Lighting Depth

Space Introduction

The four spaces for the lighting redesign include the plaza, lobby, auditorium, and the 5th floor sixty-capacity classroom of the Dorrance H. Hamilton Building. The grassy plaza consists of a 60,000 ft^2 courtyard used as a circulation space for the Dorrance H. Hamilton Building, Martin Building, Scott Library & Administration Building, and Orlowitz Residence Hall. The plaza area will also provide students and faculty with an area to enjoy the outdoors.

Upon entering the building through the curved glass façade, one would find themselves in the lobby of the building, which is the second space to be redesigned. The lobby will be mainly used for a circulation space with elevators, stairways, and a small retail space. The lobby also includes the entrance to the third space of redesign, which is the auditorium.

The 300-seat capacity auditorium resides on the first floor of the building, adjacent to the lobby. The auditorium provides a challenging redesign with a 15' high raked ceiling and 4800 ft^2 of space.

The sixty-capacity classroom is located on the 5th floor of the Dorrance H. Hamilton Building. Some other spaces that accompany the classroom on the fifth floor includes other classrooms, lecture halls, two skills simulation labs, storage rooms, a small lobby, and a library/meeting room. The back wall of the classroom is a curved glass ribbon window, which will have dual/solar blackout shades provided by the owner of the building.

Lighting Design

The lighting design will provide the four spaces with an aesthetically pleasing atmosphere and ample light on the task plane. In order to accomplish this task, the IESNA Lighting Handbook and ASHRAE 90.1 were followed throughout the design process. The spaces were modeled in AutoCAD and exported into AGI32, where the lighting design was finished with various renderings and lighting calculations.

Plaza – Lighting Redesign

Description of Space

The main entrance to the Dorrance H. Hamilton Building faces a grassy plaza where students and faculty can meet and interact informally. The facilities curved façade will feature large expanses of glass that will open on the plaza outside. The transparency of the building carries through the entire ground floor, allowing people on the street to look into the lobby, through the building and out to the plaza. The plaza includes walkways, a statue, seating areas, and an open grass area. The plaza is approximately 60,000 ft^2.

Site Plan

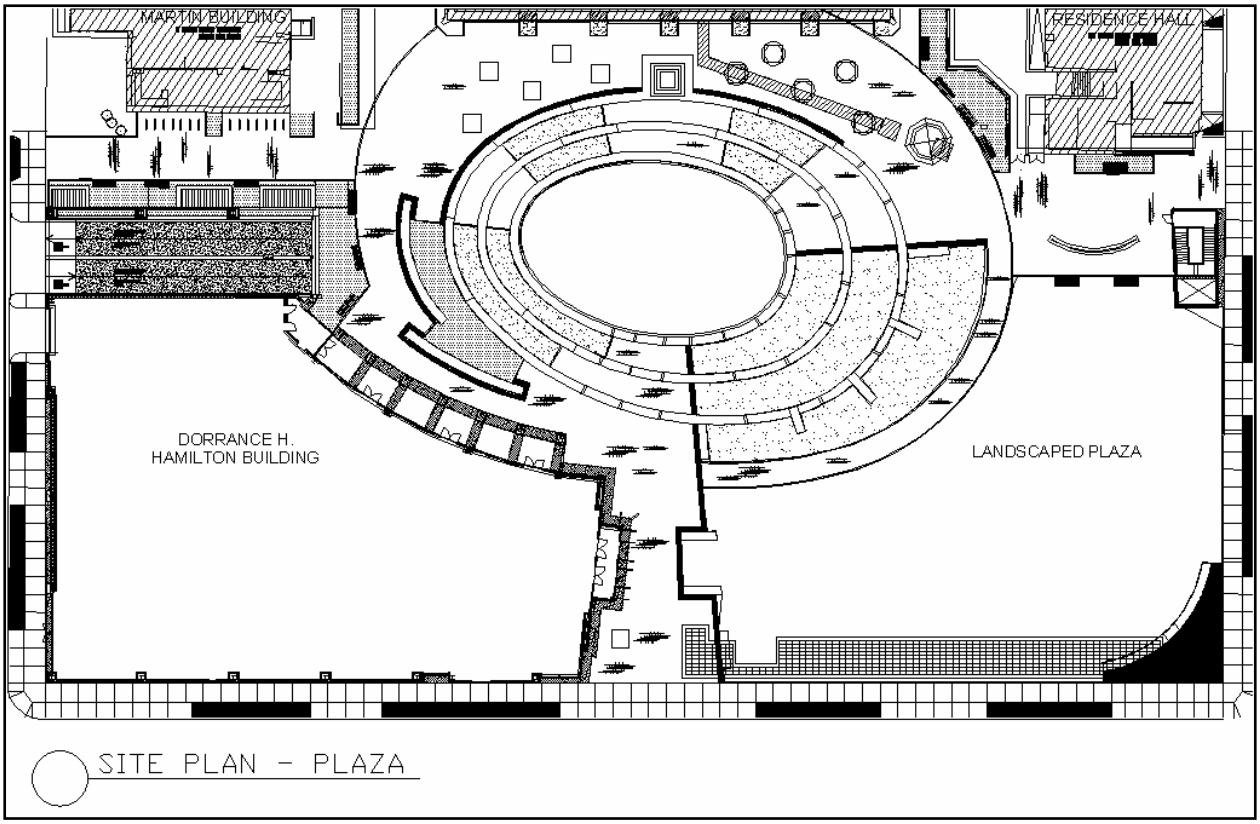


Figure 1: Plaza Site Plan

Design Concept

The design concept of the plaza is to provide sufficient illumination for circulation for buildings surrounding the Dorrance H. Hamilton Building. The main areas of interest are the walkways, stairways, the statue, and seating areas.

Design Criteria

Appearance of Space and Luminaires

The appearance of the space and luminaires is extremely important when lighting a plaza to this new "new heart of campus". The appearance of the space and luminaires has to be aesthetically appealing. The statue, walkways, and seating areas need to be lighted.

Point(s) of Interest

The points of interest in the space include the entrances and exits of buildings, walkways, statue, and grassy plaza. The points of interest will prosper with a higher illuminance due to the fact that they will stand out, such as the entrances and exits to the surrounding buildings, the statue, and walkways. The grassy area of the plaza does not need to be illuminated as high as the other points of interest. A number of luminaires surrounding the space may be a good idea instead of lighting the whole grassy area.

Illuminance (Horizontal)

The IESNA handbook calls for a horizontal illuminance of 5 lux (0.5 fc) for walkways distant from roadways and 6 lux (0.6 fc) for intermediate roadside sidewalks.

Illuminance (Vertical)

The IESNA handbook recommends a vertical illuminance of 1 lux (0.1 fc) for this space. The entrances and exits of the buildings should be at 30 lux (3 fc) for this space.

Power Allowances from ASHRAE 90.1 Standards

The power allowance in Table 9.4.5 of the ASHRAE 90.1 Standards is 0.2 W/ft^2 for the building grounds. The building grounds will include walkways 10 feet wide or greater and plaza areas. For walkways less than 10 feet wide, the power allowance is 1.0 W/ft^2. The main building entrance and exit has a power allowance of 30W/linear foot of door width.

Fixture Schedule

Label	Description	MH	Lamps	Ballast/ Transformer	Watts	Voltage	Mfr.	Catalogue No.
F-A1	18' High Pole Mounted Area Source 8-Sided Lantern Opal Text Lens with Black Finish	18'	1 – 175 Watt MH	IMH-175-C – Advance - e-Vision Electronic Ballast for MH Lamps	175	277	Allscape	AA-01-22-175MH-E-17-277-OA-BK-PCB
F-A2	6" Diameter Bollard with Spherical Variform Reflector with 42" Overall Height	3.5'	1 – 70 Watt MH	IMH-70-A-BLS-ID - Advance – e-Vision Electronic Ballast for MH Lamps	70	277	Allscape	LL-02-70MH-E-17-277-O-42-BK
F-A3	SP-108 Metric Series Cutoff Step Light Luminaire	2'	2 – 18 Watt CFL	ICF-2S18-H1-LD – Advance – Smartmate Electronic Ballast	36	277	Allscape	SP-108-2(18)CFL-277-BK-PL
F-A4	SL-50 Die-Cast Aluminum Floodlight	1'	1 – 50 Watt MR16	N/A	50	277	Allscape	Sl-50-50LV-MR-16-277-BK-UD
F-A5	BL-49 Cast Aluminum Wall Mount Black Fixture	6'	1 – 70 Watt MH	IMH-70-A-BLS-ID - Advance – e-Vision Electronic Ballast for MH Lamps	70	277	Allscape	BL-49-70MH-277-OP-BK-EMG

Table 1: Plaza Fixture Schedule

Light Loss Factors

The assumed space cleaning period for this space is 12 months and the space has a medium dirt condition. For fixture F-A4, a LLD of 0.80 was assumed for the MR-16 lamp.

Label	Maintenance Category	LLD	RSDD	LDD	BF	LLF
F-A1	V	0.75	-	0.82	1.00	0.62
F-A2	V	0.72	-	0.82	1.00	0.59
F-A3	V	0.85	-	0.82	1.05	0.73
F-A4	V	0.80	-	0.82	-	0.82
F-A5	V	0.72	-	0.82	1.00	0.59

Table 2: Plaza Light Loss Factors

Ballast Information

Label	Type	Ballast Watts	Ballast Factor	Voltage	Max THD %	Mfr.	Catalogue No.
B-A1	Electronic	191	1.00	277	15	Advance – e-Vision	IMH-175-C
B-A2	Electronic	84	1.00	277	18	Advance – e-Vision	IMH-70-A-BLS-ID
B-A3	Electronic - Programmed Start	39	1.05	277	10	Advance – Smartmate	ICF-2S18-H1-LDGE
B-A5	Electronic	84	1.00	277	18	Advance – e-Vision	IMH-70-A-BLS-ID

Table 3: Plaza Ballast Information

Lamp Information

Label	Type	CRI	CCT	Watts	Initial Lumens	Mean Lumens	Mfr.	Ballast
L-A1	GE Constant Color CMH ED17	90	4200	175	12000	9000	GE	IMH-175-C – e-Vision Electronic Ballast for MH Lamps
L-A2	GE Protected Constant Color PulseArc CMH ED17	80	3000	70	5700	4100	GE	IMH-70-A-BLS-ID – e-Vision Electronic Ballast for MH Lamps
L-A3	GE Ecolux Biax T4 CFL	82	4100	18	1200	1020	GE	ICF-2S18-H1-LD – Advance – Smartmate Electronic Ballast
L-A4	GE MR16 – Q50MR16/HI R/CG40	-	3000	50	2600	-	GE	N/A
L-A5	GE Protected Constant Color PulseArc CMH ED17	80	3000	70	5700	4100	GE	IMH-70-A-BLS-ID – e-Vision Electronic Ballast for MH Lamps

Table 4: Plaza Lamp Information

Power Density

Label	Ballast Watts	No. of Fixtures	Total Watts	
F-A1	191	6	1146	
F-A2	84	11	924	
F-A3	39	72	2808	
F-A4	50	28	1400	
F-A5	84	15	1260	
			7538	Watt Total
			41,500	Square Foot Total
			0.18 W/ft^2	

Table 5: Plaza Power Density

Therefore, the power density is slightly below the target IESNA value of 0.20 W/ft^2. The value is conservative because the building entrance and exit values and the walkways less than 10 feet wide are calculated into the total value. The space is at an appropriate illuminance level, so the power density is sufficient. Note: The square foot total of the plaza is 60,000 ft^2; however, the grassy of the plaza is 18,500 ft^2. Therefore, the total square foot total of the plaza is 41,500 ft^2.

Lighting Plan

The lighting site plan for the plaza is too large to view with one drawing. Therefore, the lighting site plan is cut into four sections: lower left, upper left, upper right, and lower right. All of the fixtures are labeled with their respected panelboard location on the drawing. The lights will be controlled by a timer during the year.

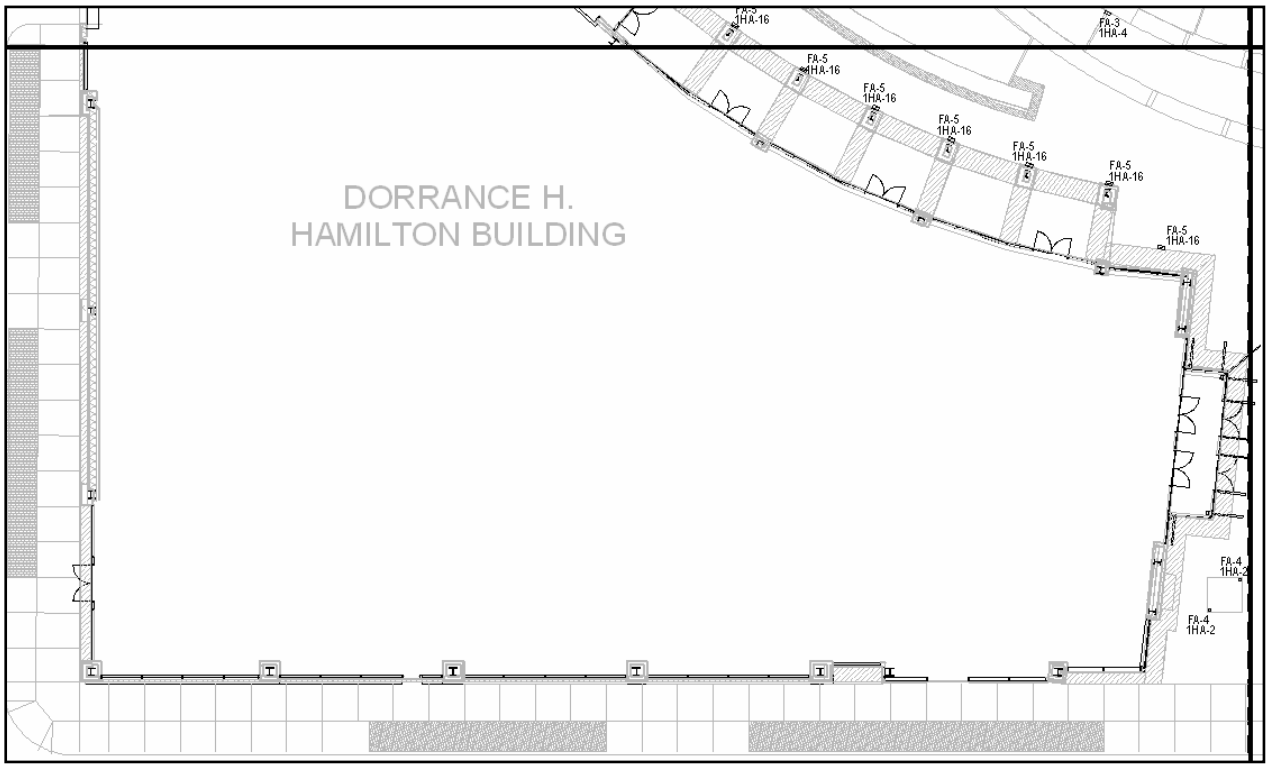


Figure 2: Plaza Lighting Plan (Lower Left)

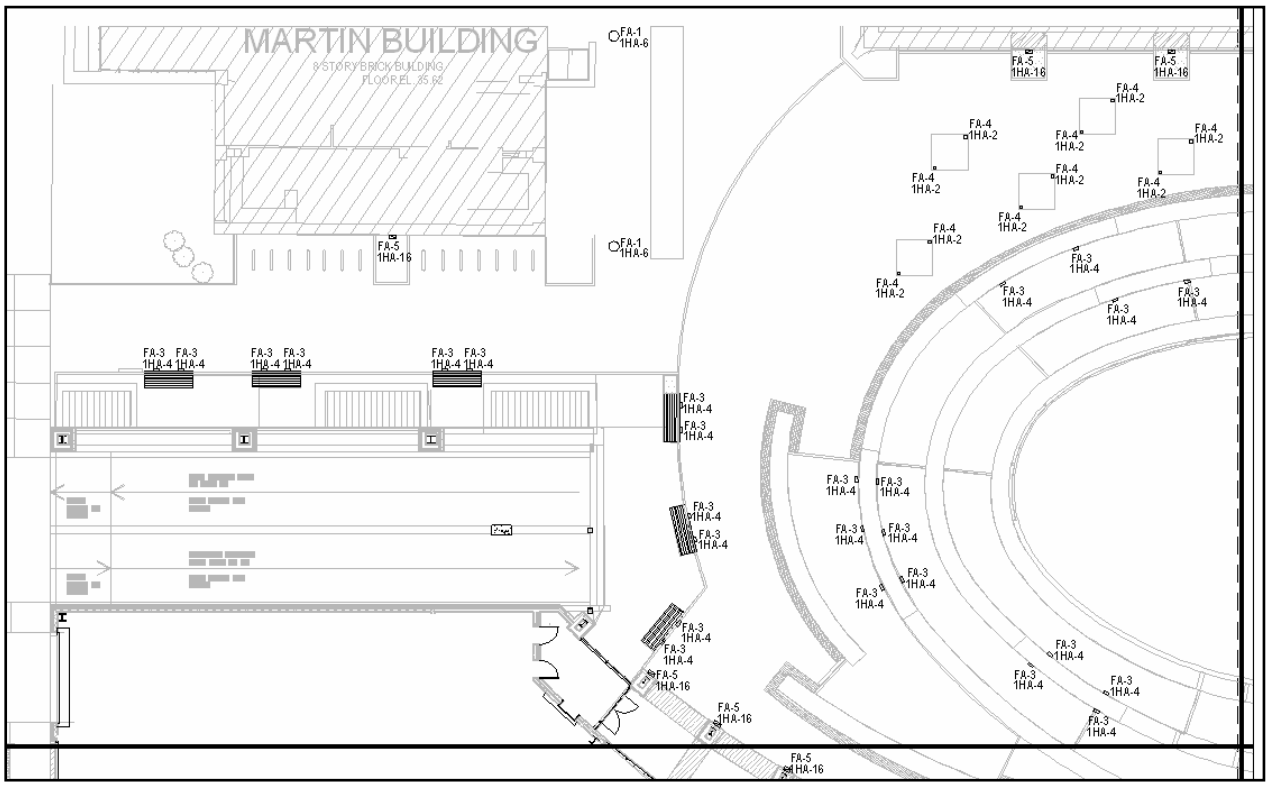


Figure 3: Plaza Lighting Plan (Upper Left)

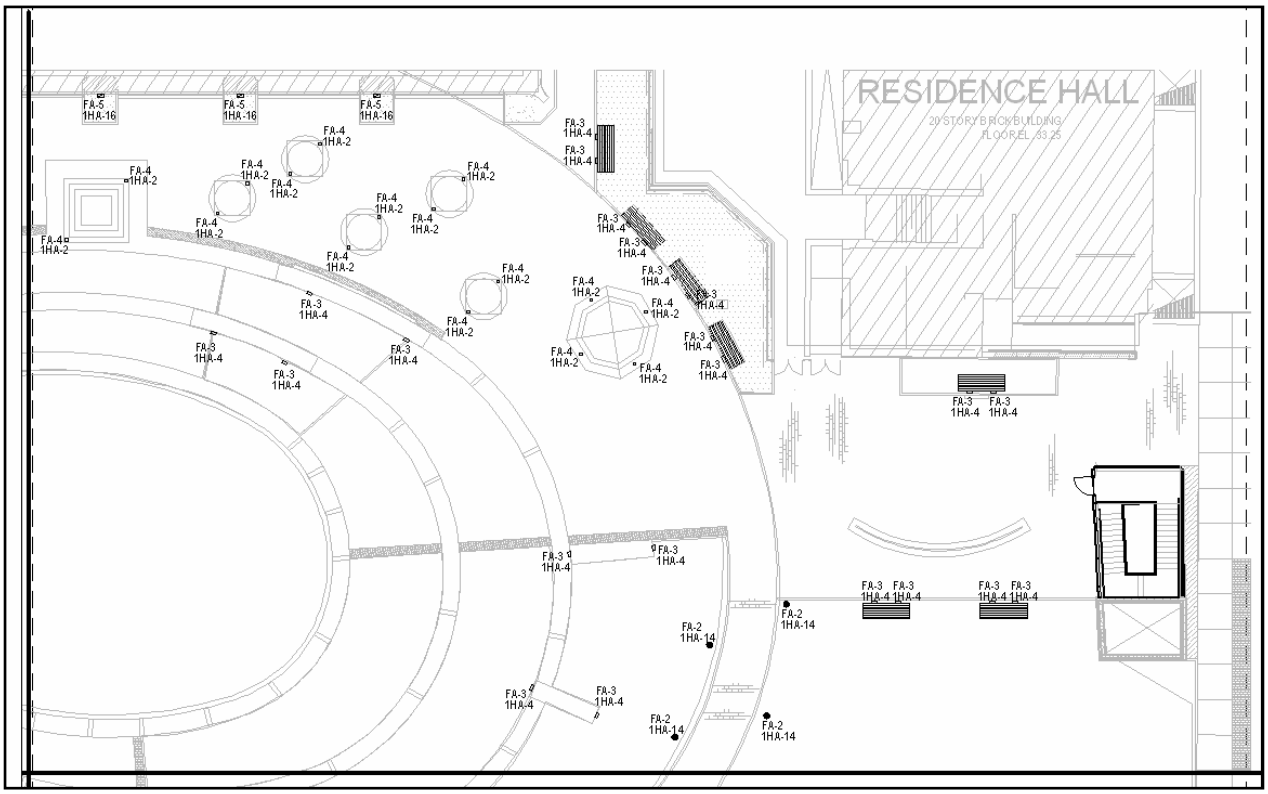


Figure 4: Plaza Lighting Plan (Upper Right)

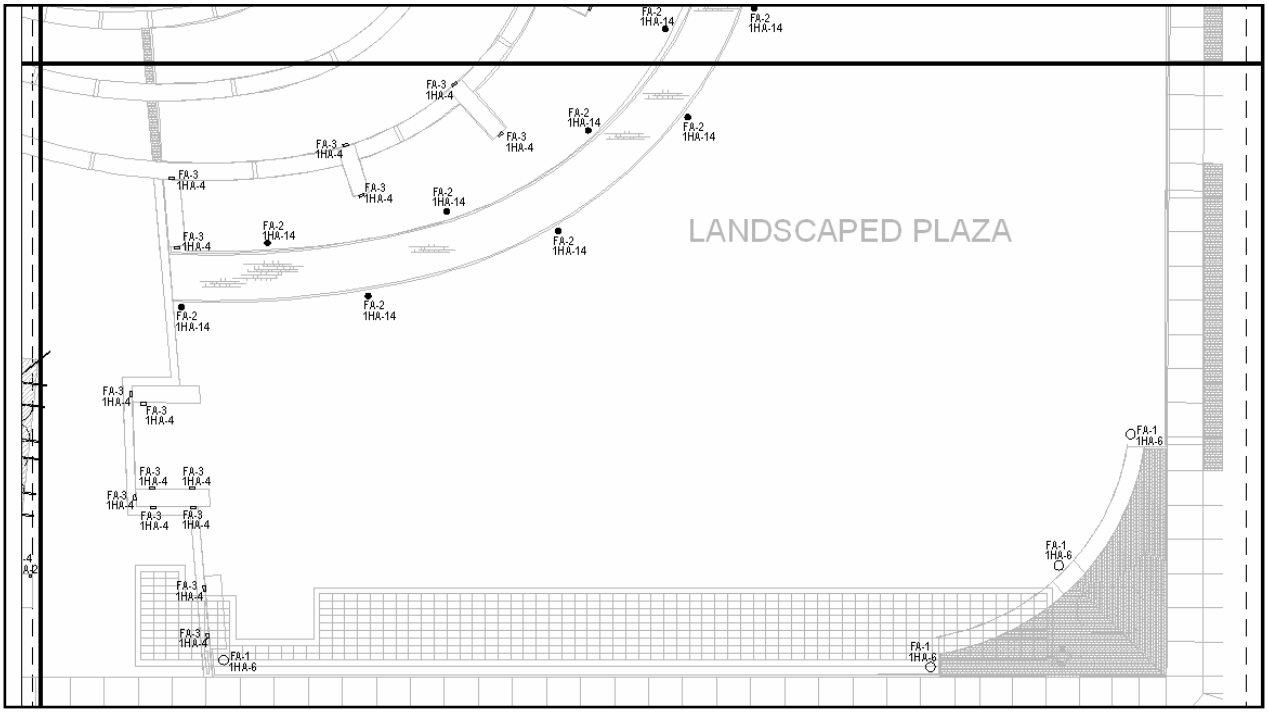
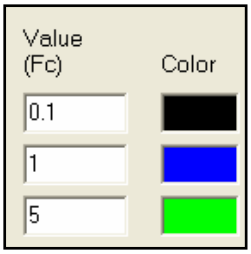


Figure 5: Plaza Lighting Plan (Lower Right)

Isometrics

The isolines from AGI32 were analyzed on the work plane height of 0.0'. The average illuminance throughout the walkways of the plaza was 0.99 fc.



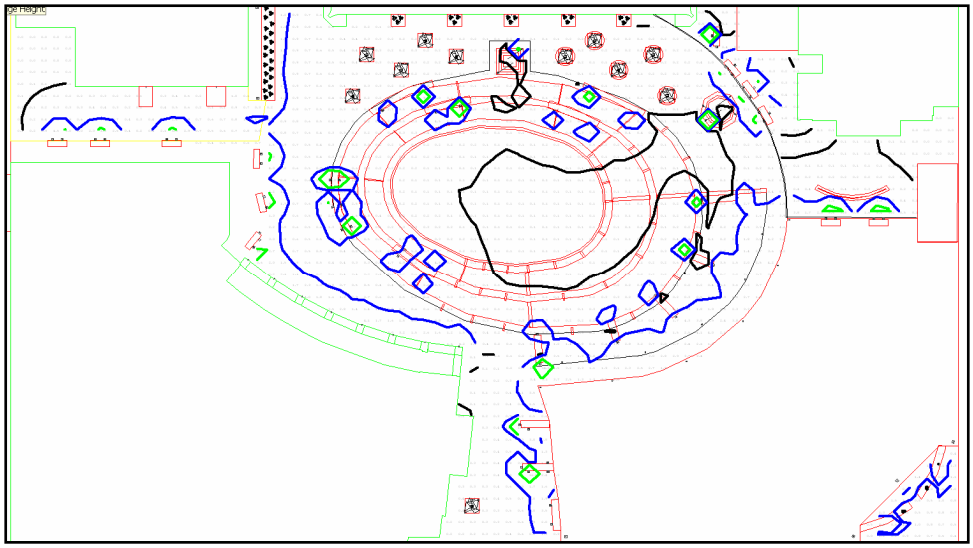


Figure 6: View of Isolines of Plaza

The isolines from AGI32 were analyzed on the work plane height of 0.0'. Figure 7 is a close-up view of the isolines of the center of the plaza.

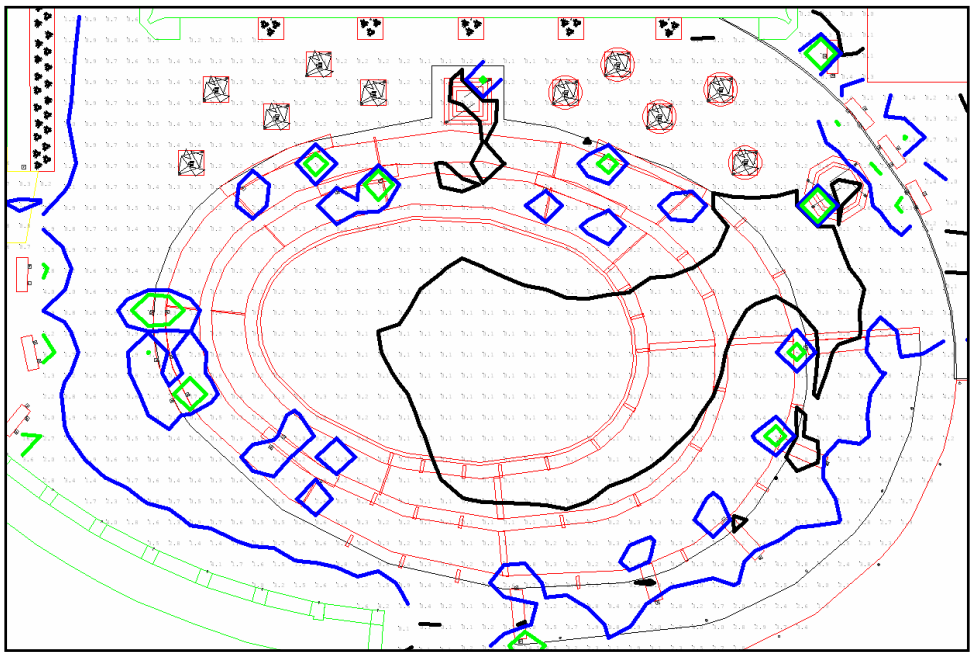


Figure 7: Close-up View of Isolines of Plaza

Conclusion

Overall, the lighting design achieved the space design goals. The step lights were inserted into the various benches around the plaza. The step lights provided the area with a luminaire source without cluttering the space. The middle of the plaza is used for a large tent, so fixtures were not permitted to be placed in the center of the ovals. The walkway closest to the grassy area was illuminated nicely by the bollard fixtures placed along the walkway. Outdoor wall sconces were placed on the columns of the DH Hamilton Building and above the planters of the Scott Library and Administrative Building. The trees, statue, and fountain outside of the Scott Library Building were accentuated by directional spotlights, which provided aesthetic appeal to the space. A few 18' high architectural area source luminaires were used at various places throughout the design.

The average illuminance on the work plane was 0.99 fc, which was high for the IESNA value for a plaza of 0.50 fc. The trees, statue, and fountain were accentuated; therefore, the average illuminance was higher. The power density was 0.16 W/ft^2, which was under the ASHRAE 90.1 Standards of 0.20 W/ft^2 for outdoor walkways/plaza.

Lobby – Lighting Redesign

Description of Space

The lobby is located on the first floor of the building. Upon entering the building through the curved façade that features large expanses of glass, one would find themselves in the lobby of the building. The auditorium entrance would then be straight ahead when in the lobby. The lobby will be mainly used for a circulation space although the space will have plasma screens in it. A small retail space is located in one corner of the lobby and is not included in the lighting redesign. The lobby is 70’ wide by 110’ long with the ends tapering out to a triangle. This equates to an area of 6,597 ft^2. The two-story height ceiling provides the space with a various options for the lighting design. The ceiling is 15’ high were the spaces are not two-stories high.

Floor Plan

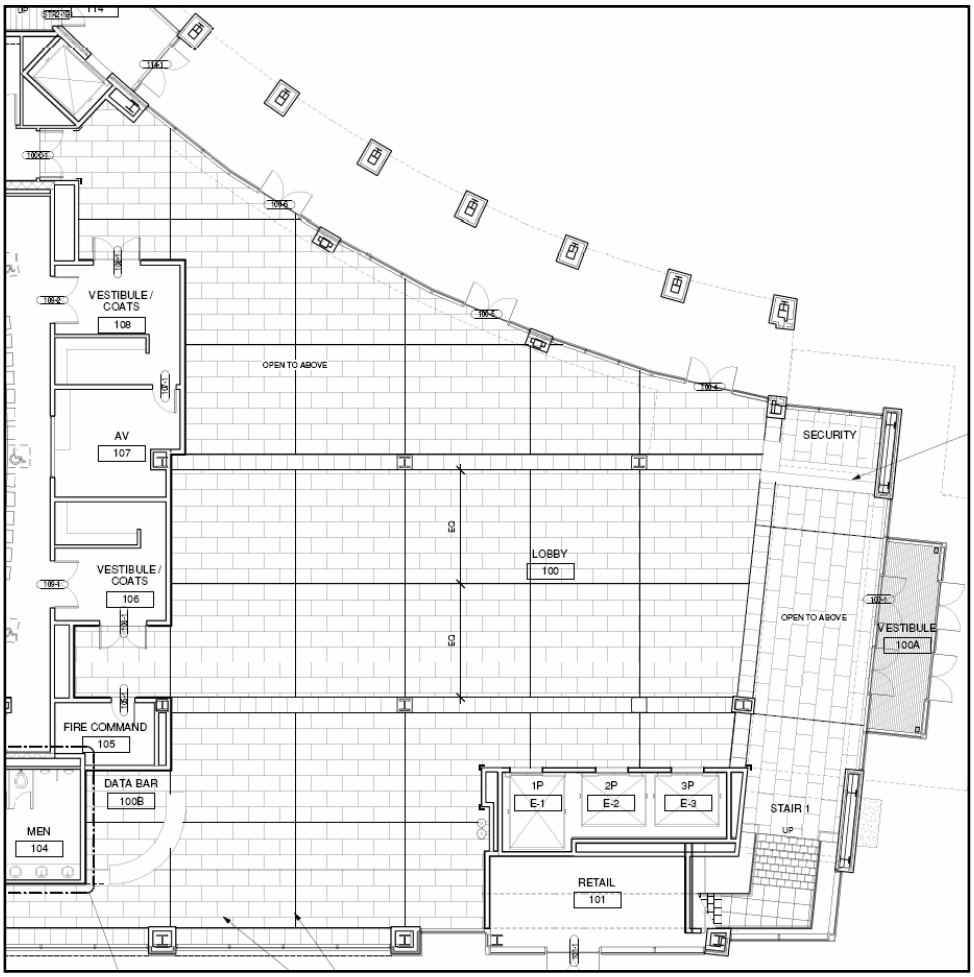


Figure 8: Lobby Floor Plan

Design Concept

The design concept of the lobby is to provide an inviting appeal to the space by adding sparkle and aesthetically pleasing fixtures. The large glass façade provides daylighting into the space, which will provide an opportunity to save on energy. The space is in the middle of the plaza and auditorium, so a smooth transition is necessary between the three spaces. The lighting design should accent the architecture and have a warm CCT for the wood panels used in the space. Attention to the plasma screens is also necessary in the lobby. Since the lobby is only used for circulation, the controls should be simple to use.

Design Criteria

Appearance of Space and Luminaires

The appearance of the space and luminaires is extremely important when lighting the lobby to this "new heart of campus". The appearance of the space and luminaires has to be aesthetically appealing. The architecture, such as the double height space, columns, and wood paneling, can be highlighted.

Color Appearance (and Color Contrast)

Color appearance can affect visibility and aesthetics. A color rendering index (CRI) of 70 or above is acceptable when dealing with educational facilities; however, a CRI greater than 80 may be needed in order to ensure a pleasant appearance of skin tones.

Daylighting Integration and Control

The space incorporates an expansive curved glass façade on the entire northeast wall. This will be an issue for the use of the VDT on the walls and may cause glare on the screen. The orientation of the plasma screens with respect to the daylighting is used in order to cut down on the directed glare. A daylighting system can be used to limit the amount of energy used in the room during the day. Controls such as a photo sensor and switching can be used to dim the luminaires in the room when daylighting is entering the room.

Luminances of Room Surfaces

User comfort and satisfaction is increased when spaces deliver both direct and diffuse light to the occupant and task. With the number of luminaires in the space and

daylighting, the luminances of the room surfaces are assumed to be from direct and diffused light. The special surfaces in the space include the doors of the space, the retail room, and the entrance to the lobby.

Modeling of Faces or Objects

The modeling of faces or objects is somewhat important to a lobby. A CRI of 80 or higher will provide a better skin tone color. Another consideration should be that light will hit the face at all angles. In this space with all the different light sources including daylight, the modeling of faces or objects should not be a problem.

Point(s) of Interest

The points of interest in the space include the entrances, exits, plasma screens, circulation paths, retail space, and security space. The points of interest will prosper with a slightly higher illuminance due to the fact that they will stand out, such as the entrances and exits.

Reflected Glare

The reflected glare in the space will be an issue with the VDT screens in the space. Caution should be used when placing luminaires around the area of the plasma screens.

Source/Task/Eye Geometry

The source/task/eye geometry is somewhat important to a lobby application. The angular relationships between the viewer, the task (VDTs), and the luminaire are frequently critical to task visibility. The luminaires should not be placed in the reflected view of the VDTs.

Sparkle/Desirable Reflected Highlights

The lobby is a good place to add sparkle because it enhances the look of the space. Sparkle should not create reflected glare, but may include some desirable reflected highlights, especially in the double height area of the lobby.

Surface Characteristics

The surface characteristics of the space are somewhat important due to the appearance of the space. The surfaces of the space should be a high gloss, grand

looking material. The space should appear to be high class.

Illuminance (Horizontal)

The IESNA handbook calls for a horizontal illuminance of 50 lux (5 fc) on the work plane for circulation.

Illuminance (Vertical)

The IESNA handbook recommends a vertical illuminance of 30 lux (3 fc) for this space. The entrances and exits should have a vertical illuminance of 50 lux (5 fc). Artwork and the directory should have an illuminance of 300 lux (30 fc).

Power Allowances from ASHRAE 90.1 Standards

The power allowance by the space by space method for a lobby is 1.3 W/ft^2.

Reflectances

Ceiling: Gypsum Wallboard Soffits/banding & Armstrong "Optima Vector" #3900, white acoustical ceiling tile

- Assume 90% ceiling reflectance

Walls: Wood Paneling/Painted Gypsum Wallboard

- Assume 50% wall reflectance

Floor: Cotto D'Este Porcelain Tile "Buxy", Cendre Natural Finish in 2'x2' and 2'x4' tiles

- Assume 40% floor reflectance

Fixture Schedule

Label	Description	MH	Lamps	Ballast/ Transformer	Watts	Voltage	Mfr.	Catalogue No.
F-B1	Campbell Pendant with Clear Glass and Sandblasted Stripes	18′	1 – 75 Watt R20	N/A	75	120	Louis Poulsen Lighting	CAM-1/75W/R20 Med-120V-Striped Glass
F-B2	Recessed Compact Fluorescent Downlight/Wallwasher with EvenTone Clear Flange	17′	2 – 26 Watt Triple Tube CFL	ICF-2S26-H1-LD - Advance Smartmate Electronic Programmed Start	52	277	Edison Price Lighting	TRPH 226/7–WW –277–VOL-PS
F-B3	Saturn Maxi Wall Sconce	6.5′	2 – 26 Watt Triple Tube CFL	ICF-2S26-H1-LD - Advance Smartmate Electronic Programmed Start	52	277	Louis Poulsen Lighting	SAW-MAX-2/26W/CF Gx24q-3/4-277V-NAT. PAINT ALUM.
F-B4	41″ Dia x 2″ Deep Semi-Indirect Area Source with Specular Segmented/White Reflector	12′	4 – 42 Watt CFL & 1 - 38	ICF-2S42-M2-BS – Advance – Smartmate Electronic Programmed Start	168	277	LAM	HR41-4/42-1/382D-HC-CN-62-SGW-SGW-277-ALB/3

Table 6: Lobby Fixture Schedule

Light Loss Factors

The assumed room cleaning period for this room is 6 months and the room is clean. The expected dirt depreciation was calculated at 8%.

RCR = [(5)*(H)*(L + W)] / (L)*(W)

RCR = [(5)*(16′-8″)*(88′ + 75′)] / (6597 ft^2) = 2.06 = 2.1

Label	Maintenance Category	LLD	RSDD	LDD	BF	LLF
F-B1	IV	0.88	0.98	0.92	1.00	0.79
F-B2	IV	0.92	0.98	0.92	1.00	0.83
F-B3	II	0.92	0.94	0.96	1.00	0.83
F-B4	VI	0.92	0.90	0.91	0.97	0.73

Table 7: Lobby Light Loss Factors

Ballast Information

Label	Type	Ballast Watts	Ballast Factor	Voltage	Max THD %	Mfr.	Catalogue No.
B-B2	Electronic – Programmed Start	54	1.00	277	10	Advance – Smartmate	ICF-2S26-H1-LD@277
B-B3	Electronic – Programmed Start	54	1.00	277	10	Advance – Smartmate	ICF-2S26-H1-LD@277
B-B4	Electronic – Programmed Start	2 @ 93	0.97	277	10	Advance – Smartmate	ICF-2S42-M2-BS@277

Table 8: Lobby Ballast Information

Lamp Information

Label	Type	CRI	CCT	Watts	Initial Lumens	Mean Lumens	Mfr.	Ballast
L-B1	DuraMax 75W Med 120V R20	80	3000	75	570	500	Philips	N/A
L-B2	ALTO PL-T 26W/830/GX2 4q-3/4P ALTO	82	3000	26	1800	1650	Philips	ICF-2S26-H1-LD - Advance Smartmate Electronic Programmed Start
L-B3	ALTO PL-T 26W/830/GX2 4q-3/4P ALTO	82	3000	26	1800	1650	Philips	ICF-2S26-H1-LD - Advance Smartmate Electronic Programmed Start
L-B4	ALTO PL-T 42W/830/GX2 4q-3/4P ALTO	82	3000	42	3200	2950	Philips	ICF-2S42-M2-BS – Advance – Smartmate Electronic Programmed Start

Table 9: Lobby Lamp Information

Power Density

The power density is slightly below the target IESNA value of 1.3 W/ft^2. The space is at an appropriate illuminance level, so the power density is sufficient.

Label	Ballast Watts	No. of Fixtures	Total Watts	
F-B1	75	22	1650	
F-B2	54	28	1512	
F-B3	54	12	648	
F-B4	224	14	3136	
			6946	Watt Total
			6597	Square Foot Total
			1.05 W/ft^2	

Table 10: Lobby Power Density

Lighting Plan

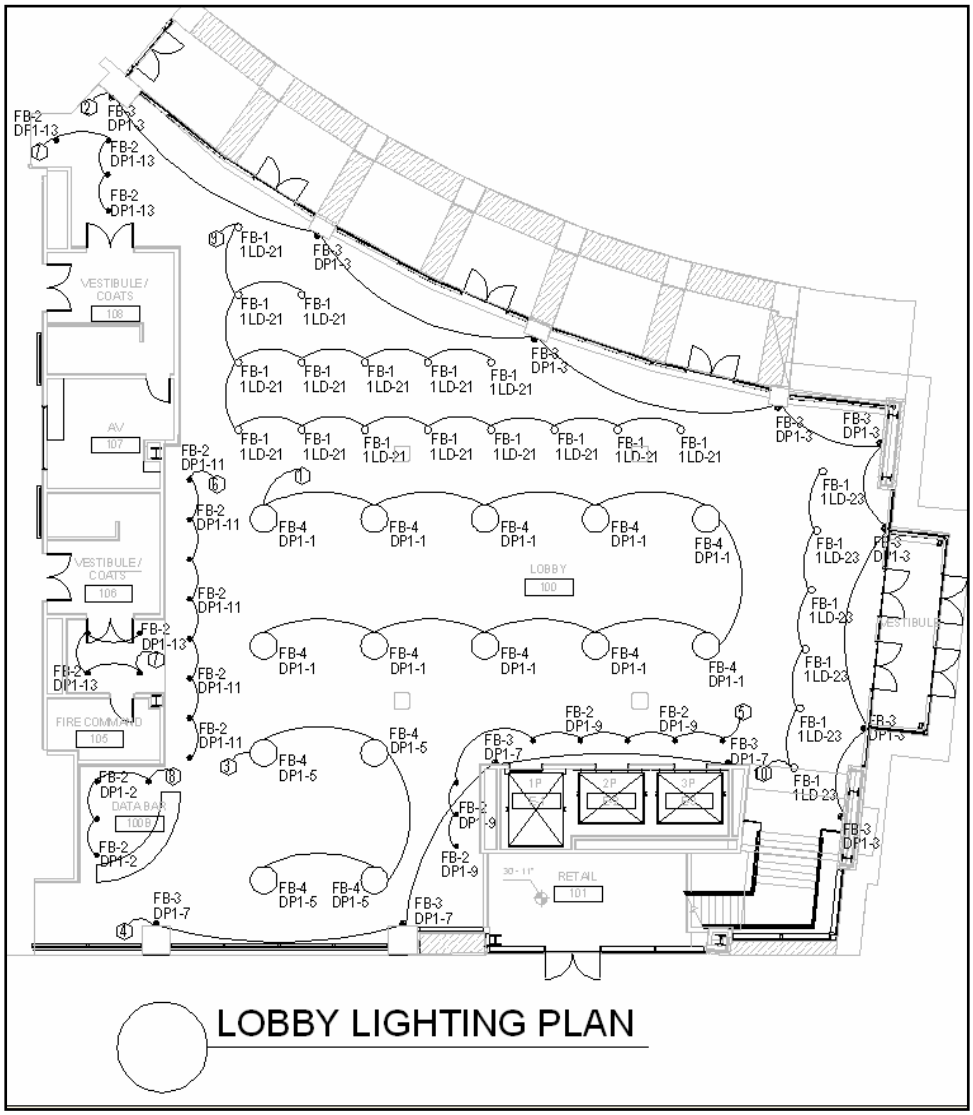


Figure 9: Lobby Lighting Plan

Isometrics

The Isolines from AGI32 were analyzed on the work plane height of 0.0'. The average illuminance throughout the lobby was 21.12 fc. The illuminance value is high for a circulation space, but the space needed a higher illuminance level.

Value (Fc)	Color	Value (Fc)	Color
5		20	
10		25	
15		30	

Figure 10: View of Isolines of Lobby

Renderings

Figure 11: Rendering of Lobby (Vestibule Entrance)

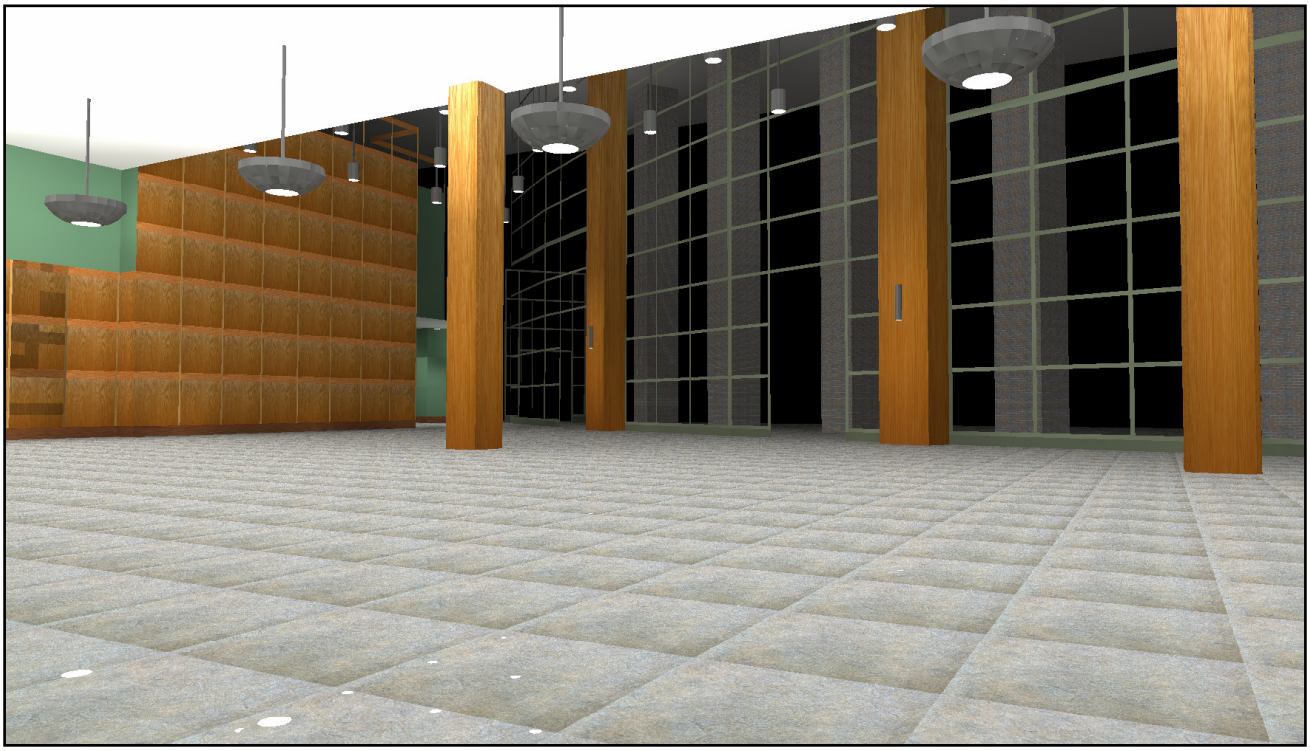


Figure 12: Rendering of Lobby (Elevator Entrance)

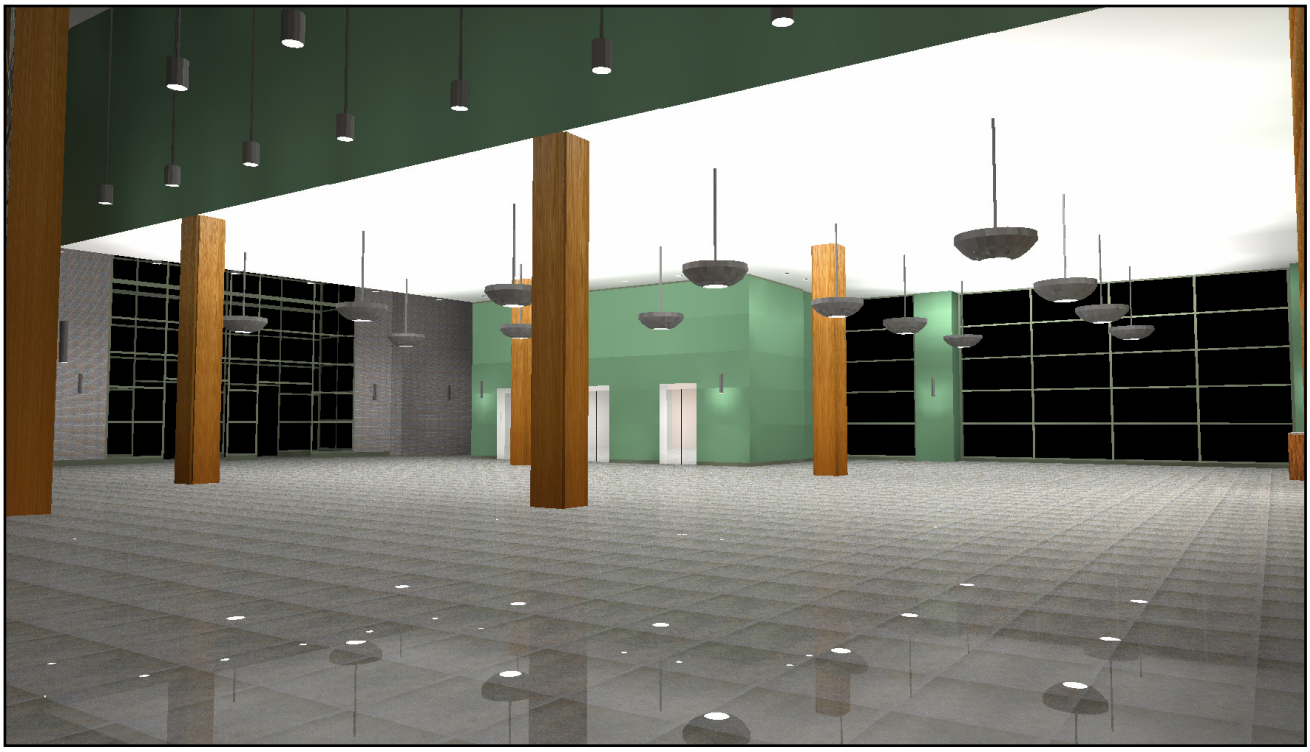


Figure 13: Rendering of Lobby (Glass Façade Entrance)

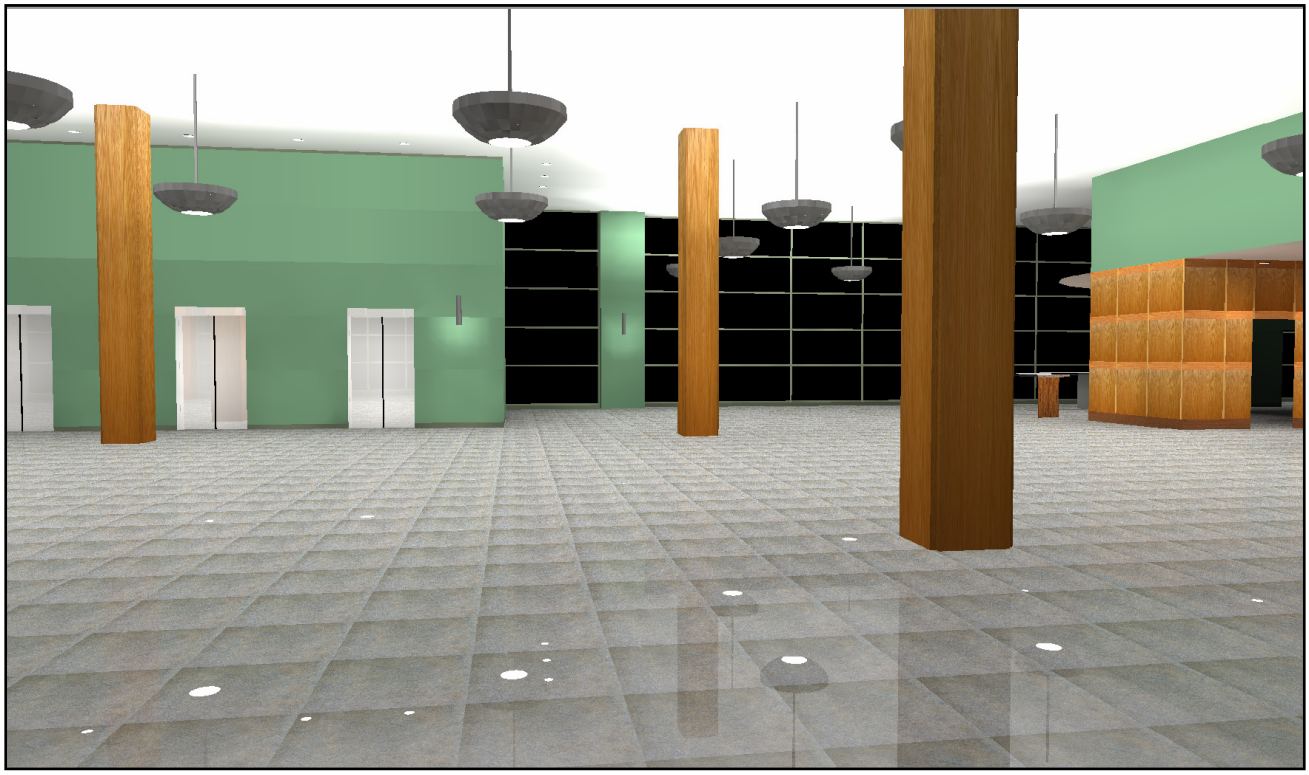


Figure 14: Rendering of Lobby (Glass Façade Entrance)

Pseudo Color Renderings

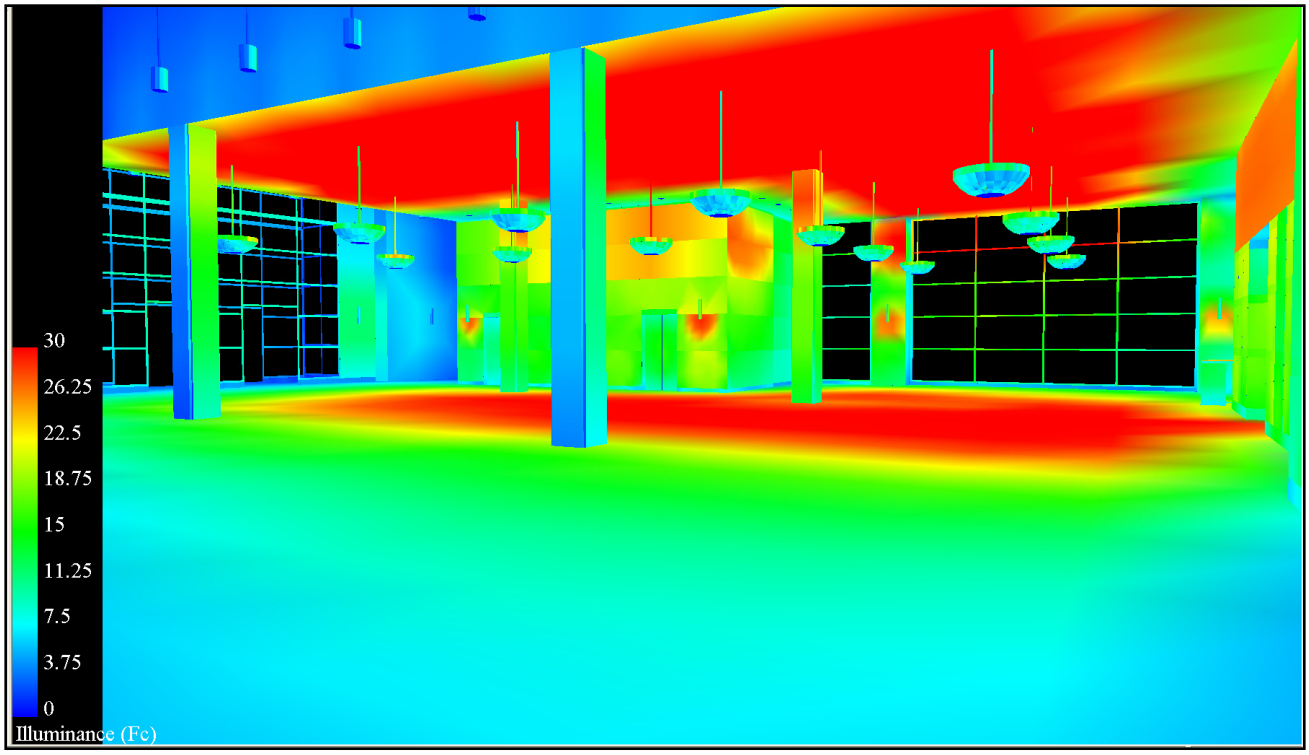


Figure 15: Pseudo Color of Lobby (Glass Façade Entrance)

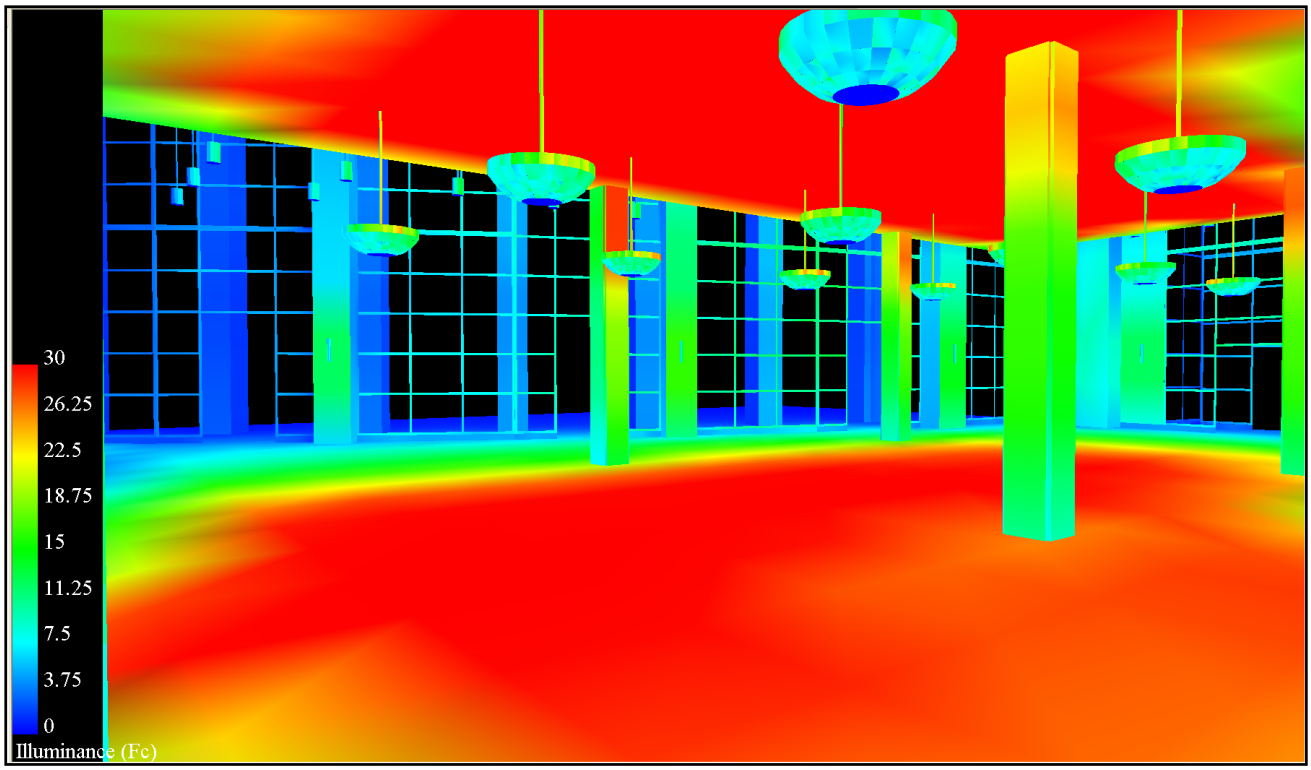


Figure 16: Pseudo Color of Lobby (@ Data Bar)

Conclusion

The lobby has an aesthetically pleasing look with the various high end construction materials and the lighting design. The space achieved all of the design goals by using pendants, recessed downlights, and wall sconces. The average illuminance on the work plane was 21.12 fc, which is above the IESNA value for a lobby/circulation space of 5 fc. However, the power density was 1.05 W/ft^2, which was under the ASHRAE 90.1 Standards of 1.30 W/ft^2 for a lobby.

Auditorium – Lighting Redesign

Description of Space

The 300-seat capacity auditorium resides on the first floor of the building. Upon entering the building through the curved façade that features large expanses of glass, one would find themselves in the lobby of the building. The auditorium entrance would then be straight ahead when in the lobby. The auditorium is used for lectures, demonstrations, film projects, and guest presentations. The tasks will be mainly note-taking, reading, and writing. The dimensions of the auditorium are 70' wide by 77' long by 15' high. This equates to a square footage of approximately 5,412 ft^2.

Floor Plan

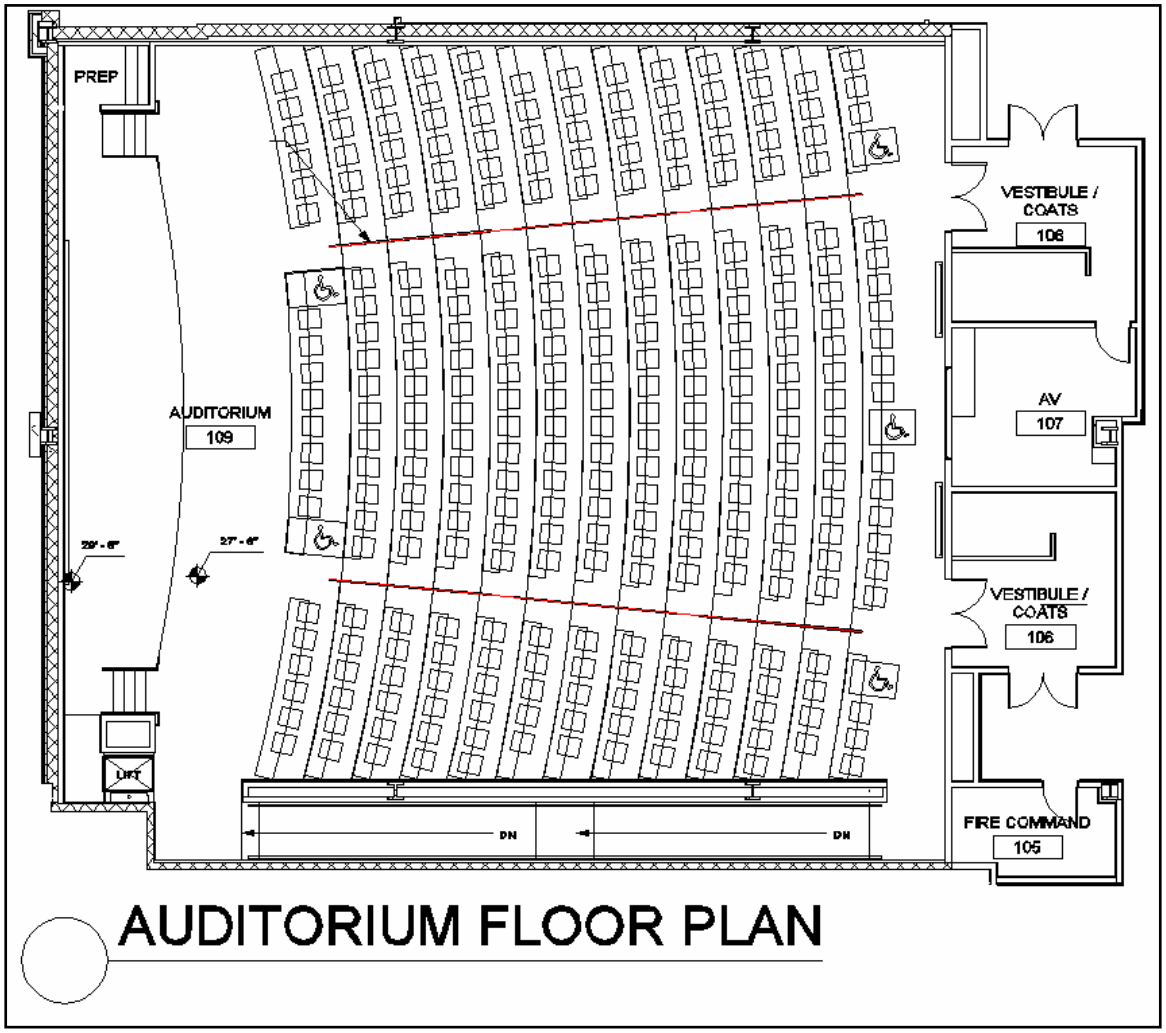


Figure 17: Auditorium Floor Plan

Design Concept

The design concept of the auditorium is to provide various scenes for the different tasks of the space, provide ample task lighting on the desks, and to accent the chalkboard/whiteboard. The space should provide a user friendly control system with the scene selection at the touch of a button. A smooth transition from the lobby will be incorporated into the design.

Design Criteria

Appearance of Space and Luminaires

The appearance of the space and luminaires is somewhat important in the auditorium. The auditorium will hold seminars with special speakers; therefore, the space and luminaires need to be aesthetically pleasing.

Color Appearance (and Color Contrast)

Color appearance can affect visibility and aesthetics. A color rendering index (CRI) of 70 or above is acceptable when dealing with educational facilities; however, a CRI greater than 80 may be needed in order to ensure a pleasant appearance of skin tones. Since the auditorium will have special speakers and guest lecturers, a CRI of 80 or greater will be beneficial. A CCT should be around 3500 K in order to provide a warmer feel to the space.

Light Distribution on Surfaces

Harsh striated patterns of excessive brightness or noticeable shadows should be avoided. Illuminance patterns should correspond with objects of the space. Ceiling and walls should have luminances within a 3:1 ratio. The current layout should not provide a harsh pattern on any surfaces in the space. The walls of the space can be uniform or non-uniform depending on the final design. Acoustical panels are on the upper portion of the wall. Depending on the appearance of the panels, a decision will be made on whether or not to make the light on the walls uniform or non-uniform.

Light Distribution on Task Plane (Uniformity)

Patterns of light on the task plane should be uniform. The desks in the room are used for reading and writing. A non-uniform pattern of light on the work plane would be distracting or confusing. The task illuminance should be higher than the immediate surroundings. With a work

plane illuminance that is 1.5 to 3 times higher than those in the surrounding areas will assist in directing the occupants' attention to the task, which is very important in educational facilities. The illuminance of the speaker should also be illuminated greater than the surrounding tasks (approximately 25-30 fc).

Point(s) of Interest

The points of interest in the space include the projection screen and the podium at the front of the space. The projection screen should be a lower illuminance and the podium will prosper with a slightly higher illuminance.

Source/Task/Eye Geometry

Extremely important to a lecture hall is the source/task/eye geometry. The angular relationships between the viewer, the task, and the luminaire are frequently critical to task visibility. This should not be an issue due to the height of the ceiling.

System Control and Flexibility

System control and flexibility is very important due to the different tasks in the space. A couple of different systems include a scene for a projection screen, a guest speaker, lectures, and general reading/writing tasks. Dimming ballasts will be required.

Illuminance (Horizontal)

The IESNA handbook calls for a horizontal illuminance of 50 lux (5 fc) on the work plane for auditoriums; however, the horizontal illuminance of a classroom is 500 lux (50 fc). When the projection screen is in use, a horizontal illuminance of 50 lux (5 fc) on the work plane is needed.

Illuminance (Vertical)

The IESNA handbook recommends a vertical illuminance of 30 lux (3 fc) when the projection screen is in use. The points of interest for vertical illuminance include the chalkboard, the speaker, and the projection screen. Note that the projection screen should be a lower illuminance than the surrounding space.

Power Allowances from ASHRAE 90.1 Standards

The power allowance by the space by space method for a classroom, lecture, or training space is 1.4 W/ft^2.

Reflectances

Ceiling: Sloped Gypsum Wallboard Planes with Fascias to Follow Radius of Seating Tiers

- Assume 90% ceiling reflectance

Walls: Fabric Covered Acoustical Panels/Wood Panels/Painted Gypsum Wallboard

- Assume 50% wall reflectance

Floor: Constantine Commercial Carpet, "Corporate Exchange" 12' W Broadloom; Color T.B.D.

- Assume 20% floor reflectance

Fixture Schedule

Label	Description	MH	Lamps	Ballast/ Transformer	Watts	Voltage	Mfr.	Catalogue No.
F-C1	Concealed Cove-30 System with High-Reflectance White Reflectors	16'	1 – T5HO	REZ-154 – Mark 10 Powerline Electronic Dimming/Programmed Start	54	120	Lite Control Corporation	CC-AI-3024-T5-CWM-TW-2CWQ-277
F-C2	Triples-H 232/7 Recessed CFL Downlight/Wallwasher with EvenTone Clear Reflector	16'	2 – 32 Watt CFL	IZT-2T42-M3-BS@277 – Mark 7 – Electronic Dimming/Programmed Start	64	277	Edison Price Lighting	TRPH 232/7-277-VOL-DM
F-C3	Strip LED Lights for the Stairs	4"	10 – LEDS	Packaged Unit	24	120	Color Kinetics Incorporated	501-000010-00 MEDIUM
F-C4	Obround Wall Mount Luminaire with Specular Aluminum Reflector	11'	2 – F40T8	B-D2 – Advance Electronic/Instant Start Optanium	80	277	LAM Lighting	OB70-2/T8-O-L-WN-8-SGW-277-GLR

Table 11: Auditorium Fixture Schedule

Light Loss Factors

The assumed room cleaning period for this room is 6 months and the room is clean. The expected dirt depreciation was calculated at 8%.

RCR = [(5)*(H)*(L + W)] / (L)*(W)

RCR = [(5)*(15')*(77' + 70')] / (5412 ft^2) = 2.04 = 2.0

Label	Maintenance Category	LLD	RSDD	LDD	BF	LLF
F-C1	VI	0.90	0.90	0.92	1.00	0.75
F-C2	IV	0.83	0.98	0.93	1.00	0.76
F-C3	II	0.70	0.94	0.97	1.00	0.64
F-C4	IV	0.93	0.98	0.93	1.03	0.87

Table 12: Auditorium Light Loss Factors

Ballast Information

Label	Type	Ballast Watts	Ballast Factor	Voltage	Max THD %	Mfr.	Catalogue No.
B-C1	Electronic Dimming/Programmed Start	63	1.00	120	10	Advance – Mark 10 Powerline	REZ-154
B-C2	Mark 7 – Electronic Dimming/Programmed Start	75	1.00	277	10	Advance	IZT-2T42-M3-BS@277
B-C4	Electronic/Instant Start/2-Lamp	81	1.03	277	10	Advance – Optanium	VOP-4P32-SC

Table 13: Auditorium Ballast Information

Lamp Information

Label	Type	CRI	CCT	Watts	Initial Lumens	Mean Lumens	Mfr.	Ballast
L-C1	F54T5/830 HO ALTO TG	85	3000	54	5000	4500	Philips	REZ-154 – Mark 10 Powerline Electronic Dimming/Program med Start
L-C2	PL-T 32W/830 GX24Q-3/4P	82	3000	32	2400	2000	Philips	IZT-2T42-M3-BS@277 – Mark 7 – Electronic Dimming/Program med Start
L-C4	F40T8 TL841 ALTO	86	4100	40	3775	3500	Philips	B-D2 – Advance Electronic/Instant Start Optanium

Table 14: Auditorium Lamp Information

Power Density

Label	Ballast Watts	No. of Fixtures	Total Watts	
F-C1	63	42	2646	
F-C2	75	48	3600	
F-C3	24	48	1152	
F-C4	81	7	567	
			7965	Watt Total
			5412	Square Foot Total
			1.47 W/ft^2	

Table 15: Auditorium Power Density

Therefore, the power density is slightly above the target IESNA value of 1.4 W/ft^2. If the power density must be lower than 1.4 W/ft2, then the amount of cove luminaires could be reduced in order to obtain the proper power density. The space is at an appropriate illuminance level of approximately 42.3 fc, so the power density is sufficient.

Lighting Plan

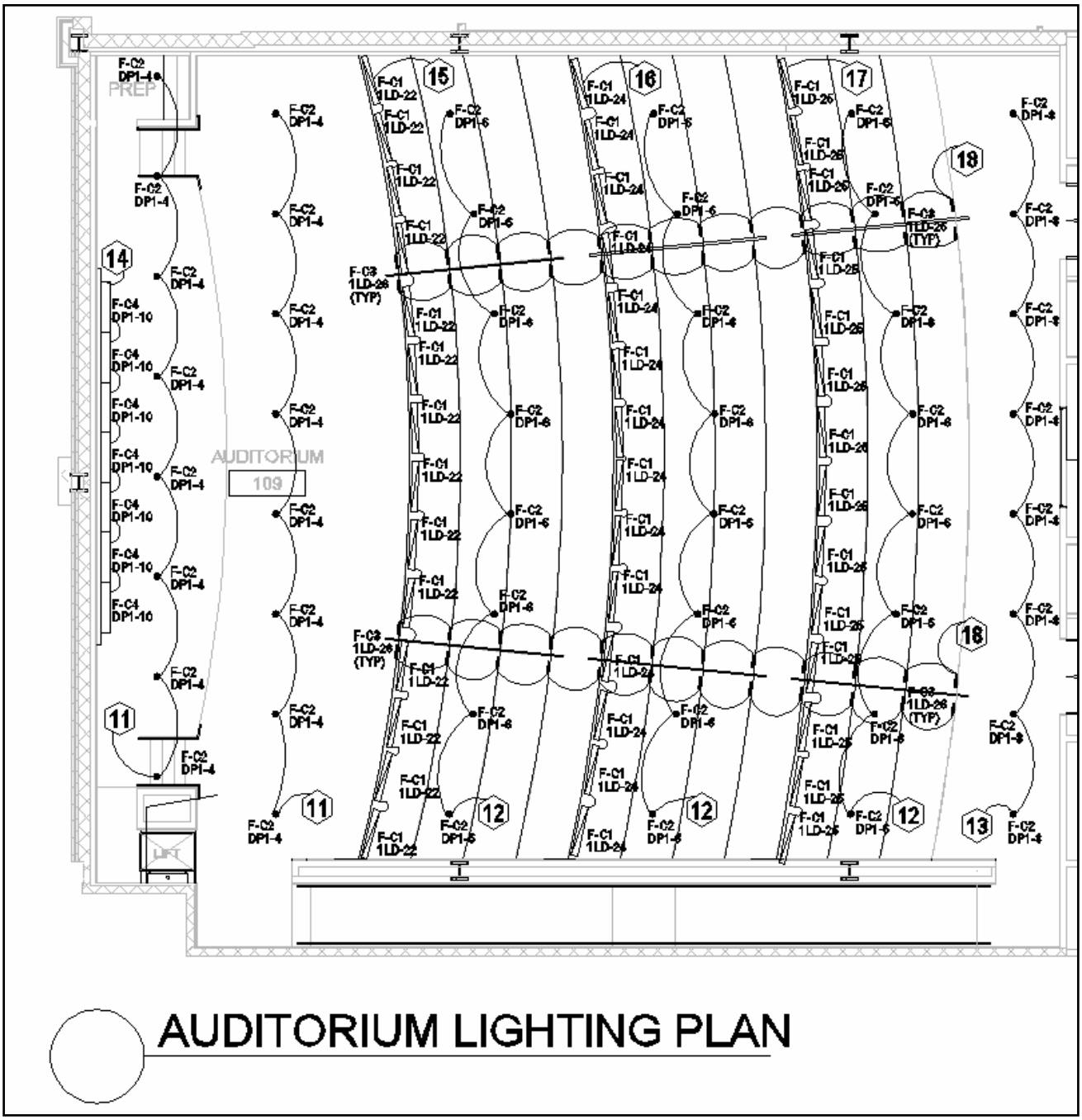


Figure 18: Auditorium Lighting Plan

Lighting Controls

The different zones represent different dimming areas. A Lutron 100 system is being utilized by the DH Hamilton Building. Occupancy sensors are being used as in the previous spaces.

Renderings

Figure 19: Rendering of Auditorium

Figure 20: Rendering of Auditorium

Renderings

Figure 21: Rendering of Auditorium

Figure 22: Rendering of Auditorium

Pseudo Color

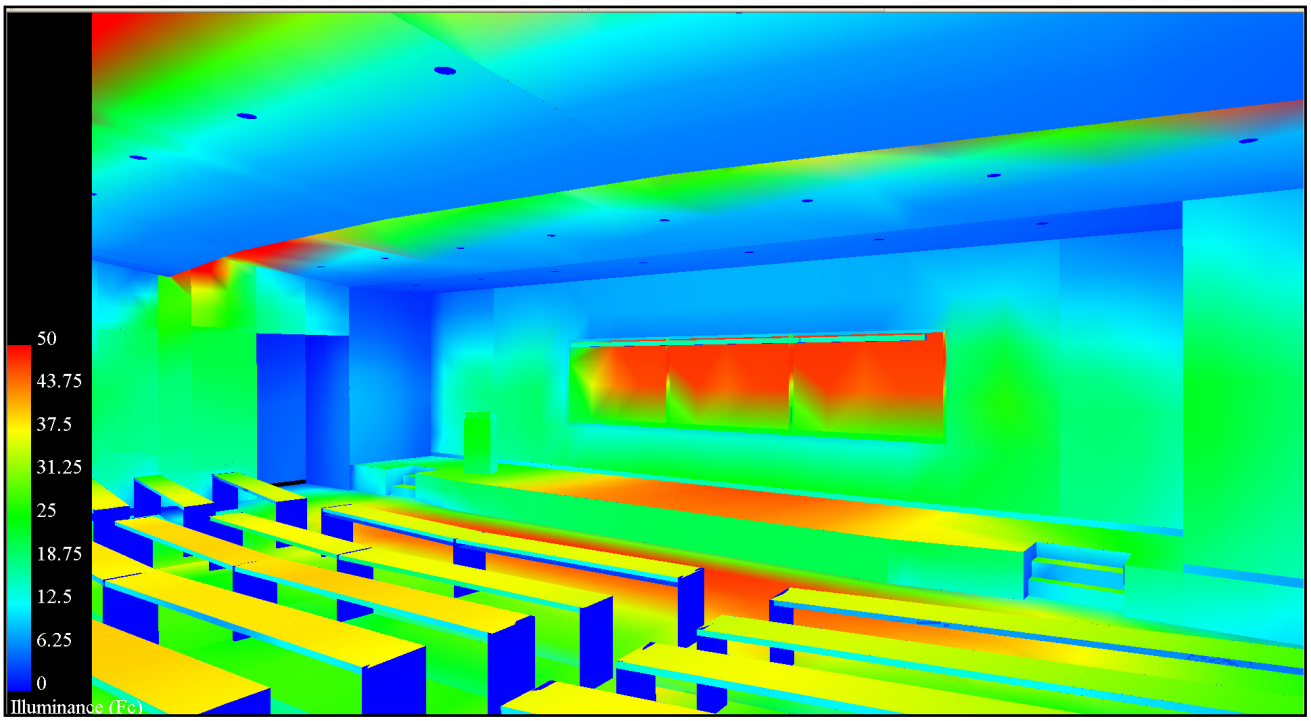


Figure 23: Pseudo Color of Auditorium

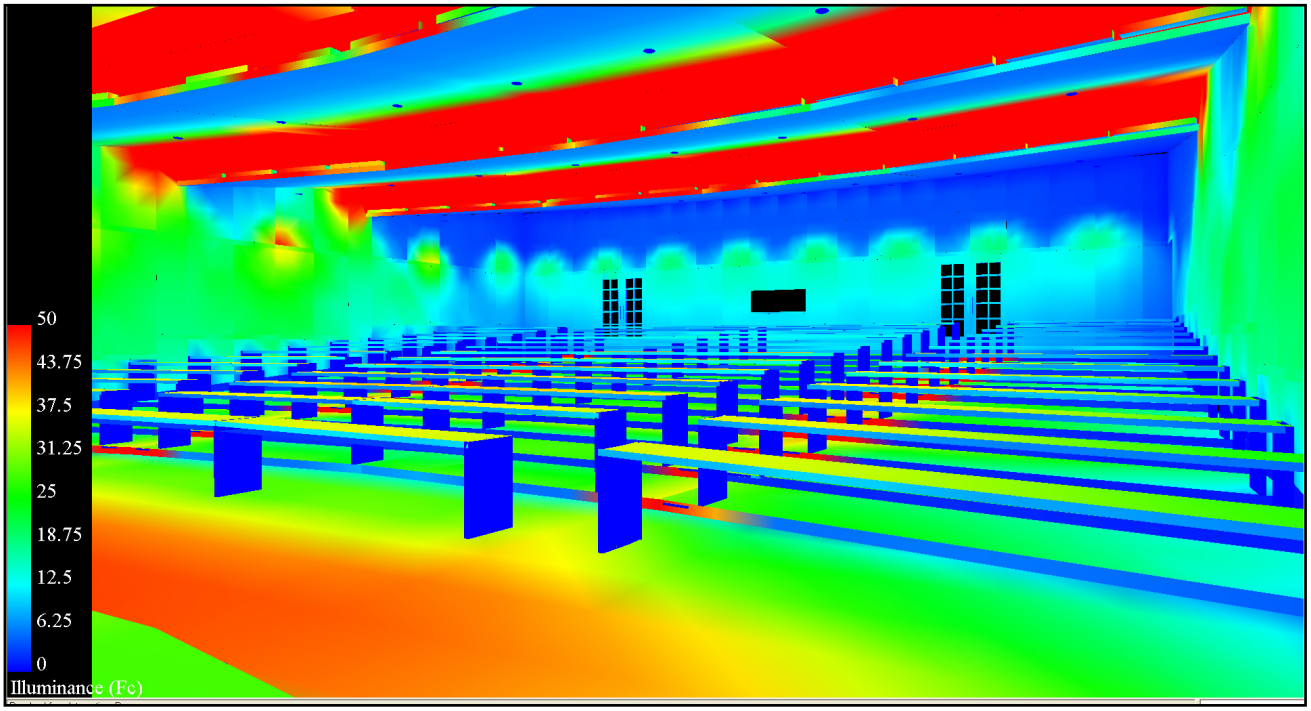


Figure 24: Pseudo Color of Auditorium

Conclusion

The auditorium was the hardest space to provide the lighting design for. The space had a curved ceiling with various heights across the whole ceiling. A curved cove was used throughout the space to achieve some area lighting. The rest of the ambient lighting was done through downlights. The steps have a built in LED strip. Overall, the lighting design achieved the space design goals. The average illuminance on the work plane was 42.3 fc, which is low for the IESNA value for a classroom/lecture space of 50 fc. The power density was 1.47 W/ft^2, which was slightly over the ASHRAE 90.1 Standards of 1.4 W/ft^2 for a classroom/lecture space.

Classroom (505) – Lighting Redesign

Description of Space

The 60-person classroom is located on the fifth floor of the building. The fifth floor of the Dorrance H. Hamilton Building also includes other classrooms, lecture halls, two skills simulation labs, storage rooms, a small lobby, and a library/meeting room. The back wall of the classroom is a curved glass ribbon window, which will have dual/solar blackout shades. The shades will provide the space with a visual display terminal (VDT) friendly environment. The space tasks include note-taking, reading, writing, chalkboard use, and VDT use. The classroom is 32' long by 54' wide by 10' high. This equates to an area of 1728 ft^2.

Floor Plan

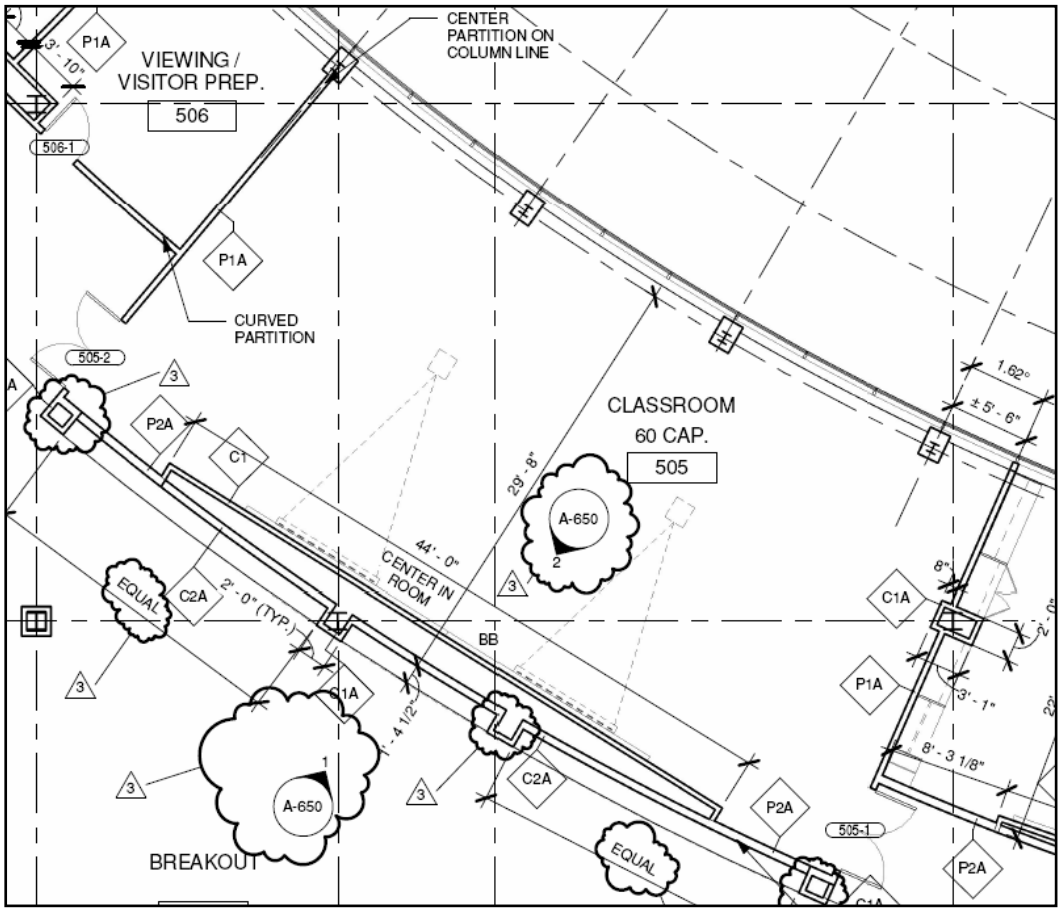


Figure 25: Classroom Floor Plan

Design Concept

The design concept of the classroom is to provide various scenes for the different tasks of the space, provide ample task lighting on the desks, and to accent the chalkboard/whiteboard. The space should be user friendly with only switching to turn the lights on and off. The front row of lights will be on a separate switch in order to provide sufficient lighting for the chalkboard/whiteboard. The 2x2 fixtures throughout the room will provide a sufficient area source of light. A fluorescent wall mounted light will be on top of the chalkboard to provide adequate illuminance.

Design Criteria

Daylighting Integration and Control

The space incorporates a curved ribbon window on the entire rear wall of the room. This will be a design issue during the use of the projector and screen and may even cause glare on the blackboard. Dual/Solar blackout blinds will remedy this potential problem; however, they will also limit the daylight in the space.

Light Distribution on Task Plane (Uniformity)

Patterns of light on the task plane should be uniform. The desks in the room are used for reading and writing, so a non-uniform pattern of light on the task plane would be distracting and/or confusing. In a learning environment, the task plane illuminance should be 1.5 to 3 times higher than those in the surrounding areas in order to assist occupant's attention on the task at hand.

System Control and Flexibility

System control and flexibility are of extreme importance in the space due to the various tasks provided in the classroom. A couple of different scenes of the space include the projection screen, blackboard/whiteboard applications, and general lecture talks. This will be accomplished by the front row of luminaires to be on a separate switch.

Illuminance (Horizontal)

The IESNA Handbook recommends a horizontal illuminance of 500 lux (50 fc) on the task plane for reading and writing tasks. When the projection screen is in use, a

horizontal illuminance of 30 lux (3 fc) on the task plane is needed.

Illuminance (Vertical)

The IESNA Handbook recommends a vertical illuminance of 30 lux (3 fc) when the projection screen is in use. The points of interest for vertical illuminance include the chalkboard, the speaker, and the projection screen. Note: The projection screen should be a lower illuminance than the surrounding space.

Power Allowances from ASHRAE 90.1 Standards

The power allowance by the space by space method for a classroom, lecture, or training space is 1.4 W/ft^2 – 1.6 W/ft^2.

Reflectances

Ceiling: Acoustical Ceiling Tile

- Assume 85% ceiling reflectance

Walls: To Be Determined

- Assume 50% wall reflectance

Floor: To Be Determined

- Assume 50% floor reflectance

Fixture Schedule

Label	Description	Lamps	Ballast/ Transformer	Watts	Voltage	Mfr.	Catalogue No.
F-B1	2x2 Parabolic Grid Troffer with Specular Louver Finish	3 – F17T8	B-D1 - Advance Electronic Dimming/Instant Start Mark 10 PowerLine	51	277	Holophane	1-HP-G-N-22-X-N-D33-023-EP-1-2
F-B2	Obround Wall Mount Luminaire with Specular Aluminum Reflector	2 – F40T8	B-D2 – Advance Electronic/Instant Start Optanium	80	277	LAM Lighting	OB70-2/T8-O-L-WN-8-SGW-277-GLR

Table 16: Classroom Fixture Schedule

Light Loss Factors

The assumed room cleaning period for this room is 6 months and the room is clean. The expected dirt depreciation was calculated at 8%.

RCR = [(5)*(H)*(L + W)] / (L)*(W)

RCR = [(5)*(10')*(32' + 54')] / (32')*(54') = 2.49 = 2.5

Label	Maintenance Category	LLD	RSDD	LDD	BF	LLF
F-D1	IV	0.95	0.98	0.93	1.05	0.91
F-D2	IV	0.93	0.98	0.93	1.03	0.87

Table 17: Classroom Light Loss Factors

Ballast Information

Label	Type	Ballast Watts	Ballast Factor	Voltage	Max THD %	Mfr.	Catalogue No.
B-D1	Electronic Dimming/ Instant Start/ 3-Lamp	56	1.05	277	10	Advance – Mark 10 PowerLine	VEZ-3S32-SC
B-D2	Electronic/Instant Start/2-Lamp	81	1.03	277	10	Advance – Optanium	VOP-4P32-SC

Table 18: Classroom Ballast Information

Lamp Information

Label	Type	CRI	CCT	Watts	Initial Lumens	Mean Lumens	Mfr.	Ballast
L-D1	F17T8 TL841 ALTO TG	85	4100	17	1400	1330	Philips	B-D1 - Advance Electronic Dimming/Instant Start Mark 10 PowerLine
L-D2	F40T8 TL841 ALTO	86	4100	40	3775	3500	Philips	B-D2 – Advance Electronic/Instant Start Optanium

Table 19: Classroom Lamp Information

Power Density

Label	Ballast Watts	No. of Fixtures	Total Watts	
F-D1	59	28	1652	
F-D2	81	4	324	
			1976	Watt Total
			1506	Square Foot Total
			1.31 W/ft^2	

Table 20: Classroom Power Density

Therefore, the power density is slightly below the target IESNA value of 1.4 W/ft^2 to 1.6 W/ft^2. The space is at an appropriate illuminance level, so the power density is sufficient.

Lighting Plan

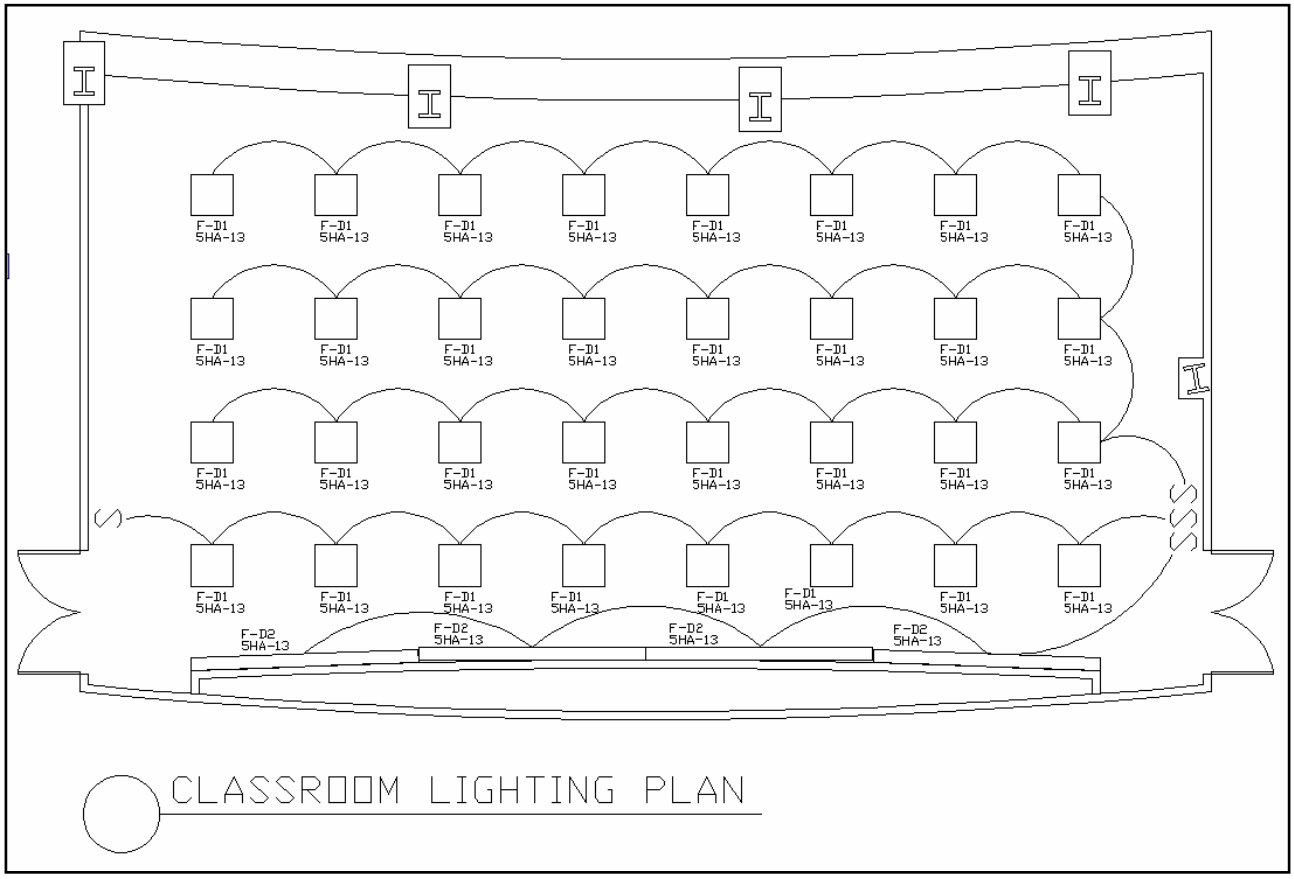


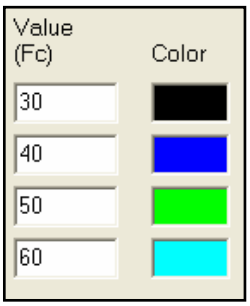
Figure 26: Classroom Lighting Plan

Lighting Controls

The classroom will use two dual technology occupancy sensors due to the size of the classroom. The sensors will be located in two rear corners of the classroom. The sensors can accommodate lower levels of activity without false triggers. Dimming ballasts are specified for use with these lighting controls.

Isometrics

The Isolines from AGI32 were analyzed on the work plane height of 2.5'. The average illuminance throughout the classroom was 49.66 fc.



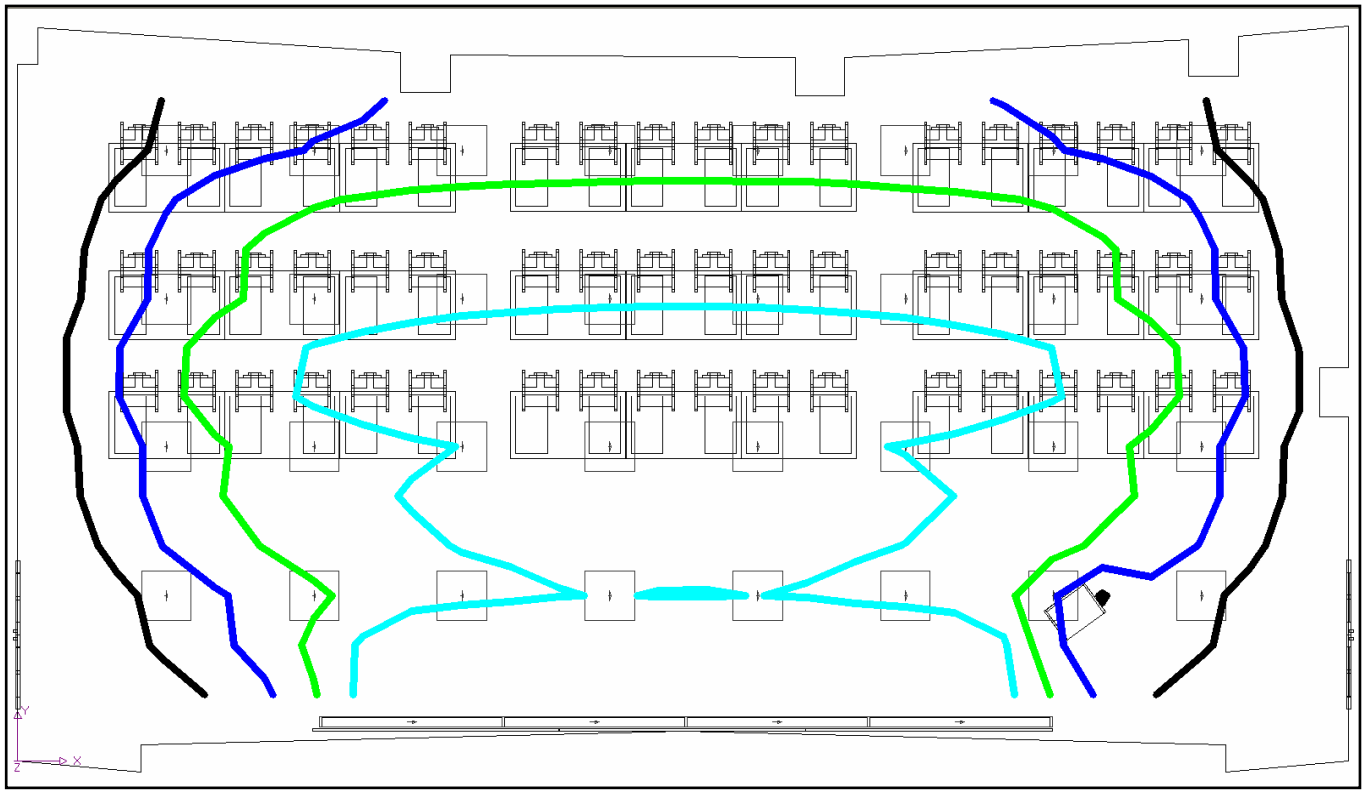


Figure 27: View of Isolines of Classroom

Renderings

Figure 28: Rendering of Classroom

Figure 29: Rendering of Classroom

Conclusion

Overall, the lighting design achieved the space design goals. The 2 by 2 fixtures worked well in accordance with the acoustical tile ceiling grid and provided sufficient light onto the workplane. The average illuminance on the work plane was 49.6 fc, which almost matched the IESNA value for a classroom of 50 fc. The power density was 1.31 W/ft^2, which was under the ASHRAE 90.1 Standards of 1.4 W/ft^2 for a classroom.