SECTION FOUR | Lighting

For a multipurpose building such as the August Wilson Center, the lighting design is especially critical. Various uses place varying demands on the lighting system which the lighting designer must identify in order to produce a successful design. As a public venue, the lighting is a key for creating a welcoming ambiance and enhancing the overall user experience.

In redesigning four of the primary building spaces (the main Liberty Avenue façade, the main lobby, the education and lecture room, and the meeting room), I have focused on using light and luminaires to create a high-class, welcoming appearance while using sophisticated control systems to offer great flexibility for varied uses. The main motivation for the overall design was the transparency of the façade which creates interaction between all the spaces and likens the building to an open stage. I have centered my design on creating continuity between spaces with clean layouts and simple luminaires.

DAYLIGHT CONDITIONS

Daylighting has become an increasingly desired feature for newly designed buildings. As a LEED building, The August Wilson Center could earn points for daylighting. Beyond LEED, however, considering the orientation of the building is imperative to any good design. The following images show the project site and surrounding buildings on multiple dates (December 21, March/September 21 and June 21) under a clear sky. The images are in sequence from sunrise to sunset.

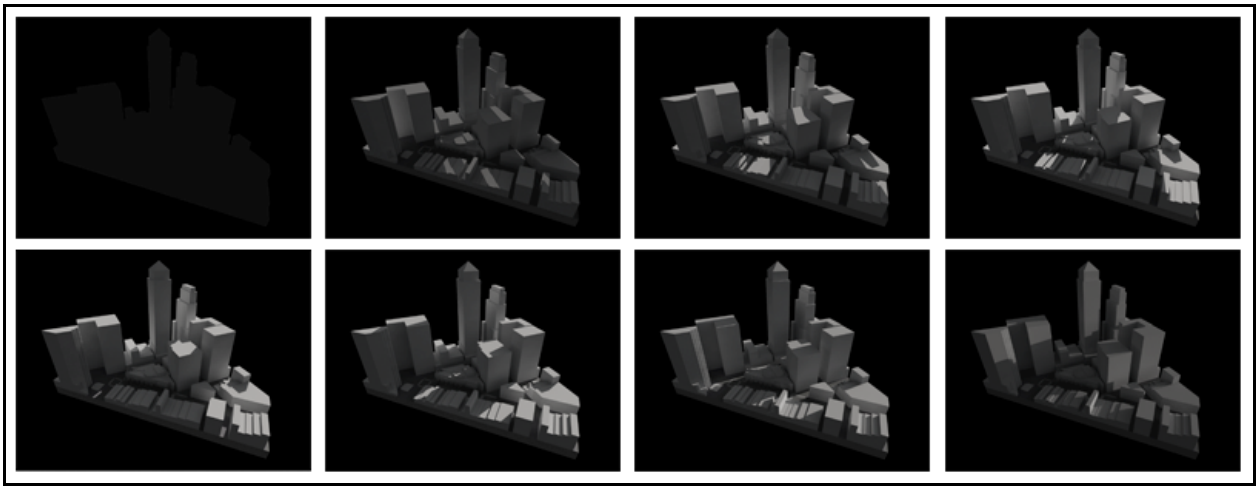

Figure 4.0.1 | December 21 Shadow Study

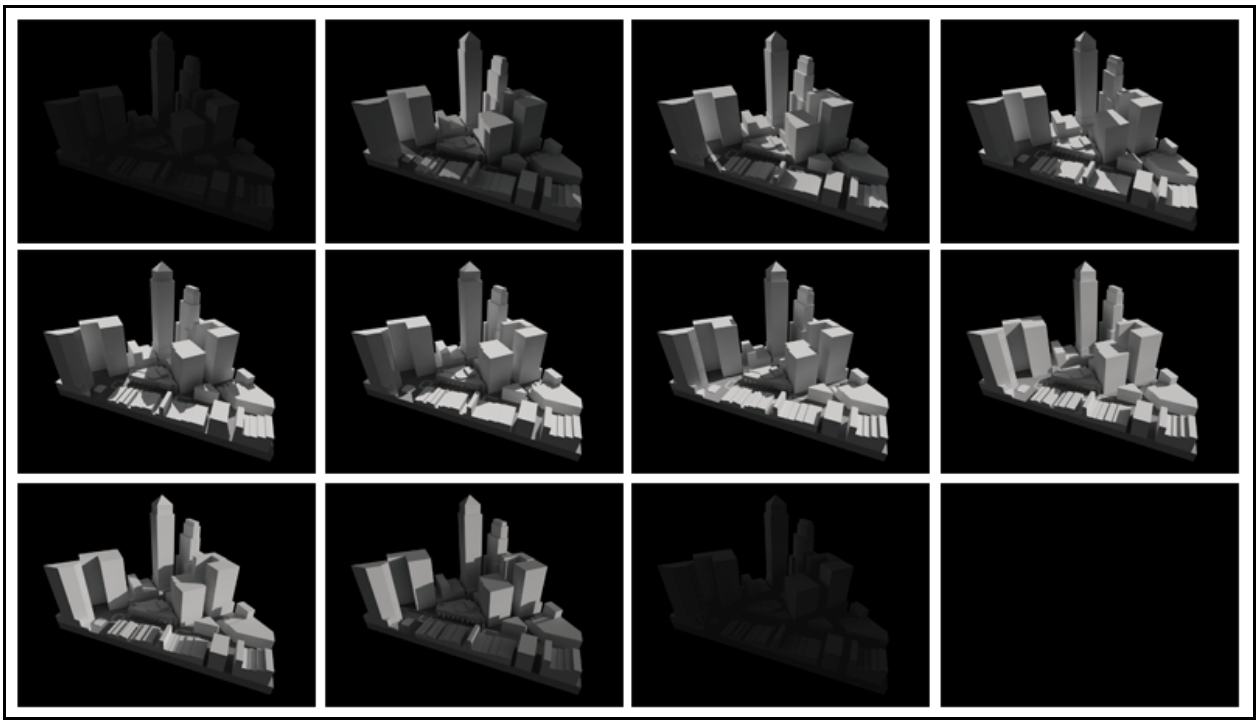

Figure 4.0.2 | March/September 21 Shadow Study

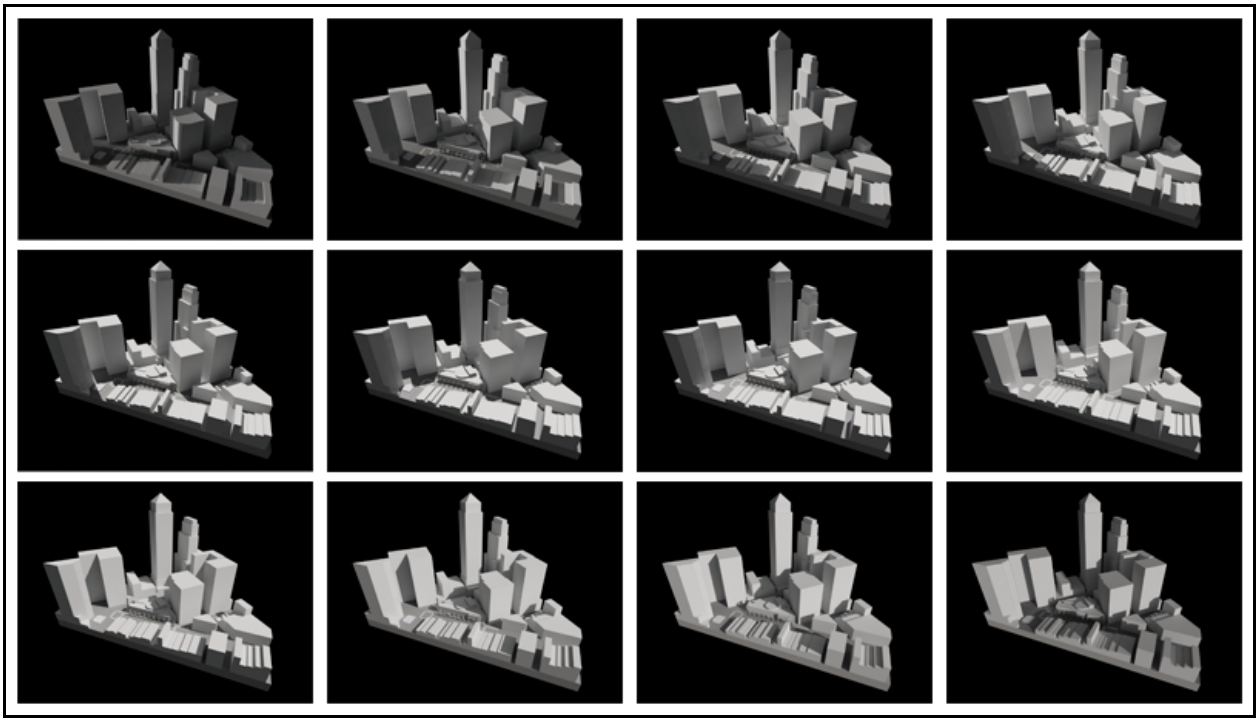

Figure 4.0.3 | June 21 Shadow Study

Figures 4.0.1, 4.0.2, and 4.0.3 show that the Liberty Avenue Façade receives very little direct sunlight. The only time that it does receive direct sunlight is very early in the day and very late in the day during the summer months. At these times the sun is very low, which results in the possibility that the direct

light would be blocked by buildings beyond the extents of the model. However, if it is not blocked, it will penetrate deep into the building creating the potential for harsh glare.

Despite the fact that very little direct light reaches the façade, a plentiful amount of daylight is able to penetrate the space. This is shown in figures 4.0.4 and 4.0.5. This cross section through the education room and the lower main lobby illustrates the daylight levels at midday on March 21st with an overcast sky. Since the glazing is north facing, this condition will provide some of the highest daylight levels. Because of the urban setting, however, sunlight reflected from buildings across the street will be an important consideration. This condition is not easily modeled because it relies heavily on the reflectance values of the building materials for the various surrounding buildings.

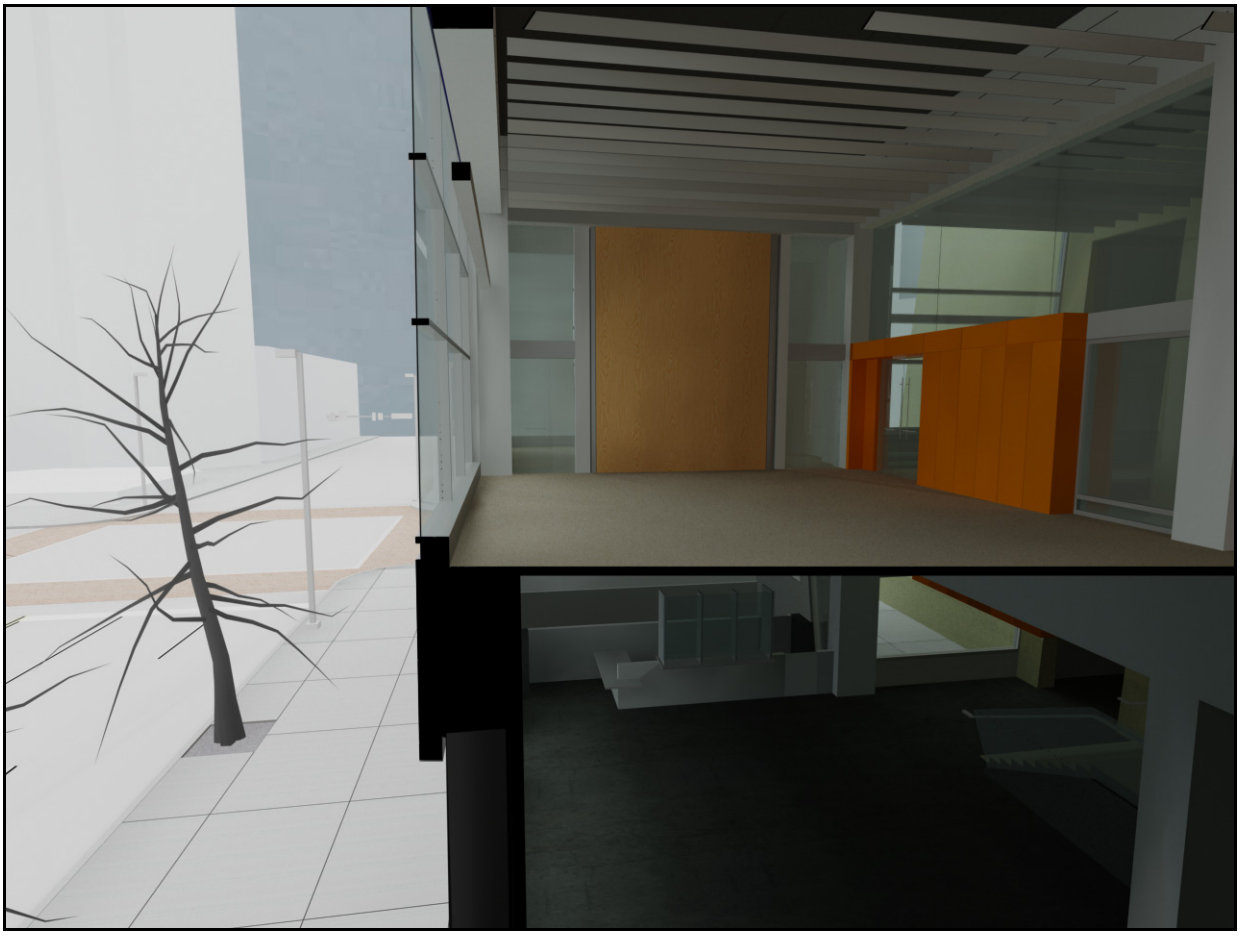

Figure 4.0.4 | Building cross-section rendered at midday on March 21 under an overcast sky. [Note: lower level ceiling baffles omitted for clarity]

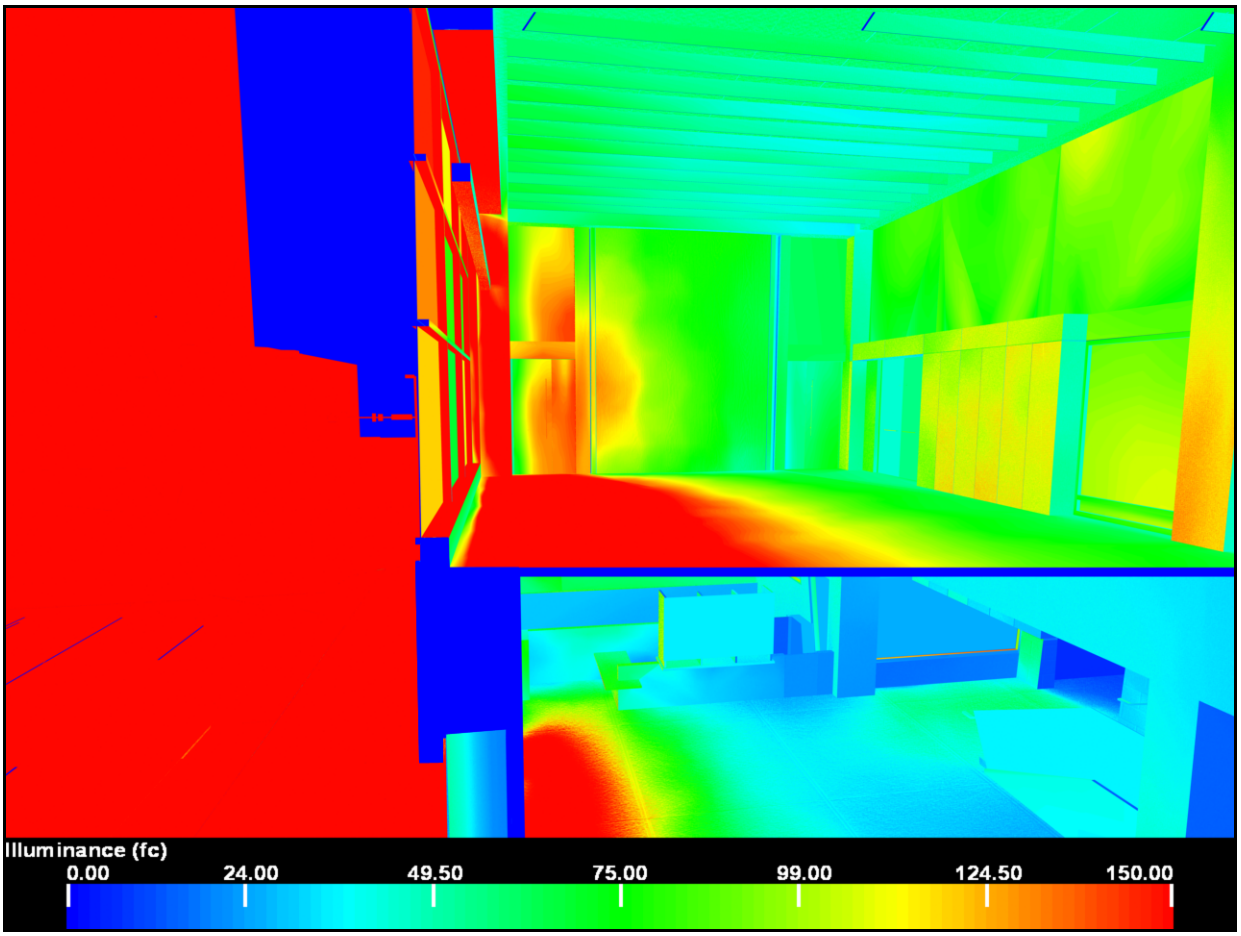

Figure 4.0.5 | Building cross-section rendered with pseudo color exposure at midday on March 21 under an overcast sky. [Note: lower level ceiling baffles omitted for clarity]

The daylight cross section illustrates that daylight is plentiful in the space on the north side of the building. The northerly orientation of the glazing will provide predominantly glare-free light. The difference between the upper level and lower level is quite significant. The ceiling height for the upper level is five feet higher than that of the lower level. Additionally, an overhang of approximately two feet exists for the lower level. These factors, as well as a lower floor reflectance, reduce the amount of daylight that is able to penetrate deep into the space.

For both the upper and lower levels, it is reasonable to conclude that photosensors could be employed to reduce energy consumption during daytime hours. Figure 4.0.5 shows that no electric light is required during the day to reach the desired illuminance levels discussed in the following sections. While these spaces are not ones that would be used on a typical working day schedule, therefore reducing the effectiveness of the photosensors in reducing energy consumption, they will be occupied at certain times during the day. With the new control scheme that has been designed for the building, the addition of photosensors will not require additional upgraded equipment other than the photosensors themselves. Thus, it is logical to provide this equipment even if the occupancy conditions are less than ideal.

1. LIBERTY AVENUE FAÇADE

***Description*:**

The Liberty Avenue façade is approximately 150' long and two stories (47') tall, making it appear very horizontal. It is punctuated by a sail shaped feature on the corner of Liberty Avenue and William Penn Place which forms the focal point of the building's exterior. The façade is book-ended on the opposite end by a protruding cube that cantilevers out from the plane of the façade by nine feet. Also at this end of the building is a small seating area outside the café which occupies the corner of Liberty Avenue and Smithfield Street. The façade sits approximately 25' back from the curb. A row of deciduous trees will run the length of the façade. Spaced approximately 35' apart, these trees are significant when viewing the façade. As the façade normal is oriented only a few degrees off of due north, it will almost always been in shadow. This is confirmed by shadow studies of the building site representing key dates of the year.

The crux of the liberty avenue façade is its function as a visual opening into the heart of the building. With clear glass as the predominant material, passersby will have a view into the building day and night. This condition is particularly relevant to the lighting design. This façade is at the heart of the architect's vision of a "conceptually transparent, flexible container."

***Surface Materials*:**

Material descriptions and assumed reflectance properties are available in Appendix E.

This façade is arranged in horizontal bands of clear curtain wall (MATERIAL GLZ-1) and aluminum composite panels (foamed in place) (MATERIAL MTL-3). Spandrels (MATERIAL GLZ-2) are used where necessary. The large sail structure is also clad with metal panels and glass but uses fritted glass for the top section (MATERIAL GLZ-5). It has a black stone base (MATERIAL STN-1).

Irregular façade features are faced with a different but visually similar metal panel system (MATERIAL MTL-1). Protrusions extending out the top of the building are surfaced in an exposed fastener profiled metal panel system (MATERIAL MTL-2). The far right section of the facade is faced with a concealed fastener metal panel system (MATERIAL MTL-4). The sidewalk in front of the building is the standard concrete that is required by the city of Pittsburgh.

Design Criteria:

Space Type: Building Exteriors – Prominent Structures

IESNA Very Important Criteria:

- Appearances of Space and Luminaires
- Light Distribution on Surfaces
- Light Pollution / Trespass
- Point(s) of Interest
- Reflected Glare
- Shadows
- Source/Task/Eye Geometry

Surface Characteristics
Category A (3 FC) Vertical Illuminance

IESNA Important Criteria:

Color Appearance (and Color Contrast)
Direct Glare
Modeling of Faces or Objects
Category B (5 FC) Horizontal Illuminance

IESNA Somewhat Important Criteria:

Peripheral Detection
Sparkle/Desirable Reflected Highlights

ASHRAE/IESNA 90.1 Regulations:

According to table 9.4.5, building facades are allowed 0.2 W/ft^2 for each illuminated surface or 5.0 W/linear foot for each illuminated wall. Also, building entrances and exits are allowed 30W/linear foot of door width (main entrances) or 20 W/linear foot of door width (other doors). For walkways 10' wide or greater and plaza areas, an allowance of 0.2 W/ft^2 is granted. Several exceptions are granted by section 9.4.5 but none are applicable to this project.

Pre-Design Criteria Analysis:

This façade is very important and prominent. Simply washing this surface would downplay the dynamic nature of the architecture and do little to create a signature appearance. Accentuating the sail feature at the end of the façade is a perhaps the most important consideration as it is the keystone of the design.

The placement of luminaires is also a very important consideration. Improper placement can create harsh glare and can also lead to light pollution. With taller buildings on adjacent sites, it is important to avoid stray light that may disturb neighbors. Placing luminaires in a way that does not clutter the clean lines of the architecture will be vital and a significant challenge for the sail feature.

It is very important to consider the overall effect that the lighting will have on the surrounding environment. Lighting to the appropriate level provides an inviting environment that will encourage visitors to the site. Lighting the sidewalk to levels that are too high will anger area residents as well as create a spotlight effect that may make pedestrians uncomfortable.

Design Goals:

1. Help to develop the signature nature of the design
2. Enhance integration between spaces as a response to the transparency of the façade
3. Create focal points to guide patrons and add visual interest
4. Define a 'theatre stage' theme which allows the building to interact with the streetscape
5. Help to define the various volumes of space

Design Approach:

1. Using the appropriate levels and punctuating the design with accents will help create a signature appearance. Most importantly, it is necessary to avoid a 'cheap' appearance such as a flat wash.
2. The interior luminaires will be equally as important to the appearance of the façade as the exterior luminaires. Placement and consistency throughout the building is paramount.
3. The sail feature is a natural focal point which can be accentuated with lighting. Additionally, pools of light based on proper luminance ratios will guide patrons to the entrances.
4. Allow the façade to become silhouetted by the light coming from within.
5. Using varying light levels and washing selected surface will highlight the theater drum volume and sail structure.

Schematic Design Images:

These images represent pre-design schematic concepts and are not necessarily representative of the final design.

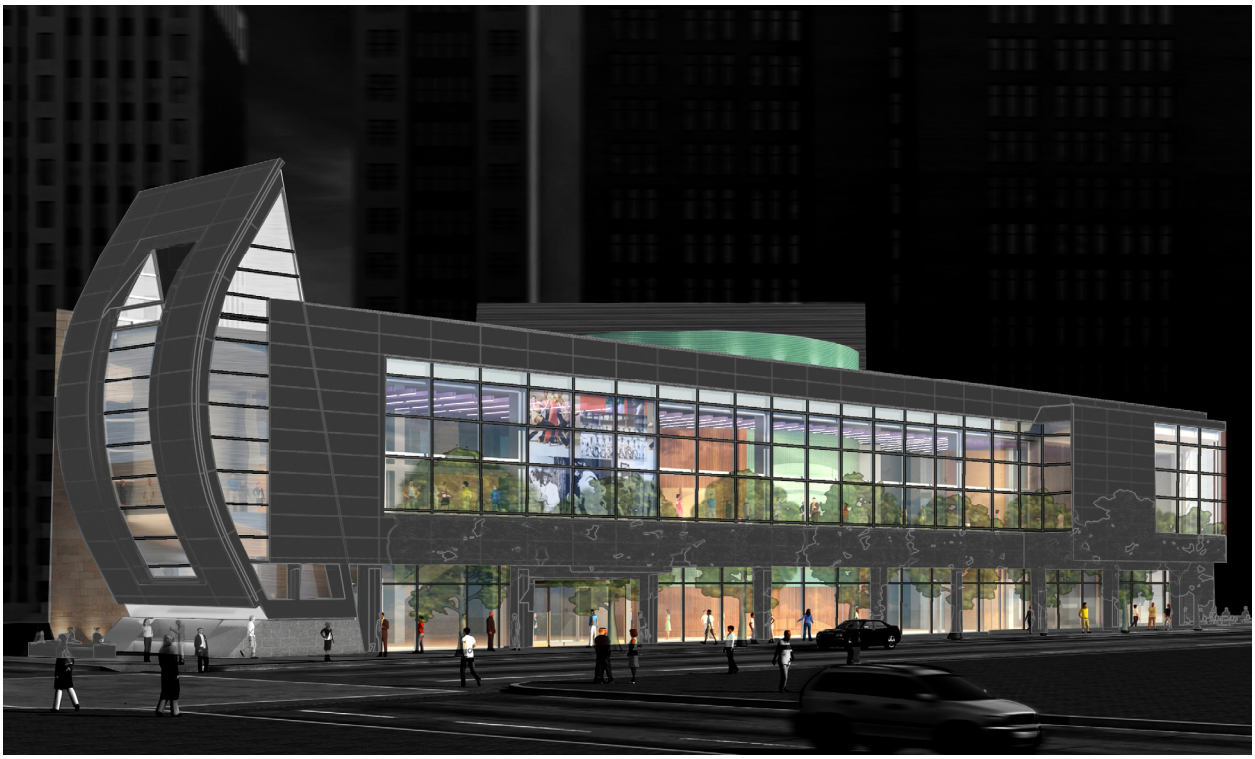

Figure 4.1.1 | Schematic Photoshop rendering showing the standard appearance of the building at night.

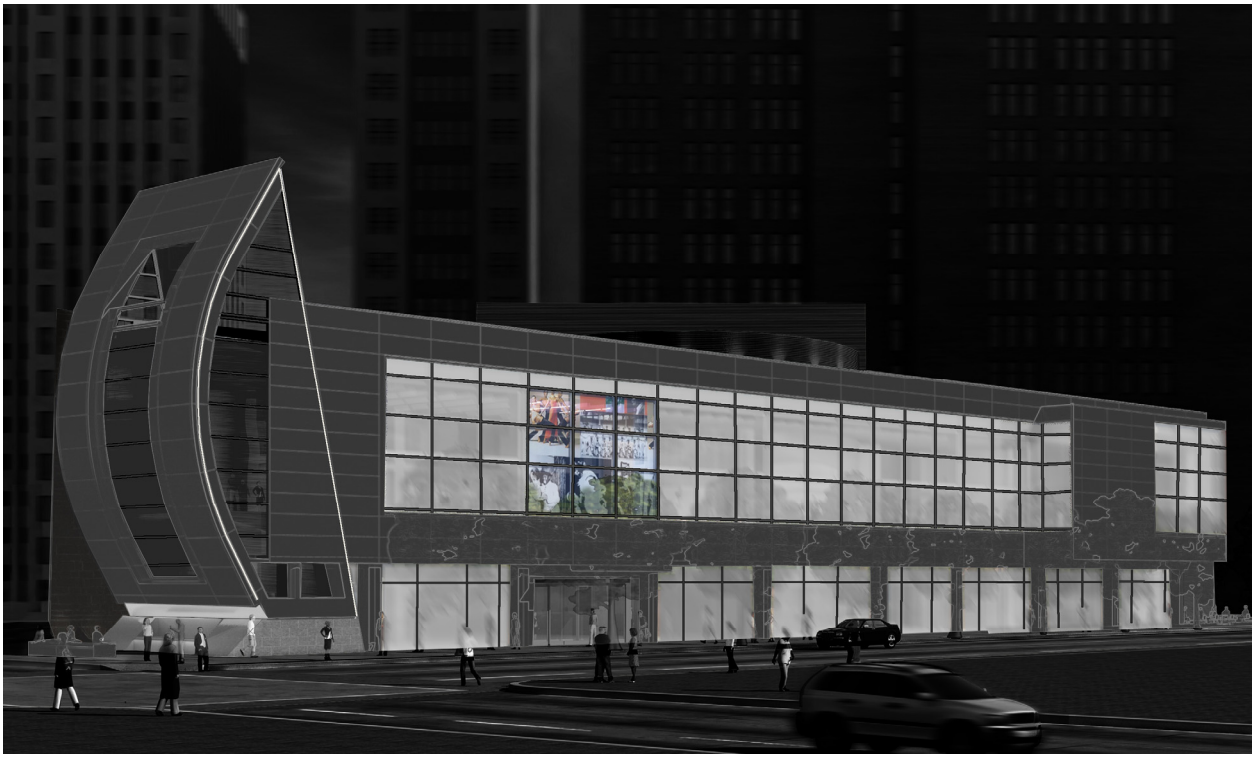

Figure 4.1.2 | Schematic Photoshop rendering showing the building after hours.

The Redesign:

The Liberty Avenue façade lighting system is divided into two scenes: one for use during standard operating times and a second for when the building is closed. The intent of this design is to highlight the transparency of the façade, allowing the occupants to serve as actors in a performance. The only exterior lighting fixtures that are used on this façade are a strip of color changing LEDs to further accentuate the sail and downlights to provide a higher illuminance at the main entrance, attracting and directing patrons. While few exterior fixtures are used, careful attention towards all the interior fixtures was absolutely necessary in order to achieve the desired appearance.

The second scene utilizes a small amount of light to accentuate building elements but clearly indicates that the building is not in operation. Color changing fixtures were used to allow various dynamic modes to correspond to varying events or holidays. This scene provides a distinct contrast to the standard lighting scheme.

One of the goals for this space was to highlight the various volumes of space that the architect has created. In creating schematic designs for this space, renderings from the architect were used. However, when the space was modeled to correct dimensions, it became apparent that the theater drum was not very visible by someone walking on the street. By incorporating lighting design goals into the design of a roof terrace (see Section Six | Architecture), the goals for the lighting design could be achieved.

Computer Renderings:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing. Full size images are available in Appendix D.

Figure 4.1.3 | View from Liberty Avenue during active lighting state.

Figure 4.1.4 | View from Liberty Avenue during un-active lighting state.

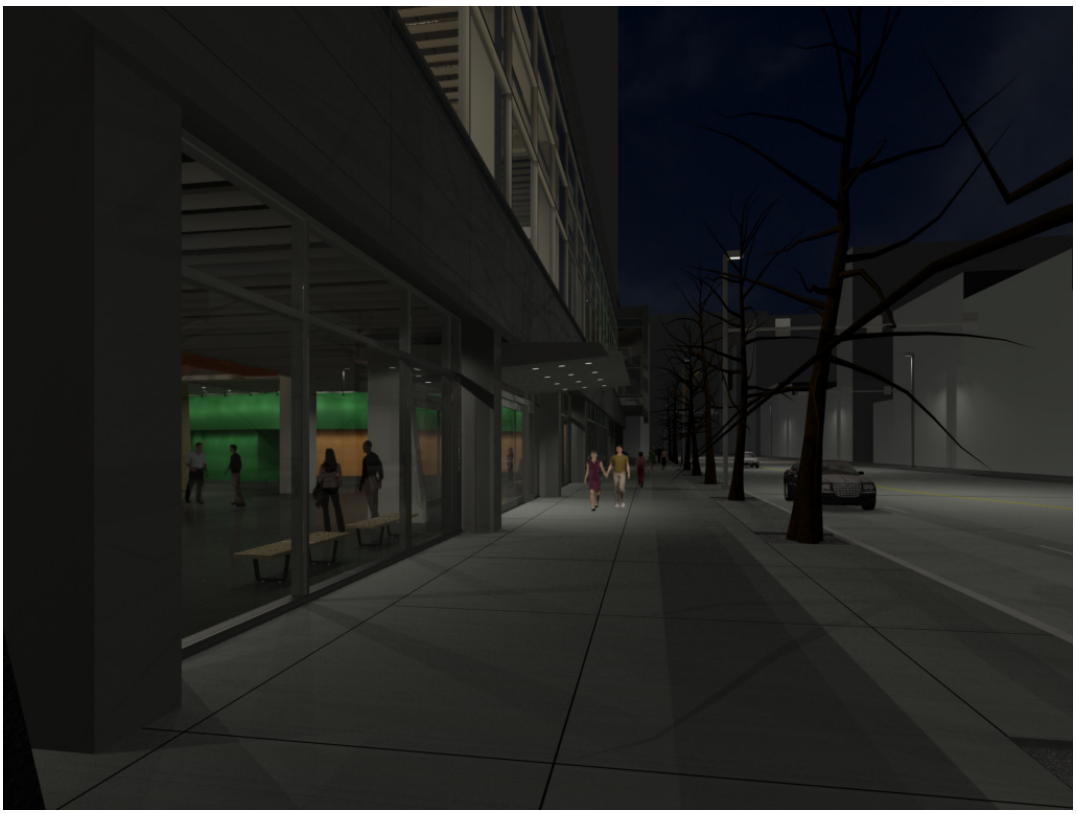

Figure 4.1.5 | View along Liberty Avenue during active lighting state.

Figure 4.1.6 | View along Liberty Avenue during un-active lighting state.

Luminaires:

[Note: The distinction of luminaires used for the façade is difficult to derive due to the nature of the design. The luminaires listed below are those whose primary function is related to the view from Liberty Avenue. The full luminaire schedule in Appendix A provides a more comprehensive listing. Product Information for luminaires, lamps, and ballasts is available in Appendix B.]

TYPE M: Exterior grade 7" Recessed Downlight (4); Main Entrance Canopy
TYPE N: Burial Uplight (5); Stone Wall
TYPE O: Flood Light (19); Exterior Theater Drum Fence
TYPE R: RGB LED Striplight (170'); Interior for Night Scene
TYPE S: RGB LED Striplight, Flexible (60'); Sail Outline

Controls:

All fixtures for the Liberty Avenue Façade are connected to Dimmer Rack DR101/201. Control for the color changing LED fixtures is provided by a DMX controller, allowing management to change the night scene colors to correspond to various events or holidays. Control for the façade lighting is via an architectural preset and dimming system located in the box office area. The location will limit access by patrons while serving as a logical central point of control. A full schedule of controls with accompanying specification sheets is provided in Appendix K.

Lighting Plans:

See Appendix B for scale lighting plans.

Performance Data Numerical Summary:

THEATER DRUM ILLUMINANCE, EXTERIOR:	30 FC
THEATER DRUM ILLUMINANCE, SECOND LEVEL:	30-40 FC (at maximum)
THEATER DRUM ILLUMINANCE, LOWER LEVEL:	30 FC (at maximum)
HORIZONTAL ILLUMINANCE LEVEL - TARGET | PROVIDED:	5 FC | 6 FC
ILLUMINANCE RATIO - TARGET | PROVIDED:	3:1 | 4:1 (Main Entrance to Surround)
NIGHT SCENE ILLUMINANCE ON SOFFIT:	9 FC
TOTAL NUMBER OF FIXTURES:	NA
TOTAL WATTS USED / ALLOWABLE:	NA
POWER DENSITY:	NA

Performance Data Images:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing with pseudo color exposure control as indicated.

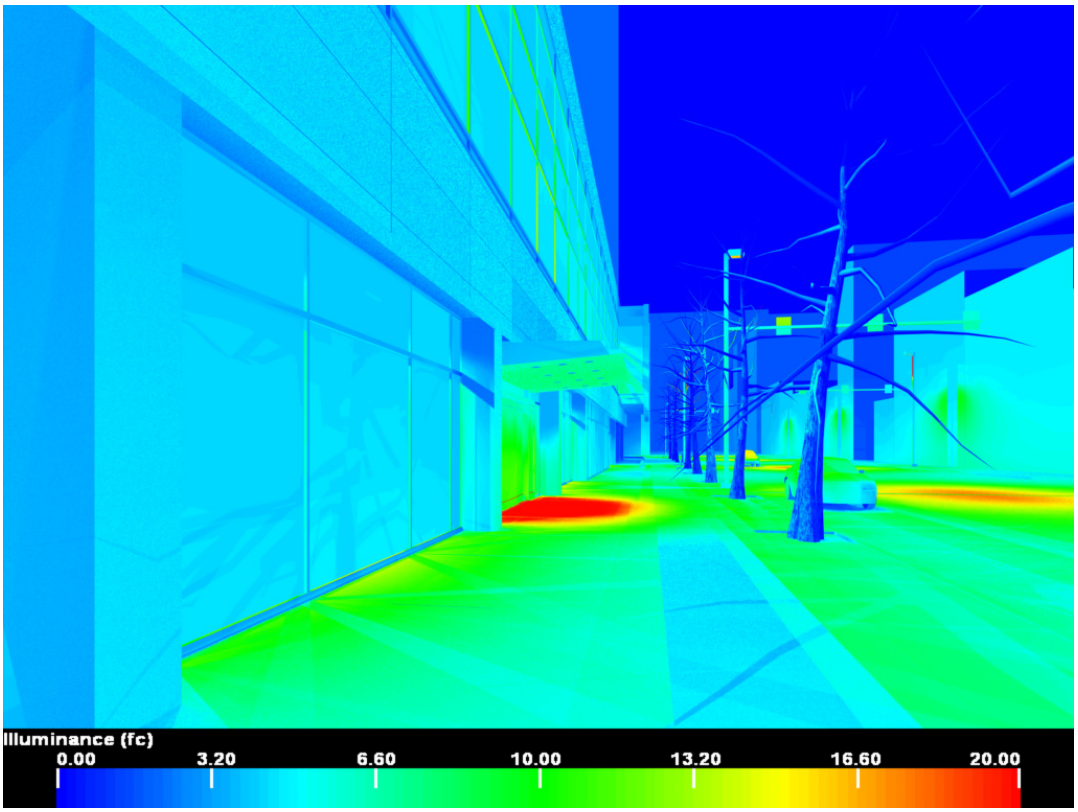

Figure 4.1.7 | Illuminance (fc) pseudo color exposure of view along Liberty Avenue [Note: glass does not appear transparent in images with pseudo color exposure.]

Summary Performance Evaluation:

While there are few fixtures dedicated to strictly lighting the façade, it was certainly one of the most complex challenges of this project. The transparency of the façade, a design feature emphasized by the architect, means that every space on the Liberty Avenue side of the building effects the impression of the building from the exterior. Thus, the 'Liberty Avenue Façade' design is more a result of the design of other spaces. The transparency and intersecting volumes of space dictate a uniform luminance be achieved on multiple surfaces with varying luminaires in order for the façade view to have a sense of continuity. This situation most notably occurs with the theater drum, on which the design is fairly successful in achieving a uniform illuminance (and luminance based on similar reflectance properties) of 30 footcandles.

The sail feature also provided a significant challenge. The shape itself makes it impossible to illuminate the surface without using a complex array of poles to mount fixtures at different locations. Even with poles, uniform illumination may be impossible. Therefore, I chose to accent this signature element with a strip of LED lights while also illuminating the interior ceiling with indirect pendants during the active scene. While this solution does not provide the punch that illuminating the sail itself would, it is a more practical solution that is comfortable for the patrons both inside and outside the building.

From the earliest schematic designs, it was a goal to create two scenes that alternate to illustrate the theatrical nature of the building. The final design also utilizes two scenes, but it is notably different from the schematic design. The original goal was to incorporate the shading system into the night scene to provide a soft uniformity to the transparent areas, contrasting the depth and openness of the active scene. In pursuing this design, it became apparent that this would require too many fixtures and too many watts to be of interest to the owner who would have to pay for the system. Instead of abandoning the idea, a simpler system was developed that integrates with an existing beam and soffit on the second level. By uplighting the white soffit, a unique pattern is created that is distinctly different from the active scene.

Another item from the schematic design that required changes was the illumination of the theater drum fence on the roof. As noted, from the renderings provided by the architect, it appeared that this surface would be visible from the street. When it became apparent that this surface was only slightly visible, the alteration of this surface became an essential piece of the architecture study of adding a roof terrace. Once the changes were made, the continual illumination of the theater drum became possible and became a powerful core element of the façade design.

Overall, the façade design is inherently reliant on the architect's vision for the building which may or may not have considered the integration of the lighting system. Based on the circumstances, I feel the design is successful and while not explicitly achieving all of the schematic design goals, it does provide solutions to the challenges presented.

2. MAIN LOBBY

Description:

The lobbies, both on the upper and lower levels, act as the main circulation core for the building. From the main lobby on the first floor, one can reach the permanent exhibit space, theater, gift shop, box office, and the main grand staircase to the second level. It totals 4,429 square feet of irregularly shaped space that is defined by surrounding spaces rather than walls. The lobby runs most of the length of the Liberty Avenue façade, approximately 120'. An open plenum ceiling exists through much of both the first and second level lobbies.

The most notable design element in this space is the large elliptical wall that forms the back of the theater space. This 'drum,' can be seen as a volume from the exterior that protrudes through the first and second levels and out the roof of the structure.

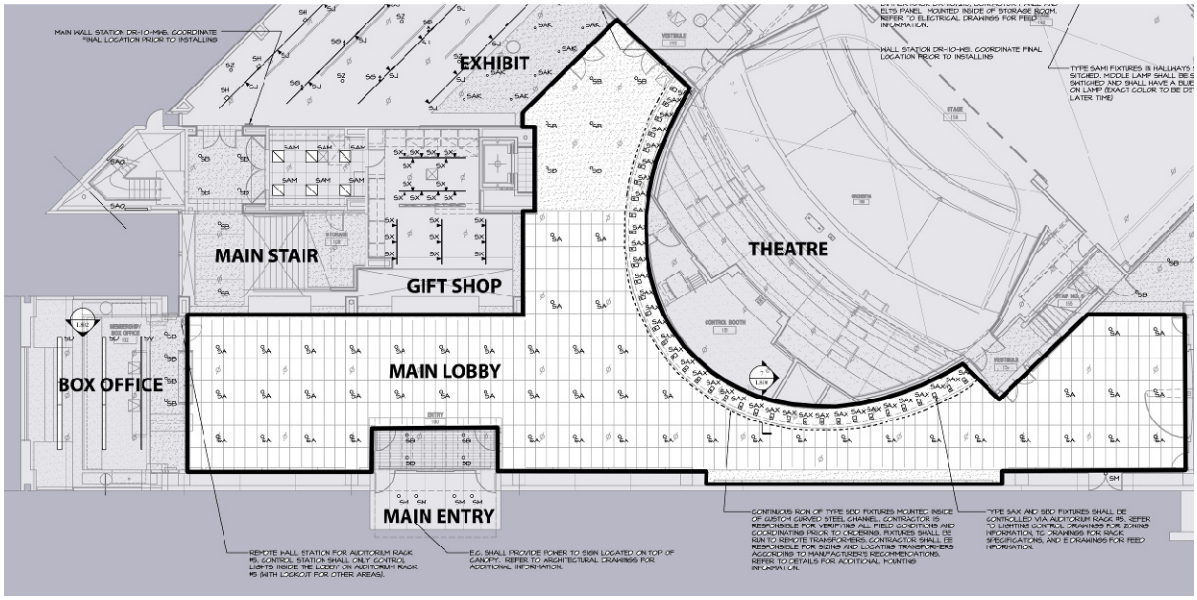

Figure 4.2.1 | Schematic view of the main lobby.

***Surface Materials*:**

Material descriptions and assumed reflectance properties are available in Appendix E.

The true definition of materials for this space relies heavily on adjacent spaces. In general, the floor is a finished concrete (MATERIAL CONC-2) while the ceiling is a combination of an open 4' by 4' black grid with 8" metal baffles running perpendicular to the Liberty Avenue facade spaced every 2'. The baffles hang (MATERIAL XPC-1) at approximately 14'-6" above the finished floor. Above the grid system is the structure which is covered with black acoustical blanket, as well as mechanical systems which are painted black (MATERIAL PT-2).

The grand staircase, on the south end of the space, is framed by a multi-story stone wall, comprised of three types of stone (MATERIALS STN-1, STN-2, STN-3). The main walls are painted white (MATERIAL PT-1), while accents are metal (MATERIALS MP-1, MP-2) and wood (MATERIALS WD-1, WD-2). The north wall is almost entirely curtain wall (MATERIAL GLZ-1). Shades are not provided

for this glazing. The prominent theater drum is painted green (MATERIAL PT-5) with sections of wood (MATERIAL WD-2).

Furnishings:

No furnishings are currently specified by the architect as they are under a separate contract. Where applicable, benches have been modeled as seen fit.

Design Criteria:

Space Type: Offices – Lobbies, Lounges, and Reception Areas (IESNA Chapter 15)

IESNA Very Important Criteria:

Appearances of Space and Luminaires

IESNA Important Criteria:

Color Appearance (and Color Contrast)
Direct Glare
Light Distribution on Surfaces
Luminances of Room Surfaces
Modeling of Faces or Objects
Surface Characteristics
Category A (3 FC) Vertical Illuminance (at the entrance)

IESNA Somewhat Important Criteria:

Daylighting Integration and Control
Flicker (and Strobe)
Reflected Glare
Shadows
Category C (10 FC) Horizontal Illuminance

ASHRAE/IESNA 90.1 Regulations:

According to table 9.6.1 a lobby for a performing arts theater has an LPD (W/ft^2) of 3.3. This is much higher than other types of lobbies which have an LPD of 1.1. Additionally, section 9.6.3 allows for an additional 1.0 W/ft^2 for lighting installed for decorative appearance.

Pre-Design Criteria Analysis:

The IESNA recommendations are accurate in suggesting that the appearance of the space and luminaires is very important for this space. As the main lobby, everyone will see this space and thus the lighting must accentuate the style of the architecture.

The IESNA Illuminance levels, based on an office lobby, are too low for this space. Looking at recommendations for theater lobbies, the 20 footcandle level is more appropriate. Phototropism, or the tendency for humans to be attracted to brighter areas, is certainly important. Creating points of interest will draw patrons to the building and to the different spaces within.

The IENSA also recommends general illuminance levels before and after performances to be 5-15 footcandles. Therefore, I believe this space needs to be flexible in order to provide proper conditions depending on the function that is occurring at the time. This space is not only the lobby for the theatre, but also for the galleries, gift shop, and café. This all indicates an advanced control system is necessary.

It is important that the lighting in this space creates a relaxed environment to welcome patrons. Layers of light can be used to create a variety of conditions that may be controlled with a preset system. A relaxing environment can be created with non-uniform and peripheral lighting. This mood will be created by highlighting the points of interest within the space. The ticket booths should be highlighted to draw the attention of patrons. Higher illuminances in the gift shop will make it another point of interest. The large curved wall that forms the back of the theatre can also be highlighted to create a visual centerpiece for the lobby.

Design Goals:

1. Create a relaxing and welcoming environment
2. Draw patrons to points of interest
3. Flexibility for various uses of the building and of the lobby
4. Smooth and appropriate transitions to surrounding spaces
5. Energy efficiency

Design Approach:

1. Use layers of light that draw focus to perimeter focal points.
2. In synergy with design approach one, the perimeter emphasis that creates a relaxing environment will draw patrons to the points of interest.
3. The control system will be instrumental to the success of the design. By utilizing dimming, the space can be illuminated to the desire level based on the current building use.
4. A smooth transition can be created by using similar systems throughout the spaces. This relates to the overall goal of building integration.
5. The use of photo sensors integrated with the control system will save energy when ample daylight is available due to the plentiful glazing. Glare will not be a problem since it is north facing. It will not be a large increase in cost because dimming is already being used to meet other goals.

Schematic Design Images:

These images represent pre-design schematic concepts and are not necessarily representative of the final design.

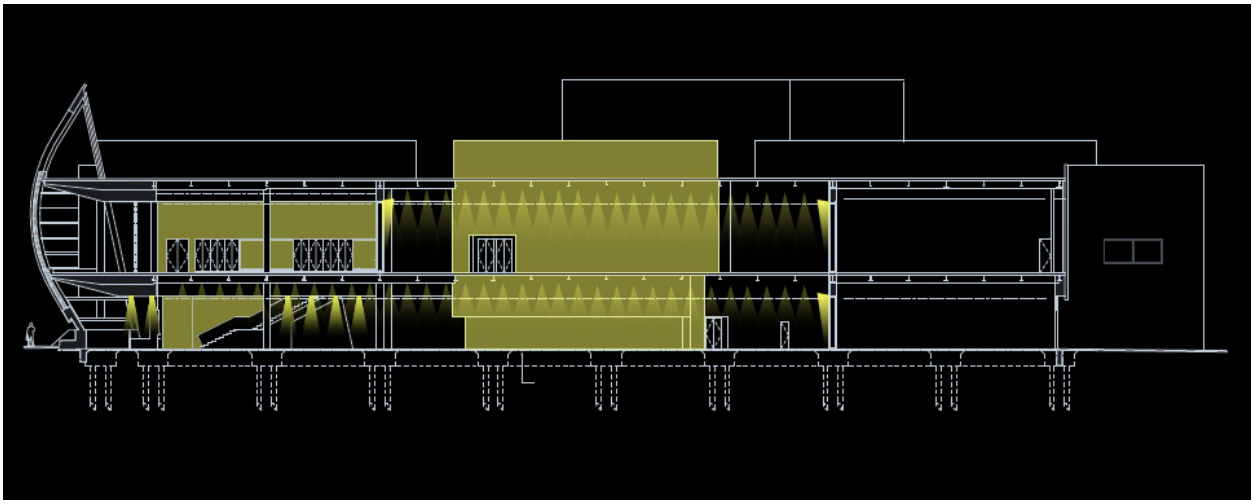

Figure 4.2.2 | Schematic section of the lighting in the lower and upper lobby areas.

The Redesign:

The key elements of the lobby lighting scheme are actually the areas surrounding the lobby. In the lobby itself, regular arrangements of inconspicuous linear luminaires integrate with the metal baffle ceiling, providing adequate lighting for a theatrical lobby. The key elements which extend through both the lower and upper lobbies, the drum and the stone wall, are washed to high levels to clearly define them for the exterior viewing condition and to create points of interest. Along with redesigning the main lobby lighting system, the adjacent spaces which are essential to the design were changed as necessary. These spaces include the box office, gift shop, grand staircase, vestibule, and upper lobby. While these spaces are not specifically documented as a redesigned space, they are visible in the computer renderings and are included in the fixture schedule and lighting plans.

Computer Renderings:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing. Full size images are available in Appendix D.

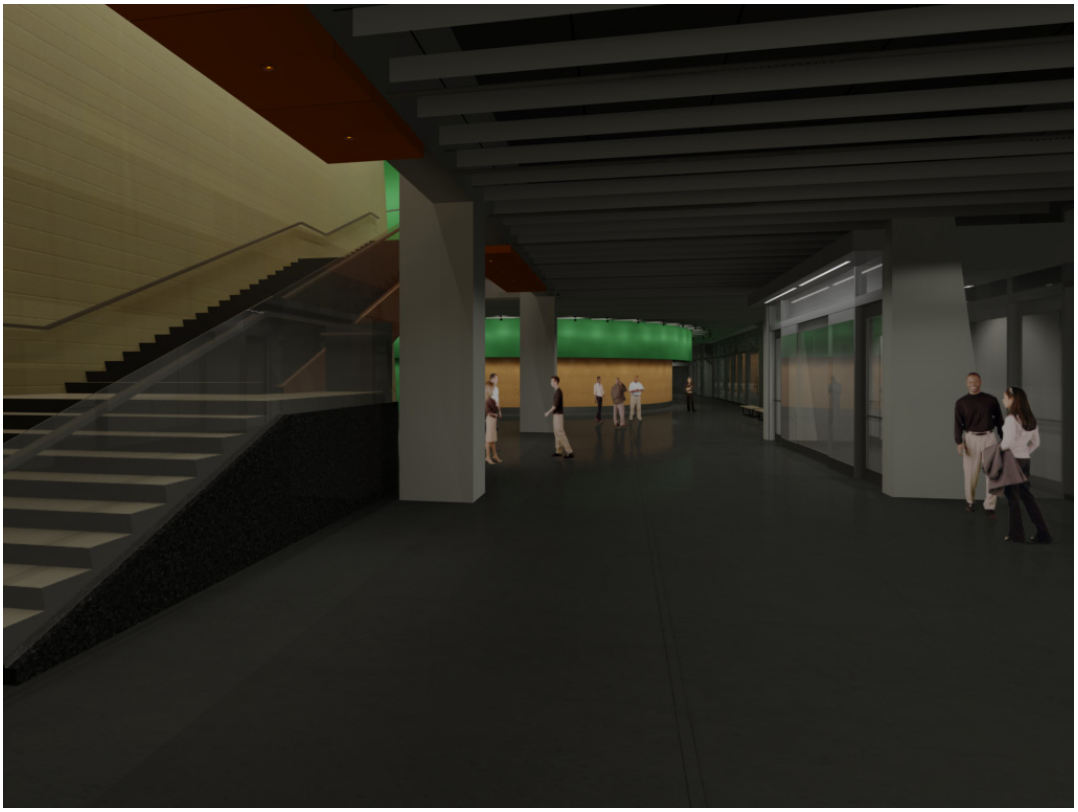

Figure 4.2.3 | Lower Lobby looking west.

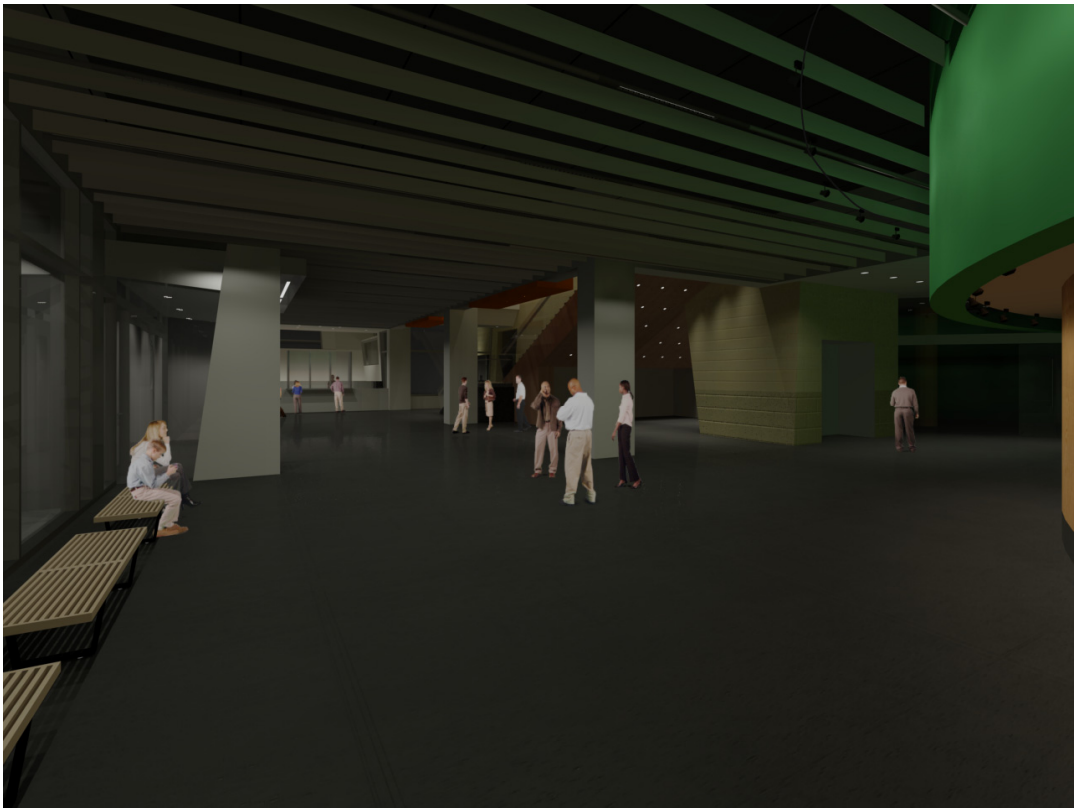

Figure 4.2.4 | Lower Lobby looking East

Figure 4.2.5 | View of grand staircase from the bridge.

Figure 4.2.6 | View of Upper Lobby from the top of the grand staircase.

Luminaires:

TYPE B: Linear Fluorescent Downlight (40); General Downlighting
TYPE D: Halogen Track Head on Curved Track, Flood Optic (50); Theater Drum Wash
TYPE E: 7" Compact Fluorescent Recessed Downlight (15); General Downlighting
TYPE F: Compact Fluorescent Pendant (4); General Downlighting
TYPE H: MR16 Pinhole Downlight (7); Downlighting Under Cabinets from Above
TYPE G: Lensed Linear Fluorescent Slot (2); Accent at Main Entrance

A full luminaire schedule, light loss factor calculations, and power density information can be found in Appendix A. Product information for luminaires, lamps, and ballasts can be found in Appendix B.

Controls:

The entire lobby system, as well as the key adjoining spaces, are connected to a single dimmer rack, DR101/201 and are controlled from a central wall station located in the box office area. This simple setup allows for easy management of many lighting systems from one central point. An additional wall station is provided for the Gift Shop to allow for precise control as necessary. This control system creates a flexible lighting system, satisfying one of the goals for the design.

Lighting Plans:

See Appendix B for scale lighting plans.

Performance Data Numerical Summary:

ILLUMINANCE LEVEL - TARGET | PROVIDED:	20 FC |22 FC (at maximum light output)
LUMINANCE RATIO, THEATER DRUM:	3:1
LUMINANCE RATIO: BOX OFFICE:	3:1
LUMINANCE RATIO, GIFT SHOP:	2:1
POWER DENSITY – ALLOWABLE | ACTUAL:	3.3 W/SF | 1.07 W/SF

Performance Data Images:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing with pseudo color exposure control as indicated.

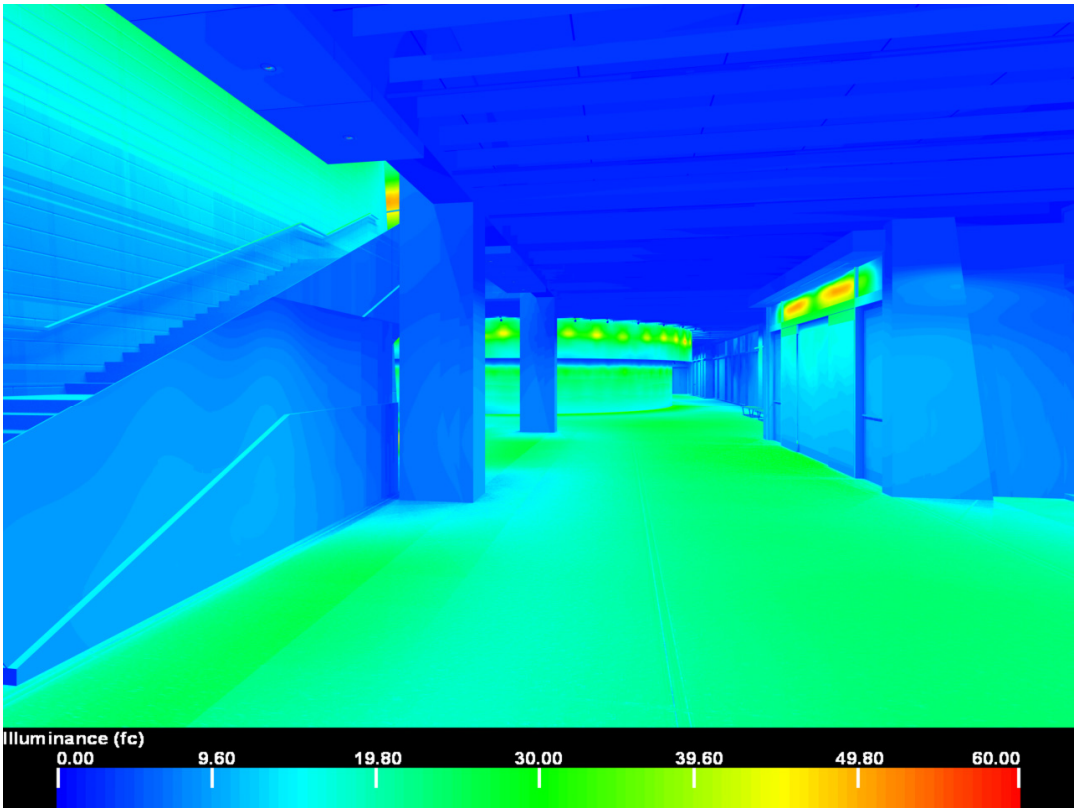

Figure 4.2.7 | Illuminance (fc) pseudo color rendering of the Lower Lobby looking west.

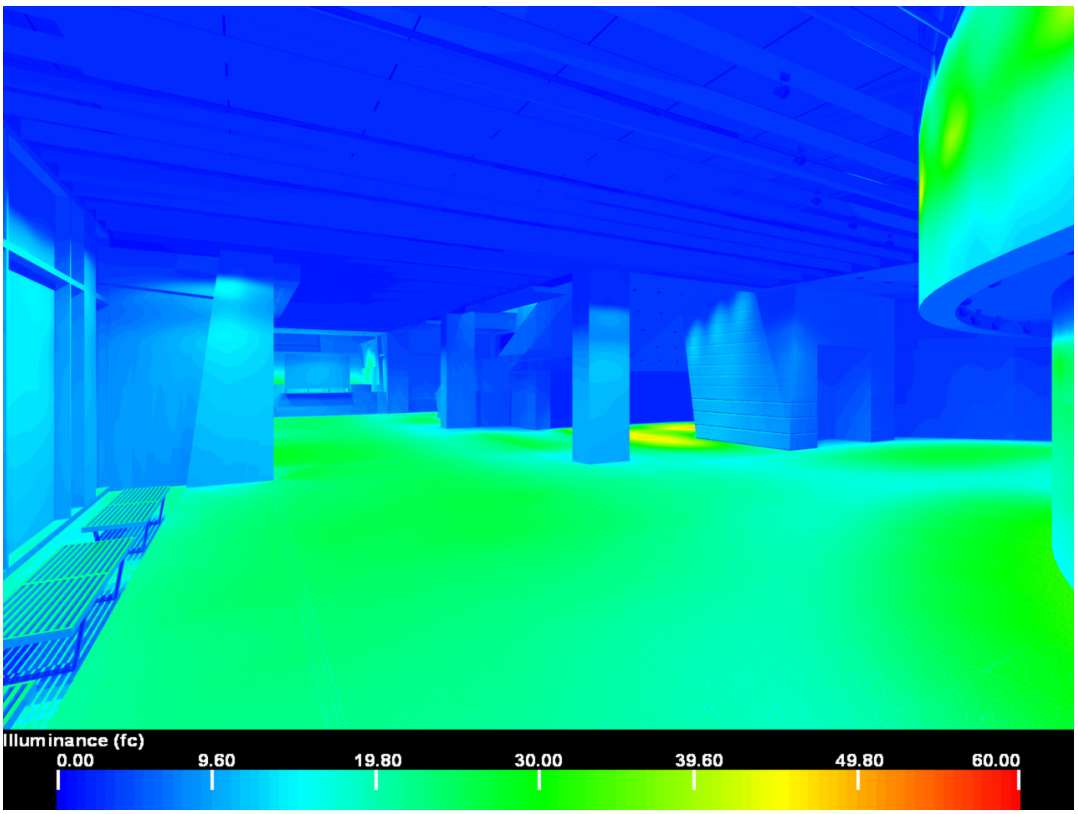

Figure 4.2.8 | Illuminance (fc) pseudo color rendering of the Lower Lobby looking east.

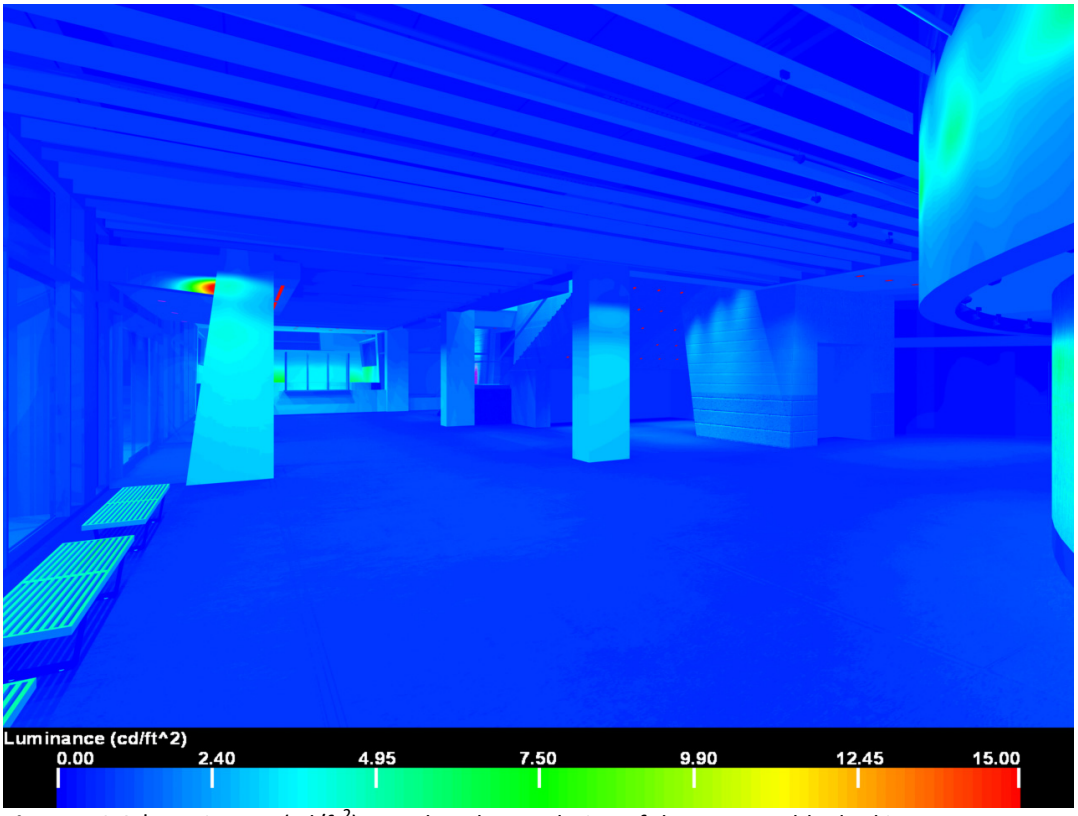

Figure 4.2.9 | Luminance (cd/ft^2) pseudo color rendering of the Lower Lobby looking east.

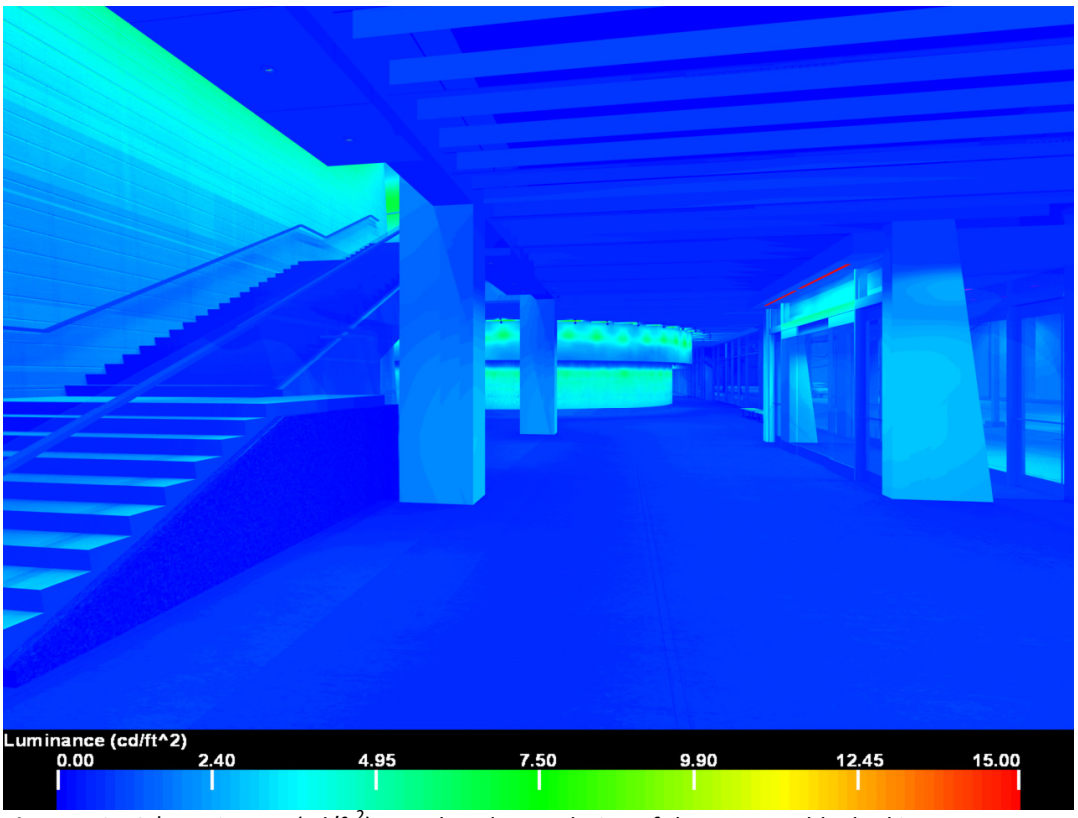

Figure 4.2.10 | Luminance (cd/ft^2) pseudo color rendering of the Lower Lobby looking west.

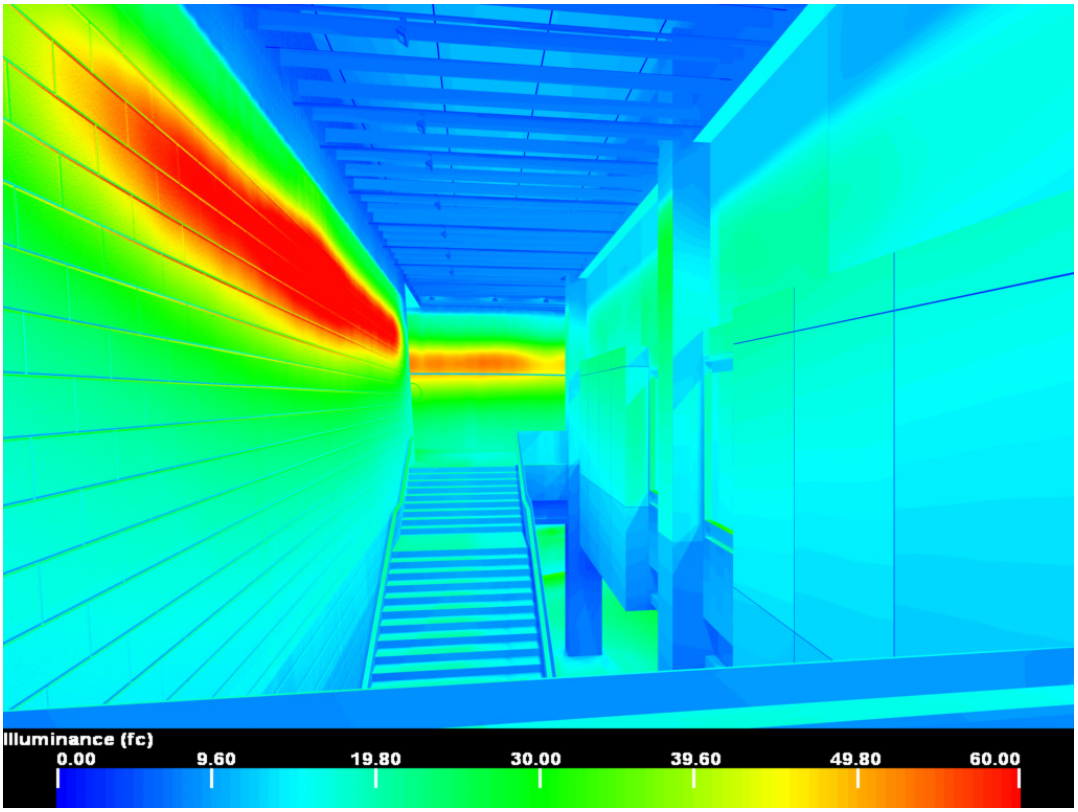

Figure 4.2.11 | Illuminance (fc) pseudo color rendering of the grand staircase looking from the bridge.

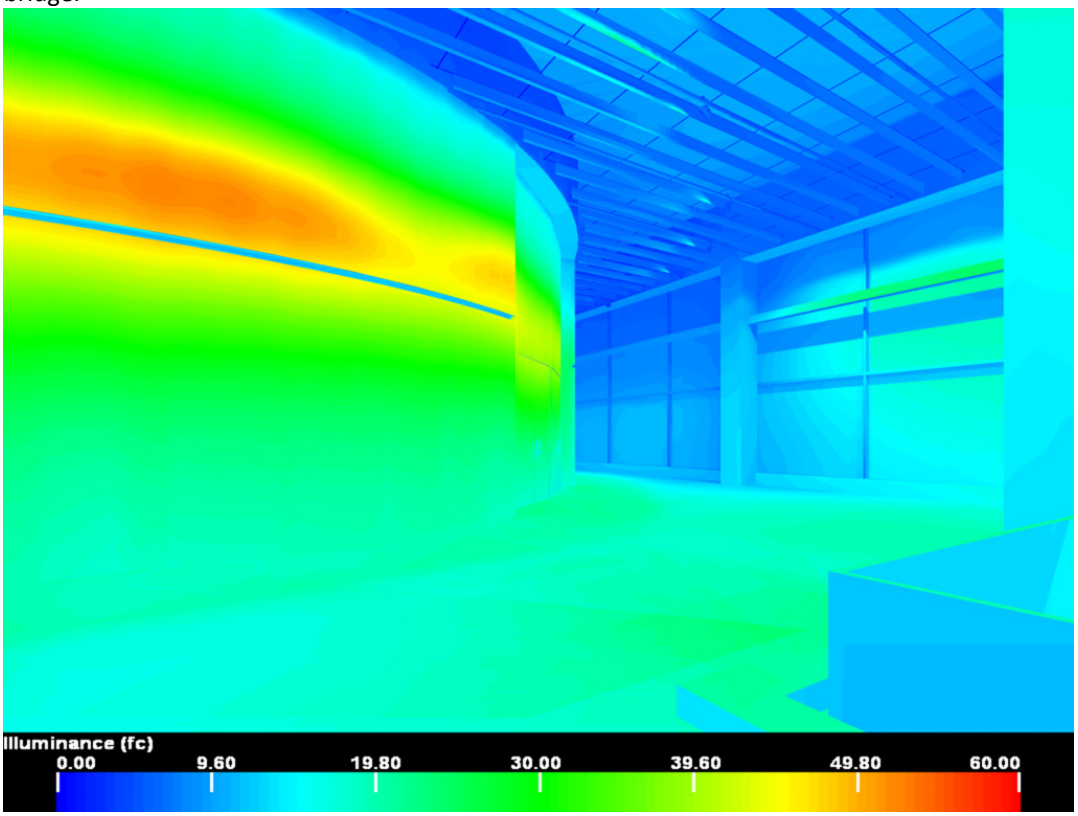

Figure 4.2.12 | Illuminance (fc) pseudo color rendering of the Upper Lobby from the top of the grand staircase.

Summary Performance Evaluation:

The lobby areas, both upper and lower, comprise a large portion of the building and their unique, undefined boundaries make the relationship between the lobby lighting and lighting of the surrounding spaces critical. The ceiling system employed in the lobby and into other spaces in the building also is very restrictive to the selection of luminaires. Furthermore, on the first floor, the very dark floor is a particular characteristic that influences the lighting design.

Creating a relaxing environment is more difficult when it isn't possible to provide any indirect lighting from the ceiling. In a compromise, discreet linear fixtures provide general lighting that isn't too harsh to walk under. The fixtures also have a favorable cut-off angle which limits the visibility of the lamp. Combined with a strong emphasis on perimeter lighting, this space should be comfortable for gathering before a performance. The control system allows for the high level of flexibility that will be required in this space. As a theater lobby, light levels must be critically controlled to provide a comfortable level and transition for patrons entering a very dark space. Furthermore, theater lobby lights are often used as a signal to indicate the start of a performance. The dimming and control system that is specified will allow for these cues to be made.

While normally a very dark floor would hinder achieving proper illuminance levels, the floor in the lower lobby aides in achieving contrast ratios that will draw patrons to points of interest. Generally, these ratios are about three to one, an acceptable value. The main entrance is also accented by lensed linear downlights above the doors to draw attention to this key location that is otherwise unremarkable.

While ASHRAE Standard 90.1-2003 allows for 3.3 W/SF for a theater lobby, this very high number seems excessive. This space has been designed at a power density of 1.07 W/SF, less than a third of the maximum allowable value. As a project seeking LEED accreditation, this provides significant energy savings and will allow for other areas with more complicated lighting schemes to exceed allowances, if necessary.

The light design for the Lower Lobby is notably effective in achieve the goals for the space. All levels and ratios are achieved at a power density far below the ASHRAE standard.

3. EDUCATION AND LECTURE ROOM

Description:

The education and lecture room is an approximately 64’ by 32’ rectangular room located on the north side of the second level. The main entrance is from the second level lobby through either two standard doors or a large, mechanically operated pivot door. A second means of egress is provided via a bridge to a separate egress stairwell. The space is almost completely transparent with large amounts of glazing on all sides. As all the glass is clear, this transparency exists both looking into the space and looking out of the space. All of the glass can be covered with mechanically operated black-out shades.

The meeting room is accessed directly from this space, meaning it will partially function as a circulation space. Access to the meeting room is provided via two glass doors as well as another mechanically operated pivot door.

The south wall features built-in cabinets which break the plane of the glass wall. These provide storage as well as a kitchen sink. The room will primarily be used for lectures and presentations. Retractable presentation screens are available on both the east and west walls.

***Surface Materials*:**

Material descriptions and assumed reflectance properties are available in Appendix E.

North Wall: The north wall is an exterior wall which is entirely curtain wall (MATERIAL GLZ-1). A painted gypsum board soffit (MATERIAL PT-1) houses a recessed window shade. Three structural columns are finished with gypsum board (MATERIAL PT-1) while a beam running the length of the space at approximately 12' above the finished floor is shielded by a formed metal cover. Radiant heaters are located along the base of this wall.

South Wall: The south wall is a combination of red/orange painted casework (MATERIAL PT-3) and glazing (MATERIAL GL-1). The casework surfaces extend approximately 18” into the room, adding depth to the wall. The glass looks into the grand staircase and onto a stone wall beyond.

West and East Walls: The west and east walls, which are identical, are predominantly a massive, mechanically operated pivot door with a slightly curved wood face (MATERIAL WD-2) and metal trim (MATERIAL MP-2). A column on either side of the door is finished with gypsum board (MATERIAL PT-1). Also to either side is a glass passage door in a glass partition wall (MATERIAL GL-2).

Ceiling: A ceiling grid hangs at 19'-6” above the finished floor. The grid consists of a 4’ by 4’ black square grid as well as 8” metal baffles spaced 2’ apart that run perpendicular to the Liberty Avenue façade . The bottom of the structure above is covered in black acoustic blanket. The ductwork is left exposed and is painted black (MATERIAL PT-2).

Floor: The floor is carpeted (MATERIAL CPT-1) wall-to-wall.

Furnishings:

The room is furnished with stackable chairs that could be removed if necessary. They are oriented in rows facing the east wall.

Design Criteria:

Space Type: Educational Facilities – Lecture Halls – Audience (Reading – Printed Tasks)

IESNA Very Important Criteria:

Reflected Glare

IESNA Important Criteria:

Category D (30 FC) Horizontal Illuminance

IESNA Somewhat Important Criteria:

Shadows
Source\Task\Eye Geometry
Light Distribution on Task Plane (Uniformity)

ASHRAE/IESNA 90.1 Regulations:

Table 9.6.3 allows for and LPD of 1.4 W/ft^2 for classroom / lecture / training rooms. An additional 1.0 W/ft^2 can be used strictly for decorative lighting.

Pre-Design Criteria Analysis:

Very few criteria are listed for this type of space. In general, the design must be efficient while avoiding problem situations with glare or non-uniformity. The IESNA recommends 30 horizontal footcandles for a reading area (printed tasks). This lecture room may have a more varied range of activities, however, so providing the flexibility to raise illuminance levels above or below the target value would be advisable.

After uniformity, the most critical aspect of the lighting for this space is the integration and control of daylight. With one entire wall of this space being north facing curtain wall, glare-free daylight is available to reduce electric lighting load. However, it is also important to consider that this light could be unwanted during a presentation. Thankfully, black-out shades are specified by the architect. Daylight harvesting will work hand-in-hand with the dimming flexibility that is required of this space due to the multiple functions it may serve.

Since it is an educational space, visual clarity should be a primary concern. Achieving this will involve eliminating or reducing glare and ensuring proper levels for the task plane. A 'clean' design will also contribute to an impression of visual clarity. As an upscale space, another factor not listed by the IESNA that is important to consider is the appearance of the luminaires.

Keeping with the overall goals, it is very important that this space integrates well with its adjoining spaces, the second level lobby and the meeting room. A continuity of luminaires from space to

space will help maintain a consistent appearance from the exterior as well as maintaining a clean visual appearance inside since the space boundaries are transparent.

Design Goals:

1. Create visual clarity
2. Provide even and adequate light to the work plane
3. Design a flexible system for varied presentations and activities
4. Use controls to allow the system to respond to the environment
5. Match the existing room aesthetics and compliment the baffle system

Design Approach:

1. Utilize a uniform layout of direct luminaires with peripheral emphasis
2. Ensure proper levels through numerical verification
3. Utilize aimable fixtures and circuit fixtures in proper zones to allow for proper scene control
4. Use a dimming system and daylight sensors to maximize energy savings
5. Use a thin linear fixture with a modern and stylish appearance

Schematic Design Images:

These images represent pre-design schematic concepts and are not necessarily representative of the final design.

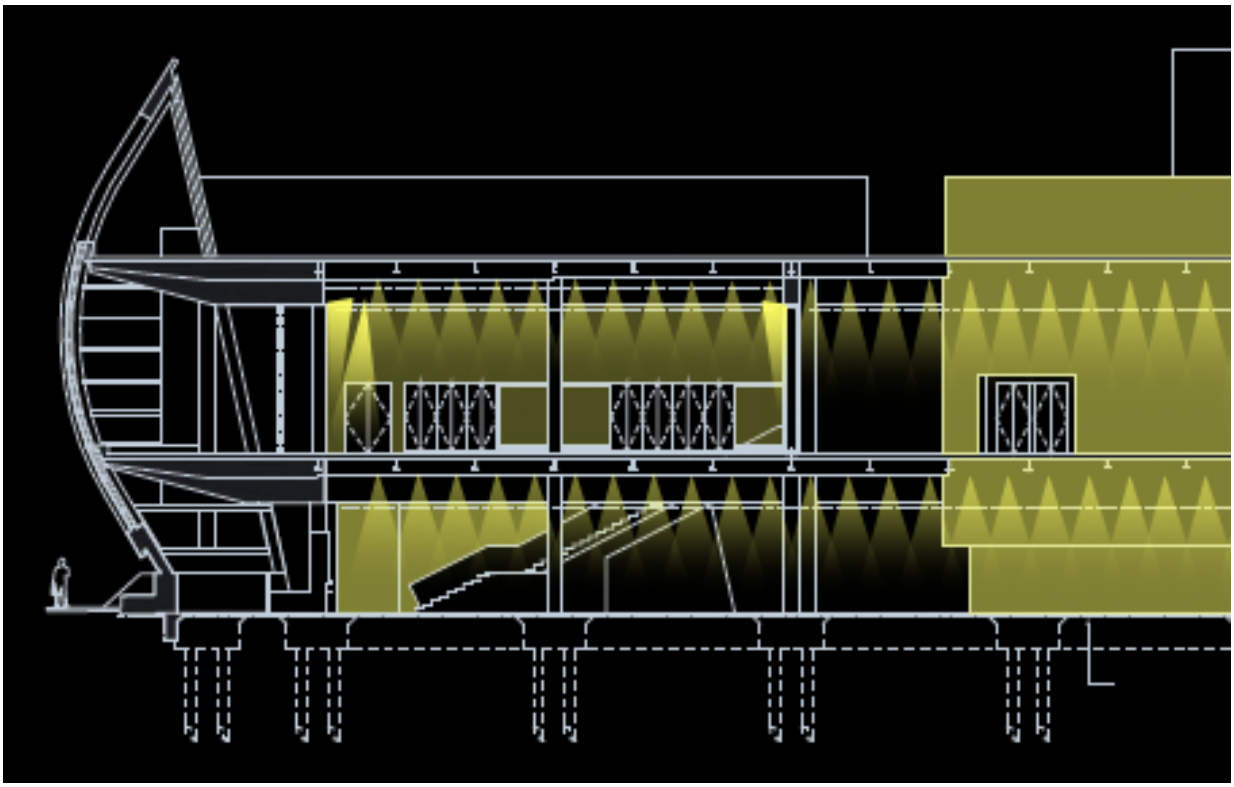

Figure 4.3.1 | Schematic section of the lighting in the education and lecture room.

The Redesign:

The new lighting system for the Education and Lecture Room utilizes a variation of the fixture that is used throughout the upper and lower lobbies. The fixtures in this room are simply grouped two together to allow for closer spacing necessary to meet higher illuminance level recommendations. This maintains a uniform appearance that is critical to the exterior view and also maintains the consistency from space to space that is necessary because of the glass partitions. The design is streamlined and efficient, integrating with the linear baffles that define the ceiling plenum. A complicated design is not necessary for this space and would likely be a distraction.

Computer Renderings:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing. Full size images are available in Appendix D.

Figure 4.3.2 | Rendering of the Education and Lecture Room. [Note: scallops on the wood are more severe than would occur in reality due to rendering lights as point sources]

Luminaires:

TYPE A: T5 Linear Fluorescent Downlight (20); General Downlighting

A full luminaire schedule, light loss factor calculations, and power density calculations can be found in Appendix A. Luminaire, Lamp, and Ballast specification sheets can be found in Appendix B.

Controls:

This space will be controlled by an architectural preset system that will have a secondary control unit at the back of the space where exiting will be more common. The room is divided into zones by quadrant, which will also allow the exterior zones to be dimmed with photosensors. The control system will incorporate the window shades.

Lighting Plans:

See Appendix B.

Performance Data Numerical Summary:

ILLUMINANCE LEVEL - TARGET | PROVIDED: 30 FC |38 FC (at maximum light output)

POWER DENSITY – ALLOWABLE | ACTUAL: 1.4 W/SF | 1.24 W/SF

Performance Data Images:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing with pseudo color exposure control as indicated.

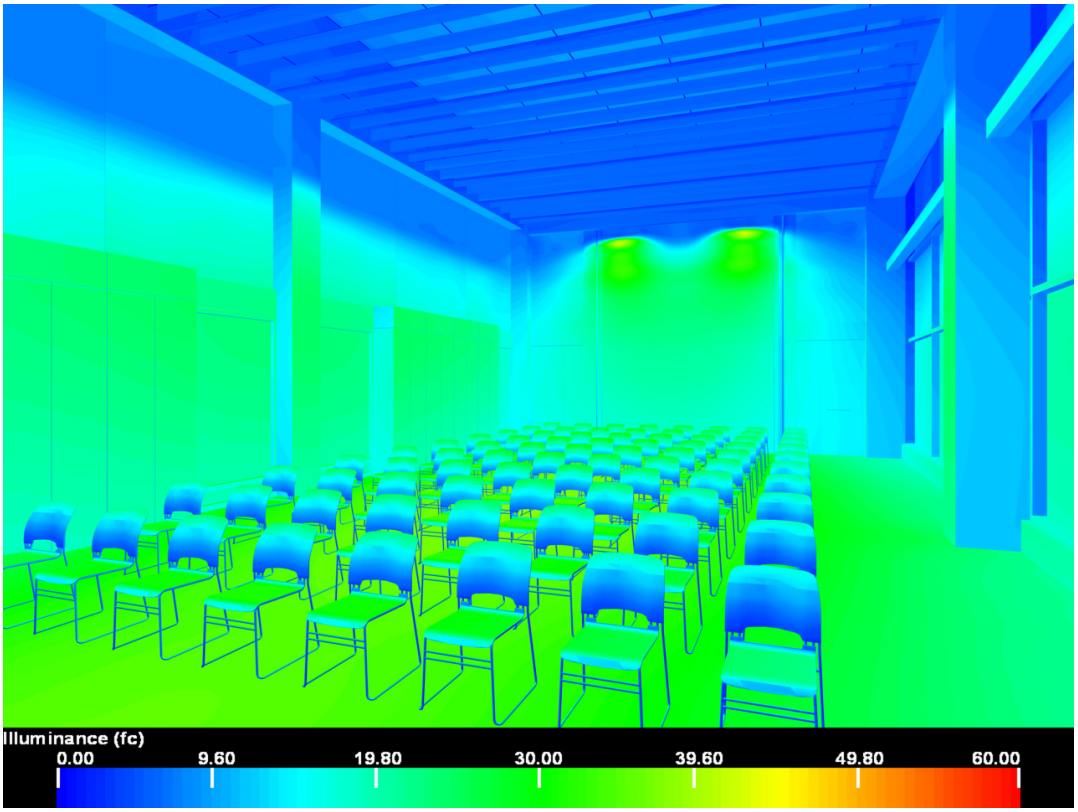

Figure 4.3.3 | Illuminance (fc) pseudo color rendering of the education and lecture room.

Summary Performance Evaluation:

The major criteria for this classroom space are performance based, rather than appearance based. The design uses only one type of luminaire but controls will allow the flexibility for varied uses that

is required of this space. The light output of the system is ideal. At maximum output, just under 40 footcandles is provided, but dimming will allow the level to be set lower as desired. The control system also will make use of the plentiful daylight reaching the space. The small aperture and louvers of the selected luminaires, as well as the uniform layout, will limit glare. Overall, the lighting design for this space is simplistic, yet it successfully meets all performance requirements.

4. MEETING ROOM

Description:

The meeting room is prominently situated within the sail on the second level, in the northeast corner of the building. The room is approximately 24' by 32' and is accessed from the education and lecture room by standard doors or a large mechanical pivot door. Because it is in the sail the east wall is arched (in section view). Large sections of curtain wall exist on the south, east, and north sides of the space which will provide plenty of daylight. Shading is provided for all of the glazing. The ceiling slopes, opening to the curved wall of the sail. While the meeting room label is ambiguous, the primary function of the space would be to host donors or hold other small, private events.

***Surface Materials*:**

Material descriptions and assumed reflectance properties are available in Appendix E.

North and South Walls: Mirror images of each other, the north and south walls are half curtain wall (MATERIAL GLZ-1) and half painted gypsum (MATERIAL PT-1). There is a column at approximately the third point of the walls at which the ceiling begins to slope upwards towards the sail.

East Wall: The east wall curves as it is a portion of the sail that forms the corner of the building. Curved curtain wall (MATERIAL GLZ-3) forms the center of this wall while the left and right sides are painted gypsum (MATERIAL PT-1).

West Wall: The west wall is the same as the East and West walls of the education and lecture room.

Ceiling: The ceiling in this space is painted gypsum (MATERIAL PT-1). Moving from west to east, it is level before beginning to slope at column line A1. This creates an aperture effect opening the view looking out of the sail.

Floor: This space is fully carpeted (MATERIAL CPT-1).

Furnishings:

Furnishings for this space are not provided on the drawings. It is assumed that the furniture would include somewhat informal seating arrangements.

Design Criteria:

Space Type: Conference Rooms – Meeting

IESNA Very Important Criteria:

- Appearance of Space and Luminaires
- Direct Glare
- Modeling of Faces and Objects

IESNA Important Criteria:

Color Appearance (and Color Contrast)
Light Distribution on Surfaces
Light Distribution on Task Plane (Uniformity)
Luminances of Room Surface
Reflected Glare
Surface Characteristics
Illuminance Category D (30 FC) Horizontal
Illuminance Category B (5 FC) Veritcal

IESNA Somewhat Important Criteria:

Daylighting Integration and Control
Flicker (and Strobe)
Shadows
Source/Task/Eye Geometry

ASHRAE/IESNA 90.1 Regulations:

Table 9.6.3 allows for and LPD of 1.3 W/ft^2 for conference / meeting / multipurpose spaces. An additional 1.0 W/ft^2 can be used strictly for decorative lighting.

Pre-Design Criteria Analysis:

The meeting room's location within the building makes it one of the most dynamic and interesting spaces. Sitting within the sail, it will receive a lot of daylight, making integration and control of daylight an extremely important issue. However, it is also important to consider how this is controlled, because the view from this space should also be considered. One of the other important factors is the flexibility of the chosen lighting system. The nebulous nature of the space means the lighting may have to respond to a wide variety of uses. A preset control system will likely be beneficial for this space.

The appearance of the luminaires will also be important as they could possibly be a decorative element for the space. This would also allow for an additional w/sf allowance according to the ASHRAE 90.1 Standard. It is important to create a high class appearance in this space. The suggested Illuminance levels seem accurate for this space, but again, flexibility is essential.

As previously stated, this space must show some sense of continuity with the education room, as they are separated by a glass partition. The contribution of the interior lighting system of this space will have a great impact on the exterior appearance of the building.

Design Goals:

1. Create a warm and relaxing ambiance
2. Design for an upscale appearance
3. Provide strong facial rendering
4. Help make the space a signature room

Design Approach:

1. Utilize non-uniformity, peripheral emphasis, and low color temperature sources
2. Use decorative luminaires to provide a distinct style
3. Avoid direct, overhead downlight
4. Use decorative, stylish luminaires with a modern appearance

Schematic Design Images:

These images represent pre-design schematic concepts and are not necessarily representative of the final design.

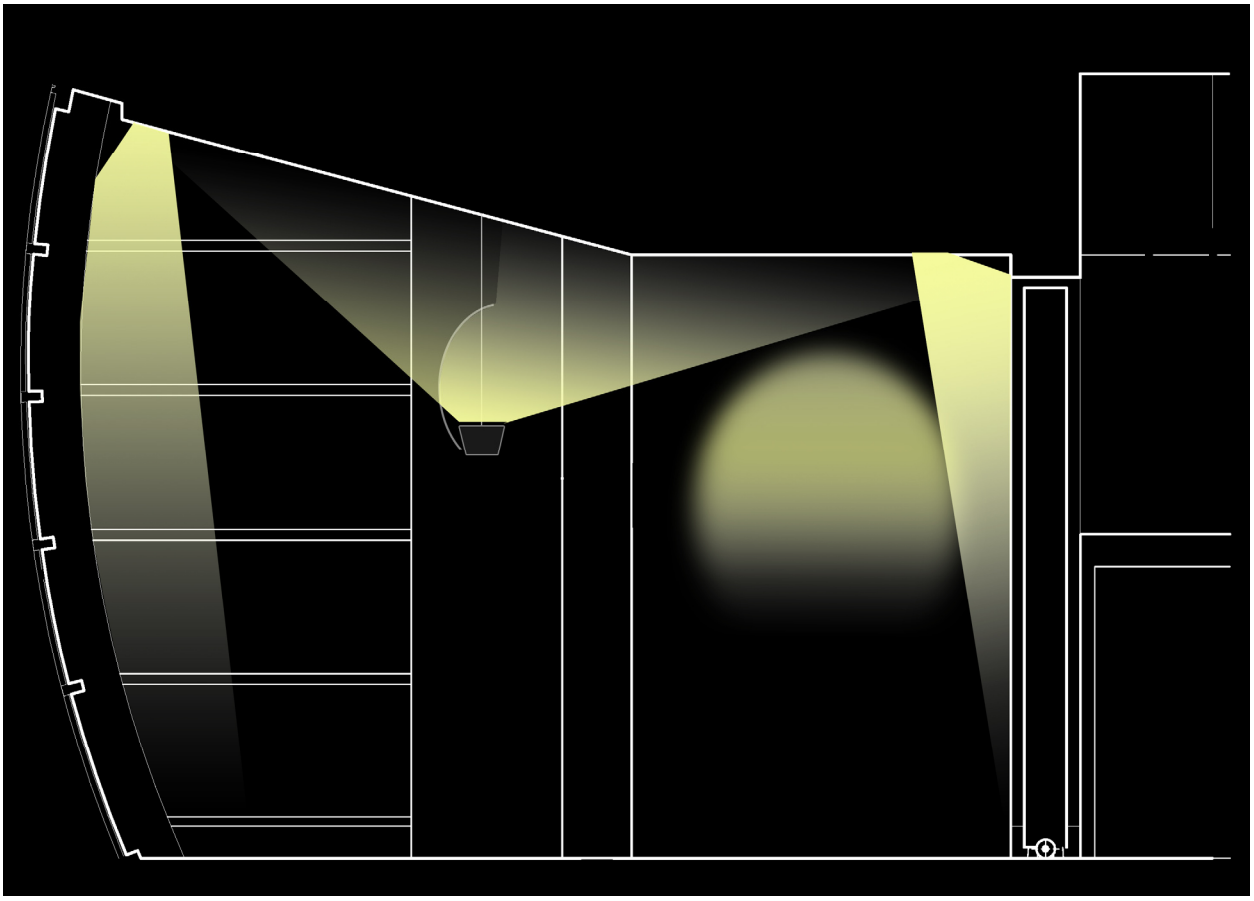

Figure 4.4.1 | Schematic section of the lighting in the meeting room.

The Redesign:

The redesigned system for the meeting room attempts to create a more relaxed atmosphere for a lounge space rather than a business-like atmosphere for a conference room. For the original design, the function of the space was somewhat undefined but labeled as 'Meeting Room.' As the project progressed, a donor was found to sponsor the room as a lounge area.

The lighting design focuses on creating a relaxing atmosphere by using as much indirect light as possible. This is somewhat difficult because the revolving door does not allow suspended fixtures in

a good portion of the space. Additionally, nearly all the walls are washed to create an emphasis away from the central seating area. The pendants were chosen based on scale and the need to fill a large volume of space while also upholding the aesthetic of the space.

Computer Renderings:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing. Full size images are available in Appendix D.

Figure 4.4.2 | Meeting room view looking west with all fixtures at full light output.

Figure 4.4.3 | Meeting room view with pendants (30%) and downlights (10%) dimmed to create a more relaxed environment.

Figure 4.4.4 | Meeting room looking east with all lights at full light output.

Luminaires:

TYPE F: 7" Compact Fluorescent Recessed Downlight (4); General Downlighting
TYPE I: Halogen Recessed Gimbal Spotlight (13); Wallwash for Door and Sail
TYPE J: Linear Fluorescent Recessed Wallwasher (4); Wallwash for recess
TYPE K: Decorative Pendant (3); General Indirect Lighting

A full luminaire schedule, light loss factor calculations, and power density calculations can be found in Appendix A. Luminaire, Lamp, and Ballast specification sheets can be found in Appendix B.

Controls:

Four zones will be used to allow maximum flexibility and scene control, which will be provided by an architectural preset control unit. The direct lights, indirect lights, linear wallwashers, and gimbal spotlights will be placed on separate zones allowing the user to create many different scenes. The window shades will also be controlled by the architectural preset control unit.

Lighting Plans:

See Appendix B.

Performance Data Numerical Summary:

ILLUMINANCE LEVEL - TARGET | PROVIDED: 30 FC |35 FC (at maximum light output)
POWER DENSITY: 1.3 W/SF | 1.61 W/SF

Performance Data Images:

Images generated using AutoDesk VIZ 2008 Radiosity and Raytracing with pseudo color exposure control as indicated.

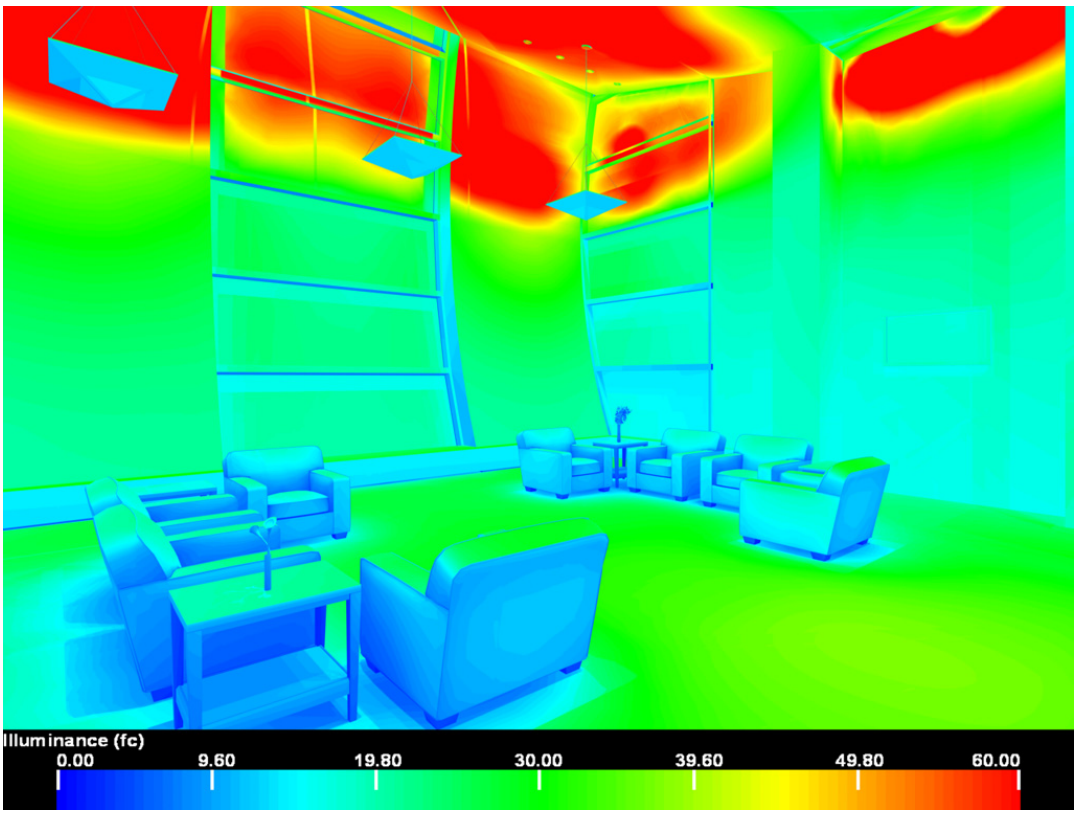

Figure 4.4.3 | Illuminance (fc) pseudo color rendering of the Meeting Room

Summary Performance Evaluation:

The meeting room is a signature space in a signature building and the lighting must represent this accordingly. The pendants used in this space coordinate effectively with the architecture while illuminating the ceiling, a critical requirement for the exterior appearance. This also creates a soft even light to help generate an inviting space.

In contrast to the education and lecture room, the lighting system in this space is all about appearance. However, the appropriate lighting levels are achieved. The power density is above ASHRAE allowance, but this is more than made up for in the other spaces. Overall, the building falls well under the ASHRAE standard using the space by space method.

The controls for this space are essential for creating a comfortable environment based on daylight levels and room function, both of which will change often.