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## Technical Assignment 1

### Executive Summary.

This report reviews the existing lighting conditions at the Pennsylvania Academy of Music in Lancaster, PA. The analysis included research into the luminaires used, their lamping, the respective light loss factors, lighting design criteria specific to the use of the space, and the lighting photometric reports. The spaces were rendered in AGI32. Luminous power densities were calculated and compared with the ASHRAE 90.1-2004 standard. I have concluded that the existing design meets nearly all of the required criteria and power densities. This reports difficulty was magnified by the lack of information I currently have about the building.

Files relating to this report are stored on my P: drive in Thesis/Tech Report 1.

## Grand Foyer.

The Grand Foyer is a double-height space that wraps entirely around the oval-shaped recital hall that is the heart of the building. There is a balcony on the north side overlooking the Grand Foyer. Below this balcony is an information kiosk that includes an electronic information display. The west end of this space steps upwards to a terrace where there will be a piano. Beyond this area is a lounge with couches, chairs and tables. Windows surround this space, daylight would be the primary light source during the day. At night, the space would be very visible from outside the building, so light placement is important to draw attention to the building, being the primary source of façade lighting.

### Existing Conditions.

	Description	Lamp	Mounting	Voltage	Manufacturer
F1	Adjustable 6" Wallwasher	1 x 250W Halogen Par-38 Flood	Recessed	120	Zumtobel Staff
F2	Downlight	1 x 32W Triple Tube CFL	Recessed	120	Lightolier
F10	Decorative Chandelier	25 x 20W Halogen Bi-pin	Pendant Mounted	12	Tech Lighting
F11	Decorative Chandelier	12 x 20W Halogen Bi-pin	Pendant Mounted	12	Tech Lighting

The lighting in this space comes most significantly from the F1 wallwashers. The goal of these are to light the wood veneer of the recital hall. At night, the space would appear to glow because the surfaces in the space behind the windows would be lit. The dense pattern of small glowing circles on the ceiling would add sparkle to the space. In the areas with lower ceiling height, the F2 downlights provide useful, more utilitarian light. Additional sparkle is delivered by the two decorative chandeliers. These fixtures use halogen bi-pin lamps surrounded by amber glass at the end of bendable, flexible stems. The stems can be intertwined and arranged by hand. Their addition to the space is to symbolize the music through a visual medium. The lights in this space would be controlled by a time clock.

The round wall surrounding the recital hall is a cherry veneer. It is relatively light in color and is assumed to have a 40% reflectance. The floor of the main section of the Grand Foyer will be a dark patterned carpet. This carpet is assumed to have a reflectance of about 20%. The balcony region of the space will have a floor painted concrete, with an assumed reflectance of 30%. The walls of this space that aren't part of the round recital hall walls are all light-painted gypsum wall board. These will have an assumed reflectance of 75%. Windows surround this space. Though I do not yet have information about the manufacturer, I am assuming that they are heat reflecting due to the amount

of window area in the space, and that they would have a transmittance of about 40%.

Luminous Power Density:

F1: 97 x 250 W = 24250 W

F2: 42 x 32 W = 1344 W

F10: 3 x 500 W = 1500 W

F11: 1 x 240 W = 240 W

Total Wattage = 27334 W

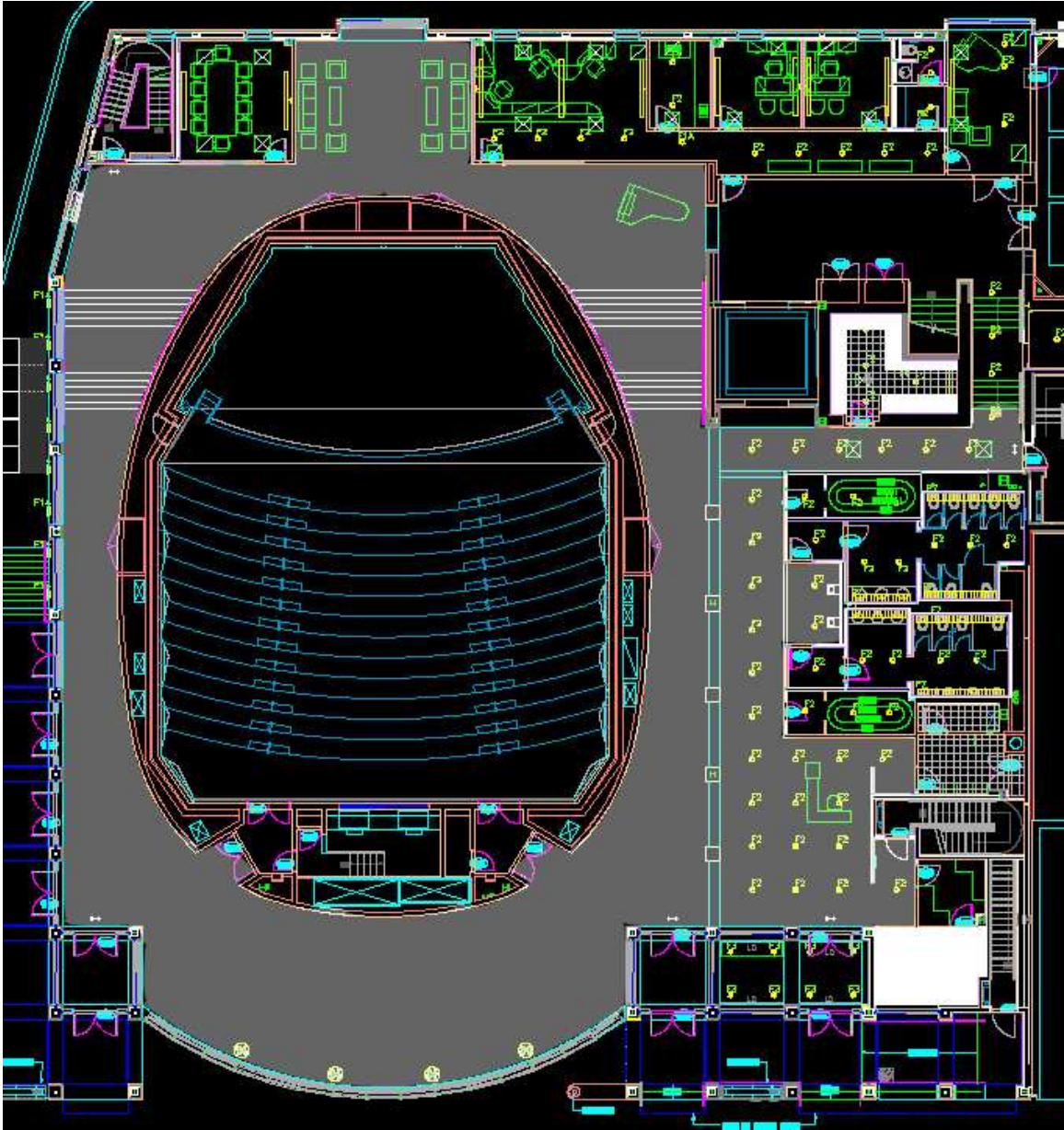
$27334 \text{ W} / 8320 \text{ ft}^2 = 3.285 \text{ W/ft}^2$

The allowable power density for this space is 3.3 W/ft<sup>2</sup> when using the space by space method. Though the current design does not exceed the power density allowances, I feel that this allotment could have been used a little more judiciously. Additionally, there is no automatic control to coordinate light levels with the daylight entering the space.

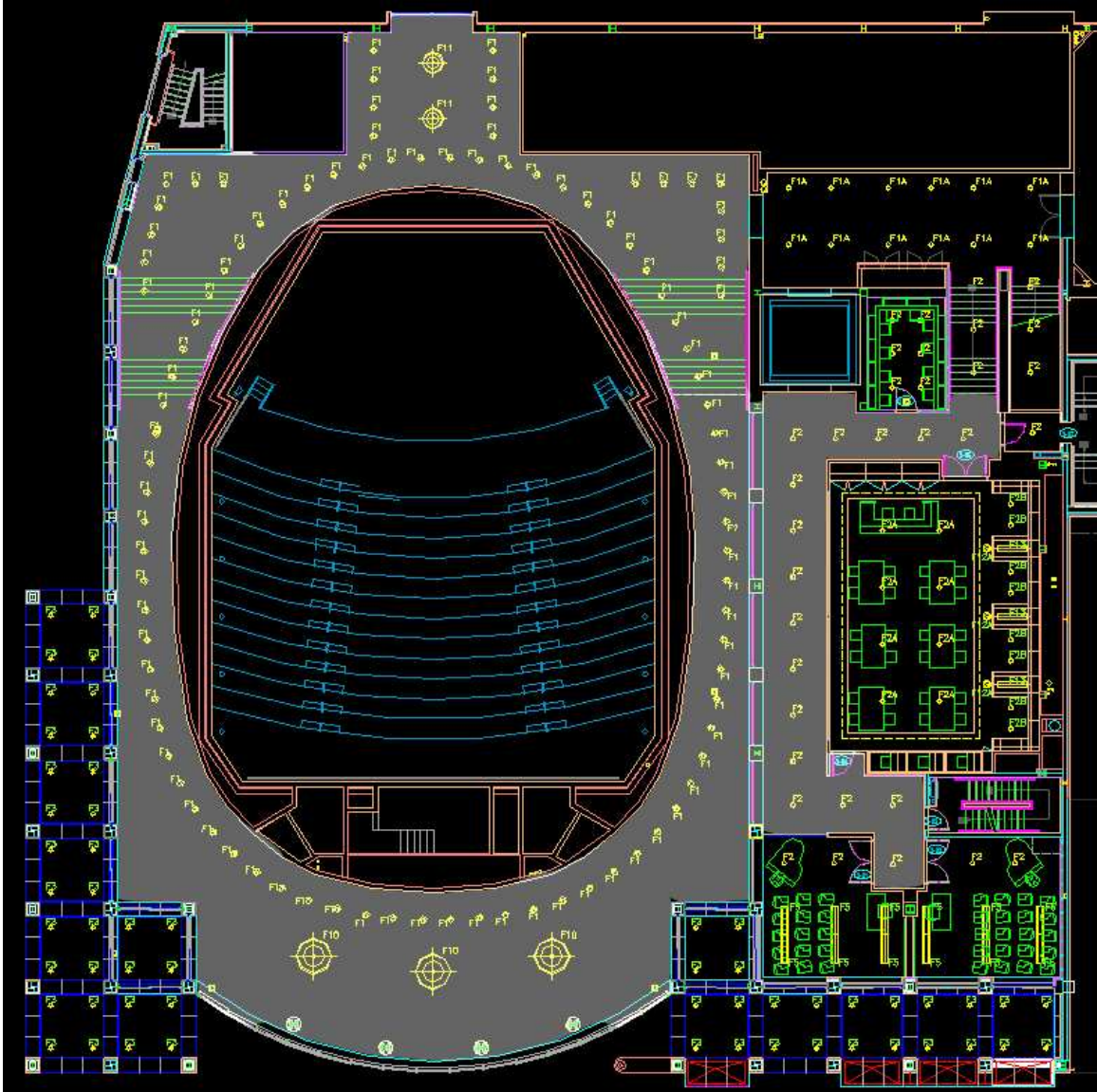
Since this space is a meeting and gathering area, facial and color rendering is very important. People will be meeting others for the first time in this space so accurate facial rendering and skin tones are very important as design criteria. Since this is a performing arts center, people will also likely use this space to be seen as well. In this case, sparkle and uniform light distribution will show off the people as well as their jewelry and clothes. Since this is a keystone space in the building, the appearance of the space is also very important. The luminances of the room surfaces should be enough to be seen from the outside and the appearance of the luminaires to the inside and outside of the space is important. The space is viewable from the street so glare to the drivers on the street must be avoided. An illuminance of 10-20 footcandles horizontal and vertical is appropriate for this space.

	Category	BF	LLD	LDD	RSDD	Total LLF
F1	IV	N/A	.93	.88	.94	.769
F2	IV	.95	.85	.88	.96	.682

Notes: The fixtures are assumed to be in a clean environment with a twelve month cleaning cycle. The decorative fixtures were not taken into consideration when calculating the amount of light in the space due to their minimal impact on the light levels in the room and unknown configuration.

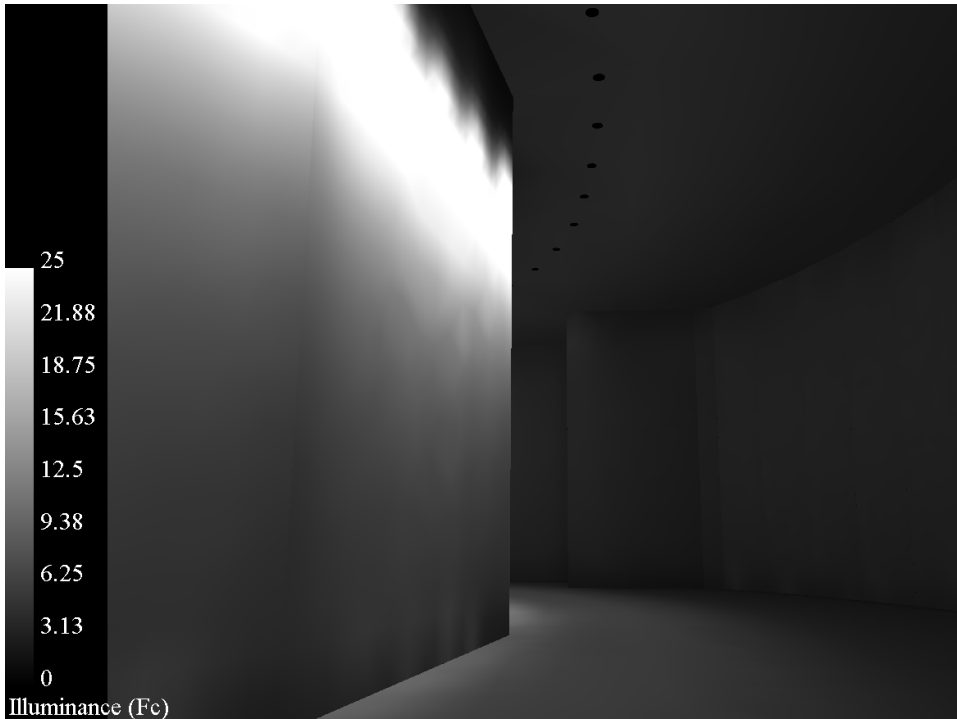


Grand Foyer RCP, ground floor.



Grand Foyer RCP, second floor.

No sections were provided to me at this time.



Illuminance at the front of the Grand Foyer near the curved glass curtain wall. I think that the illuminance is very low, mostly because of the light leaving the front window and the high ceiling height.



Illuminance at the Mezzanine at the rear of the Grand Foyer looking into lounge area. This section of the Grand Foyer has sufficient light levels.

The fluorescent ballasts are specified as Sylvania Quicktronic, Universal Triad, or Advance Smartmate programmed rapid start with a minimum ballast factor between 0.95 and 1.05 and a power factor of at least 0.90. The available manufacturers for the transformers are specified as MagneTek, Olsun, or Square D.

## Recital Hall.

The Recital Hall is the heart of the academy. The Recital Hall is designed and presented as a world-class yet intimate performance space. The unique acoustical treatments to the room to disperse sound create depth and texture in the space. The stage and walls surrounding the stage are the same cherry veneer as the walls surrounding the space, and the acoustical panels are white-painted plaster. The entrance to the space is on the ground floor, and the seating is raked down to the lower level. The space would be used for performances as well as for practices of voice and a variety of instruments.

	Description	Lamp	Mounting	Voltage	Manufacturer
F17	5" Aperture Downlight	1 x 150W Tungsten Halogen	Recessed	120	Rambusch
F17A	Downlight	1 x 150W Tungsten Halogen	Monopoint Mounted	120	Edison Price
F23	Cove Light	3 x 10W Xenon per Foot	Surface Mounted	24	Ardee Lighting
F24	9" x 36" Wallwasher	3 x 100W Par-38 Spot	Recessed	120	Edison Price
F25	Theatrical Accent Light	1 x 575W HPL Incandescent	Track Mounted	120	ETC

The primary lighting in this space comes from the F17 downlights that are placed in between the acoustical panels. These lights are placed throughout the space, including on the stage. The F17A are placed near the walls in the seating area to lighten the walls. The cherry walls of the stage area are lit with the F24 wallwashers. Performances on stage are lit by F25 theatrical ellipsoidal accent lighting. These accent lights are placed above the audience in the center of the auditorium as well as vertically behind the sides of the proscenium, mounted to theatrical pipe. The triangular acoustical panels are highlighted by the xenon cove light mounted between panels within the ceiling.

The lights in this space are controlled by an ETC Unison DR dimming rack along with an ER external processing rack to control both the theatrical and the architectural lighting in the space. The system is controlled by control modules with integrated backlit LCD displays. The system is programmed through a computer interface.

The seats of the space are dark, folding, cushioned seats. The seating is the only permanent furnishing in the Recital Hall. The carpeting is continued from the Grand Foyer and is assumed to have a reflectance of 20%. The cherry veneer would have the same assumed reflectance of 40%. There is a cherry batten separating the stage and the seating area as well as along the wall



opposite the stage. This wood structure would have gaps between to absorb sound, and would have an assumed reflectance of about 25%. The acoustical panels are white painted plaster, and are assumed to have a reflectance of 75%.

Luminous Power Density:

F17: 32 x 150 W = 4800 W

F17A: 10 x 150 W = 1500 W

F23: 144 x 30 W = 4320 W

Total Wattage = 10620 W

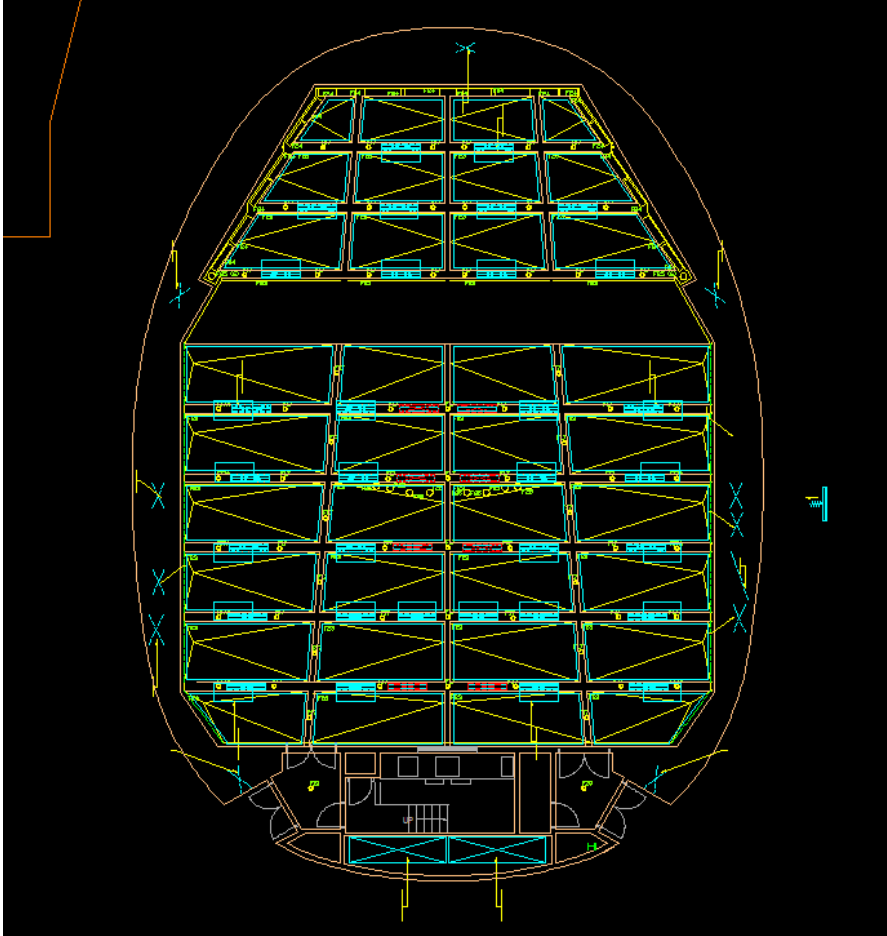
$12060 \text{ W} / 3250 \text{ ft}^2 = 3.268 \text{ W/ft}^2$

The ASHRAE 90.1 2004 allowable power density for the seating area is 2.7 W/ft<sup>2</sup> plus a 1.0 W/ft<sup>2</sup> allowance for highlighting artwork. The light used for lighting the performance is exempt from the luminous power density calculation, as is the area of the stage. It appears that the cove lighting was considered to be highlighting the art of the acoustical panels to achieve the power density goals.

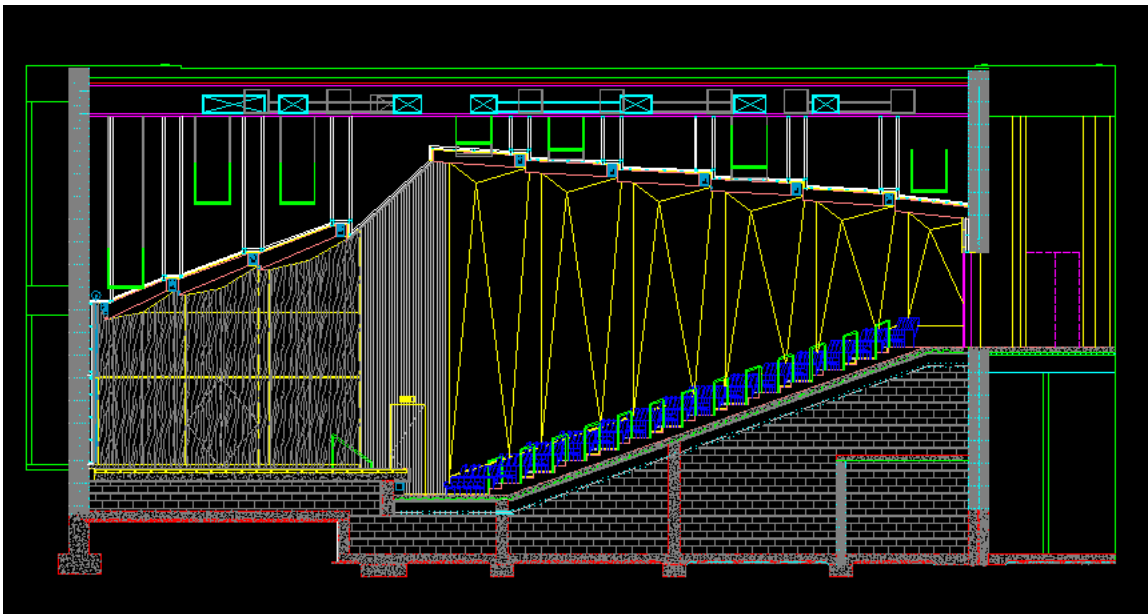
Many of the same considerations in the Grand Foyer will be continued into this space. Dimming and the appearance of this space and the luminaires are very important. This should be a dramatic, signature space and the lighting should emphasize this. Careful use of shadows and sparkle can also help in adding to the drama and regality of the space. Slightly higher luminances of the room surfaces in this space, especially on the stage, can help focus attention away from the people, making them feel more comfortable as well as emphasize the focal point of the room. Quality facial modeling and color rendering are important to make the audience look good.

	Category	BF	LLD	LDD	RSDD	Total LLF
F17	IV	N/A	.93	.88	.97	.793
F17A	IV	N/A	.93	.88	.96	.786
F23	I	N/A	.93	.94	.92	.804
F24	IV	N/A	.93	.88	.97	.794

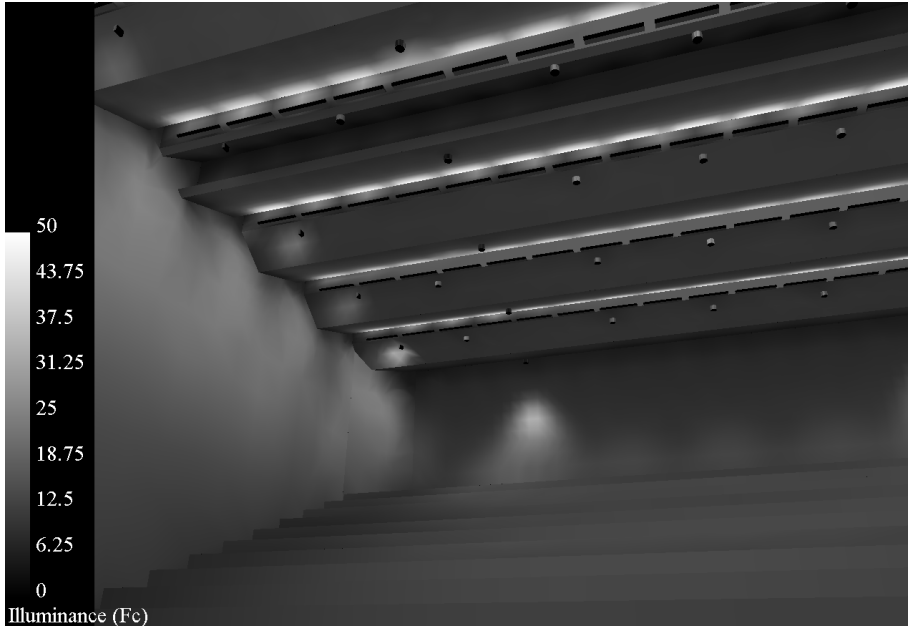
Notes: The fixtures are assumed to be in a clean environment with a twelve month cleaning cycle. The photometric file for the Rambusch fixture was unavailable, so an Omega Lighting equivalent photometric file was substituted. The theatrical fixtures were left out of the lighting calculations. This space was simplified for sake of calculations - the acoustical panels are much more complicated than shown in the renderings.



Recital Hall RCP.



Recital Hall Section.



The audience seating area is amply lit. The large contrast between the stage and the seating area keeps the attention on the stage. The cove lighting accents the acoustical treatments in the space.



The Recital Hall stage is very well lit, and will be even further enhanced by the theatrical fixtures.

The available manufacturers for the transformers are specified as MagneTek, Olsun, or Square D.

## Roof Terrace.

The Roof Terrace is an outdoor plaza surrounded by the third floor of the building. Its primary purpose would be as a gathering area for a function following a performance or for outdoor performances. It is surrounded on four sides by glass looking into corridors and some of the studio space.

	Description	Lamp	Mounting	Voltage	Manufacturer
F15A	Custom Wall Sconce	1 x 32W Triple Tube CFL	Wall Mounted	120	Forms + Surfaces
F16	Uplight	1 x 35W Metal Halide	Monopoint Mounted	120	Bega

This space is lit primarily from the custom compact fluorescent wall sconces. These sconces are reminiscent of the decorative chandeliers in the lobby. The decorative sconces will provide mostly a glow near the wall. The uplights are used to highlight a tree within an owner-provided planter. Additional spill light would come from the corridors. The light fixtures in this space should be controlled by a time clock.

The reflectances in this space are going to be fairly low. The reflectance of the pavers are assumed to be about 25%. The windows are assumed to be the same as in the lobby area with about a 40% transmittance. The columns would be clad in lead-coated copper, with an assumed 10% reflectance. There is no roof, and the walls are otherwise ten-foot sections of glass that would glow with whatever light is coming off of the surfaces behind the glass.

Luminous Power Density:

$$F15A: 18 \times 32 \text{ W} = 576 \text{ W}$$

$$F16: 2 \times 48 \text{ W (nominal)} = 96 \text{ W}$$

$$576 \text{ W} / 132 \text{ ft} = 4.364 \text{ W/ft}$$

$$96 \text{ W} / 1080 \text{ ft}^2 = 0.089 \text{ W/ft}^2$$

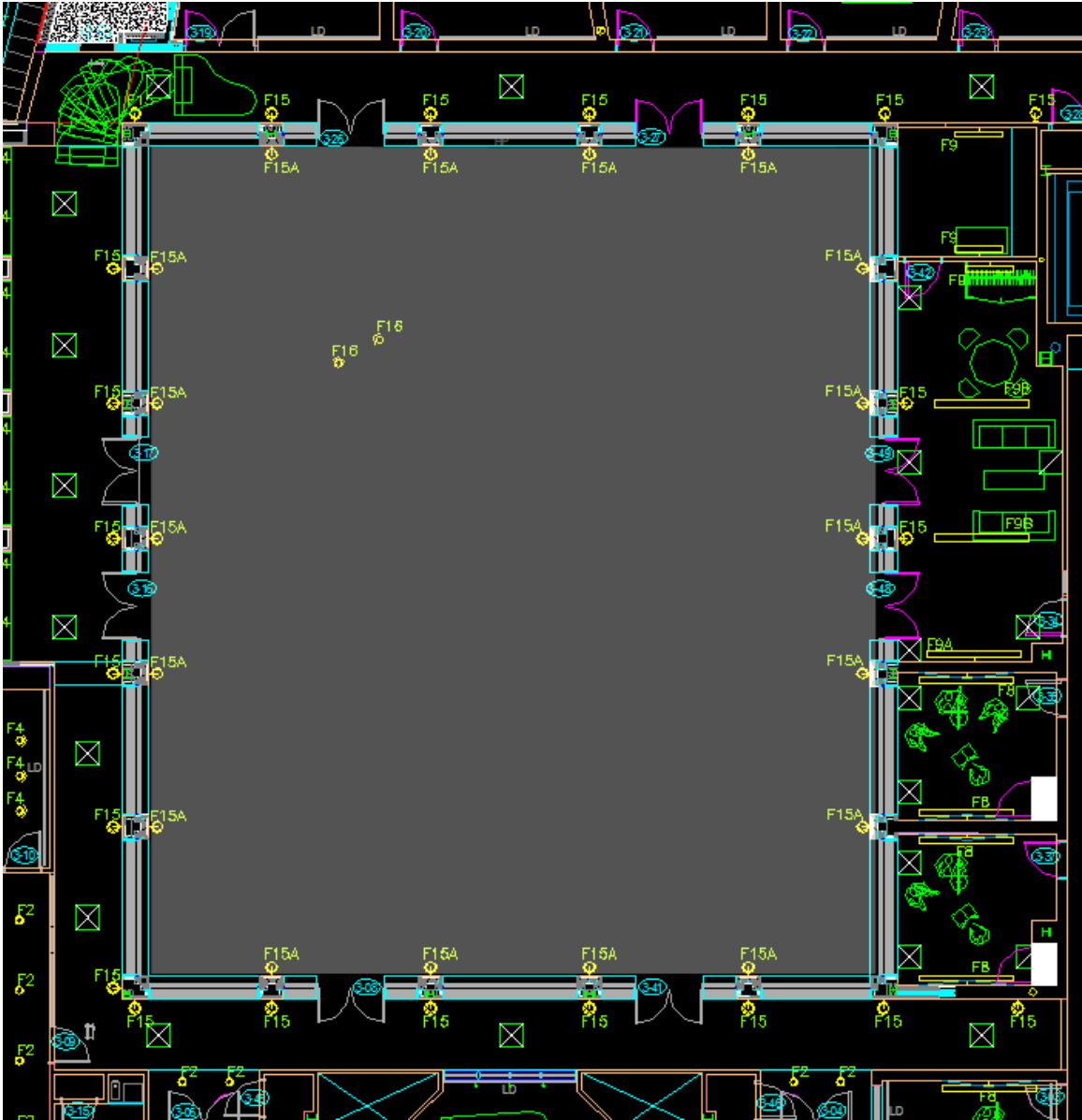
The ASHRAE 90.1 2004 allowable power density for the façade lighting is 5 W/ft. The allowable power density for the plaza section is 0.2 W/ft<sup>2</sup>. Both of these criteria are met. Allowances should be made if additional landscaping is added to the space. Additionally, the lights used currently are not cutoff fixtures and don't meet the International Dark Sky recommendations.

This space is another gathering and meeting area. However, because it is an outdoor space, luminance levels will not be very high at night. Thus, even luminance is very important in this space to make people feel safe. Even illumination will eliminate shadows and render faces evenly enough for comfort. Glare is also a very important issue to keep under control. Glare

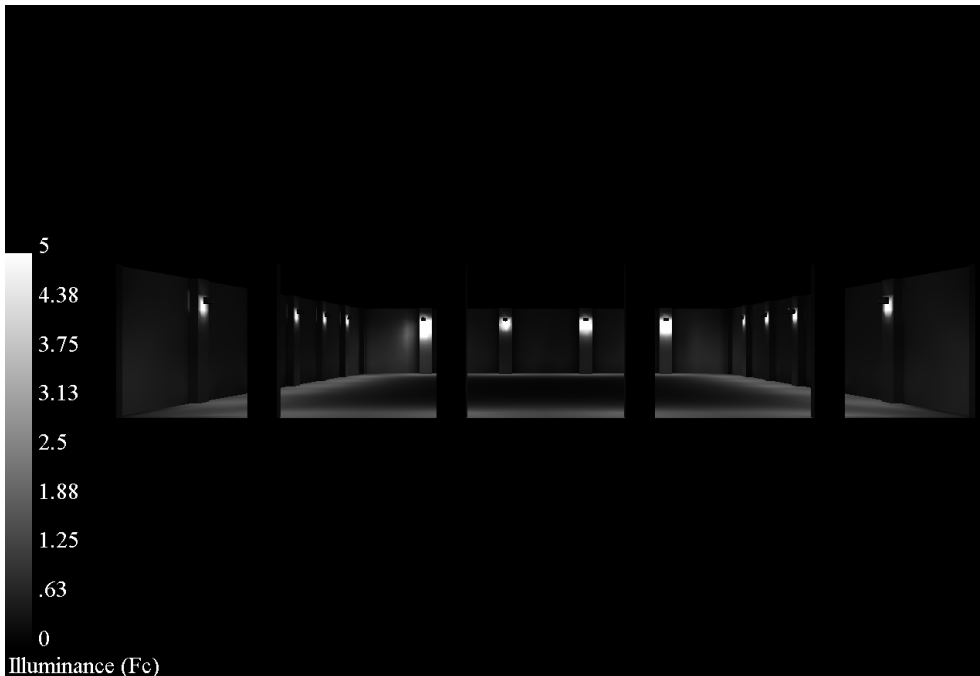
from bright point sources would be like oncoming headlights and will obscure vision and cause discomfort. In the darkness, the luminaires would stand out and their appearance should be carefully considered. Flexibility for the lighting in this space is also important. The light levels would need to be flexible enough to produce additional light in case there is a concert or other function in the space aside from an informal gathering area. Light trespass should be carefully controlled as well to keep the skies free from light pollution.

	Category	BF	LLD	LDD	RSDD	Total LLF
F15A	V	.9	.85	.78	N/A	.597
F16	V	N/A	.75	.78	N/A	.585

Notes: The fixtures are assumed to be in a dirty environment with a twelve month cleaning cycle. The F16 fixture was removed from the calculation because they will be lighting a tree that will be installed at a later date.

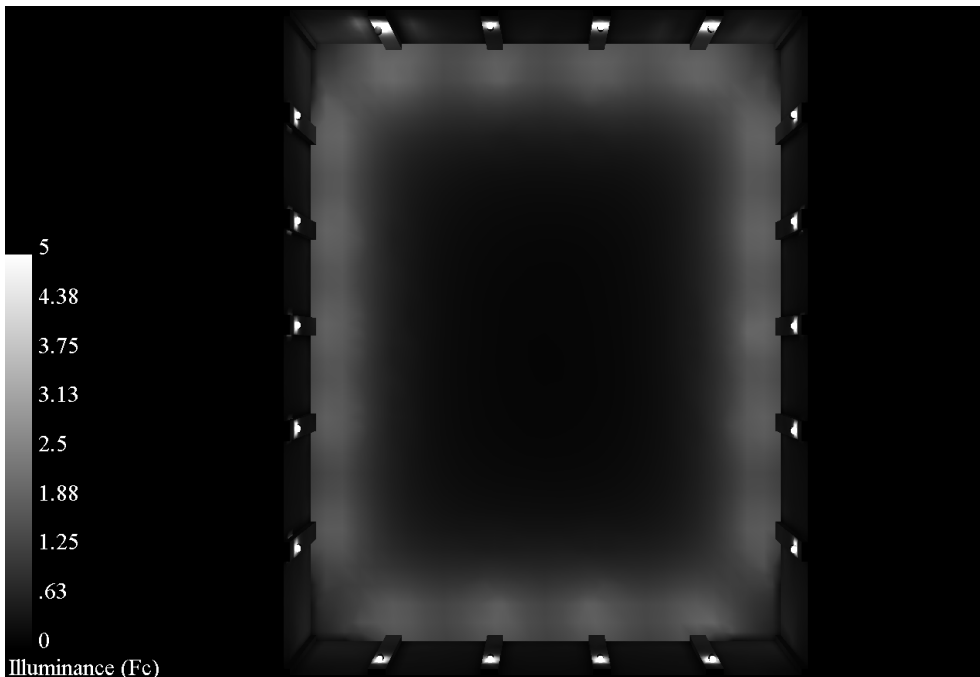


Roof Terrace RCP.



Illuminance (Fc)

The illuminance is satisfactory around the exterior of the roof terrace. Additional illuminance would come through the windows that look in to hallways on three sides of the terrace.



Illuminance (Fc)

The illumination from only the exterior of the space creates a very large and undesirable illuminance ratio.

The fluorescent ballasts are specified as Sylvania Quicktronic, Universal Triad, or Advance Smartmate programmed rapid start with a minimum ballast factor between 0.95 and 1.05 and a power factor of at least 0.90. The acceptable

HID ballast manufacturers are specified as manufactured by Aromat, Advance, or e-Vision.



Library.

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. Listening rooms are on the east side of the library. Reading tables fill the rest of the space.

Existing Conditions.

	Description	Lamp	Mounting	Voltage	Manufacturer
F2	Downlight	1 x 32W Triple Tube CFL	Recessed	120	Lightolier
F2B	Wallwasher	1 x 32W Triple Tube CFL	Recessed	120	Lightolier
F6	Fluorescent Cove light	1 x 28W T5	Surface Mounted	120	Legion Lighting
F12A	Decorative Wall Sconce	3 x 20W Halogen Bi-pin	Surface Mounted	12	Tech Lighting
F13	Downlight	1 x 54W T5HO	Recessed	120	se'lux
F26	Tasklight	1 x 14W T5	Surface Mounted	120	Alkco

The library has several layers of light. The cove light gives ambient illumination of the space while the downlights provide punch down to the reading surface. The wallwashers provide lighting on the book shelves. On the inspection counters, a fluorescent downlight provides task lighting. Decorative chandeliers that are smaller versions of the ones in the lobby adorn the ends of the inspection tables. More efficient light sources were used in this space to achieve a higher light level.

The reflectances of this space are similar to the lobby. The wood is again cherry with an assumed reflectance of 40%. The carpet is assumed to have a reflectance of 20%. The walls and ceiling are painted gypsum wallboard and will have a reflectance of 75%.

Luminous Power Density:

F2: 6 x 32W = 192W

F2B: 8 x 32W = 256W

F6: 26 x 28W = 728W

F12A: 3 x 60W = 180W

F13: 3 x 54W = 162W

F26: 3 x 14W = 42W

Reading Area Watts: 1142 W

Stack Area Watts: 418 W

Total Watts: 1560 W

Reading Area LPD:  $1142 \text{ W} / 960 \text{ ft}^2 = 1.190 \text{ W/ft}^2$

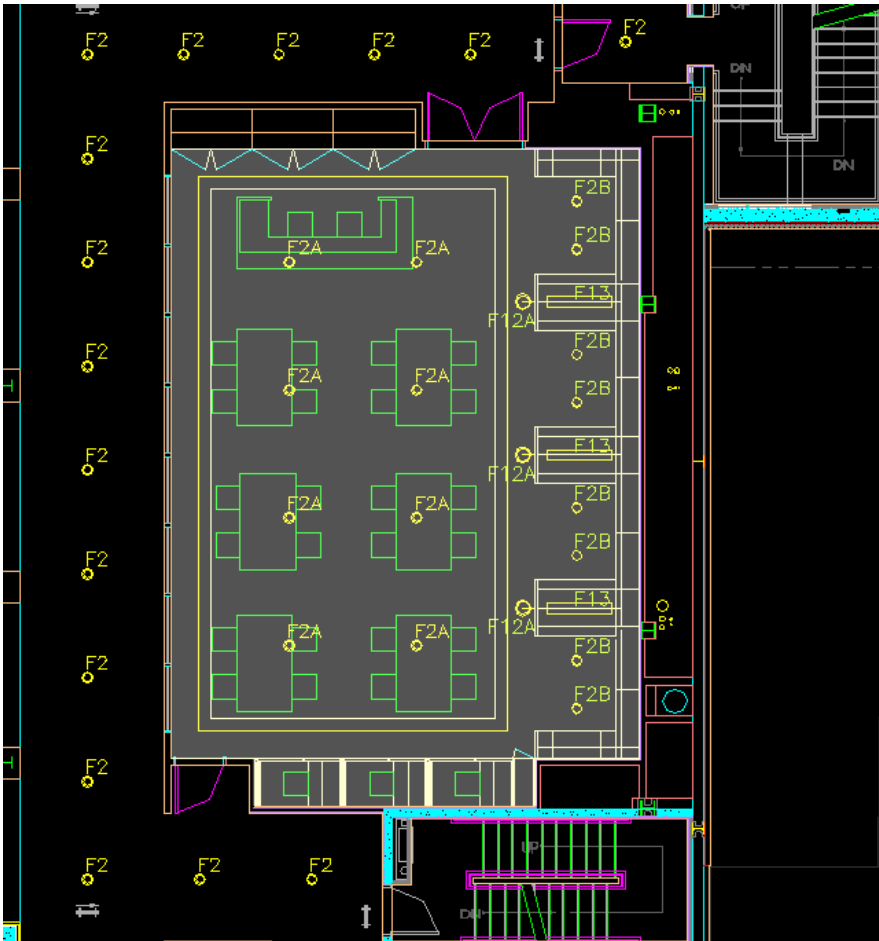
Stack Area LPD:  $418 \text{ W} / 600 \text{ ft}^2 = 0.670 \text{ W/ft}^2$

This space meets the allowed power density of  $1.2 \text{ W/ft}^2$  in the reading areas and  $1.7 \text{ W/ft}^2$  in the stack area. However, I think that the high output lamp so close to the inspection counters might be a little too bright.

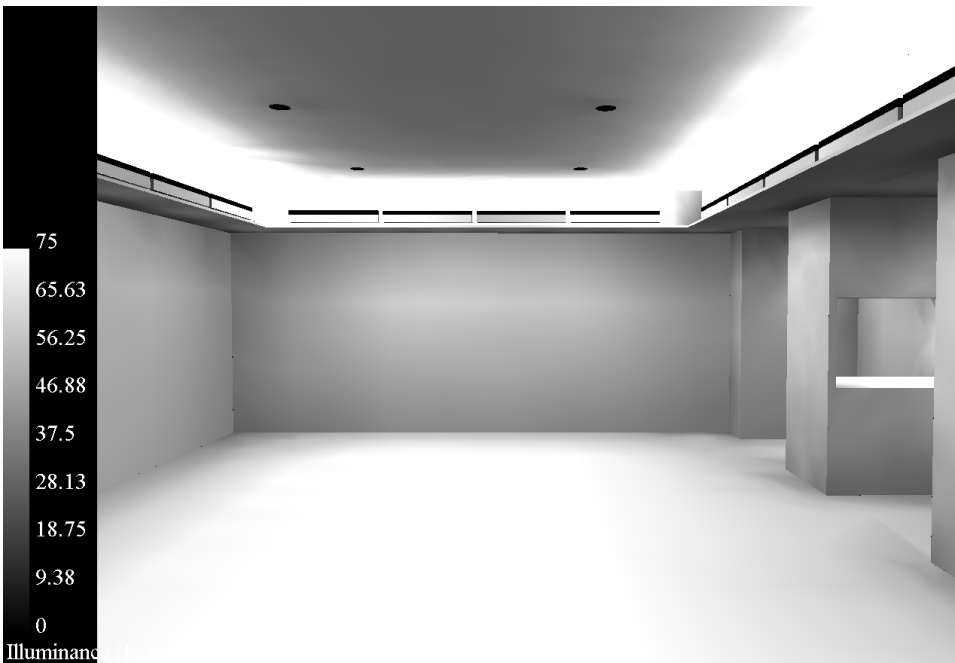
The most important design considerations in this space are to take into account glare and the relationship between the task and the light source. Glare would be distracting in this space because it would cause veiling reflections and take away from the ability to read as well. Paying attention to the relationship between the task and the source will keep shadows off of the task. There is likely to be computer use in this space so lighting for computer VDT is to be expected. This space should likely be controlled by a volumetric ultrasonic occupancy detector. The listening rooms could be controlled by an infrared occupancy sensor.

	Category	BF	LLD	LDD	RSDD	Total LLF
F2	IV	.9	.85	.88	.97	.653
F2B	IV	.9	.85	.88	.97	.653
F6	I	.9	.94	.94	.91	.724
F13	V	.9	.94	.88	.97	.723
F26	V	.9	.94	.88	.97	.723

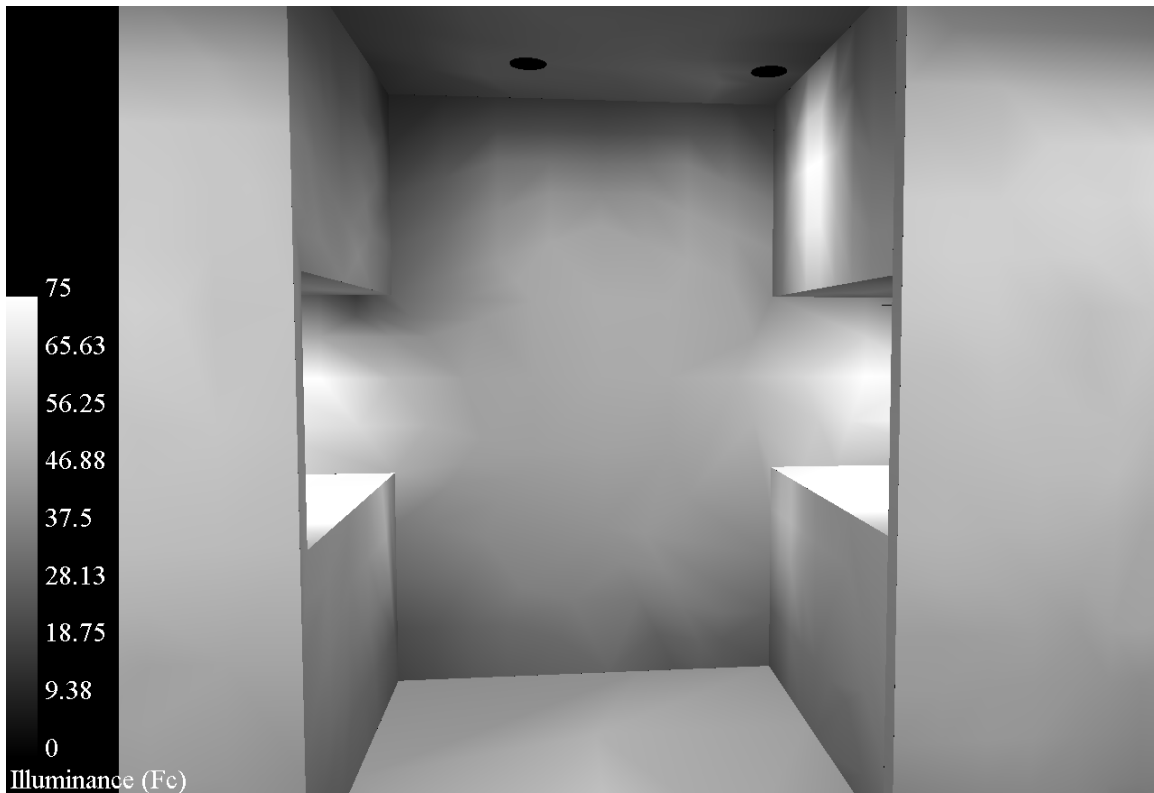
Notes: The fixtures are assumed to be in a clean environment with a twelve month cleaning cycle. F12A is a decorative fixture and its configuration is unknown, so it was left out of the calculations.



Library RCP.



Light levels are high from both a cove system and a downlight system.



The inspection counters are very bright, and the bookshelf (far wall) is very evenly illuminated, partly due to the lights for the inspection counters.

The fluorescent ballasts are specified as Sylvania Quicktronic, Universal Triad, or Advance Smartmate programmed rapid start with a minimum ballast factor between 0.95 and 1.05 and a power factor of at least 0.90.