

**Spring Semester Progress Report**  
**Library and Building Entrance Lighting Depth Work**



**The Pennsylvania Academy of Music**  
Lancaster, PA

**David Smith**  
Lighting/Electrical Option

February 16, 2007

Faculty Advisor: Dr. Mistrick  
Electrical Advisor: Ted Dannerth

# TABLE OF CONTENTS

<b>Executive Summary .....</b>	<b>4</b>
<b>Library.....</b>	<b>5</b>
Design Intent.....	5
Design Criteria .....	6
Equipment.....	6
Light Loss Factors .....	7
Power Density .....	8
Luminaire Locations .....	8
System Performance .....	9
Renderings .....	11
Lighting Power Plan.....	13
Panelboards.....	13
<b>Building Entrance.....</b>	<b>16</b>
Design Intent.....	16
Design Criteria .....	16
Equipment.....	17
Light Loss Factors .....	17
Power Density .....	18
Luminaire Locations .....	19
System Performance .....	20
Panelboards.....	21
<b>Appendix A: Library Lighting Equipment .....</b>	<b>23</b>
Fixture LF1 .....	24
Fixture LF2.....	26
Fixture LF3.....	29
Ballast LB1.....	31

Ballast LB2 .....	34
Ballast LB3 .....	36
Lamp LT5 .....	39
Lamp LT5HO.....	42
<b>Appendix B: Entrance Lighting Equipment.....</b>	<b>45</b>
Fixture FF1 .....	46
Fixture FF2.....	47
Ballast FB1.....	49
Ballast FB2 .....	50
Lamp FMH70 .....	51
Lamp FMH39 .....	56

# EXECUTIVE SUMMARY

In this spring semester progress report, I relied on the knowledge I gained from researching the lighting and electrical systems in Technical Assignment 1 and 2 to apply the concepts I came up with in Technical Assignment 3 to two of the spaces in The Pennsylvania Academy of Music. I chose luminaires and layouts to apply light to the rooms according to the conceptual designs from Technical Assignment 3 and based on the criteria set forth in Technical Assignment 1. I then used the research from Technical Assignment 2 to generate power plans and panelboard redesigns for the spaces.

This progress report only touched on two of the spaces in the building, the library and the building entrance. This report did not go very far into the electrical depth or either of my breadth areas. Once these other factors are taken into consideration, the designs for these spaces and their associated electrical configurations may be altered slightly to fit more closely the analysis and designs of the rest of the project. Additional changes will likely be made when discrepancies between the electrical plans and some of the electrical documentation can be worked out.

The files associated with this report are located in my T:\ drive under the folder “Spring Progress”.

# LIBRARY

## *Design Intent*

The Library is a space that will hold music and books for use by the students of the Academy. The bookshelves are all along the north wall and have inspection counters in them. Reading tables and an administration desk fill the rest of the space.

This space will be used for group and individual education as well as informal gatherings and meetings. It is unlikely that this space would ever be used as a performance space due to its acoustical characteristics. With this in mind, it is my intent to bring a reminder of the music though silently.

I am proposing to use the recessed ceiling cavity in the space as a sculptural element that integrates the lighting design. I have placed a series of luminaires to represent the five lines of the musical staff in this volume. I will further explore this sculptural element in my architectural breadth. Ample vertical illumination should be placed on the shelves and reading tables. More light will be placed on the horizontal planes of the inspection tables so that they may be used to assess information quickly before returning to the reading tables.

The windows in this space look out to a balcony of the Grand Foyer. Once daylight studies of this space are done as part of the rest of my depth work, revisions may be made to the lighting design to incorporate daylight contributions as well as “borrowed” light from this space.

## ***Design Criteria***

Since the task of reading music involves more active thought and visual complexity than reading words, higher than recommended illumination levels will not be viewed as detractive. The IESNA-recommended goal of 30 horizontal footcandles is desirable for the reading tables. A higher target illumination level of 50 horizontal footcandles will be established for the inspection tables. Because of the incorporation of the inspection tables, the IESNA-recommended goal of 30 vertical footcandles at 30 inches off of the floor might be higher than necessary.

A summary of the assumed reflectances for this space are given in Table 1: Library Surface Reflectances.

<b>Surface</b>	<b>Assumed Reflectance</b>
Doors	0.33
Glass	0.10
Wood	0.50
Ceiling	0.85
Walls	0.50
Floor	0.20

**Table 1: Library Surface Reflectances**

## ***Equipment***

The lighting equipment specifications can be cross-referenced through Table 2: Library Lighting Specification Cross-Reference in Table 3: Library Luminaire Specifications, Table 4: Library Ballast Specifications, and Table 5: Library Lamp Specifications. The catalog pages for these products are included in Appendix A: Library Lighting Equipment.

Fixture Label	Type	Lamp	Lamp Quantity	Ballast	Fixture Quantity
LF1	Downlight	LT5	1	LB1	40
LF2	Wallwasher	LT5HO	1	LB2	8
LF3	Downlight	LT5	1	LB3	5

**Table 2: Library Lighting Specification Cross-Reference**

Fixture Label	Manufacturer	Catalog Number
LF1	se'lux	M6R1S-1T5-OD-RC-008
LF2	Focal Point	FAVA-RL-1T5HO-1C
LF3	se'lux	M6R1-1T5-SD-RC-004-WH

**Table 3: Library Luminaire Specifications**

Ballast Label	Manufacturer	Catalog Number	Lamps	Input Watts	Ballast Factor
LB1	Advance	ICN-2M32-MC	2	68	1.05
LB2	Advance	ICN-2S54-90C	2	117	1.00
LB3	Advance	ICN-132-MC	1	34	1.05

**Table 4: Library Ballast Specifications**

Lamp Type	Manufacturer	Catalog Number	Nominal Wattage	Initial Lumen Output
LT5	Philips	F28T5/830/ALTO	28	2900
LT5HO	Philips	F54T6/830/HO/ALTO	54	5000

**Table 5: Library Lamp Specifications**

### **Light Loss Factors**

When calculating light loss factors for this space, I am assuming that it is a very clean environment with a twelve-month cleaning cycle. I am also assuming a cavity height of 8'-6" and a perimeter of 136' to get a room cavity ratio of 1.85. These calculations are in table Table 6: Library Light Loss Factors.

Fixture Label	Ballast Factor	LLD	Luminaire Maintenance Category	LDD	RSDD	Total LLF
LF1	1.05	0.95	V	0.93	0.98	0.909
LF2	1.00	0.95	IV	0.94	0.98	0.875
LF3	1.05	0.95	V	0.93	0.98	0.909

**Table 6: Library Light Loss Factors**

## ***Power Density***

The power density according to ASHRAE 90.1-2004 vary according to the spaces in a library. The total number of watts available to be used is calculated in Table 7: Library Allowable Power Density. The power used in my design is calculated in Table 8: Library Designed Power Density.

<b>Area</b>	<b>Square Footage (ft<sup>2</sup>)</b>	<b>Allowed Power Density (w/ft<sup>2</sup>)</b>	<b>Allowed Wattage</b>
Stacks	600	1.7	1020
Reading Area	960	1.2	1152
<b>TOTAL</b>			<b>2172</b>

**Table 7: Library Allowable Power Density**

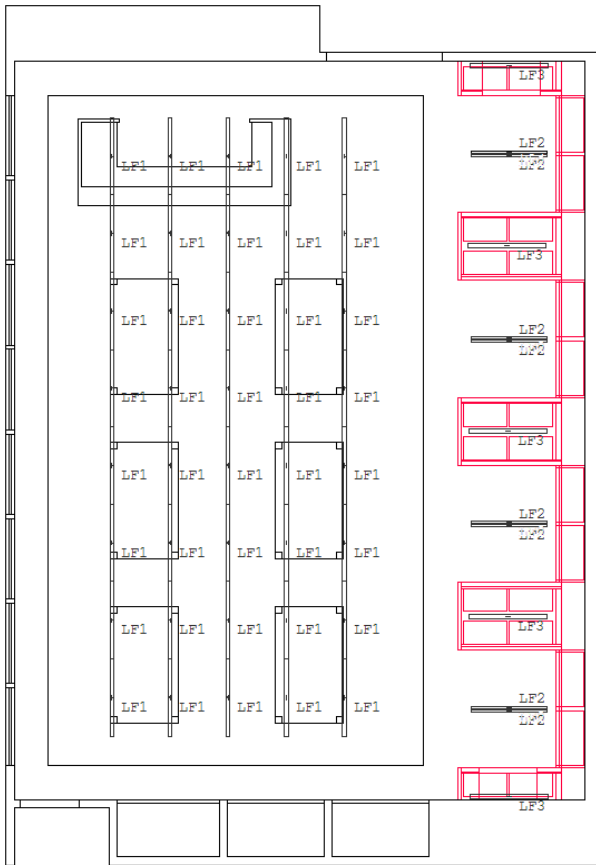
<b>Ballast Label</b>	<b>Lamps</b>	<b>Input Watts</b>	<b>Ballast Quantity</b>	<b>Watts per Ballast Type</b>
LB1	2	68	20	1360
LB2	2	117	4	456
LB3	1	34	5	170
<b>TOTAL</b>				<b>1986</b>

**Table 8: Library Designed Power Density**

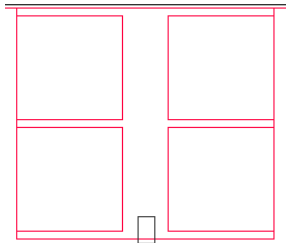
## ***Luminaire Locations***

The luminaire locations are given in Figure 1: Library Luminaire Locations. The section mounting detail of fixture type LF3 above the inspection tables, and within the millwork, is given in Figure 2: LF3 Mounting Location. Controls for the system would be located at both doors to the library.





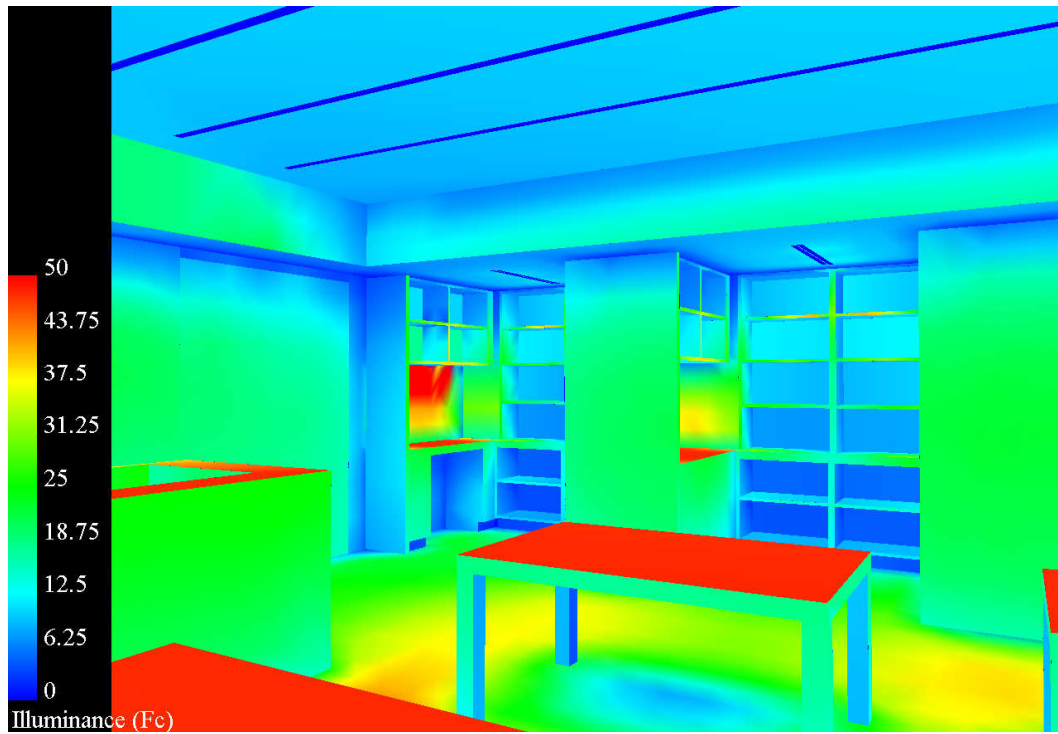
**Figure 1: Library Luminaire Locations**



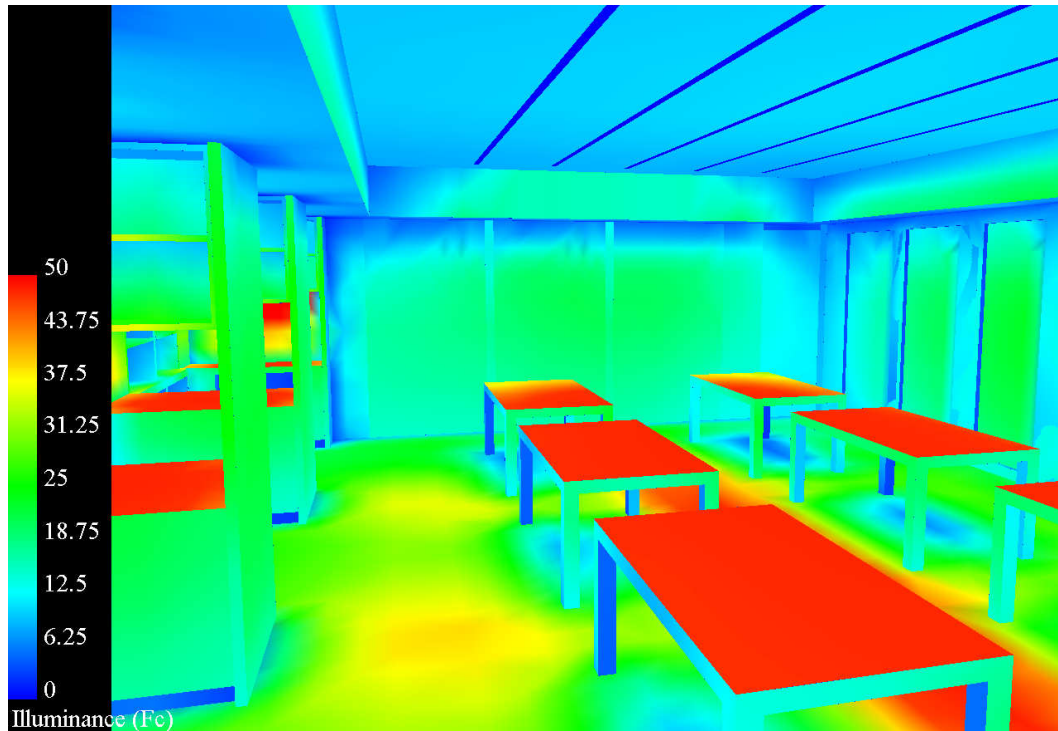
**Figure 2: LF3 Mounting Location**

### ***System Performance***

The library lighting system performance is shown in Figure 3: Library Pseudocolor Rendering, View 1 and Figure 4: Library Pseudocolor Rendering, View 2.



**Figure 3: Library Pseudocolor Rendering, View 1**



**Figure 4: Library Pseudocolor Rendering, View 2**

## ***Renderings***

Color renderings of the library can be seen in Figure 5: Library Color Rendering, View 1 and Figure 6: Library Color Rendering, View 2.



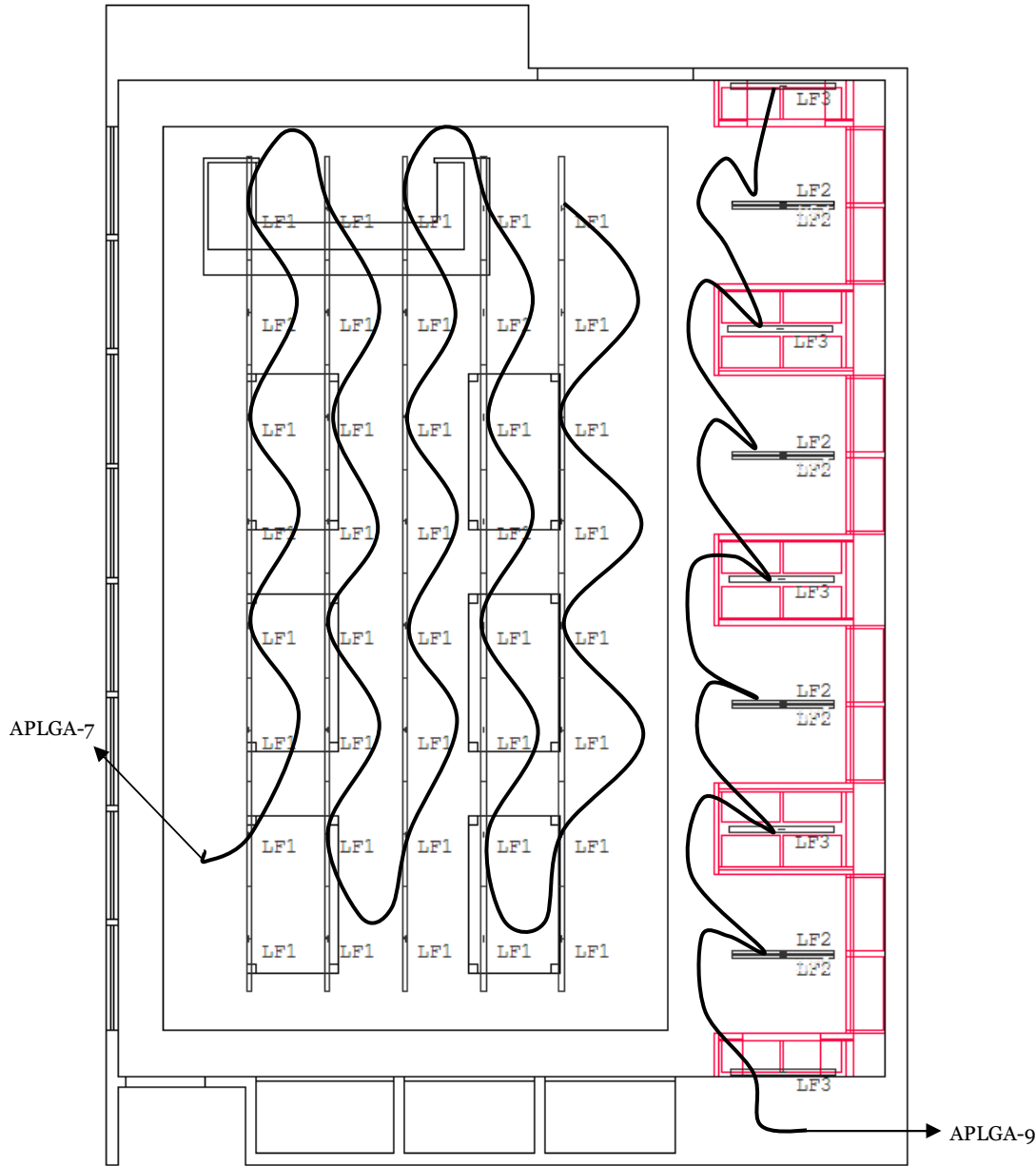
**Figure 5: Library Color Rendering, View 1**



**Figure 6: Library Color Rendering, View 2**

## Lighting Power Plan

The library lighting power plan can be seen in Figure 7: Library Lighting Power Plan.



**Figure 7: Library Lighting Power Plan**

### Panelboards

Due to discrepancies between the plans and the panelboard schedules for my building, I must make the assumptions that the plans supersede the separate panelboard schedules



PANELBOARD SCHEDULE												
VOLTAGE: 208 SIZE/TYPE BUS: 225A COPPER SIZE/TYPE MAIN: MLO			PANEL TAG: APLGA PANEL LOCATION: Dimmer Room PANEL MOUNTING: SURFACE					MIN. C/B AIC: 10K OPTIONS:				
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	0	600	20A/1P	1	*			2	20A/1P	800	2nd Floor	Receptacles
Lighting	0	1500	20A/1P	3		*		4	20A/1P	1200	Cleaning Outlet	Receptacles
Lighting	2nd Floor	1700	20A/1P	5			*	6	20A/1P	800	2nd Floor	Receptacles
Lighting	Library	1780	20A/1P	7	*			8	20A/1P	400	Grand Foyer	Receptacles
Lighting	Library	814	20A/1P	9		*		10	20A/1P	800	Grand Foyer	Coat Rack
Receptacles	Cleaning Outlet	600	20A/1P	11			*	12	20A/1P	600	Grand Foyer	Receptacles
Receptacles	2nd Floor	800	20A/1P	13	*			14	20A/1P	900	2nd Floor	Lighting
Mechanical	0	1080	20A/1P	15		*		16	20A/1P	1200	2nd Floor	Receptacles
Mechanical	0	1080	20A/1P	17			*	18	20A/1P	0	CH-4	Mechanical
Mechanical	0	1080	20A/1P	19	*			20	20A/1P	0	0	Spare
Spare	0	0	20A/1P	21		*		22	20A/1P	0	0	Spare
Spare	0	0	20A/1P	23			*	24	20A/1P	0	0	Spare
Spare	0	0	20A/1P	25	*			26	20A/1P	0	0	Spare
Spare	0	0	20A/1P	27		*		28	20A/1P	0	0	Spare
Spare	0	0	20A/1P	29			*	30	20A/1P	0	0	Spare
		0	20A/1P	31	*			32	20A/1P	0		
		0	20A/1P	33		*		34	20A/1P	0		
		0	20A/1P	35			*	36	20A/1P	0		
		0	20A/1P	37	*			38	20A/1P	0		
		0	20A/1P	39		*		40	20A/1P	0		
		0	20A/1P	41			*	42	20A/1P	0		
CONNECTED LOAD (KW) - A		6.36							TOTAL DESIGN LOAD (KW)		17.40	
CONNECTED LOAD (KW) - B		6.59							POWER FACTOR		1.00	
CONNECTED LOAD (KW) - C		4.78							TOTAL DESIGN LOAD (AMPS)		48	

Figure 9: Revised ALPGA Panelboard Schedule

# BUILDING ENTRANCE

## *Design Intent*

The main entrance to the building is the part of the façade that will be seen by most people who travel past the building. It consists of a three-story, curved glass structure looking in at the two-story lobby and a performance space on the third floor. This is nestled between an extension of the third floor supported by square columns that go to the street level. At night, the glass atrium will be given the chance to glow from the lighting in the lobby. The exterior spaces should get equal treatment.

I am proposing to pair the glowing surfaces behind the glass by making the volumes enclosed by the canopies and columns glow as well. This should be guided by the need to provide accurate facial rendering and the need to have ample horizontal illumination so that the steps scattered throughout the path are visible. Another design guideline is minimizing light trespass coming from the exterior lighting. Outside of this area under the canopy of the building, the lighting is taken care of by the city.

## *Design Criteria*

The design criteria is to get 5 footcandles of horizontal illumination on the ground and 5 footcandles of vertical illumination at about head height. The reflectances I assumed for this space are given in Table 9: Building Entrance Reflectances.

<b>Surface</b>	<b>Assumed Reflectance</b>
Limestone	0.50
Glass	0.10
Concrete	0.40

**Table 9: Building Entrance Reflectances**



## Equipment

The lighting equipment specifications can be cross referenced through Table 10: Building Entrance Specification Cross Reference in Table 11: Building Entrance Luminaire Specifications, Table 12: Building Entrance Ballast Specifications, and Table 13: Building Entrance Lamp Specifications. The catalog pages for these products are given in Appendix B: Entrance Lighting Equipment.

Fixture Label	Type	Lamp	Lamp Quantity	Ballast	Fixture Quantity
FF1	Downlight	FMH70	1	FB1	10
FF2	Uplight	FMH39	1	FB2	12

**Table 10: Building Entrance Specification Cross Reference**

Fixture Label	Manufacturer	Catalog Number
FF1	Erco	81030.023
FF2	B-K Lighting	S-HP2-T635-MS-TR-o-SAP-ICEE

**Table 11: Building Entrance Luminaire Specifications**

Ballast Label	Manufacturer	Catalog Number	Lamps	Input Watts	ANSI Code
FB1	Advance	71A5281	1	94	M139/E
FB2	Advance	71A5081	1	56	M130/E

**Table 12: Building Entrance Ballast Specifications**

Lamp Type	Manufacturer	Catalog Number	Nominal Wattage	ANSI Code	Initial Lumen Output
FMH70	Philips	CDM70/T6/830	70	M139/E	6600
FMH39	Philips	CDM35/T6/830	39	M130/E	3300

**Table 13: Building Entrance Lamp Specifications**

## Light Loss Factors

Since this is an outdoor space, I have assumed that the space is a medium cleanliness rating with a 12 month cleaning cycle. I have assumed an RSDD of 0.9 as a safety factor.

The calculations for the light loss factors are given in Table 14: Building Entrance Light Loss Factors.

<b>Fixture Label</b>	<b>Ballast Factor</b>	<b>LLD</b>	<b>Luminaire Maintenance Category</b>	<b>LDD</b>	<b>RSDD</b>	<b>Total LLF</b>
FF1	1	0.75	V	0.83	0.9	0.560
FF2	1	0.78	V	0.83	0.9	0.583

**Table 14: Building Entrance Light Loss Factors**

### ***Power Density***

The exterior lighting power density according to ASHRAE 90.1-2004 varies according to what objects are being lit. The total number of watts available to be used is calculated in Table 15: Building Entrance Allowable Power Density. The power used in my design is calculated in Table 16: Building Entrance Designed Power Density.

<b>Item Description</b>	<b>Measurement</b>	<b>Allowable Power Density</b>	<b>Allowed Wattage (w)</b>
Stair	81 ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	81
Main Entrances	42 ft	30 W/ft	1260
Secondary Entrance	3.5 ft	20 W/ft	70
Canopy (3 <sup>rd</sup> Floor)	1520 ft <sup>2</sup>	1.25 W/ft <sup>2</sup>	1900
Canopy (Signage)	183 ft <sup>2</sup>	1.25 W/ft <sup>2</sup>	229
<b>Subtotal</b>			<b>3540</b>
<b>Multiplier</b>			<b>x 1.05</b>
<b>TOTAL</b>			<b>3717</b>

**Table 15: Building Entrance Allowable Power Density**

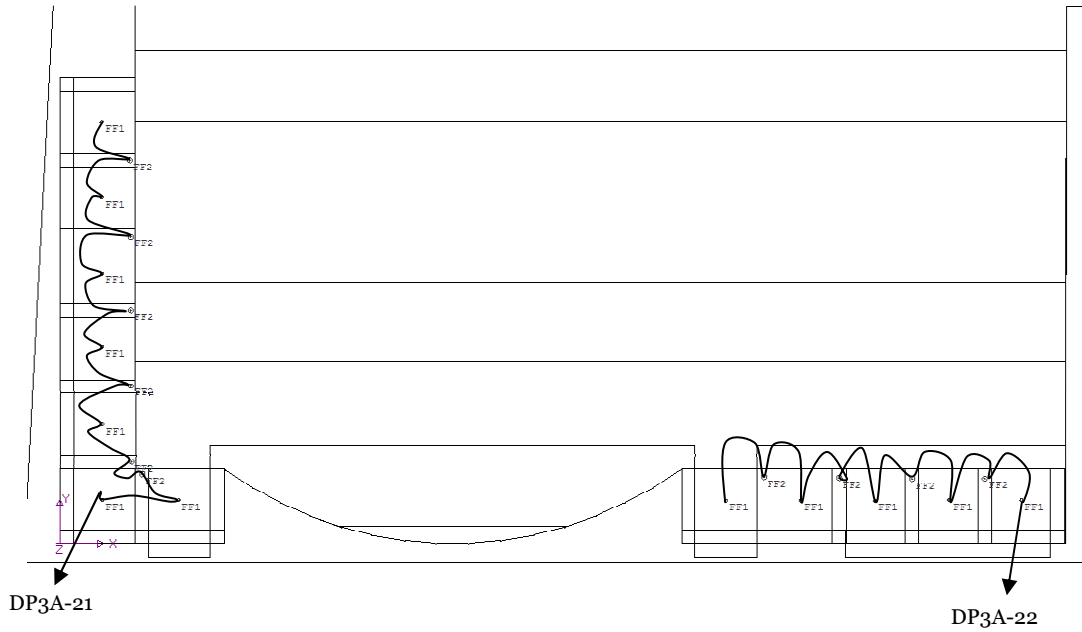
<b>Ballast Label</b>	<b>Lamps</b>	<b>Input Watts</b>	<b>Ballast Quantity</b>	<b>Watts per Ballast Type</b>
FB1	1	94	10	940
FB2	1	56	12	672
<b>TOTAL</b>				<b>1612</b>

**Table 16: Building Entrance Designed Power Density**

## Luminaire Locations

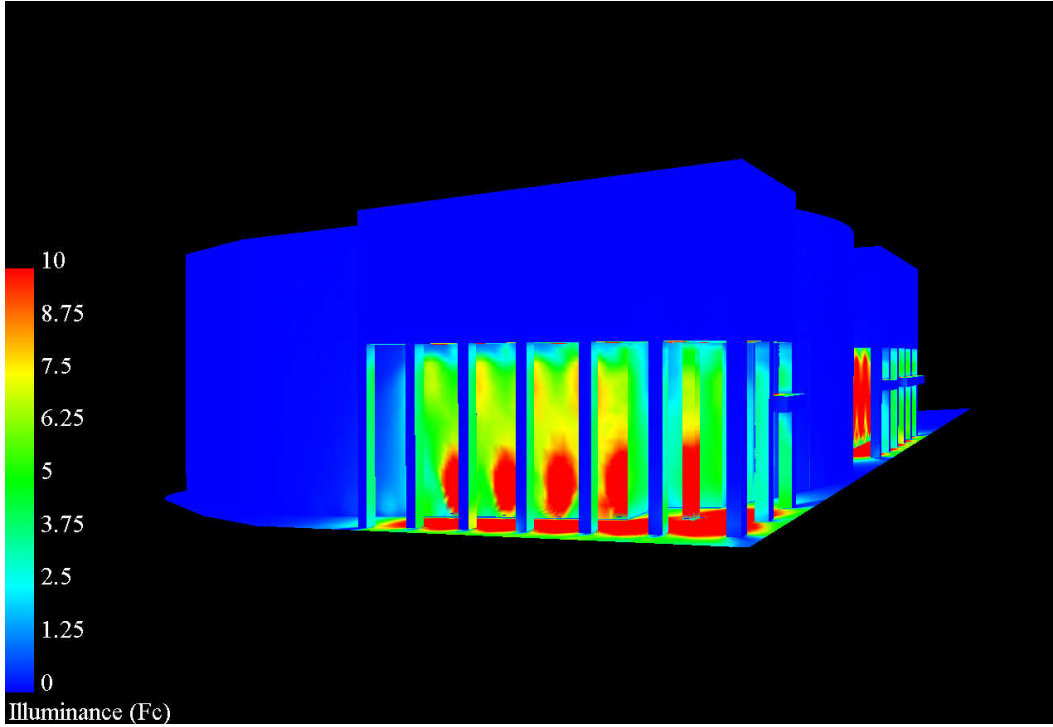
The luminaire locations are given in Figure 10: Building Entrance Luminaire Locations.

Controls for these luminaires would be integral with the building management system.

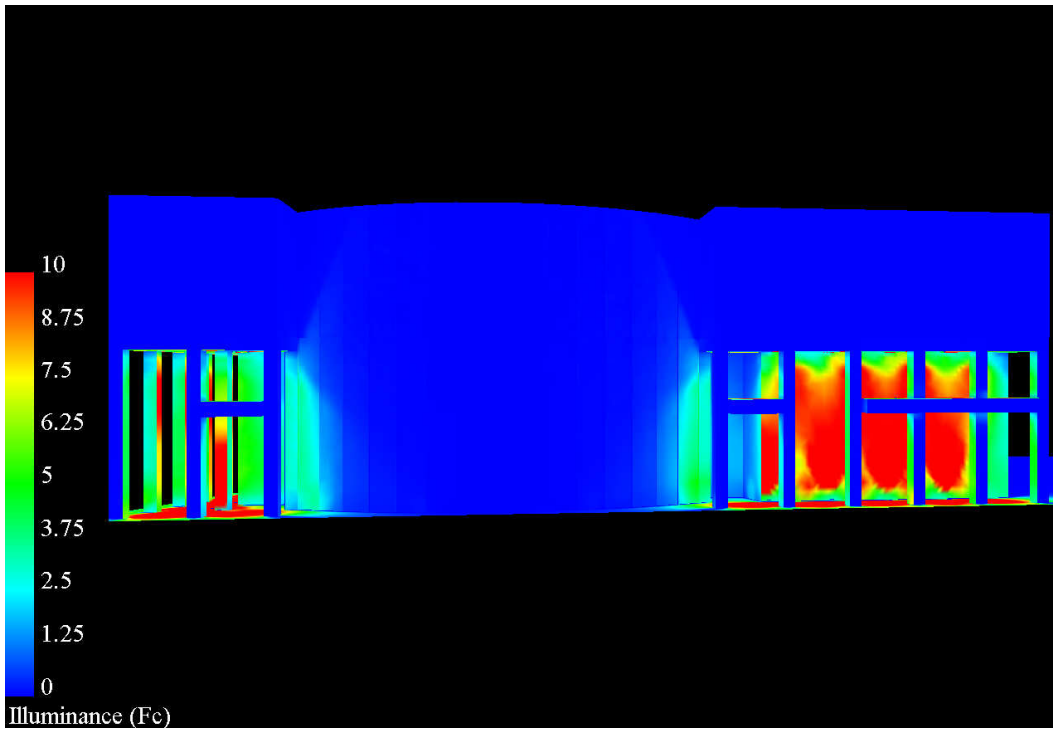


**Figure 10: Building Entrance Luminaire Locations**

## System Performance



**Figure 11: Building Entrance Pseudocolor, View 1**



**Figure 12: Building Entrance Pseudocolor, View 2**

## Panelboards

The minor changes to the loading on the original design of the panelboard, Figure 13: DP3A Panelboard Schedule (By Electrical Engineer), did not warrant redesign at this point – see Figure 14: Revised DP3A Panelboard Schedule. However, looking ahead, this panelboard will definitely be revised as I get farther along in my electrical and lighting depths.

PANEL:	DP3A	SECT.:	1	MTG.:	SURFACE
VOLTS:	120/208	PHASE:	3	WIRES:	4
MAIN C.B.:				GND.:	GROUND BUS
MAIN BUS:	225A	MINIMUM INTERRUPTING RATING:	10,000A		

CKT. No.	TRIP (Amps)	Category	DESCRIPTION OF LOAD	Category	Load (Va)	Per Phase (Va)			Load (Va)	Category	Description Of Load	Trip (Amps)	Ckt. No.
						A	B	C					
1	20		GRAND FOYER	L	1500	2500			1000	L	GRAND FOYER	20	2
3	20		GRAND FOYER	L	1750		2500		750	L	GRAND FOYER	20	4
5	20		GRAND FOYER	L	750			1750	1000	L	GRAND FOYER	20	6
7	20		GRAND FOYER	L	1000	2000			1000	L	GRAND FOYER	20	8
9	20		GRAND FOYER	L	1000		2000		1000	L	GRAND FOYER	20	10
11	20		GRAND FOYER	L	1000			2000	1000	L	GRAND FOYER	20	12
13	20		GRAND FOYER	L	1000	2000			1000	L	GRAND FOYER	20	14
15	20		GRAND FOYER	L	1000		2000		1000	L	GRAND FOYER	20	16
17	20		GRAND FOYER	L	1000			2000	1000	L	GRAND FOYER	20	18
19	20		GRAND FOYER	L	1000	2000			1000	L	GRAND FOYER	20	20
21	20		LOUNGE	L	1000		2000		1000	L	LOUNGE	20	22
23	20		LOUNGE	L	600			800	200	L	INSTITUTE	20	24
25	20		INSTITUTE	L	500	1200			700	L	INSTITUTE	20	26
27	20		INSTITUTE	L	200		1160		960	L	EXTERIOR ENTRY	20	28
29	20		EXTERIOR LOGGIA	L	660			1980	1320	L	EXTERIOR LOGGIA	20	30
31	20		EXTERIOR LOGGIA	L	1200				180	L	EXTERIOR STEP LITS	20	32
33	20											20	34
35	20											20	36
37	20											20	38
39	20											20	40
41	20											20	42
TOTAL CONNECTED LOAD (VA) PER PHASE:						9700	9660	8530					

TOTAL CONNECTED LIGHTING LOAD (KVA):	15160	29270	14110
TOTAL CONNECTED RECEPTACLE LOAD (KVA):	0	0	0
TOTAL CONNECTED OTHER LOAD (KVA):	0	0	0
TOTAL DEMAND LOAD (KVA):		36593	
TOTAL DEMAND LOAD (AMPS):		102	

SUPPLIED FROM	DEMAND LOAD
PANEL:	L= Continuous Lighting @ 125%*Connected
FEEDER:	R= Convenience Receptacles @ 100% Of 1st 10kw+50% of remainder
	O=Other Loads @ 100%*Connected

**Figure 13: DP3A Panelboard Schedule (By Electrical Engineer)**

PANELBOARD SCHEDULE												
VOLTAGE: 208 SIZE/TYPE BUS: 225A COPPER SIZE/TYPE MAIN: MLO			PANEL TAG: DP3A PANEL LOCATION: Dimmer Room PANEL MOUNTING: SURFACE					MIN. C/B AIC: 12K OPTIONS:				
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Grand Foyer	1500	20A/1P	1	*			2	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1750	20A/1P	3		*		4	20A/1P	750	Grand Foyer	Lighting
Lighting	Grand Foyer	750	20A/1P	5			*	6	20A/1P	1750	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	7	*			8	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	9		*		10	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	11			*	12	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	13	*			14	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	15		*		16	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	17			*	18	20A/1P	1000	Grand Foyer	Lighting
Lighting	Grand Foyer	1000	20A/1P	19	*			20	20A/1P	1000	Grand Foyer	Lighting
Lighting	Lounge	1000	20A/1P	21		*		22	20A/1P	1000	Lounge	Lighting
Lighting	Lounge	600	20A/1P	23			*	24	20A/1P	500	Institute	Lighting
Lighting	Institute	700	20A/1P	25	*			26	20A/1P	200	Institute	Lighting
Lighting	Exterior	1366	20A/1P	27		*		28	20A/1P	956	Exterior	Lighting
		0	20A/1P	29			*	30	20A/1P	0		
		0	20A/1P	31	*			32	20A/1P	0		
		0	20A/1P	33		*		34	20A/1P	0		
		0	20A/1P	35			*	36	20A/1P	0		
		0	20A/1P	37	*			38	20A/1P	0		
		0	20A/1P	39		*		40	20A/1P	0		
		0	20A/1P	41			*	42	20A/1P	0		
CONNECTED LOAD (KW) - A		9.40						TOTAL DESIGN LOAD (KW)		30.60		
CONNECTED LOAD (KW) - B		10.82						POWER FACTOR		1.00		
CONNECTED LOAD (KW) - C		7.60						TOTAL DESIGN LOAD (AMPS)		85		

Figure 14: Revised DP3A Panelboard Schedule