95.0	0.9
87533	GEM1CF13PH120	1	50.0	0.9

⚠ CAUTIONS & WARNINGS

See list of cautions & warnings.

NOTES

- Based on 60Hz reference circuit.
- Fluorescent lamp lumens decline during life

Return To Top

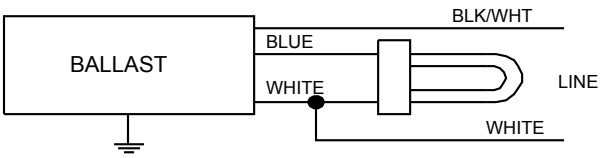
XTH-1B13-TP-W

Brand Name	COMPACT-HPF
Ballast Type	Magnetic
Starting Method	Pre-Heat
Lamp Connection	Series
Input Voltage	220
Input Frequency	50 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Starting Current (Amps)	Open Circuit (Amps)	Input Power (Watts)	Ballast Factor	MAX THD %	Power Factor
CFQ13W/GX23	1	13	0/-18	0.10	0.25	0.24	20	0.99	15	0.92
* CFT13W/GX23	1	13	0/-18	0.10	0.25	0.24	21	0.98	15	0.94

Wiring Diagram



Diag. 47

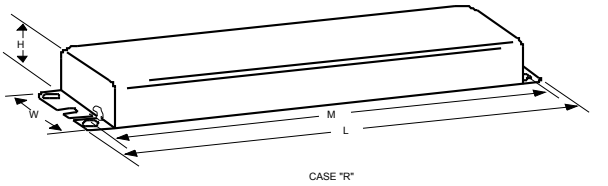
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		
White	15	
Blue	15	
Red		
Yellow		
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White	15	
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (std)/(TP)	Height (H)	Mounting (M)
4.75 "	2.21875 "/0 "	1.625 "	4.375 "
4 3/4	2 7/32 / 0	1 5/8	4 3/8
12.1 cm	5.6 cm / 0 cm	4.1 cm	11.1 cm

Revised 07/01/1999

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

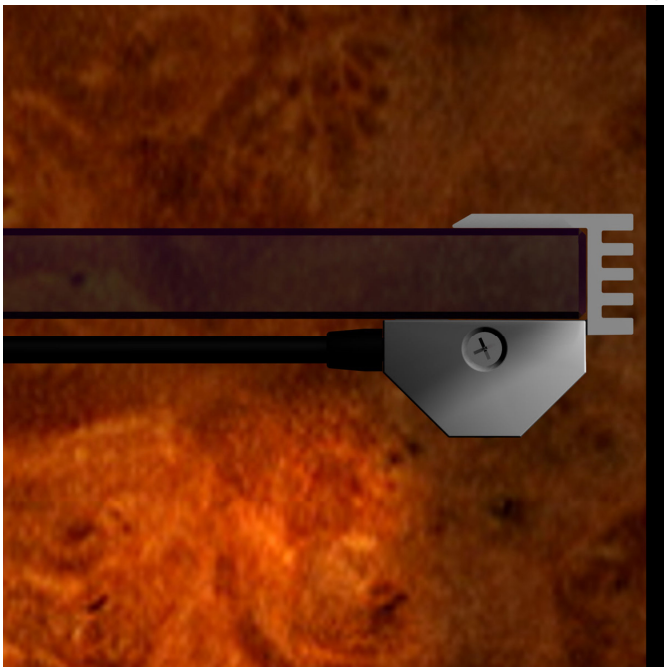
iolighting.com

PRELIMINARY

6/2/2006

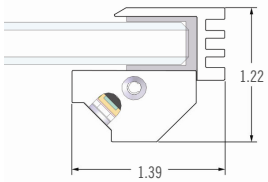
LEDge™

PATENT PENDING

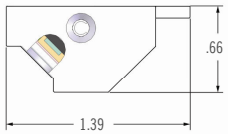


Dimensions

Glass Mount



Shelf Mount



Power Supply (Driver) Information

Standard Light Output

Type	Supplies	Remote Distance
24v100w	Up to 16'-0"	11'-0" (w/20AWG)

High Output

Type	Supplies	Remote Distance
24v100w	Up to 8'-0"	11'-0" (w/20AWG)

Application

LEDge is a low voltage LED based linear shelf light which offers exceptional warm and cool white light for a variety of different shelf and casework conditions. LEDge offers illumination levels equivalent to halogen and fluorescent based alternates with significant benefits never before available. LEDge delivers exquisite white light without the damaging ultra-violet (UV), Infrared (IR) and heat that conventional light sources produce. LEDge also offers superior definition to three dimensional objects and sparkle to reflective surfaces.

Light Output

LEDge's beam spread and luminous intensities are perfect for shelf lighting applications. Two lumen packages are offered; standard and high output.

Standard Light Output:

- Warm White: 127 lms/ft
- Cool White: 145 lms/ft

High Output:

- Warm White: 216 lms/ft
- Cool White: 246 lms/ft

Construction

Available in two profiles, LEDge can either be mounted directly to 3/8" glass or surface mounted to the underside of any shelving unit. The LEDge housing is made of extruded aluminum, providing the recommended heat sink requirements for io's proprietary printed circuit boards (PCB's). Both LEDge profiles are provided with neoprene gaskets which isolate the majority of the heat from the surface it is mounted. LEDge **is UL listed for dry locations.**

Electrical

Universal 120 or 277 volt supply required for 100 watt, 24 volt remote driver. Driver supplied by io Lighting. Driver enclosures may be supplied by io if specified (see last options in catalogue nomenclature). LEDge is supplied with a 4'-0" 20AWG, 600 volt TFFN rated power cord. See remote mounted driver requirement chart on the front cover of this specification sheet.

Power Consumption

- Standard Light Output: 6 w/ft
- high output: 12 w/ft

Finish

Clear anodized aluminum finish is standard. Custom finishes may be available upon request.

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

LEDge™

PRELIMINARY

6/2/2006

PATENT PENDING

Color Options

Applications / Light Output

Mounting Options

Electrical End Feed Options

Order Code

0	09	I	□□□□	□□	□		□	□	□
io	LEDge	Location	Color	Mounting	Finish	Length	Electrical Feed	Voltage / Dimming	Driver Enclosure
		I Interior	3k 3000°K 3kHO 3000°K High Output 5k 5000°K 5kHO 5000°K High Output	38 3/8 Glass NG No Glass	1 Anodized Aluminum 2 Custom	Specify as required to 1/8" between 18" and 80"	1 Right feed 2 Left feed 3 Right and left feed	1 120v 2 277v 3 120v w/dim 4 277v w/dim 5 other	I Interior Rated N Not Req'd By io *Supplied By other*

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

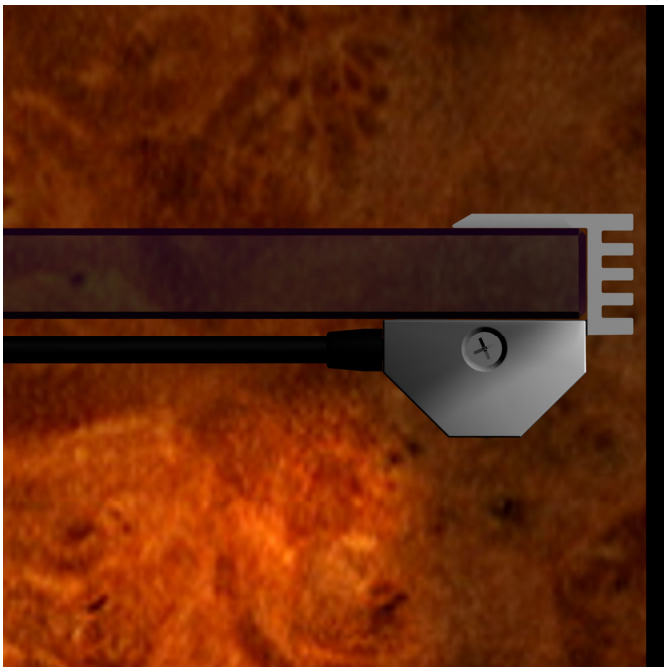
iolighting.com

LEDge™

PRELIMINARY

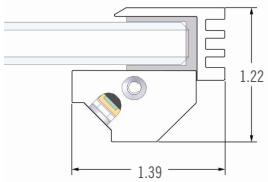
6/2/2006

PATENT PENDING

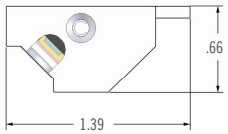


Dimensions

Glass Mount



Shelf Mount



Power Supply (Driver) Information

Standard Light Output

Type	Supplies	Remote Distance
24v100w	Up to 16'-0"	11'-0" (w/20AWG)

High Output

Type	Supplies	Remote Distance
24v100w	Up to 8'-0"	11'-0" (w/20AWG)

Application

LEDge is a low voltage LED based linear shelf light which offers exceptional warm and cool white light for a variety of different shelf and casework conditions. LEDge offers illumination levels equivalent to halogen and fluorescent based alternates with significant benefits never before available. LEDge delivers exquisite white light without the damaging ultra-violet (UV), Infrared (IR) and heat that conventional light sources produce. LEDge also offers superior definition to three dimensional objects and sparkle to reflective surfaces.

Light Output

LEDge's beam spread and luminous intensities are perfect for shelf lighting applications. Two lumen packages are offered; standard and high output.

Standard Light Output:

- Warm White: 127 lms/ft
- Cool White: 145 lms/ft

High Output:

- Warm White: 216 lms/ft
- Cool White: 246 lms/ft

Construction

Available in two profiles, LEDge can either be mounted directly to 3/8" glass or surface mounted to the underside of any shelving unit. The LEDge housing is made of extruded aluminum, providing the recommended heat sink requirements for io's proprietary printed circuit boards (PCB's). Both LEDge profiles are provided with neoprene gaskets which isolate the majority of the heat from the surface it is mounted. LEDge **is UL listed for dry locations.**

Electrical

Universal 120 or 277 volt supply required for 100 watt, 24 volt remote driver. Driver supplied by io Lighting. Driver enclosures may be supplied by io if specified (see last options in catalogue nomenclature). LEDge is supplied with a 4'-0" 20AWG, 600 volt TFFN rated power cord. See remote mounted driver requirement chart on the front cover of this specification sheet.

Power Consumption

- Standard Light Output: 6 w/ft
- high output: 12 w/ft

Finish

Clear anodized aluminum finish is standard. Custom finishes may be available upon request.

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

LEDge™

PRELIMINARY

6/2/2006

PATENT PENDING

Color Options

Applications / Light Output

Mounting Options

Electrical End Feed Options

Order Code

0	09	I	□□□□	□□	□		□	□	□
io	LEDge	Location	Color	Mounting	Finish	Length	Electrical Feed	Voltage / Dimming	Driver Enclosure
		I Interior	3k 3000°K 3kHO 3000°K High Output 5k 5000°K 5kHO 5000°K High Output	38 3/8 Glass NG No Glass	1 Anodized Aluminum 2 Custom	Specify as required to 1/8" between 18" and 80"	1 Right feed 2 Left feed 3 Right and left feed	1 120v 2 277v 3 120v w/dim 4 277v w/dim 5 other	I Interior Rated N Not Req'd By io *Supplied By other*

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

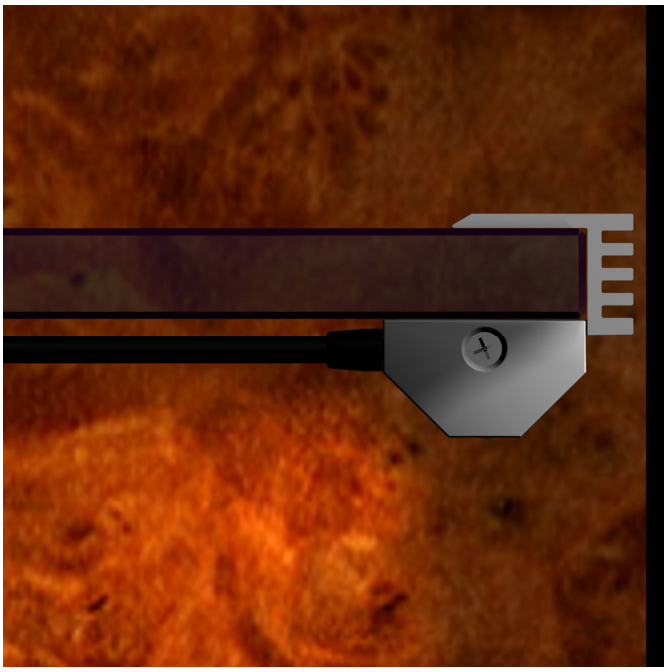
iolighting.com

LEDge™

PRELIMINARY

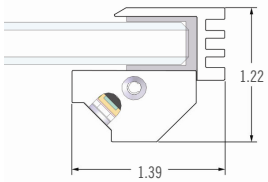
6/2/2006

PATENT PENDING

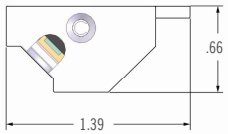


Dimensions

Glass Mount



Shelf Mount



Power Supply (Driver) Information

Standard Light Output

Type	Supplies	Remote Distance
24v100w	Up to 16'-0"	11'-0" (w/20AWG)

High Output

Type	Supplies	Remote Distance
24v100w	Up to 8'-0"	11'-0" (w/20AWG)

Application

LEDge is a low voltage LED based linear shelf light which offers exceptional warm and cool white light for a variety of different shelf and casework conditions. LEDge offers illumination levels equivalent to halogen and fluorescent based alternates with significant benefits never before available. LEDge delivers exquisite white light without the damaging ultra-violet (UV), Infrared (IR) and heat that conventional light sources produce. LEDge also offers superior definition to three dimensional objects and sparkle to reflective surfaces.

Light Output

LEDge's beam spread and luminous intensities are perfect for shelf lighting applications. Two lumen packages are offered; standard and high output.

Standard Light Output:

- Warm White: 127 lms/ft
- Cool White: 145 lms/ft

High Output:

- Warm White: 216 lms/ft
- Cool White: 246 lms/ft

Construction

Available in two profiles, LEDge can either be mounted directly to 3/8" glass or surface mounted to the underside of any shelving unit. The LEDge housing is made of extruded aluminum, providing the recommended heat sink requirements for io's proprietary printed circuit boards (PCB's). Both LEDge profiles are provided with neoprene gaskets which isolate the majority of the heat from the surface it is mounted. LEDge **is UL listed for dry locations.**

Electrical

Universal 120 or 277 volt supply required for 100 watt, 24 volt remote driver. Driver supplied by io Lighting. Driver enclosures may be supplied by io if specified (see last options in catalogue nomenclature). LEDge is supplied with a 4'-0" 20AWG, 600 volt TFFN rated power cord. See remote mounted driver requirement chart on the front cover of this specification sheet.

Power Consumption

- Standard Light Output: 6 w/ft
- high output: 12 w/ft

Finish

Clear anodized aluminum finish is standard. Custom finishes may be available upon request.

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

LEDge™

PRELIMINARY

6/2/2006

PATENT PENDING

Color Options

Applications / Light Output

Mounting Options

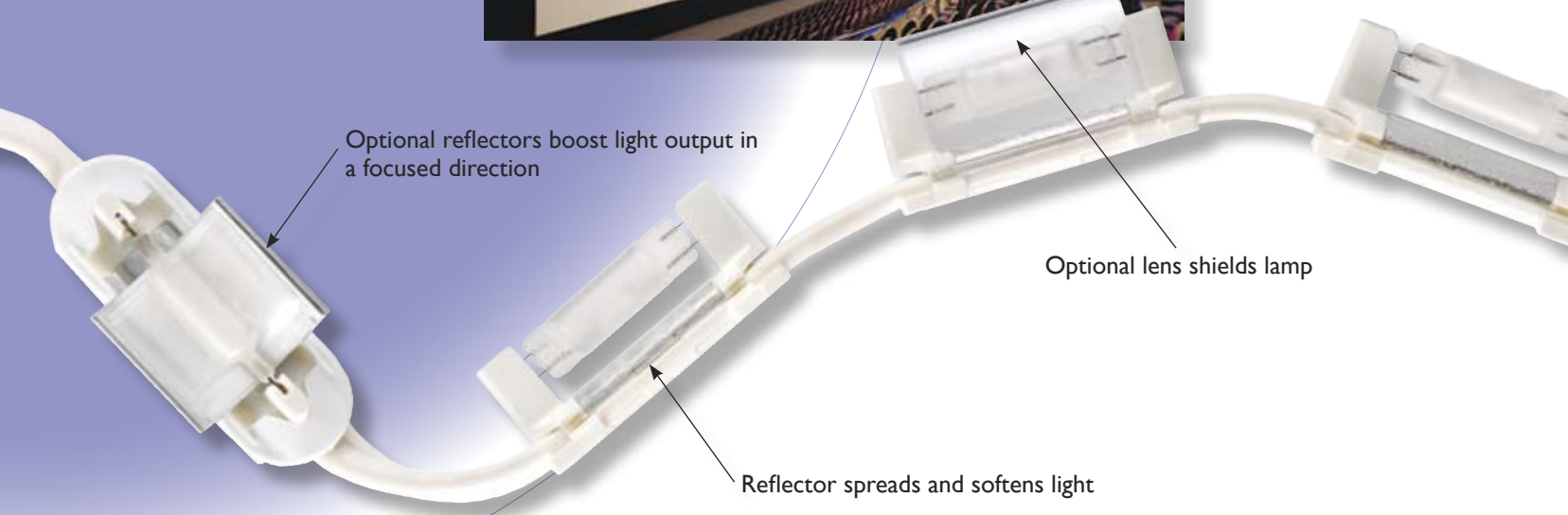
Electrical End Feed Options

Order Code

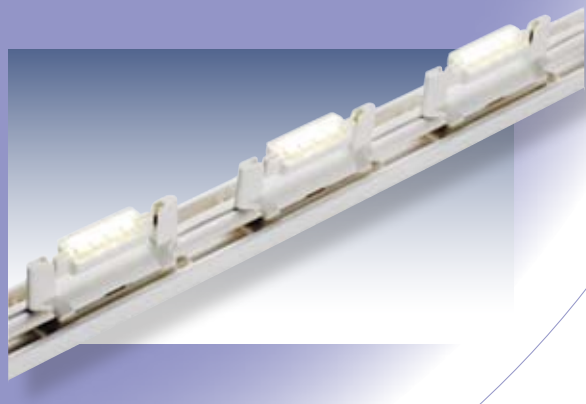
0	09	I	□□□□	□□	□		□	□	□
io	LEDge	Location	Color	Mounting	Finish	Length	Electrical Feed	Voltage / Dimming	Driver Enclosure
		I Interior	3k 3000°K 3kHO 3000°K High Output 5k 5000°K 5kHO 5000°K High Output	38 3/8 Glass NG No Glass	1 Anodized Aluminum 2 Custom	Specify as required to 1/8" between 18" and 80"	1 Right feed 2 Left feed 3 Right and left feed	1 120v 2 277v 3 120v w/dim 4 277v w/dim 5 other	I Interior Rated N Not Req'd By io *Supplied By other*

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

New LED modules consume only 0.72 Watts, making Advantage more efficient than ever. Compared to our 5 Watt lamps, LEDs reduce energy use by 85%.



LED Modules



Advantage LED modules consume only 0.72 Watts each, making them the most efficient of all light sources. With a color temperature of 2400° K, they do an outstanding job of emulating true incandescent light.

Each LED module has on-board circuitry enabling it to operate from 24 VAC magnetic transformers. This allows you to take complete control of the environment, and operate our LEDs from standard low-voltage dimming systems.

To optimize operating life, each module is packaged in a porcelain base to absorb and dissipate heat away from the LED. This also means Advantage LEDs may be specified in heat-sensitive applications you may have avoided in the past. Since these solid-state devices have no filaments, vibration will not cause them to fail prematurely.

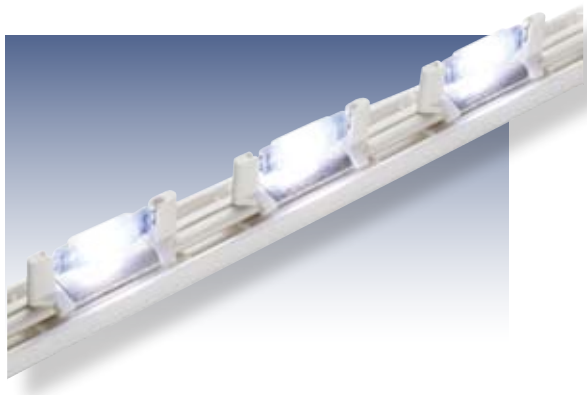
With such low power consumption, maximum run lengths become a great deal longer. Fewer transformers and secondary circuits reduce installation costs significantly.

0.72 Watt LED

This 0.72 Watt LED module is highly energy efficient and is for use with all socket spacings. It is not for use with Series AVO or symmetrical reflectors.

Part #: AVLED-WW
Volts: 24 VAC
Color: 2400˚ K
Output: 10 Lumens
Life: 30,000+ Hours

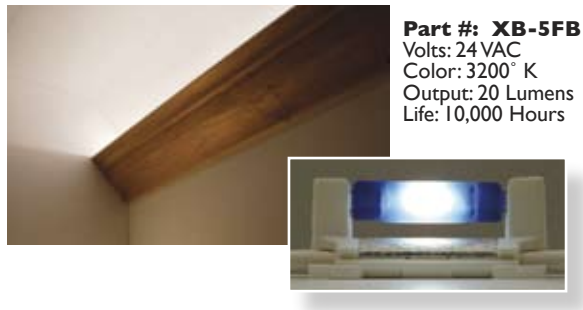
Cool White Xenon Lamps



Our cool white lamps have glass envelopes tinted to create a color temperature of 3200° K, making cool-colored walls and ceiling finishes appear more vibrant and true. Advantage cool white lamps are color balanced to complement other fixtures with higher Kelvin temperatures.

5 Watt Cool White Xenon

The XB-5FB is both energy efficient and attractive. This lamp is not for use with AV-LNS lens covers, AV Shielded Channels or Series AVO.



Part #: XB-5FB
Volts: 24 VAC
Color: 3200˚ K
Output: 20 Lumens
Life: 10,000 Hours

8.5 Watt Cool White Xenon

Our 8.5 Watt lamp provides greater lumen output in applications where more heat can be tolerated. This lamp is not for use with AV-LNS lens covers, AV Shielded Channels or Series AVO.

Part #: XB-8FB
Volts: 24 VAC
Color: 3200˚ K
Output: 40 Lumens
Life: 10,000 Hours

How To Specify

To specify the most attractive form of Advantage for an application, determine the appropriate light source and socket spacing from the guidelines presented on pages 4 through 7. Then tailor the system to the specific task by selecting from the listed options and accessories.

AV - 3 - X5 - LNS

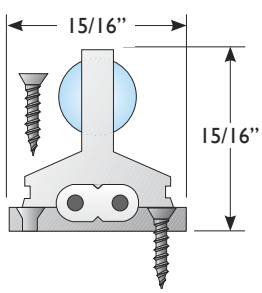
Socket Spacing		Light Source		Options	
Code	Inches (mm)	Code	Style	Code	Option
2.4	2.4" (60 mm)	**X3**	3 Watt Xenon	**LNS**	Lens Cover
3	3.0" (75 mm)	**X5**	5 Watt Xenon	**MC**	Mounting Channel
4	4.0" (100 mm)	**X8**	8.5 Watt Xenon	**SR**	Symmetrical Reflector
6	6.0" (150 mm)	**X5B**	5 Watt Cool White	**AR**	Asymmetrical Reflector
		X8B	8.5 Watt Cool White	**BK**	Black Finish
		LWW	0.72 Watt LED		

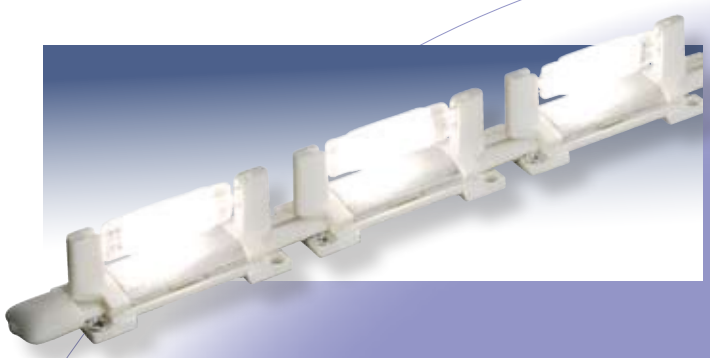
Before deciding on the finished product, it is important to note that not all light sources can be used with all options. Take into account these guidelines:

- Due to the surface temperature of lamps, our 8.5 Watt and cool white lamps are not for use with AV-LNS lens covers, AV Shielded Channels or Series AVO.
- Symmetrical and asymmetrical reflectors are not for use with AV-LNS lens covers, AV Shielded Channels or Series AVO.
- LED modules do not emit light from below, so there is no symmetrical reflector option with this light source.
- Fixtures with 2.4" socket spacing are not for use in AV Shielded Channels or Series AVO.
- Refer to page 11 for minimum distances to be maintained between fixtures and combustible surfaces.

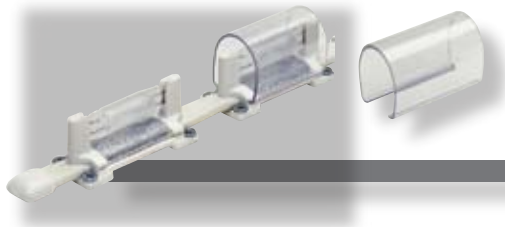
The Basic System

The basic system includes lamp sockets with integral reflectors. When specified with our LED light source, these reflectors are not included. Each socket has four holes to accept mounting screws. Two screws installed at opposing corners provide easy and secure mounting.





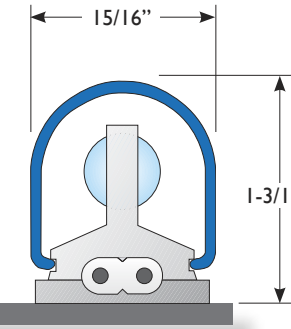
Options



Lens Covers

To prevent direct contact with lamps, we offer a protective clear polycarbonate lens. The ends of each lens are open to allow heat to vent. This optional lens cover is not for use with 8.5 Watt or cool white xenon lamps.

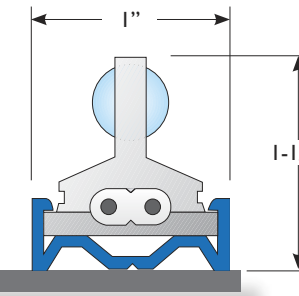
Part #: AV-LNS



Mounting Channel

A high-temperature plastic mounting channel is available for straight runs. The channel is screwed in place and the sockets snapped in, ensuring linear integrity of the fixture and reducing installation time.

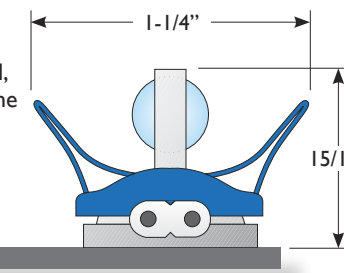
Part #: AV-MC

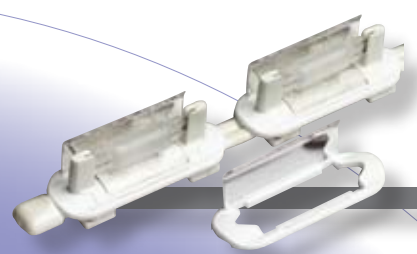


Symmetrical Reflector

For applications where a more concentrated beam of light is needed, these reflectors easily snap onto our sockets. They may be used with or without our mounting channel, increasing light output toward the center line of the fixture.

Part #: AVWH-REF-S (White)
Part #: AVBK-REF-S (Black)

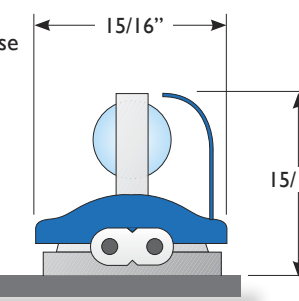


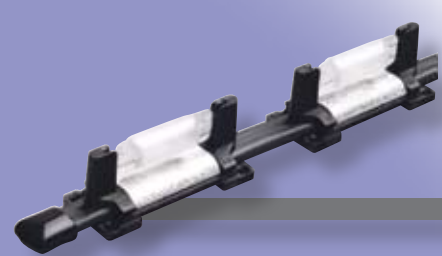


Asymmetrical Reflector

For showcase and shelf lighting applications, these reflectors direct light output to one side. They also absorb and deflect heat from the surface next to the fixture, and may be used with or without our mounting channel.

Part #: AVWH-REF-A (White)
Part #: AVBK-REF-A (Black)

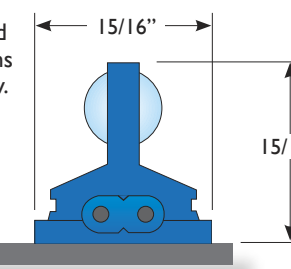




Black Finish

Although most Advantage Systems are concealed behind moldings and ledges, there are applications where the fixture may be exposed to direct view. Advantage is available in a high-tech black finish to complement such installations.

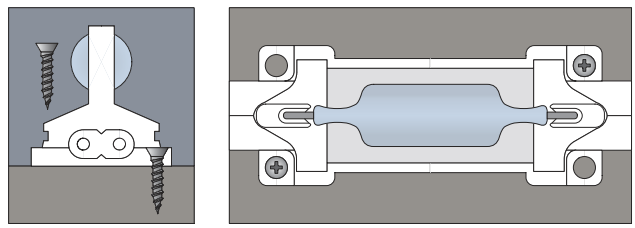
Option Code: BK



Installation Guidelines

Basic System

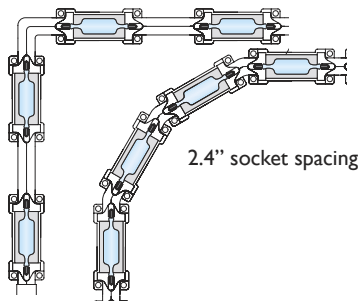
Each Advantage socket is provided with four mounting holes. For secure mounting, use two screws in opposing holes.



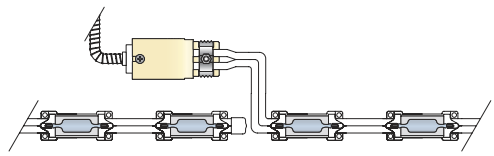
Seamless Light

Advantage fixtures are flexible enough to turn corners without the use of special hardware, eliminating any dark spots at corner locations.

3", 4" and 6" socket spacing



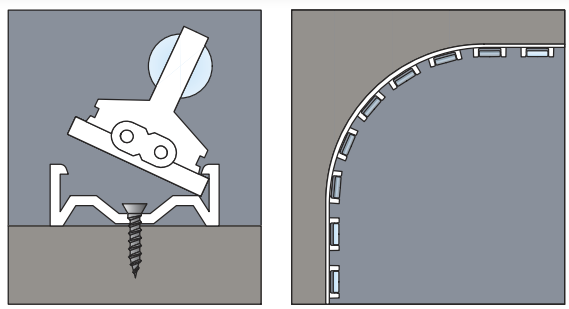
Connectors can be offset so that socket spacing is not interrupted at feed locations.



AV-MC Mounting Channel

Attach the mounting channel securely in place with screws. Insert one side of socket under the lip of the mounting channel, then snap the socket in place.

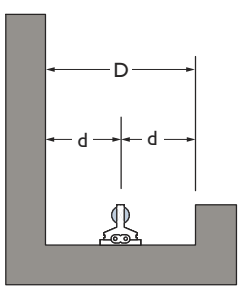
The mounting channel is flexible in one direction and will conform to a 24" radius with lamps facing into or away from the bend.



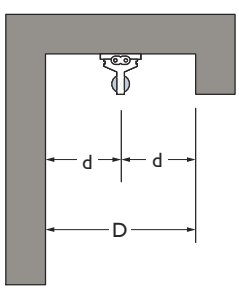
Heat Consideration

Xenon lamps produce heat and will cause damage if they come in direct contact with persons or combustible materials. If fixtures are positioned where these conditions can occur, Advantage should always be specified with the appropriate lens cover to prevent harm.

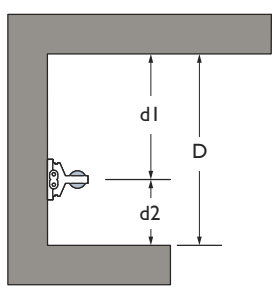
In accordance with NEC/NFPA 70 Article 410-5, combustible materials next to the fixtures must not be subjected to temperatures in excess of 90° C (194° F). In order to conform to this standard, fixtures need to be installed according to the minimum space requirements shown below.



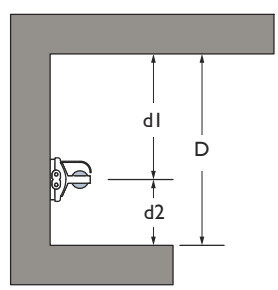
Basic System 2.4" O.C.		
Watts	d	D
3	.75"	1.5"
5	1"	2"
8.5	1.5"	3"



Basic System 2.4" O.C.		
Watts	d	D
3	1"	2"
5	1.5"	3"
8.5	2"	4"



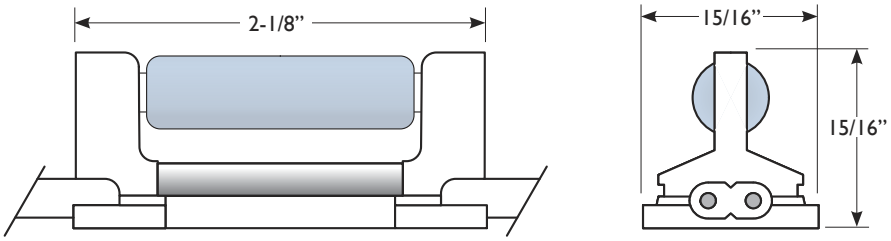
Basic System 2.4" O.C.			
Watts	d1	d2	D
3	1"	.75"	1.75"
5	1.5"	1"	2.5"
8.5	2"	1.5"	3.5"



With Reflector 2.4" O.C.			
Watts	d1	d2	D
3	.75"	.75"	1.5"
5	.75"	1.25"	2"
8.5	.75"	2"	2.75"

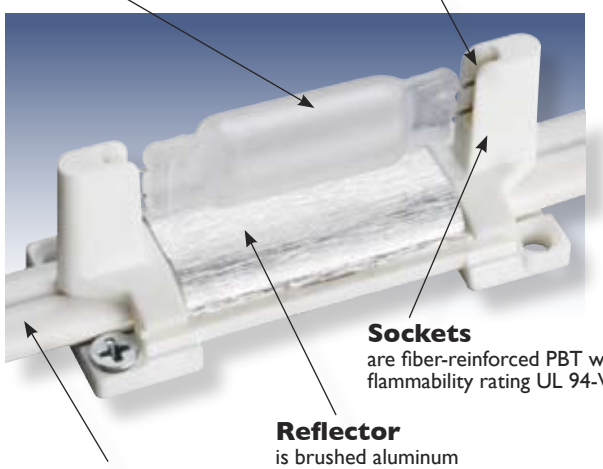
Specifications

In accordance with our policy to continually improve products based upon changes in technology, Tokistar Lighting reserves the right to vary product specifications without prior notice.



Xenon Sources
are 24 VAC lamps

Contacts
are plated copper and recessed in socket



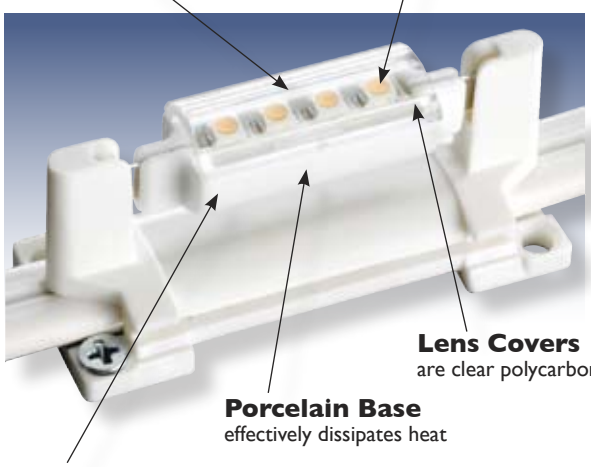
Sockets
are fiber-reinforced PBT with flammability rating UL 94-V0

Reflector
is brushed aluminum

Conductors
are #12 AWG stranded and plated copper with PVC insulation rated 105° C

Advantage LED Modules
include four each 2400° K LEDs

LED Module
consumes 0.72 Watts @ 24 VAC



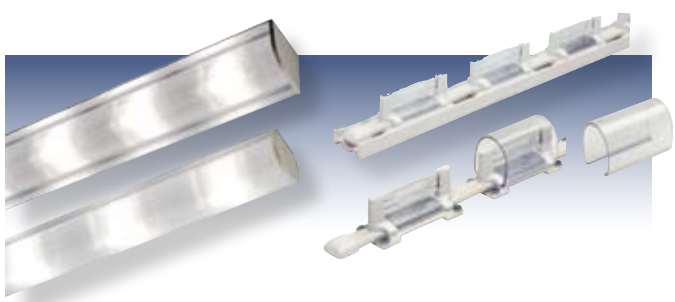
Lens Covers
are clear polycarbonate

Porcelain Base
effectively dissipates heat

Printed Circuit Board
includes on-board bridge rectifier for 24 VAC operation

Plastic Specifications

Advantage Mounting Channels and Lens Covers are extruded polycarbonate with a flammability rating of UL 94-V0.



Series AVO tube guards have a flammability rating of UL 94-V0 and conform to UL Standard 746C for exposure to ultraviolet light and water absorption.

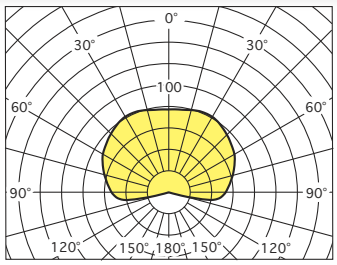
Safety Certification

Advantage Lighting Systems are ETL Listed and bear the CE Mark for conformance to European Standards.

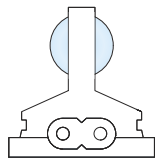
Life Ratings

Ratings are based upon the manufacturer's published life data. Life of xenon sources is determined by the industry standard Mean Time Before Failure (MTBF) method, defined as the time when 50% of lamps fail. With our LED source, life is defined as the time when lumen output depreciates to 70% of its initial value. Actual lifetime may vary based upon environmental conditions.

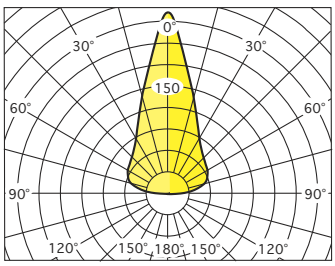
Photometrics



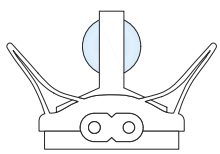
Catalog #: AV-3-X5
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



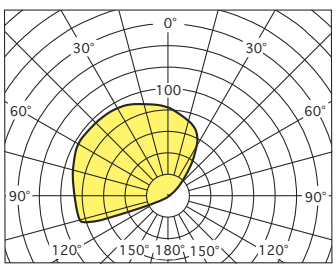
Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
8.5 Watt/70 Lumen X8, Multiply by 1.75
5 Watt/20 Lumen X5B, Multiply by 0.50
8.5 Watt/40 Lumen X8B, Multiply by 1
Spacing:
2.4" O.C., Multiply by 1.25
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



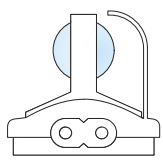
Catalog #: AV-3-X5-SR
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



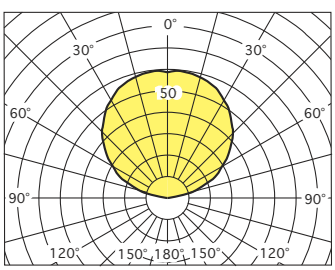
Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
8.5 Watt/70 Lumen X8, Multiply by 1.75
5 Watt/20 Lumen X5B, Multiply by 0.50
8.5 Watt/40 Lumen X8B, Multiply by 1
Spacing:
2.4" O.C., Multiply by 1.25
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



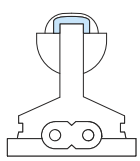
Catalog #: AV-3-X5-AR
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



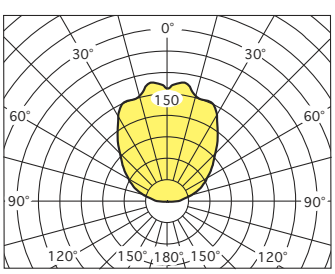
Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
8.5 Watt/70 Lumen X8, Multiply by 1.75
5 Watt/20 Lumen X5B, Multiply by 0.50
8.5 Watt/40 Lumen X8B, Multiply by 1
Spacing:
2.4" O.C., Multiply by 1.25
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



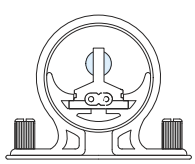
Catalog #: AV-3-LWW
Test Criteria:
0.72 Watt LED/10 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



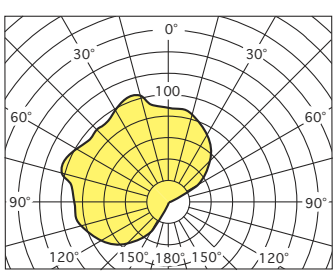
Conversion Factors
Spacing:
2.4" O.C., Multiply by 1.25
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



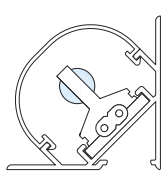
Catalog #: AVO-3-X5
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



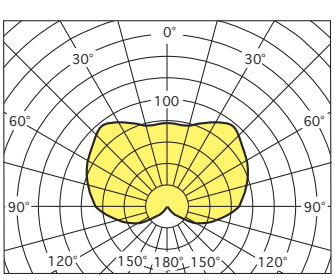
Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
Spacing:
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



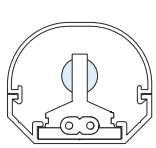
Catalog #: AVLC-WH-3-X5
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"



Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
LED: Refer to LED Graph
Spacing:
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50



Catalog #: AVCC-WH-3-X5
Test Criteria:
Lamps: 5 Watt/40 Lumen; Spacing: 3" O.C. ; Fixture length: 48"

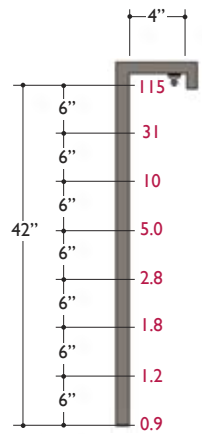


Conversion Factors
Lamps:
3 Watt/12.5 Lumen X3, Multiply by 0.31
LED: Refer to LED Graph
Spacing:
4.0" O.C., Multiply by 0.75
6.0" O.C., Multiply by 0.50

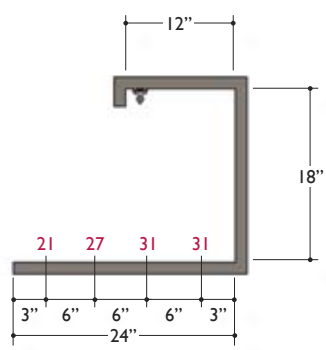
Footcandle Summary

The sections below show typical point-by-point footcandle values for three typical applications.

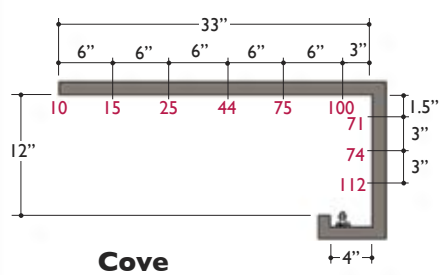
Test Criteria:
Lamps: 5 Watt/40 Lumen
Spacing: 3" O.C.
Fixture length: 48"



Overhang
Surface reflectance: 50%



Under Cabinet
Surface reflectance: 50%



Cove
Surface reflectance: 80%

Photometrics by Tokyo Metropolitan Industrial Technology Research Institute (Tokyo, Japan). Testing conducted in accordance with current IES published procedures.

ML6 SERIES

Extérieur Vert

SURFACE REAR MOUNTED PROJECTOR
High Output LED Source
1W / 24V

MINILINI™

IP 66 | 1W | 24V

Projector body

- Suitable for wet locations, IP66 rated
- Compact low profile under 2" diameter
- Lengths available in 1', 2', 3' and 4'
- Consult factory for other lengths
- Grey powder coat (RAL#9006) Standard
- For additional colors consult factory
- 24V DC Remote constant voltage (R56) power supply
- UL Listed
- 10 Year Warranty anti-corrosion
- 3 Year Warranty on driver

Lamp / Optics

- Nominal LED spacing: 1" or 2" on center
- Light source: High power 1.2W Warm White LED
- 10° x 40° spread, 25° spot & 50° flood optics
- 50,000 hour lamp life @ 70% lumen output

Remote Power Supply

- 120-277V Primary 24VDC Secondary power supply (required) ordered separately
- 15' max length for remote power supply
- Consult factory for longer lengths
- Modules can be daisy chained together for Linear installations with 0 clearance between fixtures (Consult Factory)

Cover

- UV polycarbonate lens cover
- UV Stabilized (Non yellowing)

Mounting

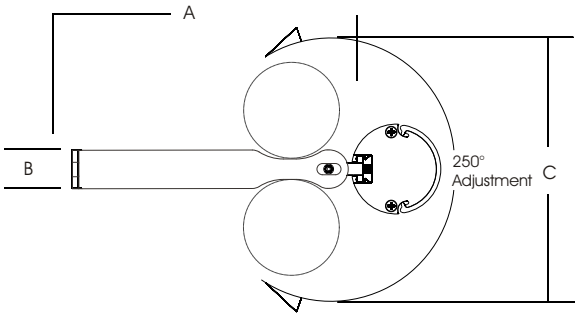
- Can be mounted end to end with zero clearance
- Mounted horizontal or vertical and can be rotated 220° on its axis

Features

- Available in 1', 2', 3' & 4' lengths
- Adjustable mounting brackets
- High light output LEDs (1.2W/LED)
- IP 66 rated
- Class 1 fixture continuous runs of 15' plus available (consult factory)

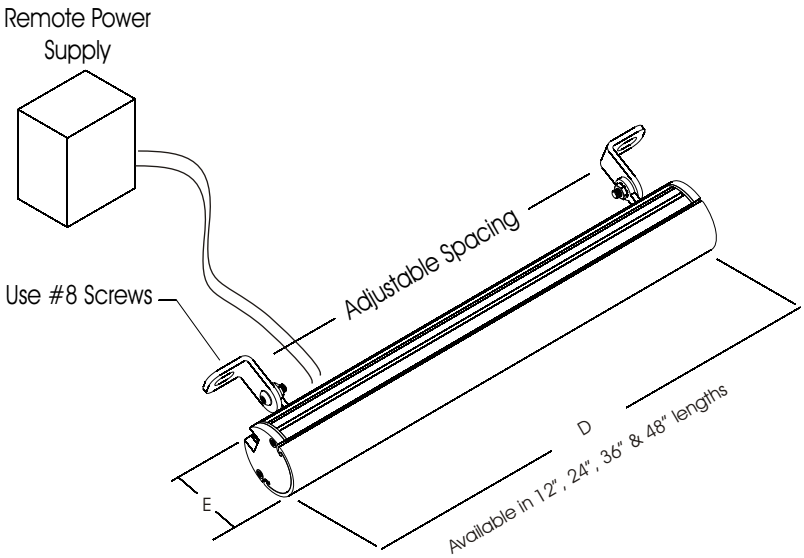
Applications

- Building facade lighting
- Wall washing
- Area Lighting
- Effects Lighting



Dimensions

A Bracket Length	B Bracket Width	C	D Fixture Length	E Fixture Diameter
Standard 1"	0.75"	4.5"	12.5"	1.75"
3"	0.75"	4.5"	24.5"	1.75"
5"	0.75"	4.5"	36.5"	1.75"
			48.5"	1.75"



LED technology is changing rapidly. LED's are made in lots and sorted into bins based on wavelength ranges that achieve colors. Products ordered at different times may not have the same color appearance due to variations of up to 10% within lots.

EXTERIEUR VERT a division of TARGETTI NORTH AMERICA
www.exterieurvert.com
1513 E. Saint Gertrude Place Tel 714 957-4960
Santa Ana, Ca 92705 Fax 714 957-4965

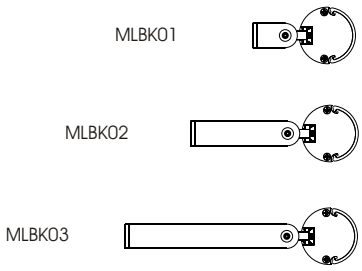
Extérieur Vert

MINILINI

Part # Logic

ML6	41	0	2	1	10SD	1	4
Base Part#	Lamp Type	LED color	LED Spacing	Length	Optics	Wattage	Finish
ML6-Minilini Projector	LED	0 - Warm White LED	1= 1" Spacing 2= 2" Spacing	1=1 foot 2=2 foot 3=3 foot 4=4 foot	10SD=10° x 40° Spread 25S=25° Refractive Optics 50F=50° Refractive Optics	1=1.2 Watt	Color 4 - Grey (std.) 9 - Custom

Required Choices for Mounting Fixture



MLBK01, MLBK02 or MLBK03 can be used with any of the three available fixture lengths.

Part No.	Extension from wall
MLBK01	1" mounting bracket length
MLBK02	3" mounting bracket length
MLBK03	5" mounting bracket length

LED driver

E	096	1
Placement	Wattage	Input Voltage
I=Interior E=Exterior	096 = 96Watt / 1 Circuit	1=120 Volt 7=277 Volt

OTHER LED DRIVER OPTIONS

300W 3 (Circuits) X 100W - 36' with multiple feeds

* Consult Factory

LED Spacing	Fixture Length	Max # of Fixtures per 96W Driver
1" Spacing	1 foot	6
1" Spacing	2 foot	3
1" Spacing	3 foot	2
1" Spacing	4 foot	1
2" Spacing	1 foot	12
2" Spacing	2 foot	6
2" Spacing	3 foot	4
2" Spacing	4 foot	3

* Overall run length not to exceed 60'

The Memorial Reception Building
Arlington National Cemetery

Secondary Lighting Design Fixture

Final Thesis Report Lighting/Electrical Jennifer Sanborn

light bars

TRIAXIS

Description:
Similar to LightBeam, asymmetrical distribution.
The unique design of this light bar has 3 different angles of distribution, 15˚, 30˚ and 35˚. This allows a broader wash of light into a display case or similar application.

Case Lighting Recommendations:
(22) recommended for 24" cases
(34) recommended for 36" cases
(46) recommended for 48" cases
(58) recommended for 60" cases
(70) recommended for 72" cases

TRX				

ordering guide

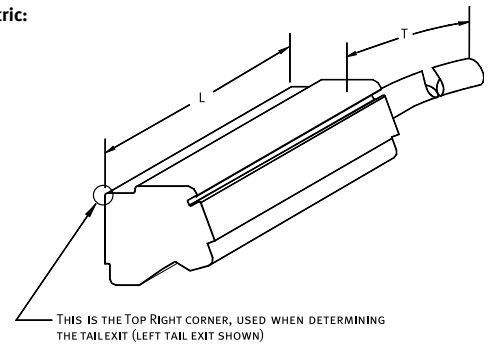
Lit Length:	Tail Length:	Finishes:	Tail Exit:
( ) Specify inches	**( )** Specify feet	**S** Standard Clear Anodized	**L** Left **R** Right **C** Custom

Specifications:

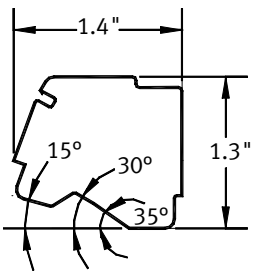
Beam Spread:	80˚ (Asymmetric)
Max Lit Lengths:	120" (3.56m)
Base Sizes:	1.4" x 1.3" (35.56mm x 33mm)
Mounting:	LB-MB or similar surface mount
Technical Remarks:	Intended for case and cabinet lighting but useful wherever a wide-dispersion, asymmetrical wash is required.
Cable Diameters:	Standard size: 7/8" Max
Max Fiber Capacity:	300 fibers
Max Lamp Wattage:	150W metal halide

Isometric Key:
L Length Up to 120"
T Tail Length
E Tail Exit, right or left

Isometric:



Cross Section:



CONVERSIONS

Apply the conversions below to the .ies f
chosen system.

Different Illuminators

Performance of	Multiply IES Results by
601/602	1.6
405N/404N	1.0
FS13/FS12	0.4
FS11L	0.25

Different Cable Lengths

To Estimate Performance of	Multiply IES Results by
10 Foot Length	1.0
15 Foot Length	0.93
20 Foot Length	0.86
25 Foot Length	0.79
30 Foot Length	0.72

Different Intensities (Lightly Expressed® Light Bars)

To Estimate Performance of	Multiply IES Results by
High Intensity	1.0
Medium Intensity	0.5
Low Intensity	0.25
TRX Bars *	1.25

*The assymetrical distrubtion
is not shown in the .ies file

Different Fixture Lengths (Lightly Expressed® Light Bars)

Your Multiplier=
(Your Fixture Length) / 36

20018 – CMH150TU/942/G12

GE ConstantColor® CMH® Ceramic Metal Halide T6

PRINT

GENERAL CHARACTERISTICS

Lamp type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T6
Base	Bi-Pin (G12)
Wattage	150
Rated Life	12000 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	13000
Mean Lumens	11000
Nominal Initial Lumens per Watt	86
Color Temperature	4200 K
Color Rendering Index (CRI)	94

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position
Warm Up Time to 90% (MAX)	2 min/3
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

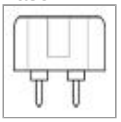
Maximum Overall Length (MOL)	3.9300 in (99.8 mm)
Light Center Length (LCL)	2.180 in (55.3 mm)

PRODUCT INFORMATION

Product Code	20018
Description	CMH150TU/942/G12
ANSI Code	M102/M142/M81
Standard Package	Case
Standard Package GTIN	10043168200186
Standard Package Quantity	12

Bulb

Base



View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures
- Ceramic Metal Halide

Application/Segment Brochures
- Contractor Lighting

MSDS (Material Safety Data Sheets)

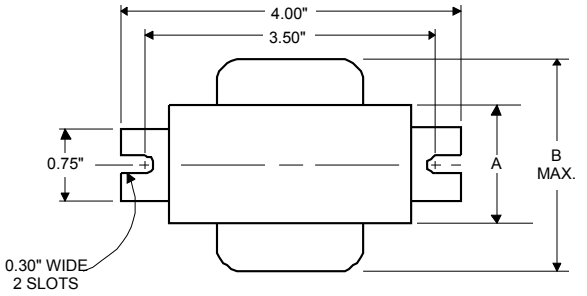
Disposal Policies & Recycling Information

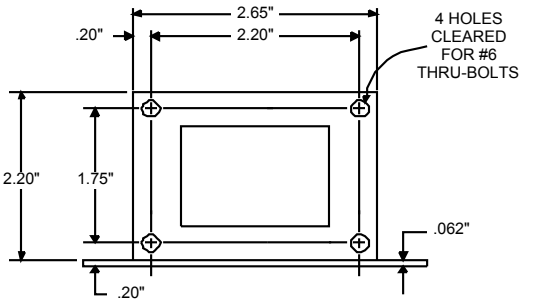
Metal Halide Lamp Ballast

Catalog Number 71A5437P
For 150W M102
60 Hz R-HPF
Status: Active

DIMENSIONS AND DATA

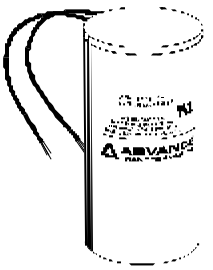
2 5/8 X 2 3/16 CORE





~~INPUT VOLTS~~		~~277~~				
CIRCUIT TYPE	R-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.63				
Open Circuit		1.50				
Starting		0.70				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	B				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	277					
INPUT VOLTAGE AT LAMP DROPOUT		170				
INPUT WATTS	173					
RECOMMENDED FUSE (Amps)		4				
CORE and COIL						
Dimension (A)	2.50					
Dimension (B)	3.80					
Weight (lbs.)	4					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	14.0					
Volts (min.)	280					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Advance Test Procedure for HID Ballasts - Form 1270)						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	250-305					
Short-Circuit Current Test (Amps)						
Secondary Current	2.00-2.50					
Input Current		0.50 0.75	-	-	-	-

Capacitor: 7C140M33-R



Capacitance: 14
Dia/Oval Dim: 1.5
Height: 2.9
Temp Rating: 105°C

Ignitor: LI533-H4

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 105°C

Wiring Diagram:

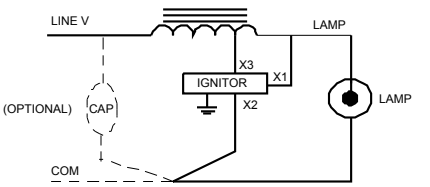


Fig. G

Typical Ordering Information

(please call Advance for suffix availability)

Order Suffix	Description
500D.	Ballast With Ignitor and Dry Film Capacitor
510D.	Ballast w/Welded Bracket, Ignitor, & Dry Film Capacitor
600.	Ballast and Ignitor, No Capacitor
610.	Ballast with Welded Bracket and Ignitor, No Capacitor

Data is based upon tests performed by Advance Transformer in a controlled environment and representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

09/20/00

The Memorial Reception Building
Arlington National Cemetery

Electrical

Model: 30RZG

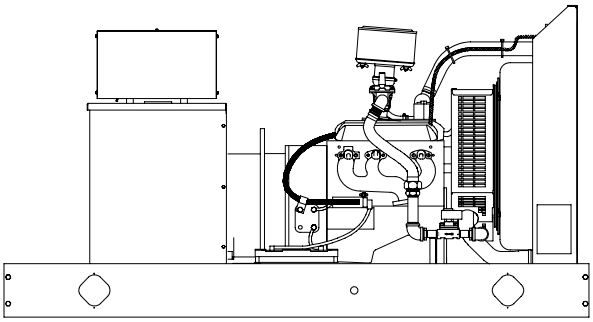
KOHLER® POWER SYSTEMS

190–600 V **Gas**

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

Ratings Range

		60 Hz	50 Hz
Standby:	**kW**	33–35	26–29
	kVA	33–44	26–36
Prime:	**kW**	30–33	23–26
	kVA	30–41	24–33



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- A one-year limited warranty covers all systems and components. Two-, five-, and ten-year extended warranties are also available.
- Alternator features:
  - The Fast-Response™ III wound field (WF) design alternator provides excellent voltage response and short-circuit capability using an auxiliary power brushless exciter.
  - The unique Fast-Response™ II excitation system delivers excellent voltage response and short circuit capability using a permanent magnet (PM)-excited alternator.
  - The brushless, rotating-field alternator has broadrange reconnectability.
- Other features:
  - A rugged industrial gas engine delivers rated power at 1800 rpm (60 Hz) and 1500 rpm (50 Hz).
  - Controllers are available for all applications. See controller features inside.
  - The electronic, isochronous governor incorporates an integrated drive-by-wire throttle body actuator delivering precise frequency regulation.

Generator Set Ratings

				Natural Gas				LP Gas			
				130°C Rise Standby Rating		105°C Rise Prime Rating		130°C Rise Standby Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
4P5W/4P5	120/208	3	60	35/44	121	33/41	115	35/44	121	33/41	115
	127/220	3	60	34/43	112	32/40	105	34/43	112	32/40	105
	120/240	3	60	35/44	105	33/41	99	35/44	105	33/41	99
	120/240	1	60	33/33	138	30/30	125	33/33	138	30/30	125
	139/240	3	60	34/43	102	31/39	93	34/43	102	31/39	93
	220/380	3	60	35/44	66	32/40	61	35/44	66	32/40	61
	277/480	3	60	34/43	51	31/39	47	34/43	51	31/39	47
	347/600	3	60	33/41	40	30/38	36	33/41	40	30/38	36
	110/190	3	50	27/34	103	26/32	97	27/34	103	26/32	97
	115/200	3	50	26/33	95	24/30	87	26/33	95	24/30	87
	120/208	3	50	26/33	92	23/29	80	26/33	92	23/29	80
	110/220	3	50	29/36	94	26/33	87	29/36	94	26/33	87
	110/220	1	50	26/26	118	24/24	109	26/26	118	24/24	109
	220/380	3	50	27/34	52	26/32	49	27/34	52	26/32	49
	230/400	3	50	26/33	48	24/30	43	26/33	48	24/30	43
	240/416	3	50	26/33	46	23/29	40	26/33	46	23/29	40

RATINGS: All three-phase units are rated at 0.8 power factor. All single-phase units are rated at 1.0 power factor. *Standby Ratings:* Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. Ratings are in accordance with ISO-3046/1, BS 5514, AS 2789, and DIN 6271. *Prime Power Ratings:* Prime power ratings apply to installations where utility power is unavailable or unreliable. At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528/1, overload power in accordance with ISO-3046/1, BS 5514, AS 2789, and DIN 6271. For limited running time and base load ratings, consult the factory. Obtain the technical information bulletin (TIB-101) on ratings guidelines for the complete ratings definitions. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. GENERAL GUIDELINES FOR DERATION: *Altitude:* Derate 1.3% per 100 m (328 ft.) elevation above 200 m (656 ft.). *Temperature:* Derate 3.0% per 10°C (18°F) temperature above 40°C (104°F).

Alternator Specifications

Specifications	Alternator
Manufacturer	Kohler
Type	4-Pole, Rotating-Field
Exciter type	
Wound field (WF)	Wound Exciter Field with Separate Excitation Power Winding
Permanent magnet (PM)	Brushless, Permanent-Magnet
Leads: quantity, type	12, Reconnectable
Voltage regulator	Solid State, Volts/Hz
Insulation:	NEMA MG1
Material	Class H
Temperature rise	130°C, Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible Disc
Amortisseur windings	Full
Voltage regulation, no-load to full-load	
Wound field (WF) alternator	±0.25% Average
Permanent magnet (PM) alternator	±2% Average
550 controller (with 0.5% drift due to temperature variation)	3-Phase Sensing, ±0.25%
Unbalanced load capability	100% of Rated Standby Current
One-step load acceptance	100% of Rating

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Vacuum-impregnated windings with fungus-resistant epoxy varnish for dependability and long life.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.
- Fast-Response™ III wound field (WF) brushless alternator with auxiliary power brushless exciter for excellent load response.
- Fast-Response™ II brushless alternator with brushless exciter for excellent load response.

Specifications	Alternator
Peak motor starting kVA:	(35% dip for voltages below)
480 V, 380 V 4P5W/4P5 (12 lead)	140 (60Hz), 95 (50Hz)

Application Data

Engine

Engine Specifications	60 Hz	50 Hz
Manufacturer	General Motors	
Engine: model, type	Industrial Powertrain Vortec 4.3 L, 4-Cycle Natural Aspiration	
Cylinder arrangement	V-6	
Displacement, L (cu. in.)	4.3 (262)	
Bore and stroke, mm (in.)	101.6 x 88.4 (4.00 x 3.48)	
Compression ratio	9.05:1	
Piston speed, m/min. (ft./min.)	318 (1044)	265 (870)
Main bearings: quantity, type	4, Babbitt	
Rated rpm	1800	1500
Max. power at rated rpm, kW (HP)	56 (75)	44.8 (60)
Engine power at standby rating, kW (HP)	44.8 (60)	35.8 (48)
Cylinder head material	Cast Iron	
Piston type and material	High Silicon Aluminum	
Crankshaft material	Nodular Iron	
Valve (exhaust) material	Forged Steel	
Governor type	Electronic	
Frequency regulation, no-load to full-load	Isochronous	
Frequency regulation, steady state	±0.5%	
Frequency	Field-Convertible	
Air cleaner type, all models	Dry	

Exhaust

Exhaust System	60 Hz	50 Hz
Exhaust manifold type	Dry	
Exhaust flow at rated kW, m^3/min. (cfm)	7.9 (280)	6.2 (220)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	649 (1200)	
Maximum allowable back pressure, kPa (in. Hg)	10.2 (3.0)	
Exhaust outlet size at engine hookup, mm (in.)	76 (3.0) OD	

Engine Electrical

Engine Electrical System	60 Hz	50 Hz
Ignition system	Electronic, Distributor	
Battery charging alternator:		
Ground (negative/positive)	Negative	
Volts (DC)	12	
Ampere rating	70	
Starter motor rated voltage (DC)	12	
Battery, recommended cold cranking amps (CCA):		
Qty., rating for -18°C (0°F)	One, 630	
Battery voltage (DC)	12	

Fuel

Fuel System	60 Hz	50 Hz
Fuel type	LP Gas or Natural Gas	
Fuel supply line inlet	1 NPTF	
Natural gas/LPG fuel supply pressure, measured at the generator set fuel inlet downstream of any fuel system equipment accessories, kPa (in. H_2O)	1.74–2.74 (7.0–11.0)	

Fuel Composition Limits *	Nat. Gas	LP Gas
Methane, % by volume	90 min.	—
Ethane, % by volume	4.0 max.	—
Propane, % by volume	1.0 max.	85 min.
Propene, % by volume	0.1 max.	5.0 max.
C_4 and higher, % by volume	0.3 max.	2.5 max.
Sulfur, ppm mass	25 max.	
Lower heating value, kJ/m^3 (Btu/ft^3), min.	26.6 (890)	67.5 (2260)

* Fuels with other compositions may be acceptable. If your fuel is outside the listed specifications, contact your local distributor for further analysis and advice.

Application Data

Lubrication

Lubricating System	60 Hz	50 Hz
Type	Full Pressure	
Oil pan capacity, L (qt.)	4.3 (4.5)	
Oil pan capacity with filter, L (qt.)	5.7 (6.0)	
Oil filter: quantity, type	1, Cartridge	

Cooling

Radiator System	60 Hz	50 Hz
Ambient temperature, °C (°F)	50 (122)	
Engine jacket water capacity, L (gal.)	6.8 (1.8)	
Radiator system capacity, including engine, L (gal.)	18.9 (5.0)	
Engine jacket water flow, Lpm (gpm)	106.0 (28)	87.1 (23)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	32.7 (1860)	29.1 (1656)
Water pump type	Centrifugal	
Fan diameter, including blades, mm (in.)	533 (21)	
Fan, kWm (HP)	4.5 (6.0)	2.6 (3.5)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)	

Remote Radiator System†	60 Hz	50 Hz
Exhaust manifold type	Dry	
Connection sizes:		
Water inlet, ID hose, mm (in.)	44.45 (1.75)	
Water outlet, ID hose, mm (in.)	38.10 (1.50)	
Static head allowable above engine, kPa (ft. H_2O)	4.32 (17.0)	

† Contact your local distributor for cooling system options and specifications based on your specific requirements.

Operation Requirements

Air Requirements	60 Hz	50 Hz
Radiator-cooled cooling air, m^3/min. (scfm)‡	181 (6400)	136 (4800)
Cooling air required for generator set when equipped with city water cooling or remote radiator, based on 14°C (25°F) rise and ambient temperature of 29°C (85°F), m^3/min. (cfm)	71 (2500)	62 (2200)
Combustion air, m^3/min. (cfm)	2.3 (81)	1.8 (64)
Heat rejected to ambient air:		
Engine, kW (Btu/min.)	14.2 (810)	12.5 (710)
Alternator, kW (Btu/min.)	4.7 (270)	3.9 (220)

‡ Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

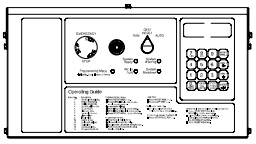
Fuel Consumption	60 Hz	50 Hz
Natural Gas, m^3/hr. (cfh) at % load§	**Standby Ratings**	
100%	15.1 (535)	11.9 (422)
75%	12.4 (439)	9.5 (335)
50%	9.6 (338)	7.4 (262)
25%	7.4 (260)	5.6 (197)
Natural Gas, m^3/hr. (cfh) at % load§	**Prime Ratings**	
100%	14.2 (500)	11.0 (390)
75%	11.6 (411)	8.9 (315)
50%	9.2 (324)	7.1 (250)
25%	7.2 (253)	5.4 (192)

LP Gas, m^3/hr. (cfh) at % load	Standby Ratings	
100%	5.7 (202)	4.7 (167)
75%	4.6 (161)	3.8 (133)
50%	3.5 (125)	2.9 (103)
25%	2.7 (94)	2.2 (77)
LP Gas, m^3/hr. (cfh) at % load	**Prime Ratings**	
100%	5.3 (187)	4.4 (155)
75%	4.3 (151)	3.5 (125)
50%	3.4 (119)	2.8 (98)
25%	2.6 (91)	2.1 (75)

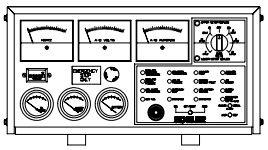
§ Fuel consumption is based on 1015 Btu/standard cu. ft. natural gas.

LP vapor conversion factors:
8.58 $ft.^3$ = 1 lb.
0.535 m^3 = 1 kg.
36.39 $ft.^3$ = 1 gal.

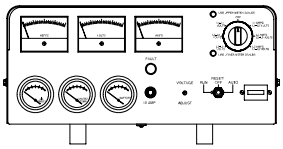
Controllers



Decision-Maker™ 550 Controller
Audiovisual annunciation with NFPA 110 Level 1 capability.
Programmable microprocessor logic and digital display features.
Alternator safeguard circuit protection.
12- or 24-volt engine electrical system capability.
Remote start, remote annunciation, and remote communication options.
Refer to G6-46 for additional controller features and accessories.



Decision-Maker™ 3+, 16-Light Controller
Audiovisual annunciation with NFPA 110 Level 1 capability.
Microprocessor logic, AC meters, and engine gauge features.
12- or 24-volt engine electrical system capability.
Remote start, prime power, and remote annunciation options.
Refer to G6-30 for additional controller features and accessories.



Decision-Maker™ 1 Controller
Single-light annunciation and basic controls with NFPA capability.
Relay logic, AC meters, and engine gauge features.
12-volt engine electrical system capability only.
Remote or automatic start options.
Refer to G6-29 for additional controller features and accessories.
Note: Not available with 600-volt alternator.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-565-3381, Fax 920-459-1646
For the nearest sales and service outlet in the
US and Canada, phone 1-800-544-2444
KohlerPowerSystems.com

Kohler Power Systems
Asia Pacific Headquarters
7 Jurong Pier Road
Singapore 619159
Phone (65) 6264-6422, Fax (65) 6264-6455

Additional Standard Features

- Alternator Protection (standard with 550 controller)
- Battery Rack and Cables
- Electronic, Isochronous Governor
- Gas Fuel System (includes fuel mixer, secondary gas regulator, gas solenoid valve, and flexible fuel line between the engine and the skid-mounted fuel system components)
- Integral Vibration Isolation
- Oil Drain Extension
- Operation and Installation Literature

Available Accessories

Enclosed Unit

❑ Sound Enclosure (with enclosed critical silencer)
❑ Weather Enclosure (with enclosed critical silencer)
❑ Weather Housing (with roof-mounted silencer)

Open Unit

❑ Exhaust Silencer, Critical (kits: PA-324468, PA-352663)
❑ Flexible Exhaust Connector, Stainless Steel

Cooling System

❑ Block Heater
[recommended for ambient temperatures below 10°C (50°F)]
❑ City Water Cooling
❑ Radiator Duct Flange
❑ Remote Radiator Cooling

Fuel System

❑ Automatic Changeover (natural gas to LP gas)
❑ Flexible Fuel Line
(required when the generator set skid is spring mounted)
❑ Gas Filter
❑ LP Gas Liquid Withdrawal
❑ Manual Valve and Gas Solenoid Bypass
❑ Secondary Gas Solenoid Valve

Electrical System

❑ Battery
❑ Battery Charger, Equalize/Float Type
❑ Battery Heater

Engine and Alternator

❑ Alternator, Wound Field (WF)
❑ Alternator, Permanent Magnet (PM)
❑ Air Cleaner Restrictor Indicator
❑ Alternator Strip Heater
❑ CSA Certification
❑ Engine Fluids (oil and coolant) Added
❑ Line Circuit Breaker (NEMA1 enclosure)
❑ Line Circuit Breaker with Shunt Trip (NEMA1 enclosure)
❑ Optional Alternators
❑ Rated Power Factor Testing
❑ Rodent Guards
❑ Safeguard Breaker (not available with 550 controller)
❑ Skid End Caps
❑ Voltage Regulation, 1%
❑ Voltage Regulator Sensing, 3-Phase

Literature and Maintenance

❑ General Maintenance Literature Kit
❑ Maintenance Kit (includes standard air, oil, and fuel filters)
❑ NFPA 110 Literature
❑ Overhaul Literature Kit
❑ Production Literature Kit

Controller (550 and 16-Light)

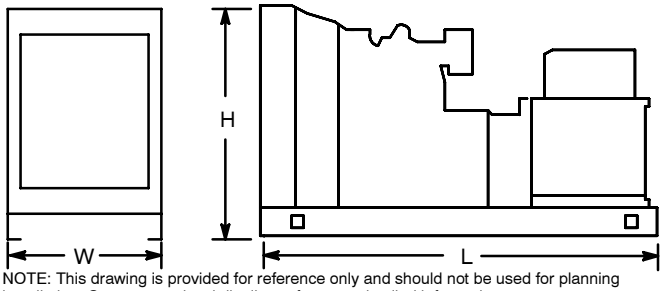
❑ Common Failure Relay Kit
❑ Communication Products and PC Software (550 controller only)
❑ Customer Connection Kit
❑ Dry Contact Kit (isolated alarm)
❑ Engine Prealarm Sender Kit
❑ Local Emergency Stop Kit
❑ Prime Power Switch (550 controller only)
❑ Remote Annunciator Panel
❑ Remote Audiovisual Alarm Panel
❑ Remote Emergency Stop Kit
❑ Remote Mounting Cable
❑ Run Relay Kit

Miscellaneous Accessories

❑ _____
❑ _____
❑ _____
❑ _____
❑ _____
❑ _____
❑ _____
❑ _____

Dimensions and Weights

Overall Size, L x W x H, mm (in.):
Wide Skid 2200 x 1040 x 1172 (86.6 x 40.9 x 46.1)
Narrow Skid 2200 x 865 x 1172 (86.6 x 34.0 x 46.1)
Weight (radiator model), wet, kg (lb.): 556 (1225)



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

DISTRIBUTED BY: