

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report



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.

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.




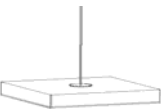


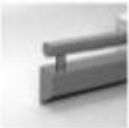
Lindsey Beane

Lighting/Electrical
 Professor Mistrick
 Harris Theater for Music and Dance
 Chicago, IL



Final Report

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

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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.

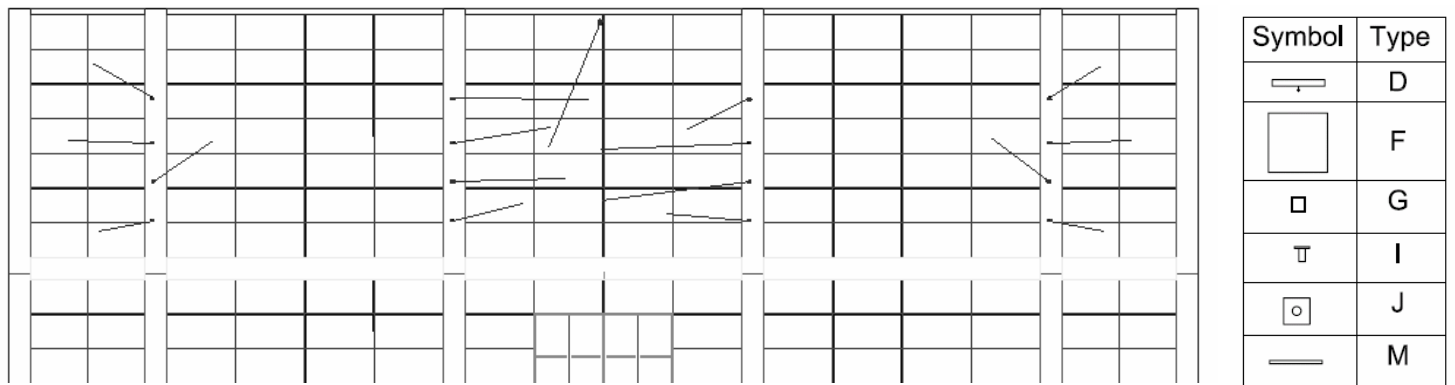
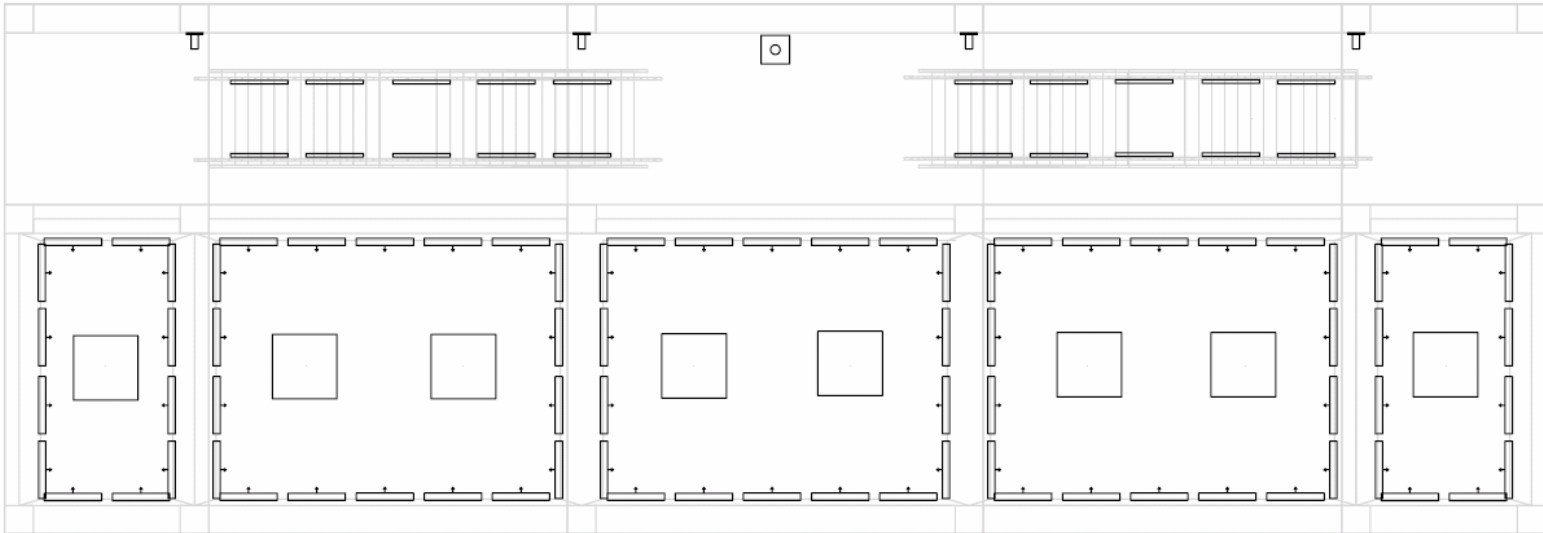
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

Lighting Layout



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.

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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

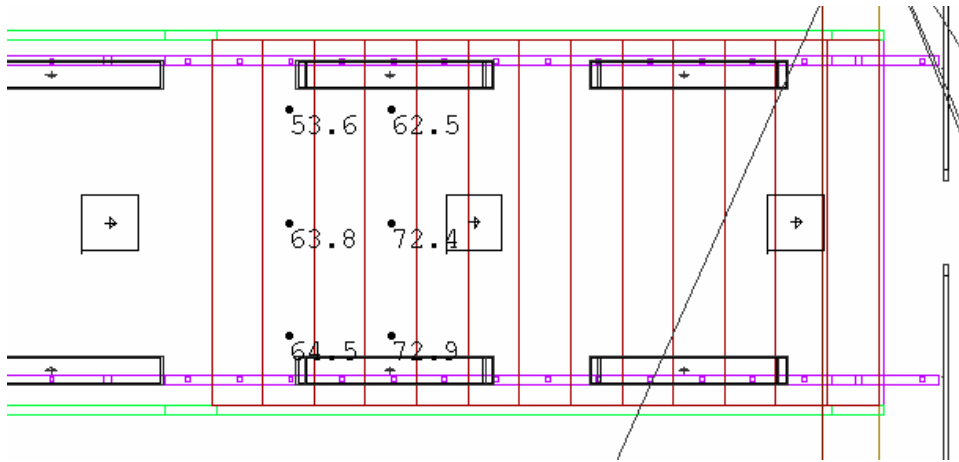
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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.

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

AGI32 Renderings

Entrance interior view



Entrance exterior view



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report



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.

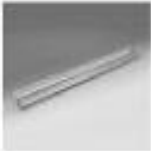
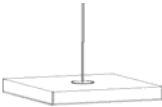

Lindsey Beane

Lighting/Electrical
 Professor Mistrick
 Harris Theater for Music and Dance
 Chicago, IL



Final Report

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.

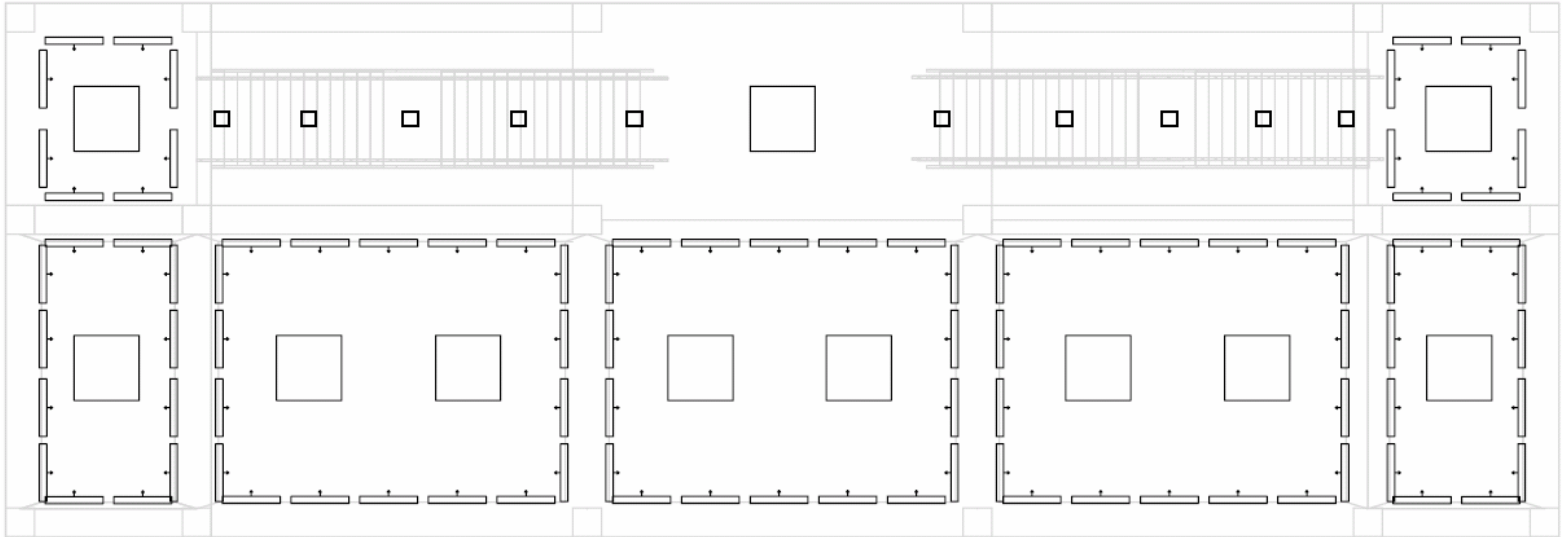
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

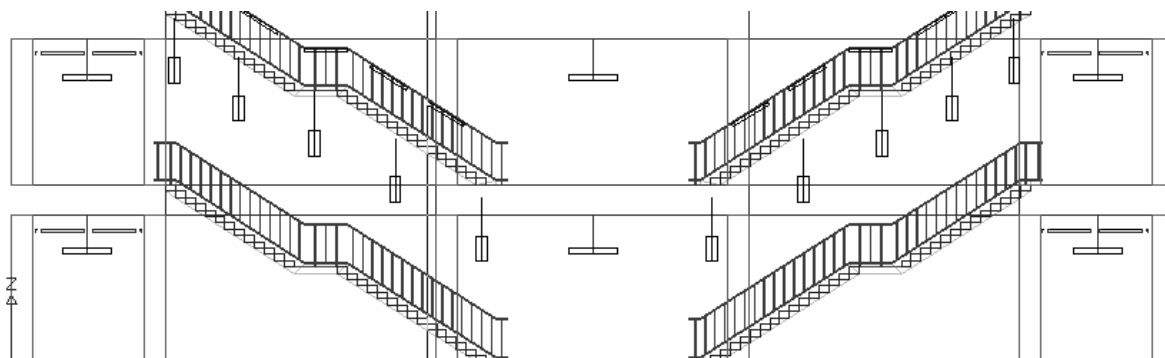


Final Report

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.



Symbol	Type
	D
	F
	G
	I
	J
	M

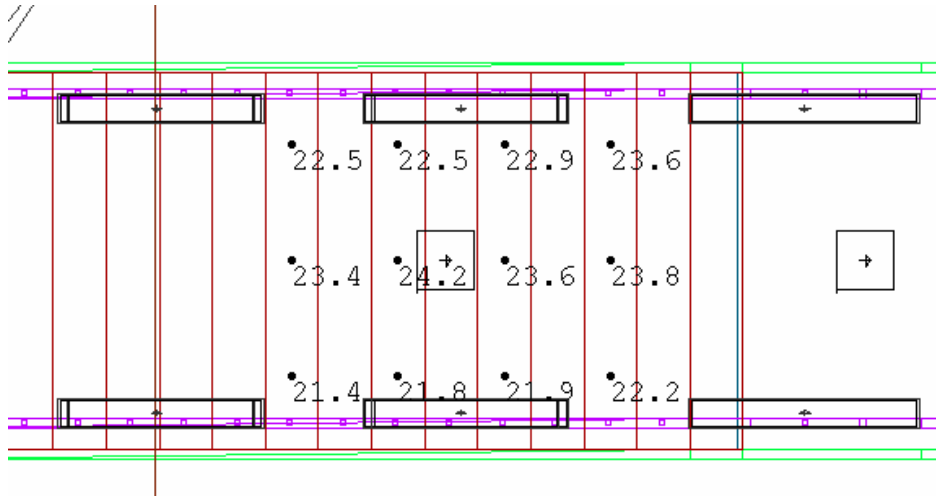
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report



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.

Lindsey Beane






Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

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.

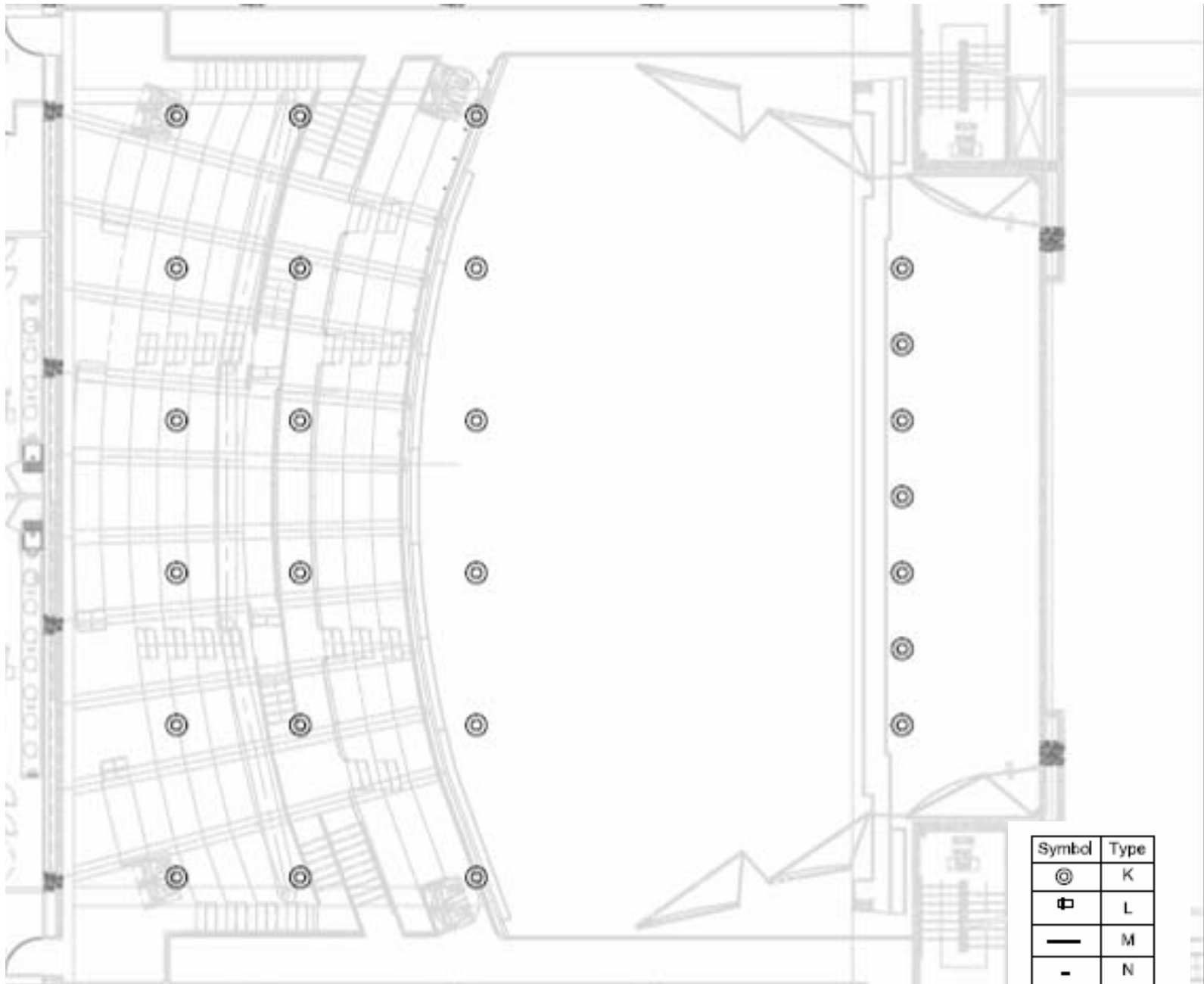
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

Lighting Layouts

Balcony and Main Ceiling



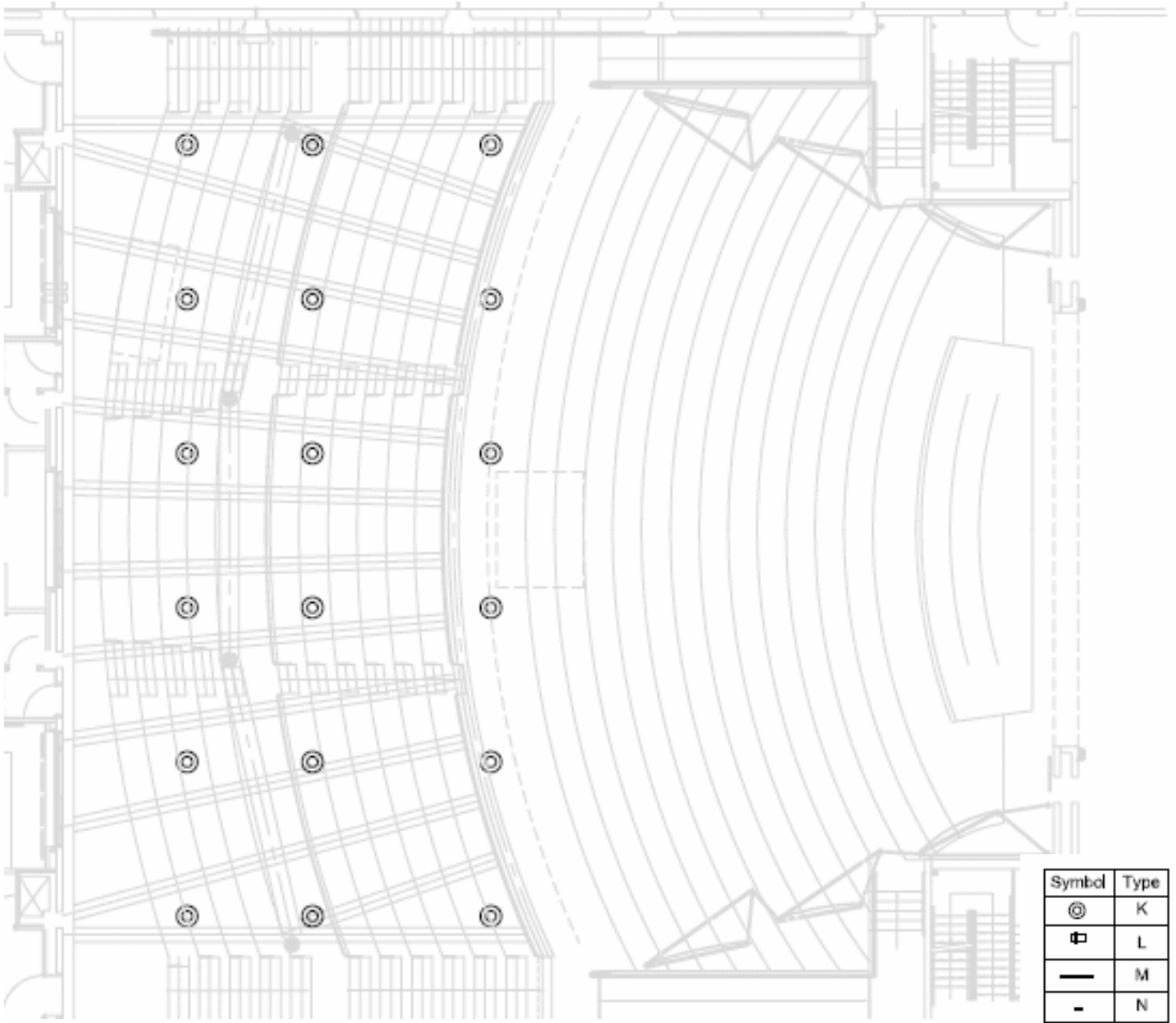
Symbol	Type
⊙	K
□	L
—	M
-	N
-----	P

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

Parterre Ceiling



Symbol	Type
⊙	K
⊠	L
—	M
-	N
----	P

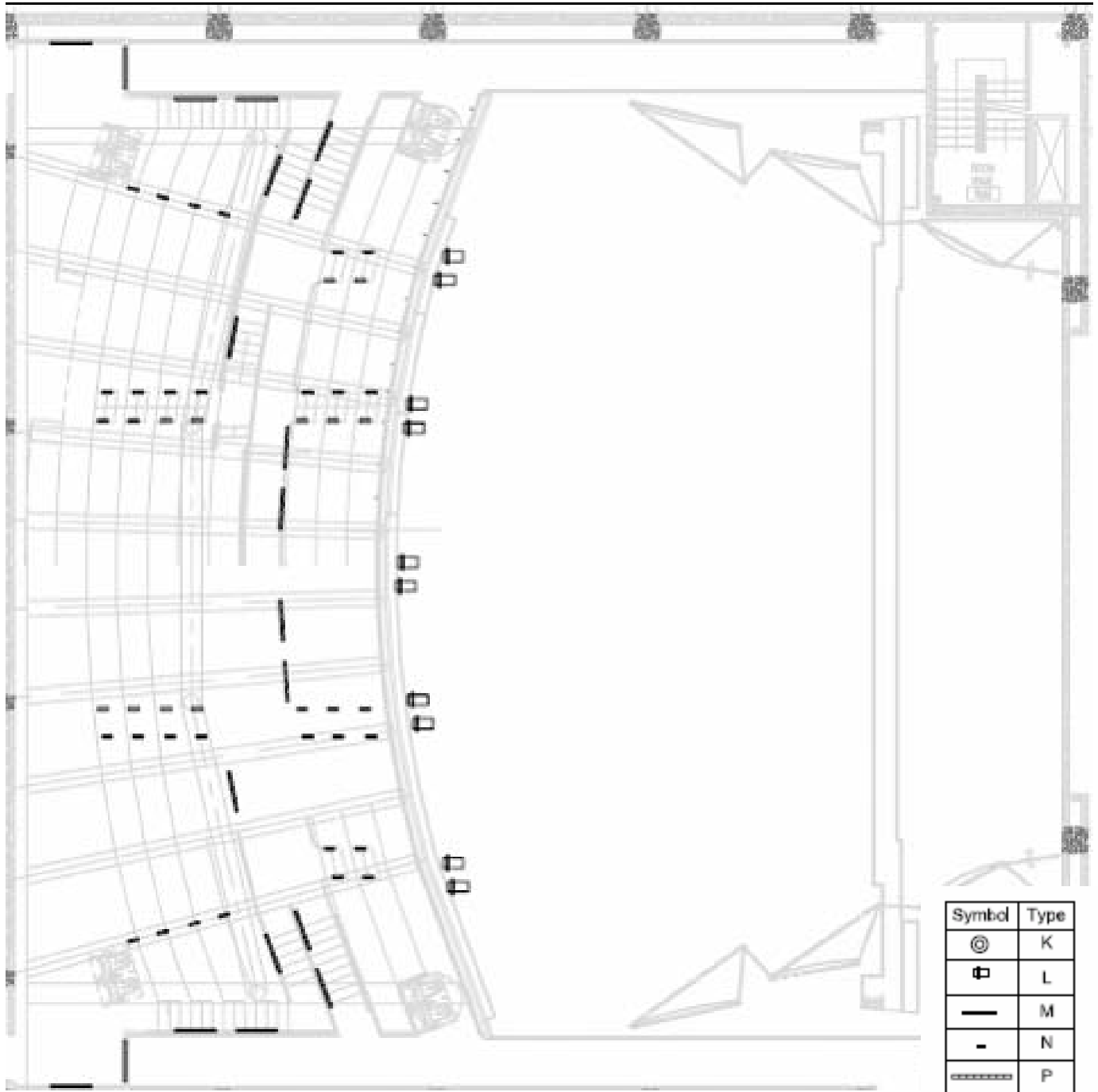
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

Balcony Floor Level



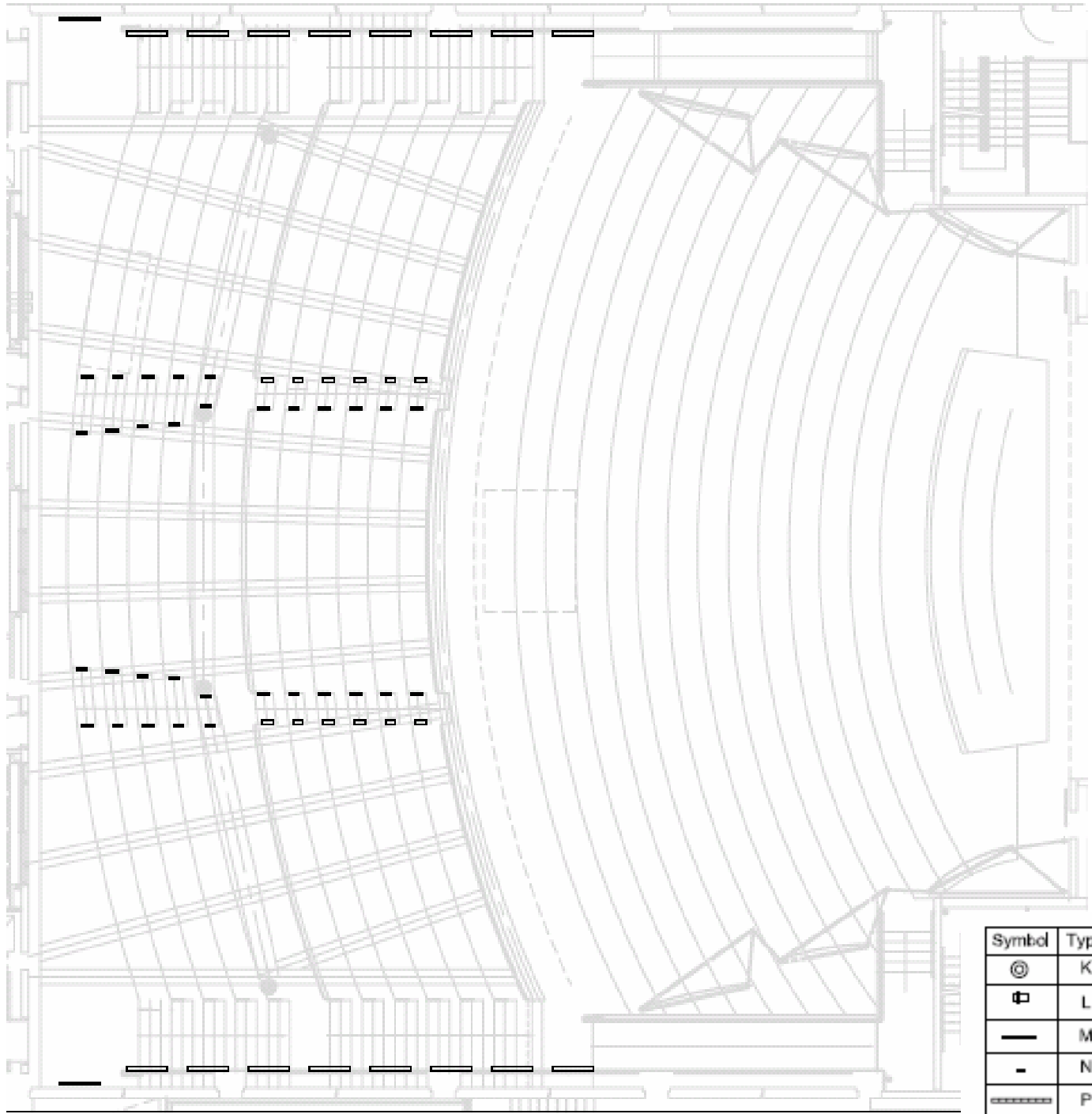
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

Parterre Floor Level



Lindsey Beane

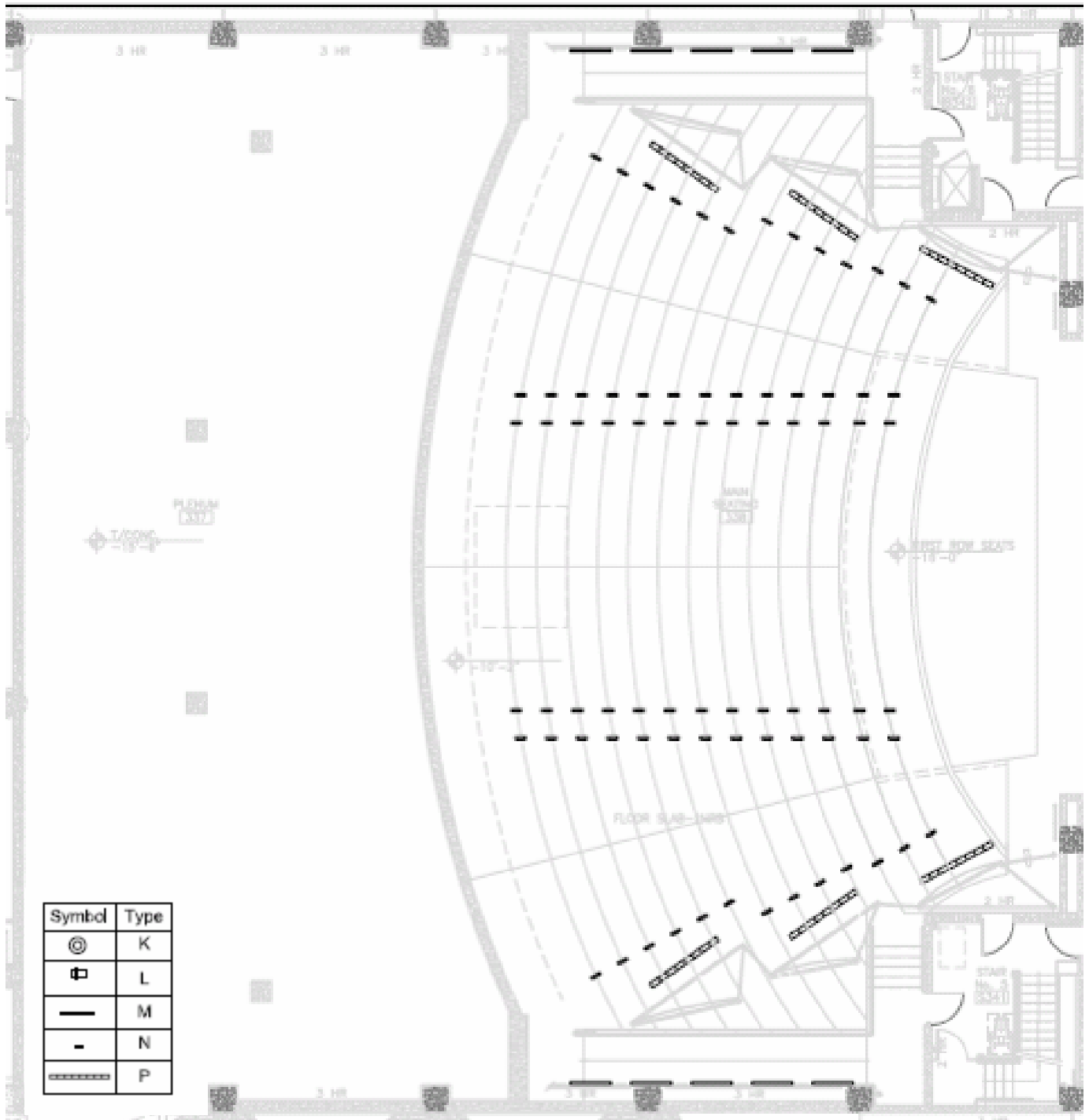
Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

Main Seating Area

Floor Level Lighting Plan



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

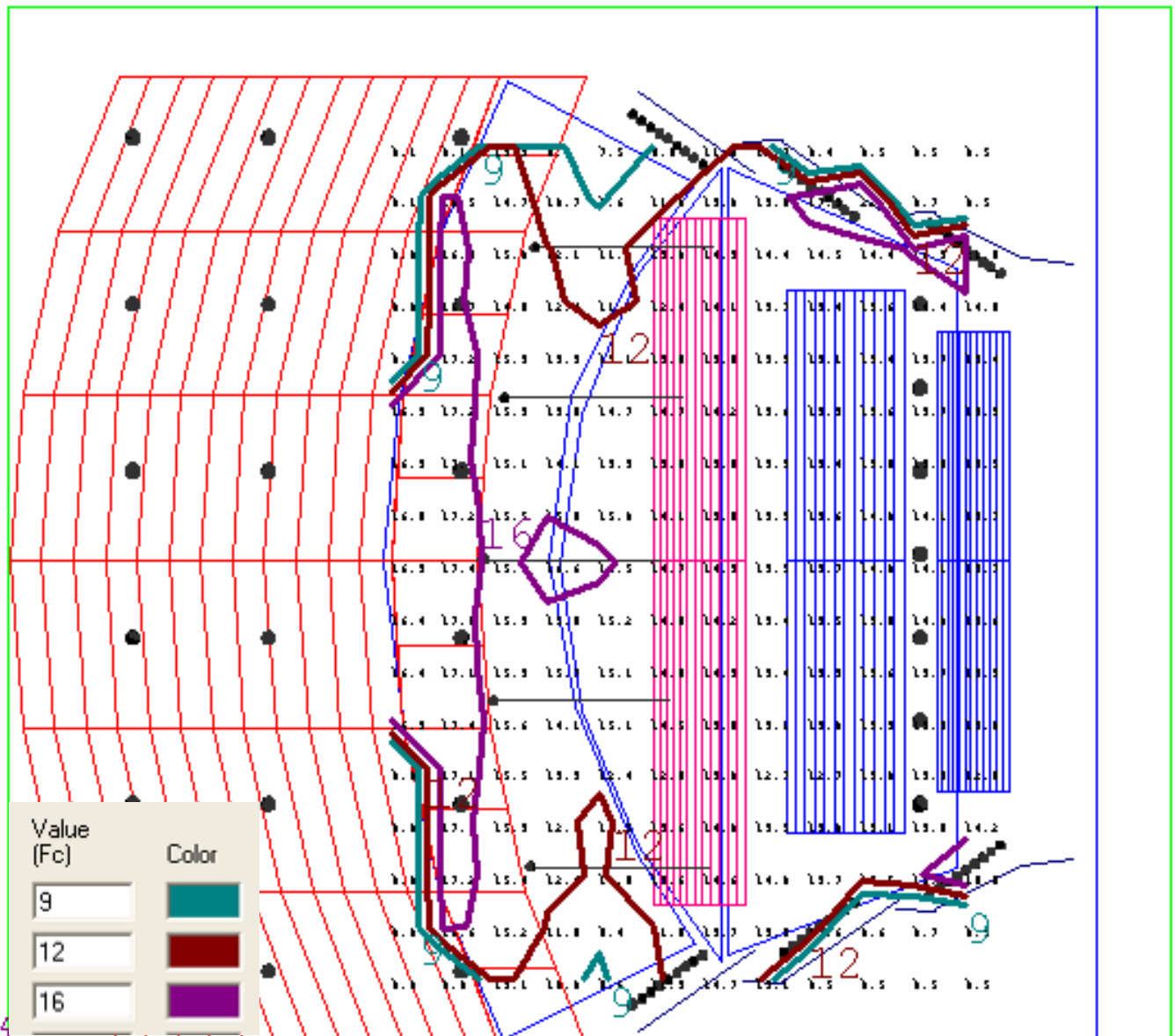


Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

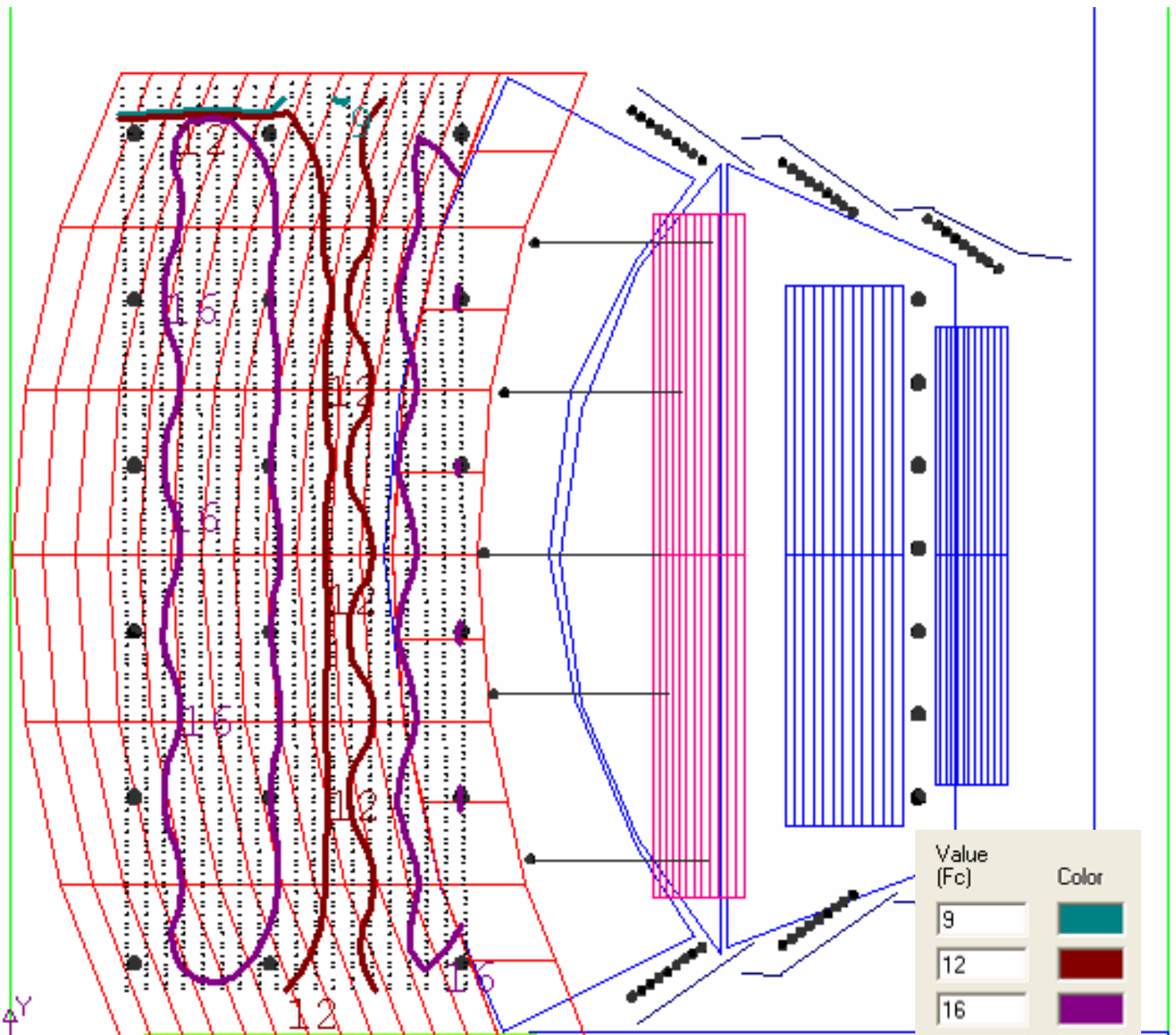


Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

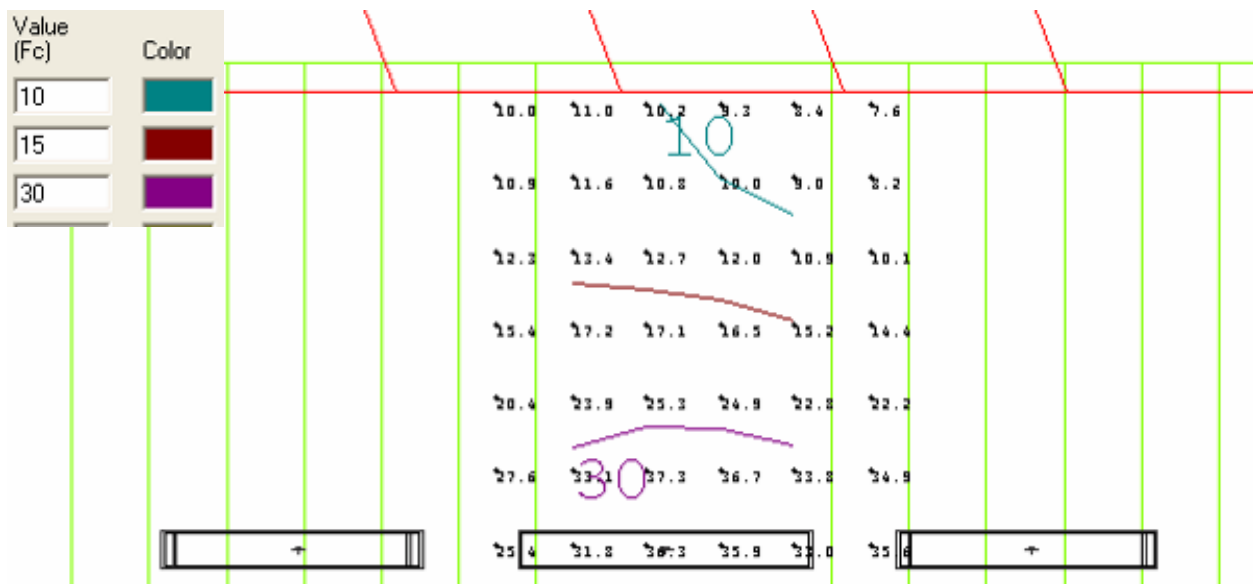


Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

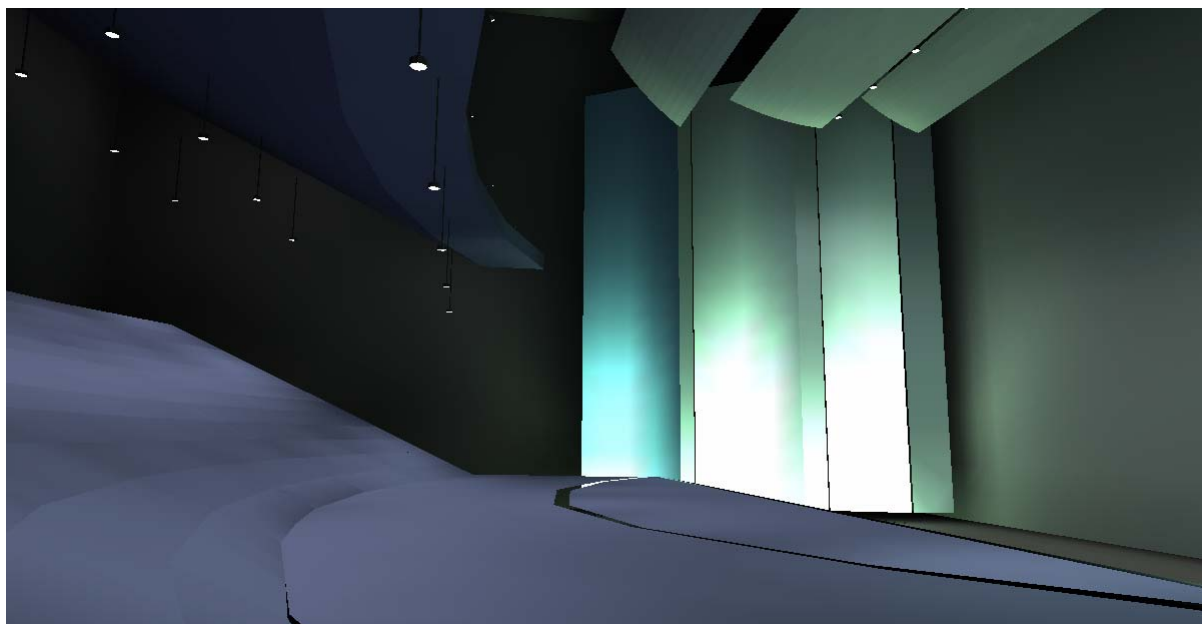
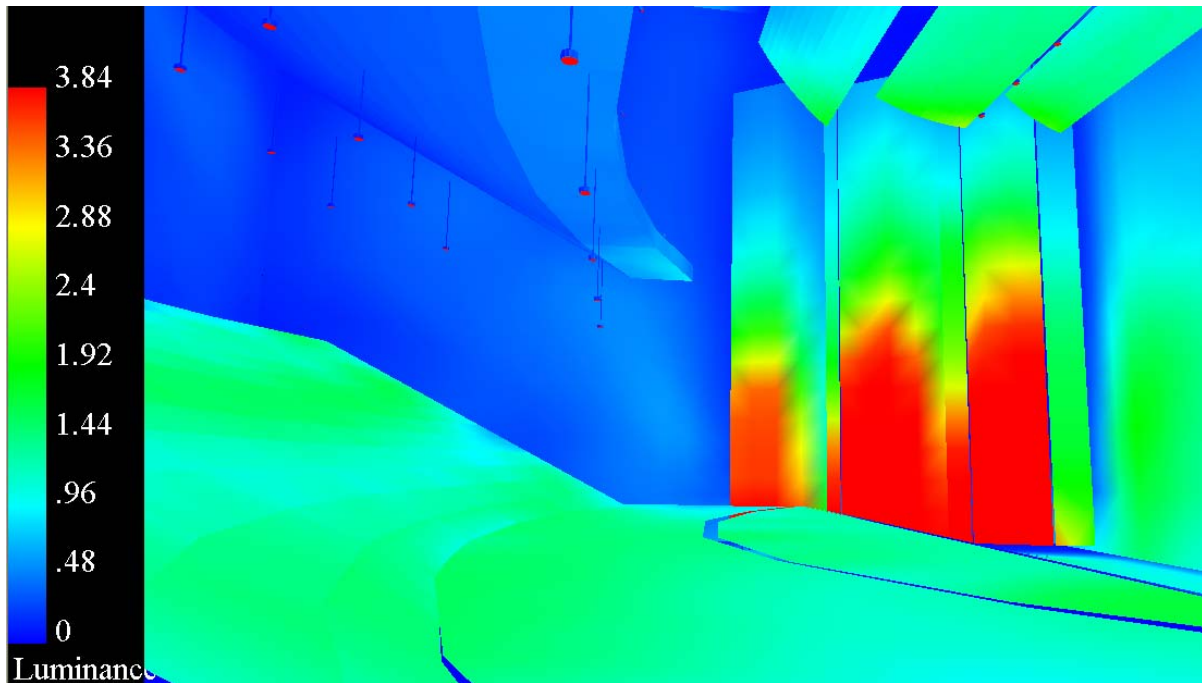


Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.






Lindsey Beane

Lighting/Electrical
 Professor Mistrick
 Harris Theater for Music and Dance
 Chicago, IL



Final Report

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.

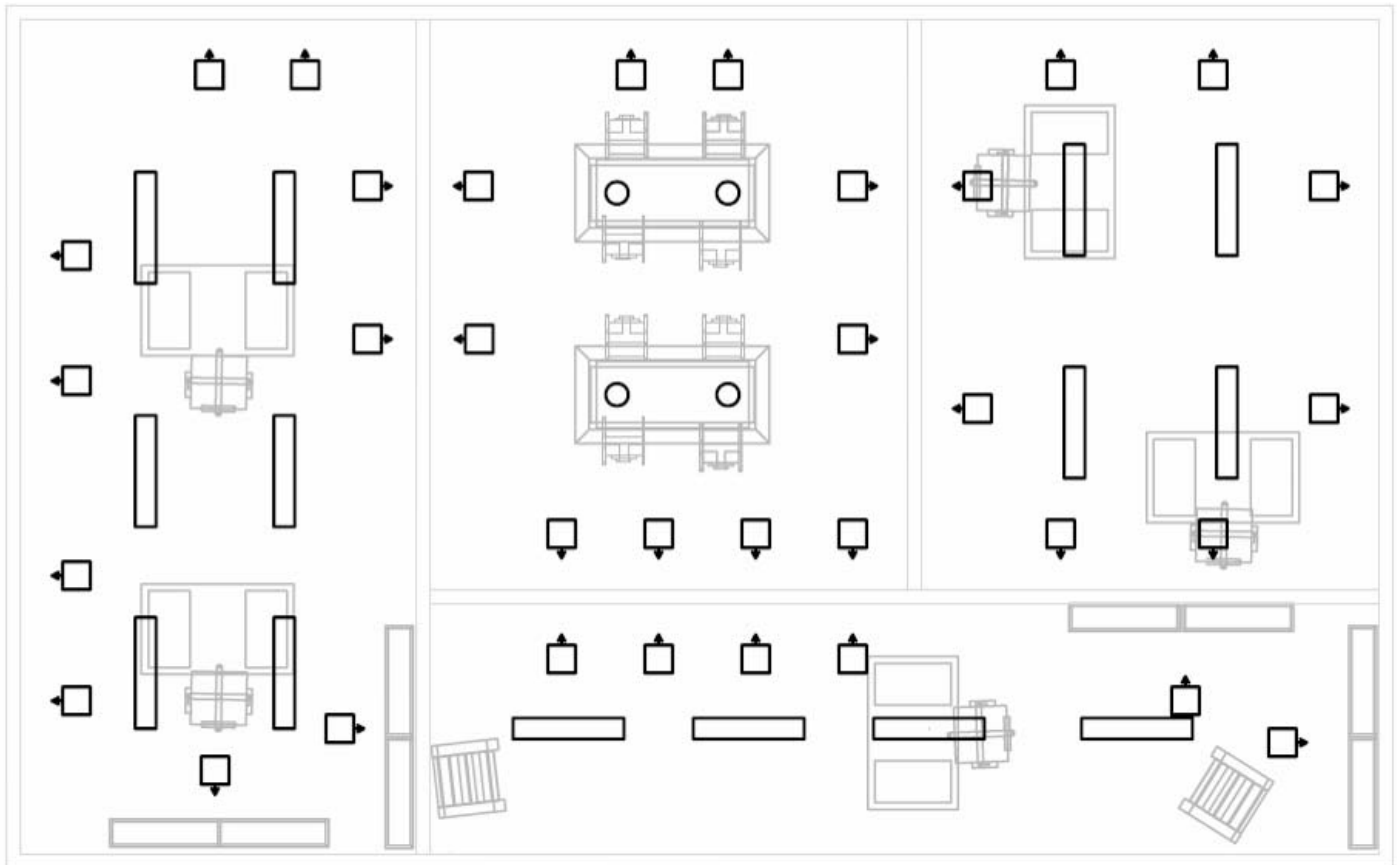
Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL



Final Report

Lighting Layout



Symbol	Type
▭	A
◻	B
○	C

Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

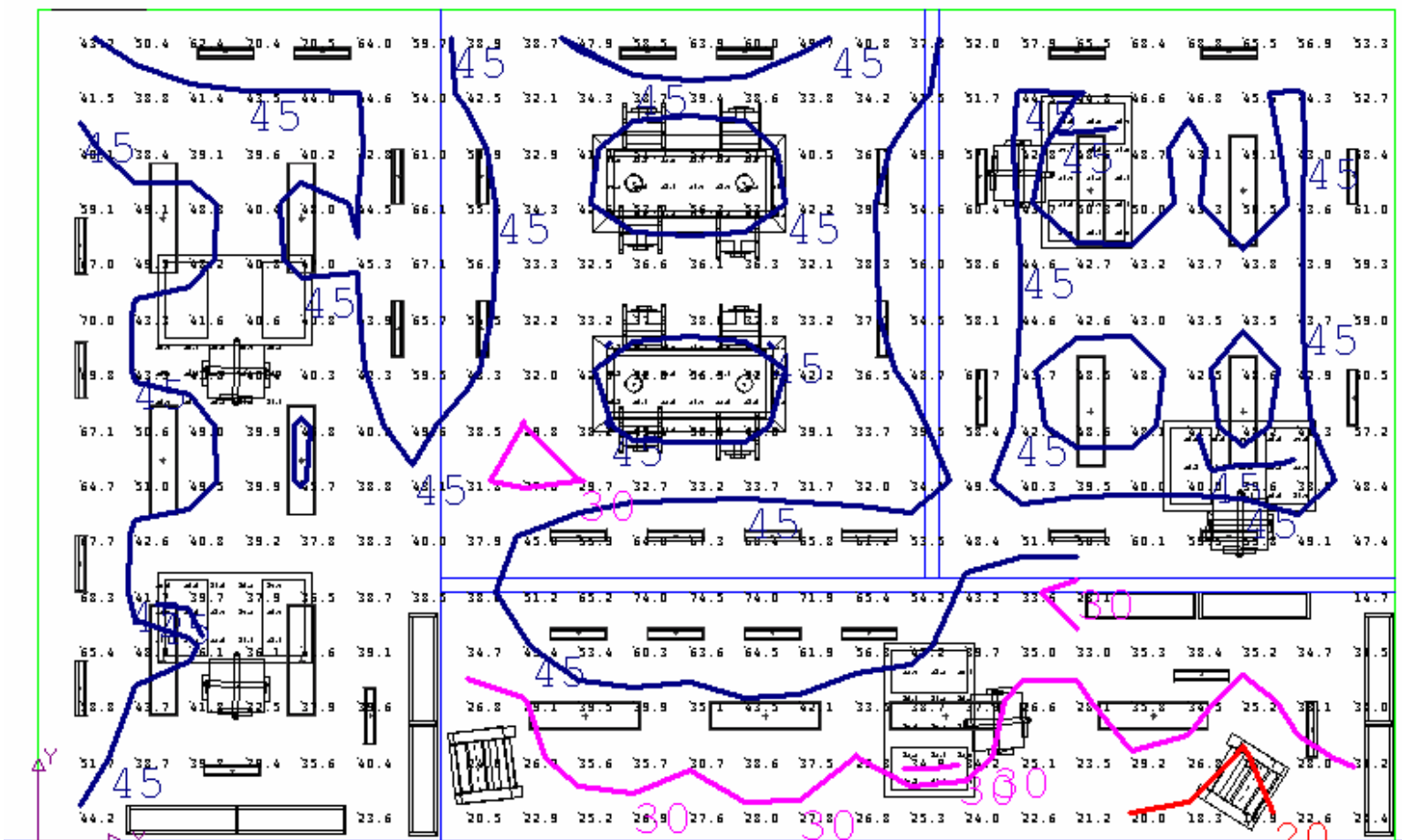


Final Report

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.



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

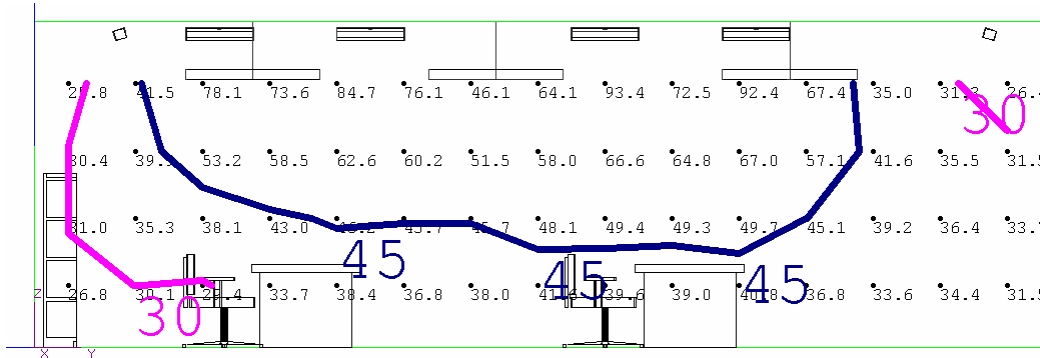


Final Report

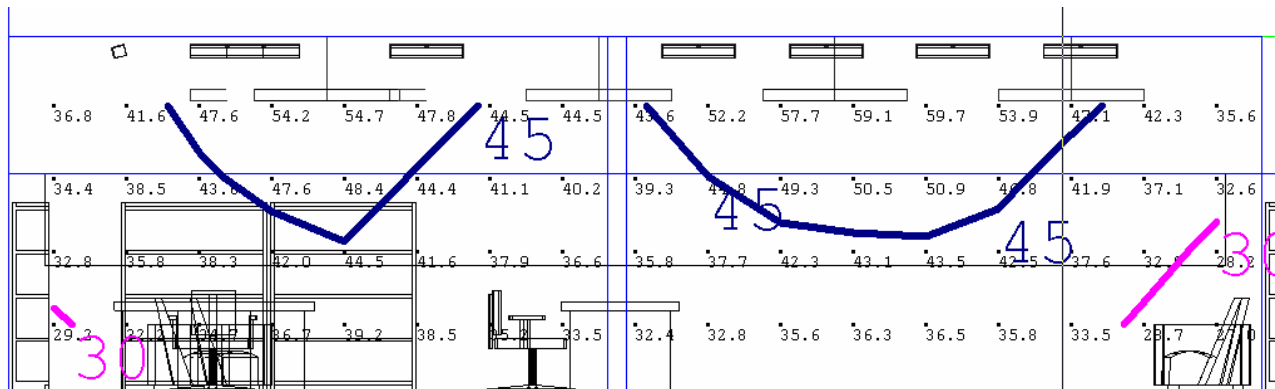
Calculation:

Vertical Calculation Grids

Office walls for highlighting/illuminating artwork.



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



Lindsey Beane

Lighting/Electrical
Professor Mistrick
Harris Theater for Music and Dance
Chicago, IL

Final Report

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.