

Harris Theater for Music and Dance

Chicago, IL

Lindsey Beane
Lighting/Electrical



Primary Project Team

Architect: Hammond Beeby Rupert Ainge
Associate Architect: Kathryn Quinn Architects
Project Manager: The Rise Group
MEP: Environmental Systems Design Inc.
Acoustical Consultant: Jaffe Holden Acoustics
Theatre Consultant: Schuler & Shook

Construction

Size: 130,000 sf
Auditorium seating: 1525 people
Number of Stories above grade: 1 story above grade with 8 partial stories total
Construction Dates: Feb. 2002-Nov. 2003

Lighting

- Colored Fluorescents for color identification
- Energy efficient metal halide in auditorium
- Linear Fluorescent on working half of theater
- Specialty theater and stage lighting
- Accent lighting in lobby with color filters

HVAC

- (4) AHUs range from 20,000 cfm to 45,000 cfm
- (16) two pipe fan coil units
- Oversized ductwork for strict acoustics

Structural

Foundation: caissons, grade beams, and concrete slabs.
Walls: precast concrete
Other structural materials: Steel framing
W shape beams range in size and weight

Electrical

Power distribution: 480/277V and 208/120V
Summary: 35 panel boards
Lighting Loads: 208/120V system
Mechanical Loads: 480/277V system
Emergency system: 425KVA/340KW generator

Specialty

- Acoustical systems in auditorium
- Sound system for performances
- Dimming rack controls for stage and auditorium



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Executive Summary

The following report is an analytical approach to describe the details of a new lighting design for a few spaces of the Harris Theater for Music and Dance. The lighting design was given the most consideration throughout this analysis, and was integrated into a construction management cost study as well as an acoustical study. The electrical design is also affected by the lighting design, so the changes to that system are also included in this report. The four main sections of the report are described below.

The Harris Theater for Music and Dance provides spaces for a number of different functions. The spaces I focused on to analyze the lighting design are the entrance, lobby, theater, and main offices. This variety of spaces provides an opportunity to make design considerations for a number of functions. In the following report there is an in-depth analytical approach to lighting designs for each of those spaces. Each space describes the design criteria, themes, equipment, and layouts used for the design. Following initial design considerations is a detailed report of the performance of each space. The spaces were analyzed for performance requirements that were set at the beginning of the design including: illumination, aesthetics and power density requirements. An analysis of the performance is found at the end of each design summary.

The new design required a revision to the circuiting information and lighting controls which is detailed in the report. The lighting design also includes plans for controls which drove the circuiting plan and can be found in the electrical depth section of this report. Also, after studying the layout of distribution panels it was determined that some panels could be consolidated to reduce installation and material costs which is found in the electrical depth section of the report.

The next two sections are an acoustical and cost analysis study. The acoustical study was driven by an architectural change needed to accommodate the lighting design, and the cost analysis study is also related to the lighting design. The cost analysis compares the existing design of the typical lobby lighting to the design I have studied and analyzed in this report.

Finally, there is an end discussion about the designs plan throughout this report. The discussion describes the difficulties and successes reach through designing process and documentation. Overall these designs were determined to be fitting although the cost of some items was higher than anticipated.

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Site and Architecture

The Harris Theater for Music and Dance is a new building located in the heart of Chicago in Millennium Park. Hammond Beeby Rupert Ainge Architects planned the theater to have a simple layout and classy feel. The theater was completed construction in November 2003, and is now hosting mid-sized performance groups of operas, choirs, and ballets. With a budget of \$39 million the theater provides 1525 seats and stretches a full 6 stories underground. The building also houses theater staff offices and accommodates visiting organizations with dressing rooms, storage and lounge areas. The building is conveniently accessed by patrons on the street or through the shared underground parking garage at Millennium Park. The theater was designed for great performance and a minimalist approach to finishes allows for affordable tickets.

The majority of the building is underground, so the exterior walls are load bearing precast concrete. There is one portion of the building above ground which is the entrance to the lobby space. The envelope at the lobby entrance is precast concrete for the outside walls, and the front of the entrance is glazing with minimal steel supports. The finishes in most spaces are simple, for instance, painted precast concrete and sealed concrete floors.

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Lighting Depth

Introduction to Lighting Depth

For the lighting depth design I have chosen four spaces of the theater to complete a design analysis of the architectural lighting. The four spaces I have chosen to design for are the entrance, lobby, auditorium seating, and main offices. The design addresses lighting quality, aesthetics and power density. A schematic design idea was proposed and critiqued by professionals to collaboratively make up the design found in this report. Design details are illustrated in the report including calculation grids, equipment details, renderings and control information. To really get the essence of the design the entrance, lobby, and offices were rendered to a realistic quality. Due to the complexity and size of the auditorium the house lighting was analyzed through calculations only. The following section begins with the details of the auditorium house lighting. The smaller segments of the lighting depth section are organized as design criteria, lighting schedules, lighting layouts, calculations, renderings and then they are followed with a performance discussion.

For questions about the details of the lighting design please reference Appendix A. This appendix includes enlarged lighting layouts, cut sheets for fixtures, lamps, and ballasts as well as existing conditions.

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Entrance

Design criteria

- Remove view of sources from exterior
- Reduce the washed out appearance of the artwork
- Provide a level of dimensionality in this tall open space
- Provide of means of attraction to catch the attention of pedestrians

Design Theme and Mood

The main level of the lobby serves as an entrance and building identifying façade. The entrance is the only portion of the theater visible from the street level and park area. This space is the most important because it gives the first impression of the theater. The artwork hanging just inside the glazing serves as an announcement that the building is a host for the arts. The entrance and lobby space should be very inviting and elegant. Cool color temperatures (4100K) should be used to work well with the daylight entering this space at the start of performances.

Lighting Layout

The entrance space ties into the lobby areas on this first floor. The focus of this section is specifically the lighting treatment to the entrance artwork, tall open atrium and stairs. There are essentially two types of fixtures used for lighting the entrance. This in effect creates two layers of light. The first layer of light is fill light which is used to create dimensionality to this tall rectangular space. Track metal halide fixtures create a light gradient from the side walls and then meet in the center at the artwork hanging above the entrance. The center is brighter than the sides and is highlighted by a spot fixture. The second layer of light is a spot fixture. The spot fixture will be programmed to continuously pan over the artwork to catch your attention from the exterior. All of the track fixtures are placed on the interior of the vertical columns to hide the source from the outside. Additionally, the lighting on the first set of stairs is treated with under railing fixtures. This is the final detail provided to eliminate view of sources from outside of the building.



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Lighting Schedule



D		Winona Lighting P1-MC-*T5*-MCVU-RA-* Description: Fluorescent cove light with 1-28T5 lamp (in cross-section).	1-28T5 lamp (in cross-section)	Location: Lobby
F		Custom Fixture 4.5' x 4.5' x 6" Square Pendant Description: 4.5' x 4.5' x 6" Pendant with acrylic glass on sides and bottom. Top is opaque and reflective on inner side of fixture.	(4) 28T5 bi-pin linear	Location: Lobby
I		Lighting Services Inc M2907-* Description: 6" track-mounted metal halide accent light with 1-70W PAR38 lamp. Optics: glare shield.	1-70W PAR38 lamp	Location: Entrance
J		Vari-lite Description: Requires DMX controls, to be programmed with designer to pan over artwork in entrance window.	(1) 700 watt short arc lamp	Location: Entrance
M		Cole Lighting LR 1P-T8 Description: Surface-mounted fluorescent step light with 1-T8 lamp (in cross-section). Optics: acrylic prismatic lens.	1-32T8 lamp (in cross-section)	Location: Auditorium/Entrance

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Light Loss Factors

Type	Manf.	Fixture Description	Parameters	LDD	RSDD	LLD	BF	LLF
D	Winona	Linear Cove	VI, Clean 24 mo	0.77	0.85	0.94	1.00	0.62
F	Custom	4.5' x 4.5' Pendant	V, Clean, 24 mo	0.84	0.96	0.94	1.00	0.76
I	LSI	Accent Track	IV, Clean, 24 mo	0.80	0.93	1.00	1.00	0.74
J	Vari-Lite	Automated Spot Light	assumed LLF					0.75
M	Rail Lights	Linear Fluorescent	V, Clean, 24 mo	0.84	0.95	0.95	0.85	0.64

Power Density Calculation

	Type	Quantity	Watts	
Track	I	16	1286.4	
Automated	J	1	700	Area (s.f.) 6252.4
Railing	M	20	636	Power Density 1.57 W/s.f.
Cove	D	78	2574	
Lg Pendant	F	8	1056	

The power density for a performing arts lobby area is 3.3W/s.f. So, this design provides a very efficient lighting system for the type of space. The lighting scheme is more efficient because a very unconventional approach was taken to the lighting source. By using fluorescent dimming in place of the typical halogen in the theater, maintenance and source life issues were improved.

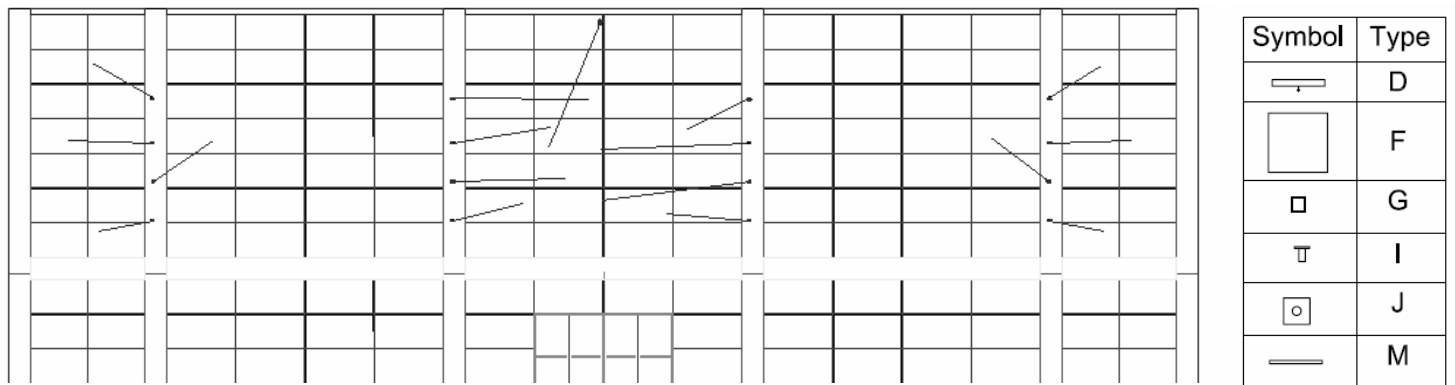
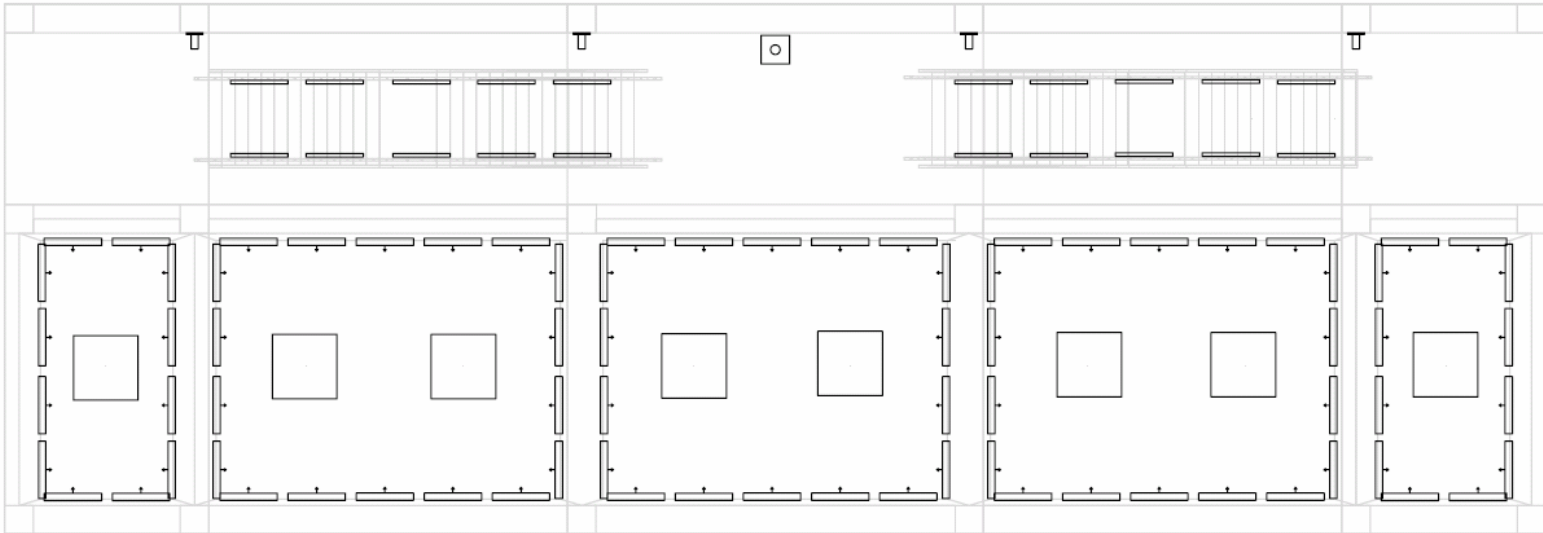
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


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Lighting Layout



Symbol	Type
	D
	F
	G
	I
	J
	M

The top figure shows the plan view of the lighting layout for the entrance and first lobby level. Note the vertical placement of type I fixtures mounted on vertical track. The lower figure is an elevation of the entrance from the interior.

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Calculation:

The performance shown below is at floor level on the first and main floor. The illuminance values of 50fc under the large decorative pendants are higher than desired. These fixtures should be dimmed in the field to provide closer to 30fc over the floor plane. The cove fixtures may also be dimmed to reduce overall lighting level on the floor.



Value (Fc)	Color
20	Red
30	Magenta
50	Blue

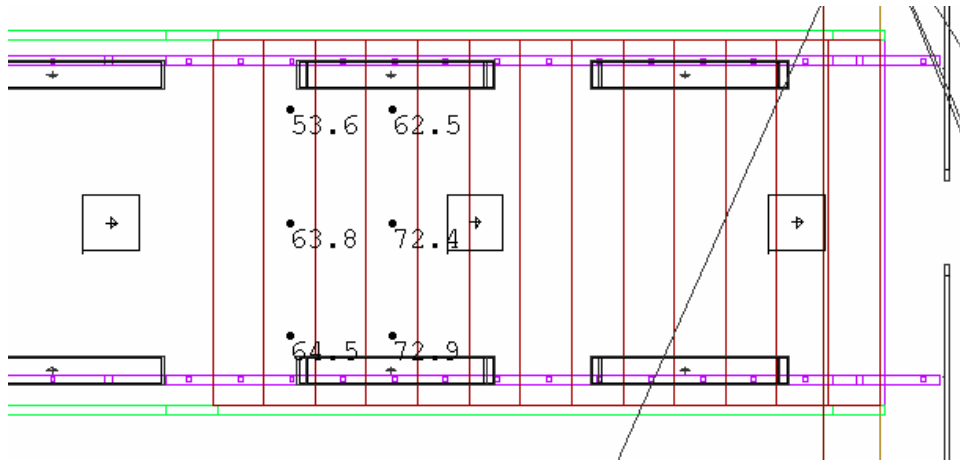
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Calculation:



The performance of the under railing lighting provides an illuminance value much higher than needed. This source needs to be dimmed in the field to meet 20-30fc over the stair floor.

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AGI32 Renderings

Entrance interior view



Entrance exterior view



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Discussion

The entrance provides a softly lighted façade with moving highlights. The fill light on the walls and artwork add dimension to a rectangular space while adding an element of illuminance to the floor as well. The main feature of this space is the automated spot light which will pan over the artwork to accent the work and capture the attention of pedestrians. This space has met the design criteria set forth with the exception of possible color rendering of the artwork. Upon mocking up this design there may be an option to add color filters to the metal halide sources which wash the artwork.



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Typical Lobby Level

Design criteria

- Remove bare bulb fixtures to reduce glare
- Provide uniformity over main lobby areas
- Tie the first floor lobby and entrance into the lower lobby levels

Design Theme and Mood

The typical lobby levels should have a similar quality of light as the first level lobby and entrance. These spaces are used as a transition and directing space and should prepare the patron to enter the theater. The lighting should have less contrast than the entrance, but still highlight interesting architectural features. This space should feel very well finished and clean. The idea is to hide functional fixtures and add a decorative element to this minimally finished space. To keep the continuous feel of the lighting this space will be lamped with 4100K color just like the entrance.

Lighting Layout

The lobby levels tie into the entrance by continuing a concealed source approach. There is an additional of decorative fixtures to add to the aesthetics of the space. The majority of the lighting contributing to the floor illuminance is indirect and the fixtures are hidden within a cove. To see the details of the cove design please reference Appendix A. The fixtures allowed in view are decorative pendants with very streamlined edges to keep the clean appearance of the simply finished space. These custom fixtures were shaped as squares to compliment the building which in many aspects is rectangular. There is a second type of decorative pendant with different proportions to provide consistency in design while tying different floors of the lobby together. The second decorative pendant is a rectangle stretched vertically and is located at the stairs. This pulls the design together from one floor to the next.

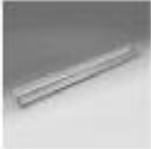
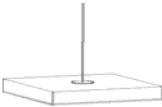

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Lighting Schedule

D		Winona Lighting P1-MC-*T5-* MCVU-RA-* Description: Fluorescent cove light with 1-28T5 lamp (in cross-section).	1-28T5 lamp (in cross-section)	Location: Lobby
F		Custom Fixture 4.5' x 4.5' x 6" Square Pendant Description: 4.5' x 4.5' x 6" Pendant with acrylic glass on sides and bottom. Top is opaque and reflective on inner side of fixture.	(4) 28T5 bi-pin linear	Location: Lobby
G		Winona Lighting 5450-10-F-*-*-* *MB-STD Description: Suspended compact fluorescent decorative pendant with 4-FT40 lamps.	4-FT40 lamps	Location: Lobby

Lighting Loss Factors

Type	Manf.	Fixture Description	Parameters	LDD	RSDD	LLD	BF	LLF
D	Winona	Linear Cove	VI, Clean 24 mo	0.77	0.85	0.94	1.00	0.62
F	Custom	4.5' x 4.5' Pendant	V, Clean, 24 mo	0.84	0.96	0.94	1.00	0.76
G	Winona	Decorative Pendant	V, Clean, 24 mo	0.84	0.96	0.90	0.85	0.62

Power Density Calculation

	Type	Quantity	Watts		
Cove	D	94	3102	Total Watts	5286
Lg Pendant	F	11	1452	Area (s.f.)	3977.5
Sml Pendant	G	10	732	Power Density	1.33 W/s.f.

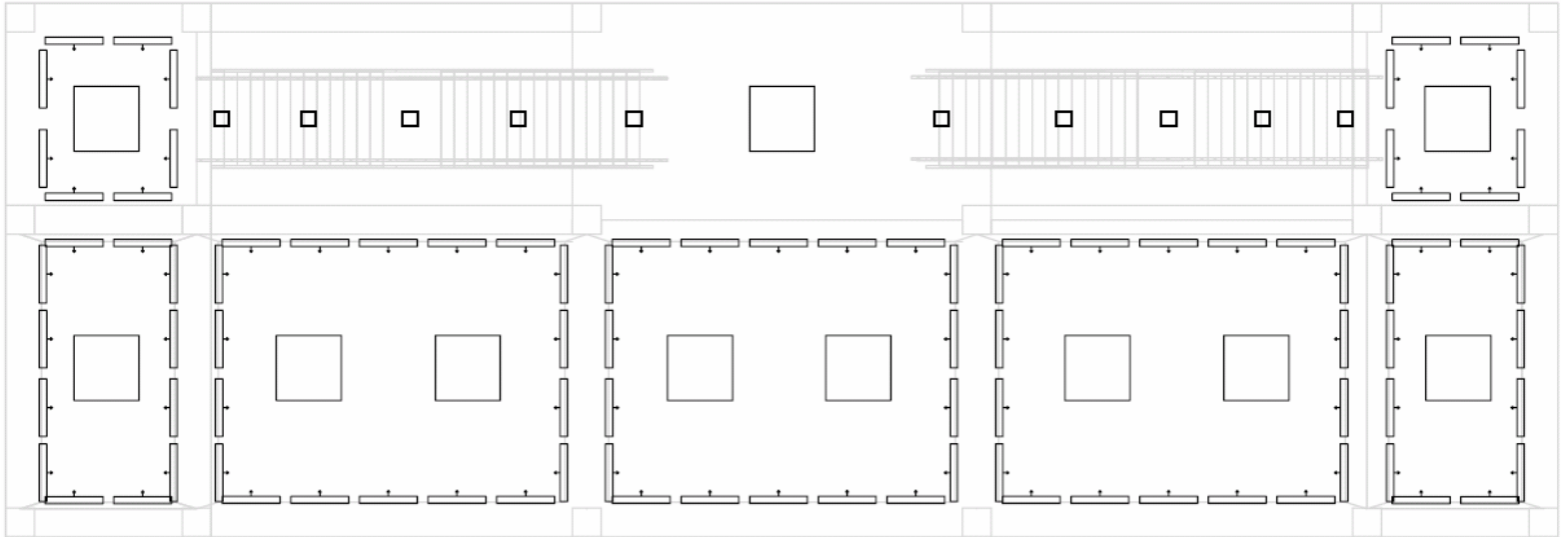
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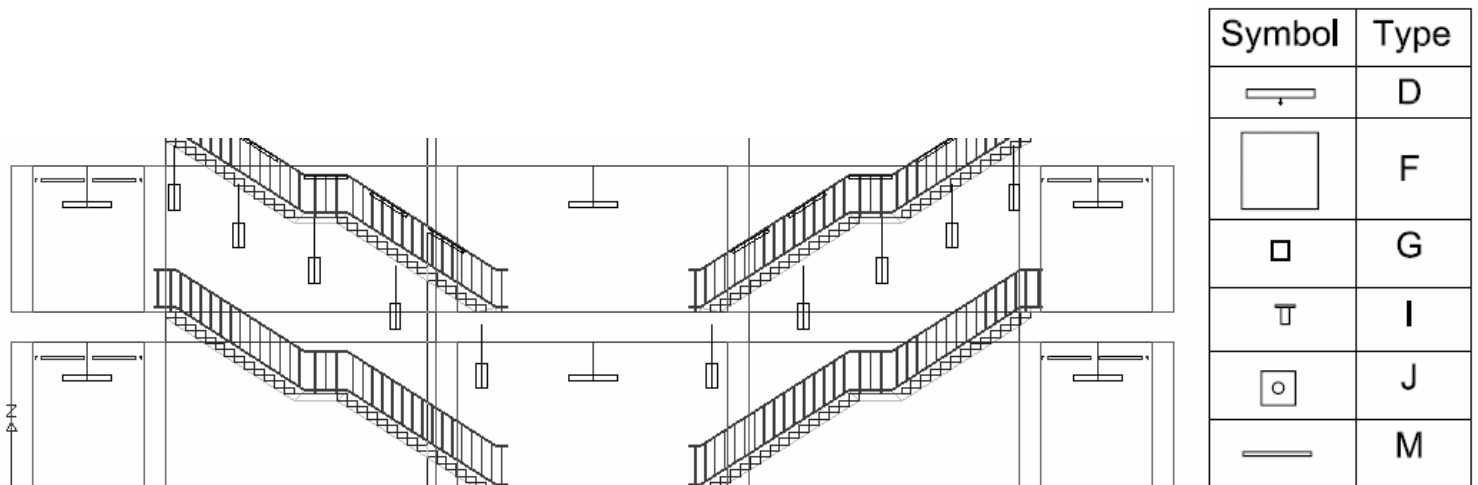


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Lighting Layout



Note the placement of type G decorative pendants to pull together the lobby levels with pendants similar to type G pendants hanging the length of the lobby floors. This lighting scheme is recommended to be implemented on the floor below as well.



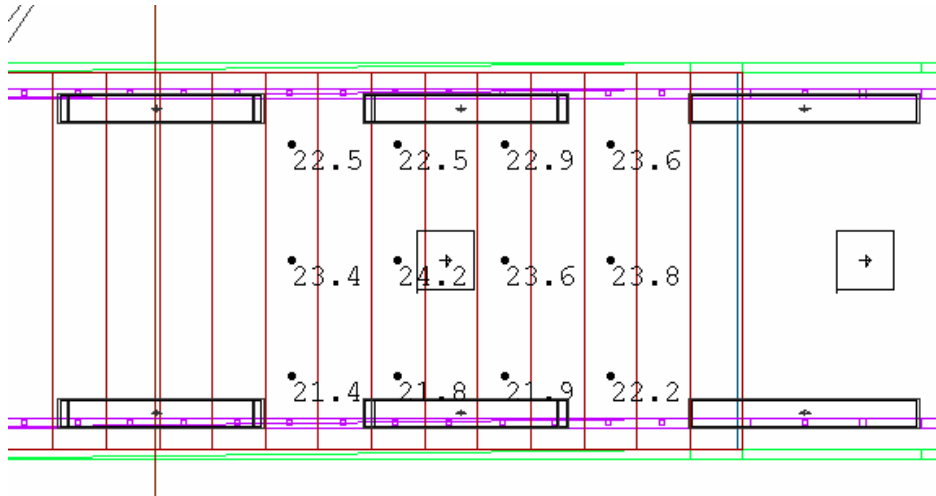
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Calculations:



The decorative pendants mounted 9.5' above the stairs provides an illuminance (fc) level that was desired. To keep continuity between the lobby floors and stairs these fixtures may be dimmed in the field.

AGI32 Renderings

Rendering of the First Level Lobby



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Rendering of a Typical Lobby Floor



Discussion

The lighting system for this space works well to tie in the lighting design from the entrance and also improve the aesthetics of this simply finished space. The illuminance values on the floor are much higher than desired. This is mostly due to the decorative pendants placed in the center of each cove area. So, the large pendant zone will need to be dimmed 30-40% to create more uniformity over the floor area.

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Auditorium Seating

Design Criteria

- High Contrast for accents-1:5
- Uniformly light the seating area to 10-20fc.
- Reduce the glare from high intensity sources by using more sources than the existing lighting scheme.
- Accent important architectural features including the acoustical reflecting towers
- Provide a source with longer life than halogen to reduce the maintenance level of the house lighting fixtures.

Design Theme and Mood

The theme and design chosen for this space should be dynamic in comparison to the lobby space to define the difference in functions. The atmosphere of this space is most like an evening in the park. This connects the theater to the site, Millennium Park, which is located in downtown Chicago. The finishes in the theater are all very dark which allows the lighting design to capture a feeling of outdoors at nighttime. Numerous down lights are used to resemble the way a park would be lighted or the essence of stars above. The tall acoustical panels are up lit in the way that many trees are lighted in a park setting.

Lighting Layout

Due to the complexity of the space the lighting layouts span over many pages to display the design well. There are two reflected ceiling plan layouts and three floor plans to show the lighting layouts more clearly. This space uses direct down lighting over the seating areas with a compact fluorescent source that is dimmable. Then the aisle ways and steps are used with a direct source that is concealed in the armrests and also the handrails. This keeps the reflected light to a minimum for both of these elements of the theater. There was one critical space that was difficult to locate fixtures for direct down lighting. That was right below the balcony and between to major catwalks. Without adding another catwalk it was impossible to add down lights at such a high ceiling height (65'). The fixtures could have been mounted at a height of 50', but this is still too high to reach from below. So, there are halogen theatrical fixtures mounted to an existing theatrical pipe that runs on the outer side of the balcony. There are twice as many fixtures placed than needed to meet the planned illuminance levels, because flexibility is desired in theaters for the direction of visiting companies and shows.

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The following pages show the layouts of the auditorium house lighting. There are larger scale plans found in Appendix A for reference. Please see the lighting schedule for this space on the following page and use the key to note the fixture type on each page.

Lighting Schedule

K		Delray Lighting 77143*CF Description: 13" suspended compact fluorescent downlight with 3-CFTR42W lamps. Optics: anodized aluminum reflector.	3-CFTR42W lamps	Location: Auditorium
L		Times Square Fresnel for Downlighting Description: Fresnel adjustable spot, pipe mounted, black finish	100W PAR38FL	Location: Auditorium
M		Cole Lighting LR 1P-T8 Description: Surface-mounted fluorescent step light with 1-T8 lamp (in cross-section). Optics: acrylic prismatic lens,	1-32T8 lamp (in cross-section)	Location: Auditorium/Entrance
N		Irwin Seating Company Description: Concealed aisle fixture. Lamp is located under armrest of seat.	4W	Location: Auditorium/Aisle
P		Times Square Lighting 702 Borderlight Description: (8) compartment 8' fixture with tilt and locking rotation. Lens available to color each compartment separately.	Q250SP	Location: Auditorium

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Light Loss Factors

Type	Manf.	Fixture Description	Parameters	LDD	RSDD	LLD	BF	LLF
K	Delray	13" Downlights	IV, Clean, 24 mo	0.80	0.95	0.84	0.95	0.61
L	Times Square	Fresnel	IV, Clean, 24 mo	0.80	0.95	1.00	1.00	0.76
M	Rail Lights	Linear Fluorescent	V, Clean, 24 mo	0.84	0.95	0.95	0.85	0.64
N	Aisle Lights	Low Voltage Concealed	assumed LLF					0.75
P	Times Square	Borderstrip	V, Clean, 24 mo	0.84	0.79	1.00	1.00	0.66

Power Density Calculation

Location	Type	Quantity	Watts
<i>Main Seating</i>			
Railing	M	10	318
Aisle	N	78	312
Borderlight	P	6	12000
<i>Parterre Level</i>			
CFL Downlight	K	18	2224.8
Railing	M	18	572.4
Aisle Light	N	44	176
<i>Balcony Level</i>			
CFL Downlight	K	25	3090
Halogen Downlight	L	10	1000
Railing	M	20	636
Aisle Lights	N	44	176

Total Watt 20505.2
Area (s.f.) 13000
Power Density **1.58** W/s.f.

The power density allowed in this space is 2.6 W/s.f. Typically the house lighting in a theater is halogen sources, but this design utilizes fluorescent dimmable sources. Some halogen sources were used for accenting and supplement down lighting, but overall this design choice has saved on the power load for this space.

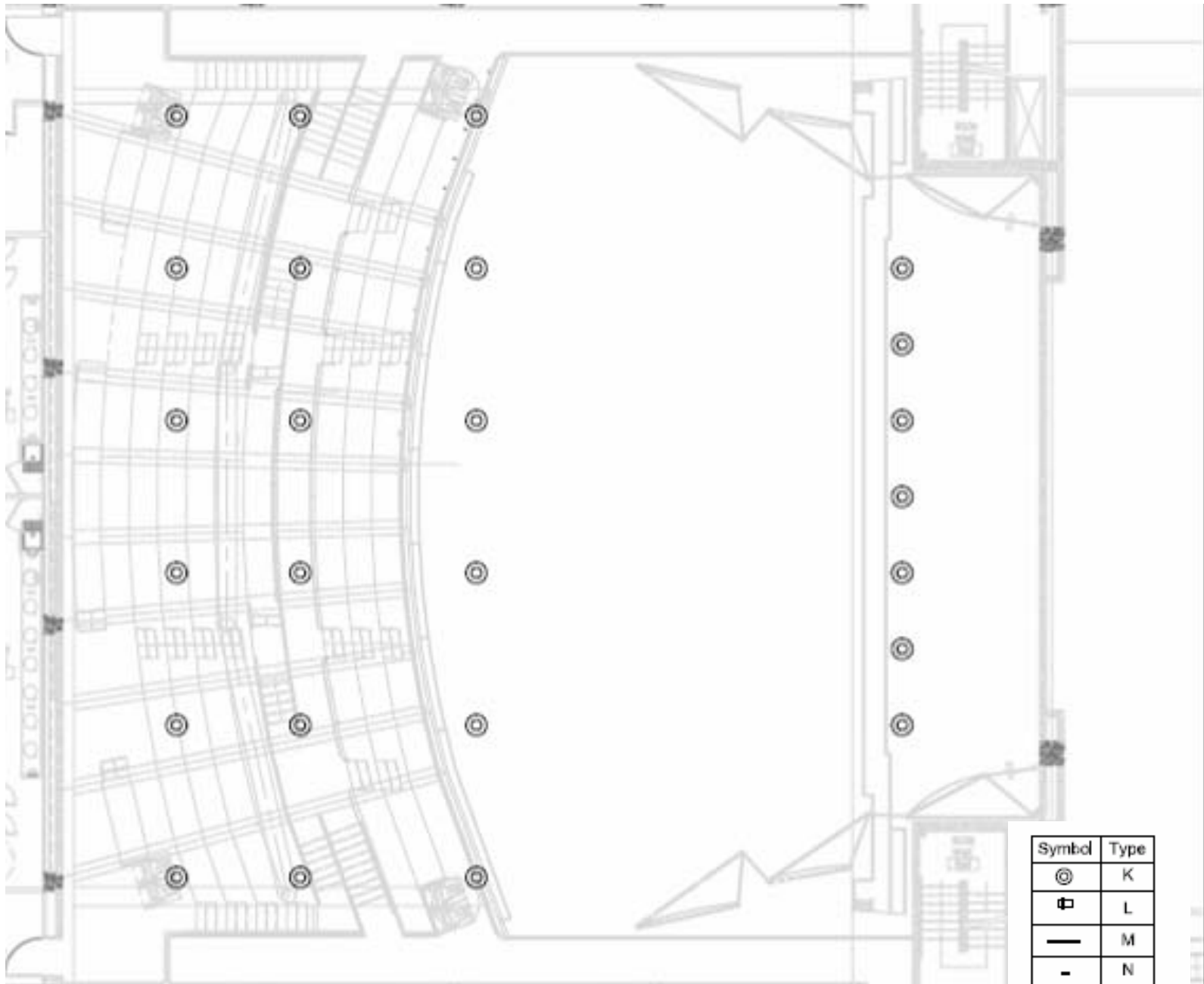
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Lighting Layouts

Balcony and Main Ceiling



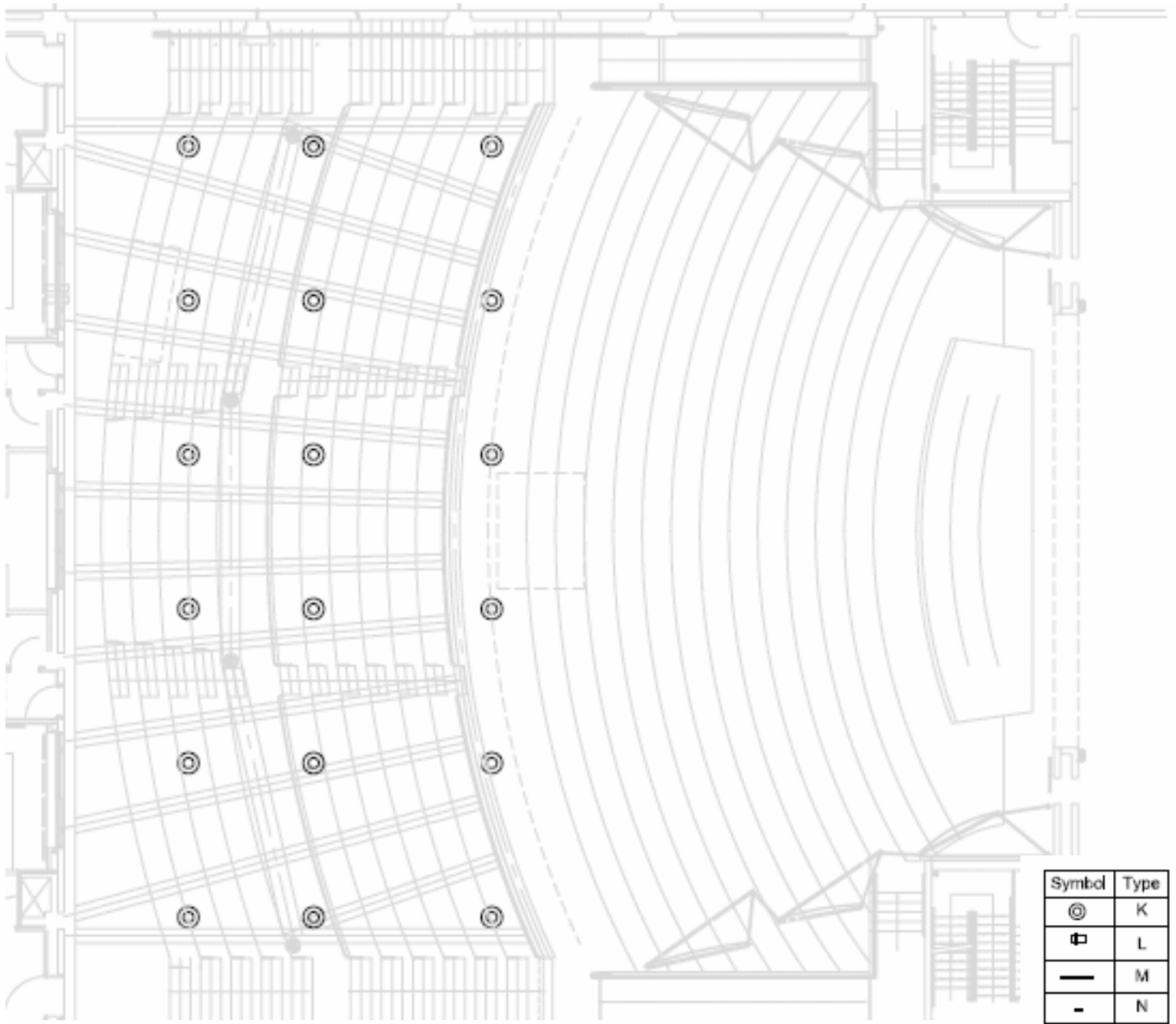
Symbol	Type
⊙	K
⊠	L
—	M
-	N
⋯	P

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Parterre Ceiling



Symbol	Type
⊙	K
⊠	L
—	M
-	N
----	P

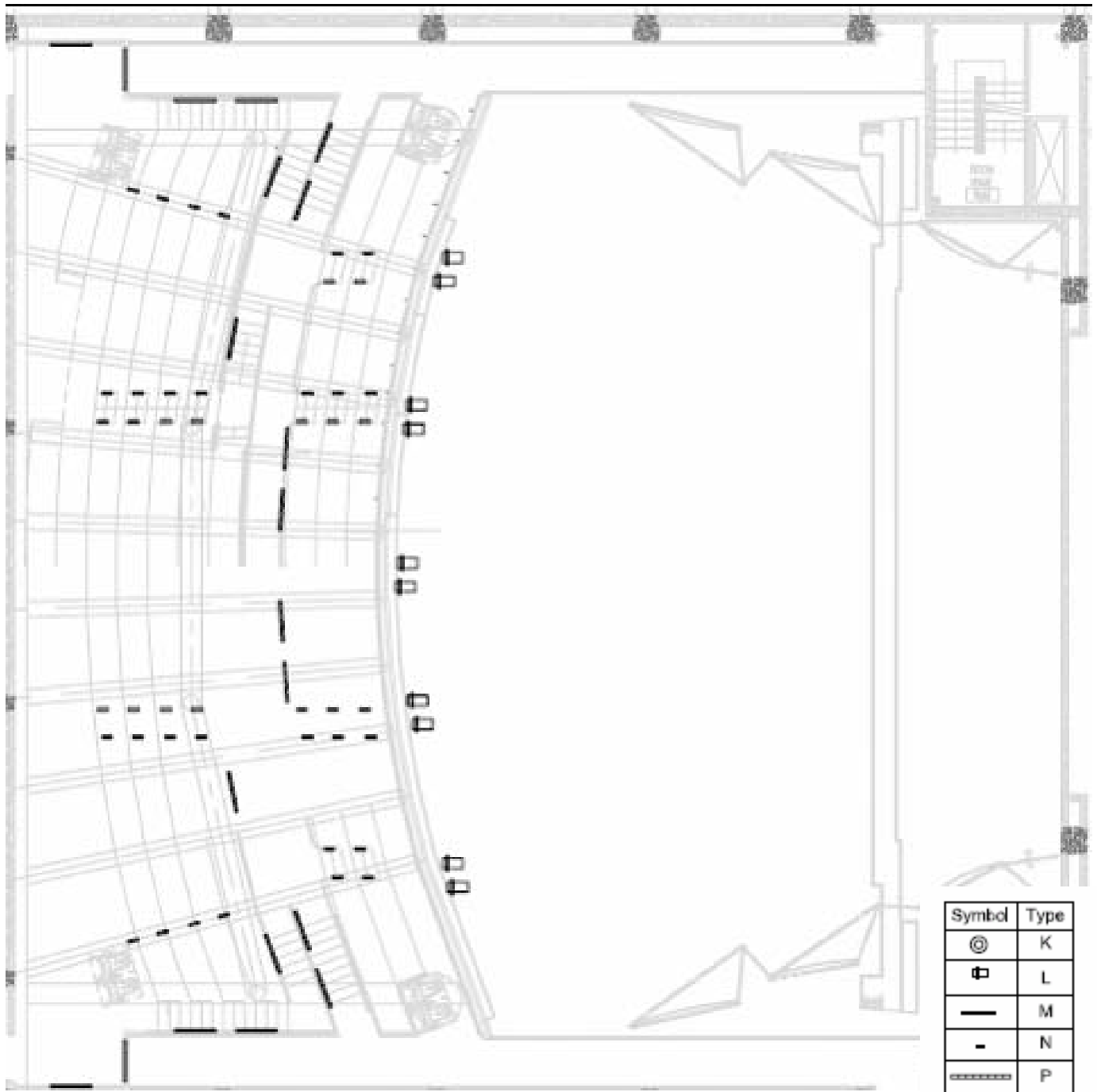
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Balcony Floor Level



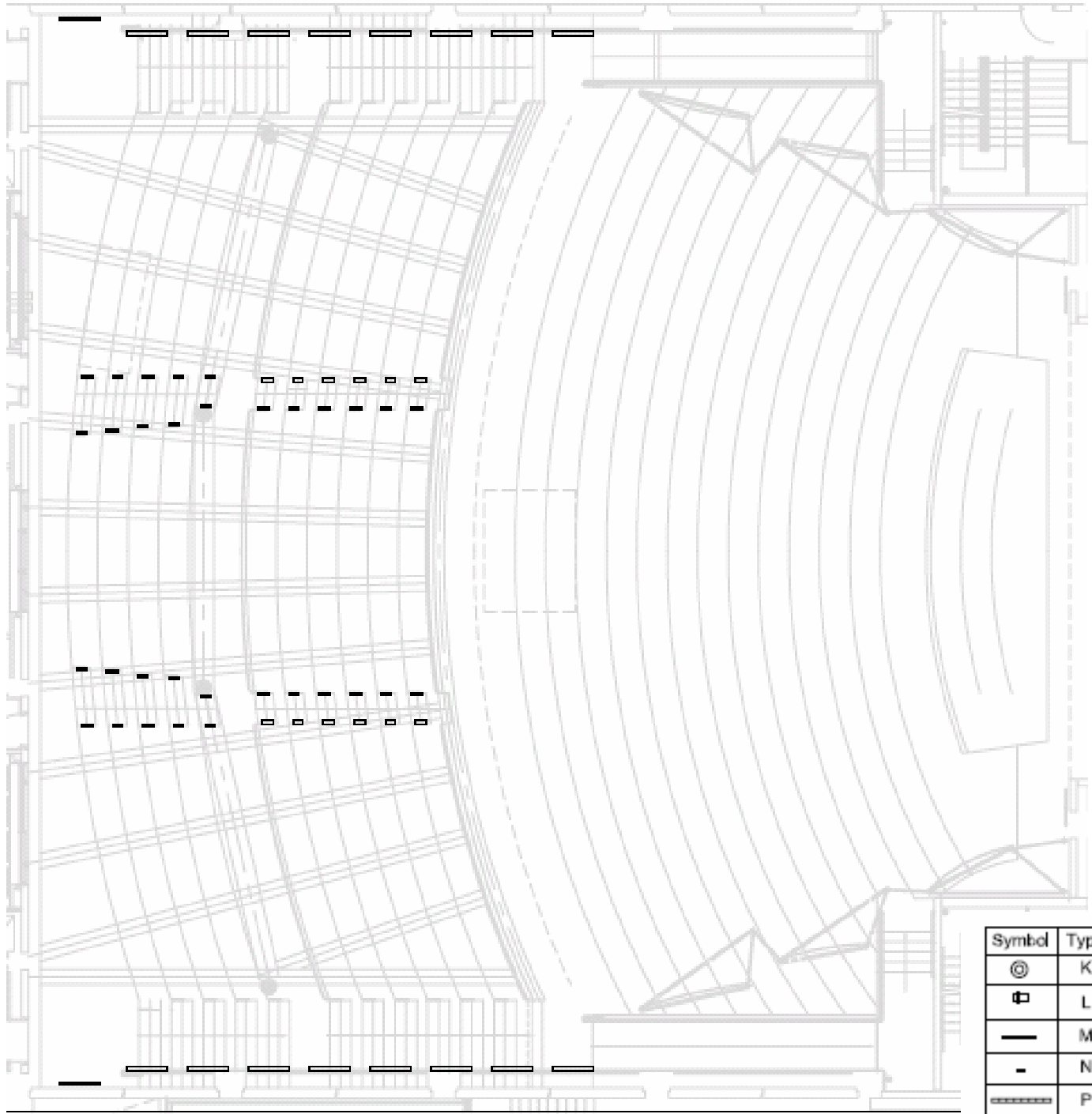
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Parterre Floor Level



Symbol	Type
⊙	K
□	L
—	M
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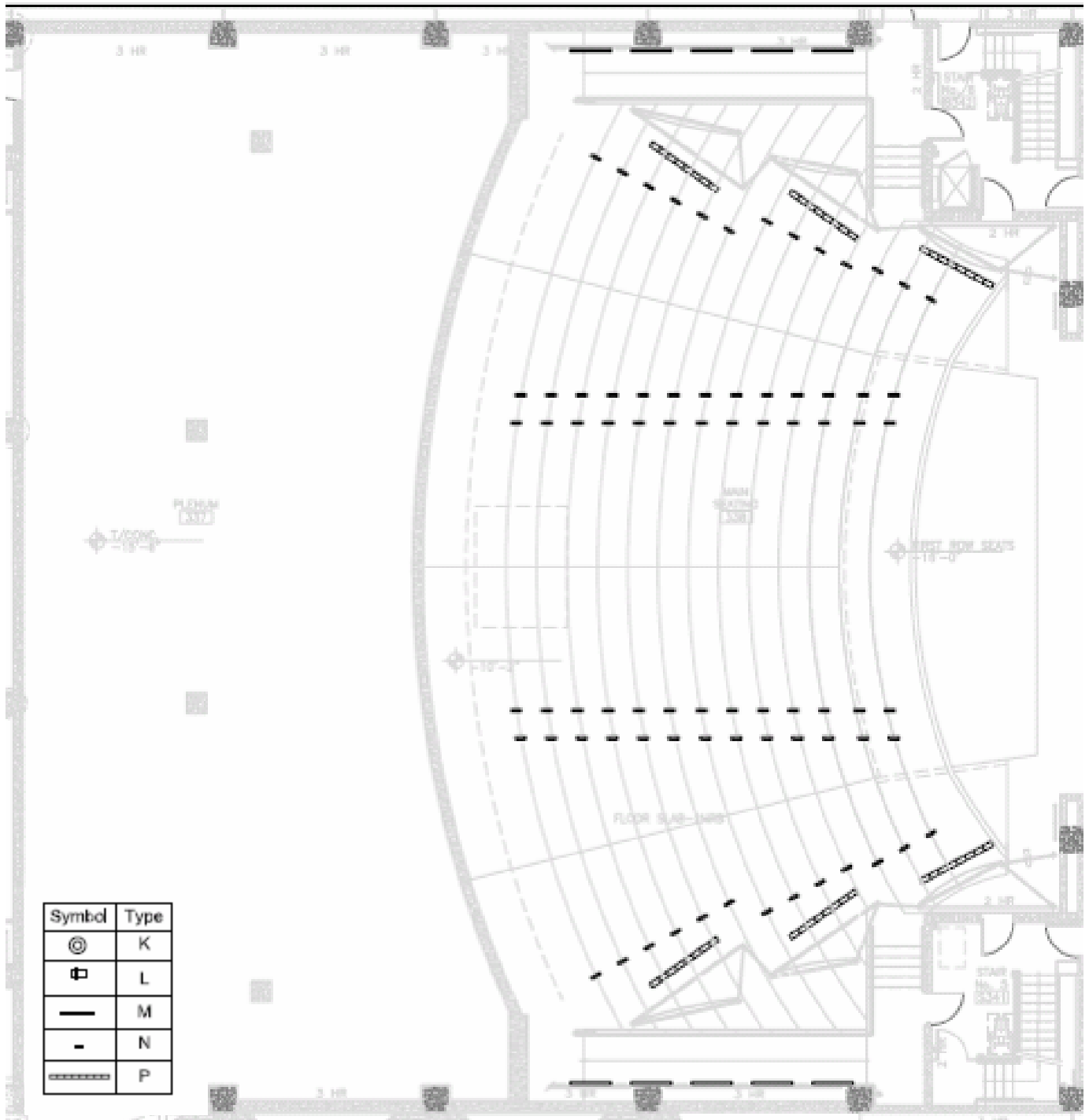
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Main Seating Area

Floor Level Lighting Plan



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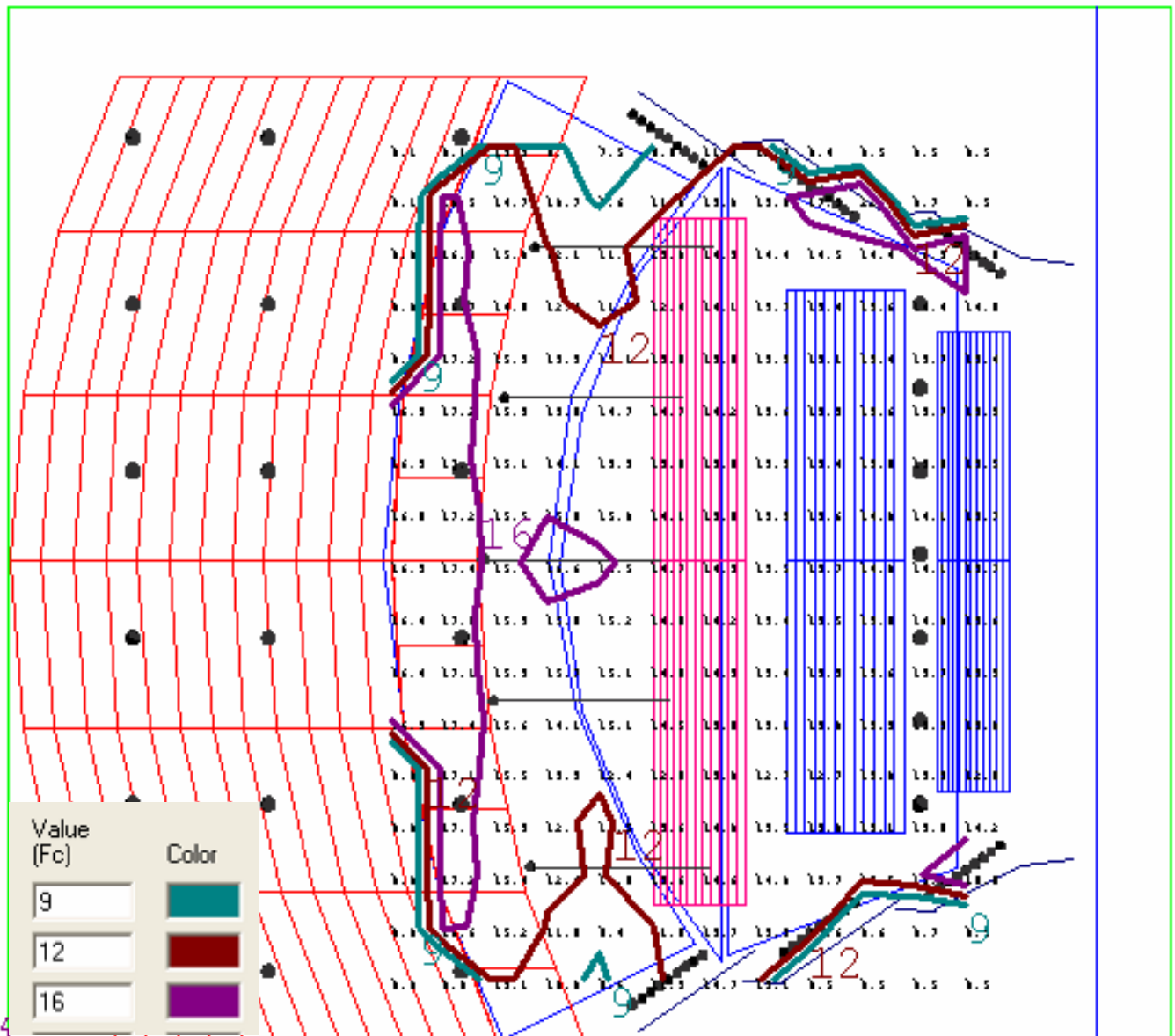


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Calculation:

Main Seating Area

The main house lighting and tower accent lighting were calculated in this run. This performance is to show the light reaching seating area. There is supplemental aisle lighting for safety before and during performances.



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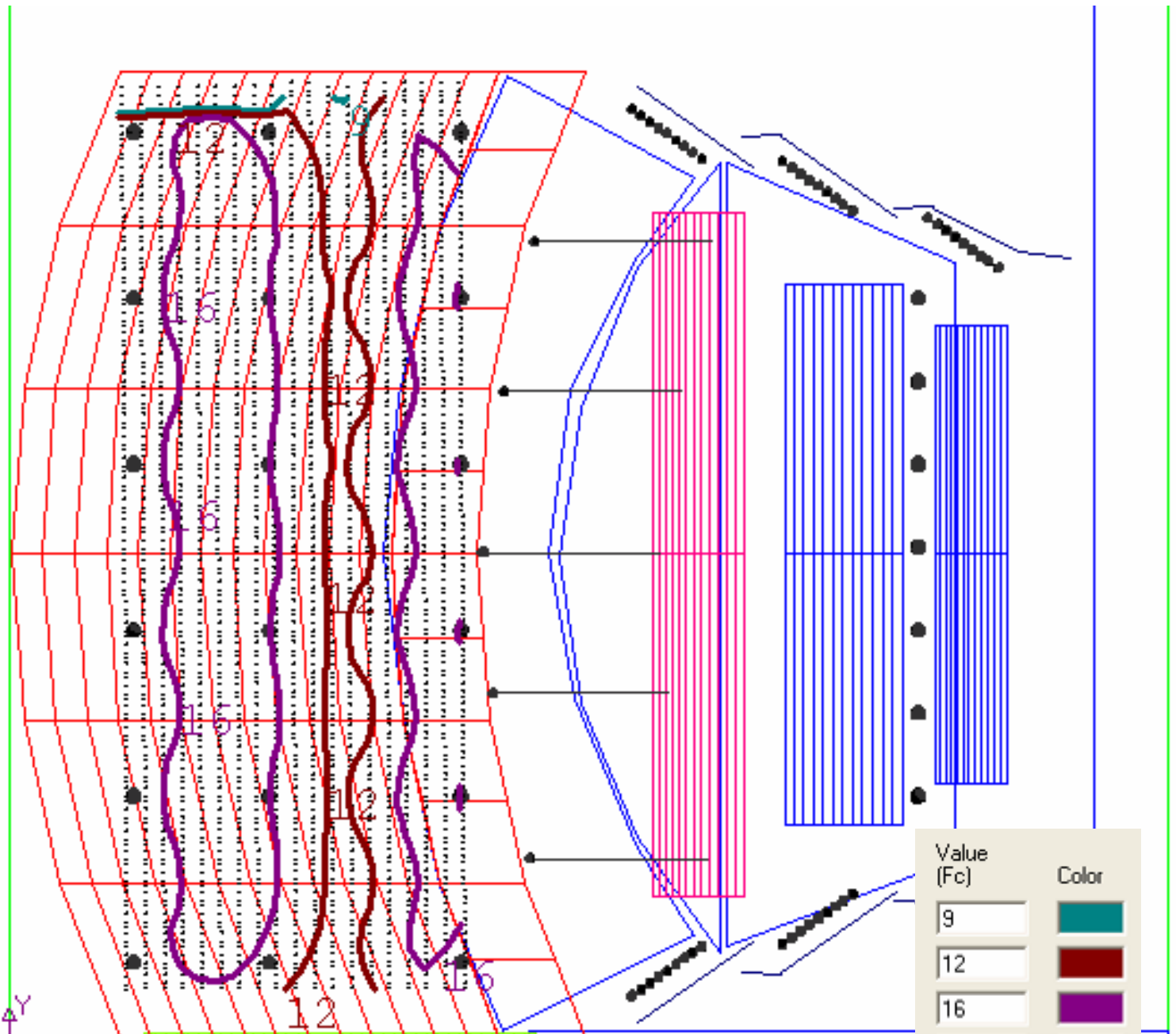


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Calculation:

Balcony Seating Area

This calculation run shows the downlighting performance for the balcony. This is the same lighting layout and mounting heights as the parterre level below. The performance of the lower level will look just like this lighting situation.



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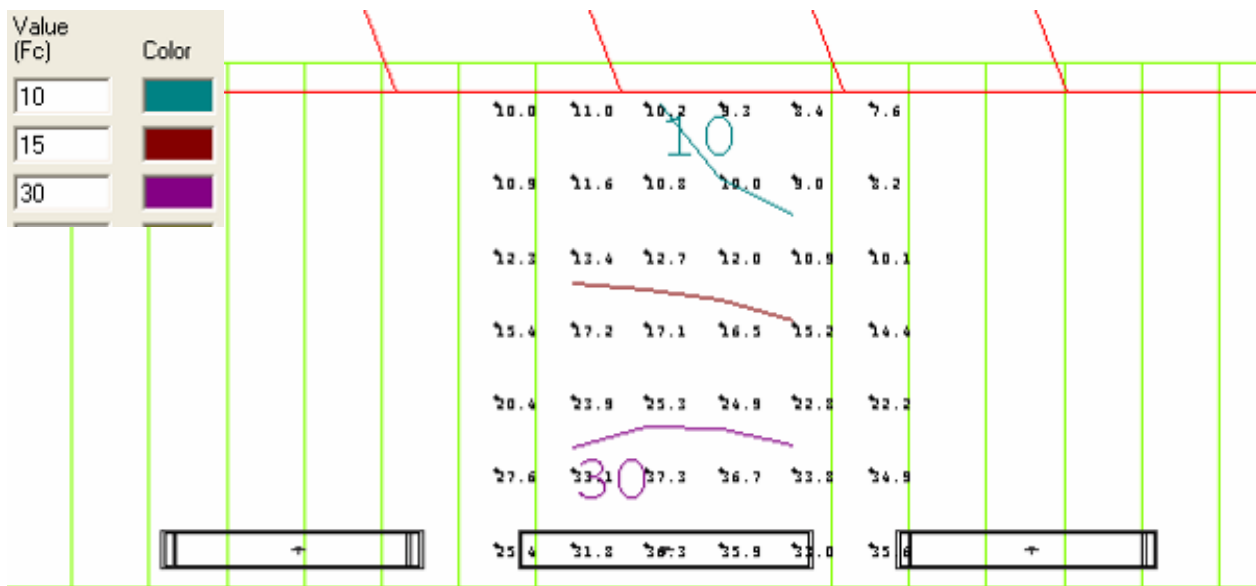


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Stair Study

Auditorium Main Stairways and Walkways

This study was to define a layout spacing distance for the railing light along the stairs. This spacing is 6' c-c and is used along the main walkways throughout the theater seating areas. These values are somewhat high compared to the main seating area values. So, these fixtures shall be dimmed to reach 5-15fc over the width of the stairs.



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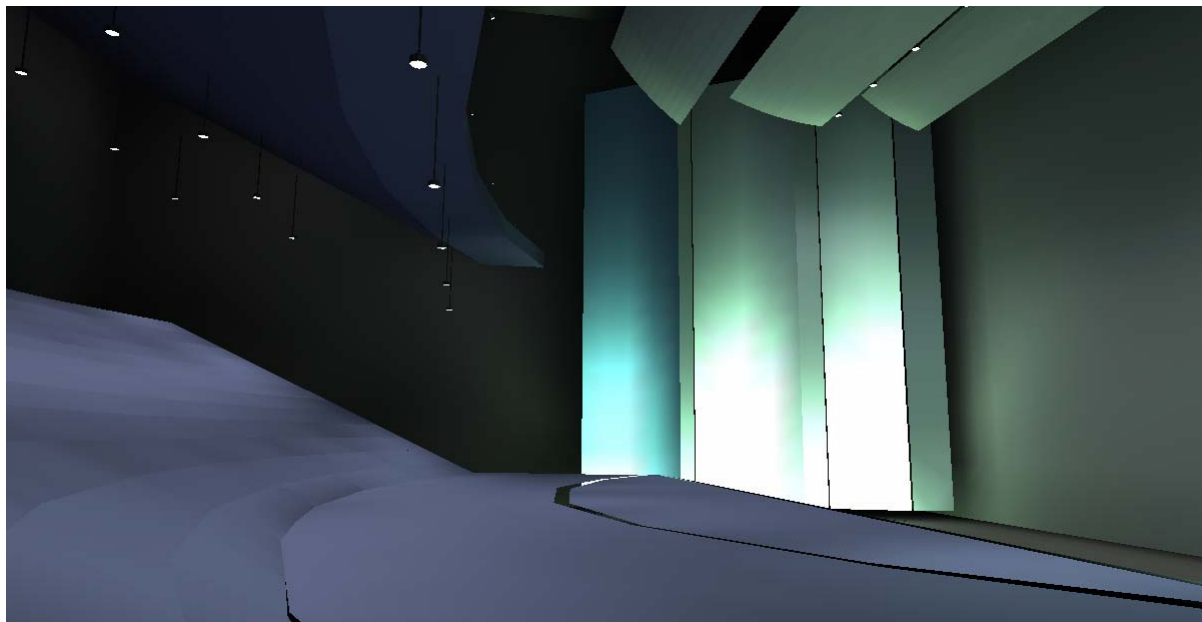
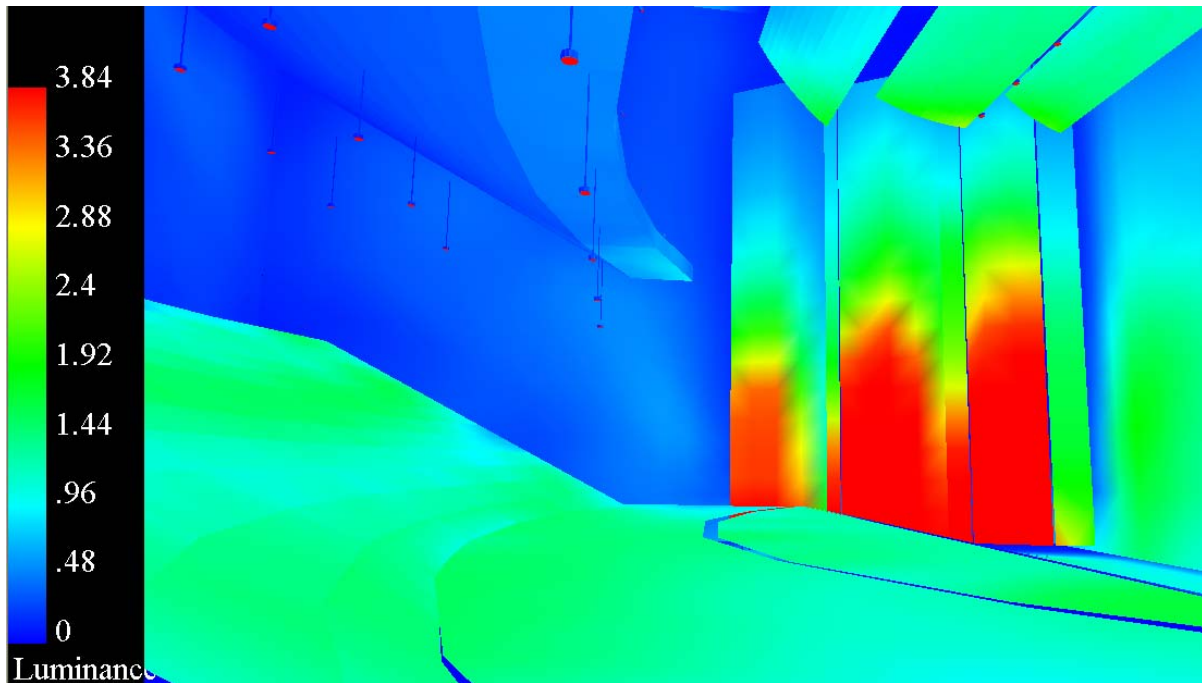


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AGI32 Renderings

Auditorium Acoustical Towers

This pseudo color map shows that the accent lighting meets the luminance ratio minimum of 1:3 desired for accenting.



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Discussion

The auditorium lighting layout was successful mainly due to the source choice. Using fluorescent sources reduces the re-lamping maintenance while maintaining the flexibility for dimming which is desired in a theater. The source also added to the uniformity achieved over the seating areas. By pure design choice, more fixtures were used for the down lighting to add an element of sparkle with the intent to look like stars in the dark sky. This design choice also reduced glare from previously high intensity sources. The illuminance levels desired were also met over the entire space.



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Private Offices

Design criteria

- Remove glare sources
- Provide uniformity on desks
- Increase the visual interest and highlight walls to open up the space
- 30-40fc on walls, 40-50fc on desk planes

Design Theme and Mood

The existing offices are treated like all back of house spaces in the theater – very minimal finishes. The lighting is just evenly spaced (2) lamp T12 strips that provide a large glare source. This new design is a transformation to a contemporary office feeling that acts less like an enclosed basement. There are windows in only one office of the main four spaces that the main office is located. These spaces are used by the theater director and other administrative support for the daily coordination of the theater operations. To open the space up there is lighting on the walls to add visual interest and highlight artwork. This also serves as a means to make the space feel more open due to a lack of windows.

Lighting Layout

There are three types of fixtures used in this space. All of the sources are fluorescent and have the ability to be dimmed by zones. The sources used to provide uniformity of the desk work planes is a modern looking T5 direct/indirect pendant. Then the conference room uses a completely direct pendant light only the two main tables in the space. All spaces have wall washers which are used to light the walls for artwork and also to light the bookshelves throughout the offices.






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Schedule

A		Zumtobel Staff AQ-2285-4-T-SE Description: Suspended fluorescent up/downlight with 2-F28T5 (48in) lamps. Optics: acrylic prismatic lens , anodized aluminum reflector 81% up/19% down.	2-F28T5 (48in) lamps	Location: Office
B		Winona Lighting P1-FT139-LS9 Description: 20" surface-mounted compact fluorescent wallwasher with 1-FT40 lamp. Optics: anodized aluminum reflector , single.	1-FT40 lamp	Location: Office
C		Zumtobel Staff 1580-FT139-U Description: 7" suspended compact fluorescent downlight with 2-CFQ13W lamp. Optics: painted or anodized aluminum reflector.	2-CFQ13W lamp	Location: Office

Light Loss Factors

Type	Manf.	Fixture Description	Parameters	LDD	RSDD	LLD	BF	LLF
A	Zumtobel Staff	9"x4' Pendant	V, Clean, 24 mo	0.84	0.89	0.94	1.00	0.70
B	Winona	Surface Wall washer	IV, Clean, 24 mo	0.90	0.94	0.94	0.85	0.68
C	Zumtobel Staff	10" Circle Pendant	IV, Clean, 24 mo	0.80	0.96	0.84	1.00	0.65

Power Density Calculation

	Type	Quantity	Watts	
Linear Pendant	A	14	924	Total Watts 2293.2
Wall Washer	B	34	1244.4	Area (s.f.) 1470
CFL Pendant	C	4	124.8	Power Density 1.56 W/s.f.

Where the typical lighting only is only: 0.71 W/s.f.

Where the wall lighting is 0.85 W/s.f. and is allowed to be 1.0 w/s.f.

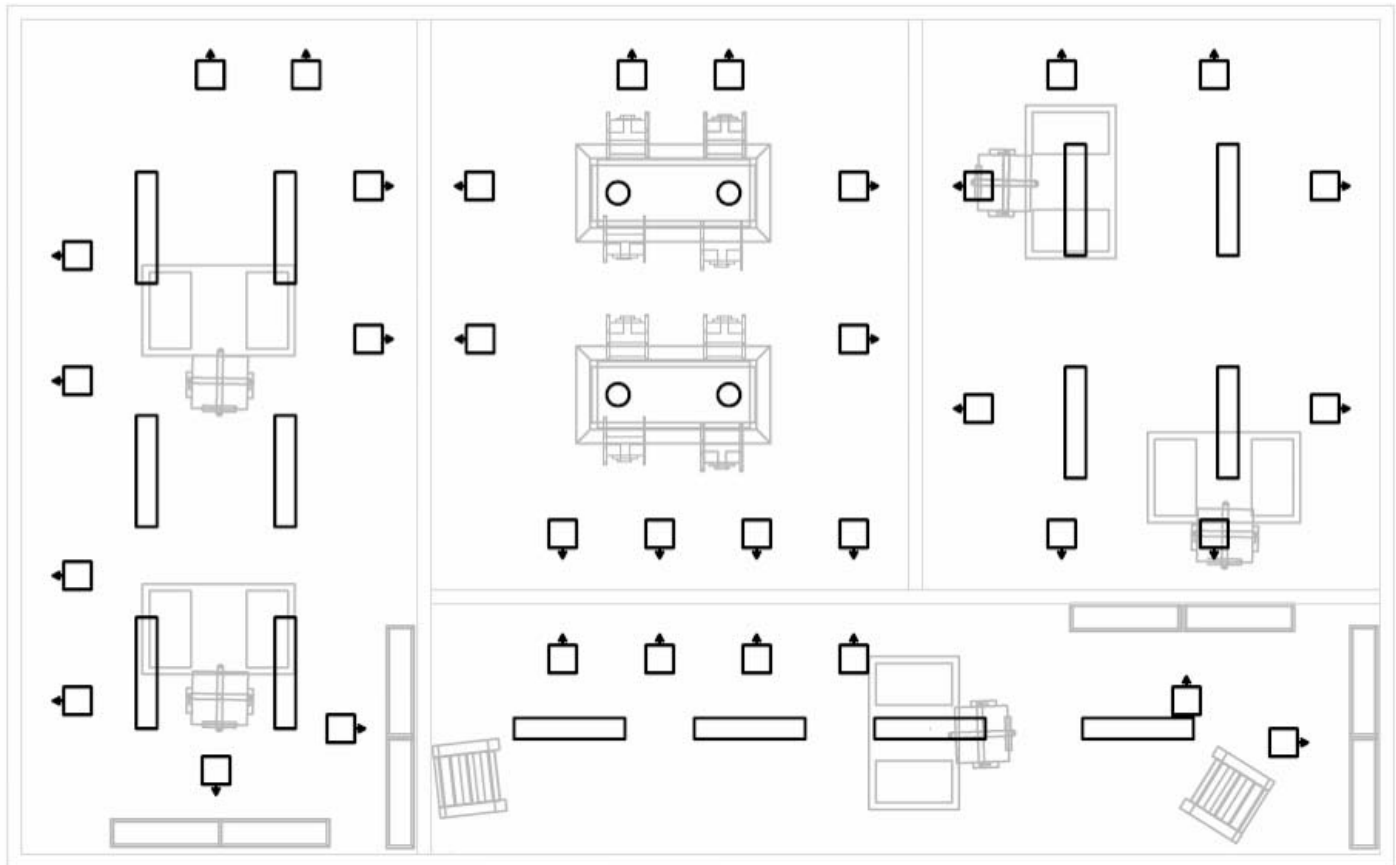
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Lighting Layout



Symbol	Type
▭	A
◻	B
○	C

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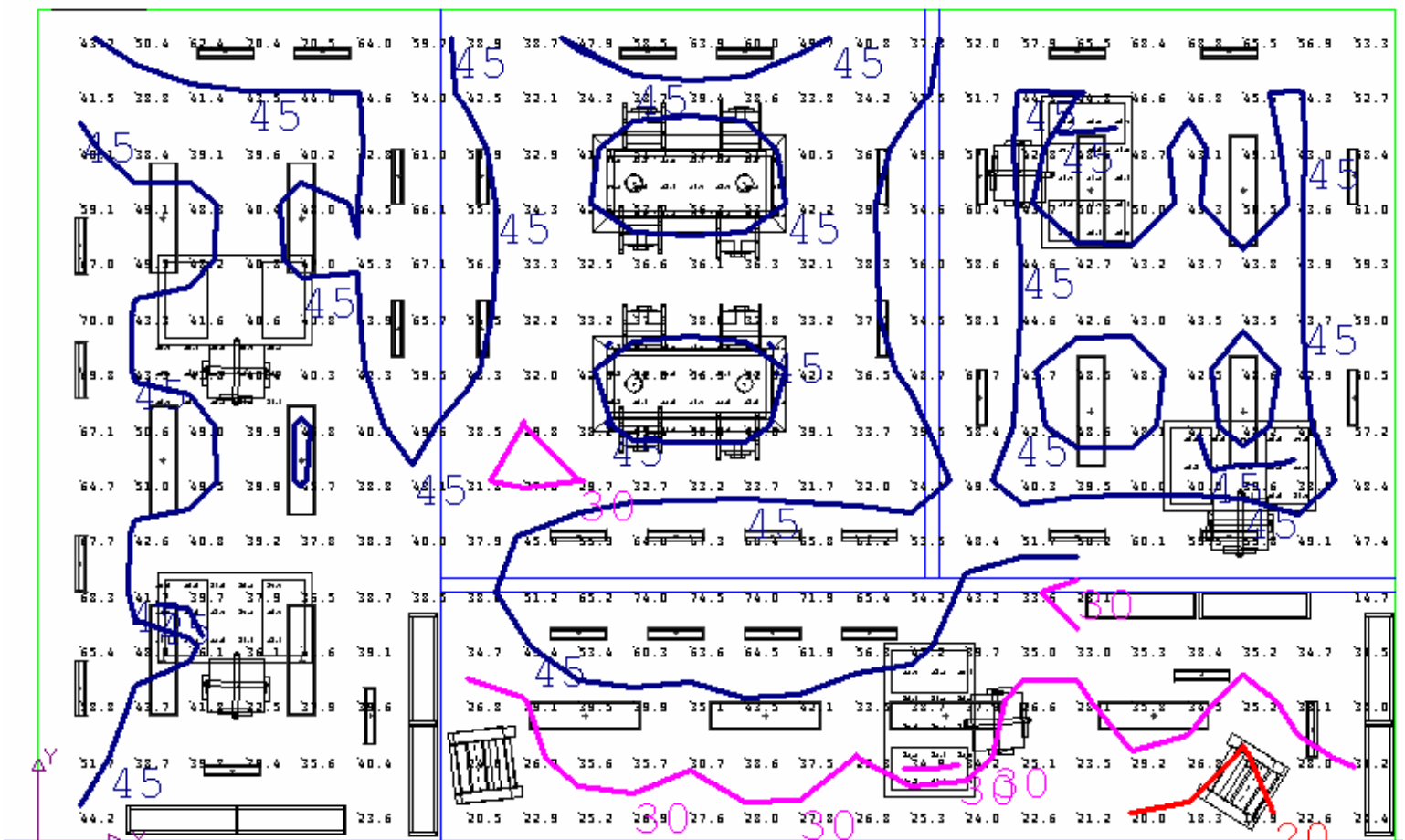


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Calculation:

Calculation grid placed at 2.5'

The uniformity over the work plane creates an environment conducive to working at a desk and makes the plan flexible to rearrange the spaces.



Value (Fc)	Color
20	Red
30	Magenta
45	Blue

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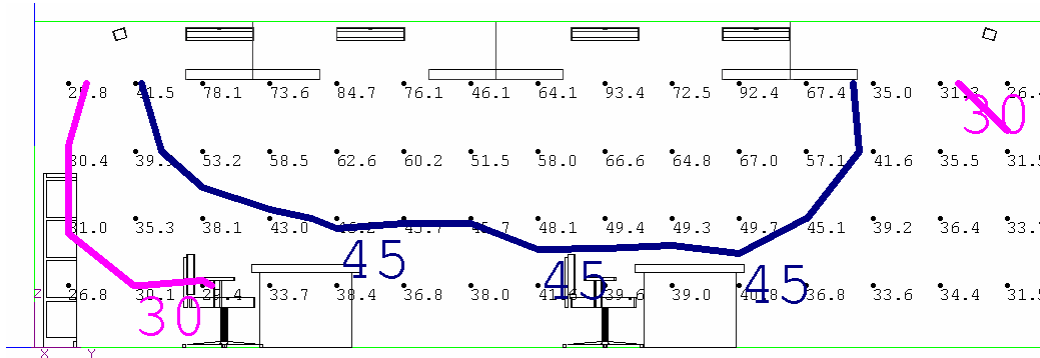


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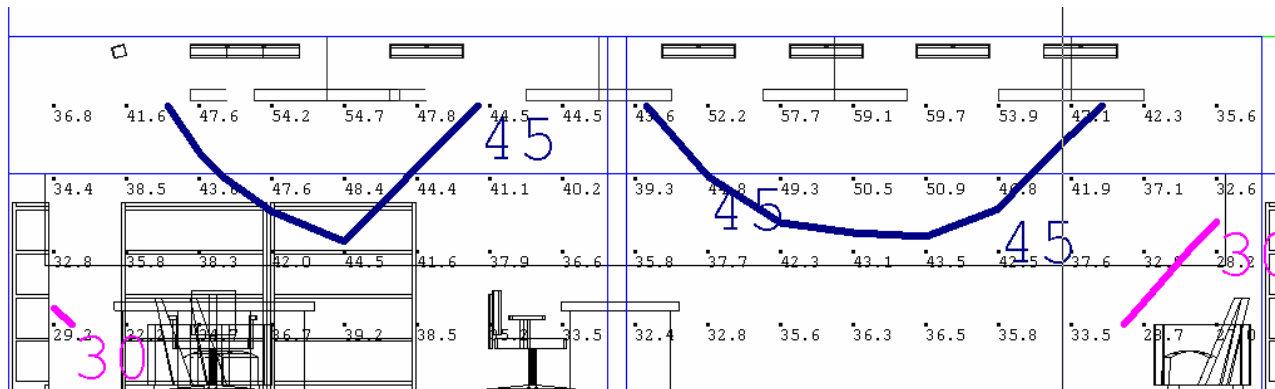
Calculation:

Vertical Calculation Grids

Office walls for highlighting/illuminating artwork.



This calculation shows the performance of varied spacing for the wall washers.



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AGI32 Renderings



Discussion

The system works well over the 2.5' calculation grid to create a uniform working environment. Because the systems are dimmable, if so desired the levels of light over the work plane can be reduced to a more residential feel. The wall lighting system is to accent artwork as well as open up these very enclosed offices. The lighting level is higher than anticipated so this group of fixtures would be dimmed about 25% to reach a vertical illuminance level of closer to 20-30fc instead of +40fc. The lighting layout and fixture choices add to a contemporary setting in the offices. This is quite an improvement compared to the existing lighting system of industrial type fluorescent fixtures.

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Electrical Depth

Introduction

The overall design ideas for the electrical design are to plan an efficient and well organized system. This includes control plans, circuiting and also distribution plans. There are two distinct plans to integrate these three systems. The first is to plan the controls and circuiting to coordinate directly. Then the secondary item is to make the distribution panels feeding these smaller items just as well planned and organized.

The new lighting design requires a level of detail for controlling and circuiting the number of different types of fixtures. This design has changes to the controls for the lobby, offices, and house light. Using Lutron's Grafik Eye system the lighting system is controlled through a number of zones in each larger space. The details to this system are specified in the following pages. There are a few exceptions to this main use for control which is for specific accent lighting that works better with DMX controls. There is an existing DMX control point at the stage area for stage and house lighting combined. So, the lighting system utilizes a few of those existing circuits for halogen fixtures in the theater and a specialty spot light in the entrance area.

Also, there was a potential to reduce the number of electrical distribution panels. There are a total of 13 distribution panels that are sized smaller than what is typical. After reviewing the existing panels, it was determined that two sets of two distribution panels can be consolidated. Each panel is 600A and was consolidated to be (2) 1200A panels instead of (4) 600A panels. This would have saved time for installation and also material costs as seen in the following electrical section of the report.



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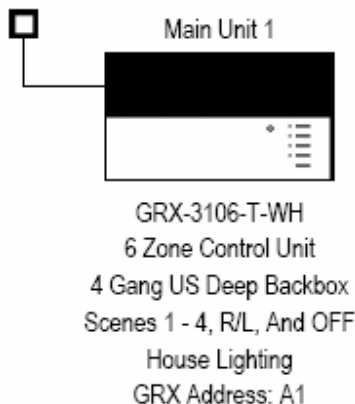
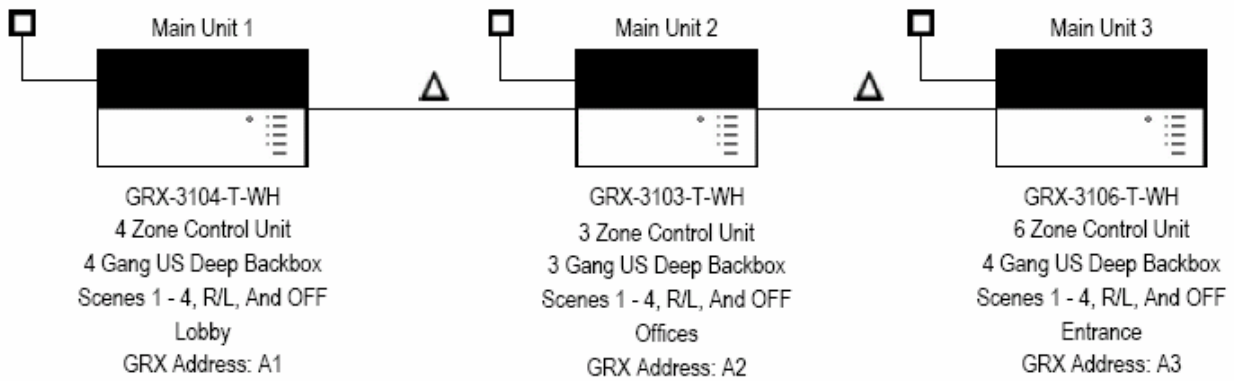


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Lighting Controls Details

The controls for all lighting systems are a combination of Grafik eye controls and a few DMX controls. The details to the DMX controls are not included, because there is an existing system to accommodate those controls. The following pages will include a discussion of the Lutron Grafik Eye controls for all four spaces. The zone analysis for the lighting controls was designed using Lutron's Designer software. This designer software provided control diagrams and a list of the zones required to fit the given design loads.

The diagrams below show the delineation between one set of controls in the entrance, lobby and offices. These systems were designed separately because the group of (3) spaces will be controlled from the main offices while the theater control point will be on the stage. This way the house lighting controls will be next to the house lighting accent and stage lighting controls for use by the director. These two systems will be called front of house and back of house controls. The front of house controls refers to the lobby, offices and entrance system while the back of house controls refers to the theater house lighting controls.



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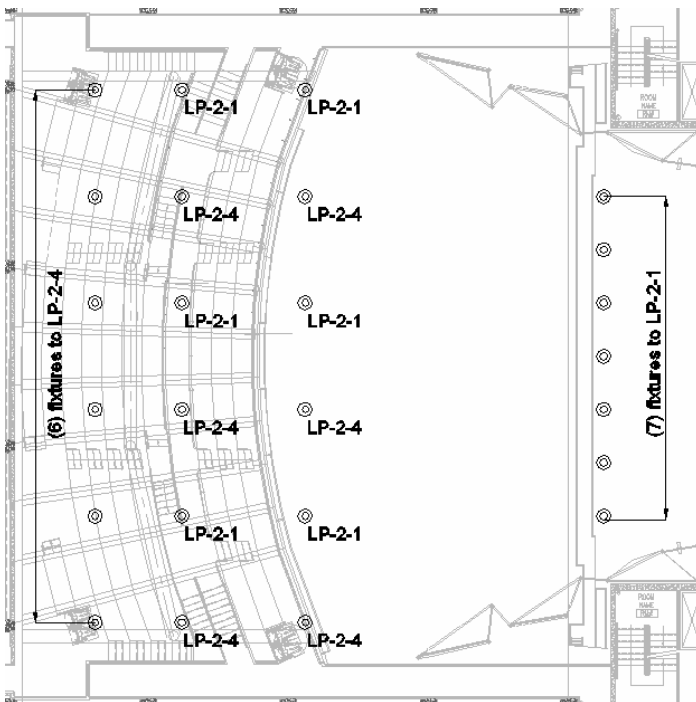
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Control System Details

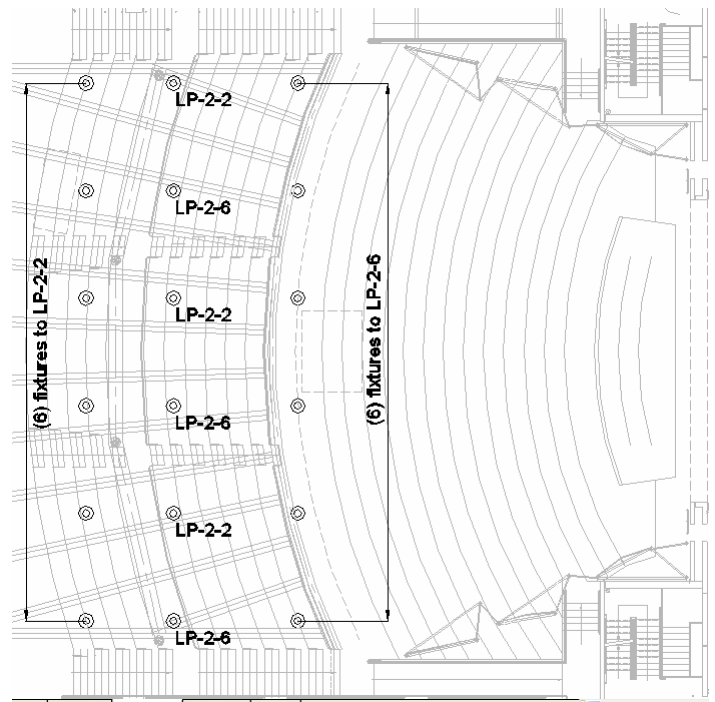
The zones for controls were chosen by circuit. All of the circuiting groups were planned for dimming/switching purposes. This page and the following page show circuiting plans which in effect relate to the listed zones described on the load schedules in Appendix B. There is some redundancy built into this system by overlaying circuits between house lighting rows.



Ceiling Lighting Circuiting Plans



Balcony Ceiling



Parterre Ceiling

Symbol	Type
⊙	K
□	L
—	M
-	N
▬▬▬▬	P

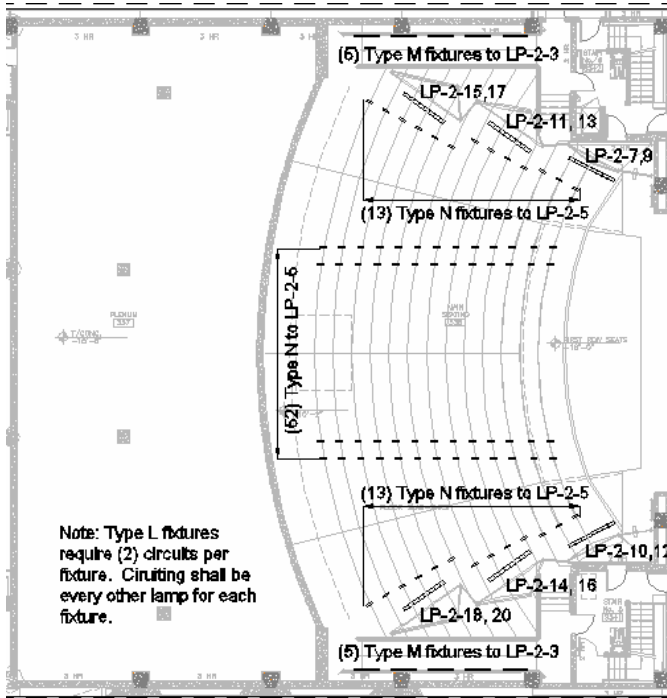
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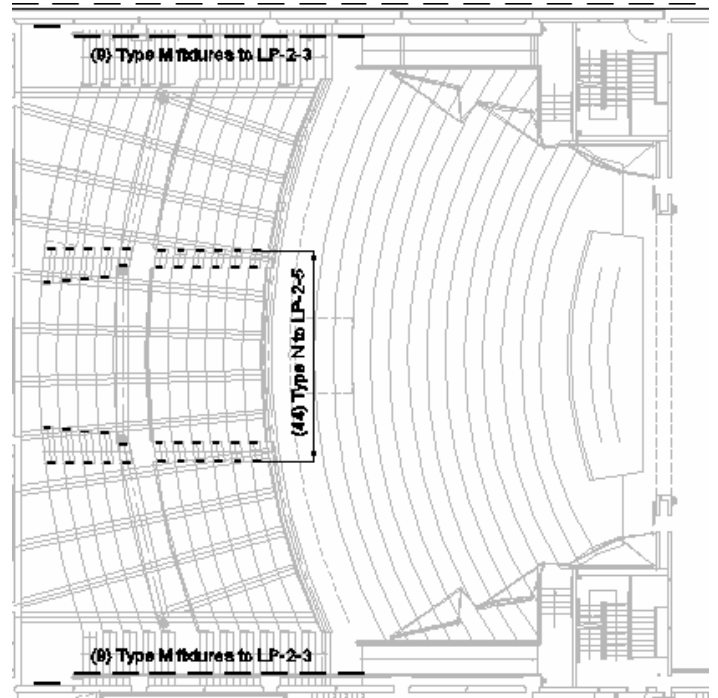
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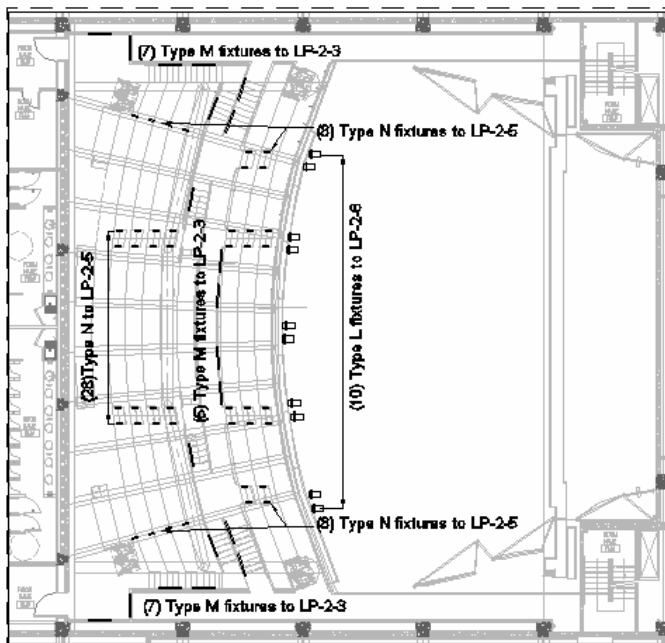
Floor Level Lighting Circuiting Plans



Main Seating Area



Parterre Seating Area



Balcony Seating Area

Symbol	Type
⊙	K
□	L
—	M
-	N
⋯	P

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Control Load Schedules

To further describe the zones and their purpose please see the load reports below and how they correlate to the load requirements on the given panel boards on the next page. To see how the zones were chosen and grouped please reference these load schedules next to the circuiting plans on the previous two pages or in Appendix A. The first three schedules describe the front of house lighting and the fourth covers the back of house lighting.

Front of House Controls

Entrance GRAFIK Eye 3000 Load Schedule						
Main Control Unit Name: Main Unit 3						
Lutron Model No.: GRX-3106-T-WH						
Control Address / Location: 3 /						
Lutron Zone	Customer Zone	Zone/Circuit Description	Customer Circuit #	Voltage	Load Type	Actual Load (W/VA)
A3-1	Accent Flood Lights		5	120V	-	GRX-TVI*
A3-2	Cove Lighting		1	120V	-	GRX-FDBI-16A-120*
A3-3	Cove Lighting -2		2	120V	-	GRX-FDBI-16A-120*
A3-4	Large Pendants		3	120V	-	GRX-FDBI-16A-120*
A3-5	Railing Lights		4	120V	-	GRX-FDBI-16A-120*

Lobby GRAFIK Eye 3000 Load Schedule						
Main Control Unit Name: Main Unit 1						
Lutron Model No.: GRX-3104-T-WH						
Control Address / Location: 1 /						
Lutron Zone	Customer Zone	Zone/Circuit Description	Customer Circuit #	Voltage	Load Type	Actual Load (W/VA)
A1-1	Cove Lighting		1	120V	-	GRX-FDBI-16A-120*
A1-2	Cove Lighting -2		2	120V	-	GRX-FDBI-16A-120*
A1-3	Large Pendants		3	120V	-	GRX-FDBI-16A-120*

Offices GRAFIK Eye 3000 Load Schedule						
Main Control Unit Name: Main Unit 2						
Lutron Model No.: GRX-3103-T-WH						
Control Address / Location: 2 /						
Lutron Zone	Customer Zone	Zone/Circuit Description	Customer Circuit #	Voltage	Load Type	Actual Load (W/VA)
A2-2	Workstations		1	120V	-	GRX-FDBI-16A-120*
A2-1	Wall Washers		2	120V	-	GRX-FDBI-16A-120*
A2-3	Conference Pendant		3	120V	-	GRX-FDBI-16A-120*

Back of House Controls

House Lighting GRAFIK Eye 3000 Load Schedule						
Main Control Unit Name: Main Unit 1						
Lutron Model No.: GRX-3106-T-WH						
Control Address / Location: 1 /						
Lutron Zone	Customer Zone	Zone/Circuit Description	Customer Circuit #	Voltage	Load Type	Actual Load (W/VA)
A1-1	Main - Balcony House Lights	Main Seating area and front of balcony	1	120V	-	GRX-FDBI-16A-120*
A1-2	Railing	All Railing Lights	6	120V	-	GRX-FDBI-16A-120*
A1-3	Balcony House Lights	Rear of balcony	2	120V	-	GRX-FDBI-16A-120*
A1-4	Parterre House Front	Front of parterre	4	120V	-	GRX-FDBI-16A-120*
A1-5	Parterre House Rear	Rear of parterre	3	120V	-	GRX-FDBI-16A-120*
A1-6	Aisle Lights	All aisle lights	5	120V	Incandescent	160

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Circuiting Information

Lighting System Load Requirements

The circuiting information below describes the design loads of the lighting system. The design loads were divided by spaces. As mentioned before there are two separate controls the front of house and back of house. The lobby, offices and entrance were located on LP-1 (referring to front of house) with the exception of the automated fixture (Type J) in the entrance. The automated circuit was separated to the LP-2 (referring to back of house) panel so that it can be located closer to the stage DMX controls which also control this specialty fixture. Panel LP-2 was organized such that the Grafik Eye controlled fixtures are circuits 1-6 and DMX controlled fixtures are circuits 7-18. To see total load information and wire sizes for the panel boards, please reference Appendix B.

Description	LOAD (VA)			Brk. Trip (A)	LP 1			LOAD (VA)			Brk. Trip (A)	Description	
	A	B	C		Cond. Size	Ckt. #	Cond. Size	A	B	C			
Off - Pendants	1048			20	#12	1	2	#12	1254			20	Lby1 - Cove
Off - Wall washer		1245		20	#12	3	4	#12		1320		20	Lby1 - Cove
Lby2 - Cove			1584	20	#12	5	6	#12			1056	20	Lby1 - Lg Pendant.
Lby2 - Cove	1518			20	#12	7	8	#12	636			20	Lby1 - Railing
Lby2 - Lg Pendant		1452		20	#12	9	10	#12		644		20	Ent - Track
Lby2 - Sml Pendant			732	20	#12	11	12	#12			644	20	Ent - Track

Description	LOAD (VA)			Brk. Trip (A)	LP 2			LOAD (VA)			Brk. Trip (A)	Description	
	A	B	C		Cond. Size	Ckt. #	Cond. Size	A	B	C			
HL - CFL Downlight	1607			20	#12	1	2	#12	1113			20	HL - CFL Downlight
HL - Railing		1527		20	#12	3	4	#12		1484		20	HL - CFL Downlight
HL - Aisle			665	20	#12	5	6	#12			1113	20	HL - CFL Downlight
HL - Borderlight Accent	1000			20	#12	7	8	#12	1000			20	HL - Hal Downlight
HL - Borderlight Accent		1000		20	#12	9	10	#12		1000		20	HL - Borderlight Accent
HL - Borderlight Accent			1000	20	#12	11	12	#12			1000	20	HL - Borderlight Accent
HL - Borderlight Accent	1000			20	#12	13	14	#12	1000			20	HL - Borderlight Accent
HL - Borderlight Accent		1000		20	#12	15	16	#12		1000		20	HL - Borderlight Accent
HL - Borderlight Accent			1000	20	#12	17	18	#12			1000	20	HL - Borderlight Accent
Ent - Automated Spot	700			20	#12	19	20	#12	1000			20	HL - Borderlight Accent

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Electrical Distribution Panels

Consolidation

The electrical distribution system is spread over 13 smaller panels with an average size of 600A. To reduce the complexity and material costs of the system the following design has consolidated (4) 600A panels into (2) 1200 A panels. To support that this is a cost-wise decision there is also a cost analysis of materials and installation.

To view the load information for the existing and designed distribution panels please reference Appendix B. The cost information listed below is compiled from Eaton Electrical for materials and RSMMeans for installation and labor information.

RSMeans #	Size	Quantity	Crew	Output	Hours	Unit	Material	Labor	Total
8600270	600 A	4	2 elec	1.2	13.33	ea	\$24,200.00	\$2,180.00	\$26,380.00
86002090	1200 A	2	2 elec	0.92	17.39	ea	\$22,502.00	\$1,420.00	\$23,922.00
Savings									\$2,458.00

Electrical Depth Discussion

Providing a more straightforward approach to the electrical distribution and lighting controls creates a cost saving and efficient building system. An organized and well-sized distribution system makes the design less complicated and easier to install. The design for lighting controls, circuit loads, and distribution panels are also a straightforward and efficient approach to the situation. And organized and well planned electrical system adds to the success of the integrated building systems as well. The efficient electrical design supports a lighting system that follows the same plan for organization. The design plans for these electrical portions of this report meet the plans for an efficient and well organized system.

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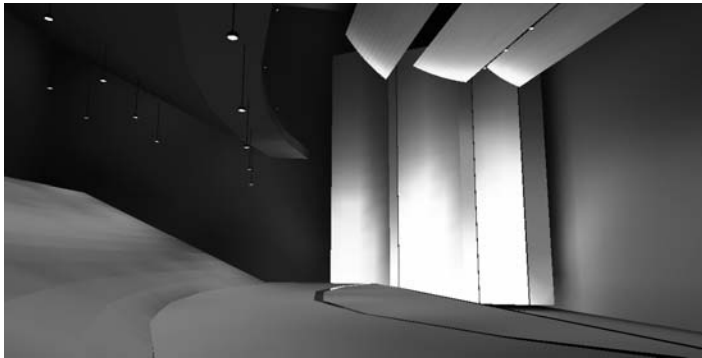
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Acoustical Breadth

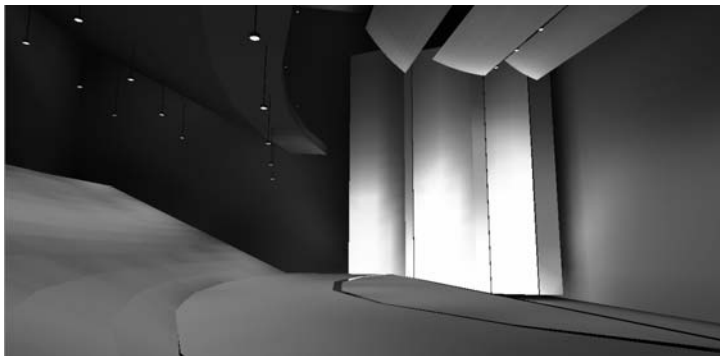
The reverberation time in a live theater is very critical to a patrons experience during a performance. My lighting design has affected an architectural element in the theater space, so I deemed it necessary to see how this change may effect the reverberation time. I proposed to change the length of horizontal hanging clouds at the ceiling. For my lighting design I planned to have the ceiling dark with the exception of the hanging down lights. My reducing the length of the clouds by a total of 6' this allows the light to upright the towers without interfering with the dark ceiling I had planned for the lighting design. By leaving an extra 3' on each end there isn't spill light from the plighting accent fixtures.

The following lighting study to determine the new length of the ceiling clouds:

Existing design



Study #1: A 6' length reduction on all three ceiling clouds.



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Study #2: From left to right 6', 8' and 10' length reductions.



Study #2 was used to compare the reverberation time, because the light spill is minimal and suitable to work with the tower accent lighting.

To calculate the reverberation time Sabine's formula can be used. To determine the value "a" you must compile the quantities of surface area for each type of material within the space. The details for Sabine's calculation are on the following page. The absorption coefficients used to calculate the reverberation time, T, were taken David Egan's Architectural Acoustics textbook.

$$T = 0.05 \frac{V}{a} \quad (16)$$

where T = reverberation time, or time required for sound to decay 60 dB after source has stopped (s)

V = room volume (ft³)

a = [see formula (11)]

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Reverberation Time Calculation:

Surface Name	Surface Area
Floor	14,976 sf
Seating	5147 sf
Towers, Clouds	5,690 sf
Ceiling	14,976 sf
Walls	12,626 sf
Volume	724,672 cf

Coefficients for absorption used for Sabine's Reverberation calculation: Sound Absorption Coefficients

Description	Surface Name	125	250	500	1000	2000	4000
Concrete Floor	Floor	0.01	0.01	0.02	0.02	0.02	0.02
Audience, seating	Seating	0.39	0.57	0.8	0.94	0.92	0.87
Acoustical Reflectors	Towers, Clouds	0.15	0.1	0.05	0.04	0.07	0.09
Concrete Ceiling	Ceiling	0.01	0.01	0.02	0.02	0.02	0.02
Concrete Block	Walls	0.01	0.02	0.04	0.06	0.08	0.1

Existing Calculation:

		S * alpha						
		125	250	500	1000	2000	4000	
		149.8	149.8	299.5	299.5	299.5	299.5	
		2,007.4	2,933.9	4,117.8	4,838.4	4,735.5	4,478.1	
		896.0	597.3	298.7	238.9	418.1	537.6	
		149.8	149.8	299.5	299.5	299.5	299.5	
		126.3	252.5	505.0	757.6	1,010.1	1,262.6	
		3,329.2	4,083.3	5,520.5	6,433.9	6,762.7	6,877.3	
		Sum of S* alpha					33,006.9	
		Reverberation time (T)=					1.098	

With cloud length reductions:

		S * alpha						
		125	250	500	1000	2000	4000	
		149.8	149.8	299.5	299.5	299.5	299.5	
		2,007.4	2,933.9	4,117.8	4,838.4	4,735.5	4,478.1	
		853.5	569.0	284.5	227.6	398.3	512.1	
		149.8	149.8	299.5	299.5	299.5	299.5	
		126.3	252.5	505.0	757.6	1,010.1	1,262.6	
		3,286.7	4,055.0	5,506.4	6,422.6	6,742.9	6,851.8	
		Sum of S* alpha					32,865.4	
		Reverberation time (T)=					1.102	

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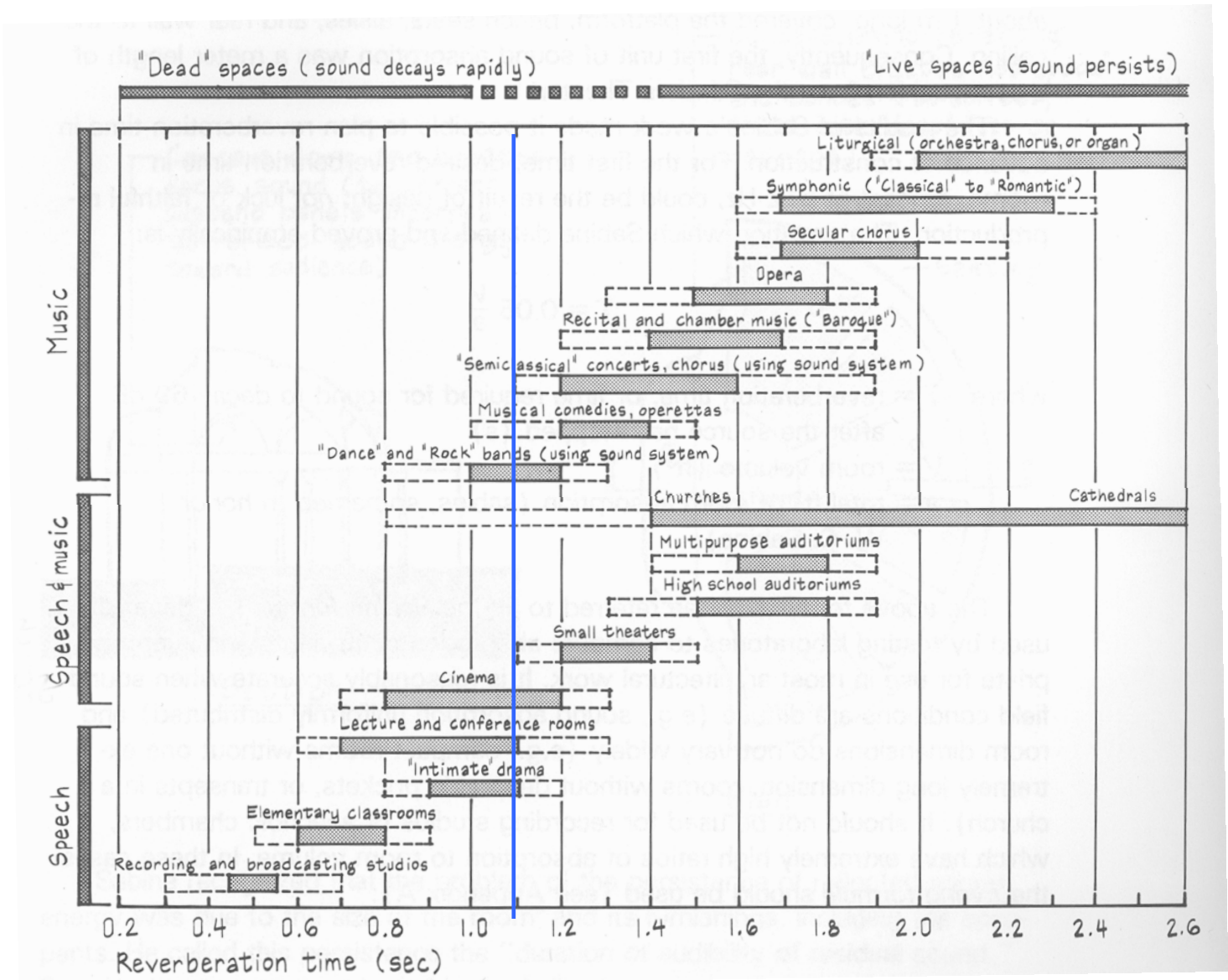
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Discussion

The line plotted below shows where both calculations would fall on the reverberation time scale. The change in reverberation time was so small on the scale shown below that the change in reflector length is recommended. This will enhance the lighting design while maintaining acoustical performance.



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Cost Analysis Breadth

After completing the design scheme that could be implemented on all lobby floors I studied the existing lighting installation cost to my design. The comparison included costs of material and labor. When this comparison was considered I had not planned to have a cove fixture, but instead to surface mount fixtures on the existing beams. After careful consideration I decided that the design need to be cleaner cut then a surface mounting design could provide. So, I have proposed to add a cove as well as the ceiling washing fixtures. So, the pricing for this new installation is significantly more expensive.

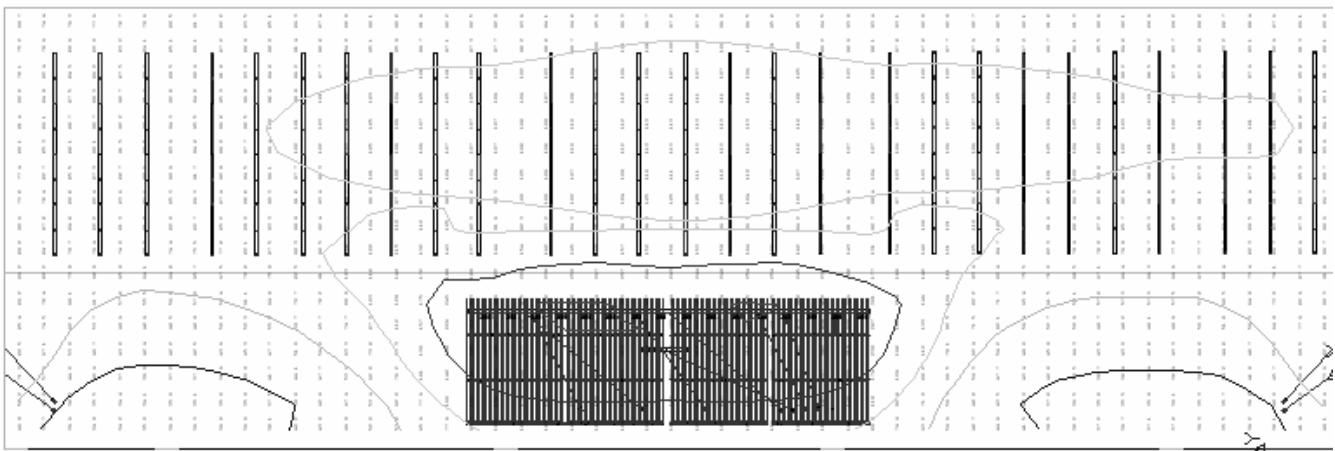
Existing Conditions

Lighting Schedule

VE-N	Fluorescent Strip Light (1) Lamp	Hubbell Lighting	Cleanroom-air Foil Series CR-X-8T-1-R-CL-A-1-CR5-1	(1) T8 Assumed 32W	120	34	0.666	L5725
VE-NC	Fluorescent Strip Light (1) Lamp 4' and 8' lengths.	Hubbell Lighting Duray	Cleanroom-air Foil Series CR-X-8T&40-1-R-CL-A-1-CR5-1 LS 96 or LS 48 Depending on	(1) T8 Assumed 32W Gel Fits T12 lamp	120	34	0.666	L5725

Lighting Layout

The layout is very uniform with the exception of colored strips used to define spaces between the columns. These are surface mounted strip fluorescents. This design provided a very economical approach to the lighting design. Half of the fixtures are 8' in length which also greatly reduced the cost of labor for the installation.



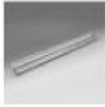
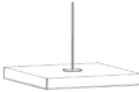

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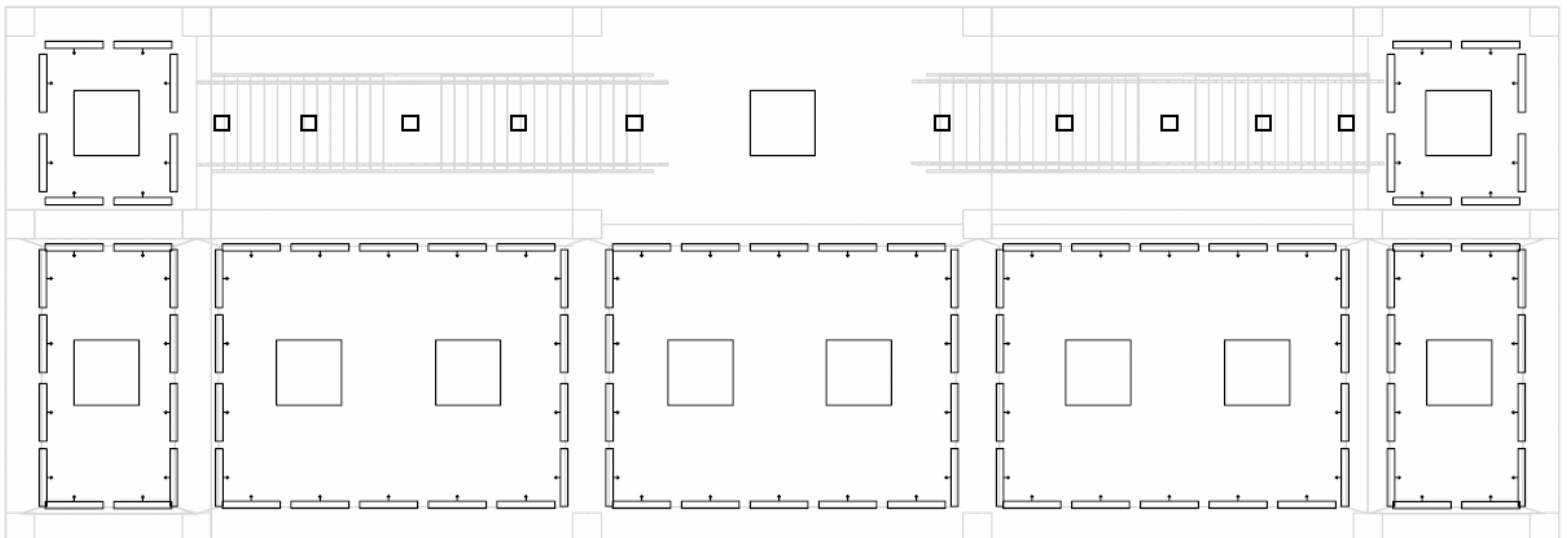
New Design for Comparison Lighting Schedule

- D**  **Winona Lighting P1-MC-T5-MCVU-RA-**
 Description: Fluorescent cove light with 1-28T5 lamp (in cross-section). 1-28T5 lamp (in cross-section) Location: Lobby
- F**  **Custom Fixture 4.5' x 4.5' x 6" Square Pendant**
 Description: 4.5' x 4.5' x 6" Pendant with acrylic glass on sides and bottom. Top is opaque and reflective on inner side of fixture. (4) 28T5 bi-pin linear Location: Lobby
- G**  **Winona Lighting 5450-10-F-MB-STD**
 Description: Suspended compact fluorescent decorative pendant with 4-FT40 lamps. 4-FT40 lamps Location: Lobby

Symbol	Type
	D
	F
	G
	I
	J
	M

Lighting Layout

This design requires the installation of a cove to give a seamless approach to the uniform lighting of the space. Additionally, to keep the layout seamless there is a large custom fixture which added greatly to the expensive of the installation. The other two types of fixtures used were specified from Winona without modifications.



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Discussion

The spreadsheet below shows the initial cost analysis of the total installation. After reviewing these costs further a second analysis was needed to put the comparison into perspective.

Existing Design

RS Means #	Type	Quantity	Description	Crew	Output	Hours	Unit	Material	Labor	Total	O & P
2600	VE-N	52	(1) 8' Long Linear Fluorescent	2 Elec	13.4	1.194	ea.	\$2,158.00	\$3,016.00	\$5,174.00	\$6,916.00
2600	VE-NC	42	(1) 8' Long Linear Fluorescent with Sleeve and colored gel	2 Elec	13.4	1.194	ea.	\$1,743.00	\$2,436.00	\$4,179.00	\$5,586.00
2400	VE-NC	80	(1) 4' Long Linear Fluorescent with Sleeve and colored gel	1 Elec	8	1	ea.	\$3,200.00	\$3,920.00	\$7,120.00	\$9,360.00
										\$16,473.00	\$21,862.00

New Design

RS Means #	Type	Quantity	Description	Crew	Output	Hours	Unit	Material	Labor	Total	O & P
3565	D	94	4' Cove fixture and prefabricated steel cove	1 Elec	5	1.6	ea.	\$17,014.00	\$7,332.00	\$24,346.00	\$29,610.00
1600	F	11	4'-6" square pendant, acrylic, with (4) 4' T5 lamps	2 Elec	7.2	2.222	ea.	\$4,565.00	\$1,199.00	\$5,764.00	\$6,820.00
1060	G	10	CFL rectangular pendant	1 Elec	3	2.667	ea.	\$5,500.00	\$1,120.00	\$6,620.00	\$7,800.00
										\$36,730.00	\$44,230.00

Existing Design

Type	Quantity	Description	Material
VE-N	52	(1) 8' Long Linear Fluorescent	\$2,158.00
VE-NC	42	(1) 8' Long Linear Fluorescent with Sleeve and colored gel	\$1,743.00
VE-NC	80	(1) 4' Long Linear Fluorescent with Sleeve and colored gel	\$3,200.00
Total	174		Total \$7,101.00 \$1.79 per s.f.

New Design

Type	Quantity	Description	Material
D	94	4' Cove fixture and prefabricated steel cove	\$17,014.00
F	11	4'-6" square pendant, acrylic, with (4) 4' T5 lamps	\$4,565.00
G	10	CFL rectangular pendant	\$5,500.00
Total	115		Total \$27,079.00 \$6.84 per s.f.

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Conclusions

The goals for this design were to create an appealing lighting design while maintaining an energy and maintenance efficient system. These goals were met by providing concealed fixtures where possible and using mostly fluorescent lighting sources. Fluorescent sources allowed the ability to be energy efficient while maintain the flexibility to be dimmed as well. To complete this design flexibility, a Grafik Eye system was specified for controls. The system design has the option to dim the different layers of light in each major space. The system has a straightforward plan for wiring because the circuiting plan reflects the lighting control zoning plans directly. This design is successful because the electrical layout plan was integrated into the lighting controls to simplify the installation.

Breadth studies provide a better understanding of the overall design. To improve the details of the lighting system other elements of the architectural design are affected. There are two architectural elements that would be modified by this design to avoid conflict with the lighting system plan. The first is the addition of coves in the lobby areas which was analyzed within the fixture cost installation analysis. The second conflict occurs in the auditorium space and affects the size of acoustical reflectors. The outcomes of both studies show that the results can either support the design or suggest modifications. As it turns out, the cost to install the cove lighting significantly adds to the lobby lighting installation costs. As a designer without a budget or limits to creativity, it is still recommended that the design be implemented as planned in this report. The added flexibility, aesthetics, and efficiency make the design a success.

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Lighting

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Electrical

Hughes, David. *Electrical Systems in Buildings*. 1988.

General

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RSMMeans 2005.

Image Sources for Renderings

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www.postersarts.com/Images/artposterssalvador dali.jpg

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Acknowledgements

To Schuler Shook for guidance in not only choosing a thesis project, but also answering my numerous design questions all year long!

To Hammond Beeby Rupert Ainge Architects for their help in learning about this great architectural project and providing all the project documentation.

Thanks for your help with questions:

Ted Dannerth, Professor Mistrick, Professor Moeck and Steven Puchek

For your humor and support in the lab:

All the lighting kids and Courtney, too!

To my roommates for their patience over the last few weeks...

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Appendix A

Appendix A includes supplemental information for the lighting design system. Below is a description of the order of information in this appendix.

Existing Conditions

Power Density Chart

Cove Detail for Type D

Lighting Fixture Schedule

Lighting Fixture Cut Sheets

Ballast Cut Sheets

Lamp Cut Sheets – Reference lighting schedule for fixture type

Lighting and Circuiting Layouts

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Appendix A

Existing Conditions

Theater Materials

All walls, floor and ceiling were assumed to have a reflectance of 15%. All of those items are painted black or dark gray.

Office Materials

Finishes were all assumed. In the lobby area all walls are painted white and assumed to have a reflectance of 89%. The floor is sealed concrete and was assumed to have a reflectance of 45% and shows some specular qualities.

Lobby and Entrance Materials

Finishes were all assumed. In the lobby area all walls are painted white and assumed to have a reflectance of 89%. The floor is sealed concrete and was assumed to have a reflectance of 45% and shows some specular qualities.

Power Density ASHRAE 90.1

Space-by-Space Method

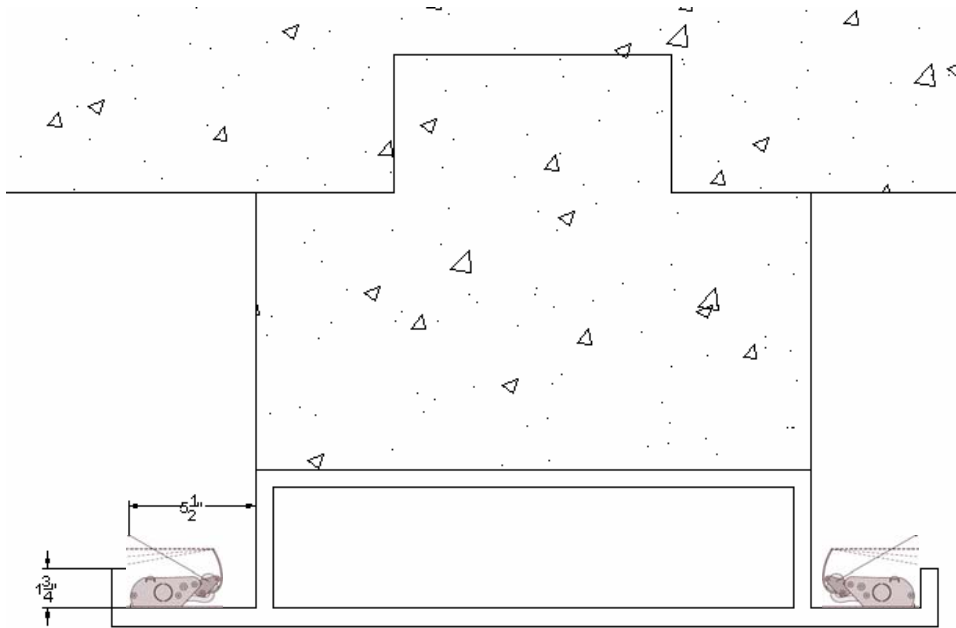
Lobby, for performing arts theater	3.3 W/ft ²
Audience/Seating Area, for performing arts theater	2.6 W/ft ²
Office-Enclosed	1.1 W/ft ²
Conference/Meeting/Multipurpose	1.3 W/ft ²
*1.0 W/ft ² may be added for accenting artwork	

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Appendix A

Cove Detail for Fixture Type D



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Appendix A

The following sections of Appendix A include cut sheets for the lighting equipment used. Below is a description of the organization for the cut sheets.

Lighting Fixture Cut Sheets

The lighting fixtures are arranged in order of Type name. Please note the fixture type at the bottom right corner of each cut sheet page. The lamping listed here is correct and the lamps used are in the cut sheets following the ballast section.

Type	Mfr/Catalog #	Lamping				
A	 Zumtobel Staff AQ-2285-4-T-SE Description: Suspended fluorescent up/downlight with 2-F28T5 (48In) lamps. Optics: acrylic prismatic lens, anodized aluminum reflector 81% up/19% down.	2-F28T5 (48In) lamp	I		Lighting Services Inc M2907-** Description: 6" track-mounted metal halide accent light with 1-70W PAR38 lamp. Optics: glare shield.	1-70W PAR38
			J		Vari-lite Description: Requires DMX controls, to be programmed with designer to pan over artwork in entrance window.	(1) 700 watt
B	 Winona Lighting P1-FT139-LSS Description: 20" surface-mounted compact fluorescent wallwasher with 1-FT40 lamp. Optics: anodized aluminum reflector, single.	1-FT40 lamp	K		Delray Lighting 77143-CF Description: 13" suspended compact fluorescent downlight with 3-CFTR42W lamps. Optics: anodized aluminum reflector.	3-CFTR42W
C	 Zumtobel Staff 1580-U Description: 7" suspended compact fluorescent downlight with 2-CFQ13W lamp. Optics: painted or anodized aluminum reflector.	2-CFQ13W lamp	L		Times Square Fresnel for Downlighting Description: Fresnel adjustable spot, pipe mounted, black finish	100W PAR38
D	 Winona Lighting P1-MC-T5-MCVU-RA Description: Fluorescent cove light with 1-28T5 lamp (in cross-section).	1-28T5 lamp (in cross-section)	M		Cole Lighting LR 1P-T8 Description: Surface-mounted fluorescent step light with 1-T8 lamp (in cross-section). Optics: acrylic prismatic lens.	1-32T8 lamp section)
F	Custom Fixture 4.5' x 4.5' x 6" Square Pendant Description: 4.5' x 4.5' x 6" Pendant with acrylic glass on sides and bottom. Top is opaque and reflective on inner side of fixture.	(4) 28T5 bi-pin line	N		Irwin Seating Company Description: Concealed aisle fixture. Lamp is located under armrest of seat.	4W
G	 Winona Lighting 5450-10-F-MB-STD Description: Suspended compact fluorescent decorative pendant with 4-FT40 lamps.	4-FT40 lamps	P		Times Square Lighting 702 Borderlight Description: (8) compartment 8' fixture with tilt and locking rotation. Lens available to color each compartment separately.	Q2500P

Aria™ Fluorescent Two Lamp, 28W T5 or 54W T5 HO

Indirect/Direct Cable-Mounted

9" x 4"



Applications: An indirect/direct luminaire featuring new "waveguide" technology that results in a minimal profile and lightweight appearance. The patented microprism structure directs light downward in a glare free manner that is ideal for flat screen displays. The **square edges** conceal the T5 or T5 HO lamps within. The single array of lenses offers an even smaller profile at cost slightly lower than the double array.

Square edge, single panel

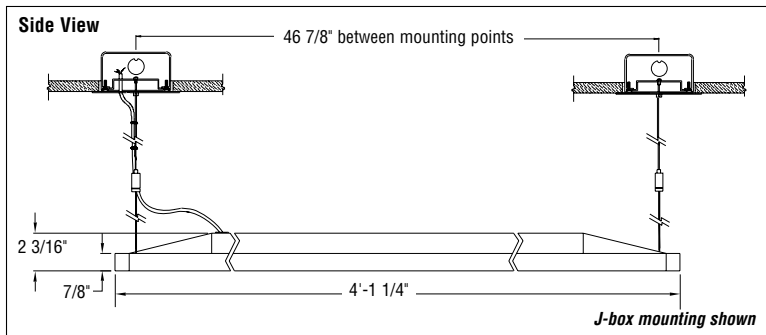
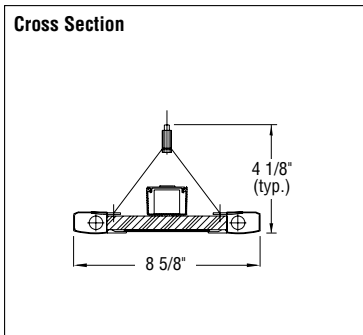
Type: _____

Project: _____

USE THIS CHART FOR INDIVIDUAL FIXTURES ONLY (FOR CONTINUOUS RUNS SEE PAGE ARIA-4A)

ORDERING NOTE: Specify lampping, voltage, mounting and options.

▼ Fixture	▼ Lampping	▼ Length	▼ Color	▼ Optic	▼ Voltage	▼ Mounting	▼ Options
AQ		4	T	SE			
AQ Indirect/Direct Aria, Square Edge	2285 (2) 28W T5 2545 (2) 54W T5 HO	4	T Titan	SE Single panel wave-guide	U Multivoltage 120V/277V 2 277V (NYC only) 3 347V* 4 Dimming 120V* 5 Dimming 277V* 6 Dimming 347V* *consult factory for availability of ballast	C1 70" Cable C2 157" Cable <i>Cable set comes factory installed with correct power feed and 5" canopy.</i>	1 Stand-By Battery Pack, 1-lamp, (28W) 2 Stand-By Battery Pack, 1-lamp, (54W)



US Patent Des. #428,058
IBEW Union Made

1. Housing - Extruded and die-cast aluminum with titan (matte silver) finish.

2. Inner Reflector - Specular aluminum, attached with concealed spring clips.

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3. Lens - Patented "waveguide" acrylic laminated lens with micro-prism structure. Single row of four panels for downward distribution. Pre-treated to be anti-static; clean with dry cloth only.

4. Sockets - Miniature bi-pin. Twist lock lamp installation.

5. Lampping - Two 28W T5 or 54W T5 HO (high output) fluorescent lamps. Supplied by others.

6. Ballast - Electronic multivoltage 120V/277V ballast. Ballast is mounted in center channel above

lenses, and accessible from above fixture. For availability of dimming ballasts, consult factory.

7. Mounting - Aircraft cable is available for junction box mounting with a 5" diameter canopy in standard lengths of 70" and 157". Cable sets and appropriate power feeds are factory installed on individual fixtures. Canopy covers are flat, 5" diameter, 16 gauge steel, white finish. Power cord is 18/3, gray. A 1/4-20 fastener (with cable and 2" diameter canopy) is provided for optional use at the non-power feed end. **Note: see page Aria-4A/4B for mounting in continuous runs.**

8. Junction Box - 4" octagonal junction box, supplied by others.

9. Stand-by Battery Pack - Integral, for one lamp operation, will operate for 90 minutes at 500 (28W) or 825 (54W) lumens. Charge indicator/test switch is factory installed.

10. Weight - 22.0 lbs.

In a continuing effort to offer the best product possible we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product. Technical specification sheets that appear on www.zumtobelstaffusa.com are the most recent version and supersede all other versions that exist in any other printed or electronic form.

ARIA-4

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Continuous Run Fixtures

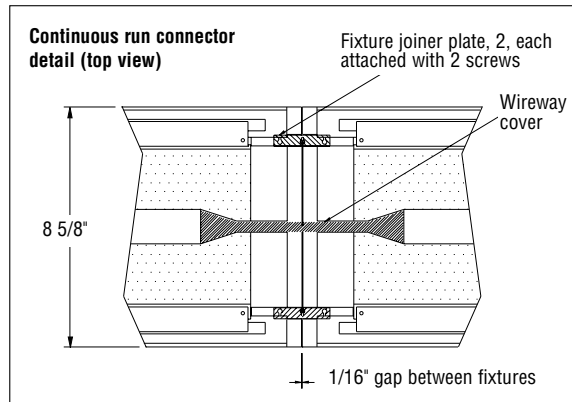
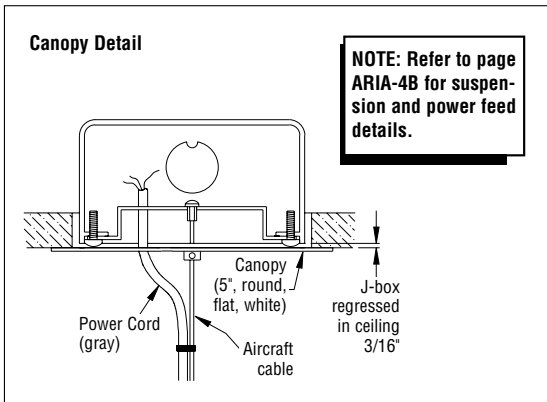
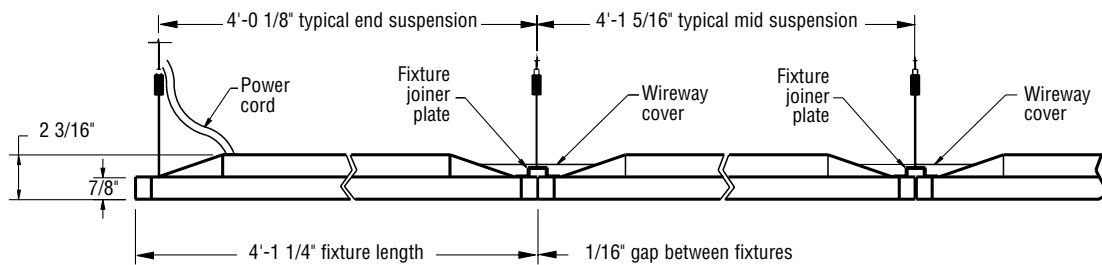
USE THESE CHARTS FOR CONTINUOUS RUNS ONLY (FOR INDIVIDUAL FIXTURES SEE PAGE ARIA-4)

1. Select fixtures. Figure quantity of fixtures needed by using combinations of nominal 4' units, based on the overall length of the row.

ORDERING NOTE: Specify lamping, voltage, mounting, options.

▼ Fixture	▼ Lamping	▼ Length	▼ Color	▼ Optic	▼ Voltage	▼ Mounting	▼ Options
AQ		4	T	SE		00	
AQ Indirect/Direct Aria, Square Edge	2285 (2) 28W T5 2545 (2) 54W T5 HO	4	T Titan	SE Single panel waveguide	U Multivoltage 120/277V 3 347V* 4 120V dimming* 5 277V dimming* 6 347V dimming* <i>*consult factory for availability of ballast</i>	00 Fixture body only (please use charts on page ARIA-4B to specify power feeds, canopies, and suspensions for continuous run fixtures)	1 Stand-By Battery Pack, 1-lamp, (28W) 2 Stand-By Battery Pack, 1-lamp, (54W)

Typical Continuous Run



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ARIA-4A

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Continuous Run/Suspension Information

2. Select Power Feed Suspensions

AS	Suspension Type/Length	Power Cord Color	Canopy	Feed	Fixture Voltage
AS Aria Single panel waveguide	CBL070 Aircraft Cable 70" CBL157 Aircraft Cable 157"	T Gray	J5 J-box mounting, 5" round, flat canopy, white T5 T-bar mounting, 5" round, flat canopy, white	F3 3-wire power feed (standard) F5 5-wire power feed (use for dimming or for stand-by battery pack)	U Multivoltage 120/277V 2 277V (NYC) 3 347V NOTE: If voltage is not specified, U (Multivoltage 120/277V) feeds will be supplied.

Maximum length of fixture run per feed:
(2) 28W T5 (2) 54W T5 HO

120V	32 ft.	16 ft.
277V	80 ft.	44 ft.

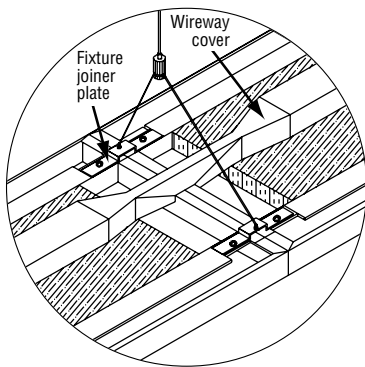
3. Select Non-Power Feed Suspensions

AS	Suspension Type/Length	Canopy
AS Aria Single panel waveguide	CBL070 Aircraft Cable 70" CBL157 Aircraft Cable 157"	J5 J-box mounting, 5" round, flat canopy S2 1/4-20, 2" flat canopy S5 1/4-20, 5" flat canopy Note: for T-bar mounting, use S2 or S5 canopies.

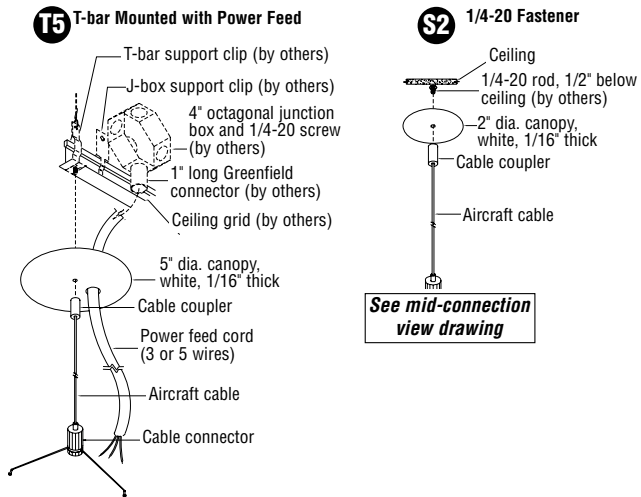
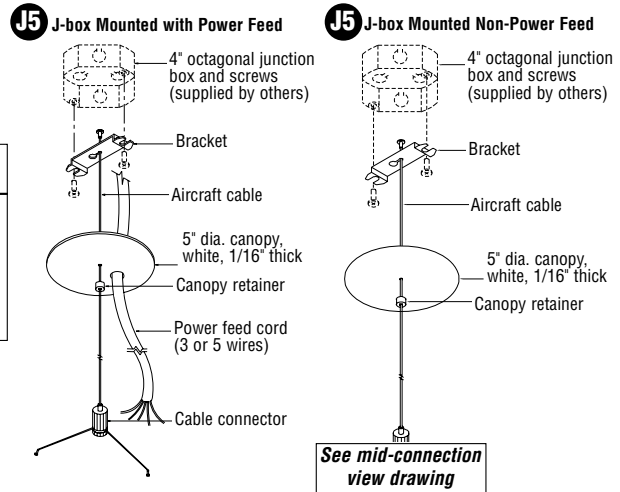
NOTE: Number of non-feed suspension kits needed per row equals the number of fixtures per row.

NOTE: Each non-power feed suspension (**J5**, **S2** or **S5**) is supplied with wireway cover, fixture joiner plate, hardware and (not shown) wire harness.

Mid-connection view (typical)



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ARIA-4B

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Photometric Data

AQ 2545 4' T SE (2) 54W T5 HO

INDIRECT/DIRECT, SQUARE EDGE, SINGLE PANEL

Total Luminaire Efficiency 66%

81% Uplight 19% Downlight

Spacing Criteria

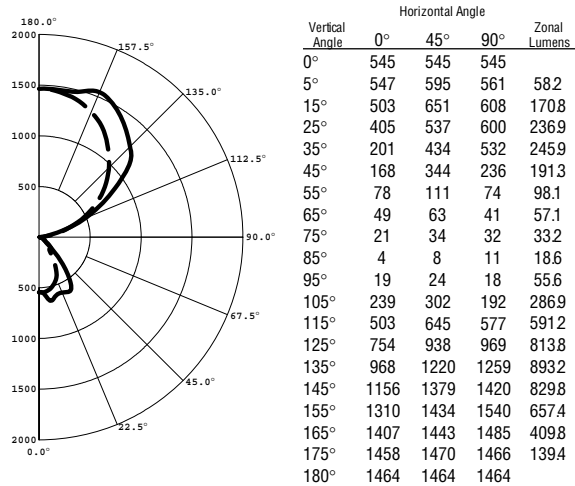
Lateral Plane 0° 90°

1.01 .4

TOTAL LAMP LUMENS = 8800

INPUT WATTS = 118

Candela Distribution



Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	23053	47190	32337
55°	13103	18732	12494
65°	11312	14547	9293
75°	7943	12552	11877
85°	4896	8790	11683

Coefficients of Utilization

Effective Floor Cavity Reflectance = 20%

pcc	0.8				0.7				0.5				0.3			
	pw	0.7	0.5	0.3	0.1	0.7	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1	
0	66	66	66	66	58	58	58	58	44	44	44	30	30	30		
1	60	57	55	53	53	51	49	47	38	37	36	27	26	26		
2	55	51	47	44	48	45	42	39	34	32	30	24	23	22		
3	50	45	40	37	44	40	36	33	30	28	26	22	20	19		
4	46	40	35	31	41	35	31	28	27	24	22	19	18	16		
5	42	35	30	27	37	31	27	24	24	21	19	17	16	14		
6	39	32	27	23	34	28	24	21	22	19	17	16	14	13		
7	36	28	24	20	32	25	21	18	20	17	15	14	13	11		
8	33	26	21	18	29	23	19	16	18	15	13	13	11	10		
9	31	23	19	16	27	21	17	14	16	14	12	12	10	9		

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ARIA-4C

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Profile - P1 (basic): Anodized, extruded aluminum specular reflector with solid aluminum endcaps and stainless steel hardware.

Type - Large profile with smooth or ribbed detail.

Indoor; non-gasketed, captive extruded alum. hinge for lens and baffle options.

Outdoor; silicone gasketed lens, captive extruded alum. door with window cut-out for regressed lens.

Aperture; open aperture is standard for indoor fixtures. Outdoor fixtures shall be specified with clear acrylic lens option.

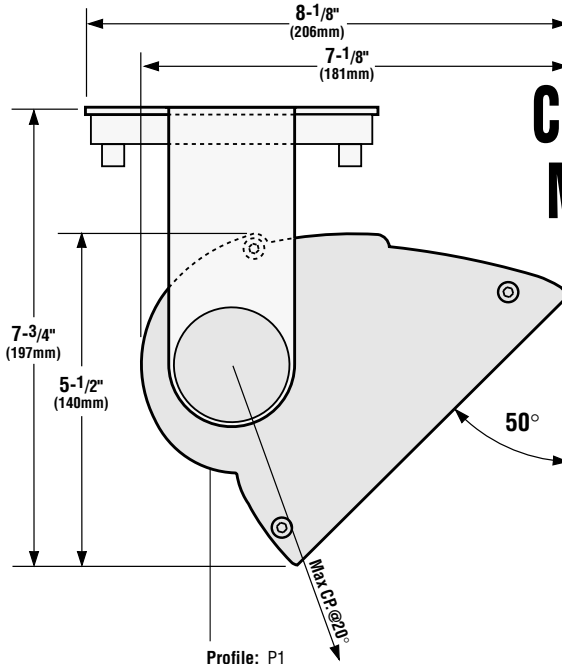
Mounting - Three standard mounts are fully adjustable and lockable. Designed for remote or integral ballast.

Performance - Asymmetric distribution provides a concentration of light on to target surface for smooth illumination. Maximum candlepower aimed 20° above nadir has less than 10% spill light within the 0-20° zone and less than 2% spill light within the 90 - 180° zone.

Electrical - Electronic, HPF ballast, lamp protection circuit, Class P and thermally protected. Provide 90° C supply wire. See Technical section for ballast data.

Finishes - An electrostatically applied wet paint system utilizes a multi-stage process to provide a durable acrylic enamel finish. Suitable for indoor and outdoor applications.

Options - For complete list and detailed descriptions, refer to Options Section.



Profile: P1
Type: LS, LR, LSW, LRW
Mount: LS8
Length: Refer to chart below.
Scale: 3/8" = 1"

Large Ceiling Mount

INDOOR | OUTDOOR

HOW TO SPECIFY

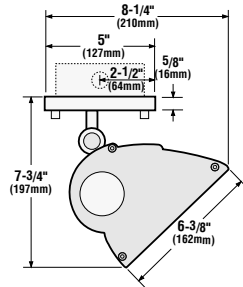
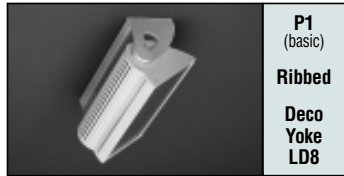
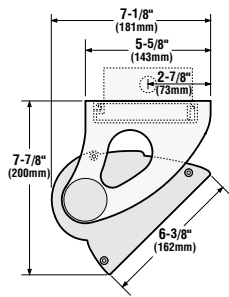
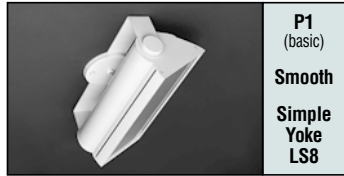
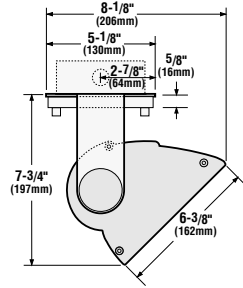
PROFILE	TYPE	LAMPING - VOLTAGE	MOUNTING	FINISH	OPTIONS	CLASS
		120V or 277V				
 P1 (basic)	Indoor Locations: (damp label) LS: Large Smooth LR: Large Ribbed Outdoor Locations: (wet label)† LSW: Large Smooth Wet LRW: Large Ribbed Wet	Code Description Length Weight Compact Fluorescent †CFM142 (1)CFM42W/GX24 12" 8 lbs. *†CFM157 (1)CFM57W/GX24 12" 8 lbs. †CFM170 (1)CFM70W/GX24 16" 10 lbs. †CFM242 (2)CFM42W/GX24 20" 13 lbs. *†CFM257 (2)CFM57W/GX24 20" 13 lbs. FT139 (1)FT39W/2G11 20" 13 lbs. FT239 (2)FT39W/2G11 20" 13 lbs. FT140 (1)FT40W/2G11 25" 19 lbs. FT240 (2)FT40W/2G11 25" 19 lbs. FT150 (1)FT50W/2G11 25" 19 lbs. FT250 (2)FT50W/2G11 25" 19 lbs. FT155 (1)FT55W/2G11 25" 19 lbs. FT255 (2)FT55W/2G11 25" 19 lbs. *†CFM270 (2)CFM70W/GX24 25" 19 lbs.	Remote Ballast LS8: Simple Yoke LD8: Deco Yoke LK8: Knuckle Integral Ballast LS9: Simple Yoke LS13: Simple Yoke 	SGW: Semi-Gloss White SGB: Semi-Gloss Black ALP: Aluminum Paint (matte finish) LGP: Light Gold Iridescent (gloss finish) PBP: Pale Bronze Paint (gloss finish) CPF: (MOD) Custom Painted Finish	X: No Options SV: (P1 only) Short Visor SB: Straight Blade Baffle (external mount CFM lamps only) PB: Parabolic Blade Baffle (internal mount) EM: (remote) Emergency Battery CA: (CFM lamps only) Clear Acrylic Lens SO: (MOD) Special Option	STD: Indicate only when specifying a standard. MOD: Indicate when specifying any modification. PHOTOMETRY (1) FT40W Refer to Technical Section for detailed Photometry Reports. Report #10935
		Linear Fluorescent - For single linear or continuous row applications see Surface Linear Tab. Note: CFM42 lamp is a "delta" pattern lamp. CFM57 and CFM70 lamps are "octa" pattern lamps.	† Wet label and CA option are available for CFM type lamps only. *Consult Factory for availability of CFM57 and CFM70 lamps.			

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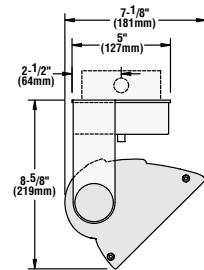
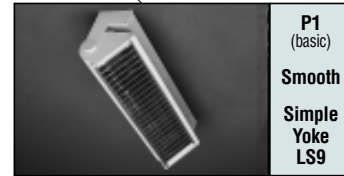
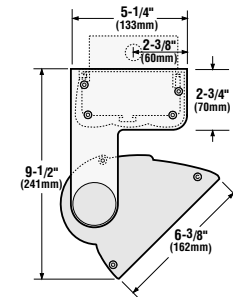
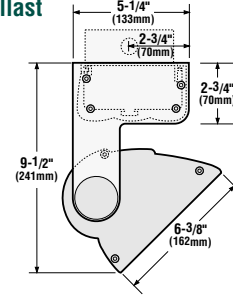
Large Ceiling Mount

MOUNTING STYLES*

Remote Ballast



Integral Ballast



NEW!



* P1 profile can be combined with any mounting style

PAGE:SC.8

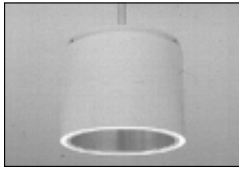
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Pendant

**Compact Fluorescent
(2) 13w, 18w or 26w
Quad Tube**

**Pendant-Mounted
Cylinder Downlight**

10"



Applications: The classic cylindrical shape, pendant mounted, to provide downlighting in high ceilings. Easy to install and maintain, this energy efficient luminaire suits a wide variety of projects.

Type: _____

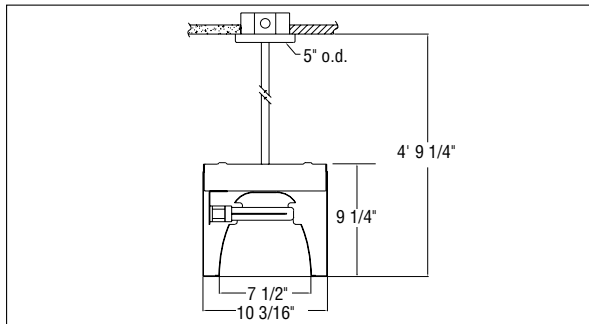
Project: _____

ORDERING NOTE: Fixture supplied as complete unit. Specify fixture, reflector finish, fixture finish and options.

▼ Fixture ▼ Reflector Finish ▼ Fixture Finish ▼ Ballast/Voltage ▼ Options

			U	
1580 Pendant-Mounted Cylinder Downlight, (2) 13w Quad Tube 1583 Pendant-Mounted Cylinder Downlight, (2) 18w Quad Tube 1587 Pendant-Mounted Cylinder Downlight, (2) 26w Quad Tube	CL Clear Specular GD Gold Specular Alzak®	WH White SP Specify Color (approved color chip required)	U Multivoltage 120/277V	FS Fusing HDM Dimming Electronic (18w or 26w only)* EEB4 Stand-By Battery Pack (18w or 26w only)* 77500 Stand-Off and Lens (Diffuse)* 77600 Stand-Off and Lens (Clear)*

*consult factory



IBEW Union Made

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 Highland, NY 12528-2630
 TEL (845) 691-6262 • (800) 932-0633 • FAX (845) 691-6289
 89 00149 9/00

1. Socket Assembly - 16 gauge galvanized formed steel stationary socket assembly.

2. Ballast - One two-lamp, thermally protected Class P electronic ballast is supplied. Micro-processor-controlled ballast operates on 120/277v, 60 Hz.

3. Junction Box - 4" round or octagonal, supplied by others.

4. Mounting Pan - 20 gauge steel base pan.

5. Pendant Mounting Assembly - Canopy and pendant supplied with

40° hang straight swivel. Standard pendant length is 4'. Custom lengths are available (consult factory). Pendant is field-cuttable.

6. Lamps/sockets - Two 13w, 18w or 26w quad tube T4 (supplied by others). Two G24q-1 sockets (for 13w), G24q-2 (for 18w) or G24q-3 (for 26w) quad tube T4 lamps. Lampholders are supplied pre-wired to ballast.

7. Reflector - Aluminum reflector photometrically designed for horizontally-oriented quad tube T4 fluorescent lamps. Finished with 99.98% pure clad, anti-iridescent

aluminum coating, polished and sealed. Gold Alzak® finish is also available.

8. Fixture Housing - .050" spun aluminum housing painted with thermosetting powdercoat (specify finish).

9. Weight - 7.0 lbs. without pendant.

Note: For EM or HDM, consult factory. Height of fixture will increase.

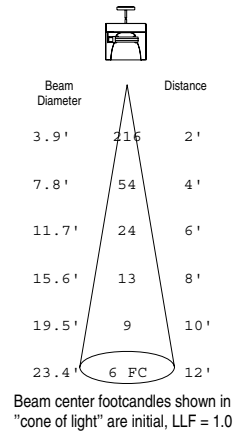
In a continuing effort to offer the best product possible, we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product.

SP-2

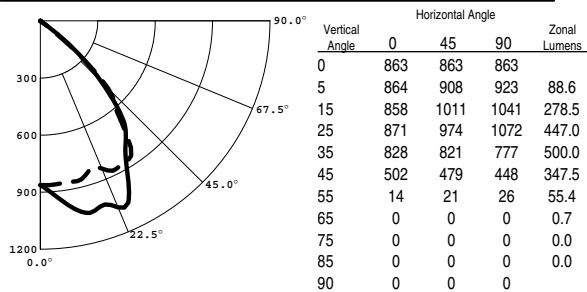
ZUMTOBEL STAFF
 THE LIGHT ®

Photometric Data

1587 CL (2) 26W CFL
 10° PENDANT MOUNTED DOWNLIGHT
 ITL 35501
 Total Luminaire Efficiency 48%
 0% Uplight 100% Downlight
 Spacing Criteria
 Lateral Plane 0 90
 1.4 1.4
 TOTAL LAMP LUMENS = 3600
 INPUT WATTS = 50



Candela Distribution



Luminance Data in Candela / Sq. Meter

Angle in Vertical	Average 0	Average 45	Average 90
45	24908	23742	22229
55	856	1285	1590
65	0	0	0
75	0	0	0
85	0	0	0

Coefficients of Utilization

Effective Floor Cavity Reflectance = 20%

pcc	0.8				0.7				0.5				0.3				
	0.7	0.5	0.3	0.1	0.7	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
0	57	57	57	57	56	56	56	56	53	53	53	51	51	51	51	51	51
1	54	53	51	50	53	52	50	49	50	49	48	48	47	46	46	46	46
2	51	48	46	44	50	47	45	44	46	44	43	44	43	42	42	42	42
3	48	44	41	39	47	44	41	39	42	40	38	41	39	38	38	38	38
4	45	41	37	35	44	40	37	35	39	36	34	38	36	34	34	34	34
5	42	37	34	32	41	37	34	31	36	33	31	35	33	31	31	31	31
6	39	34	31	28	39	34	31	28	33	30	28	32	30	28	28	28	28
7	37	32	28	26	36	31	28	26	31	28	26	30	27	25	25	25	25
8	35	29	26	24	34	29	26	23	28	25	23	28	25	23	23	23	23
9	32	27	24	21	32	27	24	21	26	23	21	26	23	21	21	21	21

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SP-2A

ZUMTOBEL STAFF
 THE LIGHT ®

Micro Cove Mount



Profile - P1 (basic): Anodized, extruded aluminum specular reflector with solid aluminum endcaps and stainless steel hardware.

Type - Micro reflector profile for concealed applications. For indoor use only.

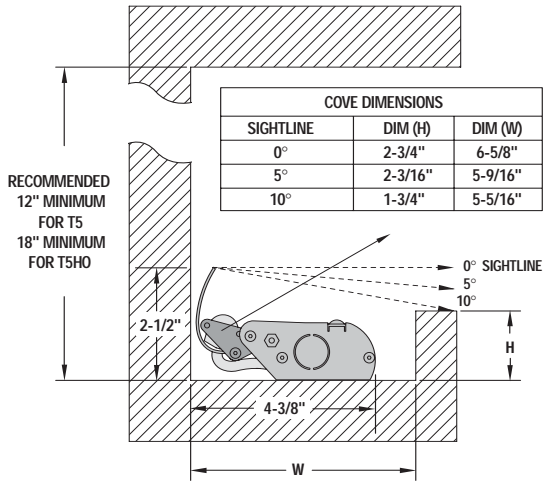
Mounting - Integral electronic ballast with fully adjustable and lockable aiming mechanisms. Fixtures may be mounted end to end and aimed individually without gaps between them. Mounting holes located within ballast compartment. Universal base or wall mount.

Performance - Asymmetric distribution provides a concentration of light on target surface for smooth illumination. Maximum candlepower aimed 115° above nadir has less than 15% spill light within the 0-115° zone and less than 3% spill light within the 180-270° zone.

Electrical - Electronic HPF ballast, with end of lamp life protection circuit, less than 10% THD. Class P and thermally protected. Provide 90° C supply wire. Ballast compartment includes conduit entry at each end for through-wiring when mounted end to end. Access to ballast is gained via removable cover that runs the length of the enclosure. Specify Quick Connect (QC) wiring option for fast through wiring of multiple sections.

Finishes - Bright anodized specular reflector with mill finished aluminum components and stainless steel hardware.

Options - See below specification worksheet for a complete list of options for this product.



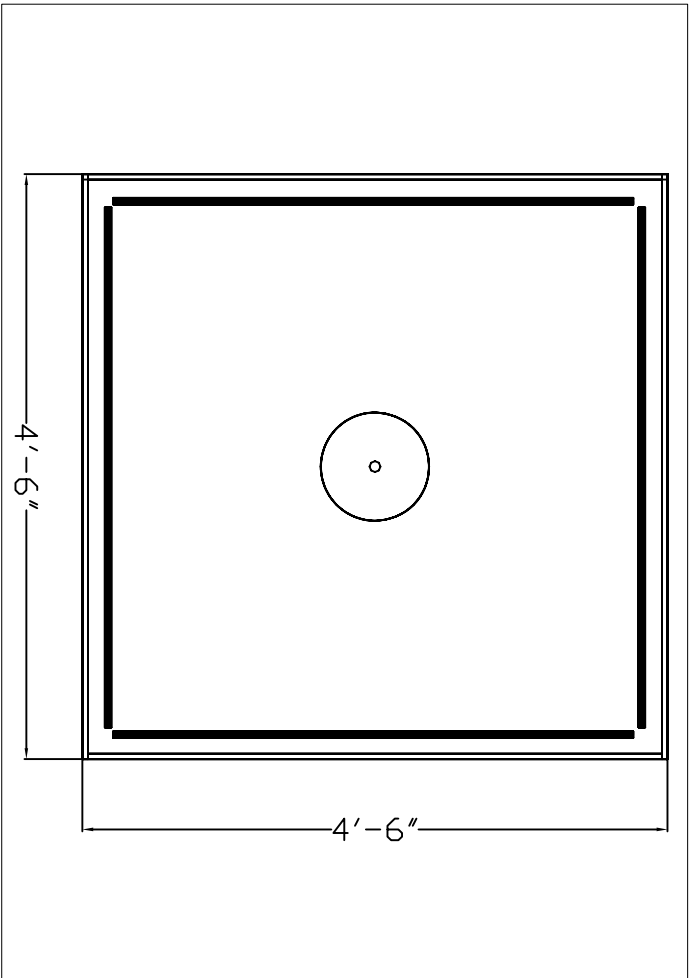
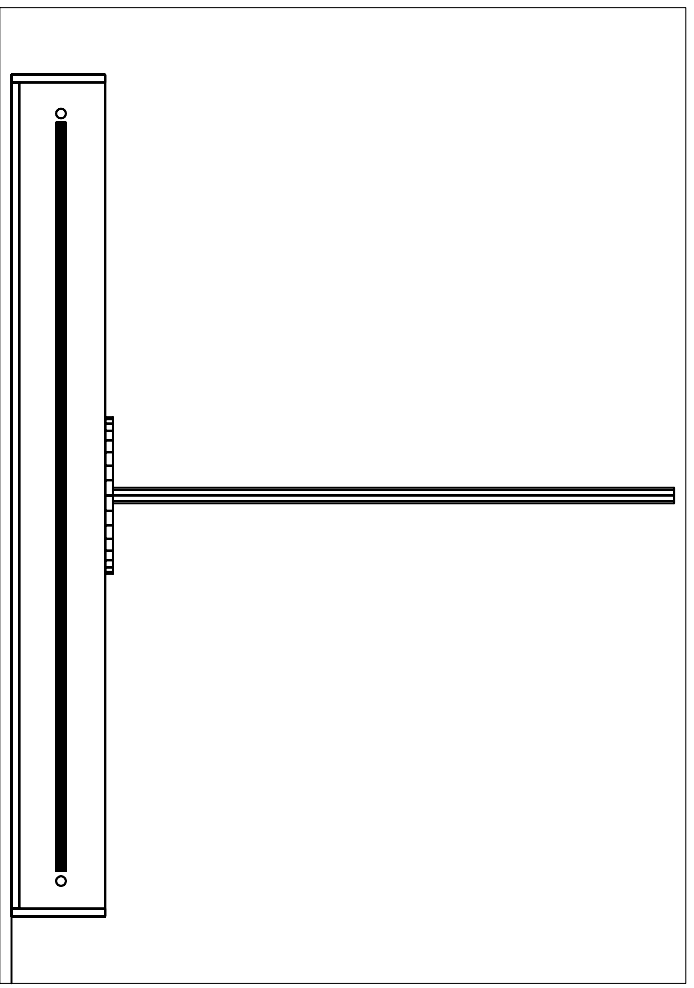
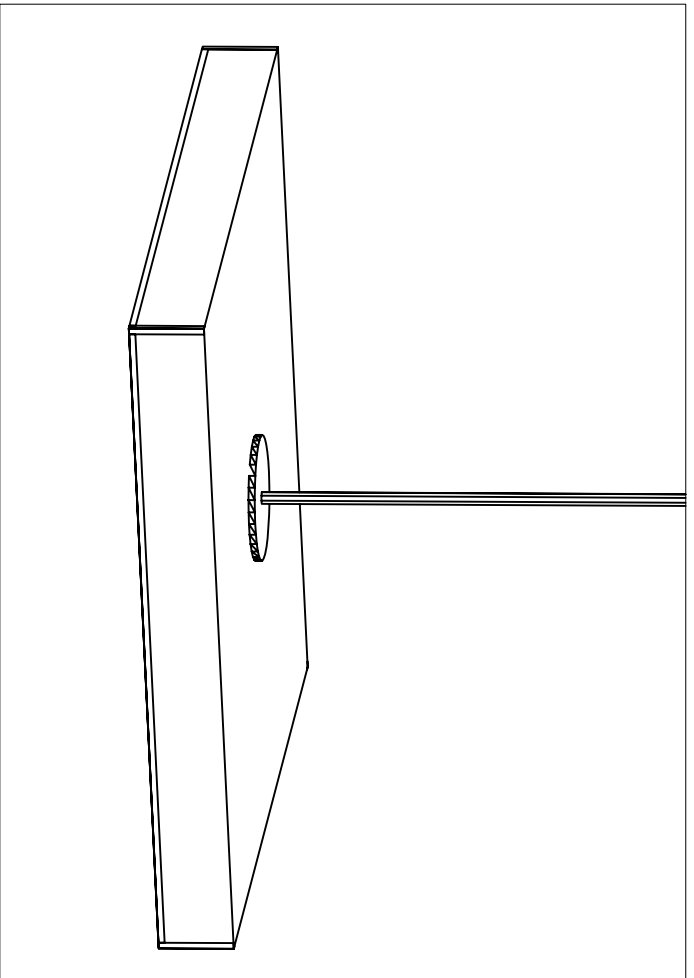
Lamp Code	Lamp Wattage	Actual Luminaire Length	Weight
124T5 or 124T5/HO	1-14w or 1-24w/HO	23"	3 lbs.
136T5 or 136T5/HO	1-21w or 1-39w/HO	34-13/16"	4 lbs.
148T5 or 148T5/HO	1-28w or 1-54w/HO	46-5/8"	5 lbs.
160T5 or 160T5/HO	1-35w or 1-80w/HO	58-7/16"	6 lbs.
272T5 or 272T5/HO	2-21w or 2-39w/HO	69-13/16"	8 lbs.
296T5 or 296T5/HO	2-28w or 2-54w/HO	93-7/16"	10 lbs.

HOW TO SPECIFY								
PROFILE	TYPE	LAMPING CODE		VOLTAGE	MOUNTING	FINISH	OPTIONS	
<p>P1 (basic)</p>	Indoor Locations:	MC: Micro Cove	Lamp Count	Nominal Length	Lamp Type	120 or 277	Integral Ballast MCVU	
			1	24"	T5(1-F14w)			
			1	36"	T5(1-F21w)			
			1	48"	T5(1-F28w)			
			1	60"	T5(1-F35w)			
			2	72"	T5(2-F21w)			
	<p>(base mount)</p> <p>OR</p> <p>(wall mount)</p>	RA: Anodized Aluminum	X: No Options EM: (remote) Emergency Battery SO: (MOD) Special Option QC: Quick Connect (see product text) DM: Dimming Ballast (10%-100% range)	STD: Indicate only when specifying a standard. MOD: Indicate when specifying any modification.	<p>PHOTOMETRY</p> <p>F54WT5/HO Refer to Technical Section for detailed Photometry Reports. Report #10900</p>			
						2	96"	T5(2-F28w)
						1	24"	T5/HO(1-F24w)
						1	36"	T5/HO(1-F39w)
						1	48"	T5/HO(1-F54w)
						1	60"	T5/HO(1-F80w)
						2	72"	T5/HO(2-F39w)
						2	96"	T5/HO(2-F54w)

INDOOR

PAGE:CC.3

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Custom Square Pendant

4'-6" Square

Frosted Acrylic Glass on sides and bottom

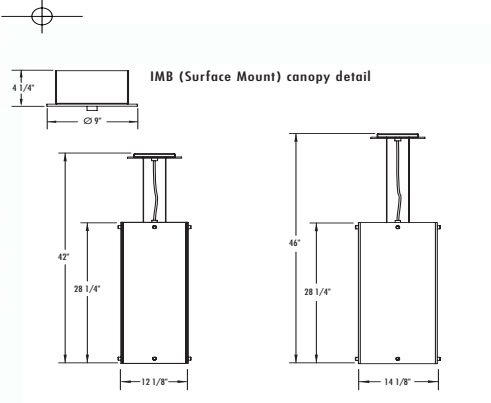
Solid top, inside painted matte white

(4) 28T5 lamps mounted as shown above

Type F



5450
SHARIS



SUBMITTAL SPECIFICATIONS:

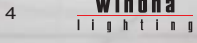
5450	CATALOG NUMBER	LAMPING	VOLTAGE	LENS OPTION	FINISH	BALLAST	SPECIAL
------	----------------	---------	---------	-------------	--------	---------	---------

PRODUCT SPECIFICATIONS:

Catalog#:		5450-10, 5450-12	
Lamping:	5450-10	F - F/H100- F/MH100-	(4) FT40W/2G11 (4) FT40W/2G11 and (1) 100W Par 38 Halogen Downlight (4) FT40W/2G11 and (1) 100W Par 38 Metal Halide Downlight
	5450-12	F - F/H250- F/MH100-	(4) FT50W/2G11 (4) FT50W/2G11 and (1) 250W Par 38 Halogen Downlight (4) FT50W/2G11 and (1) 100W Par 38 Metal Halide Downlight
Voltage:	120V or 277V <i>(when using Halogen Downlight 120V only)</i>		
Lens Option:	FAH is our Hand Painted Acrylic. See page 13 for an example or visit our website for more information.	QA- WLG- FAH4- FAH5- FAH6- FAH7-	Opal Acrylic - Etched White Laminated Glass (Shown) White Vein Hand Painted Foxx Alabaster Antique (Brige) Hand Painted Foxx Alabaster Grey Vein Hand Painted Foxx Alabaster Beige Vein Hand Painted Foxx Alabaster
Finishes:	Standard	BN- BB- CPF- CMF-	Brushed Nickel (Shown) Brushed Brass Custom Painted Finish (Consult Factory) Custom Metal Finish (Consult Factory)
Ballast:	Metal Halide	IMB- RMB-	Integral Electronic (See Surface Mount Canopy Detail) Remote Mount Magnetic
	Fluorescent**	DIM-	Dimming (Lutron ECO 10)
	Fluorescent/Metal Halide**	DIM/IMB- DIM/RMB-	Dimming (Lutron ECO 10) / Integral Electronic (See Surface Mount Canopy Detail) Dimming (Lutron ECO 10) / Remote Mount Electronic
Special:		STD- MOD-	Standard Modified Standard
Weight:		F- F/H- F/MH-	10- 40 lbs. 12- 55 lbs. NOTE: For fixtures over 50 lbs. additional mounting support required. 10- 45 lbs. 12- 60 lbs. 10- 55 lbs. 12- 70 lbs.

** Dimming option for Fluorescent lamps only; Lutron ECO-10 ballast's offer 100% to 10% dimming. ECO-10 ballast's are fully compatible with Lutron's complete line of 3-wire fluorescent controls.

5451 / LESLEY COMPLIMENTARY WALL BRACKET - SEE PAGE 12 FOR BRACKET SPECIFICATIONS



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Job Name: _____

Type: _____

Order Number: _____

M2907 Series 120/277V PAR38

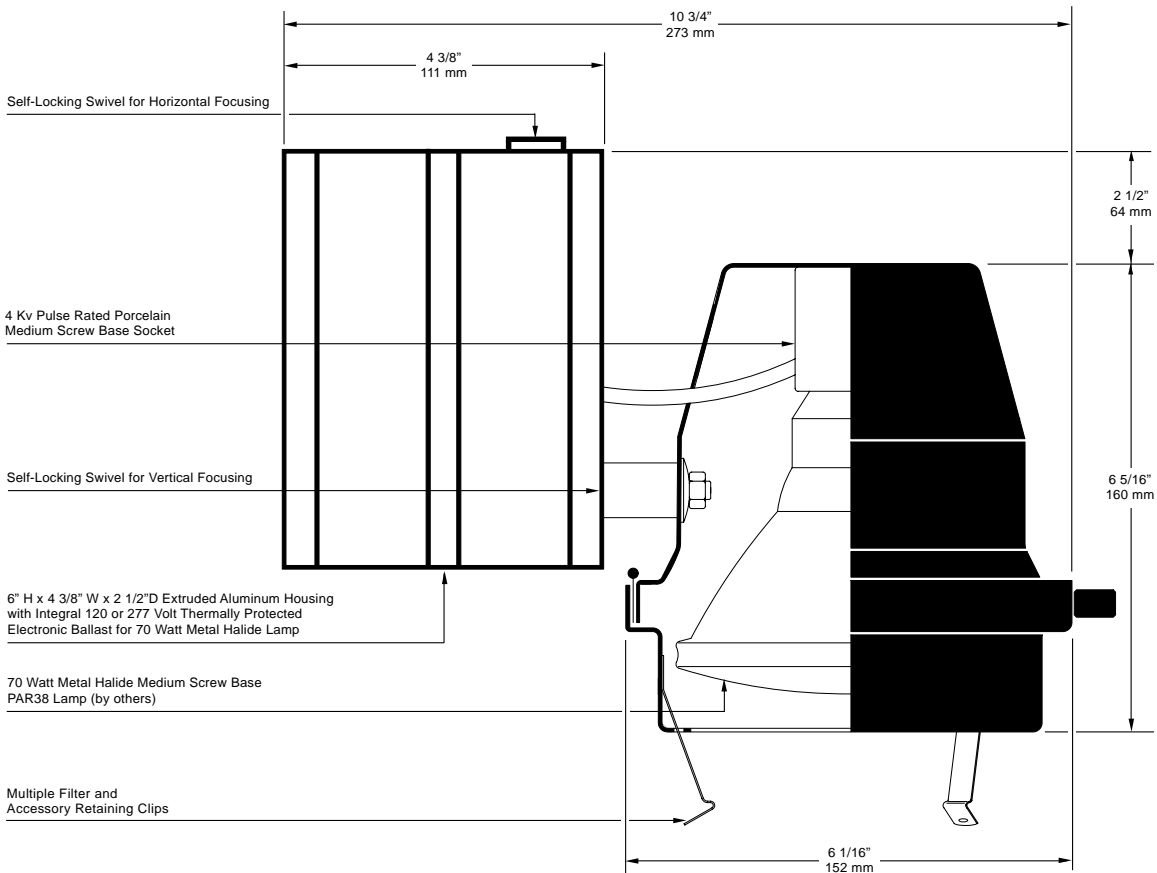


The M2907 Spotlight Series is a specification grade medium and long throw, high intensity unit specifically designed for the 70 watt PAR38 ceramic Metal Halide medium screw base lamps, which are highly efficient and long lived. Its light weight and functional styling also make it the perfect unit for all retail, display and exhibit, architectural and residential environments.

Features include rugged steel and aluminum construction, on/off switch on most mounting types, and multiple accessory clips for Size C accessories which include: Color Filters and Spread Lens, Louver, Hoods, Light Blocking Screens and UV Blocking Filter. Unit available with 120 volt or 277 volt ballast.

UL and CUL Listed
USA Manufactured/IBEW

M2907-00 (120V)
VM2907-00 (277V)



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Job Name: _____

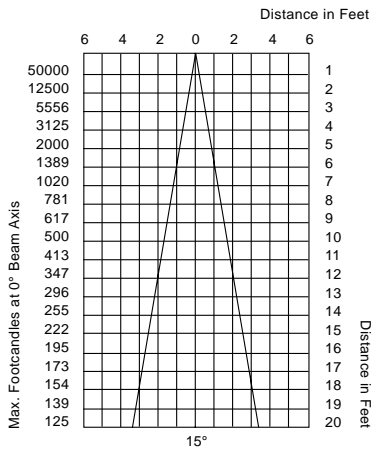
Type: _____

Order Number: _____

M2907 Series 120/277V PAR38

Photometric Data ⁴

CDM70/PAR38/SP/3K 70 watt, Spot
Beam Spread to 50% of CBCP 15°
Center Beam Candlepower 50000



CDM70/PAR38/SP/4K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 15°
Center Beam Candlepower 42000
Color Temperature 4000K
Color Rendering Index 92

CDM70/PAR38/FL/4K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 16000
Color Temperature 4000K
Color Rendering Index 92

CDM70/PAR38/WFL/4K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 60°
Center Beam Candlepower 4000
Color Temperature 4000K
Color Rendering Index 92

Ballast Type (Electronic)
ANSI Specification M98
Maximum Input Current 120/67, 277/29
Input Power 120/78W, 277/79W
Power Factor >95%
THD <10%, Nominal 6%

Accessories

Louver C
1/2" cellular metal louver, controls spill light and glare, 45° cutoff.

Hood C
3" deep cylindrical hood controls spill light and glare, black interior.

Hood Sparkle C
3" deep cylindrical hood controls spill and glare, with decorative sparkle effect.

Cross Baffle C
2 1/8" deep cylindrical cross baffle hood, controls spill light and glare, black interior.

Delta Baffle C
2 1/8" deep cylindrical delta baffle hood, controls spill light and glare, black interior.

Barndoor C
4-way individually adjustable blades for control of light beam.

Glass Color Filters, Size C
Selection of 95 permanent rimmed dichroic, and rimmed and slotted standard colors.

Spread Lens C990
Permanent glass for spreading light beam in one axis, 5°X50°, rimmed and slotted for heat expansion.

Spread Lens C992
Permanent molded glass lens for spreading light beam in one axis—nominal 5°X30°.

Spread Lens C995
Permanent molded glass lens for spreading light beam in all directions—nominal 50°X50°.

Spread Lens C996
Permanent molded glass lens for spreading light beam slightly more in one direction than in the other—nominal 45°X50°.

Beam Softener C998
Permanent glass lens for conditioning light to create a softer beam.

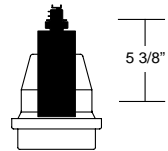
OPTIVEX™ UV Blocking Filter C962
Eliminates ultra-violet wavelengths below 410±10nm. Especially useful for conservation of artworks and to help prevent fading.

Coiled Cord
18/3 105°C, 18" retracted, 6 foot extended. Specify by adding suffix **CC** to model number. White fixture supplied with white cord, all other finishes supplied with black cord.

Ordering Information

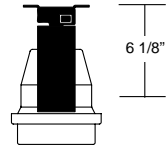
Model Number
add prefix **V** for **277 Volt**
add suffix letters for finish

M2907-00
Lexan Fitting for 1 and 2 circuit LSI Track. With switch.

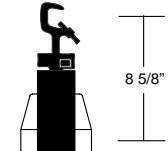


M2907-00F
Same as above, with fuse.

M2907-2G
Universal fitting for Unistrut Systems and any screw or bolt-up applications. With switch, 6-foot 3-wire grounding cord and plug.

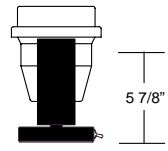


M2907-3G
C-clamp for pipes from 5/8" to 1 1/4" O.D. With switch, 6-foot 3-wire grounding cord and plug.

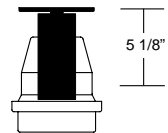


M2907-3GA
Same as above for pipes from 1" to 2" O.D. Change 8 5/8" to 9 7/8"

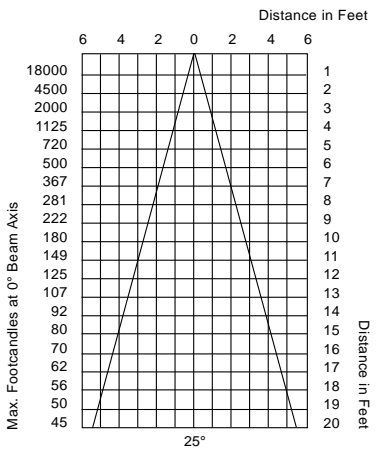
***M2907-4G**
Cushioned weighted base for floor or table use. With switch, 6-foot 3-wire grounding cord and plug.



M2907-5A
Canopy for permanent mounting on standard 4" octagonal outlet box.



CDM70/PAR38/FL/3K 70watt, Flood
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 18000



Lamp Types

CDM70/PAR38/SP/3K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 15°
Center Beam Candlepower 50000
Color Temperature 3000K
Color Rendering Index 82

CDM70/PAR38/FL/3K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 18000
Color Temperature 3000K
Rendering Index 82

CDM70/PAR38/WFL/3K 70 watt, 10000 hours
Beam Spread to 50% of CBCP 60°
Center Beam Candlepower 5000
Color Temperature 3000K
Color Rendering Index 82

Light Blocking Screens, Size C
C801S-20% Light Blocking, C802S-30% Light Blocking, C803S-40% Light Blocking Stainless Steel Screens. Used individually or in combination to reduce transmitted light without changing its color temperature.

Finishes (Paint)
Black (suffix B)
White (suffix W)
Silver (suffix S)
Graphite (suffix G)
Platinum (suffix P)

Notes:
1. CBCP = Center Beam Candlepower
2. K = Color Temperature in Kelvin degrees
3. OPTIVEX™ glass is a trademark of Bausch & Lomb Inc.
4. Lamp manufacturers published data
*Non-UL and Non-CUL

Lighting Services Inc 2 Kay Fries Drive, Stony Point NY 10980-1996 / +1 845 942-2800 Fax +1 845 942-2177 / www.LightingServicesInc.com CM268 3-03

VL2000™ Spot

l u m i n a i r e



The VARI***LITE**® VL2000™ Spot luminaire is based on the groundbreaking technology used in some of the most popular and innovative spotlights in the history of automated lighting. The VL2000 Spot luminaire features an upper enclosure that houses the control electronics as well as a power factor corrected arc power supply for the 700 watt short arc lamp. The VL2000 Spot luminaire also features a zoom lens system and rotating gobos. The luminaire is small, fast, lightweight and virtually silent.

The VL2000 Spot luminaire accepts a wide variety of colors and gobos. Two fixed wheels are included, one factory configured for gobos and the second for color filters. A standard palette of gobos and colors is provided with the unit. Custom gobos are also available.

The VL2000 Spot luminaire can be controlled from a wide variety of DMX-512 consoles.

Programmable Functions

Zoom Optics:	Continuously variable field angle from 19° to 43°, programmable over a timed range of 2 seconds to 20 minutes.
Beam Size Control:	In addition to the zoom optics, a mechanical iris provides continuous beam size control for both rapid changes and smooth timed beam angle changes.
Intensity Control:	Full field dimming designed for both smooth timed fades and strobe effects.
Color/Fixed Gobo Wheels:	Two wheels, each providing 11 easily loaded positions for dichroic color and gobo choices.
Rotating Gobo Wheel:	Six-position rotating gobo wheel with five rotatable, indexable gobo positions and one open position.
Edge & Pattern Focus:	Variable beam focus to soften edges of gobos or spots.
Pan & Tilt:	Smooth, timed continuous motion by way of a three-phase stepper motor system.
Range:	Pan - 540°, Tilt - 270°.
Accuracy:	0.3° resolution.

Description

Source:	700 Watt Short Arc Lamp	Color Temperature	5600°K
		CRI	80
Output:	15,500 lumens.		
Power Requirements:	Standard AC power distribution from 90-264 VAC, 50/60 Hz. The unit requires 4 to 12 A depending on the AC supply voltage.		
Reflector:	Precision glass reflector with dichroic cold mirror coating.		
Operational Temperature:	-20° to 122°F (-29° to 50°C). Note: Derate to 113°F (45°C for operation below 100 VAC).		
Cooling:	Forced air cooling.		
Control:	Completely compatible with a wide variety of DMX-512 consoles.		
Mounting Position:	The VL2000™ Spot luminaire can be mounted and operated in any orientation.		
Spacing:	Hangs on 19.0 in. (48.3 cm) centers.		
Weight:	55 lbs (25 kg) with rails.		

Accessories

71.2528.0700	700 Watt Short Arc Lamp
22.9620.0194	Safety Cable Assembly
55.6840.0001	Truss Hook, Mega-Clamp, Round and Square
55.6841.0001	Truss Hook, Mega-Claw for 2" Round Tube

PART # : 20.9673.0001



VARI*LITE****
Express yourself.
a Genlyte company

VL2000™ Spot

l u m i n a i r e

Specifications

The unit is an integrally designed, remote-controlled, motorized spot luminaire. The head, yoke and enclosure housings are constructed of aluminum alloy, plastic and steel for lightweight strength and durability. Virtually silent fans provide forced-air cooling for internal components. The rear cap is removable, providing easy access to the lamp for replacement.

A single AC input cable along with two, five-pin DMX-512 compatible connectors (in and through) are provided. The unit can be controlled by a wide variety of DMX-512 consoles. In addition, a built-in Master/Slave function enables operation of multiple luminaires without a control console.

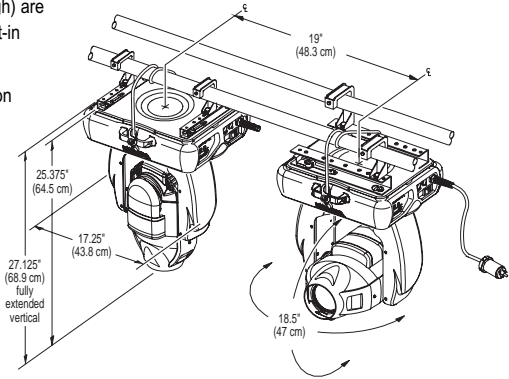
Each unit is equipped with multiple on-board processors providing diagnostic and self-calibration functions as well as internal test routines and software update capabilities.

The unit contains two independent three-phase stepper motors to provide movement of the head through 540° in the horizontal plane (pan) and 270° in the vertical plane (tilt). The pan and tilt mechanisms are belt-driven, providing positional resolution and repeatability of 0.3° on either axis.

Two continuously spinning, removable filter wheels are integral to the luminaire. Each wheel holds up to eleven interchangeable dichroic color or gobo choices to allow for custom configurations. In addition, a gobo wheel containing five individually rotating, indexable gobos is included. Its operation is achieved by two motors, which provide independent drive regardless of the direction of movement. All five rotating gobos are easily interchangeable to allow further customization of the unit. (A wide selection of color and patterned gobos is available from Vari-Lite.)

The unit contains an aluminum dimmer blade that provides full field dimming and allows for smooth timed fades and fast blackouts, as well as variable strobe effects. A mechanical iris provides continuous beam size control for both rapid changes and smooth timed beam angle changes. Variable beam focus is provided to soften the edges of gobos or spots and to provide gobo morphing. A powerful zoom lens system offers an adjustable field angle from 19° to 43°. When used in combination with the beam size iris, the unit can project a beam with a field angle of 8°.

The unit is ETL and ETLc certified and CE marked. Exterior finish is black.



Photometric Data*

VL2000 Spot Luminaire - 700W Metal Halide					
Zoom Lens Positions	Candela* (cd)	Beam Angle (DEGREES)	Beam Diameter TN ¹	Field Angle (DEGREES)	Field Diameter TN ¹
NFOV	297,000	15.0°	.263	18.5°	.326
MFOV	104,000	25.0°	.443	30.5°	.545
WFOV	50,000	34.5°	.621	42.5°	.777

¹ Multiply distance by Tn to determine coverage.

To calculate center beam illuminance (I), at a specific distance (D): $I = \frac{cd}{D^2}$
 — if (D) is in feet, (I) is in foot candles
 — if (D) is in meters, (I) is in lux

* Note:
 All data taken with seasoned light source at 20 hours of life.
 Fixture output = 15,500 lumens.

VARILITE***[®]
 Express yourself.
 a Genlyte company

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Vari-Lite
 10911 Petal Street
 Dallas, TX 75238
 1.877.VARILITE
 fax: 214.647.8038
 www.vari-lite.com

CE
 03/05, 5K

ROCKET I SPECULAR ALZAK OPEN HIGHBAY



TYPE: _____ **PROJECT:** _____

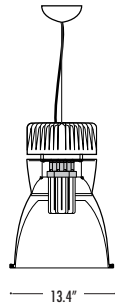
ORDER NUMBER:

Model#	Lamp Qty.	Wattage	Ballast	Options
7714	1, 2, 3	26-42 CF	UE, SS	D3, D4, D5, EM
7714	1, 2	57-70 CF		CM1
7714	1	70,100 MH	MH1, MH2	Q1, Q2
7714	1	INC150 W		
7714	1	85 QL	QL1	

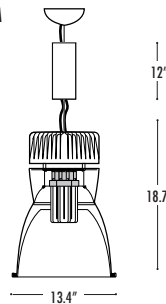
COMPACT FLUORESCENT

Housing is .063 spun matte anodized aluminum. Canopy mounts to standard J-boxes; suspends from aircraft cables with push button gliders; and supplied with 6 foot power cord. Order **CM1** pipe mount for outdoors. Sockets and ballasts operate 26, 32 and 42 watt triple tubes; voltage is 120 thru 277V. Separate switching **SS**, dimming ballasts **D** and emergency battery pack **EM**. Voltage must be specified. U.L. listed for damp locations.

7714
fluorescent



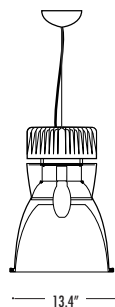
7714/EM
fluorescent
emergency
pack



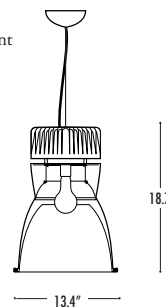
**METAL HALIDE/
INCANDESCENT**

Housing is .063 spun matte anodized aluminum. Canopy mounts to standard J-boxes; suspends from aircraft cables with push button gliders; and supplied with 6 foot power cord. Incandescent 150W max. Metal halide ballasts are electronic, for use with medium base, ceramic arc tube lamps rated for open fixtures. For quartz restrike, order **Q1** for 120V and **Q2** for 277V. U.L. listed for damp locations.

7714
metal
halide



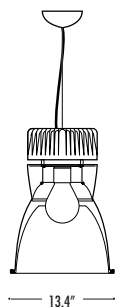
7714
incandescent



QL INDUCTION

Housing is .063 spun matte anodized aluminum. Canopy mounts to standard J-boxes; suspends from aircraft cables with push button gliders; and supplied with 6 foot power cord. The HF generator is electronic component connected to a discharge vessel via a shielded triaxial cable. Voltage must be specified for the 85W lamp. U.L. listed for damp locations.

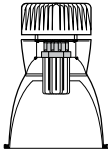
7714
QL
induction



BURBANK,
CALIFORNIA,
91505
WWW.
DELRAY
LIGHTING.
COM

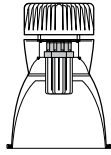
OPEN HIGHBAY

7714332



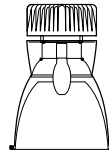
OPEN HIGHBAY

7714342



OPEN HIGHBAY

7714170



BALLASTS

FLUORESCENT BALLASTS

UE Universal electronic
wattage: 26, 32 and 42
voltage: 120 thru 277
All **UE** and **SS** models have sockets
and ballasts that operate 26, 32 and
42 watt lamps.

SS Separate switching for 3 lamps

CONE OF LIGHT

MTG. HT.	FC/0*	DIA.
4'	222	4.3
6'	99	6.4
8'	56	8.55
10'	36	10.6
12'	25	12.8

50% FC at edge

MTG. HT.	FC/0*	DIA.
4'	296	4.3
6'	132	6.4
8'	74	8.55
10'	47	10.6
12'	33	12.8

50% FC at edge

MTG. HT.	FC/0*	DIA.
4'	121	4.3
6'	54	6.4
8'	30	8.55
10'	19	10.6
12'	13	12.8

50% FC at edge

DIMMING NOTES:

Due to different operating temperatures, please review number of lamps that can be used per manufacturers ballast before ordering dimming.

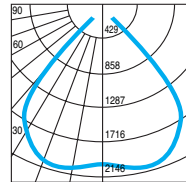
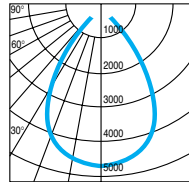
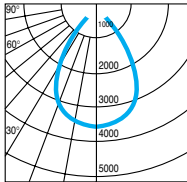
DIMMING BALLASTS

D3 Advance Mark X
wattage: 1,2or 3-26,32,42 or 1-57
voltage: 120 or 277
voltage must be specified
range: 5% - 100%
control wires: none
dimmers: standard incandescent
recommended Advance C500A

D4 Lutron Tu-Wire
Scene control dimming
wattage: 1-32, 2-32,
voltage: 120 only
range: 5% - 100%
control wires: none
dimmers: Lutron Grafik Eye,
Nova T, Diva, Skylark

D5 Advance Mark VII
wattage: 1,2or 3-26,32,42 or 1-57
voltage: 120 or 277
voltage must be specified
range: 5% - 100%
control wires: 2 low voltage
dimmers: 1-10V analog

CP DISTRIBUTION



COEFFICIENTS OF UTILIZATION

	% CEILING 80 (20% FLOOR)		
	% WALL 70	50	30
0	70	70	70
1	68	66	65
2	65	63	61
3	63	60	58
4	60	57	54
5	58	54	52
6	56	52	49
7	54	49	47
8	52	47	44
9	49	45	42
10	46	40	37

	% CEILING 80 (20% FLOOR)		
	% WALL 70	50	30
0	69	69	69
1	66	65	64
2	64	62	60
3	62	59	56
4	59	56	53
5	57	53	50
6	55	51	48
7	53	48	46
8	53	48	46
9	48	44	41
10	45	39	36

	% CEILING 80 (20% FLOOR)		
	% WALL 70	50	30
0	76	76	76
1	73	71	70
2	70	68	66
3	68	65	62
4	65	61	58
5	63	58	55
6	60	56	53
7	58	53	50
8	56	51	47
9	53	51	47
10	49	43	40

NOTES

7714332
3-32 watt triple tube
G24q-3 socket
Total lumens-7200
Spacing criteria-1.0

7714342
3-42 watt triple tube
G24q-4 socket
Total lumens-9600
Spacing criteria-1.0

7714170
1-70 watt ED17
medium base socket
Total lumens-5900
Spacing criteria-1.0

EXTERIOR LOCATIONS

For suspending out side or for any windy location that could cause oscillation, you must order the pipe mount option. Pipe is 7/8" O.D. and is mounted to an earthquake canopy. Pipe replaces power cord and cable. Length of pipe must be specified.

CM1 pipe mount

times square THEATRICAL

FR38 PAR38 Travel Series



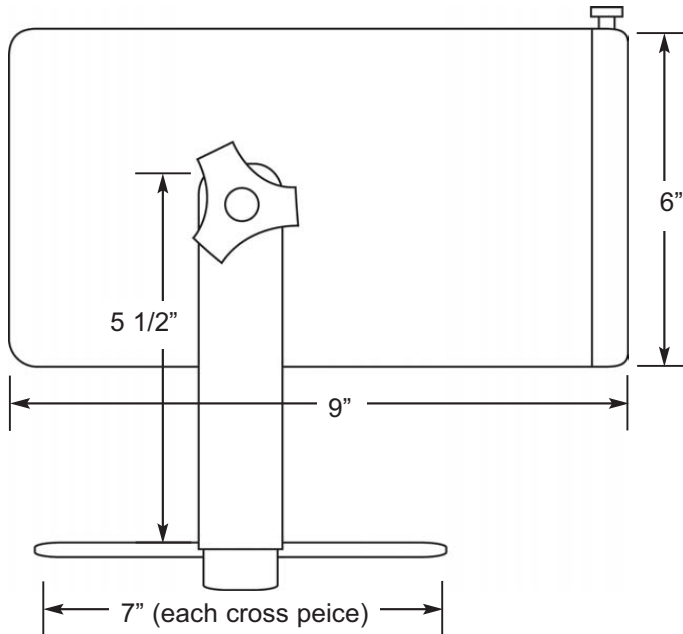
Ideal for rental companies where the installation and break-down needs to be quick and easy. Each unit is supplied with a special X-Bar that acts as a base when opened or pipe mounted when closed. A special spun front omits the need for gel frames. A variety of lamp, accessories and mounting options available.

Product Number: FR38
 Product Reference: 250W Parlight
 Field Angle: 24° - 124°
 Typical Throw: 15 Feet
 Lamp Base: Medium Screw
 Lamp Reference: PAR38
 Weight: 4 lbs

FEATURES:

- Compact Theatrical Design
- Built-in Gel Holder
- Built-in X-Bar for Floor Mounting, can also be Pole Mounted
- Medium Screw Base
- 6' Line Cord with Grounded Edison Plug

Manufactured in the USA - IBEW
 UL Listed



www.tslight.com

TIMES SQUARE LIGHTING
 5 Kay Fries Drive
 Stony Point, NY 10980

Phone: 845-947-3034
 Fax: 845-947-3047
 Email: info@tslight.com

times square THEATRICAL

LAMP TYPES:

90PAR/H/SP10 90W; 2,500Hrs; 10° Beam; 16,000 Candlepower

90PAR/H/FL25 90W; 2,500Hrs; 25° Beam; 4,100 Candlepower

120PAR38/SP 120W; 2,000Hrs; 27° Beam; 11,500 Candlepower

120PAR38/FL 120W; 2,000Hrs; 52° Beam; 4,000 Candlepower

Q250PAR38/SP 250W; 6,000Hrs; 10° Beam; 52,000 Candlepower

Q250PAR38/FL 250W; 6,000Hrs; 30° Beam; 9,000 Candlepower

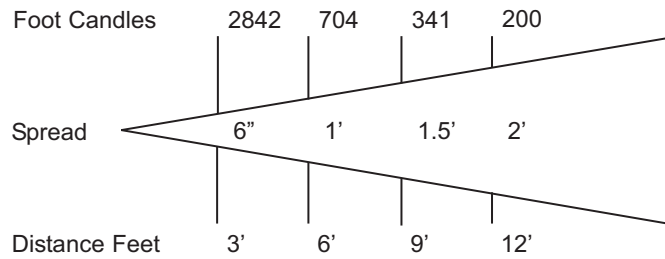
ACCESSORIES:

- SC Safety Cable

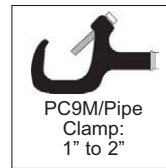
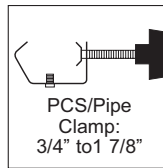
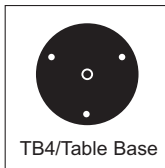
FINISHES:

- Black
- White
- Custom Color

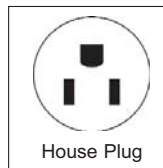
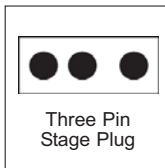
PHOTOMETRICS: 120PAR38/FL



MOUNTING OPTIONS:



CONNECTORS:



Illuminated Handrails

LIGHTRAIL • LR 1

LR 1W Wall Mounted
LR 1P Post Mounted

Description

LR1 Series Lightrail is a flexible system of wall or post mounted illuminated handrails. This asymmetrical design projects illumination to one side along walkways and stairways. LR 1 Series Lightrail is complementary to the LR 2 Series, which should be used when a symmetrical light pattern is required. Companion non-illuminated Lightrail is also available. Design features comply with ADA and other codes.

Features

An angled, high impact acrylic lens provides an asymmetrical illumination pattern that effectively reduces light to the background. To ease maintenance the lens prisms are on the lamp side. Illumination is provided by T5 or T8 fluorescent lamps. The extruded aluminum rail is welded at all intersections and features cast aluminum wall mounting brackets or extruded aluminum posts. The standard finish is a polyester coating, available in a wide range of colors. The optional grip rail with smaller dimensions meets ADA requirements.

Applications

LR 1 Lightrail is ideal as guardrails on pedestrian bridges and stair and ramp railings.

Custom

We would be pleased to discuss the production of modified standard Lightrail or custom railings to suit your specific conditions. Modifications possible include custom extrusions, alternate finishes or materials, mounting adaptations, end treatments and alternate light sources.

To learn more about our custom capabilities and standard product lines call us directly or contact your local Cole representative.

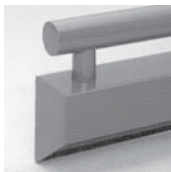


C. W. Cole & Company, Inc.
2560 N. Rosemead Boulevard
South El Monte, CA 91733-1593

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Tel. (626) 443-2473
info@colelighting.com
www.colelighting.com

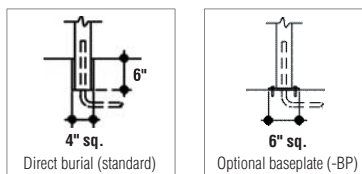
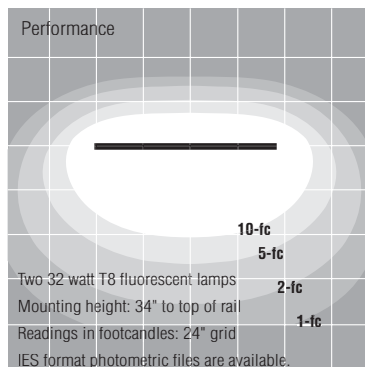
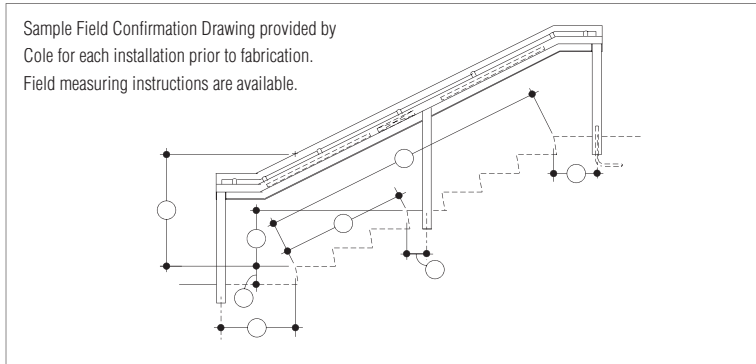
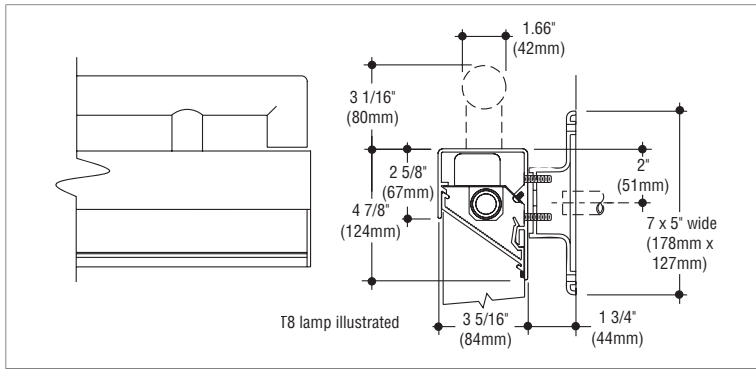


LR 1 Lightrail produces an asymmetrical light distribution pattern that washes walkways with light while reducing illumination to the background.



Optional grip rail may be specified for mounting on the top of the Lightrail when required by ADA or other codes.





Options

- Grip-rail:** 1.66" diameter. Add suffix **-H**.
- Baseplate:** 6" x 6" x 3/8" baseplate with four 5/8" holes. Add suffix **-BP**.
- Pickets:** 3/4" pickets, 4 3/4" on center, top rail 4" below bottom of Lightrail, bottom rail 4" above ground. Add suffix **-K**.
- Non-illuminated:** Without lighting components. Add suffix **-U**.
- Finishes:** Special finishes are available; contact factory.
- Emergency Battery:** Provides battery operation for up to 90 minutes during power outage for all or selected lamps. Add suffix **-EM**.

How to Specify

- Every Lightrail is custom designed and fabricated to your specific project conditions. Architectural drawings are required that clearly show the desired configurations and locations. A detailed drawing (similar to the sample above) will be provided by Cole prior to fabrication for your field verification.
1. Give catalog number, options, lamp size, and voltage. Example: LR 1P-H-T5-120. Lamping will be determined by the factory to maximize even illumination.
 2. Select desired options and add appropriate suffixes.

Illuminated Handrails

LIGHTRAIL-LR 1

LR 1W Wall Mounted
LR 1P Post Mounted

Specifications

Construction

- Railing is extruded .125" wall, 6063-T5 aluminum
- Posts are 3" square, .125" wall extruded aluminum tubing
- Wall brackets are cast aluminum
- Clear, prismatic snap-in lens is extruded high-impact acrylic with prisms on the inside for better maintenance
- Ends and all railing miters are welded and ground smooth
- Optional grip-rail is 1.66" diameter x 0.19" wall aluminum pipe with cast aluminum support
- Medium bronze polyester coating is the standard finish; other colors and finishes are available.

Electrical

- Prewired for T5 or T8 fluorescent lamps with 120V-277V standard (347V available) electronic 0° F (-18° C) ballasts
- Lamping will be determined by the factory to ensure maximum even illumination
- Other lamping available for special applications
- Ballasts in T5 lamp models are above the lamp, allowing continuous illumination
- Ballasts in T8 lamp models are in-line with lamps in railing, and that area is non-illuminated
- UL/cUL listed suitable for wet locations.

Mounting

- Posts are provided to a maximum of 8' centers, wall brackets provided up to 6' centers, subject to spacing requirements of the particular installation
- Posts are provided with extra 6" length for direct burial and 4" square x 6" styrofoam forms for precasting hole; contractor to finish with quick-setting concrete
- 6" x 6" x 3/8" baseplate with four 5/8" holes is available as an option
- Wall bracket allows mounting over conduit stub.



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Concealed Low Voltage Aisle Light

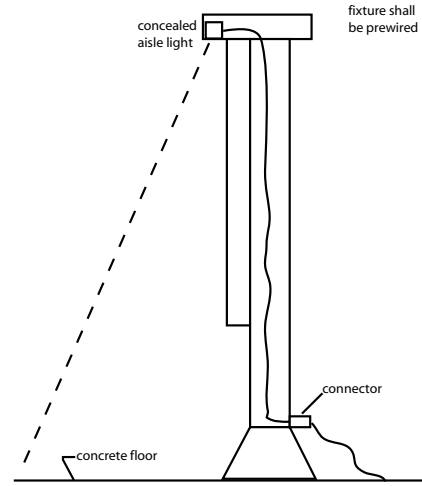
General Description:

The Irwin Concealed Aisle Light fixture is recessed into the underside of the aisle armrest, providing a pattern of illumination on the aisle floor. The wiring to the fixture is enclosed in the tubular steel standard, with an 18" wire lead extending from the bottom of the standard. The electrical connection at site is made by the Electrical Construction Contractor. Aisle lights are wired in parallel and connected to a 24 volt, pre-wired power supply, which is engineered per project.

Advantages:

Irwin's Concealed Low Voltage Aisle Light System offers the following unique advantages:

1. The lighting is indirect, with no visible devices.
2. Minimum Life Expectancy - 13,000 hours
3. Easy fixture replacement
4. Virtually no heat to the touch
5. Available for all style ends
6. Low voltage protects the patron
7. Suitable for outdoor installation with proper modifications
8. Aisle standards are pre-wired at the factory
9. Moderate cost



Specification: Low Voltage Concealed Aisle Light System:

Aisle lights shall be furnished for the aisle standards located as designated on the architectural drawings. Aisle lights shall be low a voltage system (24 VAC Maximum) providing adequate illumination for floor and/or steps adjacent to aisle standards. Light assembly shall be concealed in the aisle armrest, protected from sight and damage and shall be completely pre-wired. Wiring shall extend 18" beyond the base of the standard, and shall be provided with a 3/8" flex-steel conduit connector. The seating supplier shall furnish as part of the aisle light package, suitable power supplies for powering the aisle lights.

Method of Installation:

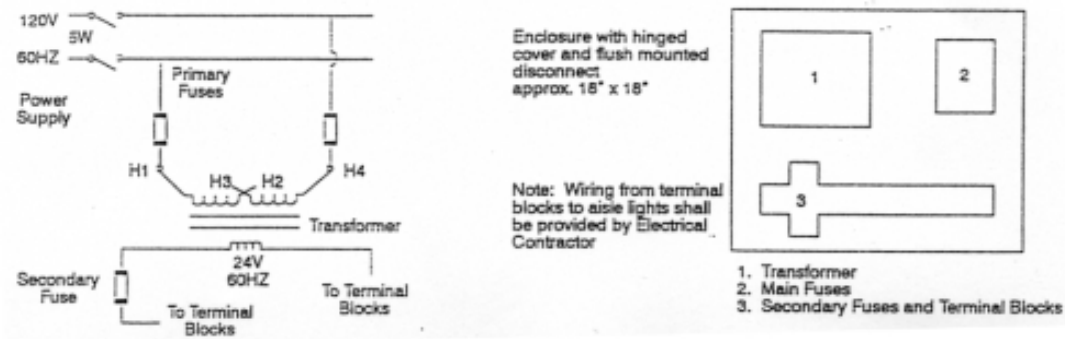
The seating contractor shall erect and set in place the seating end standards containing the pre-wired aisle lights. All wiring connections from the electrical distribution system to the aisle light standards and installation and connection of the transformer(s) shall be the responsibility of the electrical contractor.

-continued-

Detailed Technical Description:

1. **Light Source:**
Enclosed in a 1/4" x 1/4" x 6" clear plastic enclosure with two 48" wire leads.
2. **Aisle Standard Wiring:**
Three wire leads, concealed in the tubular standard, exit the standard just above the foot, and extend 18" beyond the flexible conduit fitting.
24 VAC Power Lead 16 gauge
Common Lead 16 gauge
Ground Lead (Green) 14 gauge
3. **Connector Fitting:**
3/8" x 90 degree flexible metal conduit fitting is supplied for each standard.
4. **Power Supply and House Wiring Specifications:**
Primary Voltage 120 Volts AC, 60 hz. (20 AMP)
Secondary Voltage 24 Volts AC, 60 hz.
Primary Wiring #12 Wire - Consult Electrical Engineer
Secondary Wiring #12 Wire, except where run is longer than 400 ft., then use #10 wire
5. **Power Supply Housing for Aisle Lights:**
Equipment housed in NEMA 12 enclosure with main disconnect, transformer, primary and secondary fuses, and twelve medium/heavy duty terminal blocks.
6. **Power Requirements:**
4 watts per aisle standard (.167 AMP)
24 Volt, 60 Hz
7. **Light Intensity:**
.8 foot candles

Wiring Diagram:



Job Name: Fixture Type: Qty:

Wall Wash by Times Square Lighting



Manufactured in the USA - IBEW



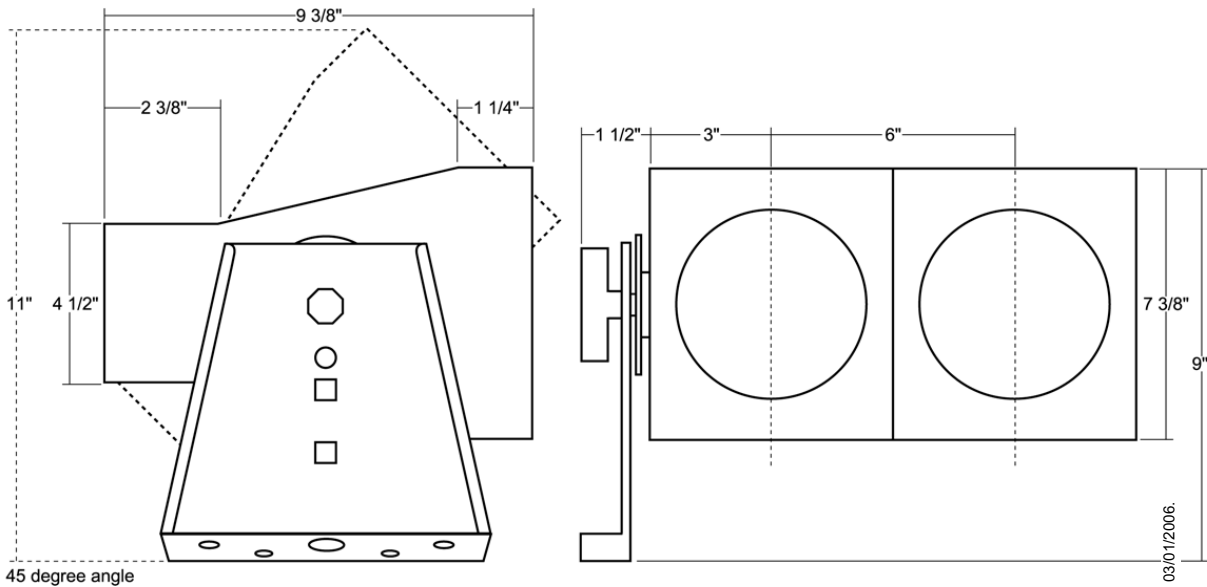
Series 702 90-250W PAR38

702-6 6', 6 compartment, 3 or 4-circuit
702-8 8', 8 compartment, 4-circuit
702-X custom length

The Series 702 borderlight is a multi-lamp, compartmented striplighting fixture designed for use as a general wash of light. Manufactured standard in portable lengths of 6 and 8 feet with 3 or 4-circuit operation, but custom lengths and circuitry are available. Sockets spaced on 6" centers. Ideal for use when toning, color separation or blending is required.

Features:

- Medium screw sockets on 6" centers
- Three 36" lead wires per circuit on portable units
- Spring-loaded color frame holder
- Compartmented for color separation
- Combination glass/gel sheet frame
- Hanging or floor mount hardware available
- Custom lengths and circuitry available



Last updated 03/01/2006.



5 Kay Fries Drive • Stony Point, NY 10980
Phone: 845-947-3034 • Fax: 845-947-3047 • www.tsilight.com
Specifications are subject to change without notice.

Series 702 90-250W PAR38

Specify:	702-	-	-	-
	MODEL NUMBER	FINISH	CONN./MOUNTING	ACCESSORIES (optional)
Example:	702-6	-B	-E2867 -PC9M	-702CF

Lamp Types

90PAR38/SP 90W; 2500Hrs; 10° Beam;
1600 CBCP

90PAR38/FL 90W; 2500Hrs; 25° Beam;
4100 CBCP

120PAR38/SP 120W; 3000Hrs; 12°
Beam; 25500 CBCP

120PAR38/FL 120W; 3000Hrs; 30°
Beam; 8000 CBCP

Q250PAR38/SP 250W; 6000Hrs; 10°
Beam; 52000 CBCP

Q250PAR38/FL 250W; 6000Hrs; 30°
Beam; 9000 CBCP

Connectors

See index for details.

E2867	Edison Plug
E876	Twist Lock
600G	Stage Pin

Mounting Options

See index for details.

PC9M

Heavy duty pipe clamp for larger, heavier fixtures. For pipes 1" to 2" O.D. 6-foot, 3-wire u-ground cord and plug.

SBB

Set of casted trunions.

Accessories

See index for details.

702CF	Combo Color Frame
7074	Color Roundel - available in red, blue, green, yellow and clear. 150-watt lamp max.

Finish

B	Black
W	White
S	Silver
CC	Custom Color

Specifications

Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards




- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

 **LUTRON**® SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:
Job Number:	


Eco-10 Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
 5/8" diameter T5 linear	14W (22")	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
		2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
	21W (34")	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
		2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W (45.3")	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
		2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
 5/8" diameter T5-HO linear high output	24W (21.5")	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
		2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
	39W (33.4")	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
		2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W (45.3")	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
		2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
 5/8" diameter T5 Twin-Tube	36/39W (16")	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
		2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
	40W (22")	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
		2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W (22")	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
		2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2



Job Name:	Model Numbers:
Job Number:	

Eco-10 Ballast Models continued ...

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
T8 linear and U-bent  1" diameter	17W (24")	1	F	.19	ECO-T817-120-1	.08	ECO-T817-277-1
		2	F	.31	ECO-T817-120-2	.15	ECO-T817-277-2
		3	F	.43	ECO-T817-120-3	.20	ECO-T817-277-3
	25W (36")	1	F	.24	ECO-T825-120-1	.12	ECO-T825-277-1
		2	F	.43	ECO-T825-120-2	.19	ECO-T825-277-2
	32W (48")	1	C	- -	- -	.14	E 3 T832 C 277 1
		1	D	.34	ECO-T832-120-1-L	.14	ECO-T832-277-1-L
		1	D	.34	ECO-T832-120-1-T	.14	ECO-T832-277-1-T
		1	F	- -	- -	.15	ECO-T832-277-1
		2	C	- -	- -	.23	E 3 T832 C 277 2
		2	D	.53	ECO-T832-120-2-L	.23	ECO-T832-277-2-L
		2	D	.53	ECO-T832-120-2-T	.23	ECO-T832-277-2-T
2		F	- -	- -	.22	ECO-T832-277-2	
3		F	.82	ECO-T832-120-3	.35	ECO-T832-277-3	



LUTRON SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:
Job Number:	

Eco-10 Overview

Eco-10 lighting management electronic dimming ballasts are designed to maximize the benefits of a lighting management system. Eco-10 offers 100% to 10% dimming, and is ideal for use in any space where saving energy is the primary goal of the design.

Features

- Continuous, flicker-free dimming from 100% to 10%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T5 and T5-HO linear, T8 linear and U-bent, and T5 twin-tube lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T5 and T5-HO linear models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase



Eco-10, case type C

1.18”w (30mm) x 1.00”h (25mm) x 18.00”l (457mm)



Eco-10, case type D

1.58”w (40mm) x 1.00”h (25mm) x 9.50”l (241mm)



Eco-10, case type F

2.38”w (60mm) x 1.50”h (38mm) x 9.50”l (241mm)

Job Name:	Model Numbers:
Job Number:	

Specifications

Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards




- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

 **LUTRON®** SPECIFICATION SUBMITTAL

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Job Name:	Model Numbers:
Job Number:	

Eco-10 Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
 5/8" diameter T5 linear	14W (22")	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
		2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
	21W (34")	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
		2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W (45.3")	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
		2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
 5/8" diameter T5-HO linear high output	24W (21.5")	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
		2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
	39W (33.4")	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
		2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W (45.3")	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
		2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
 5/8" diameter T5 Twin-Tube	36/39W (16")	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
		2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
	40W (22")	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
		2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W (22")	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
		2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2




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Job Name:	Model Numbers:
Job Number:	

Eco-10 Ballast Models continued ...

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
T8 linear and U-bent  1" diameter	17W (24")	1	F	.19	ECO-T817-120-1	.08	ECO-T817-277-1
		2	F	.31	ECO-T817-120-2	.15	ECO-T817-277-2
		3	F	.43	ECO-T817-120-3	.20	ECO-T817-277-3
	25W (36")	1	F	.24	ECO-T825-120-1	.12	ECO-T825-277-1
		2	F	.43	ECO-T825-120-2	.19	ECO-T825-277-2
	32W (48")	1	C	- -	- -	.14	E 3 T832 C 277 1
		1	D	.34	ECO-T832-120-1-L	.14	ECO-T832-277-1-L
		1	D	.34	ECO-T832-120-1-T	.14	ECO-T832-277-1-T
		1	F	- -	- -	.15	ECO-T832-277-1
		2	C	- -	- -	.23	E 3 T832 C 277 2
		2	D	.53	ECO-T832-120-2-L	.23	ECO-T832-277-2-L
		2	D	.53	ECO-T832-120-2-T	.23	ECO-T832-277-2-T
		2	F	- -	- -	.22	ECO-T832-277-2
		3	F	.82	ECO-T832-120-3	.35	ECO-T832-277-3



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Job Name:	Model Numbers:
Job Number:	

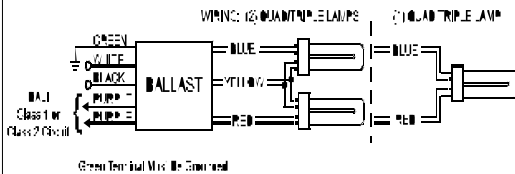


IDL-2S26-M5-BS@120	
Brand Name	ROVR
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

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	0.14	04/16	0.30/1.00	10	0.99	1.6	6.25
* CFQ13W/G24Q	2	13	50/10	0.26	06/31	0.03/1.00	10	0.99	1.6	3.23

Wiring Diagram



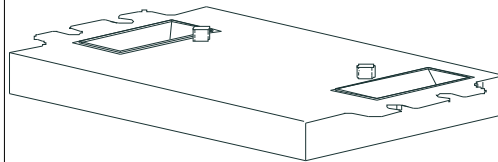
Diag. 165

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

Standard Lead Length (inches)

	in.	cm.		in.	cm.
Black	0	0	Yellow/Blue		0
White	0	0	Blue/White		0
Blue	0	0	Brown		0
Red	0	0	Orange		0
Yellow	0	0	Orange/Black		0
Gray		0	Black/White		0
Violet		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 12/03/2003



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 TRANSFORMER CO.

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

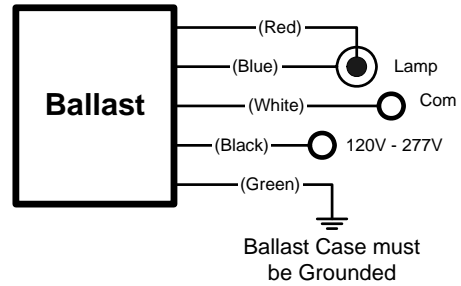
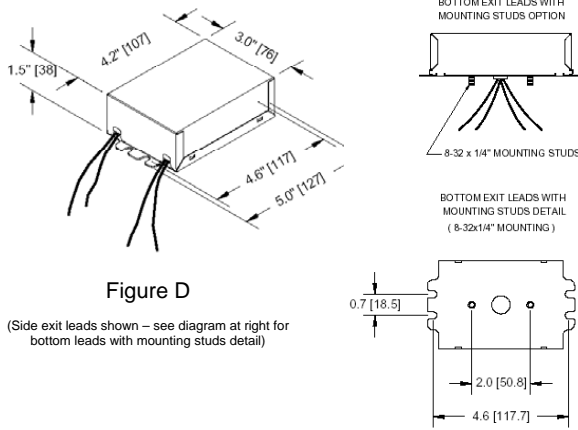


e-Vision® Electronic Ballast for Metal Halide Lamps

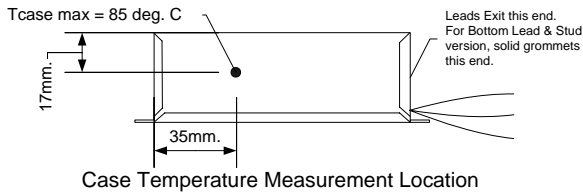
Catalog Number IMH-70-D
 For (1) 70W Metal Halide Lamp
 ANSI M98, M139, M143
 120-277V 50/60Hz Electronic
 Status: Active

DIMENSIONS AND DATA

Lamp Data		Input Volts	Catalog Number*	Line Current (Amps)	Input Power (W)	Ballast Factor	Max THD (%)	Min Power Factor	Wiring Dia	Figure	Weight (lb)	Max Distance to Lamp (ft)
Number	Watts											
70 Watt Lamp, ANSI Code M98, M139 or M143 Minimum Starting Temp -30°C/-20°F												
1	70	120	IMH-70-D-xxx	0.67	80	1.0	15	0.9	3	D	1.6	5
		277		0.29	79							



Wiring Diagram 3



INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 85°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 12 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp

*Ordering Information

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

Data is based on 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 Transformer Co. • 10275 West Higgins Road • Rosemont, Illinois 60018-5603 • (847) 390-5000 • fax: 847-390-5109 • www.advancetransformer.com

A DIVISION OF PHILIPS ELECTRONICS NORTH AMERICA CORPORATION

Revised 1/13/06

Specifications

Performance




- Dimming Range: 100% to 5% measured relative light output (RLO)
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output: constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .95 for T4 quad or triple tube lamps, and greater than .85 for T5 twin-tube lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 10%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer for EMI/RFI emissions requirements
- T4 compact fluorescent ballasts are MIL Std. 461E compliant (meets the requirements of CE101, RE101 and RE102)
- Meets ANSI C62.41 Category A surge protection standards to 6kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001

Job Name:	Model Numbers:
Job Number:	

Compact SE Ballast Models

Lamp Type	Lamp Watts	Lamps per ballast	Case Type	Ballast Current (amps)	120 VOLTS		277 VOLTS	
					Ballast Model Number ¹	Ballast Current (amps)	Ballast Model Number ¹	Ballast Current (amps)
T4 4-Pin Quad-Tube  1/2" diameter	18W	1	A	.20	FDB-T418-120-1-S	.08	FDB-T418-277-1-S	.08
		2	B	.42	FDB-T418-120-2-S	.17	FDB-T418-277-2-S	.17
	26W	1	A	.26	FDB-T426-120-1-S	.12	FDB-T426-277-1-S	.12
		2	B	.50	FDB-T426-120-2-S	.21	FDB-T426-277-2-S	.21
T4 4-Pin Triple-Tube  1/2" diameter	18W	1	A	.20	FDB-T418-120-1-S	.08	FDB-T418-277-1-S	.08
		2	B	.42	FDB-T418-120-2-S	.17	FDB-T418-277-2-S	.17
	26W	1	A	.26	FDB-T426-120-1-S	.12	FDB-T426-277-1-S	.12
		2	B	.50	FDB-T426-120-2-S	.21	FDB-T426-277-2-S	.21
	32W	1	A	.31	FDB-T432-120-1-S	.13	FDB-T432-277-1-S	.13
		2	B	.59	FDB-T432-120-2-S	.24	FDB-T432-277-2-S	.24
	42W	1	B	.36	FDB-T442-120-1-S	.16	FDB-T442-277-1-S	.16
		2	B	.67	FDB-T442-120-2-S	.29	FDB-T442-277-2-S	.29
T5 Twin-Tube  5/8" diameter	36/39W (16")	1	F	.33	FDB-1643-120-1	.14	FDB-1643-277-1	.14
		2	F	.58	FDB-1643-120-2	.25	FDB-1643-277-2	.25
		3	F	.85	FDB-1643-120-3	.35	FDB-1643-277-3	.35
	40W (22")	1	F	.33	FDB-2227-120-1	.14	FDB-2227-277-1	.14
		2	F	.61	FDB-2227-120-2	.25	FDB-2227-277-2	.25
		3	F	.88	FDB-2227-120-3	.38	FDB-2227-277-3	.38
	50W (22")	1	F	.38	FDB-2243-120-1	.17	FDB-2243-277-1	.17
		2	F	.69	FDB-2243-120-2	.32	FDB-2243-277-2	.32



¹ Mounting studs standard for T4 ballasts. Delete suffix -S in the model number if mounting studs not needed.

 **LUTRON**® SPECIFICATION SUBMITTAL

Page

Job Name:	Model Numbers:
Job Number:	

Specifications

Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant $\pm 2\%$ light output for line voltage variations of $\pm 10\%$
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards




- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

 **LUTRON®** SPECIFICATION SUBMITTAL

Page

Job Name:	Model Numbers:
Job Number:	

Eco-10 Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
 5/8" diameter T5 linear	14W (22")	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
		2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
	21W (34")	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
		2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W (45.3")	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
		2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
 5/8" diameter T5-HO linear high output	24W (21.5")	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
		2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
	39W (33.4")	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
		2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W (45.3")	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
		2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
 5/8" diameter T5 Twin-Tube	36/39W (16")	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
		2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
	40W (22")	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
		2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W (22")	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
		2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2




LUTRON SPECIFICATION SUBMITTAL

Page

Job Name:	Model Numbers:
Job Number:	

Eco-10 Ballast Models continued ...

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	Eco-10 Model Number	Ballast Current (amps)	Eco-10 Model Number
T8 linear and U-bent  1" diameter	17W (24")	1	F	.19	ECO-T817-120-1	.08	ECO-T817-277-1
		2	F	.31	ECO-T817-120-2	.15	ECO-T817-277-2
		3	F	.43	ECO-T817-120-3	.20	ECO-T817-277-3
	25W (36")	1	F	.24	ECO-T825-120-1	.12	ECO-T825-277-1
		2	F	.43	ECO-T825-120-2	.19	ECO-T825-277-2
	32W (48")	1	C	- -	- -	.14	E 3 T832 C 277 1
		1	D	.34	ECO-T832-120-1-L	.14	ECO-T832-277-1-L
		1	D	.34	ECO-T832-120-1-T	.14	ECO-T832-277-1-T
		1	F	- -	- -	.15	ECO-T832-277-1
		2	C	- -	- -	.23	E 3 T832 C 277 2
		2	D	.53	ECO-T832-120-2-L	.23	ECO-T832-277-2-L
		2	D	.53	ECO-T832-120-2-T	.23	ECO-T832-277-2-T
		2	F	- -	- -	.22	ECO-T832-277-2
		3	F	.82	ECO-T832-120-3	.35	ECO-T832-277-3



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T5 Starcoat High Efficiency

T5 Starcoat High Output

T5 Preheat

T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat

T8 Ecolux XL and SXL (4') Extra Life w/ Starcoat

T8 ULTRA Watt-Miser (4', 8', XL) w/ Starcoat

T8 ULTRA F28T8 UltraMax System w/ Starcoat

T8 ULTRA High Lumen w/ Starcoat

T8 Mod-U-line®

F25T12 for T8 Ballasts

8' T8

8' T8 XL Extra Life

8' T8 Watt-Miser XL Extra-Life

8' T8 High Output

8' T8 Instant Start

T8 Other Lengths

T8 Preheat

3' T12 (F30T12 and F25T12) - Rapid Start

F40 Standard Rapid Start

F40 XL Extra Life Rapid

Subcategory

T5 Starcoat High Efficiency

Product Code	46706
Description	F28W/T5/841/ECO
Watts	28
Lumens (Initial)	2900
Lumens (Mean)	2726
Average Rated Life	20000
Color Temperature (K)	4100
Color Rendering Index (Ra) CRI	85
Bulb Type	T5
Base Type	Miniature BiPin (G5)
Nominal Length (In.)	45.2
Nominal Length (mm)	1150
Sales Unit UPC	043168467063
Case UPC	043168467063
SCC	10043168467060
Case Quantity	40
Additional Information	S/P Ratio: 1.3 Lumen Ratings at 35C. At 25C, Initial Lumens

Set the current view to the default view

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[Return to: Dulux S \(single, 2-Pin\)](#)
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Product Number: 20306
Order Abbreviation: CF13DS/841
General Description: DULUX 13W single compact fluorescent lamp with 2-pin base, 4100K color temperature, 82 CRI, ECOLOGIC

Product Information

Abbrev. With Packaging Info.	CF13DS841 50/CS 1/SKU
Average Rated Life (hr)	10000
Base	GX23
Bulb	T4
Color Rendering Index (CRI)	82
Color Temperature/CCT (K)	4100
Family Brand Name	Dulux® S
Industry Standards	ANSI C78.901 - 2001, IEC 60901- 0013
Initial Lumens at 25C	800
Mean Lumens at 25C	688
Maximum Overall Length - MOL (in)	7.1
Maximum Overall Length - MOL (mm)	180
NEMA Generic Designation (current)	CFT13DS/GX23/841
Nominal Wattage (W)	13.00

Additional Product Information

Product Documents, Graphs, and Images

Packaging Information



Footnotes

- Approximate initial lumens after 100 hours operation.
- The life ratings of fluorescent lamps are based on 3 hr. burning cycles under specified conditions and with ballast meeting ANSI specifications. If burning cycle is increased, there will be a corresponding increase in the average hours life.
- Rule of Thumb for Compact Fluorescent Lamps: Divide wattage of incandescent lamp by 4 to determine approximate wattage of compact fluorescent lamp that will provide similar



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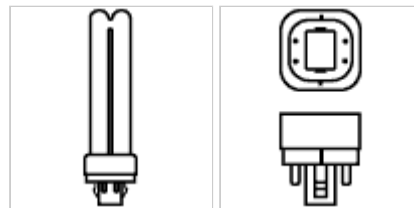
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Subcategory	Plug-in 4-Pin Double Biax®
Product Code	30038  
Description	F13DBX/SPX41/4P
Watts	13
Average Rated Life	12000
Lumens (Initial)	900
Lumens (Mean)	755
Color Temperature (K)	4100
Color Rendering Index (Ra) CRI	82
Bulb Type	BiaxD (T4)
Base Type	G24q-1
Nominal Length (In.)	5
Nominal Length (mm)	127
Max Overall Length (In.)	4.9
Max Overall Length (mm)	125
Sales Unit UPC	043168982733
Case UPC	043168300384
SCC	00043168300384
Case Quantity	50
Additional Information	NEMA Generic Designation: CFQ13W/G24q/841
Footnotes	Fluorescent lamp lumens decline during life. Based on 60Hz reference circuit lamp minimum starting temperature is a function of the ballast. Most ballasts with a minimum starting temperature of 50° F (10° C). Ballasts are also available provide reliable starting to 0° F (-18° C) and -20° F (-29° C).

 Reduced Wattage  LSB Data Available



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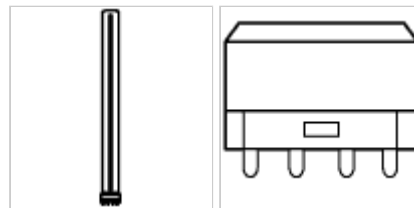
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Subcategory	Plug-in 4-Pin High Lumen Biax®
Product Code	16954
Description	F40/30BX/SPX41
Watts	40
Average Rated Life	20000
Lumens (Initial)	3150
Lumens (Mean)	2840
Color Temperature (K)	4100
Color Rendering Index (Ra) CRI	82
Bulb Type	BiaxL (T5)
Base Type	2G11
Nominal Length (In.)	22.5
Nominal Length (mm)	572
Sales Unit UPC	043168169547
Case UPC	043168169547
SCC	10043168169544
Govt. Nat'l Stock Number	6240013537705
Case Quantity	40
Additional Information	NEMA Generic Designation: FT40W/2G11/RS/841
Footnotes	Fluorescent lamp lumens decline during life. Based on 60Hz reference circuit. lamp minimum starting temperature is a function of the ballast. Most ballasts with a minimum starting temperature of 50° F (10° C). Ballasts are also available provide reliable starting to 0° F (-18° C) and -20° F (-29° C). Life ratings based on instant start operation. On instant start ballast, life rating is 25% lower.

Reduced Wattage

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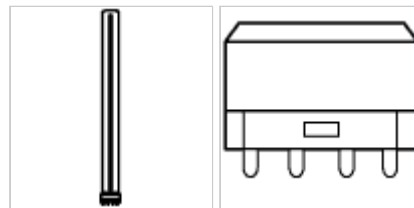
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Subcategory	Plug-in 4-Pin High Lumen Biax®
Product Code	16954
Description	F40/30BX/SPX41
Watts	40
Average Rated Life	20000
Lumens (Initial)	3150
Lumens (Mean)	2840
Color Temperature (K)	4100
Color Rendering Index (Ra) CRI	82
Bulb Type	BiaxL (T5)
Base Type	2G11
Nominal Length (In.)	22.5
Nominal Length (mm)	572
Sales Unit UPC	043168169547
Case UPC	043168169547
SCC	10043168169544
Govt. Nat'l Stock Number	6240013537705
Case Quantity	40
Additional Information	NEMA Generic Designation: FT40W/2G11/RS/841
Footnotes	Fluorescent lamp lumens decline during life. Based on 60Hz reference circuit. lamp minimum starting temperature is a function of the ballast. Most ballasts with a minimum starting temperature of 50° F (10° C). Ballasts are also available provide reliable starting to 0° F (-18° C) and -20° F (-29° C). Life ratings based on instant start operation. On instant start ballast, life rating is 25% lower.

Reduced Wattage

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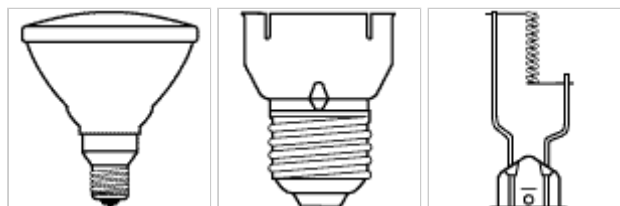
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Subcategory	HIR™ PAR38
Product Code	18631
Description	100PAR/HIR/FL25
Volts	120
Watts	100
Average Life in Hours	3000
Lumens	2030
CBCP	7000
Color Temperature (K)	2900
Bulb Type	PAR38
Base Type	Med Skirt
Max Overall Length (In.)	5.313
Max Overall Length (mm)	135
Filament Type	CC-8
Sales Unit UPC	043168906364
Case UPC	043168186315
SCC	00043168186315
Govt. Nat'l Stock Number	6240013445132
Case Quantity	12
Additional Information	Floodlight
Footnotes	<p>WARNING</p> <ul style="list-style-type: none"> - Turn power off before inspection, installation or removal - Keep combustible materials away from lamp - Do not use lamp if outer glass is scratched or broken <p>CAUTION</p> <ul style="list-style-type: none"> - Allow lamp to cool before handling - Do not use lamp if outer glass is scratched or broken

Reduced Wattage

Set the current view to the default view

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T5 Preheat

T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat

T8 Ecolux XL and SXL (4') Extra Life w/ Starcoat

T8 ULTRA Watt-Miser (4', 8', XL) w/ Starcoat

T8 ULTRA F28T8 UltraMax System w/ Starcoat

T8 ULTRA High Lumen w/ Starcoat

T8 Mod-U-line®

F25T12 for T8 Ballasts

8' T8

8' T8 XL Extra Life

8' T8 Watt-Miser XL Extra-Life

8' T8 High Output

8' T8 Instant Start

T8 Other Lengths

T8 Preheat

3' T12 (F30T12 and F25T12) - Rapid Start

F40 Standard Rapid Start

F40 XL Extra Life Rapid

Subcategory

T5 Starcoat High Efficiency

Product Code	46706
Description	F28W/T5/841/ECO
Watts	28
Lumens (Initial)	2900
Lumens (Mean)	2726
Average Rated Life	20000
Color Temperature (K)	4100
Color Rendering Index (Ra) CRI	85
Bulb Type	T5
Base Type	Miniature BiPin (G5)
Nominal Length (In.)	45.2
Nominal Length (mm)	1150
Sales Unit UPC	043168467063
Case UPC	043168467063
SCC	10043168467060
Case Quantity	40
Additional Information	S/P Ratio: 1.3 Lumen Ratings at 35C. At 25C, Initial Lumens

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APPLICATION: EVENT LIGHTING

Philips MSR SA / Single Ended

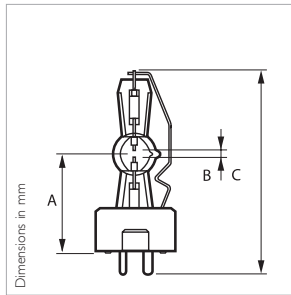
Features	Benefits
Philips Pinch Protection	Enables use at higher temperatures in any burning position. Longer lifetime, fewer early failures, consistent performance over time
Very short arc	High beam intensity
Compact lamp design	Compact design luminaries
MSR filling	Excellent color characteristics, optimal colors on stage



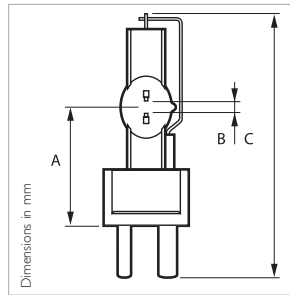
MSR 400 SA / MSR 700 SA



MSR 1200 SA / MSR 2000 SA



MSR 400 SA / MSR 700 SA



MSR 1200 SA / MSR 2000 SA

Dimensions			
Type	A	B	C max.
MSR 400 SA	36.5±0.5	3.0	80
MSR 700 SA	39.0±0.5	4.0	85
MSR 1200 SA	59.0±0.5	7.0	135
MSR 2000 SA	59.0±1.0	7.0	135

Ballast specifications			
Type of lamp	Impedance Ω	Current A	Ballast losses W
MSR 400 SA	Electronic Ballast only		
MSR 700 SA	"	"	"
MSR 1200 SA	"	"	"
MSR 2000 SA	"	"	"

Ignitor Specifications			
Type	Vp (kV) min.	Min. Ignation time max. (sec)	
MSR 400 SA	2	4.5	20
MSR 700 SA	2	4.5	20
MSR 1200 SA	2	5	20
MSR 2000 SA	2.5	5	20

Maximum permissible temperatures (°C)		
Type	Pinch	Bulb
MSR 400 SA	500	1000
MSR 700 SA	500	1000
MSR 1200 SA	500	1000
MSR 2000 SA	500	1000

Type	Lamp wattage	Cap/ base	Lumen output	Efficacy source	Chromaticity coordinates		Color rendering index	Color temp.	Burning position ¹⁾	Average lamp life	Replacement before hrs	Minimum ignition supply voltage	Lamp current	Ordering number
	W		lm	lm/W	x	y	R _a	K	h		V	A		
MSR 400 SA	400	GY9.5	30000	75	.330	.342	75	5600	ANY	750	1000	207	8.4	9281 702 05100
MSR 700 SA	700	GY9.5	55000	80	.330	.342	80	5600	ANY	750	1000	207	11.0	9281 703 05100
MSR 1200 SA	1200	GY22	96000	80	.330	.342	80	5600	ANY	750	1000	207	13.8	9281 709 05100
MSR 2000 SA	2000**	GY22	155000	86	.320	.330	> 80	6000	ANY	750	1000	207	20.0	9281 732 05100

¹⁾ Tip at side

**Lamp can be operated at 2000 W for max 50% of specified average lifetime



Philips pinch protection technology

- **Reliability**, through longer lifetime and fewer early failures.
- **Quality**, through excellent storage characteristics and consistent performance over time.
- **Compactness**, allowing more compact design of fixtures and burning positions.
- **Philips P3 technology**, Max 500° C pinch temperature
- **No pinch protection**, Max 350° C pinch temperature

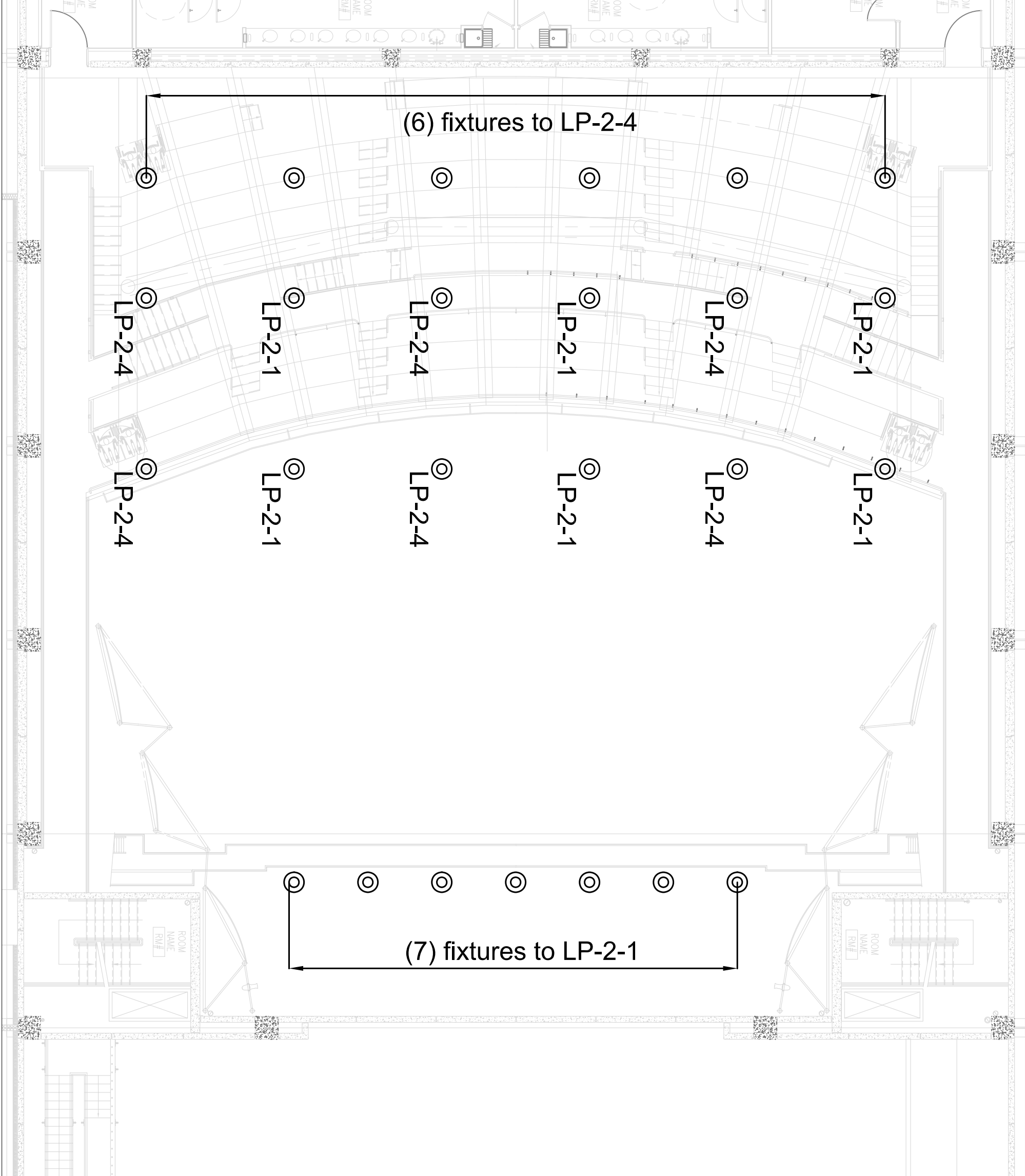


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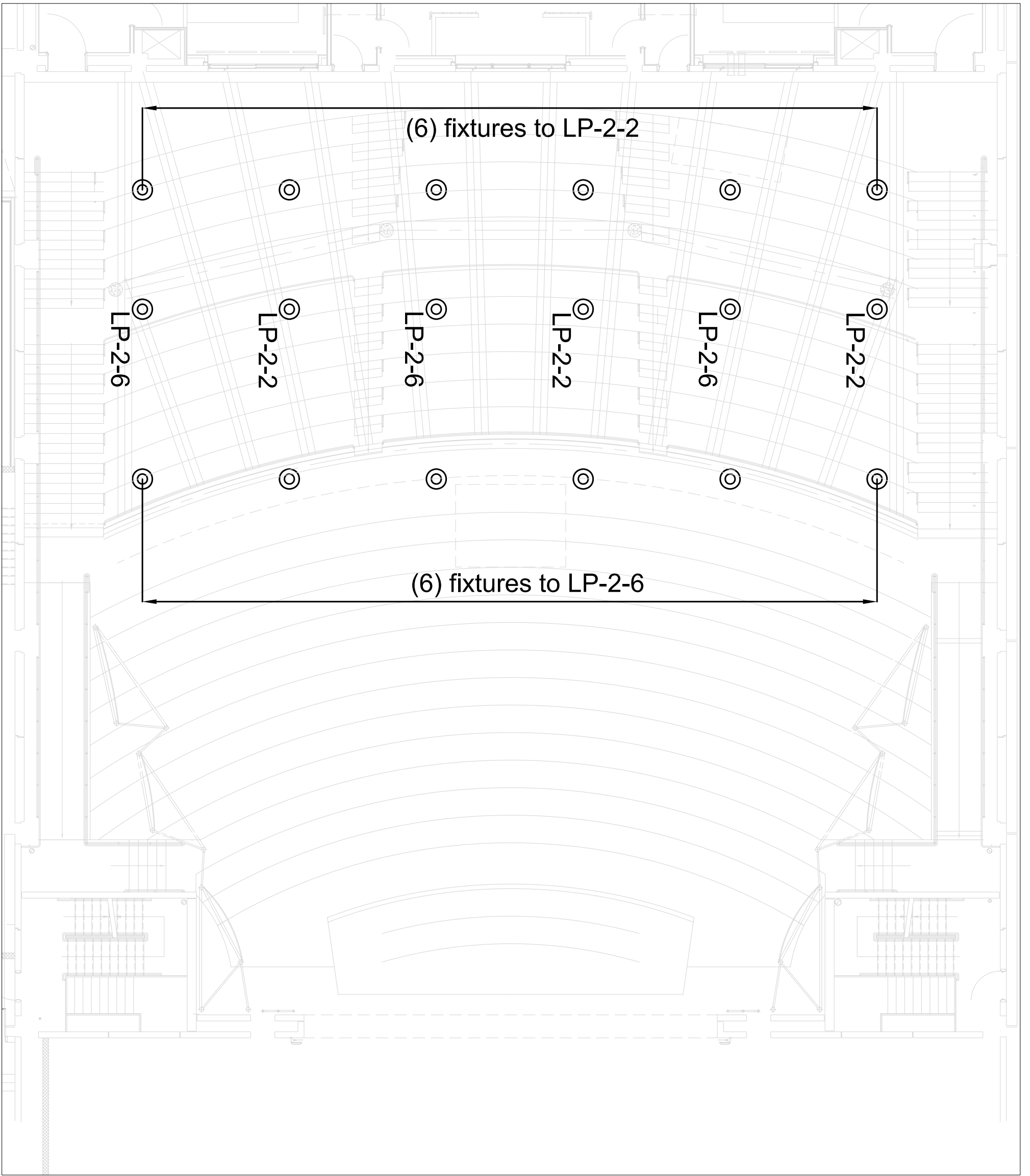
www.philips.com/broadway



Symbol	Type
⊙	K
⊕	L
⊖	M
⊗	N
⊘	P

Balcony Ceiling Level

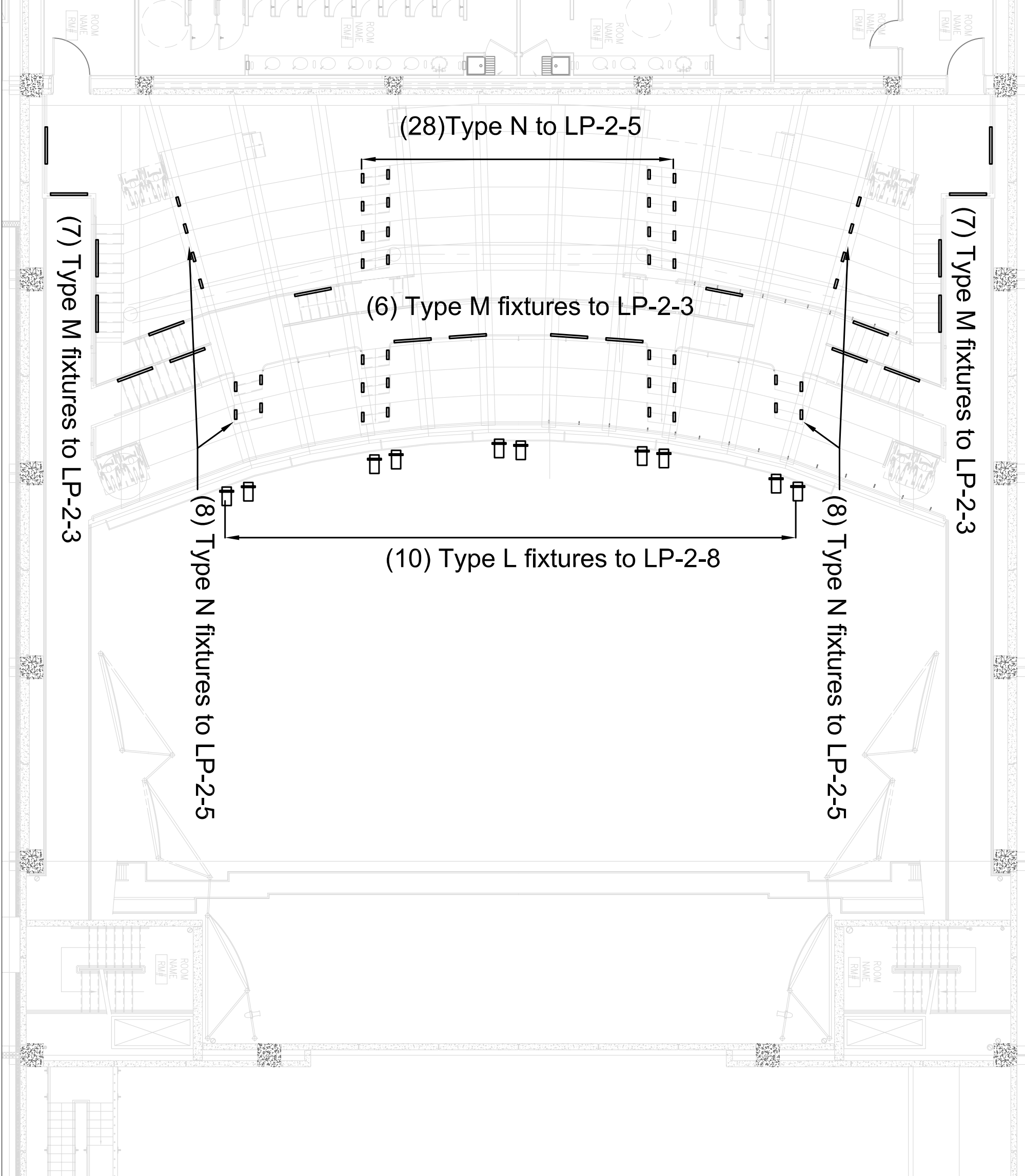
Lighting and Circuiting Plan



Symbol	Type
⊙	K
⌘	L
—	M
-	N
▬	P

Parterre Ceiling Level

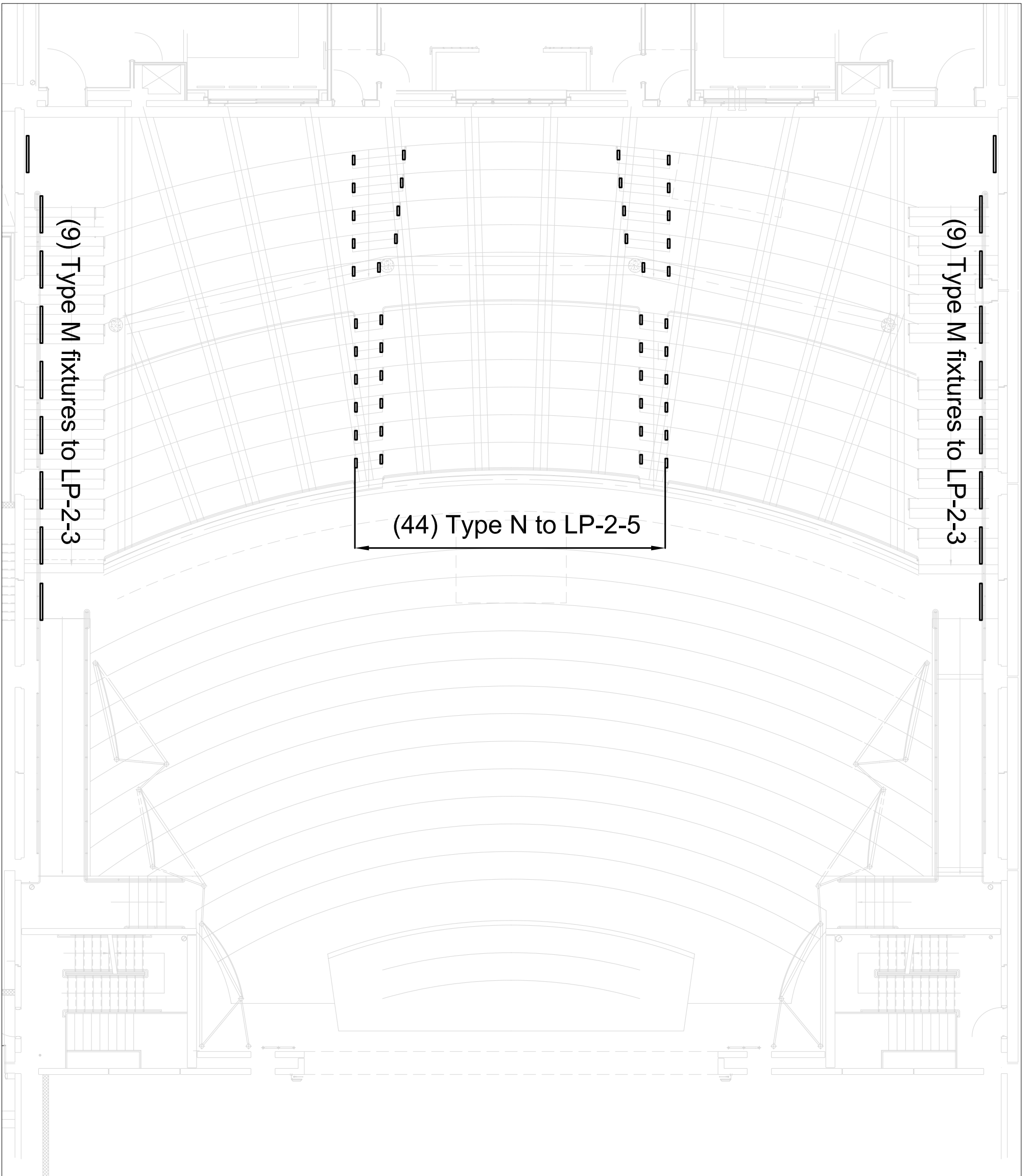
Lighting and Circuiting Plan



Symbol	Type
⊙	K
⊞	L
—	M
-	N
⌈	P

Balcony Floor Level

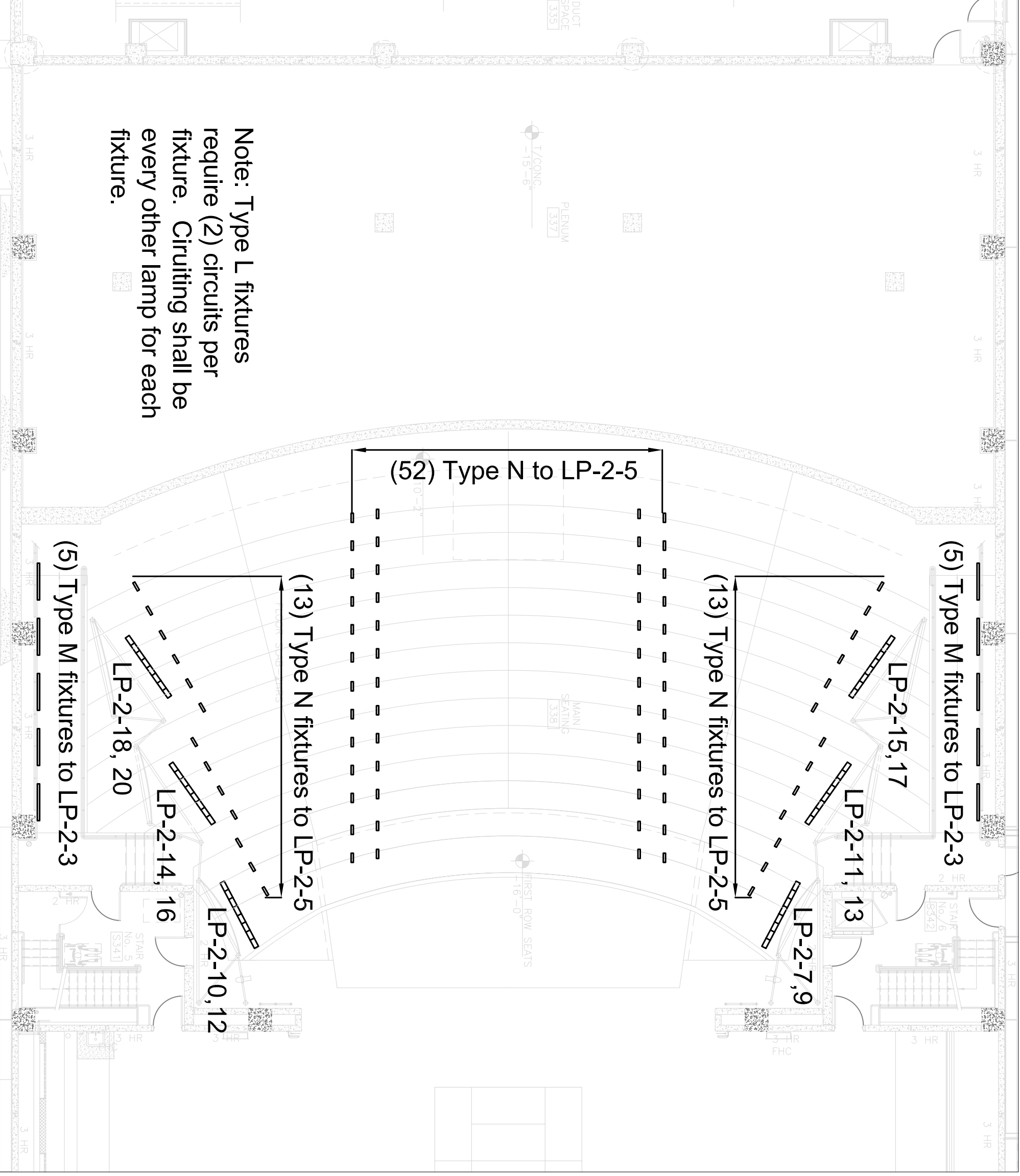
Lighting and Circuiting Plan



Symbol	Type
⊙	K
⊞	L
—	M
-	N
⏏	P

Parterre Floor Level

Lighting and Circuiting Plan



Note: Type L fixtures require (2) circuits per fixture. Circuiting shall be every other lamp for each fixture.

(52) Type N to LP-2-5

(5) Type M fixtures to LP-2-3

(13) Type N fixtures to LP-2-5

(13) Type N fixtures to LP-2-5

(5) Type M fixtures to LP-2-3

LP-2-18, 20

LP-2-14, 16

LP-2-10, 12

LP-2-15, 17

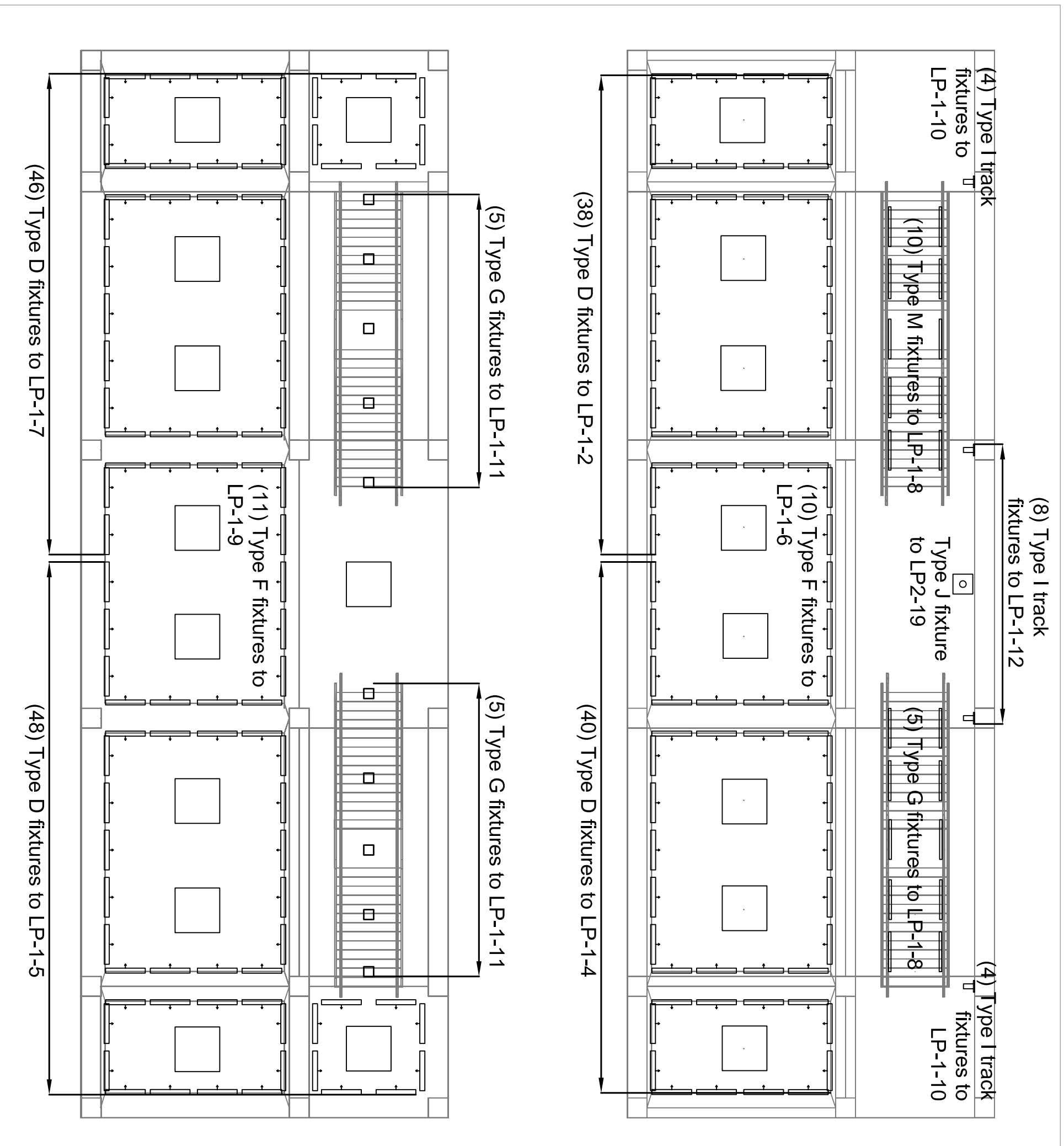
LP-2-11, 13

LP-2-7, 9

Symbol	Type
⊙	K
⊞	L
—	M
-	N
▬	P

Main Seating Floor Level

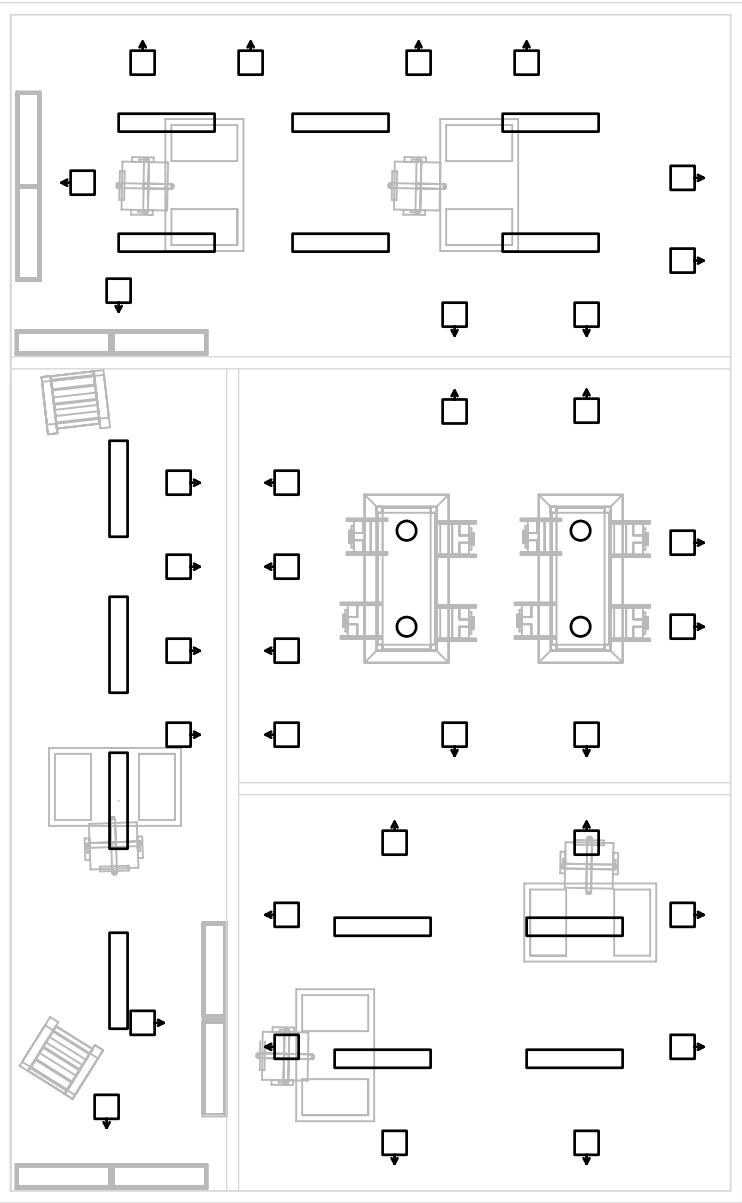
Lighting and Circuiting Plan



Symbol	Type
	D
	F
	G
	I
	J
	M




Entrance and Lobby Spaces

Lighting and Circuited Plan



Notes:

1. Types A and C are both fluorescent pendants controlled by LP-1-1
2. Type B wall washers are controlled by LP-1-3

Symbol	Type
	A
	B
	C

Office Ceiling Level

Lighting and Circuiting Plan

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Final Report Appendix B

**The following sections of Appendix B include information for the equipment used.
Below is a description of the organization for this appendix.**

Lighting System Electrical Loads *Panel boards*

Controls Diagrams *Back of House Controls* *Front of House Controls*

Distribution Panels *Existing Panels* *Designed Panels*

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Final Report Appendix B

Lighting System Electrical Loads

Voltage: 208Y/120 Main Breaker: 200 A Feeder: (4) 3/0 THW, 2" C
 (#, size wire & conduit)

Description	LOAD (VA)			Brk. Trip (A)	LP 1				LOAD (VA)			Brk. Trip (A)	Description
	A	B	C		Cond. Size	Ckt. #	Cond. Size	A	B	C			
Off - Pendants	1048			20	#12	1	2	#12	1254			20	Lby1 - Cove
Off - Wall washer		1245		20	#12	3	4	#12		1320		20	Lby1 - Cove
Lby2 - Cove			1584	20	#12	5	6	#12			1056	20	Lby1 - Lg Pendant.
Lby2 - Cove	1518			20	#12	7	8	#12	636			20	Lby1 - Railing
Lby2 - Lg Pendant		1452		20	#12	9	10	#12		644		20	Ent - Track
Lby2 - Sml Pendant			732	20	#12	11	12	#12			644	20	Ent - Track
						13	14						
						15	16						
						17	18						
						19	20						
						21	22						
						23	24						
						25	26						
						27	28						
						29	30						
						31	32						
						33	34						
						35	36						
						37	38						
						39	40						
						41	42						
	2566	2697	2316						1890	1964	1700		

Total Load on Phase A: 4456 VA

Total Load on Phase B: 4661 VA

Total Load on Phase C: 4016 VA

Total Load on Panel: 13.133 kVA Demand

109.441667 A

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Lighting System Electrical Loads

Voltage: 208Y/120 Main Breaker: 200 A Feeder: (4) 3/0 THW, 2" C
 (#, size wire & conduit)

Description	LOAD (VA)			Brk. Trip (A)	LP 2			LOAD (VA)			Brk. Trip (A)	Description
	A	B	C		Cond. Size	Ckt. #	Cond. Size	A	B	C		
HL - CFL Downlight	1607			20	#12	1 2	#12	1113			20	HL - CFL Downlight
HL - Railing		1527		20	#12	3 4	#12		1484		20	HL - CFL Downlight
HL - Aisle			665	20	#12	5 6	#12			1113	20	HL - CFL Downlight
HL - Borderlight Accent	1000			20	#12	7 8	#12	1000			20	HL - Hal Downlight
HL - Borderlight Accent		1000		20	#12	9 10	#12		1000		20	HL - Borderlight Accent
HL - Borderlight Accent			1000	20	#12	11 12	#12			1000	20	HL - Borderlight Accent
HL - Borderlight Accent	1000			20	#12	13 14	#12	1000			20	HL - Borderlight Accent
HL - Borderlight Accent		1000		20	#12	15 16	#12		1000		20	HL - Borderlight Accent
HL - Borderlight Accent			1000	20	#12	17 18	#12			1000	20	HL - Borderlight Accent
Ent - Automated Spot	700			20	#12	19 20	#12	1000			20	HL - Borderlight Accent
						21 22						
						23 24						
						25 26						
						27 28						
						29 30						
						31 32						
						33 34						
						35 36						
						37 38						
						39 40						
						41 42						
	4307	3527	2665					4113	3484	3113		

Total Load on Phase A: 8420 VA
 Total Load on Phase B: 7011 VA
 Total Load on Phase C: 5778 VA

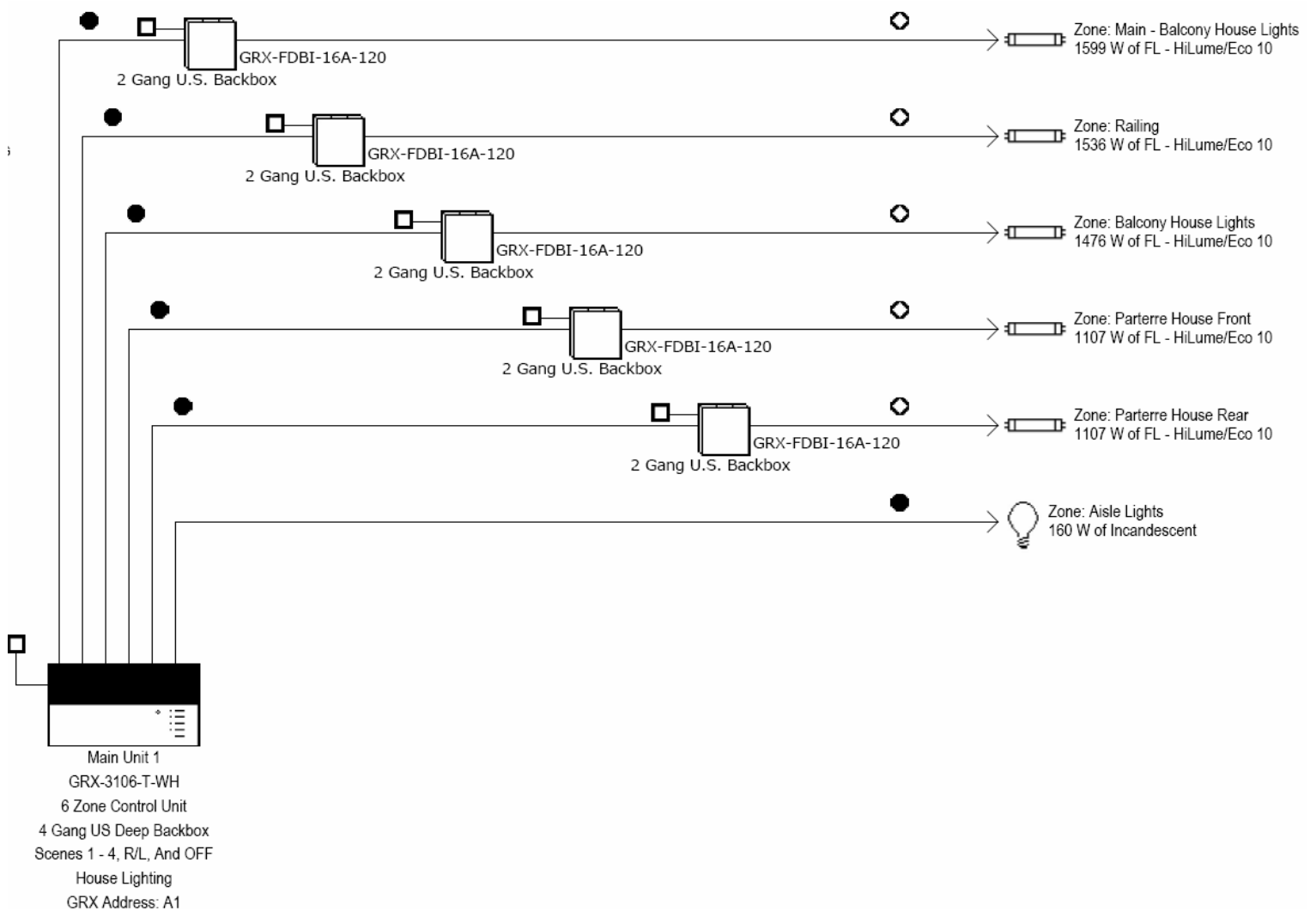
Total Load on Panel: 21.209 kVA Demand
176.741667 A

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Back of House Controls

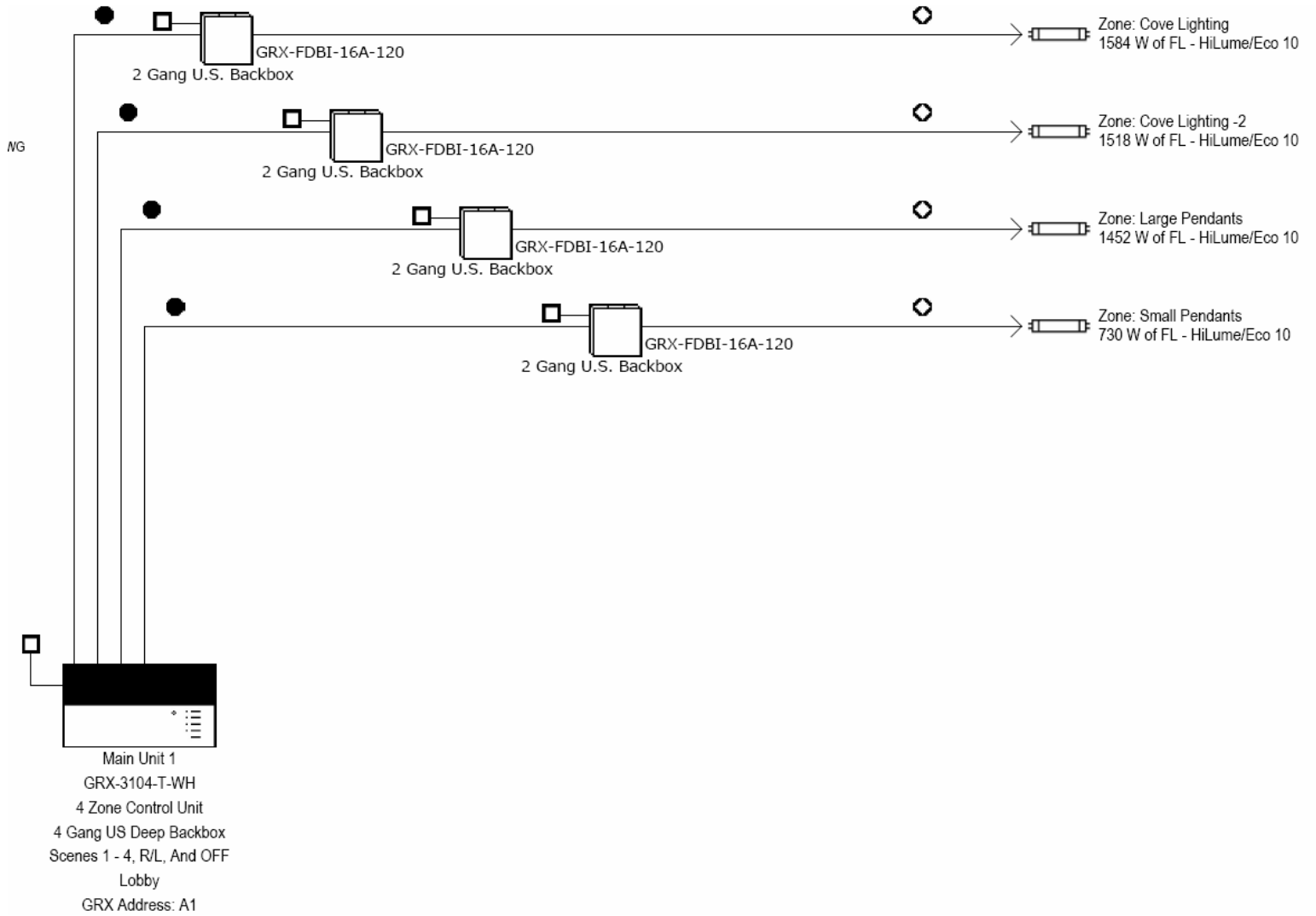


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Front of House Controls Lobby

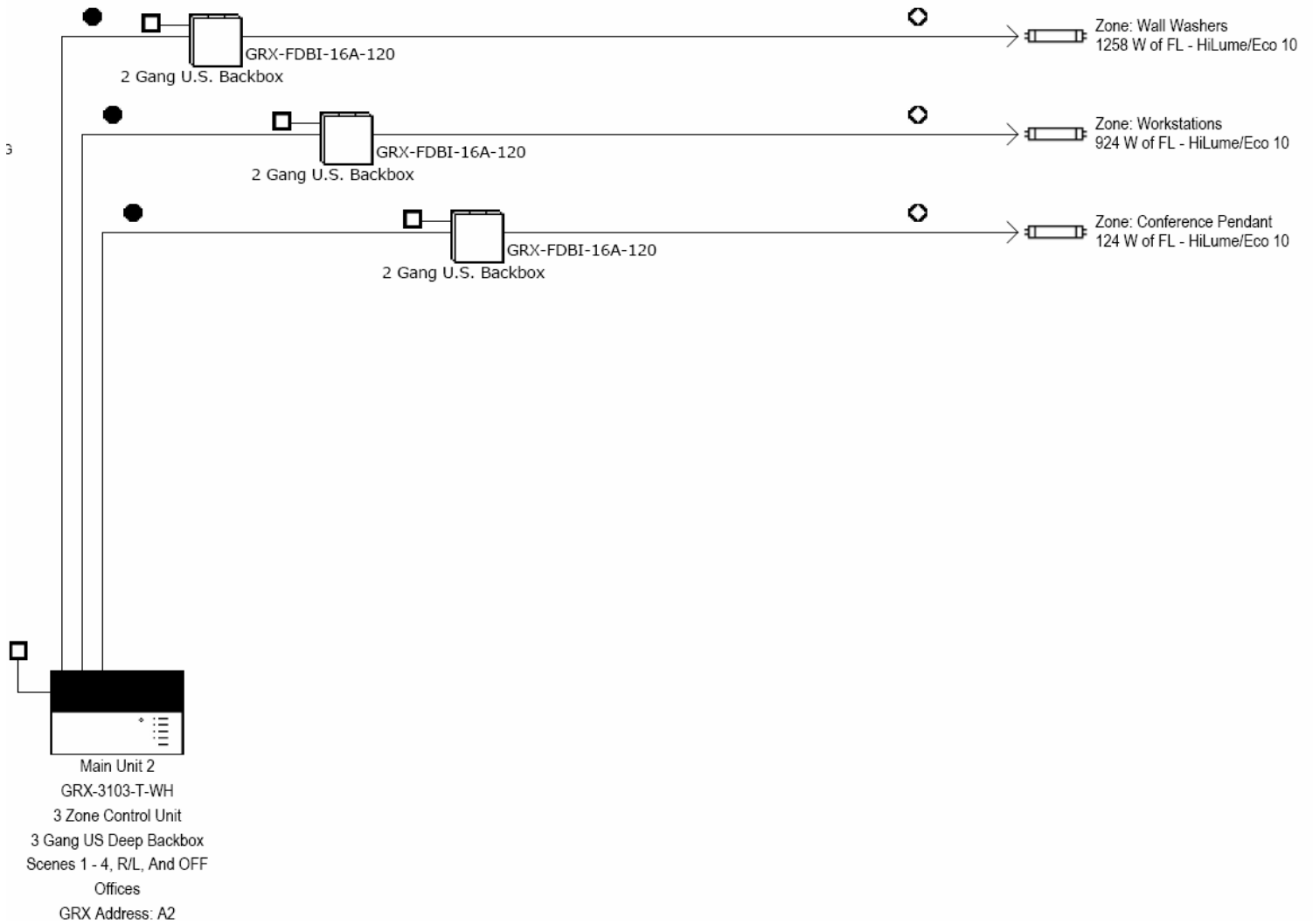


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Final Report Appendix B

Front of House Controls *Offices*

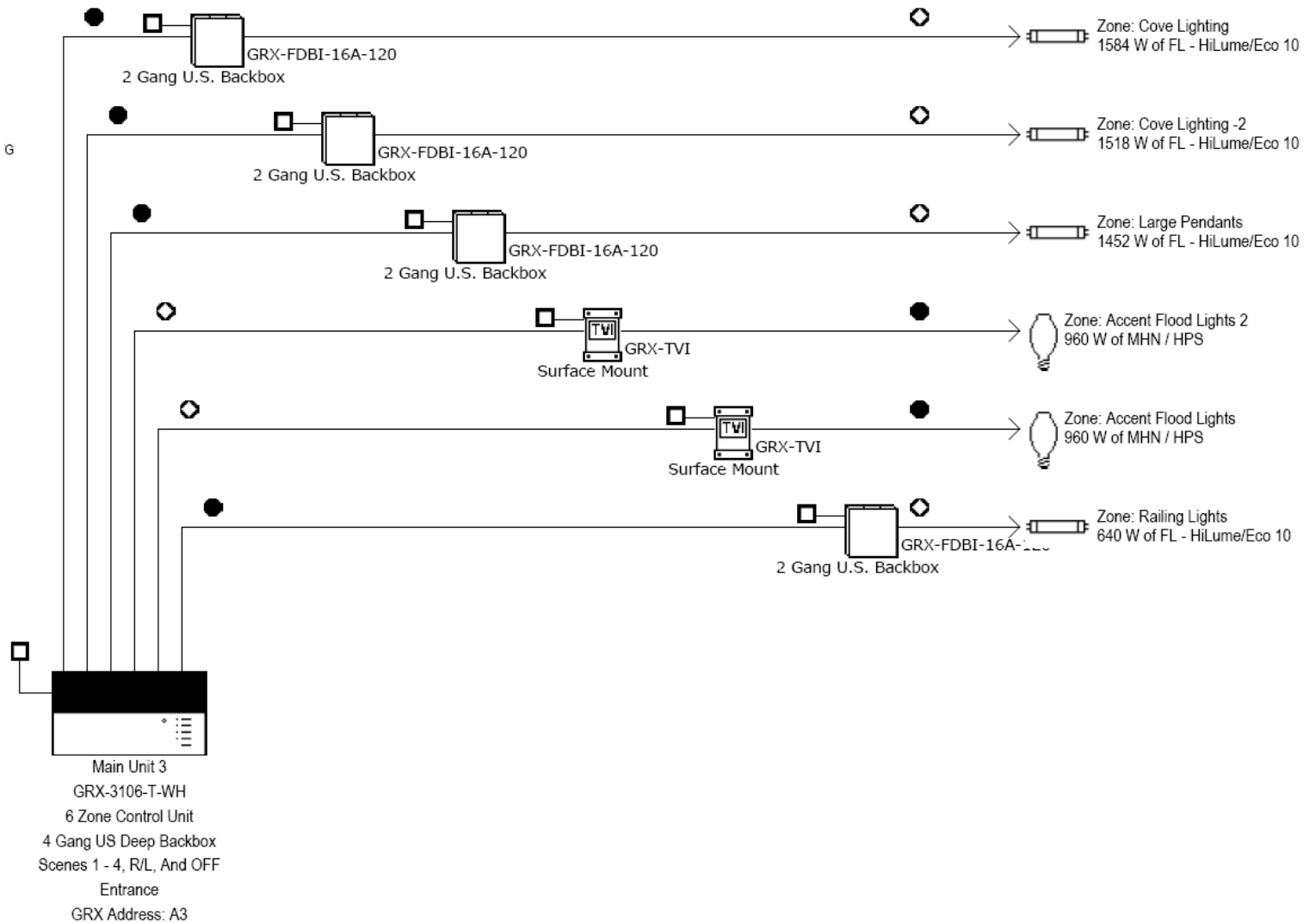


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Front of House Controls Entrance



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Existing Distribution Panels

DP-1-H-OL-1		480Y/277			
Label	V	HP	amps	kVA	
HUM-1, HUMIDIFIER#1	480		99.00	47.52	
HUM-2, HUMIDIFIER#2	480		50.00	24.00	
DP-1-H-UB-1	480		150.00	72.00	
S-2, E-1	480		13.00	6.24	
PNL HB-OL-2	480		57.00	27.36	
PNL HB-ST-2	480		20.00	9.60	
EHC-4	480		84.00	40.32	
					227.04

DP-1-H-OL-2		480Y/277			
Label	V	HP	amps	kVA	
PNL HP-UR-1	480	102.00	102.00	48.96	
PNL HP-LR-2	480	40.00	40.00	19.20	
PNL HP-OL-1, HP-LB-1	480	62.00	62.00	29.76	
PNL HP-PT-1, HP-LR-1, HP-ST-1	480	151.00	151.00	97.92	
Spare	480		100		
					195.84

DP-1-H-OL-3		480Y/277			
Label	V	HP	amps	kVA	
PASSENGER ELEVATOR #1	480	60.00	77.00	36.96	
PASS ELEV #4, FRT ELEV #1	480	60, 2@50	207.00	99.36	
PASSENGER ELEVATOR #5	480	25.00	34.00	16.32	
PNL HP-ST-3	480		17.00	8.16	
Space	480		60.00		
Space	480		100.00		
					160.80

DP-1-H-SL-1		480Y/277			
Label	V	HP	amps	kVA	
BP-1 BOOSTER PUMP	480	2@10	28.00	13.44	
EP-1 SEWAGE EJECTOR	480	2@3	10.00	4.80	
WH-1 WATER HEATER	480		217.00	104.16	
WH-1 WATER HEATER	480		217.00	104.16	
JOCKEY PUMP	480	1.5	3.00	1.44	
AC-1 DRY SYS, COMP	480	1	2.00	228.00	
Spare	480		30.00		
Spare	480		60.00		
					456.00

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Design for Consolidated Distribution Panels

DP-1-H-OL-3/DP-1-H-SL-1		480Y/277		
Label	V	HP	amps	kVA
PASSENGER ELEVATOR #1	480	60.00	77.00	36.96
PASS ELEV #4, FRT ELEV #1	480	60, 2@50	207.00	99.36
PASSENGER ELEVATOR #5	480	25.00	34.00	16.32
PNL HP-ST-3	480		17.00	8.16
Space	480		60.00	28.80
Space	480		100.00	48.00
BP-1 BOOSTER PUMP	480	2@10	28.00	13.44
EP-1 SEWAGE EJECTOR	480	2@3	10.00	4.80
WH-1 WATER HEATER	480		217.00	104.16
WH-1 WATER HEATER	480		217.00	104.16
JOCKEY PUMP	480	1.5	3.00	1.44
AC-1 DRY SYS, COMP	480	1	2.00	228.00
Spare	480		30.00	14.40
Spare	480		60.00	28.80
				736.80

The empty spaces on this distribution panel were not included in the sizing calculation. The listed denotes the frame size available.

DP-1-H-OL-1/2		480Y/277		
Label	V	HP	amps	kVA
HUM-1, HUMIDIFIER#1	480		99.00	47.52
HUM-2, HUMIDIFIER#2	480		50.00	24.00
DP-1-H-UB-1	480		150.00	72.00
S-2, E-1	480		13.00	6.24
PNL HB-OL-2	480		57.00	27.36
PNL HB-ST-2	480		20.00	9.60
EHC-4	480		84.00	40.32
PNL HP-UR-1	480	102.00	102.00	48.96
PNL HP-LR-2	480	40.00	40.00	19.20
PNL HP-OL-1, HP-LB-1	480	62.00	62.00	29.76
PNL HP-PT-1, HP-LR-1, HP-ST-1	480	151.00	151.00	97.92
Spare	480		100	48.00
				470.88

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Table 14-29. Base Prices — PRL4 Main Fusible Switches

Ampere Rating	Interrupting Rating (kA Symmetrical)			Price U.S. \$		
	240 Vac	480 Vac	Device Type	3-Phase 4-Wire	1-Phase 3-Wire, 1-Phase 2-Wire	3-Phase 3-Wire
Main Fusible Switch 240 Vac, 250 Vdc ⑧⑨⑩						
200	See Table 14-32	FDPB		2,144.	1,783.	1,943.
400			FDPW	4,217.	3,353.	3,939.
600 ⑨			FDPW	6,050.	5,105.	5,673.
800 ⑨			FDPW	9,570.	8,109.	9,031.
1200 ⑨			FDPW	11,251.	8,644.	10,636.
Main Fusible Switch 600 Vac ⑧⑨						
200	See Table 14-32	FDPB		2,510.	1,896.	2,304.
400			FDPW	5,008.	3,802.	4,754.
600 ⑨			FDPW	6,585.	5,152.	6,071.
800 ⑨			FDPW	9,570.	8,109.	9,031.
1200 ⑨			FDPW	11,251.	8,644.	10,636.

- ⑧ For ground fault protection on main devices, see **Modification 15, Page 14-46.**
- ⑨ Fuses not included. **Specify required fuse clips on all switches. For T fuse clips, add \$308. per switch.**
- ⑩ Class J Fuse provisions are applicable only to 600 volt units. When required, use price and dimensions of 600 volt units for all voltages 600 and below.
- ⑪ No dc rating on 600, 800 and 1200 ampere switches.

Discount Symbol CE9