2.0 INTRODUCTION TO LIGHTING DEPTH

The following section outlines the redesigned lighting system for the Harry Ransom Humanities Research Center. Five spaces were chosen for analysis and redesign: exterior canopy and site lighting, the Spencer Lobby, a north/south corridor, the Prothro Family Theatre, and the Prothro Family Gallery. These rooms were selected because lighting plays an important role in how the user perceives and interacts with the spaces. In addition to the spaces themselves, lighting systems were redesigned for the Gutenberg Bible Display and First Photograph area. These two displays represent the Ransom Center's signature collection items and are the main attraction in the lobby space.

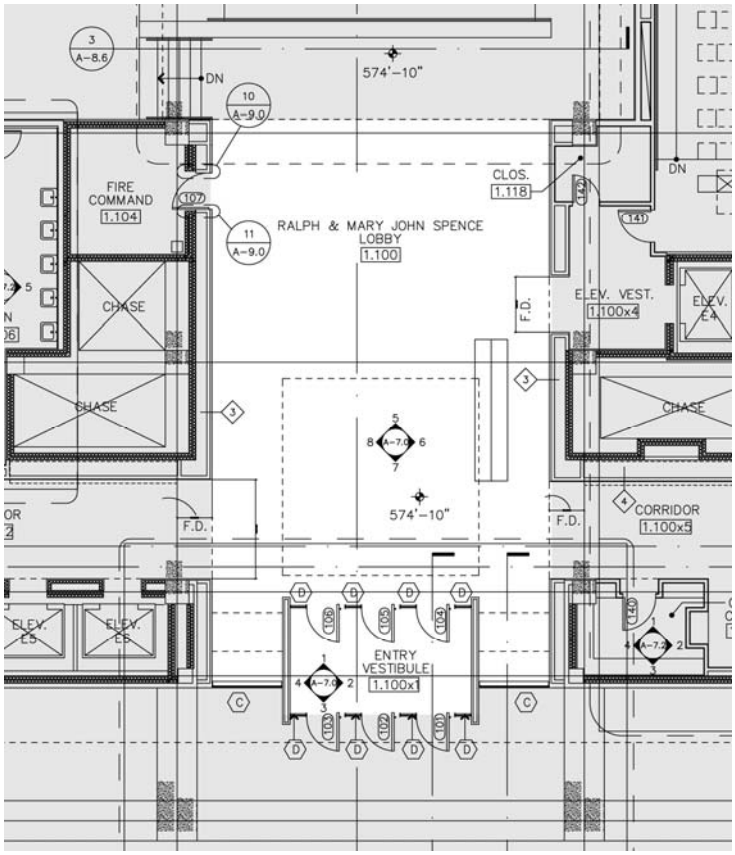
This portion of the report steps through the selected areas of redesign space by space. Recommended illuminance levels, uniformity, and specific design themes and objectives are provided for each of the areas of study. After presenting schematic and final design, specification and performance data is summarized. This includes documentation of control devices, lighting levels, and overall effectiveness of the new lighting system.

Successful lighting design is never an easy task. A myriad of challenges exist, and a sincere attempt was made to balance aesthetic expectations, desired light levels, lighting functionality, lighting flexibility, and construction coordination issues. That said, each design space was analyzed in key areas and comments on the outcome of the redesigned system is provided. During design and construction of the Ransom Center renovations, power consumption was required to conform to ASHRAE 90.1-1999 performance recommendations. Standard 90.1-2004 has since been issued, and therefore both guidelines are referenced for each space. Spaces that do not currently conform to the new guidelines provided an interesting challenge during the redesign study; creating an equally appealing, flexible lighting system while using less energy is exceptionally idealistic. Compromises were made, and the ultimate goal was to provide a useful lighting system that is environmentally responsible and visually stimulating.

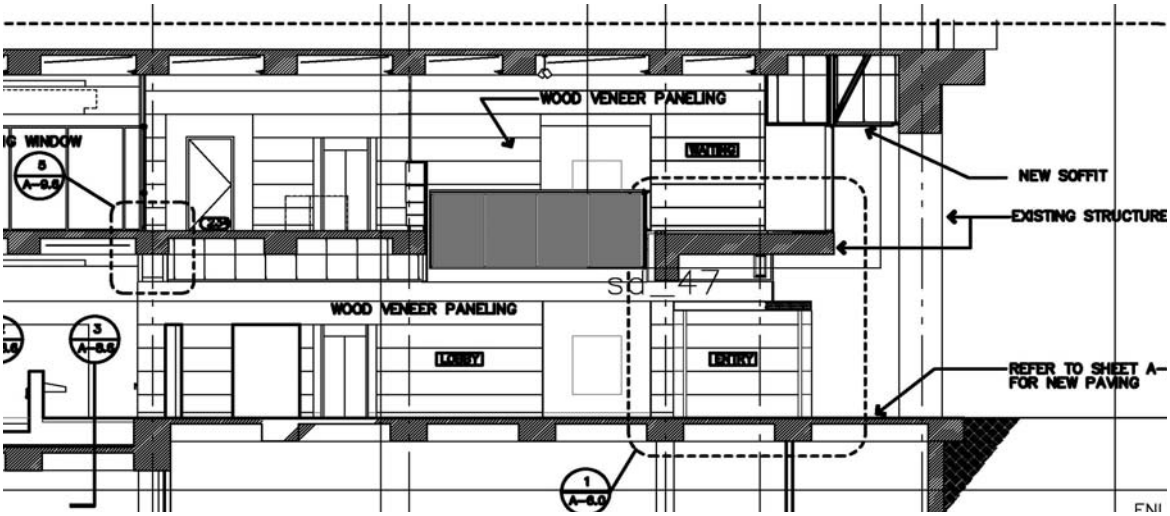
2.1 RALPH and MARY JOHN SPENCER LOBBY + ENTRY VESTIBULE

OVERVIEW
This room functions as a primary area of circulation and "greets" guests upon entering the building. Occasionally, the space is also used as a lobby for special events. First impressions are always important, and the lobby allows guests to convene, ask for help at the security desk, and transition into the gallery spaces or corridor leading to other rooms. Security personnel are stationed in the lobby twenty-four hours a day all year long. The space is approximately 11'-8" in height and features an opening to the second floor research wing lobby. Additionally, it is entirely open to the adjacent gallery space and circulation corridor. Surfaces include plaster ceiling, wood walls, and honed granite floors.

Lobby Floor Plan



Lobby Section



ROOM DATA

Total area

2,477 square feet

Furniture

Lobby/Reception Desk

Finishes

Glass (doors), transmittance 0.74
Frosted glass (balcony railings), transmittance 0.74
Etched glass (door surrounds), transmittance 0.35 (not including etchwork transmittance)
Wood veneer paneling, reflectance 0.70
Plaster ceiling, reflectance 0.80
Honed granite (floors), reflectance 0.37

DESIGN NARRATIVE

Objective

Lighting for the Ransom Center lobby was designed to create a warm, relaxing environment. This was achieved by highlighting the rich wood walls and Gutenberg Bible display area for visual interest. The needs of the security desk were also addressed, including sufficient workplane illuminance and an intuitively designed central control station for the building's lighting systems.

Lighting Layout and Luminaire Selection

Fixtures in this space were carefully selected for ease of maintenance, high quality lighting performance, and overall integration with the building's architecture. The primary source of lighting in the lobby is thirty-two Watt compact fluorescent downlights (3000K). These lights are echoed in the entry vestibule, although eighteen Watt lamps were selected to allow for nighttime adaptation between exterior and interior spaces. During the daytime, there will be natural light in the vestibule. Along the rich wood walls, PAR-20 ceramic metal halides lamps provide wall grazing and are located in a unique fixture that is recessed into a perimeter cove. A gold tinted reflector was selected to compliment the warm wood colors and give the appearance of incandescent light sources. MR-16 downlights provide light on the guest side of the security desk, and under-counter dimmable T-5 fluorescent task lights are located on the security

personnel's side. Fully recessed, adjustable AR-111 halogen sources were selected to highlight the Gutenberg Bible display area's half-walls because of their excellent color rendering, superior overall life performance compared to MR-16s, and offering of a crisp eight degree beam for precise focusing on the engraved script on the wall. These tight beams will also reduce spill light onto the sensitive pages of the Gutenberg Bible. An in-depth analysis of the Gutenberg Bible and First Photograph display areas is provided in section 2.7, Special Lighting.

DESIGN CRITERIA

Horizontal Illuminance (important): 10 fc

Vertical Illuminance (important): 3 fc

The lobby space should provide even, diffuse light that compliments facial modeling by providing adequate levels of vertical illumination. This space is frequently used for social gatherings, and consequently needs quality light rather than excessive, directional brightness.

Appearance of Space and Luminaires (very important)

The lobby should provide an engaging environment for those who enter it. It should also provide an upscale appearance to foreshadow the rare collections that are on display in the proceeding spaces. In contrast to most of the public gallery space which features track lighting, this is an area where luminaries can be neatly tucked away and "invisible." A decorative fixture, if appropriate in design for the space, may provide a focal point; there is no art in the lobby for it to distract from.

Color Appearance and color contrast (somewhat important)

Although this space should maintain a high level of finish and features expensive wood finishes, colored light, including variations of white light and unintentional spectral rainbows created from optic diffraction, should be avoided in this space. Proper lamp and fixture selection will ensure this.

Daylighting Integration and Control (very important)

Personal recommendation: important

Daylighting is always an issue in art galleries; harmful ultraviolet rays will damage precious artwork. That said, the Ransom Center lobby has no artwork oh its walls. The only concern is spill light from the lobby into the adjacent gallery opening and Gutenberg bible display area, which is far enough away to alleviate the need for special concern.

Direct Glare (somewhat important)

The reception desk is the only area of concern; luminaries immediately around the desk attendant should not be glaring or create reflections on work plane surfaces.

Flicker and Strobe (somewhat important)

No special equipment in the lobby warrants concern over flicker and strobe.

Light Distribution on Surfaces (somewhat important)

To create visual interest, intentional variance of light distribution on surfaces is appropriate and acceptable.

Light Distribution on Task Plan/Uniformity (somewhat important)

This is not a concern in the lobby, except at the information desk.

Luminance of Room Surfaces (somewhat important)

Only the information desk needs adequate illuminance. Architectural features should be highlighted.

Modeling of Faces or Objects (important)

Though not critical to this space, receptions are frequently held here and care should be made to make this room compliment facial features.

Points of Visual Interest (very important)

The etched glass entrance and open balcony area are the main architectural features in the lobby. Appearance of the second floor around this open area should be considered; it is in direct view from the lobby.

Reflected Glare (not important)

Personal recommendation: important
The rich wood surfaces through the lobby are a potential source of unsightly lamp image reflections.

Shadows (not important)

Personal recommendation: somewhat important
The etched glass signature wall can provide interesting shadow effects on the lobby floor.

Source/Task/Eye Geometry (somewhat important)

The space should be enjoyable to view, and decorative fixtures may be appropriate.

Sparkle/Desirable Reflected Highlights (not important)

Some sparkle, if appropriate, can be implemented in this space.

Surface Characteristics (important)

Wood and etched glass are unique features to this room.

System Control and Flexibility (somewhat important)

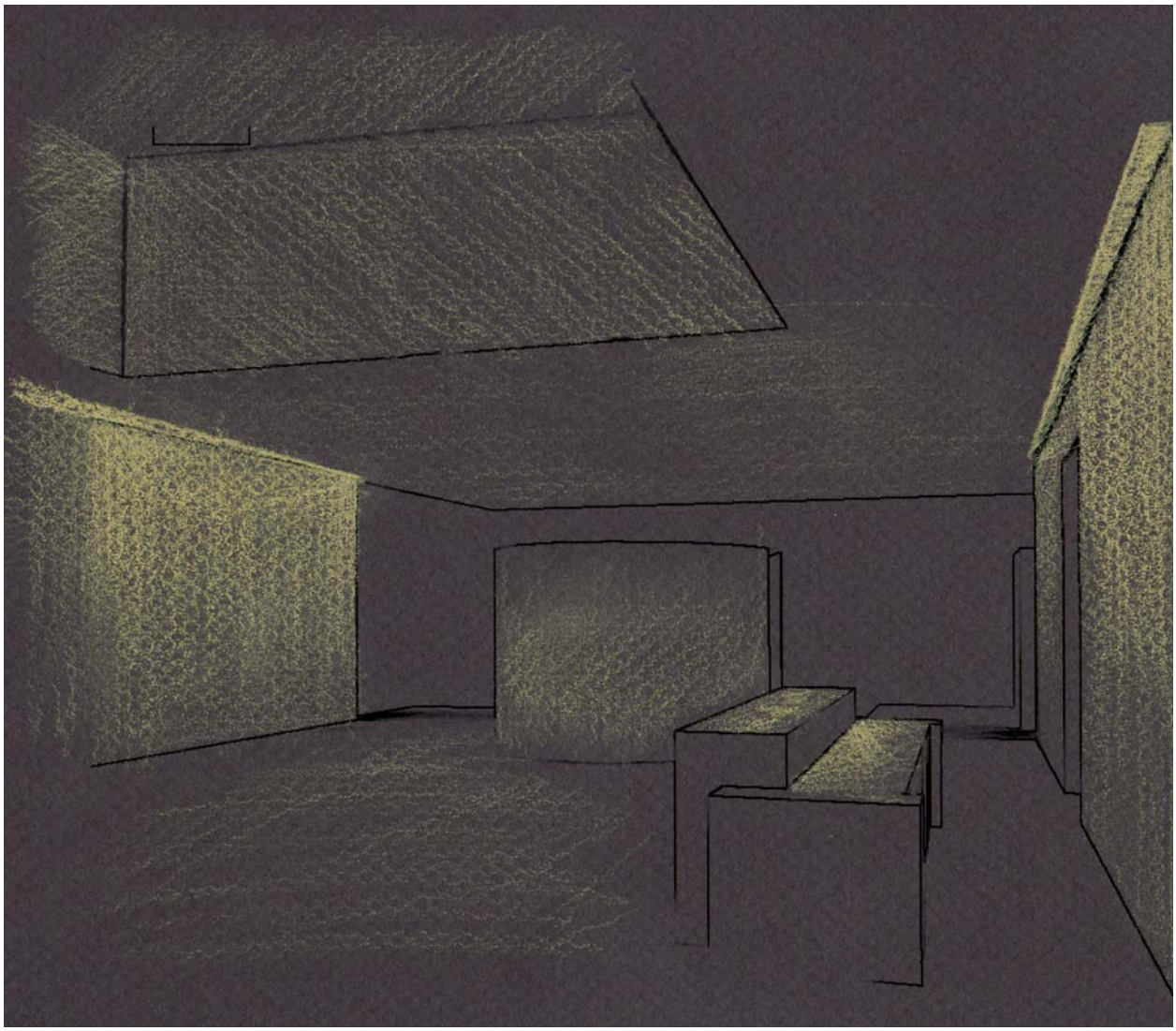
Generally this room serves one use: to greet occupants and allow them a space to convene.

Special Considerations

Any non-recessed luminaries in the lobby may be visible from the balcony on the second floor lobby. Lighting of the Gutenberg bible must be account for potentially harmful ultraviolet rays and heat radiation.

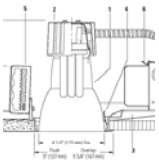
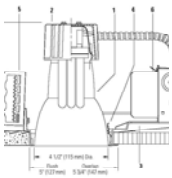
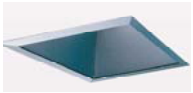
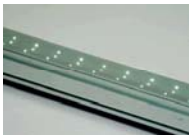
CONCEPT SKETCHES

Sketch of Main Lobby



LIGHTING SYSTEM DATA

Fixture Schedule

	TYPE	DESCRIPTION	LAMP	FIXTURE WATTS
F1		**Lightolier 8021CCP-S6321BCU3** Lutron Compact SE dimming ballast Fully recessed compact fluorescent 6" aperture downlight with 50 degrees cutoff and clear alzak reflector.	Philips PL-T /32W/830	32W
F2		**Lightolier 8021CCP-S6321BCU3** Fully recessed compact fluorescent 6" aperture downlight with 50 degrees cutoff and clear alzak reflector.	Philips PL-T /18W/830	18W
F3		**Kurt Versen Lighting H-8653** Recessed compact fluorescent 5-1/2" square downlight.	Philips PL-T/26W/830	26W
F4		**Edison Price Darklite AR111/5AA** Dimming electronic transformer Fully recessed adjustable accent 5" aperture halogen downlight with 358 degrees horizontal rotation and 0-35 degrees angular adjustment.	Philips ALU111MM-75W-G53-12V-8D 8 degrees beam	75W
F5		**Edison Price Darklite MR/4** Dimming electronic transformer Fully recessed halogen downlight with 4" aperture clear alzak reflector.	Philips 45W MRC16/IRC/NFL24 24 degrees beam	50W
F6 Option 1		**Fiberstars Triaxis Lightbar** Fiber optic accent lighting with remote housing for ceramic metal halide lamp.	T6 Philips CMH	70W
F6 Option 2		**io Lighting LEDge** Surface mounted LED accent light.	LED, 3000K	6 W/lf

Fixture Schedule, continued

F7		**Times Square Lighting** Track mounted adjustable accent light with shutter cuts, snoot and UV shield.	50 W MR16 15 deg	50W
F8		**Not Used**		
F9		**Edison Price Spredlite 20MH DL/9** Cove recessed ceramic metal halide wall grazer (9" o.c. lamp spacing) with 10 degrees angular adjustment and champagne gold alzak baffled reflectors.	Philips CDM35/PAR20/M/SP 10 degrees beam	48.75 W/lf
F10		**io Lighting Luxrail** Custom fixture - assymetric distribution Railing recessed LED linear array with custom assymetric distribution.	3000K Warm White LED	8 W/lf
F11		**Alkco Lighting** Lutron Hi-Lume dimming ballast Surface mounted linear fluorescent undercabinet light with electronic dimming ballast.	Philips F35T5/830	7.2 W/lf
F16		**io Lighting Line 2.0** Floor recessed LED with 5 degree beam spread and window grazing filter.	5000K Cool White LED	10W/lf

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F1	IV	Clean, 12 months	2400	2040	0.85	0.88	0.97	1.00	0.95	0.69
F2	IV	Clean, 12 months	1200	1020	0.85	0.88	0.97	1.00	0.97	0.70
F3	IV	Clean, 12 months	1800	1530	0.85	0.88	0.97	1.00	0.95	0.69
F4	IV	Clean, 12 months	1575	1496.25	0.95	0.88	0.97	1.00	n/a	0.81
F5	IV	Clean, 12 months	1080	1026	0.95	0.88	0.97	1.00	n/a	0.81
F6o1	IV	Very clean, 6 months	n/a	n/a	0.70	0.88	0.97	1.00	n.a	0.60
F6o2	IV	Very clean, 6 months	n/a	n/a	0.70	0.88	0.97	1.00	n/a	0.60
F7	IV	Very clean, 6 months	940	893	0.95	0.88	0.97	1.00	n/a	0.81
F9	IV	Clean, 12 months	2000	1300	0.65	0.88	0.97	1.00	1.00	0.55
F10	IV	Clean, 12 months	n/a	n/a	0.70	0.88	0.97	1.00	n/a	0.60
F11	III	Clean, 12 months	3650	3450	0.95	0.90	0.97	1.00	1.00	0.83
F16	VI	Clean, 12 months	n/a	n/a	0.70	0.85	0.97	1.00	n/a	0.58

Power Density Calculation

Type	Quantity	Watts/Fixture	Watts			
F1	19	33	627	**Total Watts**	5265	
F2	6	20	120			
F4	8	75	600	**Area (Sq.ft)**	2477	
F5	3	50	150			
F6*	1		n/a	**Power Density**	2.13	W/sq.ft.
F7*	1		n/a			
F9	53 lf	57 W/lf	3031.6			
F10	68 lf	8 W/lf	544			
F11	3	24	72			
F16*	12 lf	10 W/lf	120			

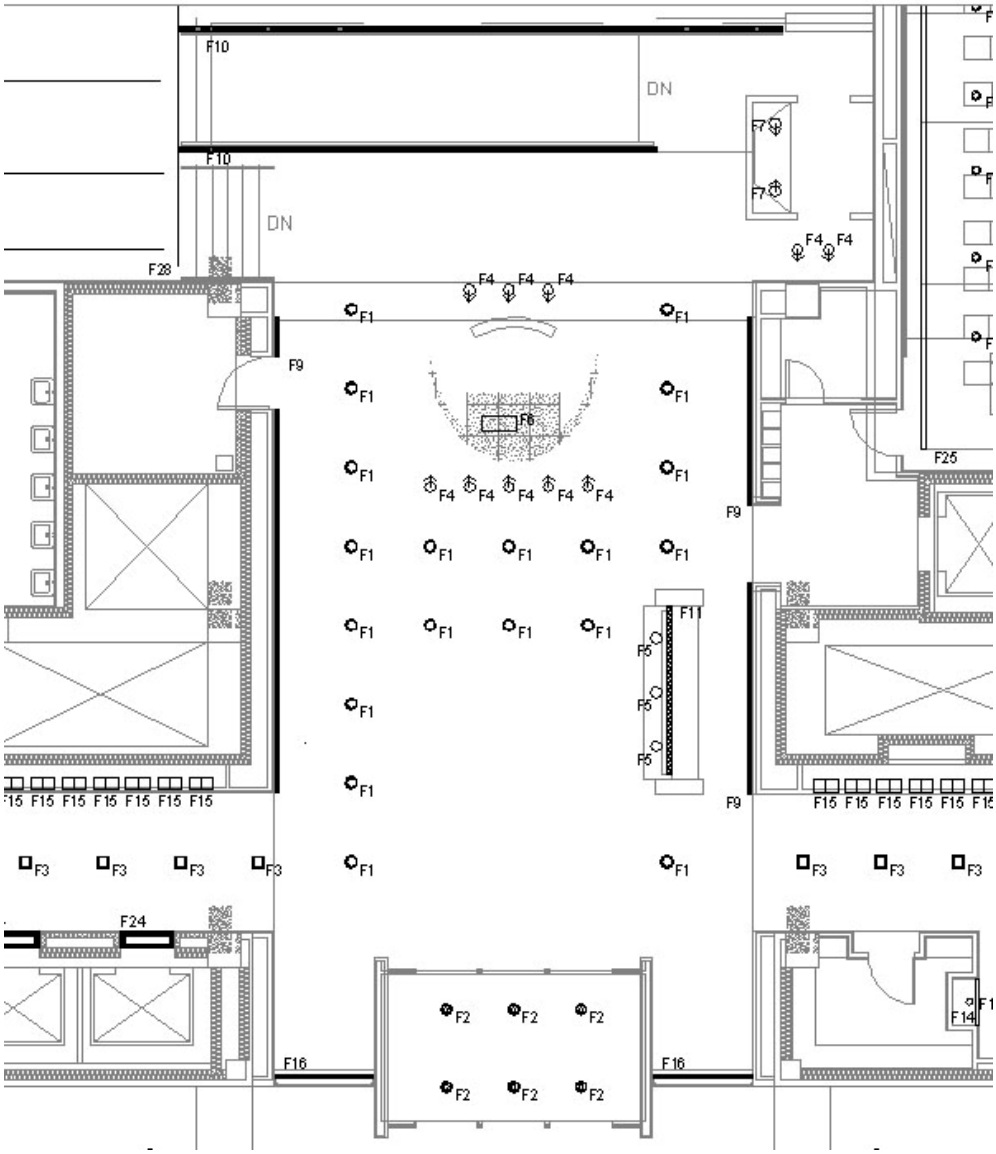
*Fixture types F6 and F7 are highlighting critical artwork and are not included in lighting power density calculation per ASHRAE 90.1-2004, section 9.2.2.3

Power Density Allowances

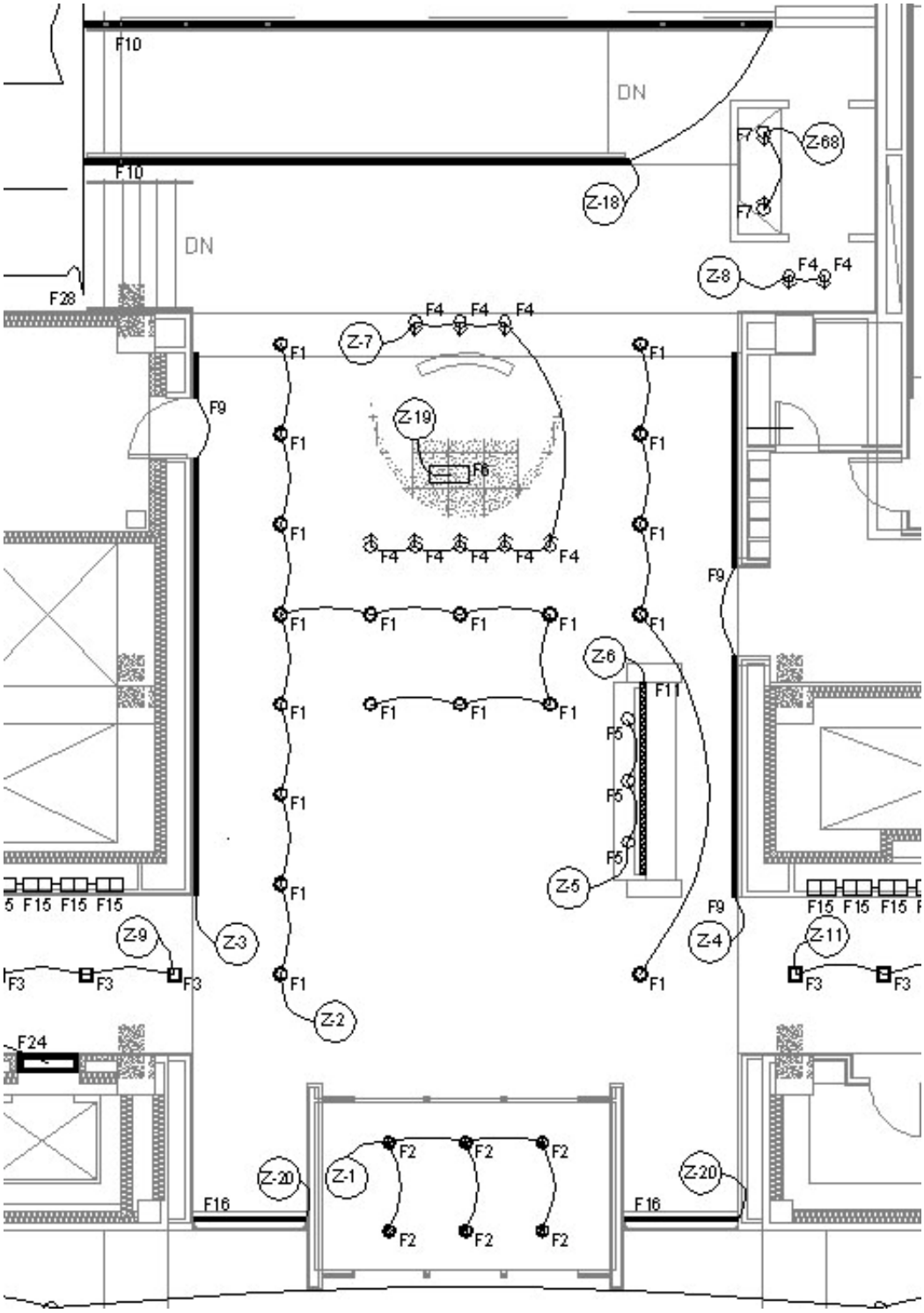
ASHRAE 90.1-1999: 1.8 W/sq.ft., plus 1.0W/sq.ft. for artwork
ASHRAE 90.1-2004: 1.3 W/sq.ft., plus 1.0W/sq.ft. for artwork

The lobby power consumption meets the requirements of ASHRAE 90.1 when using the 1.0W/sq.ft. allowance for artwork.

Lighting Layout

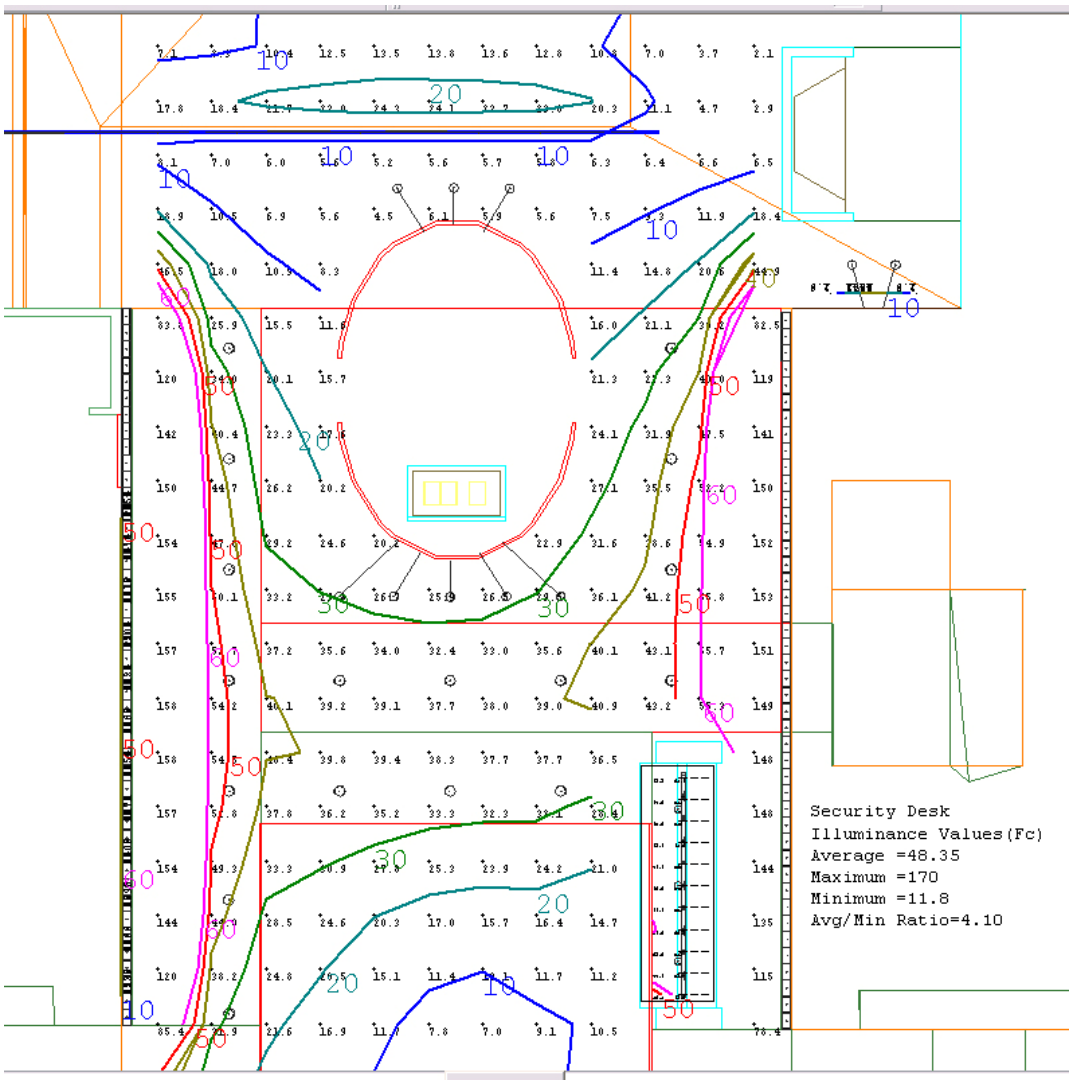


Lighting Control Diagram

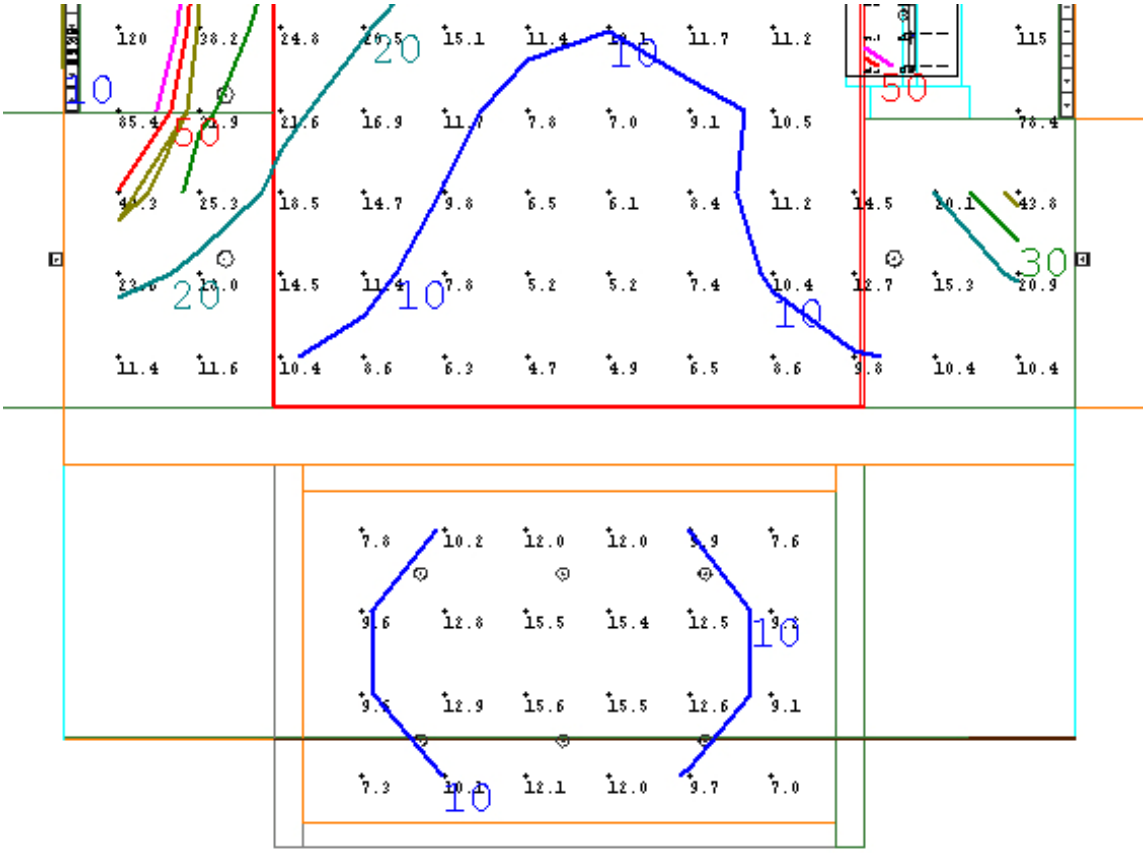


CALCULATIONS

Lobby Floor Illuminance Grid (Fc)



Lobby Vestibule Illuminance Grid (Fc)



Calculation Summary data (charts)

Lobby Floor Illuminance (FC)	
Average	35
Maximum	158
Minimum	2
Avg/Min	20

Wall 1 Illuminance (FC)	
Average	55
Maximum	195
Minimum	9
Avg/Min	21

Vestibule Floor Illuminance (FC)	
Average	11
Maximum	16
Minimum	7
Avg/Min	1.60

Wall 2 Illuminance (FC)	
Average	7.35
Maximum	54
Minimum	1
Avg/Min	7.35

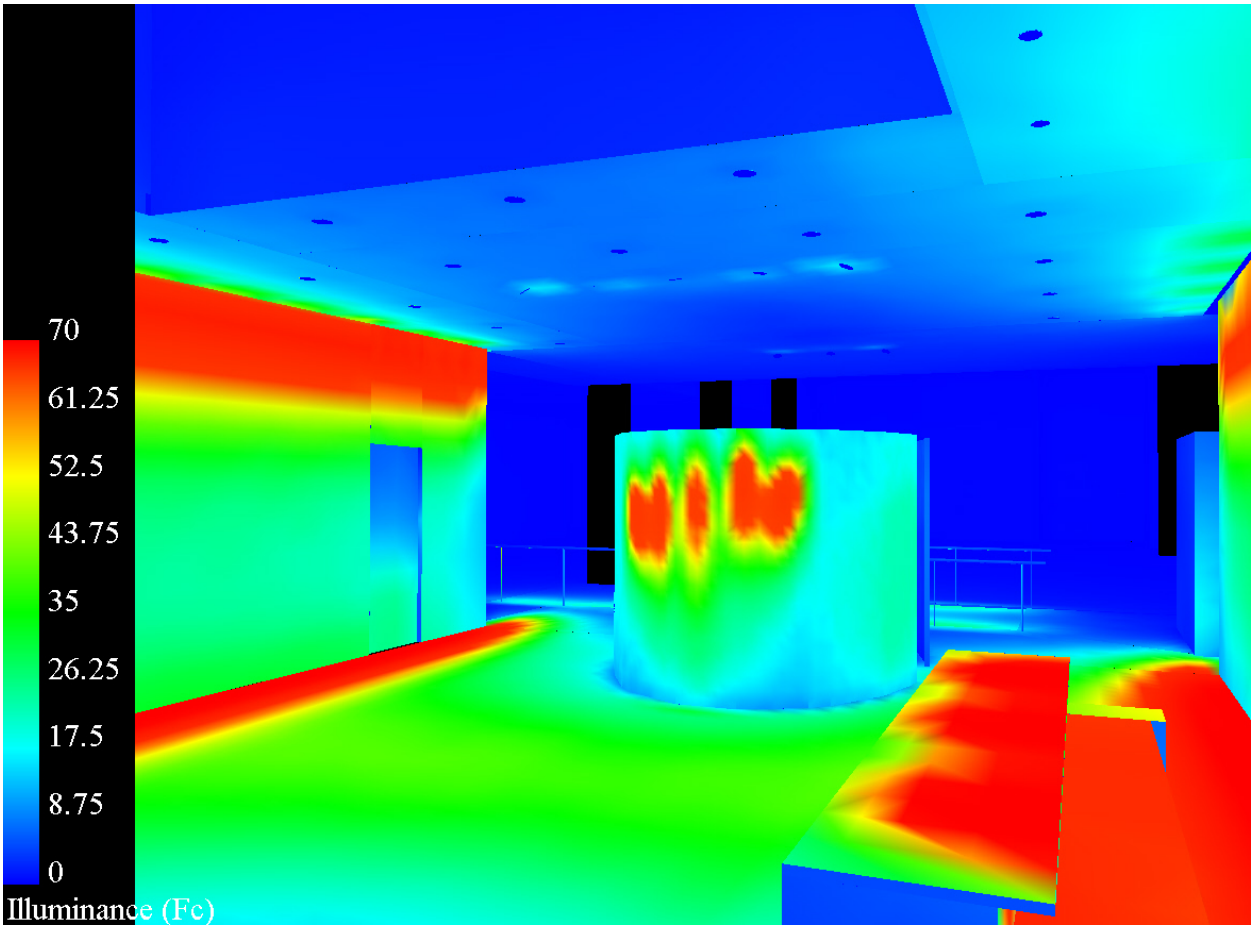
Counter (Help Side) Illuminance (FC)	
Average	16
Maximum	18
Minimum	11.8
Avg/Min	1.33

Counter (Task) Illuminance (FC)	
Average	97
Maximum	170
Minimum	41
Avg/Min	2.40

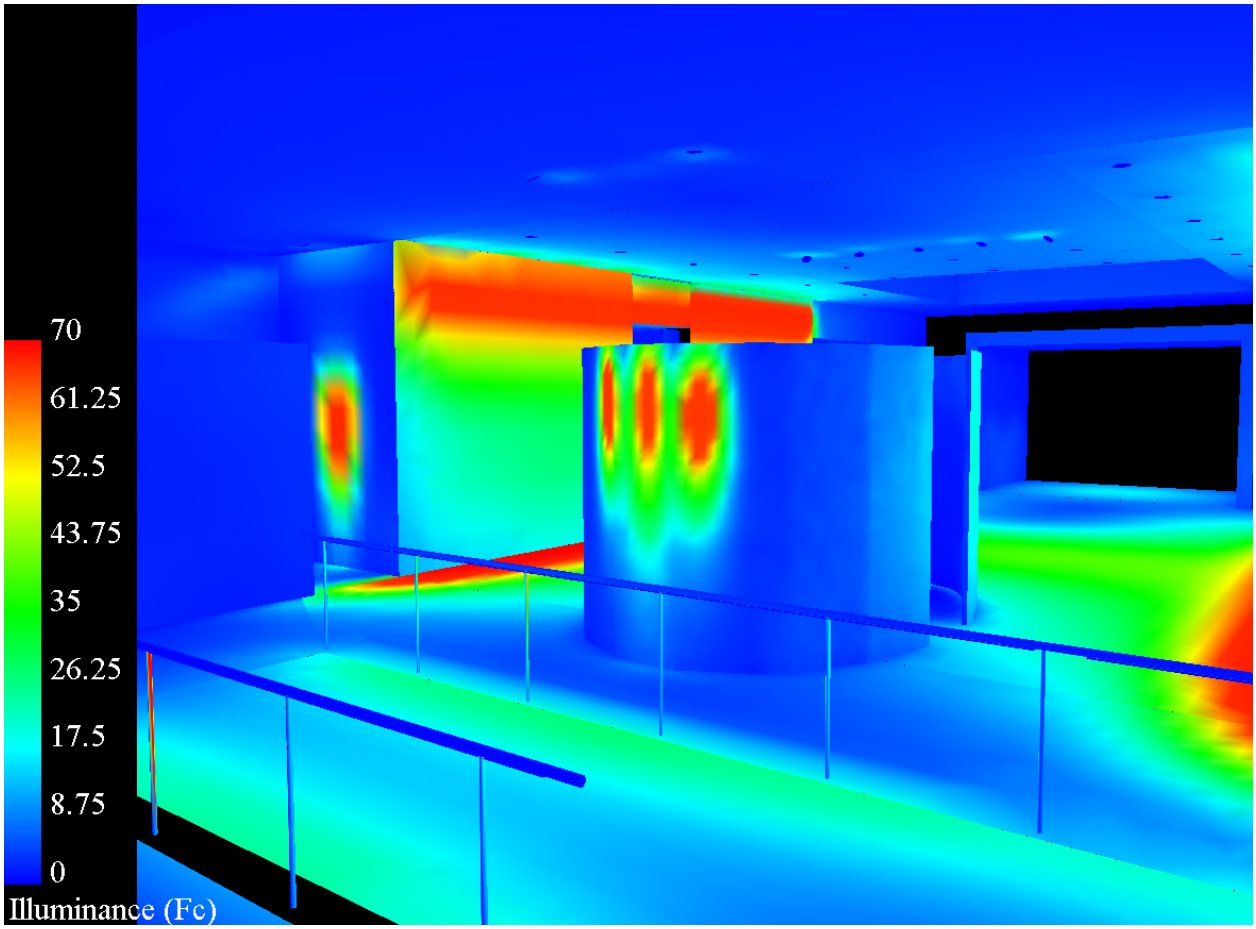
RENDERINGS (AGI32 SOFTWARE)

Lobby Rendering

Pseudo Rendering Facing Gallery



Pseudo Rendering from Gallery Looking at Bible Display Walls



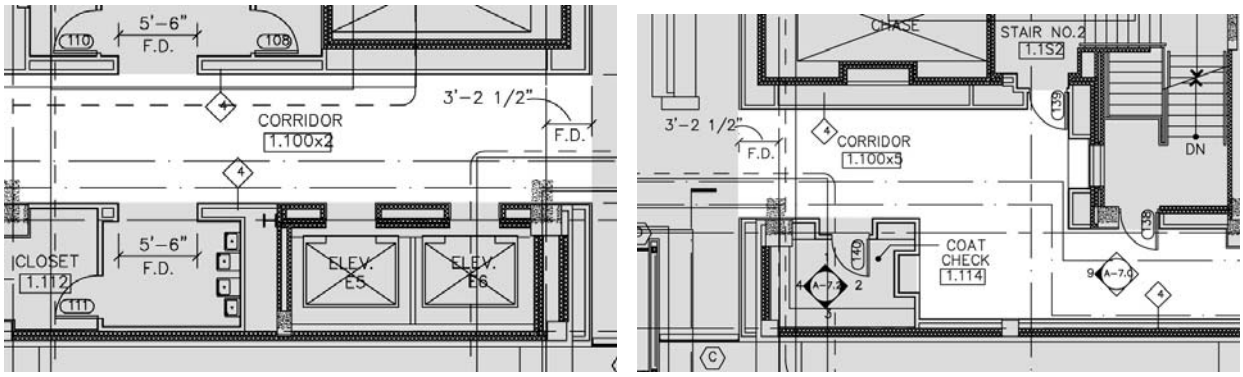
DISCUSSION

The lighting design for the Ransom Center lobby successfully meets illumination requirements while providing a dynamic environment that reinforces the building's architecture. Power consumption was significantly reduced from the existing incandescent system and conforms to ASHRAE 90.1-2004 requirements.

2.2 NORTH and SOUTH CORRIDORS

OVERVIEW
The Ransom Center has a main circulation corridor that spills off of the entrance lobby in both the north and south direction. On the north end, it terminates at the theatre lobby, and at the south end the corridor meets the stair hall. Sculpture coves are located in both the north and south ends of the corridor, and other features include two art niches (north corridor) and elevators (south corridor). These corridors are wide and function as an extension of the lobby areas. The mixed use of this space as circulation, lobby, and exhibit space will be used as justification for an ASHRAE power density allowance equal to that of the lobby. Materials include honed granite, plaster walls, etched glass, and plaster ceilings.

North/South Corridor Floor Plan



ROOM DATA
Total area
911 square feet
Furniture
There is no furniture in this space.
Finishes
Etched glass (doors), transmittance 0.74
Wood veneer paneling, reflectance 0.74
Plaster ceiling, reflectance 0.80
Honed granite (floors), reflectance 0.37
Polished aluminum (elevator doors), reflectance 0.31

DESIGN NARRATIVE

Discussion
Similar to the lobby, effort was made to make the corridor a warm and inviting space for visitors. General lighting was designed to be minimal, and emphasis is placed on the art niches and sculpture coves.

Lighting Layout and Luminaire Selection
Square aperture twenty-six Watt compact fluorescent downlights were selected for general illumination of the corridors. These luminaries are energy efficient and will compliment the room rectangular geometry with their shape. The geometric theme is echoed with the choice of AR-111 adjustable accent fixtures (Type F17) chosen to accent the sculpture niches. Due to the sharp angle from which these pieces must

be illuminated from two AR-111 sources will light each sculpture. Crossing angles from these point sources should help reduce shadows. In the art niches, fully recessed AR-111 halogen accent sources are used to illuminate the artwork, while xenon festoon sources are tucked into a cove to allow ambient lighting and reduce scallop shadows. In the elevator thresholds, RGB light emitting diodes provide white light that will shift to red when the cars arrive.

DESIGN CRITERIA

Horizontal Illuminance (important): 10 fc

Vertical Illuminance (important): 3 fc

Appearance of Space and Luminaires (very important)
These spaces are "front of the house" and providing a visually pleasing environment is important.

Color Appearance and Color Contrast (somewhat important)
A lighting system that compliments the natural wood colors should be provided.

Daylighting Integration and Control (very important)
The lobby/corridor area features large daylight spaces at each end. There is no special artwork in this area to protect from harmful rays, but thought should be given into providing a lighting system that can adapt to the varying levels of natural light.

Direct Glare (somewhat important)
Direct glare is not a major concern in this area because no prolonged, visually intensive tasks will be taking place.

Flicker and Strobe (somewhat important)
No equipment in this room should result in flicker or strobe.

Light Distribution on Surfaces (somewhat important)
Even distribution should be achieved on wall surfaces, though varied lighting levels between surfaces may be a desired effect.

Light Distribution on Task Plan/Uniformity (somewhat important)
There are no "task plans" in this space other than normal walking surfaces. These areas should be adequately lit, especially the steep set of stairs. Shadow and/or light intensity changes on the stair treads may be desirable to help occupants identify the edges of each step.

Luminance of Room Surfaces (somewhat important)
Surfaces should be illuminated in a manner that enhances the architecture and makes the space visually pleasing. No strict luminance requirements need to be followed for any of the surfaces in this room.

Modeling of Faces or Objects (important)
Lighting in this space should compliment faces.

Points of Visual Interest (very important)
Areas of visual interest include the large open stairwell, etched glass curtain walls, and veneer wood interiors.

Reflected Glare (not important)

Personal recommendation: important
Reflected glare may be a concern on the glossy wood veneer walls, and the lighting design should plan for this accordingly.

Shadows (not important)

Personal recommendation: important
Large shadows will be cast onto the floors of the spaces with etched glass. This will create interesting images and are a central part of the design.

Source/Task/Eye Geometry (somewhat important)

There are no areas in this space where view of luminaries and/or their may provide an annoying distraction from task work.

Sparkle/Desirable Reflected Highlights (not important)

Personal recommendation: somewhat important
If implemented properly, this space may be able to incorporate sparkle.

Surface Characteristics (important)

There are many interesting surfaces in this space, and a successful lighting system will compliment these features.

System Control and Flexibility (somewhat important)

The use of these spaces on average does not vary. A lighting system that responds to daylight levels may be desirable, but the spaces themselves are generally single-use.

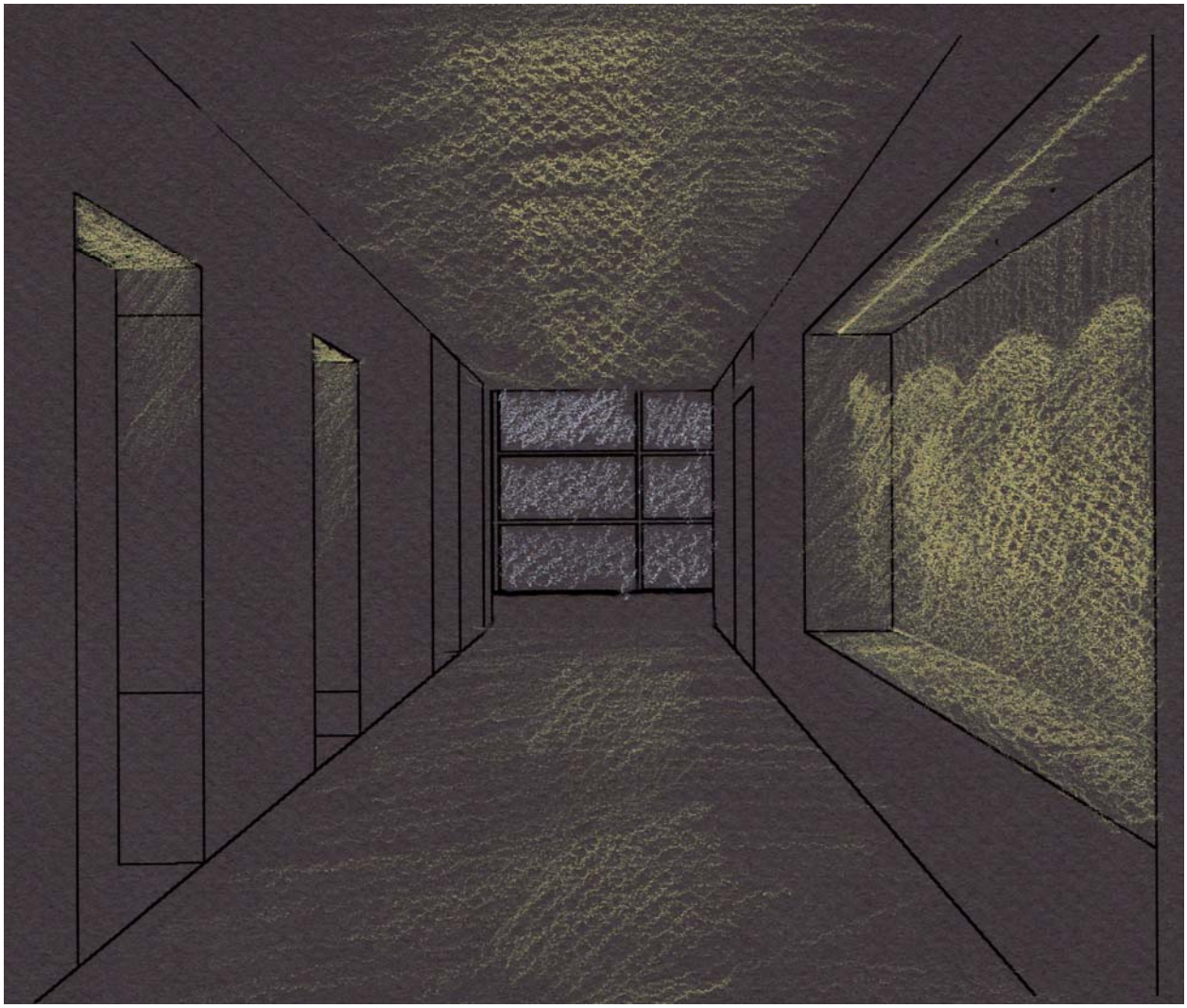
Special Considerations

It is important to determine the best lighting system to compliment the etched glass walls.

CONCEPT SKETCHES

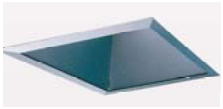
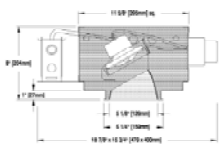
North Corridor Lighting Concept Sketch

South Corridor Lighting Concept Sketch



LIGHTING SYSTEM DATA

Fixture Schedule

TYPE		DESCRIPTION	LAMP	FIXTURE WATTS
F3		**Kurt Versen Lighting H-8653** Recessed compact fluorescent 5-1/2" square downlight.	Philips PL-T/26W/830	26W
F14		**Ardee Clickstrip CLK Series** Surface mounted xenon strip light with white thermoplastic housing.	5W Xenon Festoon	5W
F15		**3G Lighting AR111 Square Gimbal** Recessed adjustable accent halogen accent light with integral dimming electronic transformer.	Philips ALU111MM-75W-G53-12V-8D 8 degrees beam	150W
F17		**Edison Price Darklite AR111/5AA** Dimming electronic transformer Fully recessed adjustable accent 5" aperture halogen downlight with 358 degrees horizontal rotation and 0-35 degrees angular adjustment.	Philips ALU111MM-75W-G53-12V-24D 8 degrees beam	75W
F24		**Color Kinetics iColor Cove MX** Linear LED system recessed in transucent glass.	RGB LED	12W/lf

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F3	IV	Clean, 12 months	1800	1530	0.85	0.88	0.96	1.00	0.95	0.68
F14	I	Clean, 24 months	200	190	0.95	0.89	0.84	1.00	n/a	0.71
F15	IV	Clean, 12 months	1575	1496.25	0.95	0.88	0.96	1.00	n/a	0.80
F17	IV	Clean, 12 months	1575	1496.25	0.95	0.88	0.96	1.00	n/a	0.80
F24	I	Clean, 24 months	n/a	n/a	0.70	0.89	0.84	1.00	n/a	0.52

Power Density Calculation

Type	Quantity	Watts/Fixture	Watts			
F3	21	20	420	**Total Watts**	726	
F14	6 lf	20 W/lf	120			
F15*	14	150	n/a	**Area (Sq.ft)**	911	
F17	2	75	150			
F24	3 lf	12 W/lf	36	**Power Density**	0.80	W/sq.ft.

*Fixture type F15 is highlighting critical artwork and is not included in lighting power density calculation per ASHRAE 90.1-2004, section 9.2.2.3

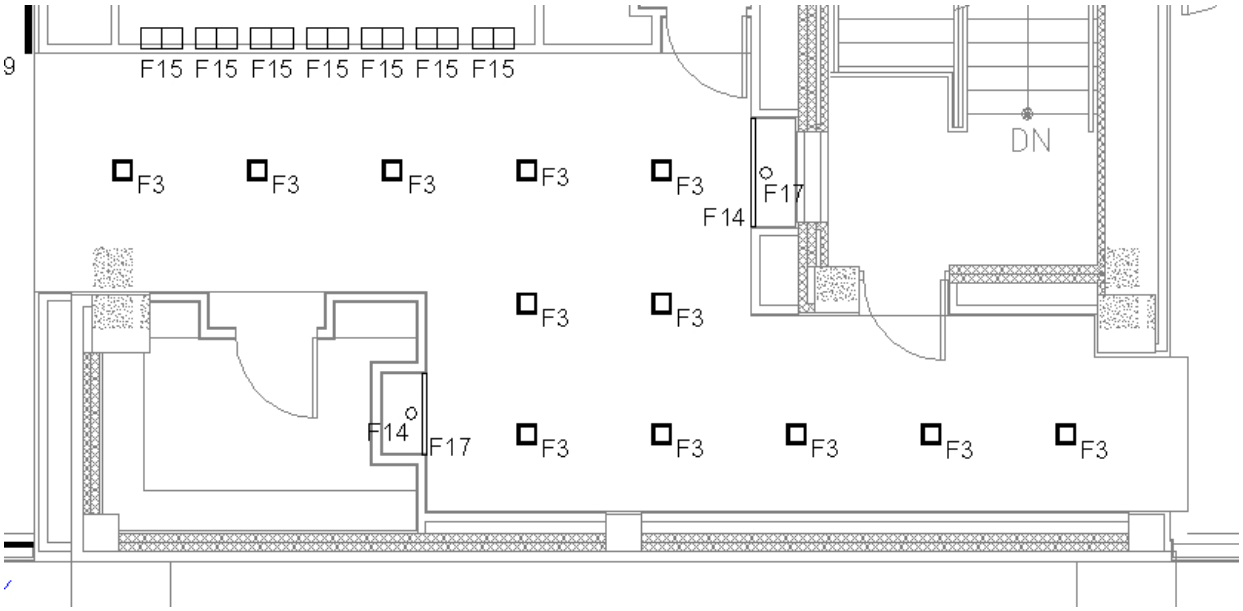
Power Density Allowances

ASHRAE 90.1-1999: 1.8 W/sq.ft., plus 1.0W/sq.ft. for artwork
ASHRAE 90.1-2004: 1.2 W/sq.ft., plus 1.0W/sq.ft. for artwork

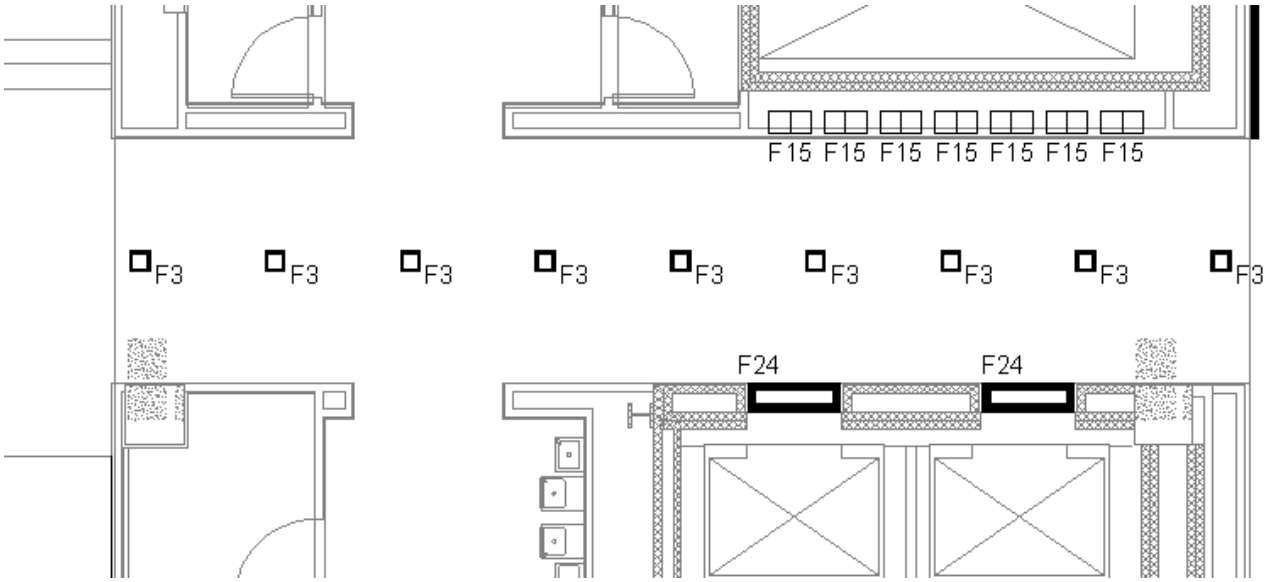
The North and South Corridor meet ASHRAE power density requirements by a considerable margin. This space can be used for power density tradeoff in areas that may have higher energy consumption.

LIGHTING LAYOUT

North Corridor Lighting Plan

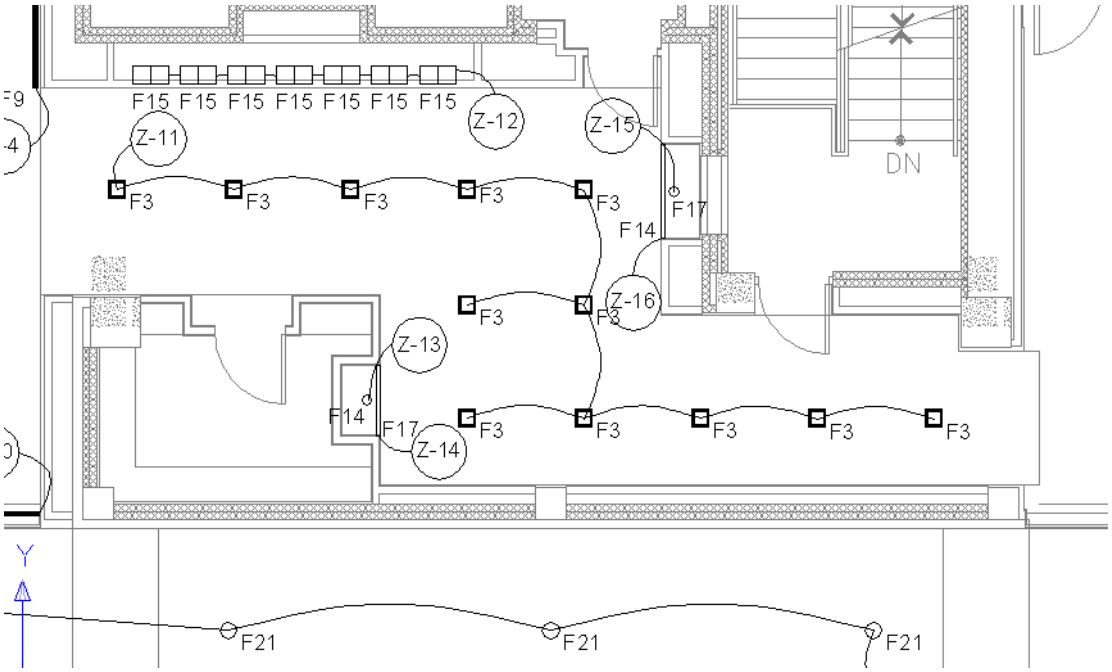


South Corridor Lighting Plan

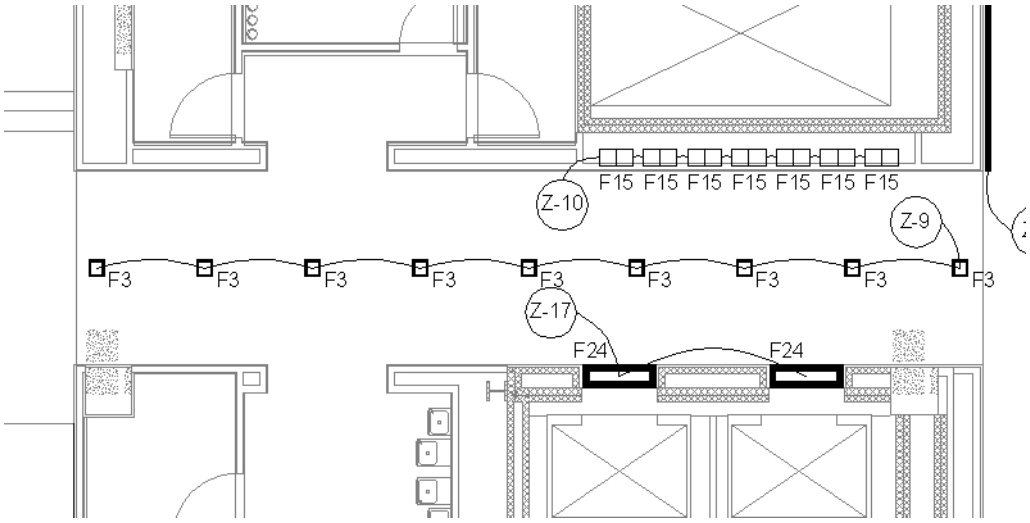


LIGHTING CONTROLS

North Corridor Lighting Controls Diagram

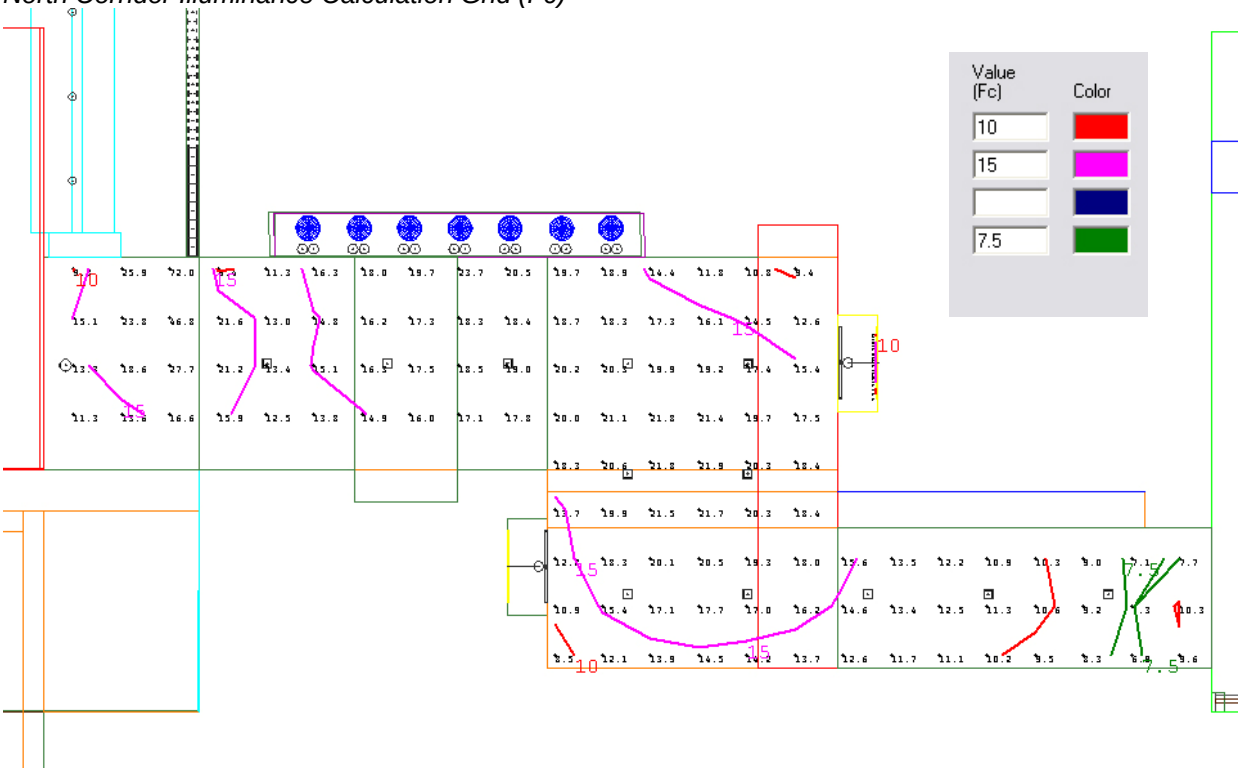


South Corridor Lighting Controls Diagram

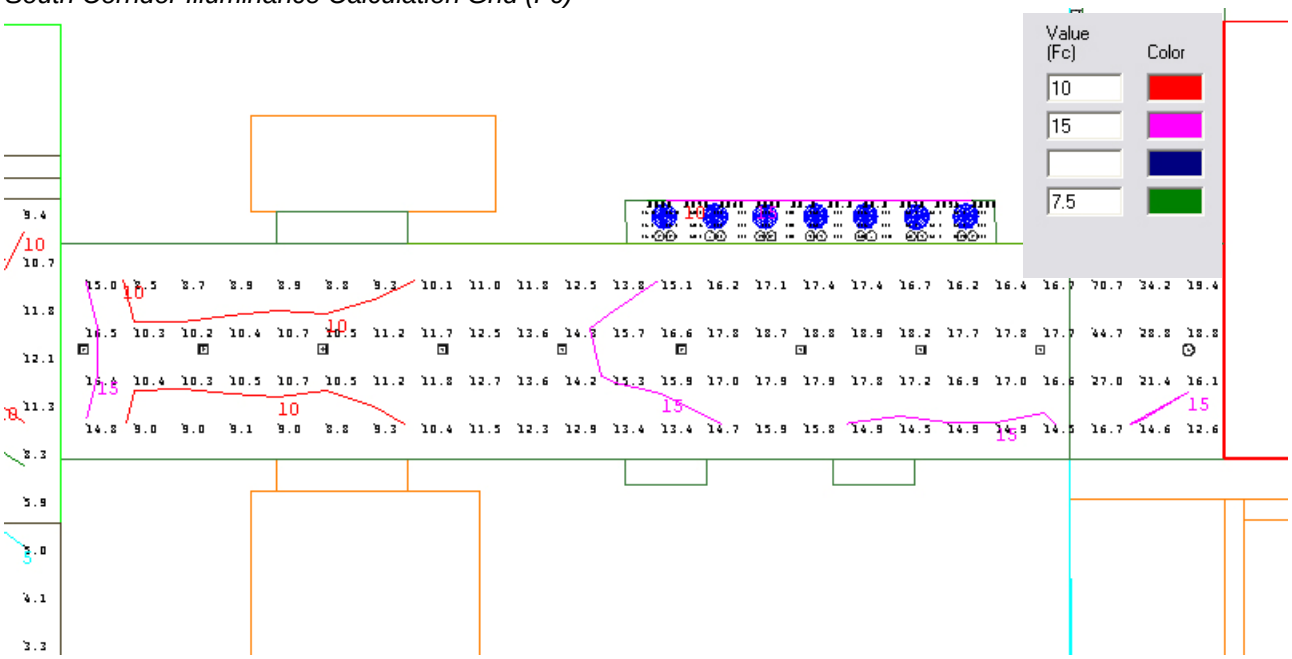


CALCULATIONS

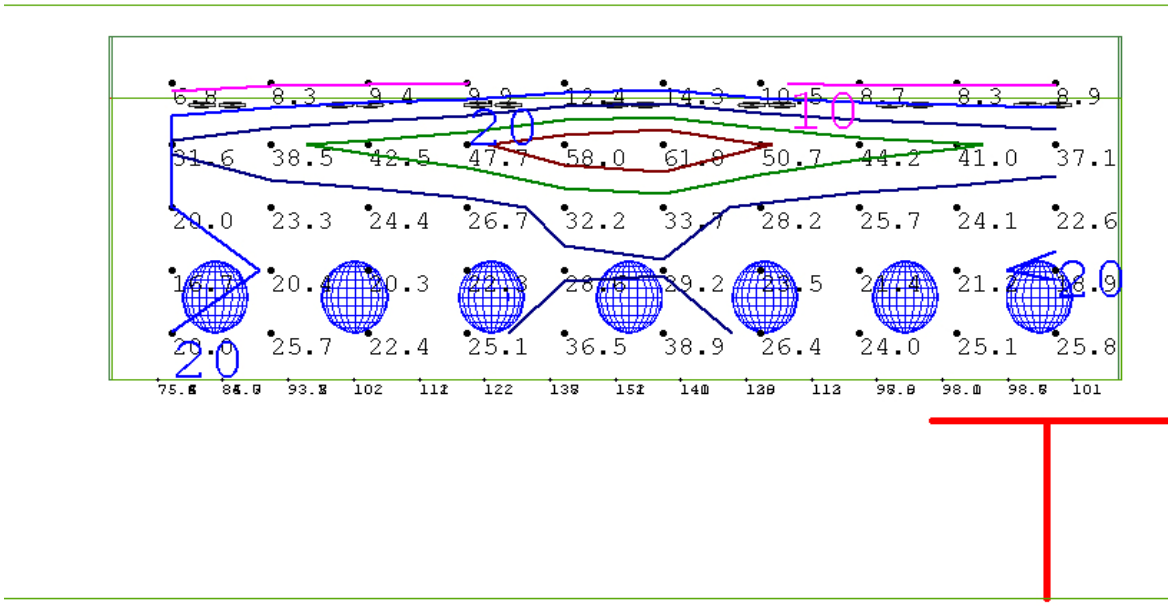
North Corridor Illuminance Calculation Grid (Fc)



South Corridor Illuminance Calculation Grid (Fc)



Vertical Illuminance Calculation Grid on Wall of Sculpture Cove (Fc)



Calculation Summary Data

North Corridor Illuminance (FC)	
Average	16.5
Maximum	72
Minimum	6.9
Avg/Min	2.40

South Corridor Illuminance (FC)	
Average	15.4
Maximum	70.7
Minimum	8.5
Avg/Min	2.47

Sculpture Cove Wall Illuminance (FC)	
Average	26.1
Maximum	61.8
Minimum	6.8
Avg/Min	3.84

Art Cove Painting Illuminance (FC)	
Average	45.62
Maximum	270
Minimum	8.2
Avg/Min	5.56

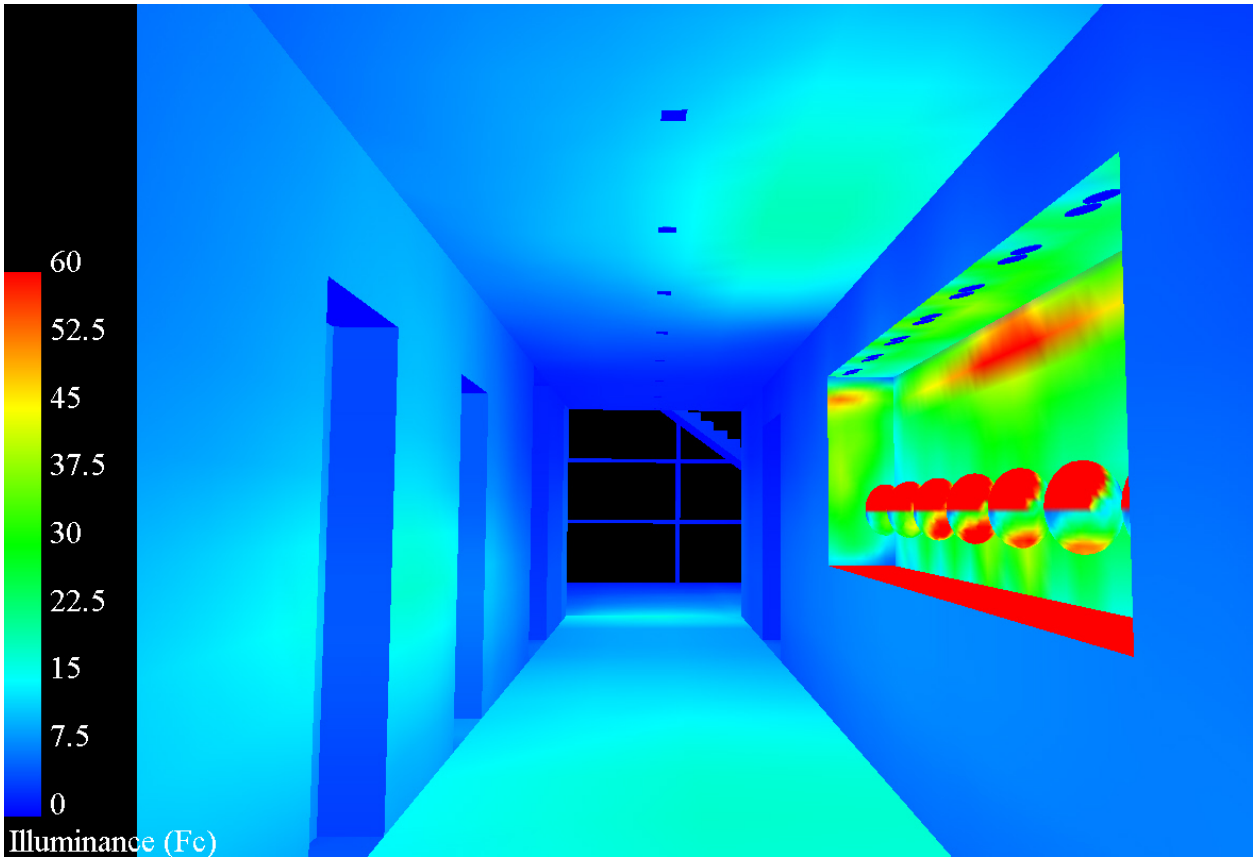
RENDERINGS (AGI32 SOFTWARE)

North Corridor Rendering

South Corridor Rendering Looking North

South Corridor Rendering Looking Toward Stair Hall

Pseudo Rendering of South Corridor



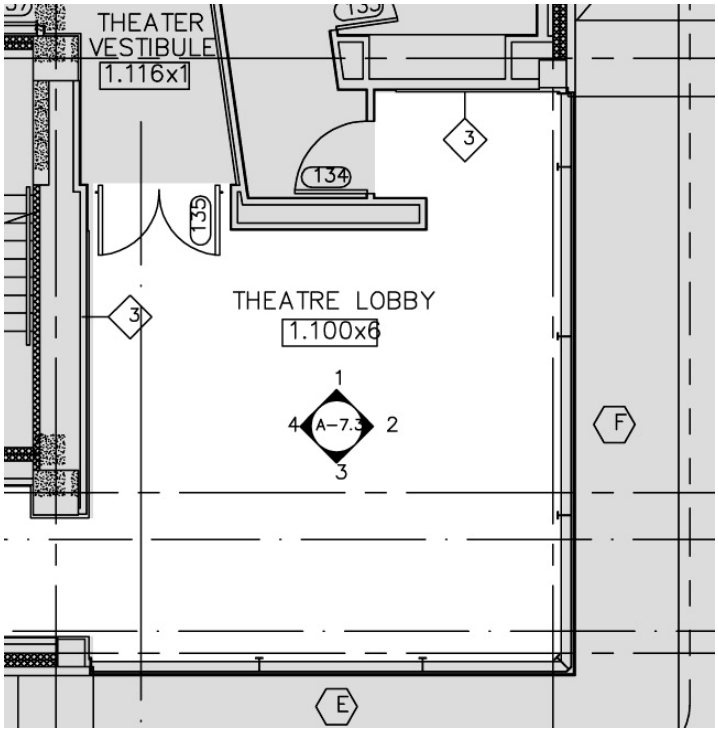
DISCUSSION

The redesigned lighting system for the North and South Corridors successfully meets corridor illumination requirements while providing improved accent lighting for the hallway's artwork. The theme of square and rectangular shapes integrates well with the architecture of the space while providing excellent lighting functionality. Illumination of the sculpture coves has been improved, while the art niches now have adjustable accent fixtures that are supplemented with ambient lighting. The color changing LEDs help draw attention to the elevators and provides better illumination on what would otherwise be a dark surface.

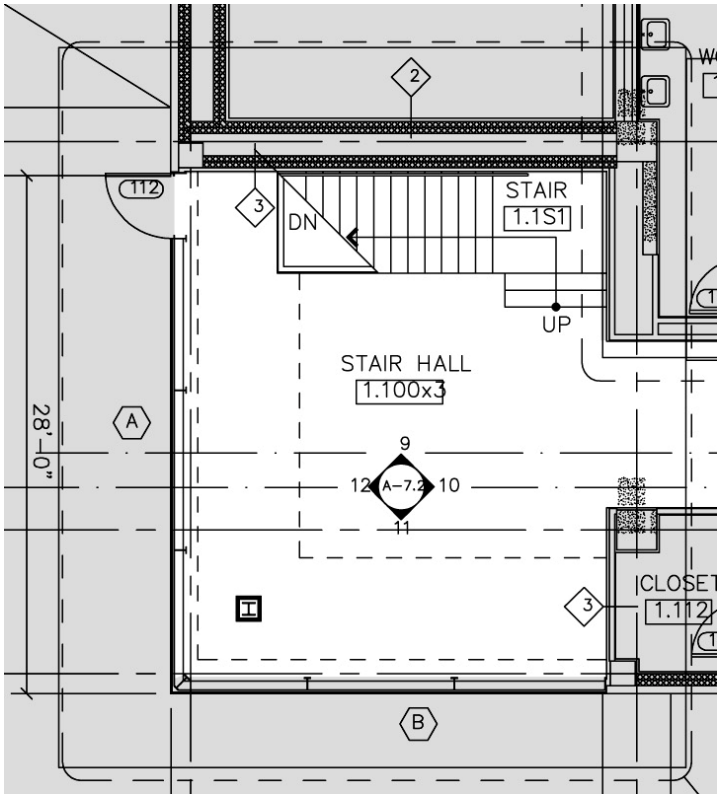
2.3 PROTHRO THEATRE LOBBY and STAIR HALL

OVERVIEW
The Prothro Theatre Lobby and South Stair Hall are two similarly designed rooms that function as circulation and gathering spaces. Both spaces feature a two-story atrium with floor to ceiling etched glass curtain walls. Common surface materiality includes honed granite floors, wood veneer walls, and high grade painted acoustical tile ceilings. The Prothro Theatre Lobby was designed with a feature red wall, and the Stair Hall features an open winding staircase with metal mesh banisters.

Theatre Lobby Floor Plan



Stair Hall Floor Plan



ROOM DATA

Total area

975 square feet (each)

Furniture

There is no furniture in this space.

Finishes

Etched glass (doors), transmittance 0.74
Wood veneer paneling, reflectance 0.74
Plaster ceiling, reflectance 0.80
Honed granite (floors), reflectance 0.37
Polished aluminum (elevator doors), reflectance 0.31

DESIGN NARRATIVE

Discussion

The lighting design for the Theatre Lobby and Stair Hall aims to provide a sense of spaciousness by channeling light to the warm wood walls. Lower light levels are desired in these spaces with high quality ambient light to compliment facial modeling. During daytime use, shadows cast through the dynamic etched glass windows will create an interesting effect on the floor and walls. At nighttime, white Light Emitting Diodes will highlight the etched glass in a patterned sequence, creating a beacon that is visible from the streets of Austin.

Lighting Layout and Luminaire Selection
Ceramic metal halide semi-recessed fixtures are strategically placed on the ceiling to evenly illuminate the wood paneled walls. In the Prothro Theatre Lobby, this is the extent of the lighting. The Stair Hall's metal halide lighting is supplemented with fully recessed compact fluorescent downlights identical to those located in the North and South Corridors. Cool white Light Emitting Diodes are located along the top and bottom faces of all window mullions to graze the glass curtain walls and catch the etched glass images.

DESIGN CRITERIA

Horizontal Illuminance (important): 10 fc

Vertical Illuminance (important): 3 fc

Appearance of Space and Luminaires (very important)
These spaces are "front of the house" and providing a visually pleasing environment is important.

Color Appearance and Color Contrast (somewhat important)
A lighting system that compliments the natural wood colors should be provided.

Daylighting Integration and Control (very important)
The lobby/corridor area features large daylight spaces at each end. There is no special artwork in this area to protect from harmful rays, but thought should be given into providing a lighting system that can adapt to the varying levels of natural light.

Direct Glare (somewhat important)
Direct glare is not a major concern in this area because no prolonged, visually intensive tasks will be taking place.

Flicker and Strobe (somewhat important)
No equipment in this room should result in flicker or strobe.

Light Distribution on Surfaces (somewhat important)
Even distribution should be achieved on wall surfaces, though varied lighting levels between surfaces may be a desired effect.

Light Distribution on Task Plan/Uniformity (somewhat important)
There are no "task plans" in this space other than normal walking surfaces. These areas should be adequately lit, especially the steep set of stairs. Shadow and/or light intensity changes on the stair treads may be desirable to help occupants identify the edges of each step.

Luminance of Room Surfaces (somewhat important)
Surfaces should be illuminated in a manner that enhances the architecture and makes the space visually pleasing. No strict luminance requirements need to be followed for any of the surfaces in this room.

Modeling of Faces or Objects (important)
Lighting in this space should compliment faces.

Points of Visual Interest (very important)
Areas of visual interest include the large open stairwell, etched glass curtain walls, and veneer wood interiors

Reflected Glare (not important)

Personal recommendation: important
Reflected glare may be a concern on the glossy wood veneer walls, and the lighting design should plan for this accordingly.

Shadows (not important)

Personal recommendation: important
Large shadows will be cast onto the floors of the spaces with etched glass. This will create interesting images and are a central part of the design.

Source/Task/Eye Geometry (somewhat important)

There are no areas in this space where view of luminaries and/or their may provide an annoying distraction from task work.

Sparkle/Desirable Reflected Highlights (not important)

Personal recommendation: somewhat important
If implemented properly, this space may be able to incorporate sparkle.

Surface Characteristics (important)

There are many interesting surfaces in this space, and a successful lighting system will compliment these features.

System Control and Flexibility (somewhat important)

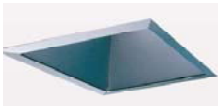
The use of these spaces on average does not vary. A lighting system that responds to daylight levels may be desirable, but the spaces themselves are generally single-use.

Special Considerations

It is important to determine the best lighting system to compliment the etched glass walls.

LIGHTING SYSTEM DATA

Fixture Schedule

TYPE		DESCRIPTION	LAMP	FIXTURE WATTS
F3		**Kurt Versen Lighting H-8653** Recessed compact fluorescent 5-1/2" square downlight.	Philips PL-T/26W/830	26W
F12		**Elliptipar Style 204** Semi-recessed ceramic metal halide wall grazer with semi-gloss white reflector and vertical baffles.	Philips 175W CMH	175W
F18		**io Lighting Line 0.75** Window mullion recessed linear LED system with 10 degrees beam spread.	5000K Cool White LED	8W/lf

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F3	IV	Clean, 12 months	1800	1530	0.85	0.88	0.96	1.00	0.95	0.68
F12	IV	Clean, 36 months	13500	9100	0.67	0.75	0.96	0.90	1.00	0.44
F18	I	clean, 24 months	n/a	n/a	0.70	0.88	0.96	1.00	n/a	0.59

Power Density Calculation for Theatre Lobby

Type	Quantity	Watts/Fixture	Watts			
F3	0	20	0	**Total Watts**	955	
F12	5	191	955			
F18*	n/a	n/a		**Area (Sq.ft)**	975	
				Power Density	0.98	W/sq.ft.

*Fixture type F18 is highlighting critical artwork and is not included in lighting power density calculation per ASHRAE 90.1-2004, section 9.2.2.3

Power Density Calculation for Stair Hall

Type	Quantity	Watts/Fixture	Watts			
F3	11	20	220	**Total Watts**	1175	
F12	5	191	955			
F18*	n/a	n/a		**Area (Sq.ft)**	975	
				Power Density	1.21	W/sq.ft.

*Fixture type F18 is highlighting critical artwork and is not included in lighting power density calculation per ASHRAE 90.1-2004, section 9.2.2.3

Power Density Allowances

ASHRAE 90.1-1999: 1.8 W/sq.ft., plus 1.0W/sq.ft. for artwork
ASHRAE 90.1-2004: 1.2 W/sq.ft., plus 1.0W/sq.ft. for artwork

Although the Stair Hall exceeds the ASHRAE power density requirements, a simple calculation shows that the room power density tradeoff from the Theatre Lobby will balance the two spaces:

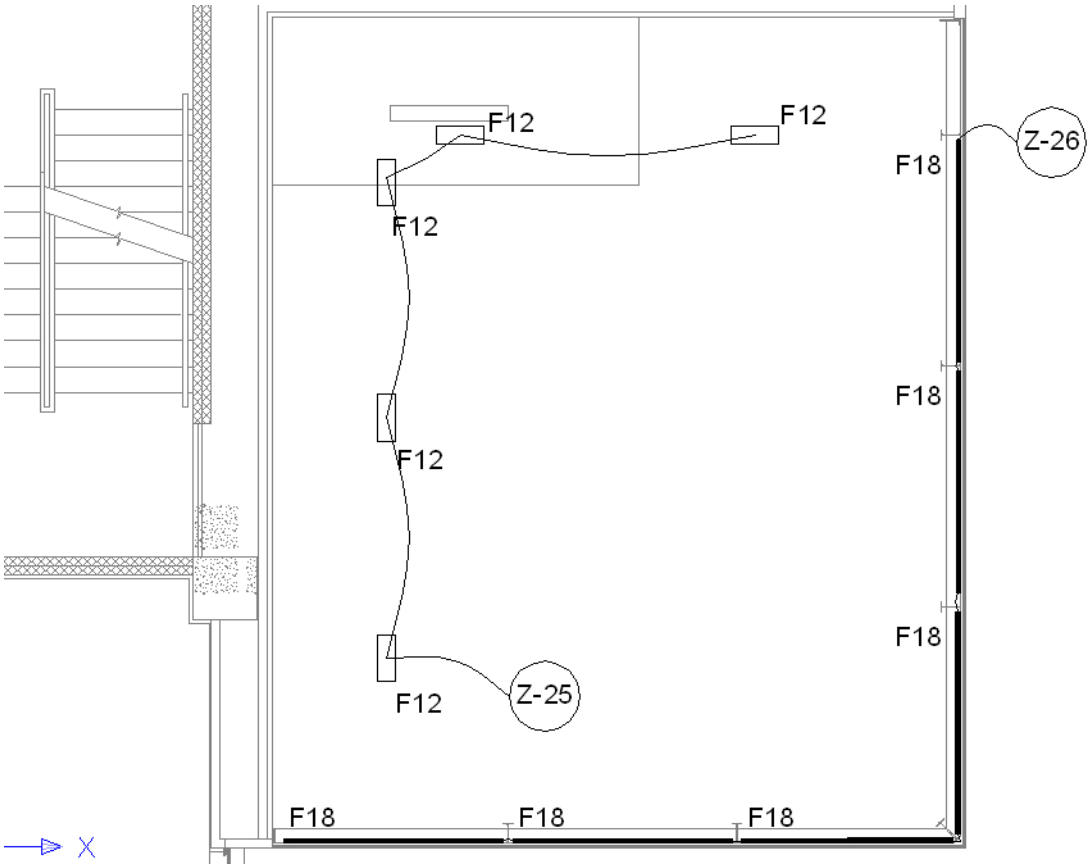
Power overuse Stair Hall:
(0.01 W/sq.ft) x (975 sq.ft.) = 9.75 Watts

Power underuse Theatre Lobby:
(1.0 W/sq.ft. – 0.98 W/sq.ft.) x 975 sq,ft. = 19.5 Watts

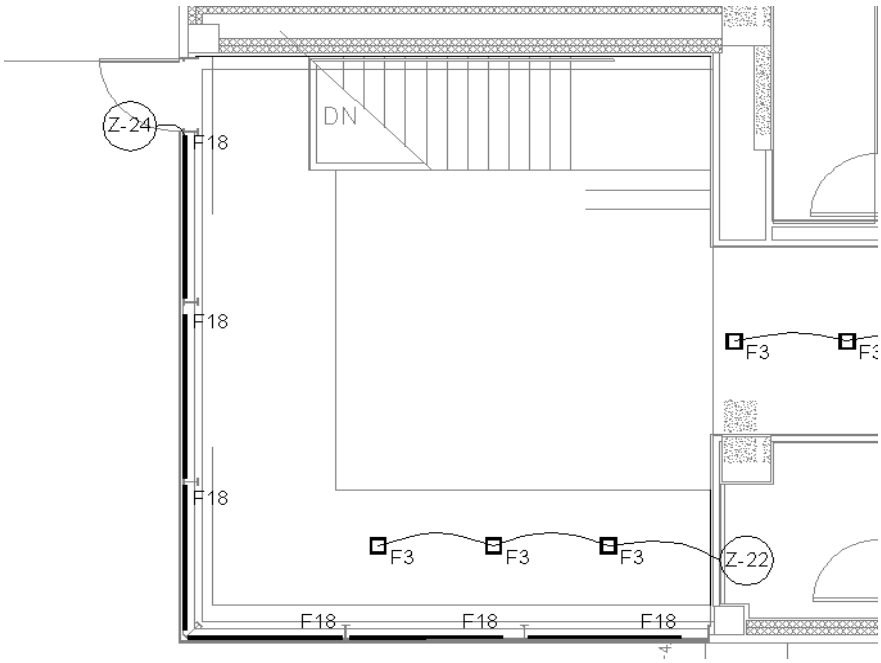
The additional 9.5 Watts consumed by the Stair Hall can be made up for with the 19.5 Watts not used in the Theatre Lobby.

LIGHTING LAYOUT

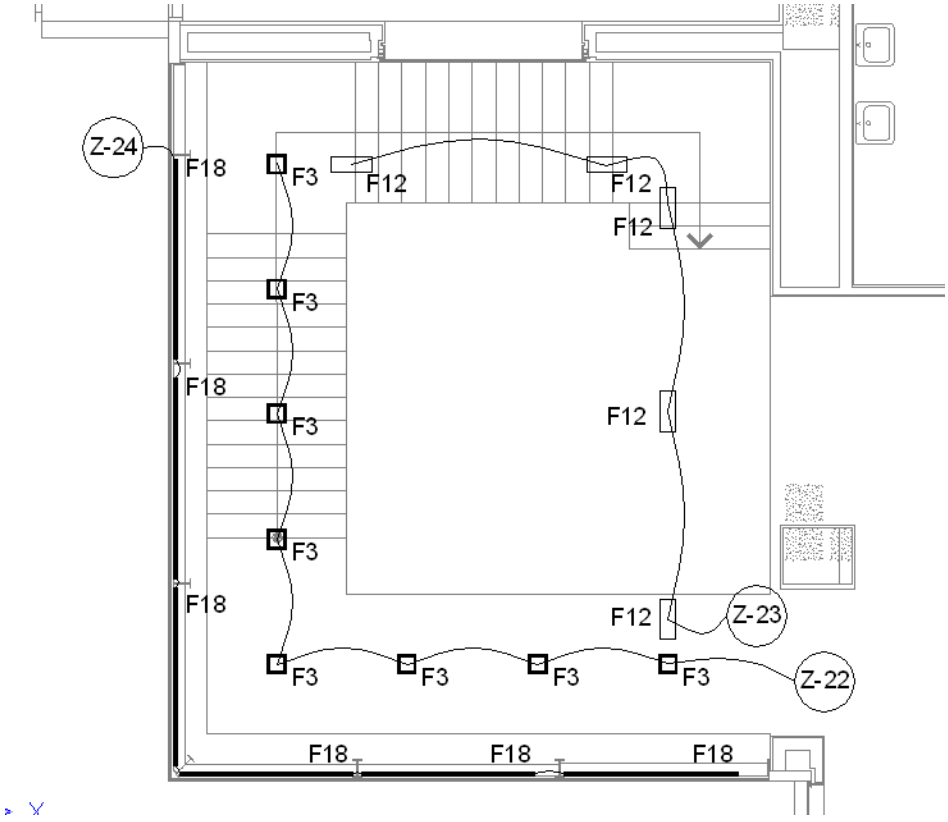
Theatre Lobby Reflected Ceiling Plan and Controls Diagram



Stair Hall Reflected Ceiling Plan and Controls Diagram, First Floor

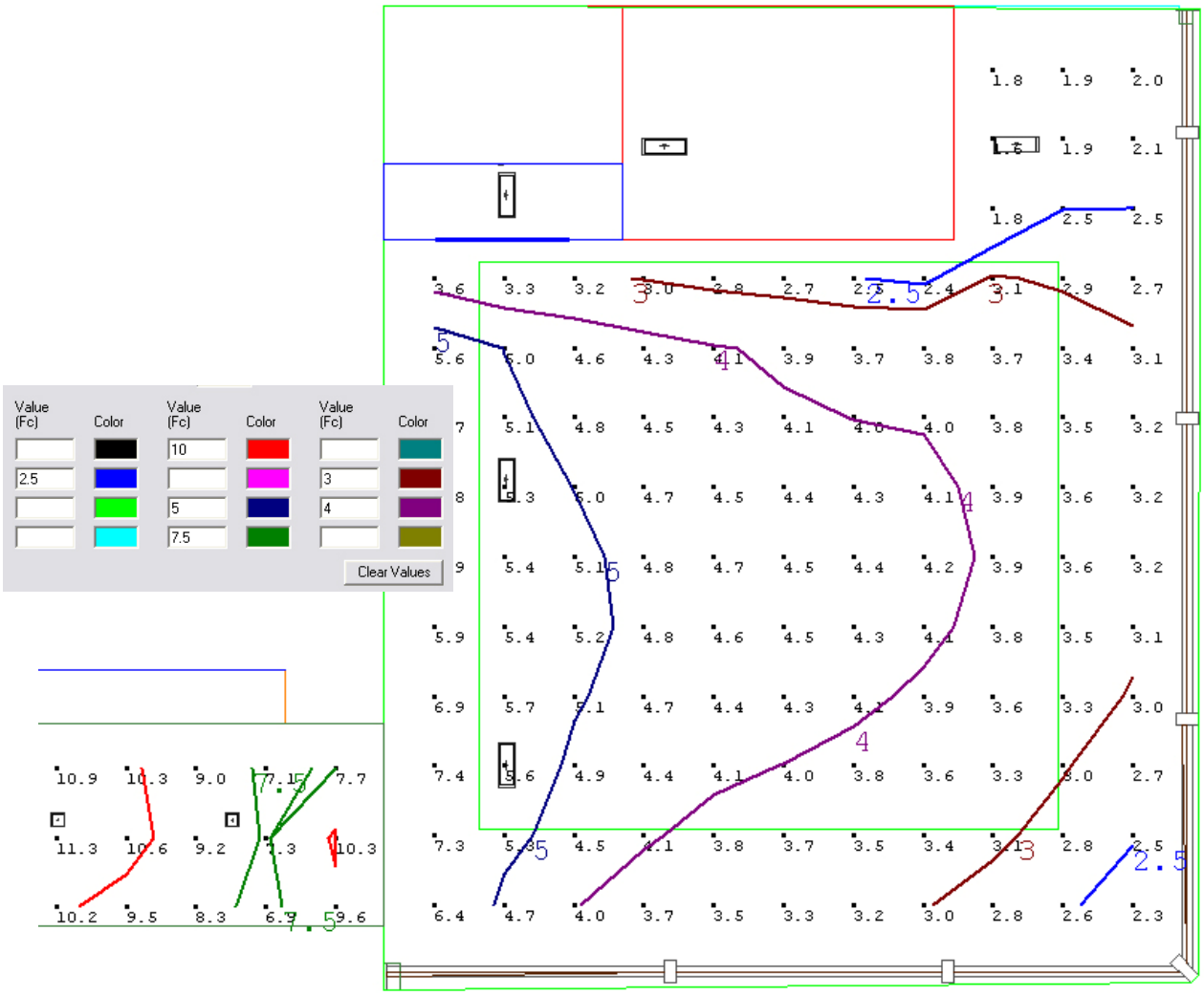


Stair Hall Reflected Ceiling Plan and Controls Diagram, Second Floor

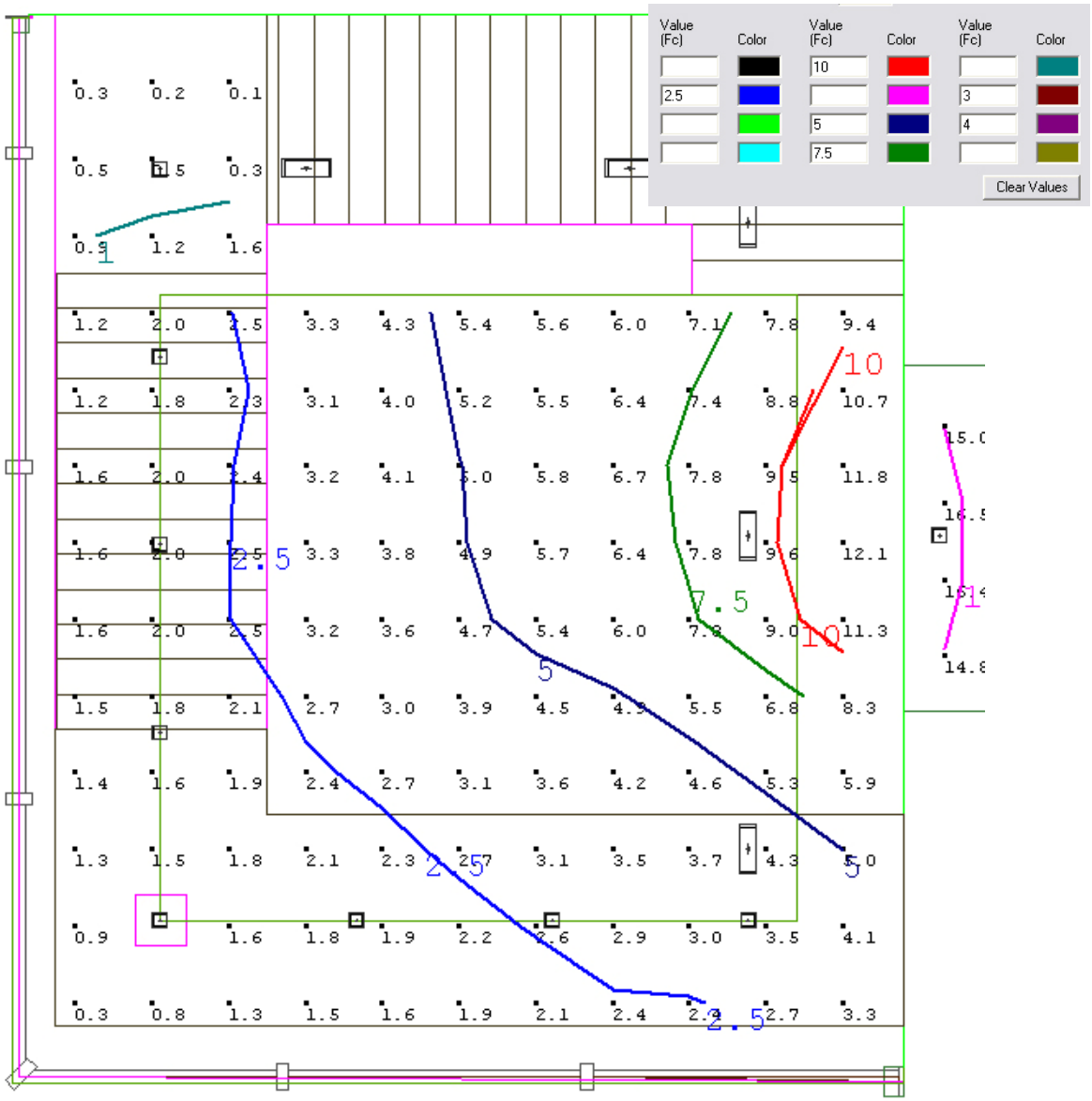


CALCULATIONS

Theatre Lobby Iluminance Grid (Fc)



Stair Hall Calculation Grid (Fc)



Calculation Summary Data

Theatre Lobby Floor Illuminance (FC)	
Average	3.95
Maximum	7.40
Minimum	1.60
Avg/Min	4.63

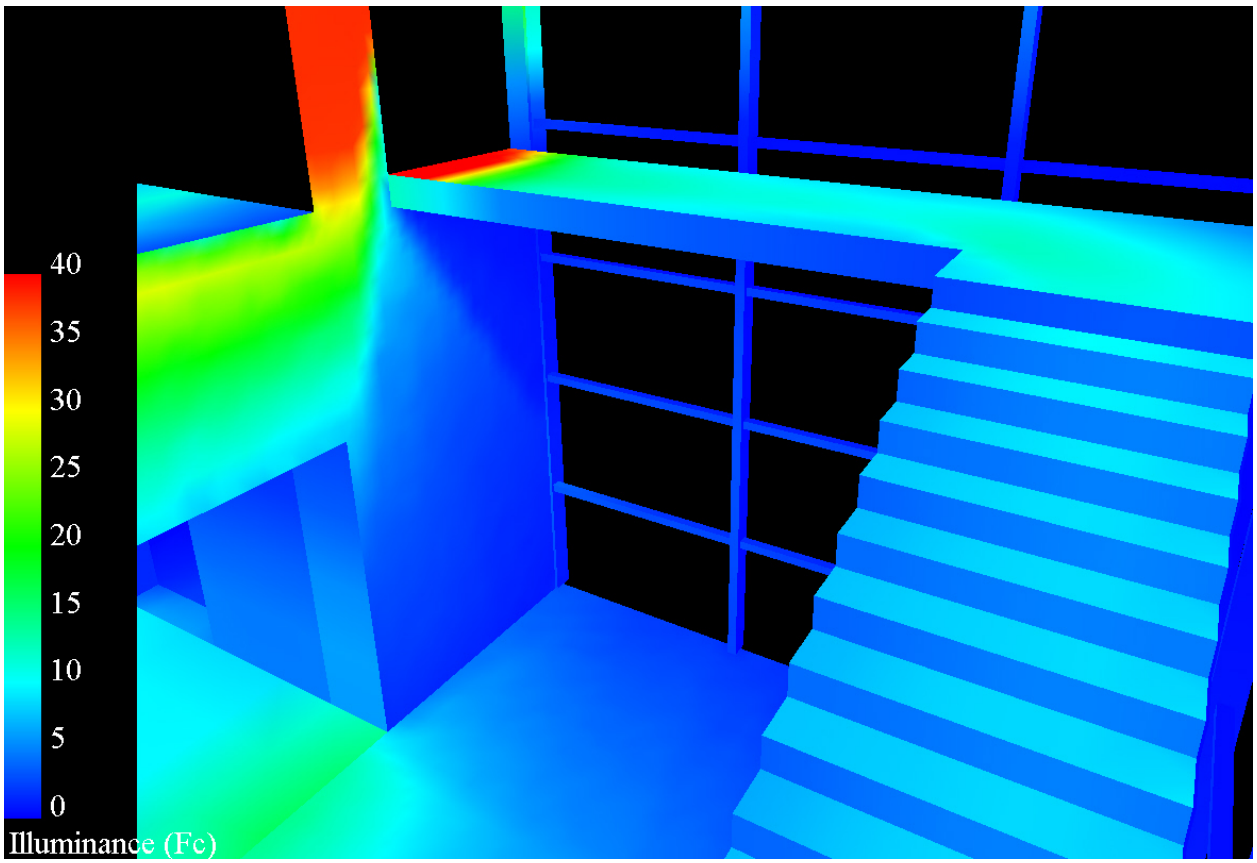
Stair Hall Floor Illuminance (FC)	
Average	3.83
Maximum	12.1
Minimum	0.90
Avg/Min	4.26

RENDERINGS (AGI32 SOFTWARE)

Theatre Lobby Rendering

Stair Hall Rendering

Pseudo Rendering of Stair Hall



DISCUSSION

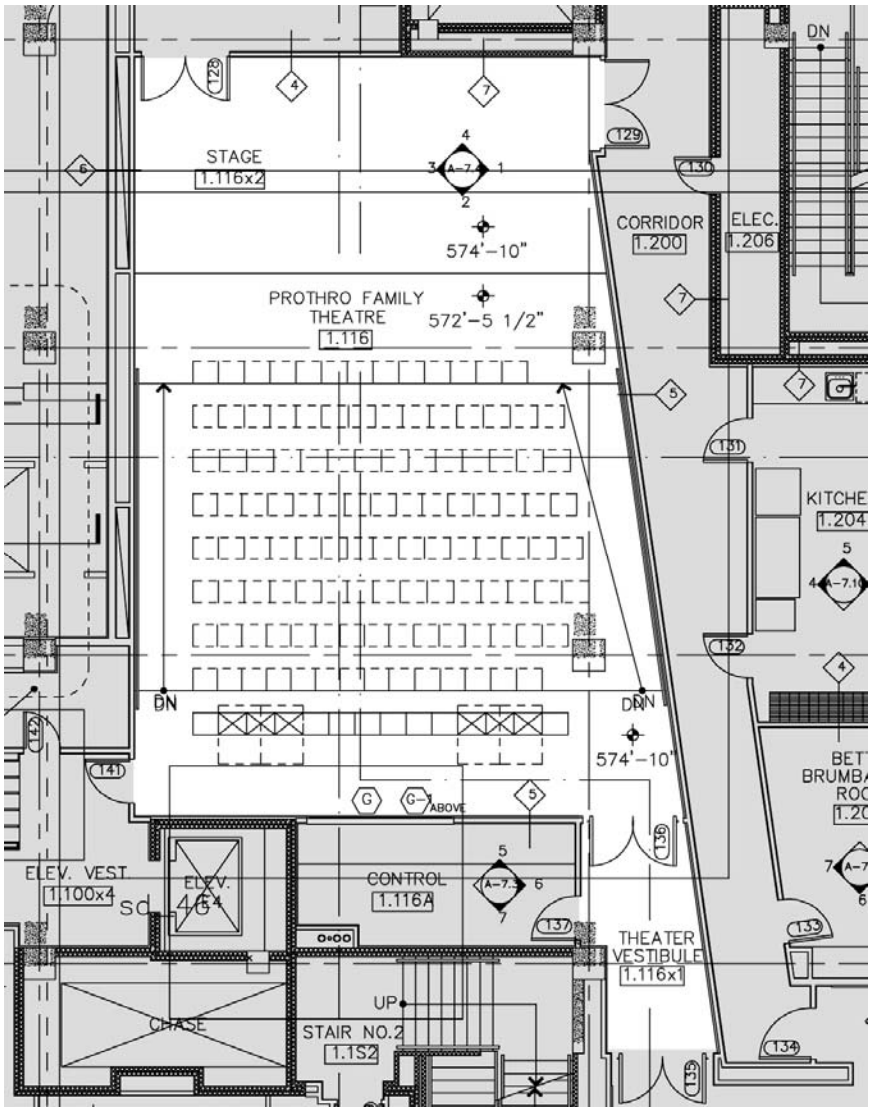
The redesigned lighting for the Theatre Lobby and Stair Hall successfully meets design requirements, including ASHRAE power density restrictions. It was challenging to provide a viable design to illuminate the double height wood veneer walls without surpassing power density requirements. Compared to the existing PAR incandescent wall grazing system, the new system illuminates the walls less evenly. This sacrifice was considered necessary because of the strict power density requirements that have been imposed since the construction of this building. It should be noted that the wood walls are evenly illuminated, but not with as precise a consistency as with the existing system. The new system does provide the advantage of eliminating the need to continually replace short-lived incandescent lamps; the ceramic metal halides will only need to be replaced every few years.

2.4 PROTHRO FAMILY THEATRE

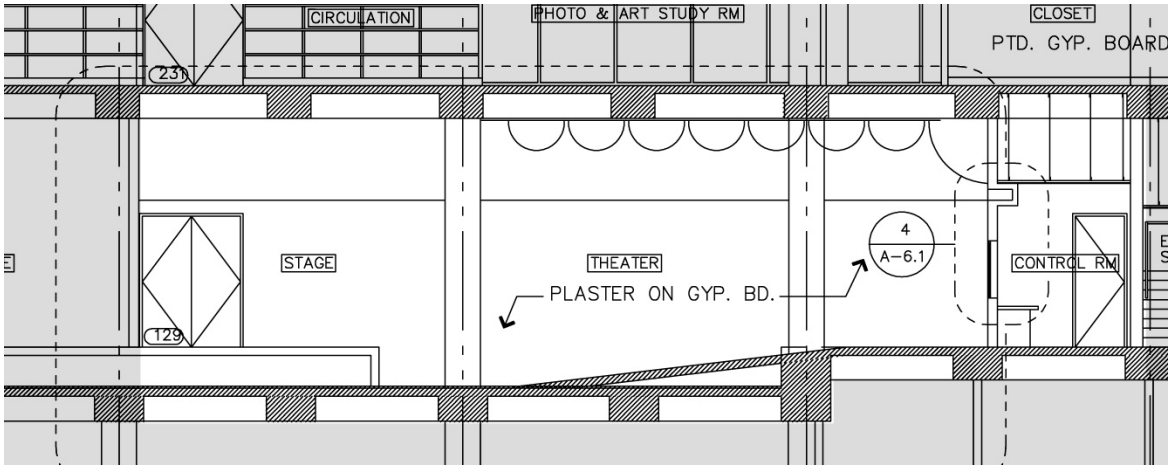
OVERVIEW
The Prothro Family Theatre serves various functions, ranging from video presentation to guest lectures. In some cases, the audience may become part of the presentation. The theatre is designed for a capacity of 130. Materials within the space include wood, a suspended (draped) fabric ceiling, exposed concrete structure, vibrant red walls, and carpeted floors. There is also a large waiting lobby with floor to ceiling windows and a transition vestibule leading to the auditorium space.

Please not that more information regarding this space, including room sections, is covered in Section 3, Acoustical Breadth Work.

Theatre Plan



Theatre Section



ROOM DATA

Total area

1,600 square feet (excluding stage area)
460 square feet (stage)

Furniture

Theatre seating

Finishes

Red fabric walls, reflectance 0.45
Carpeted floors, reflectance 0.30
Draped fabric ceiling, transmittance 0.15, reflectance 0.35
Hardwood floors, reflectance 0.20
Painted concrete columns, reflectance 0.25

DESIGN NARRATIVE

Discussion

When redesigning this space, considerable time was spent coordinating the lighting system with the needs of the acoustical redesign of the space. After a study of the room acoustics, it was determined an entirely new ceiling solution was needed. The lighting of this space seeks to create a warm, inviting environment for the theatre guests. The new ceiling design was taken advantage of and used to create a warm glowing pad of light along the perimeter of the ceiling, while downlights were used to illuminate the center of the space.

Lighting Layout and Luminaire Selection

Halogen downlights were selected for their excellent color rendering and the ability to easily integrate with theatrical systems. The halogen sources will allow simple, dependable dimming while producing a warm, inviting space that will compliment the incandescent lighting of common theatrical lighting equipment. Along the perimeter linear fluorescent sources have been selected to give the acoustical ceiling a light, floating appearance. The fluorescent fixtures are connected to Lutron Hi-Lume zero to full output dimming ballasts. The fluorescent system is designed to supplement the halogen system. Lighting designers will have the ability to control the fluorescent system separately and may choose to leave it off for some events.

DESIGN CRITERIA

Horizontal Illuminance (important): 10-20 fc

Horizontal illuminance should be sufficient enough to provide a clear path of travel down the isles and allow brief periods of paper reading.

Vertical Illuminance (somewhat important): 3 fc

Enough vertical illuminance should be provided to allow facial recognition.

Appearance of Space and Luminaires (somewhat important)

Luminaires should integrate well with the theatre's architecture.

Color Appearance and color Contrast (important)

Quality light should be provided to match the grandeur of the theatre.

Daylighting Integration and Control (important)

No daylight is present in the theatre.

Direct Glare (somewhat important)

Direct glare should be avoided; occupants will be sitting in one place without the ability to move away from glare spots.

Flicker and Strobe (somewhat important)

Luminaires and related equipment should be selected that can easily be dimmed without flicker and strobe effects.

Luminance of Room Surfaces (somewhat important)

Surfaces should be highlighted to compliment the architecture and create visual points of intrigue while the occupants are waiting for their performance.

Modeling of Faces or Objects (somewhat important)

Facial identification should be sufficient enough to hold brief conversations before the performance.

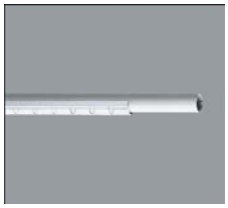
System Control and Flexibility (very important)

System controls should be very flexible; modern theatre performances frequently use the seating area and house lights as part of their set design. All luminaries should be linked to the stage lighting controls and have capability to be dimmed to one per cent.

Design guidelines provided by the IESNA handbook are less specific for theatres than other spaces. During normal use, house lights in the theatre are off or dimmed to low levels. Instead, the most important objective is to provide a flexible, easy to use control system.

LIGHTING SYSTEM DATA

Fixture Schedule

TYPE		DESCRIPTION	LAMP	FIXTURE WATTS
F25		**Erco Monopole** Lutron Hi-Lume 0-100% Dimming Ballast Hanging track mounted linear fluorescent area downlight with adjustable bezel.	Philips F54T5HO/830	54W
F26		**Erco Lightcast Downlight** Fully recessed halogen downlight with 40degrees cutoff.	Philips 150Q/CL	100W

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F25	III	Clean, 24 Months	5000	4750	0.95	0.90	0.95	0.90	1.00	0.77
F26	IV	Very Dirty, 24 months	2800	2660	0.95	0.88	0.95	0.90	n/a	0.71

Power Density Calculation

Type	Quantity	Watts/Fixture	Watts			
F25	21	55	1155	**Total Watts**	4855	
F26	37	100	3700			
				Area (Sq.ft)	2060	
				Power Density	2.36	W/sq.ft.

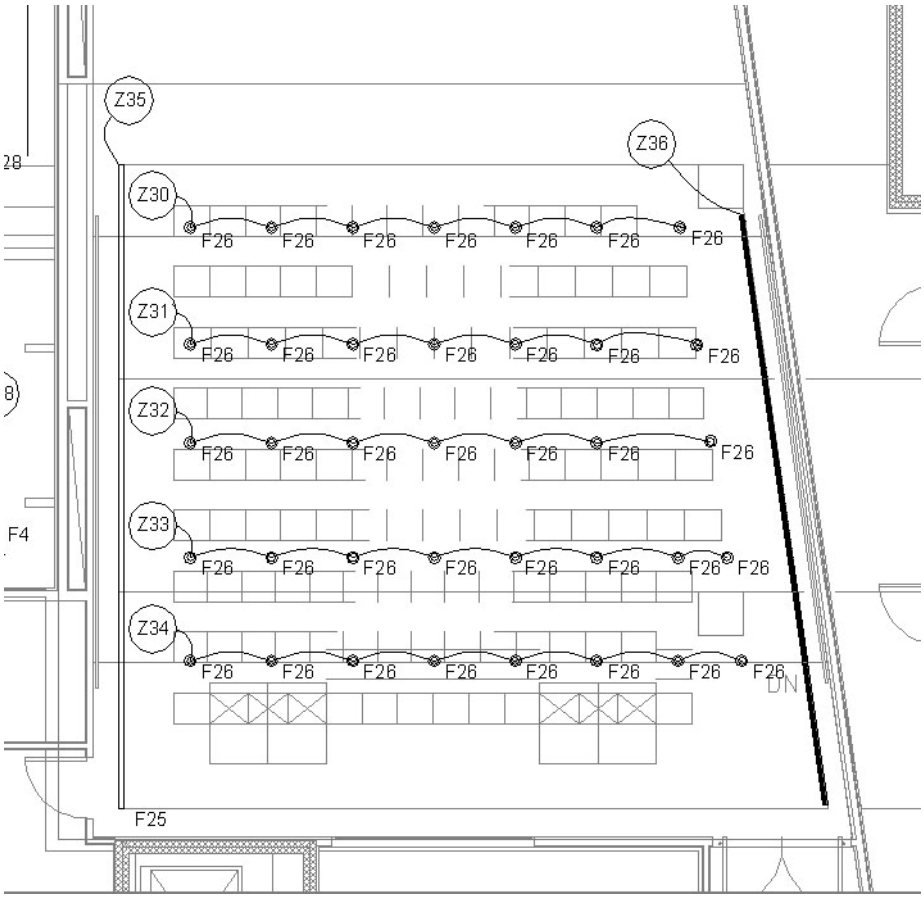
Power Density Allowances

ASHRAE 90.1-1999: 1.8 W/sq.ft, plus 1.0 W/sq. ft for artwork
ASHRAE 90.1-2004: 2.6 W/sq.ft, plus 1.0 W/sq. ft for artwork

The theatre lighting design meets power density requirements. The combination of high quality halogen downlights and diffuse fluorescent sources in perimeter areas seems to provide the best combination of color rendering, control flexibility, and energy consciousness.

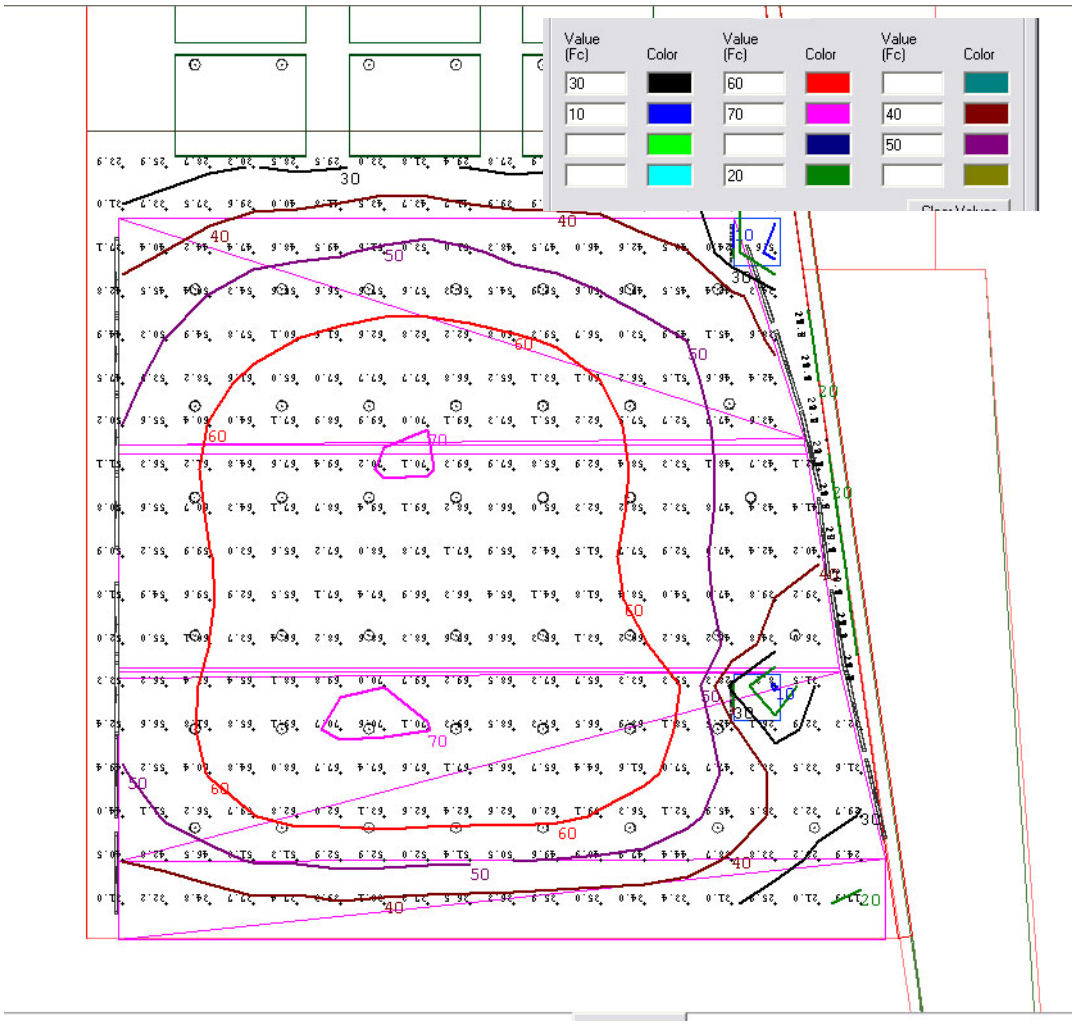
LIGHTING LAYOUT

Theatre Lighting Layout with Controls



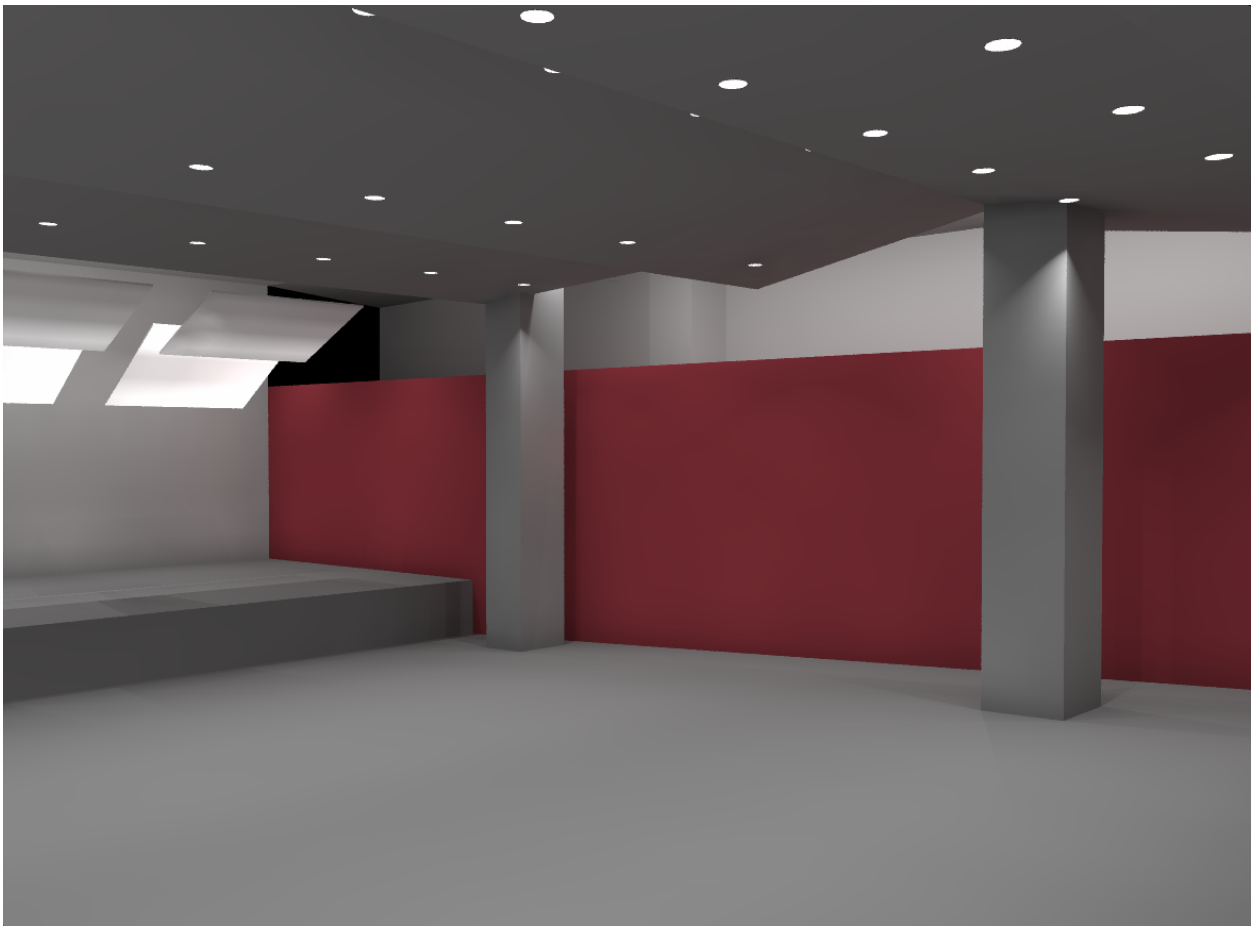
CALCULATIONS

Theatre Calculation Grid (Fc)

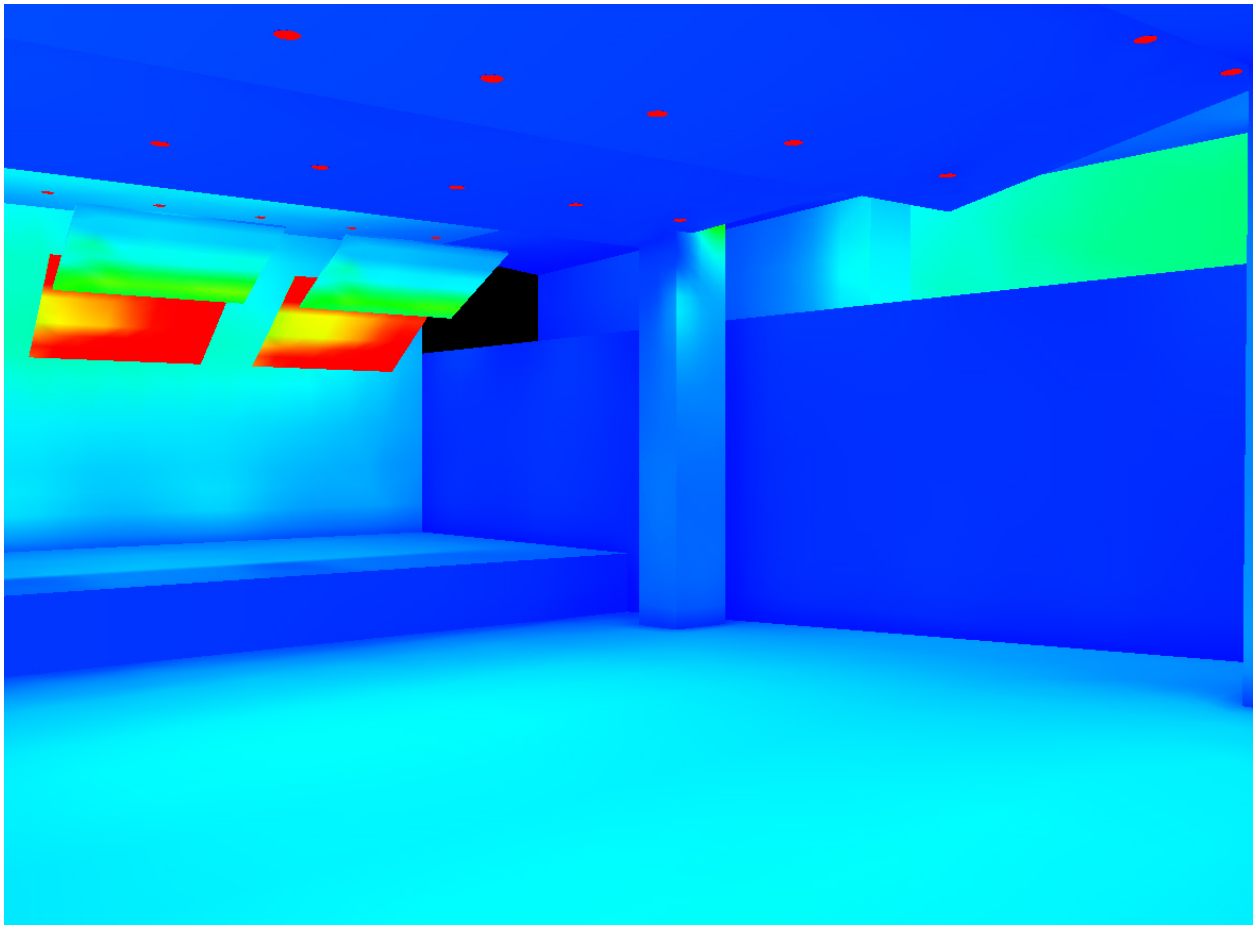


RENDERINGS (AGI32 SOFTWARE)

Theatre Rendering



Theatre Pseudo Rendering



DISCUSSION

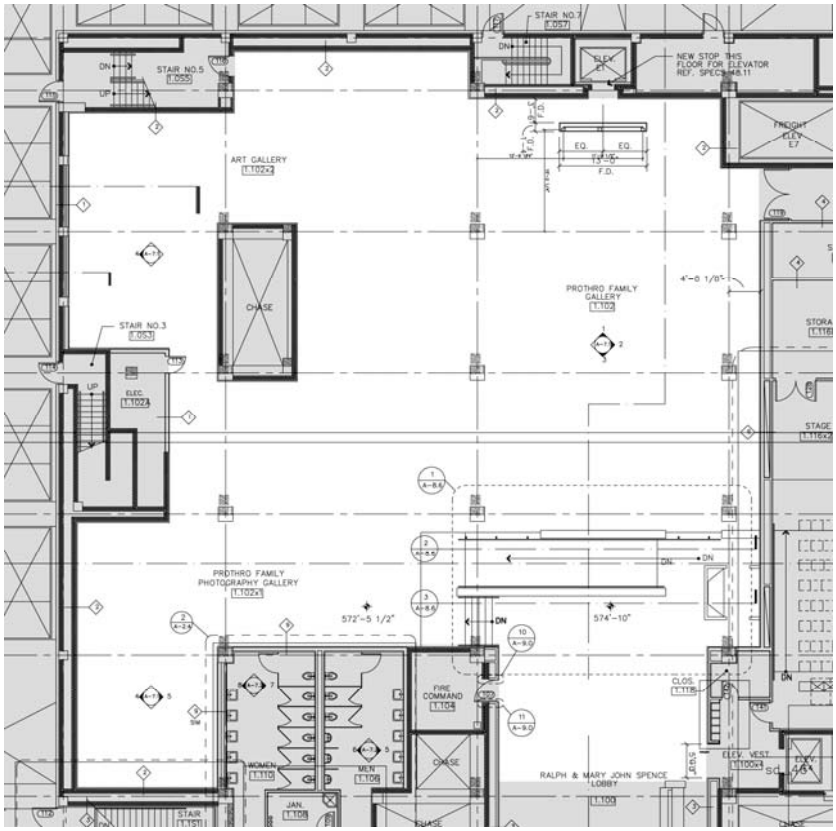
The redesign of this space is strikingly different than the existing system. A new ceiling system was required for the acoustical breadth redesign, and consequently the lighting system was designed with an entirely new approach. The recessed halogen downlights are effective at providing warm, dependable house lights that will compliment theatrical lighting installations. Undesirable scallop patterns are visible on some of the room's columns. This was an unintentional change to the space, but it was decided there was no viable alternate arrangement of the downlights; due to the skewed angle of the theatre aisle in relation to column spacing, there was no predictable spacing patter from the columns. Improvements to the lighting controls portion of this system are discussed in section 3.1, Electrical Breadth.

2.5 PROTHRO FAMILY GALLERY

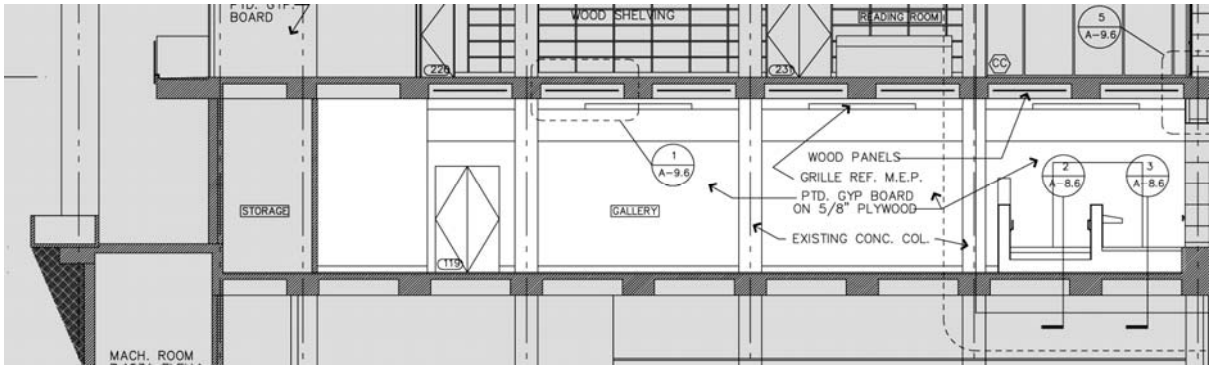
OVERVIEW

The Prothro Family Gallery is one of the main attractions at the Harry Ransom Center. Rotating exhibits are presented in this space. Additionally, many of the Ransom Center's featured collections are displayed in this area. Items include paintings by Frida Kahlo, Diego Rivera, and the first photograph. Room materials consist of gypsum board, suspended wood panels, plaster, woven wire metal panel, wood flooring, and glass. One of the more unique features of the Prothro Gallery is the Louis I. Kahn / Richard Kelly inspired light well. This light wells serve two functions: to carry indirect natural light into the second floor, and to allow diffuse ambient light down a channel and along the perimeter walls of the gallery.

Gallery Floor Plan



Gallery Section



ROOM DATA

Total area

8,360 square feet

Furniture

No furniture is present, although there are some temporary moving walls.

Finishes

Wood veneer paneling, reflectance 0.70
Plaster ceiling, reflectance 0.80
Hardwood floors, reflectance 0.13
White painted gypsum board, reflectance 0.55
Painted concrete columns, reflectance 0.50

DESIGN NARRATIVE

Discussion

A more comprehensive description of the overall design concept for the gallery can be found in Section 5, Architecture Breadth Study. The lighting system was designed to compliment the architectural revisions made in the space. The new system was designed to produce a useful, flexible lighting system for the gallery that does not distract the visitors from the artwork.

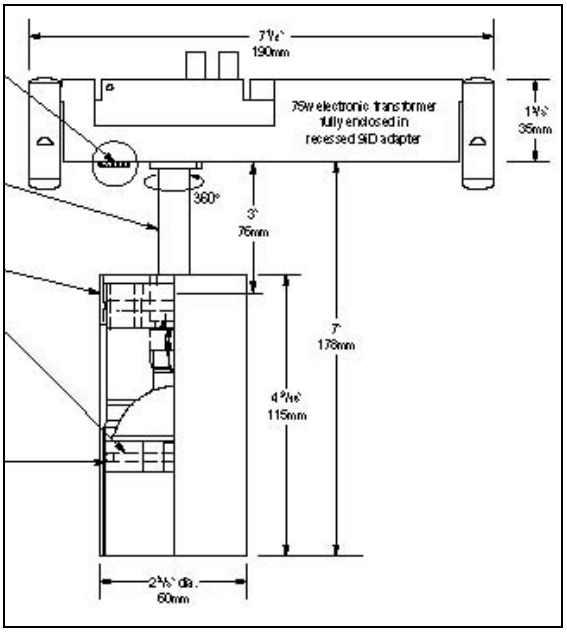
Lighting Layout and Luminaire Selection

In the main area of the gallery space, a monopoint track system has been integrated with the new architectural wood ceiling. These fixtures are easily concealed within the ceiling and give the gallery a very unique look; the typical lines of surface mounted track fixtures are virtually hidden from view. To preserve ceiling height in the lower spaces of the gallery and save in material costs, a linear system has been specified. This system further saves energy by functioning as an electric busway; the track is 277 volt power and capable of accepting 60 Ampere power feeds. This allows for considerable longer runs of track and less wire.

Track Luminaires

The busway track system incorporates an innovative luminaire design. MR-16 sources have been selected for their slim profile and superior color rendering. These fixtures incorporate an electronic transformer that is integrated into the track mounting point; the transformer snaps into the recessed busway and is hidden from view. These fixtures create a seamless design by limiting the visible fixture components to the lamp housing and stem.

Dimensioned Diagram of Fixture Type F29 (Similar to F30)



The adjustable track luminaires feature a built-in snoot to reduce direct glare. They also have the ability to be locked into position after being focused. Maintenance crew can easily replace lamps by twisting off the front piece without the need to worry about moving the aiming location of the fixture. A lighting designer or curator will not have to refocus the fixtures whenever maintenance crews replace lamps.

DESIGN CRITERIA

Criteria for this room are the combined criteria from two categories listed in the IESNA lighting handbook: "general gallery areas" and "flat displays on vertical surfaces." The more stringent of the two assessments was taken for each listed design issue.

Horizontal Illuminance (very important): 10 fc

Vertical Illuminance (very important): 3 fc general areas, 30 fc display walls

Appearance of Space and Luminaires (very important)

The overall appearance of an art gallery is extremely important. The space cannot seem cheap in comparison to the fine art it provides a home for, while on the other hand it should not distract visitors from the very reason they came – the artwork. From a lighting standpoint, this is challenging because often the only solution to gallery lighting is the most flexible choice: a track system. Track lighting is invasive because it protrudes from the ceiling, often conflicting with other architectural elements.

Color Appearance and color (very important)

Artwork must be illuminated perfectly for full appreciation. Perhaps most important to this is color appearance. Sources that provide a full spectrum of color output must be employed.

Daylighting Integration and Control (very important)

Protection of artwork from harmful ultraviolet radiation is imperative. The Prothro Gallery also incorporates a natural light well, and therefore daylight is of particular importance in this building.

Direct Glare (very important)

Direct glare should be reduced in this space to prevent distraction from the artwork.

Flicker and Strobe (somewhat important)

There does not appear to be any particular equipment in the room that will cause undesirable flicker and strobe effect.

Light Distribution on Surfaces (important)

Light in galleries should be dramatic, focusing on the artwork. Distribution on the artwork is important and individualistic to each piece, while light distribution in the room should be secondary to the needs of the artwork.

Light Distribution on Task Plan/Uniformity (very important)

As stated previously, the why light is distributed on each piece of artwork should cater to its specific needs, and the lighting system should be prepared to accommodate different distribution techniques as artwork rotates in and out of the space.

Luminance of Room Surfaces (important)

Display walls and stations should be highlighted, while other architectural features should not be lit in any manner that will compete with the artwork.

Modeling of Faces or Objects (not important)

The importance of lighting for facial recognition should be secondary to providing artwork-generated lighting displays. A silhouette image of people viewing a vibrant artifact is more enticing to the entering occupant than a crowded room of people.

Points of Visual Interest (important)

*T*he gallery lighting should enforce the important role of the artwork.

Reflected Glare (very important)

Reflected glare from any gallery art will both hide the finer details of the piece and prevent viewers from engaging in longer studies of the object.

Shadows (very important)

Shadows should not be cast on artwork unless the artist intended to create such an effect. One of many common and avoidable problems includes improper luminaire focusing, consequently creating cast shadows from bulky art frames.

Source/Task/Eye Geometry (very important)

Luminaire locations should be carefully arranged so the artwork is lit properly from all viewing angles; the viewer should not experience direct or reflected glare, and expected viewing positions should not allow the occupants to cast shadows onto the artwork (unless intended by the artist).

Sparkle/Desirable Reflected Highlights (not important)

Sparkle and desirable reflected highlights are inappropriate in art galleries unless intended by the artist.

Surface Characteristics (important)

Surface characteristics of artwork should be accentuated, with the exception of seams and other unavoidable flaws in the artist's work.

System Control and Flexibility (very important)

The lighting system should incorporate dimming for flexibility. A full set of accessories should be available for interchangeable use in the luminaries, including snoots, ultraviolet shields, spread lenses, light filters, and cross baffles.

Special Considerations (very important)

Supplementing the light well with electrical lighting must be considered. The lighting system must provide adequate ultraviolet protection as well as reduced levels of radiation. Refer to next section for details.

LIGHTING SYSTEM DATA

Fixture Schedule

TYPE		DESCRIPTION	LAMP	FIXTURE WATTS
F27		**LiteLab BusPoints** Monopoint track system recess mounted into wood ceiling.	Fixtures F29, F30	150W
F28		**LiteLab BusRun Busway** Recessed track with busway system for power, communication devices, and lighting fixtures.	Fixture F29, F30	13296 W
F29		**LiteLab Museum Collection Object Light** Busway track mounted halogen adjustable accent light with front relamping and adjustmet lock.	Philips 50MRC/SP15	N/A
F30		**LiteLab Museum Collection Wallwash** Busway track mounted halogen adjustable wallwash accent light with front relamping and adjustment lock.	Philips 50MRC/NFL24	N/A

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F28			N/A - Monopoint for Fixture Types F29 and F30							
F28			N/A - Busway track for Types F29 and F30							
F29	III	Very Clean, 9 Months	930	884	0.95	0.94	0.99	1.00	1.00	0.88
F30	III	Very Clean, 9 Months	960	912	0.95	0.94	0.99	1.00	1.00	0.88

Power Density Calculation

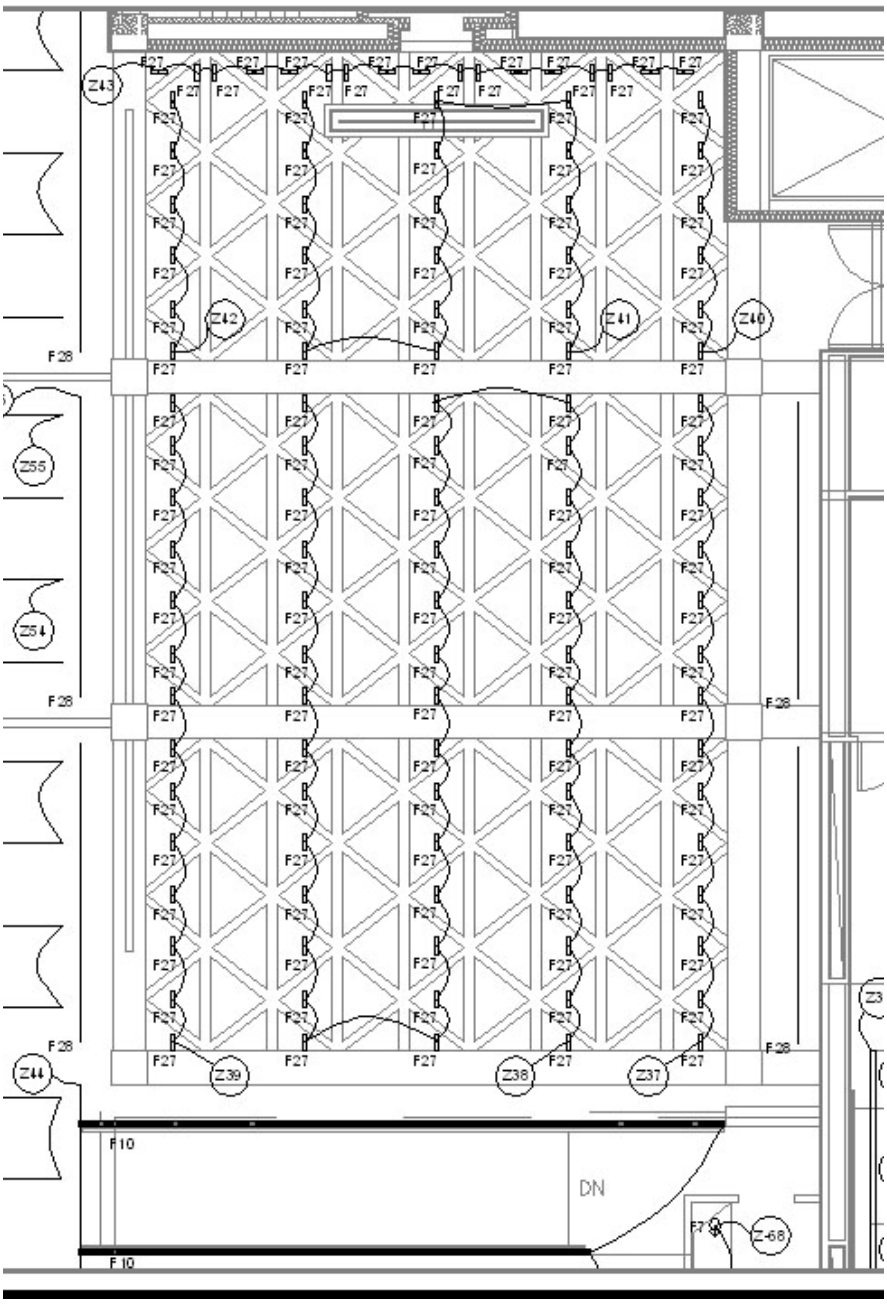
There are no power density requirements for gallery areas provided that the fixtures are used to illuminate critical artwork. Emergency and pathway lighting is integrated within the busway and monopoint system, eliminating the need for a secondary system and calculations for general lighting power density usage. This will be achieved by using a modified version of fixtures F29 and F30 that will be permeably attached to the busways; the release latch on these fixtures will be removed.

Power Density Allowance

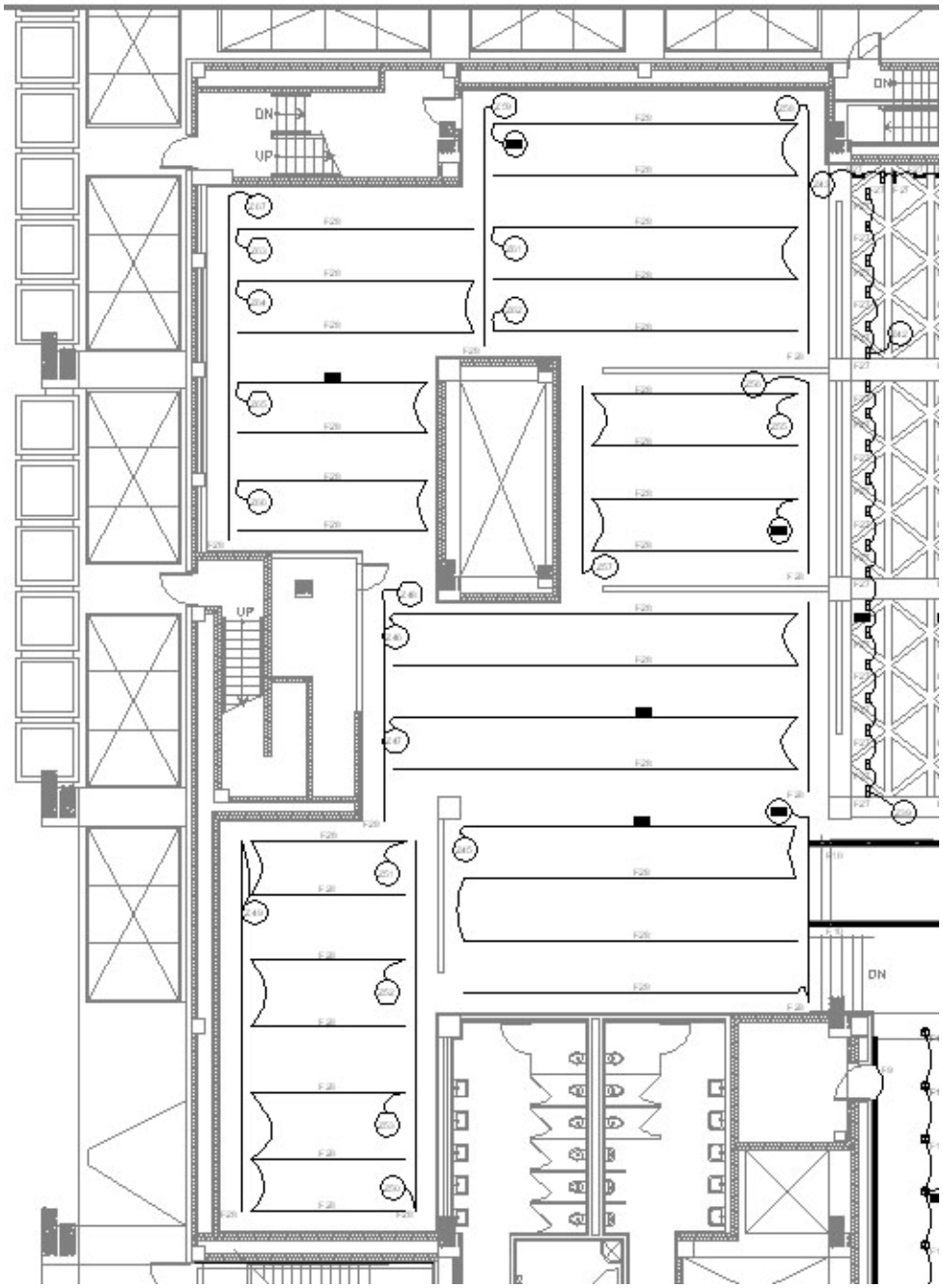
No power density allowances are listed for this space because emergency lighting is integrated with the critical artwork fixtures.

LIGHTING LAYOUT

Lighting Layout with Control Zones for Main Gallery Space

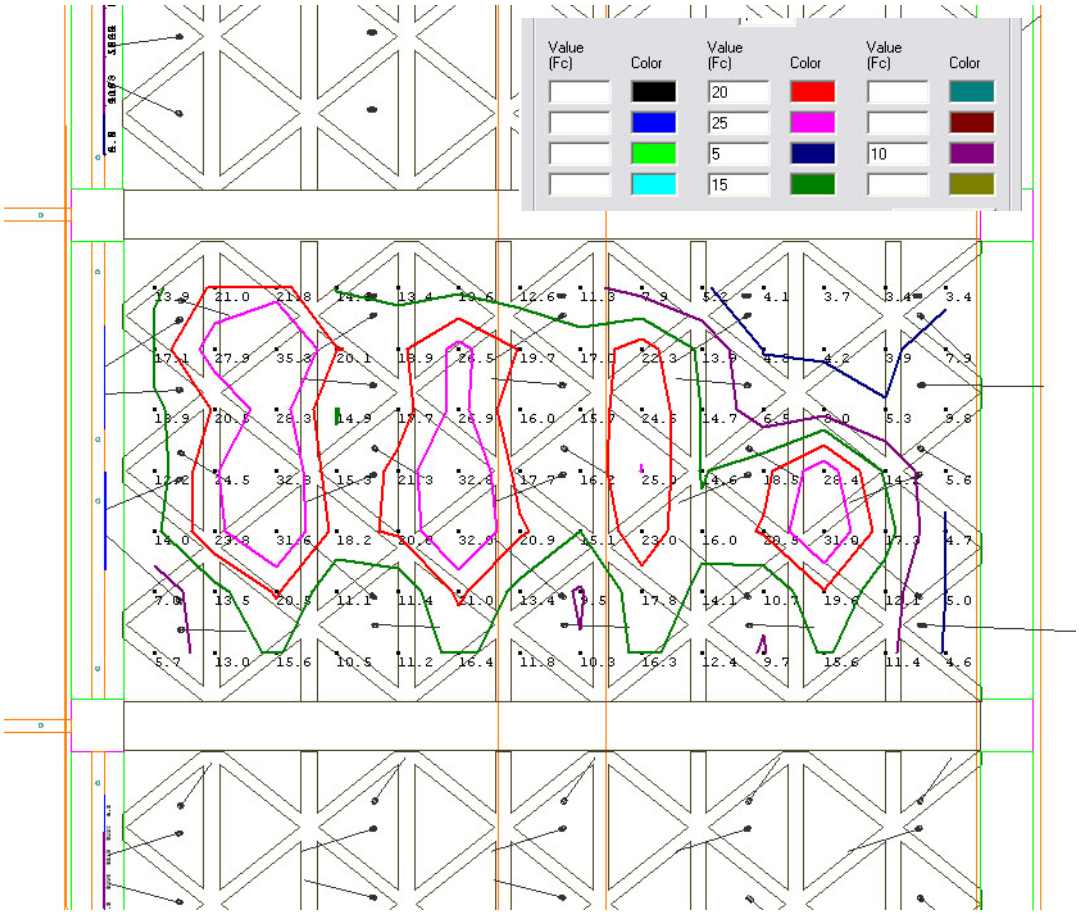


Lighting Layout with Controls for Photography Gallery

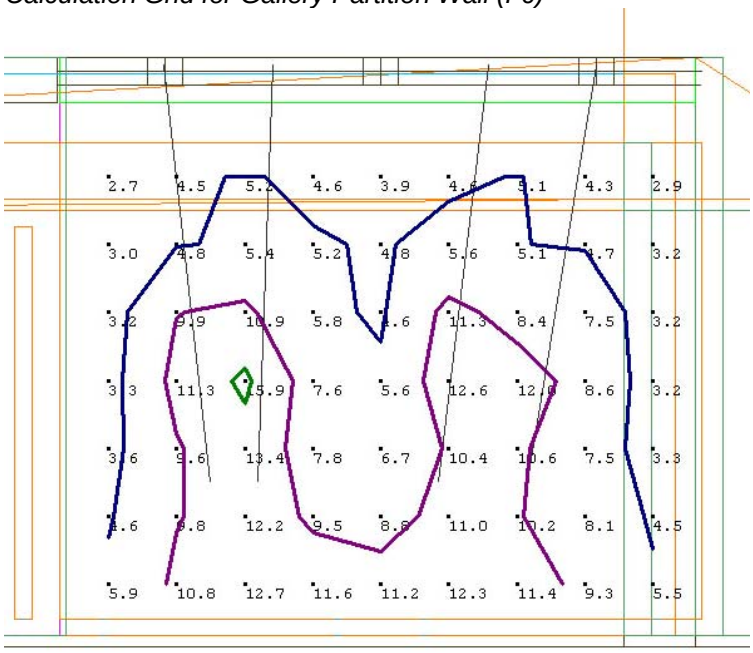


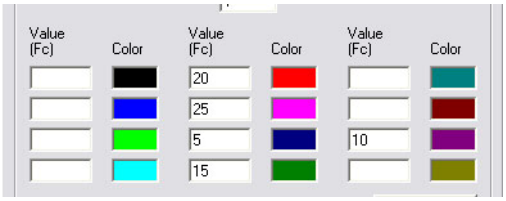
CALCULATIONS

Sample Calculation Grid for Gallery Floor (Fc)

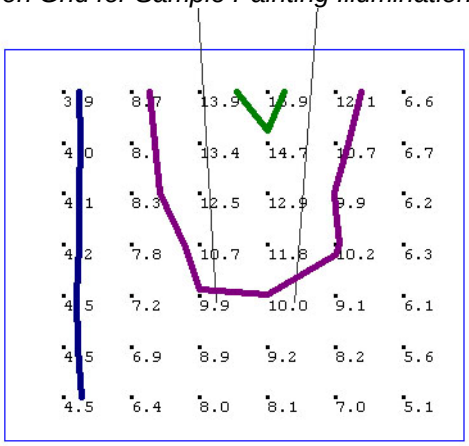


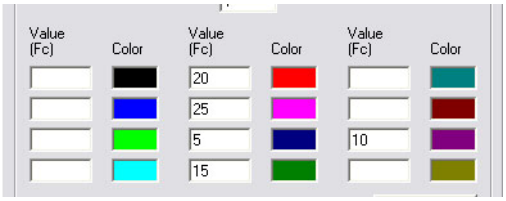
Calculation Grid for Gallery Partition Wall (Fc)





Calculation Grid for Sample Painting Illumination (Fc)





Calculation Summary Data

Wall Sample Illuminance (FC)	
Average	7.41
Maximum	15.9
Minimum	2.7
Avg/Min	2.7

Painting Illuminance (FC)	
Average	8.4
Maximum	15.9
Minimum	3.9
Avg/Min	2.15

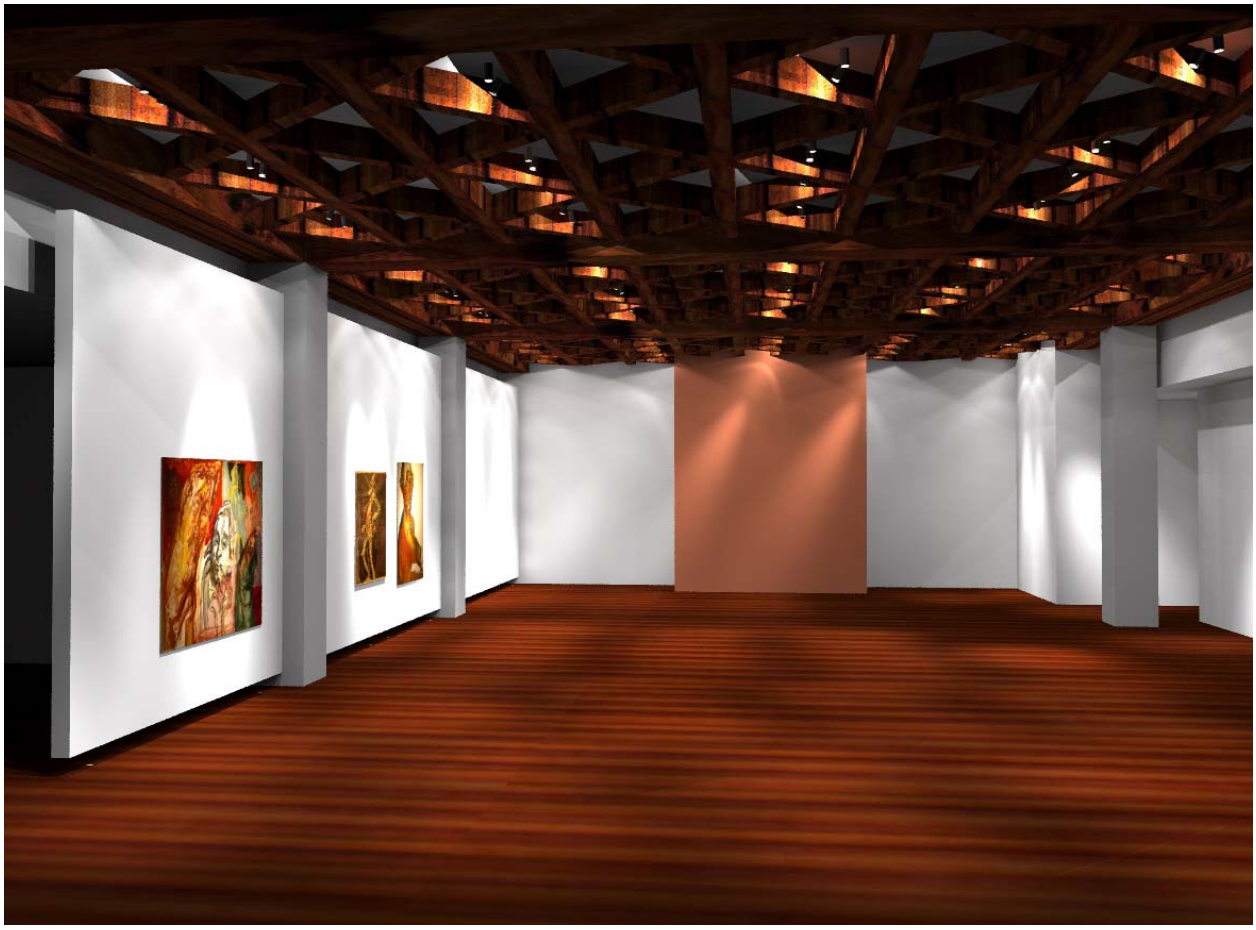
Floor Sample Illuminance (FC)	
Average	15.6
Maximum	35.3
Minimum	3.4
Avg/Min	4.6

Remarks
This lighting system has successfully achieved acceptable illuminance proportions between artwork and surround. Although the calculation summary may seem to indicate the average illuminance of walls to artwork is nearly identical, please note that artwork is not typically illuminated in its entirety. Curators frequently highlight specific areas of artwork to present the piece in a new manner and create a cohesive theme between pieces. Keeping this in mind, a look at the illuminance grid for the painting shows a general range of 10-15 footcandles in the highlighted areas. The Illuminance ratio of the highlighted area to average wall intensity is approximately 2:1, a good proportion for making a piece stand out.

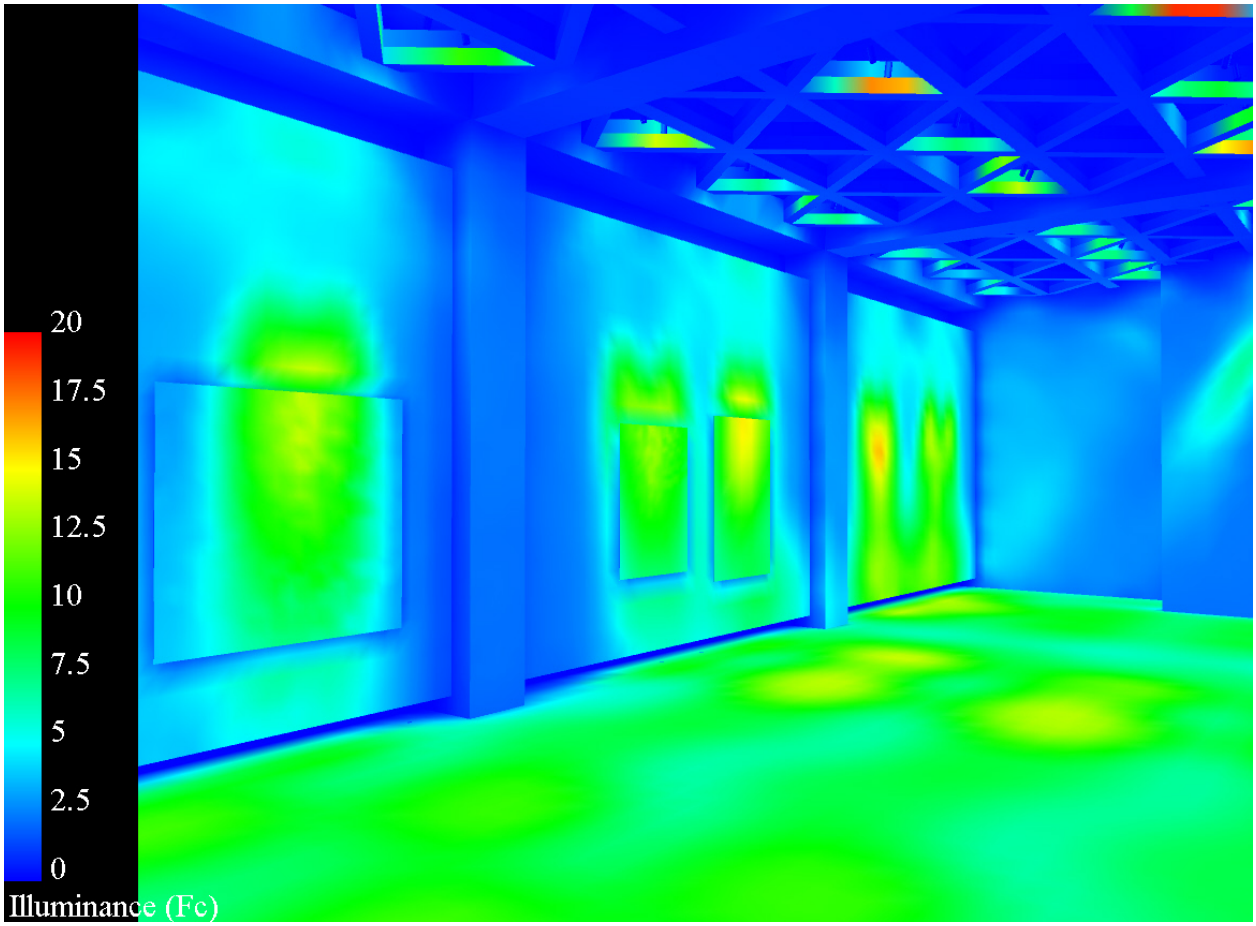
RENDERINGS (AGI32 SOFTWARE)

Gallery Wall Rendering

Main Gallery Area Rendering



Main Gallery Area Pseudo Rendering



DISCUSSION
The redesigned system has also successfully reduced the visibility of fixtures, allowing the focus to be directed toward the artwork. In gallery spaces that have lower ceiling heights exposed track exists, but the slim profile of the accent lights with hidden transformer make the space appear considerably less cluttered than with the existing system.

2.6 SPECIAL LIGHTING: GUTENBERG BIBLE AND FIRST PHOTOGRAPH

2.6.1 SPECIAL CONSIDERATIONS for ARTWORK LIGHTING and PRESENTATION

Museum and art gallery lighting requires a special design process encompassing everything from conceptualization to technical execution. Successful art lighting must be dramatic and enhancing to the piece while also preserving the object from damaging heat and ultraviolet radiation.

Design Concept
Before selecting equipment for lighting artwork, the overall design intent must be determined. Generally, light track should be located parallel to the vertical surface to be illuminated. The selection of lamp is largely based upon desired color temperature, rendering, and intensity. Artwork demands a very high color rendering index (CRI), preferably above 80. Incandescent and tri-phosphor fluorescent sources are usually best at provided high levels of CRI, although certain ceramic metal halide sources may also be appropriate.

Accessibility
In 1990, the Americans with Disabilities Act officially required that museum and art galleries provide access for people with disabilities. The renovation of the existing Ransom Center, originally constructed in 1972, was designed to increase disability access to the gallery spaces. Ramps and elevators are located within the center as needed. The lighting designer is obligated to provide enough light for objects to be visible to all visitors. Additionally, labels should be visible to all and glare from cases and labels needs to be considered.

For the lighting designer, there are no strict illumination requirements in galleries. Thirty footcandles is recommended for highlighting artwork, although ultimately the designer may determine some artwork requires less light. This is especially true of valuable and ancient artworks; any increase in light level accelerates the degradation process. Light levels may become extremely low in galleries, and the lighting designer should do his or her best to make viewing spaces safe to navigate. Light and color should combine to produce a clear circulation route in, through, and out of display spaces; clear paths around obstructions must be provided.

Preserving museum objects
Light is radiant energy that can cause permanent damage to valuable artifacts. Light can damage artwork in two ways: radiant heating and photochemical actions. Radiant heating produces an increase in temperature of the illuminated object and may cause the object to expand and lose moisture. Surface cracking, lifting of surface layers, and loss of color may occur. Photochemical actions result in the permanent change in the structure of an object, and for artwork, the result may be fading or darkening of colors, yellowing, brittling, loss of strength, degradation of fabrics, and color changes in certain pigments. Reduced ambient light levels may allow less light to be focused on delicate objects. A dimming system can help in this regard. Additionally, occupancy sensors and timed switches may be helpful in small display areas to allow light on delicate objects only when they are being directly viewed.

Assessing exposure
Two factors are used in assessing the annual extent of exposure of an object to harmful radiation. The first of these two is the reciprocity factor:

$$\text{Exposure} = \text{intensity} * \text{time}$$
$$= (W/m^2)*(t)$$

To elaborate, the overall exposure effect must take into account both the intensity of radiant energy with respect to power density and the length of time it experiences that amount of energy. 25 W/m^2 over (4) hours is equally to the amount of radiant exposure for only (1) hour at 100 W/m^2. The lighting designer

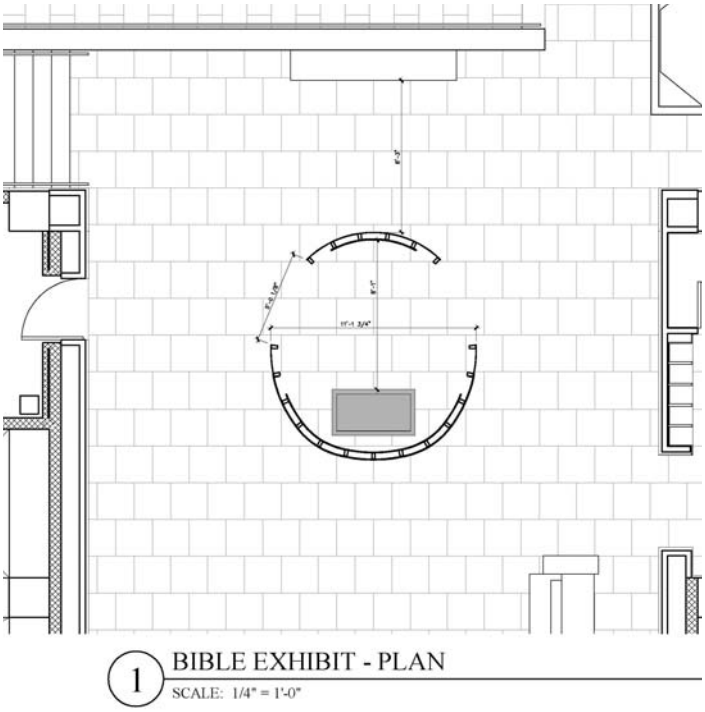
must account for both light intensity levels and duration of exposure time. Equally important is an understanding of the spectral power composition of a light source. Infrared and Ultraviolet radiation is usually released from lamps and must be controlled. Incandescent sources release more infrared radiation than visible light. Although fluorescent and mercury lamps introduce less infrared exposure, they also produce far more ultraviolet energy.

Spectral power of ultraviolet (UV) light is measured in two ways: Microwatts of UV per lumen (μW/lm) and UV percent; energy between 300 nm and 400 nm as a proportion of that between 300 nm and 700 nm. Figure 14-3 of the IESNA Handbook (ninth edition) includes a general list of absolute and relative amounts of ultraviolet radiation to be expected from electric and natural light sources. Figure 14-4 provides recommended total exposure limits in terms of illuminance hours per year. These tables, as well as consultation with the conservator, should be used when determining the appropriate lighting for delicate objects. The IESNA handbook recommends as little as 5 fc of illuminance for highly susceptible artifacts, and a mere 3.5 fc for the most precious of artwork. These light levels are low, but provided the viewer has adapted to such illuminance levels, viewing of the artwork should not be difficult

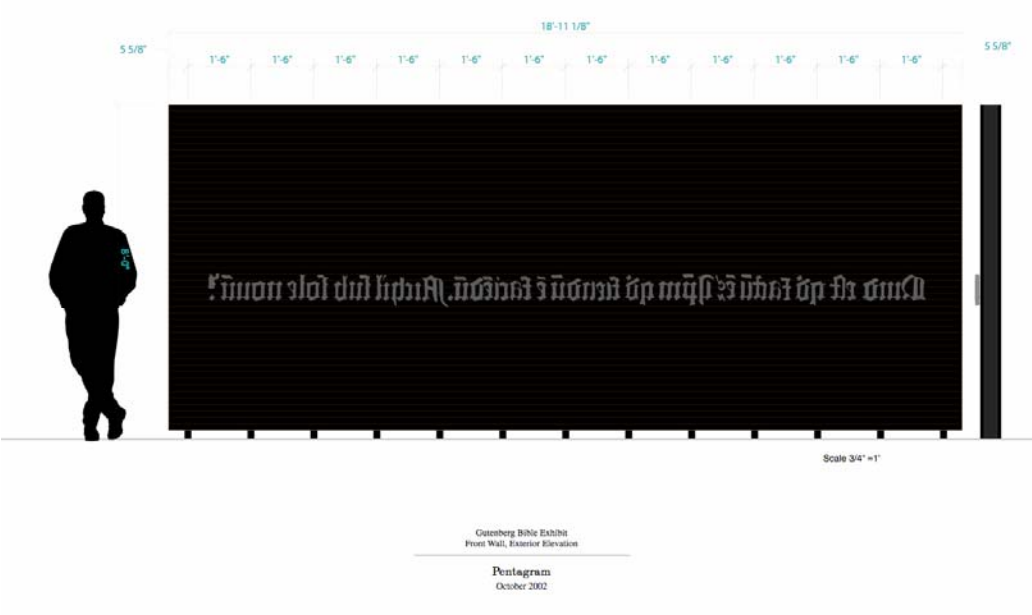
2.6.2 GUTENBERG BIBLE DISPLAY

OVERVIEW
The Ransom Center Lobby features a special display area for the Gutenberg Bible. The prominent location of this display draws people further into the lobby and functions as a transition from general public space to the adjacent First Photograph Display and gallery areas. Placement of recessed ceiling luminaries should be sensitive to potential reflected glare created from the glossy glass casing around the bible display table.

Gutenberg Bible Display Case (Plan View)



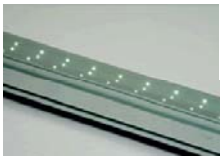
Gutenberg Bible Display Case (Exploded Elevation)



DESIGN NARRATIVE

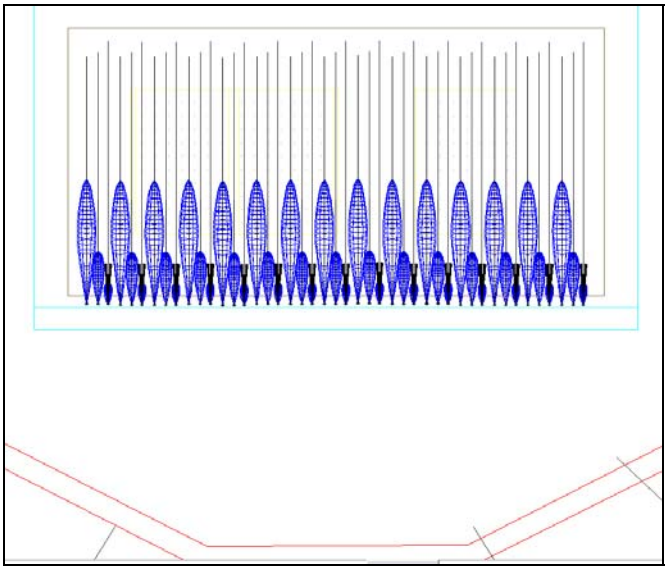
Discussion
Two separate systems are proposed for this space. Each system was designed to provide subtle, dimmable illumination on the Gutenberg bible while protecting the piece from ultraviolet and infrared damage.

Fixture Schedule

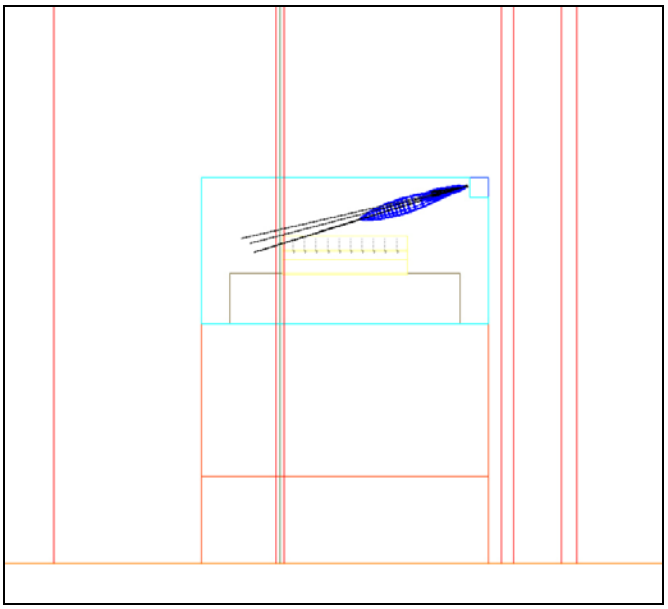
F6 Option 1		**Fiberstars Triaxis Lightbar** Fiber optic accent lighting with remote housing for ceramic metal halide lamp.	T6 Philips CMH	70W
F6 Option 2		**io Lighting LEDge** Surface mounted LED accent light.	LED, 3000K	6 W/lf

LIGHTING LAYOUT

Plain View of Fixture Type F6 as Focused

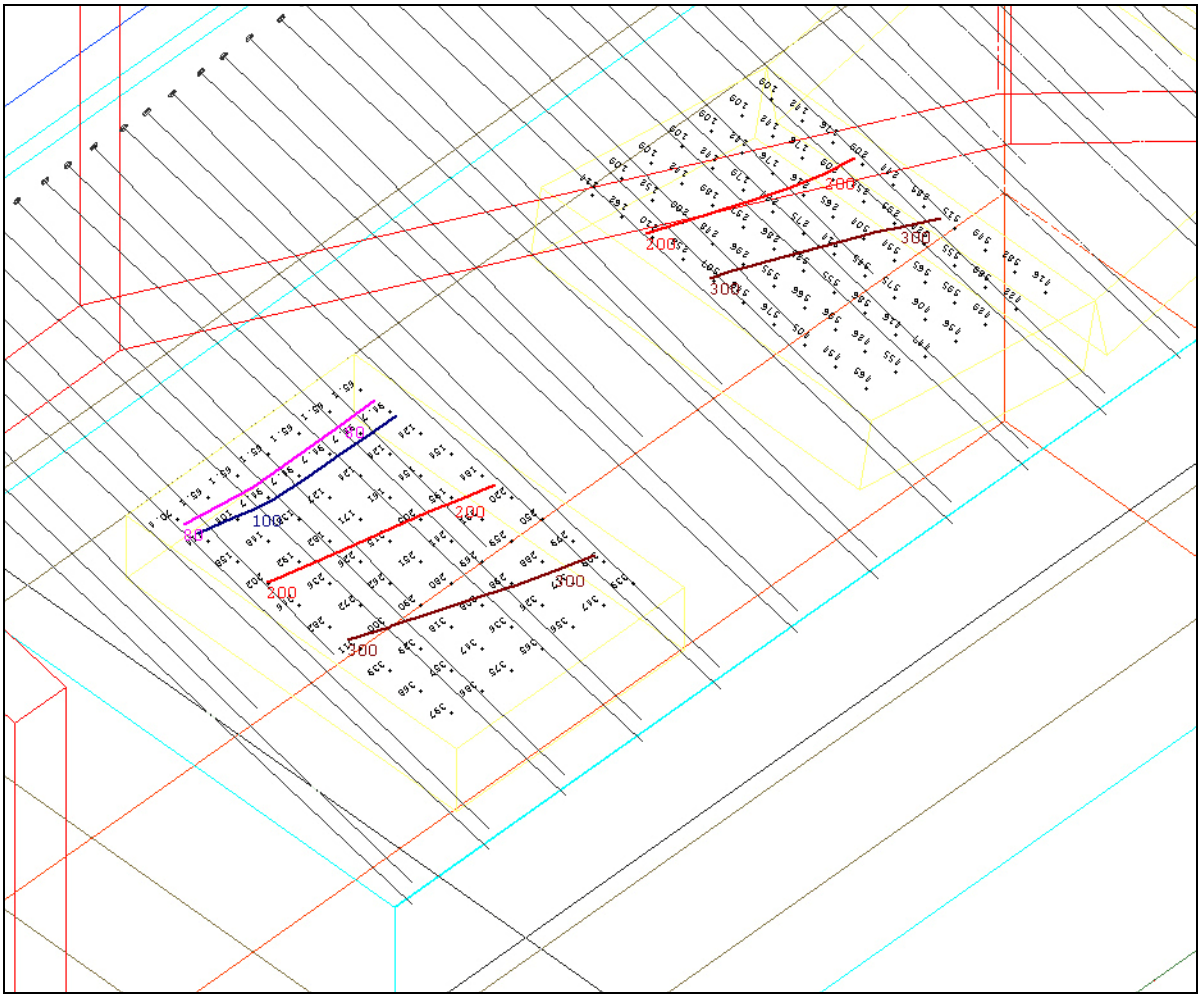


Section View of Fixture Type F6 as Focused

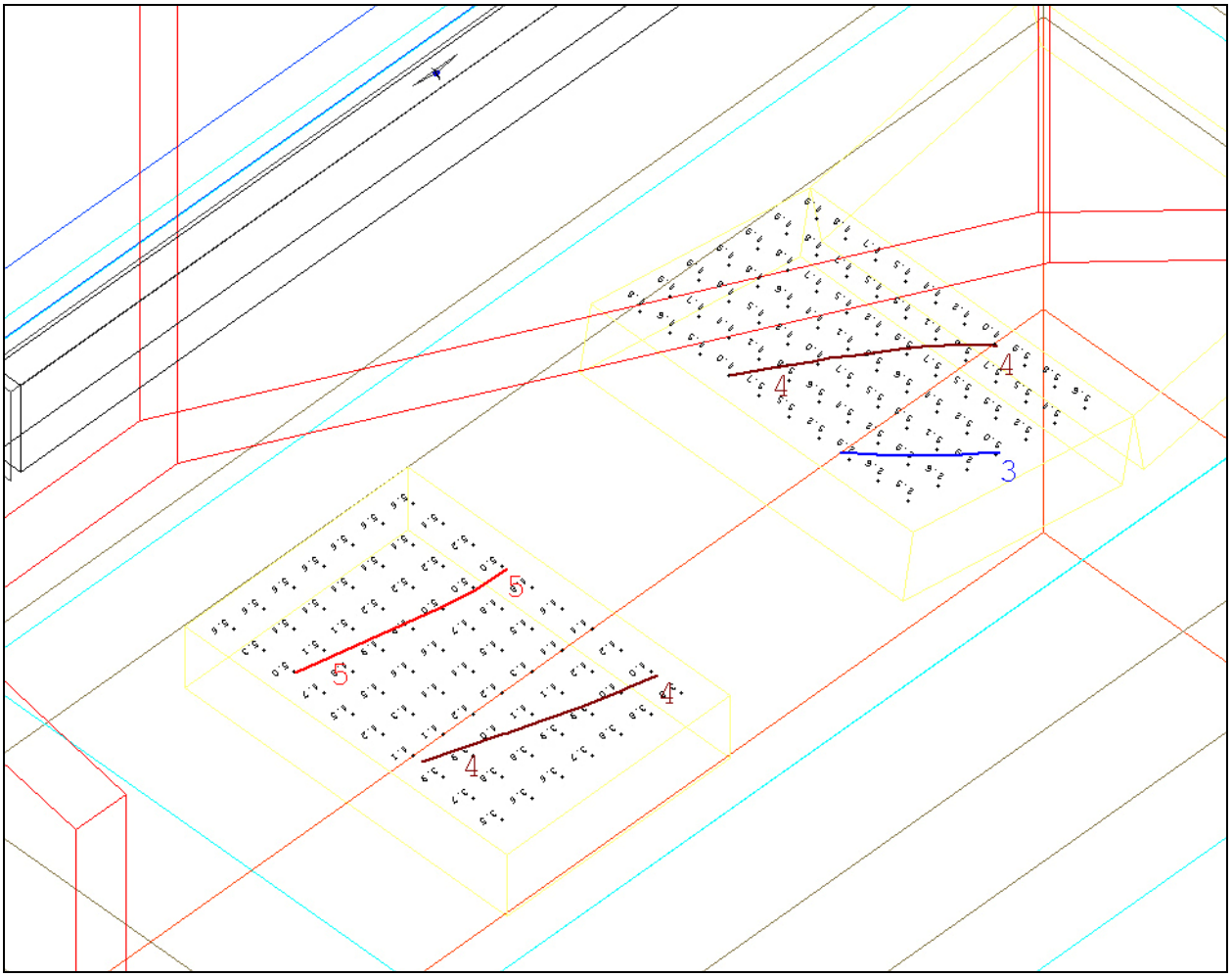


CALCULATIONS

Fixture Type F6, Option 1 Calculation Grid



Fixture Type F6, Option 2 Calculation Grid



Calculations Summary (Both Type F6 Options)

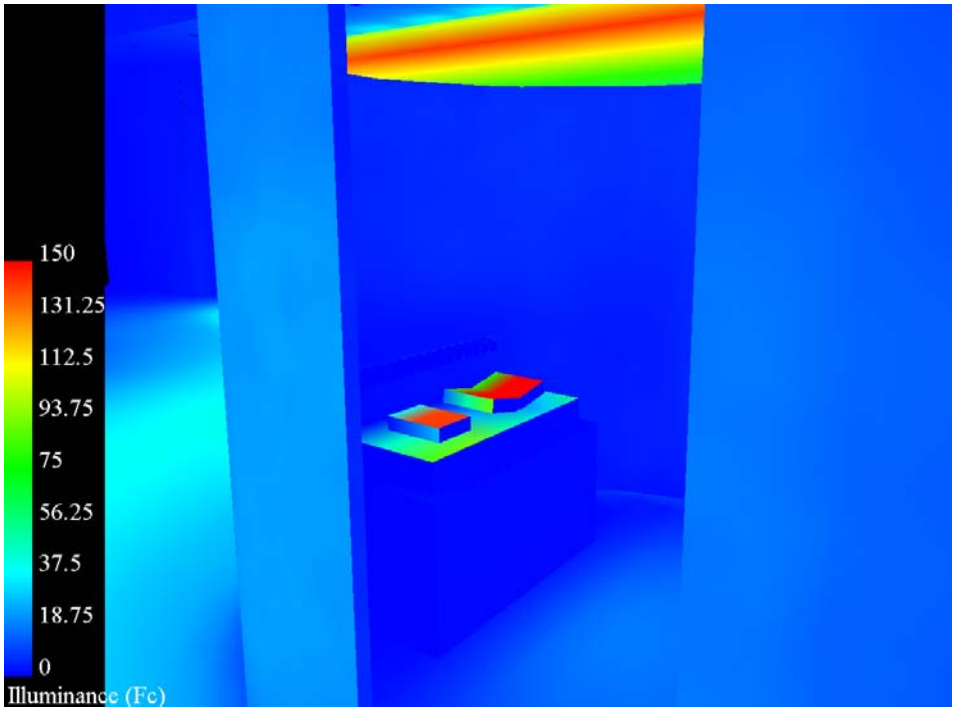
Bible Page Fiber Optics Illuminance (FC)	
Average	282
Maximum	463
Minimum	109
Avg/Min	2.6

Bible Cover Fiber Optics Illuminance (FC)	
Average	223
Maximum	397
Minimum	65
Avg/Min	3.43

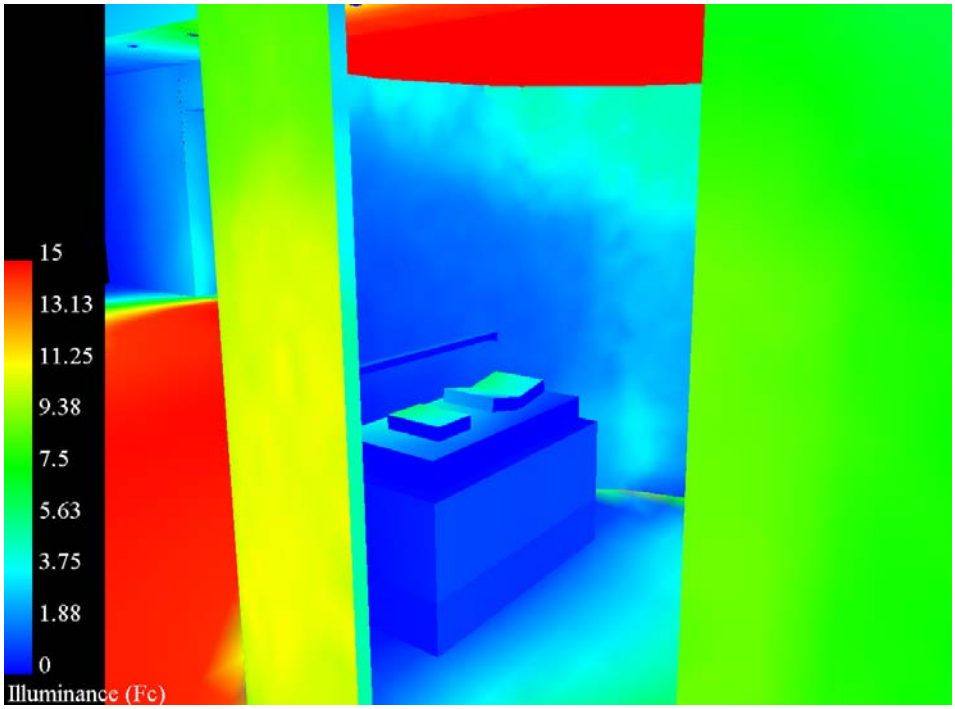
Bible Page LED Illuminance (FC)	
Average	3.96
Maximum	4.9
Minimum	2.3
Avg/Min	2.1

Bible Cover LED Illuminance (FC)	
Average	4.6
Maximum	5.6
Minimum	3.5
Avg/Min	1.6

Comparison of Fixture Types F6

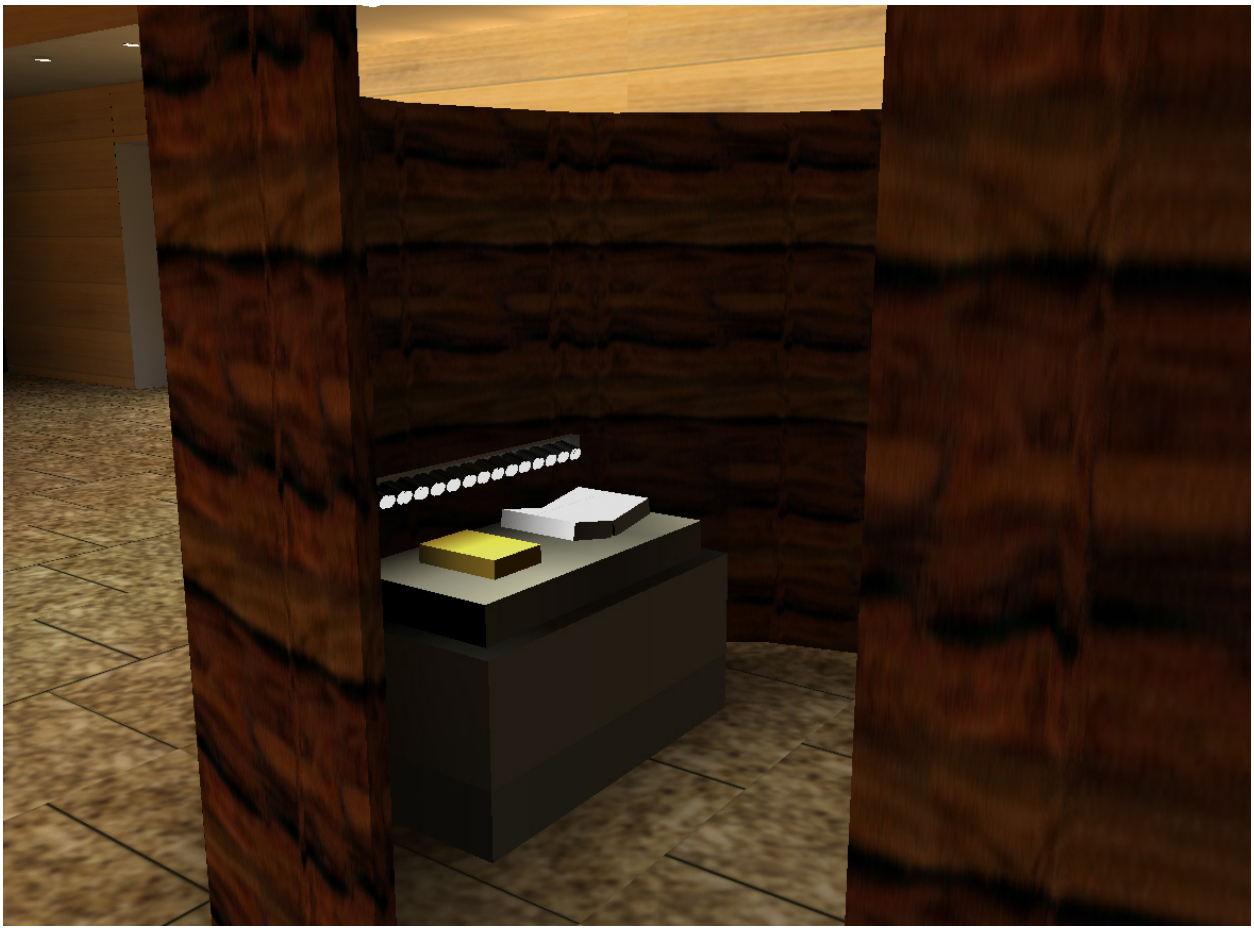


Above: Type F6, Option1
Below: Type F6, Option2

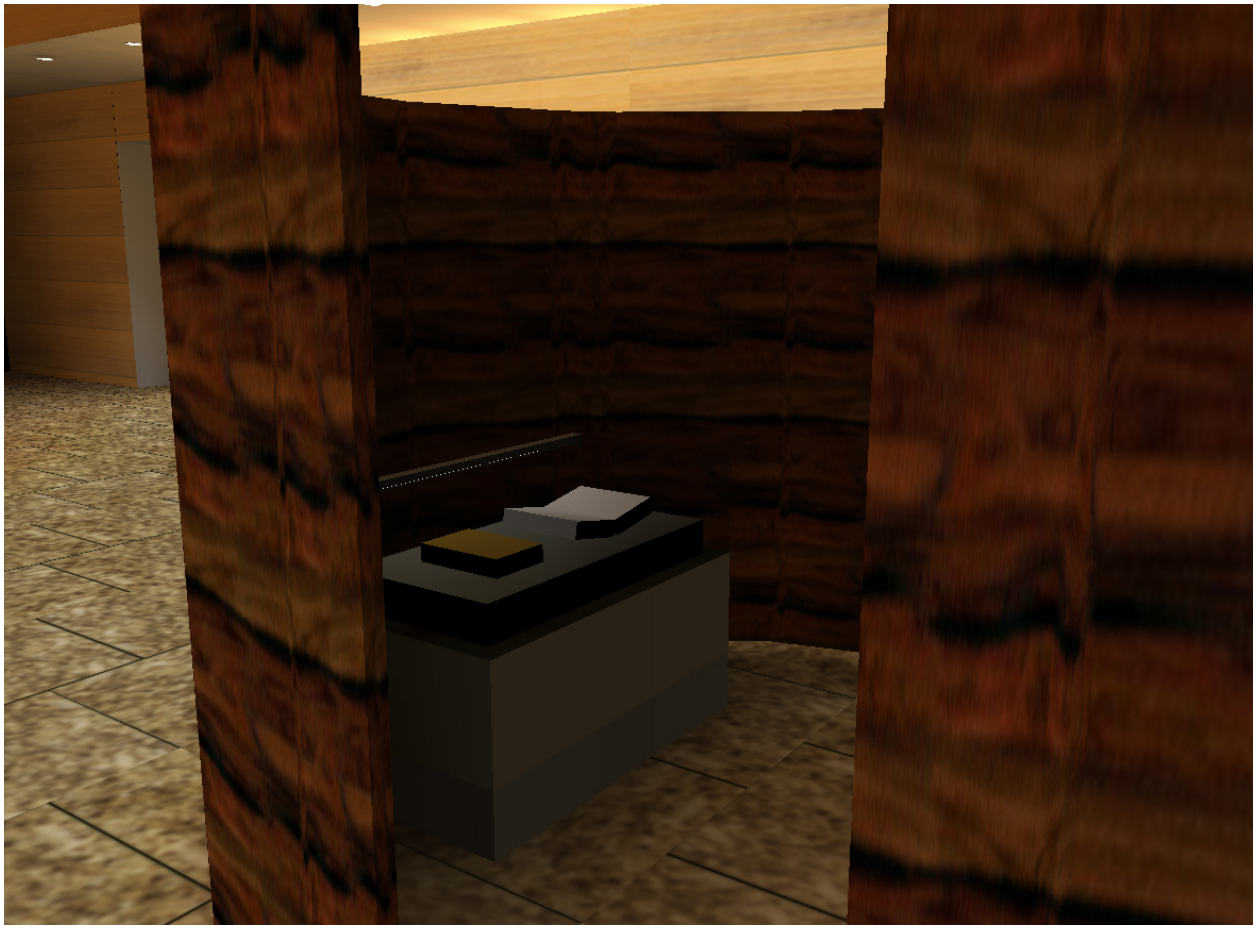


RENDERINGS (AGI32 SOFTWARE)

Rendering with Fixture Type F6, Option 1



Rendering with Fixture Type F6, Option 2



DISCUSSION
It seems there is an error with the IES file for Option 1 of Fixture Type F6. Efforts were made to adjust this file, but ultimately it was determined the file was simply an incorrect representation of the fixture. In lieu of an analysis of illumination properties on the bible, a list of advantages and disadvantages are compiled on the following page for each of the two fixture options.

Type F6, Option 1

Advantages
- Warm color temperature appearance with ceramic metal halide source.
- Infrared exposure to the Bible is reduced with remotely located fixture.
- Simple lamp maintenance (long lamp life).

Disadvantages
- *Compared to LED system, lamp maintenance is higher.*
- *Inability to dim fixture should lighting levels be too high.*
- *Construction coordination must be carefully planned to ensure fiber cords work properly.*

Type F6, Option 2

Advantages
- Extremely long lamp life and virtually no maintenance.
- Ability to dim fixture.
- Low power consumption.

Disadvantages
- Color temperature will appear cooler than metal halide color rendering is poor.
- Lumen output may be too low.
- Information about infrared and ultraviolet spectrum radiation is not provided.

Ultimately it seems a choice will have to be made between a dimming system with poorer rendering qualities and illumination intensity or a system with better rendering, higher maintenance, and the inability to dim.

2.6.3 FIRST PHOTOGRAPH DISPLAY

OVERVIEW
In the rear of the Ransom Center lobby there is a special display for the first photograph. The Ransom Center's Website provides a description of this exhibit:

> "One of the finest pieces of the Ransom Center's Photography Collection is the first photograph which Frenchman Joseph Nicéphore Niépce produced in 1826. The 8" x 6.5" heliograph depicts a view just outside the workroom window of Niépce's estate in Gras in east central France. The image, on a pewter plate sensitized with bitumen of Judea, took a full eight hours of exposure to produce. Niépce's image forms part of the Gernsheim Collection -- an internationally-renowned photography archive encompassing the history of the medium -- which was acquired by the Ransom Center in 1964."
> Source: <http://www.hrc.utexas.edu/exhibitions/permanent/>

Figure 2.7.3-1 Helmut Gernsheim & Kodak Research Laboratory Reproduction of First Photograph

Figure 2.7.3-2 First Photo Display Exterior

Figure 2.7.3-3 First photo Display Interior

The current display provides a safe, climate-controlled environment for the fragile piece. Upon entering the booth (refer to figures 2.7.3-2 and 2.7.3-3), visitors find themselves in an environment of approximately 0.1-0.3 footcandles. Consequently, very little illumination is needed to highlight this piece. This helps preserve the piece from exposure to light, but the current fixture produces too much glare. In figures 2.7.3-4 and 2.7.3-5, two high dynamic range (HDR) images were compiled to provide a Luminance map (cd/m^2).

Figure 2.7.3-4 HDR Image of First Photograph

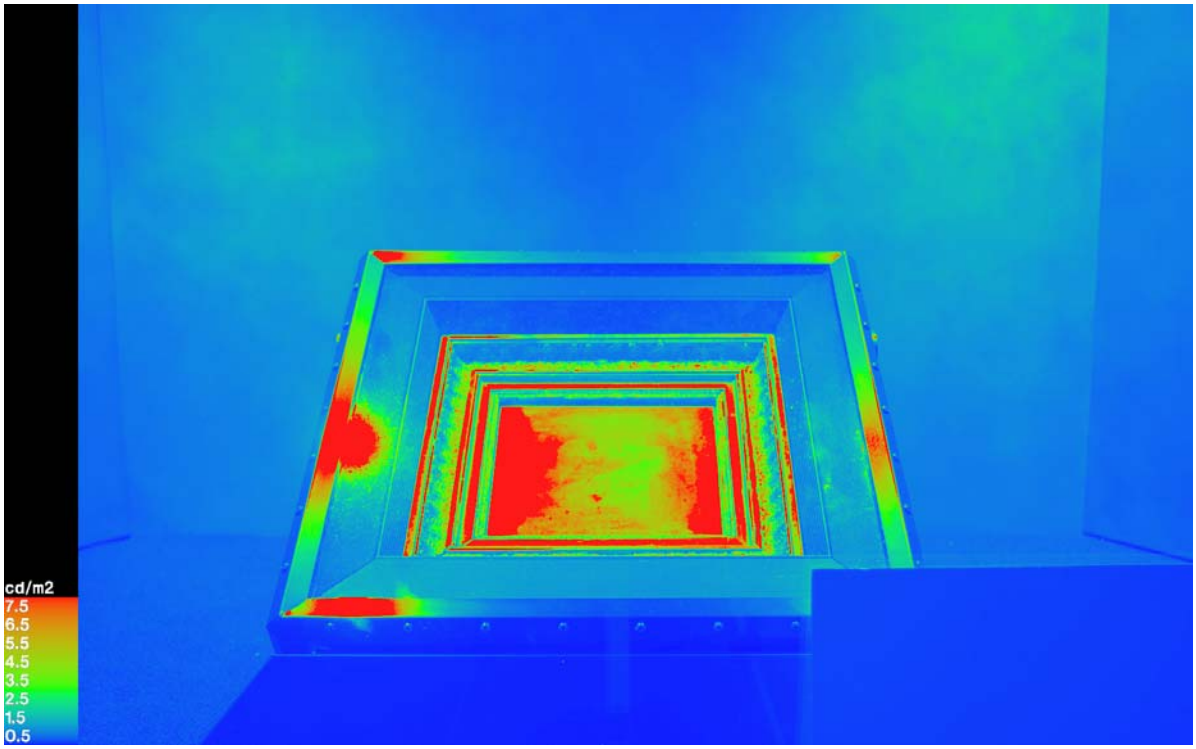


Figure 2.7.3-5 HDR Image of First Photograph

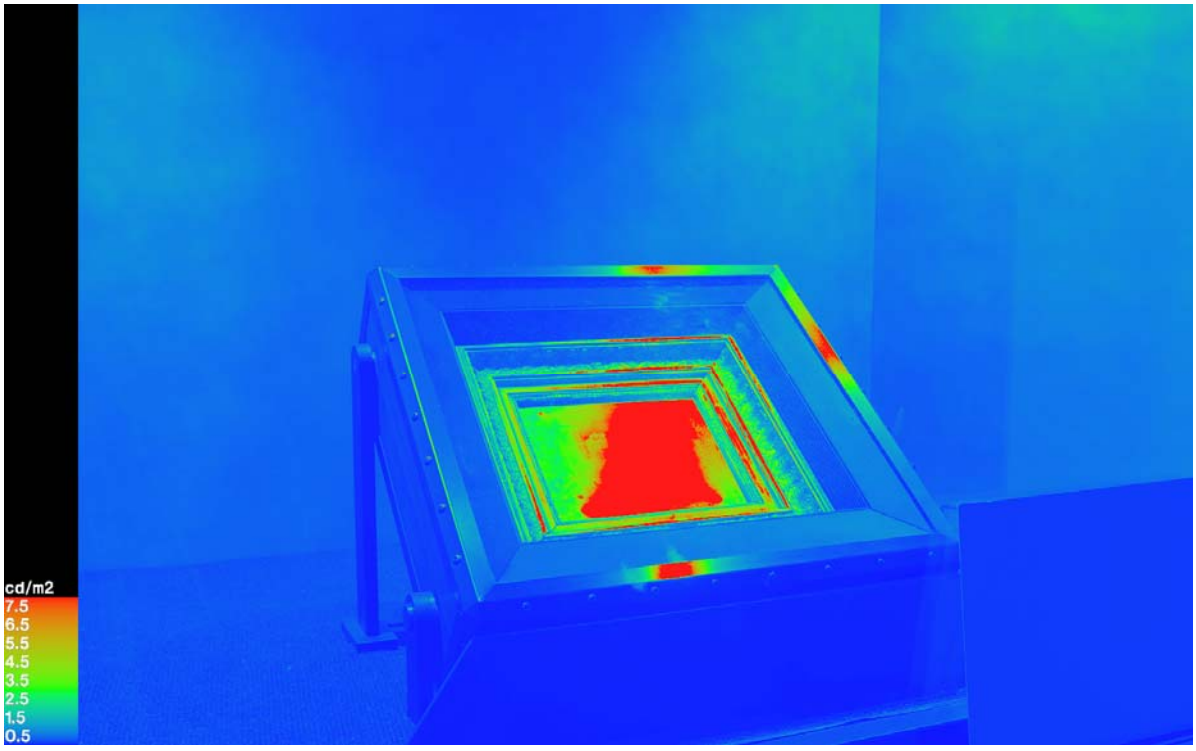
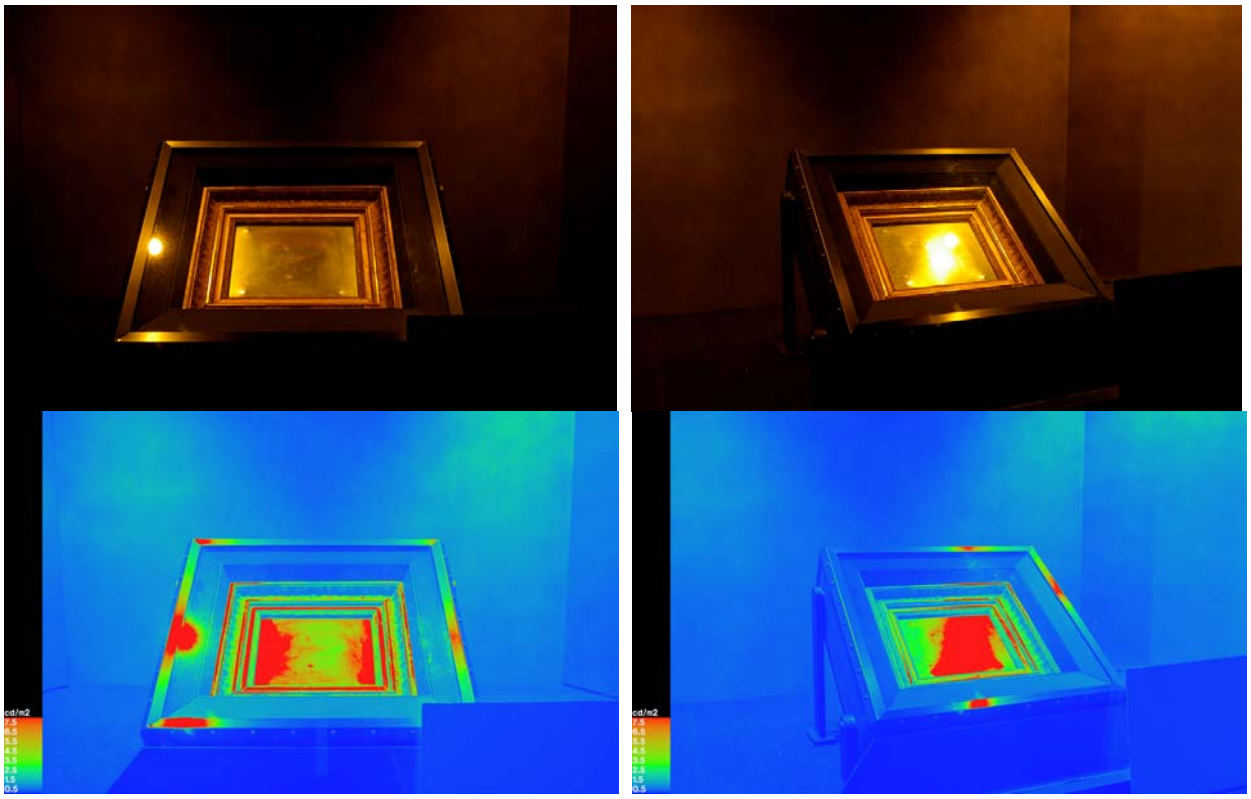


Figure 2.7.3-6 is an array that demonstrates the current glare issues with the First Photograph display and corresponding illuminance values.

Figure 2.7.3-6 HDR and Photograph Array



DESIGN NARRATIVE

Discussion
Actual dimensions of the photograph display area were not provided by the architect, and consequently an AGI32 model could only be designed to a rough level of accuracy. The proposed design allows the users to do considerable site adjustment and testing to perfect the system.

Lighting Layout and Luminaire Selection
Fixture type F7 is a halogen adjustable accent track mounted fixture. This model was selected because it features several control features that will allow the properties of light to be fine tuned after installation. Among other features, the luminaire is notable for the following: the fixture is track-mounted to allow horizontal location adjustment after installation; four way adjustable beam shuttering will allow the light to be framed to the display; a long snoot helps direct glare; visually interesting appearance will help should the fixture need to be positioned within view of the display; ultraviolet and light reduction filters can be added to adjust the quality of light.

LIGHTING CONTROLS
This fixture will be dimmable to zero percent light output and can be controlled by a Lutron Grafik Eye/See-Touch control station located at the security desk. Please refer to Section 3.0, Electrical Systems Depth, for further information on controls.

Fixture Schedule

F7		**Times Square Lighting** Track mounted adjustable accent light with shutter cuts, snoot and UV shield.	50 W MR16 15 deg	50W

Manufactured in the USA - IBEW

c UL us LISTED

CMR16P 50-75W MR16

The clean and sleek style of the CMR16P makes this fixture ideal for any interior space such as a museum, gallery, or anywhere a visually interesting fixture is needed. This compact unit accepts energy efficient MR16 lamps from 50 to 75-watts featuring a wide variety of beam spreads, longer lamp life and minimal heat output.

The CMR16P is constructed of lightweight aluminum and its four-way adjustable framing shutters allow precise geometric beam shaping. Built-in pattern slot for stock or custom, steel or glass patterns that project on walls, ceilings and floors. Comes in anodized silver finish only.

Features:

- 120, 220 and 277-volt available
- Accepts energy efficient MR16 lamps from 50 to 75-watts
- Stock or custom, steel or glass patterns
- Numerous mounting options

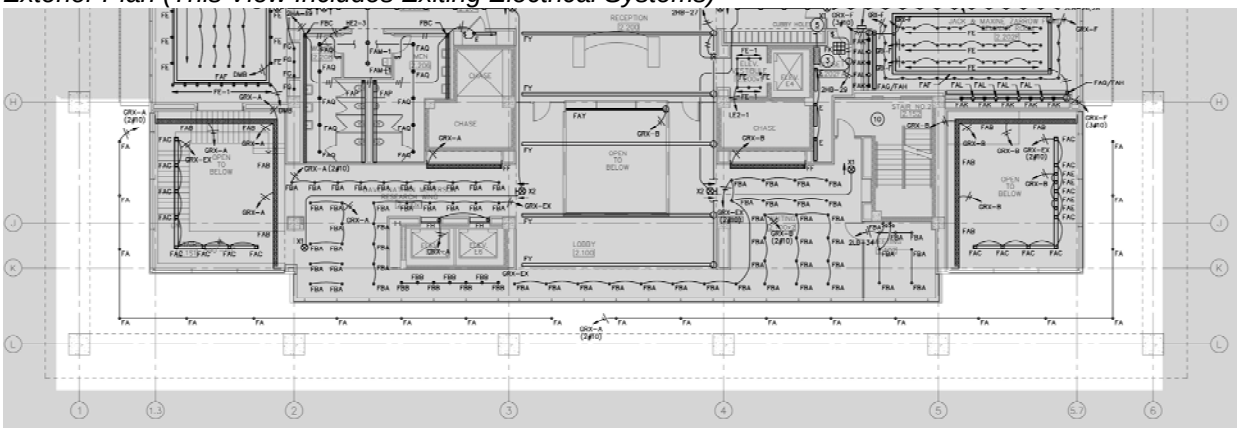
DISCUSSION
Although a calculation was not completed for this fixture, this does not mean the effectiveness of this luminaire cannot be inferred. The current light source provides adequate light levels, but it simply is not flexible enough to allow for precise aiming and light control adjustments. This fixture uses the same lamp source but features many methods to adjust the quality of light. It should adequately address issues in the existing design.

2.7 EXTERIOR and SITE LIGHTING

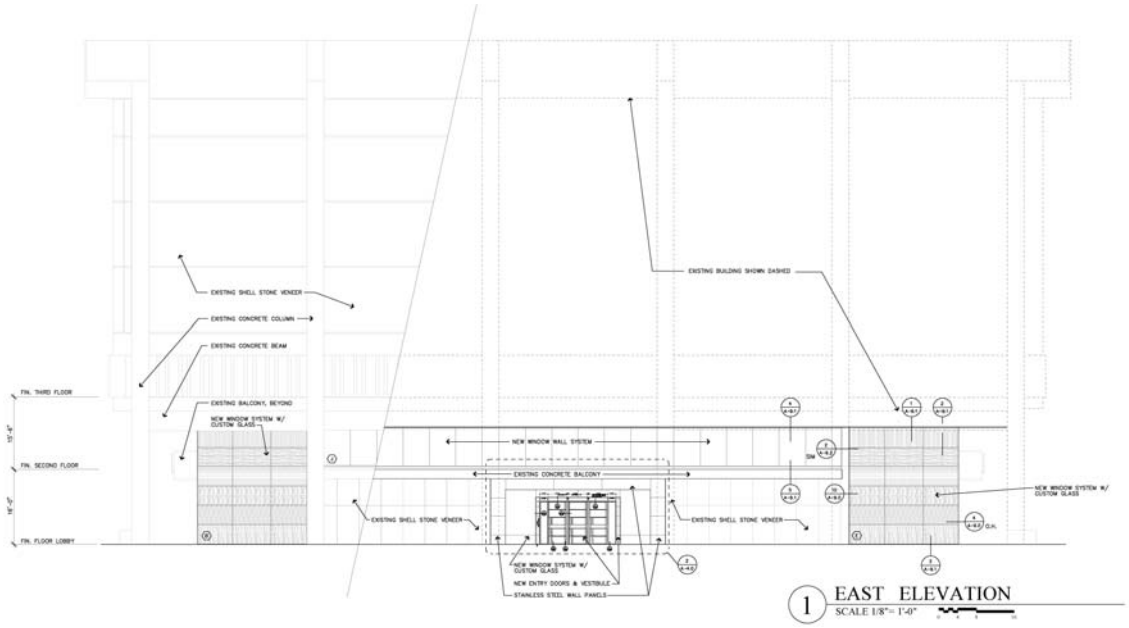
OVERVIEW

The Harry Ransom Center is a massive, 7-story structure with a natural stone façade. The building is located in the "tower area" of the University of Texas campus, on the southwest edge of the campus property. Over the history of the structure, the landscaping has grown and helps to soften the hard, intentionally monumental feel of this brutalist style building. In many ways, the Ransom Center provides a welcoming to the University of Texas campus; in addition to being located on the corner of campus, it is the main cultural attraction of the university. Visitors are very likely to see this space, and consequently a strong first impression is important. This starts with proper outdoor lighting of the building, canopy area, and adjacent courtyard space.

Exterior Plan (This View Includes Exiting Electrical Systems)



Front Elevation



SITE DATA

Total area

5,880 square feet (canopy area).

Furniture

*C*oncrete benches.

Finishes

Natural stone, reflectance 0.65
Glass (doors), transmittance 0.74
Glass (etched), transmittance 0.74
Stainless Steel, reflectance 0.20

DESIGN NARRATIVE

Discussion

The lighting for general areas outside the Harry Ransom Center will be as minimalist as possible without lacking visual interest; there will be no illumination of the building façade other than the canopy area. The primary objective of the new lighting system will be to address existing issues: a bland selection of unpleasant looking fixtures incorporating old lamp technology, and an undesirable scallop pattern on the exterior of the building façade. (Refer to rendering below to see existing scallop pattern. These calculations were backed by photographic evidence provided by the building's Architect.) Although the Ransom Center is located in a dense area on the corner of campus in downtown Austin, environmental responsibility is always appreciated. Consequently, exterior site lighting will be lowered to the plaza level and considerable efforts were made to reduce stray light. The new lighting will produce banded patterns of light aligned with the plaza granite and canopy columns. An optional design is also provided that illuminates the etched images on the glass curtain walls located in the Stair Hall, Theatre Lobby, and Entry Vestibule.

Rendering of Existing Exterior Lighting to Demonstrate Scallop Patterns

Lighting Layout and Luminaire Selection
General lighting under the building canopy is provided by fully recessed T6 ceramic metal halide adjustable accent downlights. Adjustable accent fixtures were selected that have the ability to be aimed directly downward, as would be with traditional downlights. To help reduce scallop patterns, these fixtures will be adjusted on site to direct light outward and away from the façade of the building. This proposal seems to be the most feasible option; these fixtures can be installed as a retrofit application in the location of the existing downlights. Placing luminaries in new locations would make the renovation project unnecessarily complicated. Small twenty-four Watt T5 fluorescent bollards (louvered aperture) are located along the main campus pathway and will reinforce the banding pattern created by the granite stone. Small thirty Watt MR-16 grade recessed asymmetric distribution uplights are aligned one foot away from the building's columns to highlight the front faces at pedestrian level while maintaining a very traditional appearance from afar. At the pathway, a dynamic striped pattern is created, while from street level the column highlights will be barely noticeable. This will help preserve the existing lighting scheme that is modeled after a very effective strategy famously employed by Richard Kelly: backlight the columns and canopy floors to make the massive façade seem "weightless and floating."

DESIGN CRITERIA

Horizontal Illuminance (very important): 1-5 fc (canopy)
0.2-2 fc (site lighting)

Horizontal illuminance should be sufficient enough to provide a clear path into and around the building while also complimenting the architecture of the structure.

Vertical Illuminance (not important): 0-3 fc

Vertical illuminance can highlight the building façade, but this structure's modern, Mies van der Rohe inspired base lends itself well to an unlit façade with a glowing canopy overhang to suggest a "lightness" to the structure. Excessive vertical illumination (for example, façade grazing) may also create unnecessary light pollution.

Appearance of Space and Luminaires (very important)

Luminaires should not distract from the natural stone and architecture of the building exterior.

Color Appearance and color Contrast (very important)

Quality of light should compliment the exterior building materials. Luminaires with low color rendering indexes should only be used if they compliment the exterior material.

Direct Glare (very important)

Direct glare from luminaries in the canopy area is aesthetically undesirable and may leave visitors without clear peripheral vision, making them vulnerable to attack.

Flicker and Strobe (somewhat important)

Luminaires, lamps and ballasts should be selected that reduce the possibility of undesirable, annoying flicker.

Light Distribution on Surfaces (important)

Exterior surfaces should be evenly light or highlighted with punches of light as appropriate.

Light Pollution/Trespass (very important)

Light pollution should be minimized in all ways possible.

Modeling of Faces or Objects (very important)

Facial identification should be sufficient enough to recognize those that are approaching.

Peripheral Detection (very important)

Peripheral view should be preserved by reducing luminaire source glare and excessively bright ground illumination.

Points of Interest (very important)

Points of interest should be highlighted as applicable.

Reflected Glare (very important)

Reflected glare should be avoided to prevent excessive contrast between canopy area and the surrounding environment.

Shadows (very important)

Shadows should be reduced to prevent locations that make facial identification difficult.

Source/Task/Eye Geometry (very important)

Geometry should be studied to prevent unsightly views into canopy recessed luminaries and unsafe levels of high contrast.

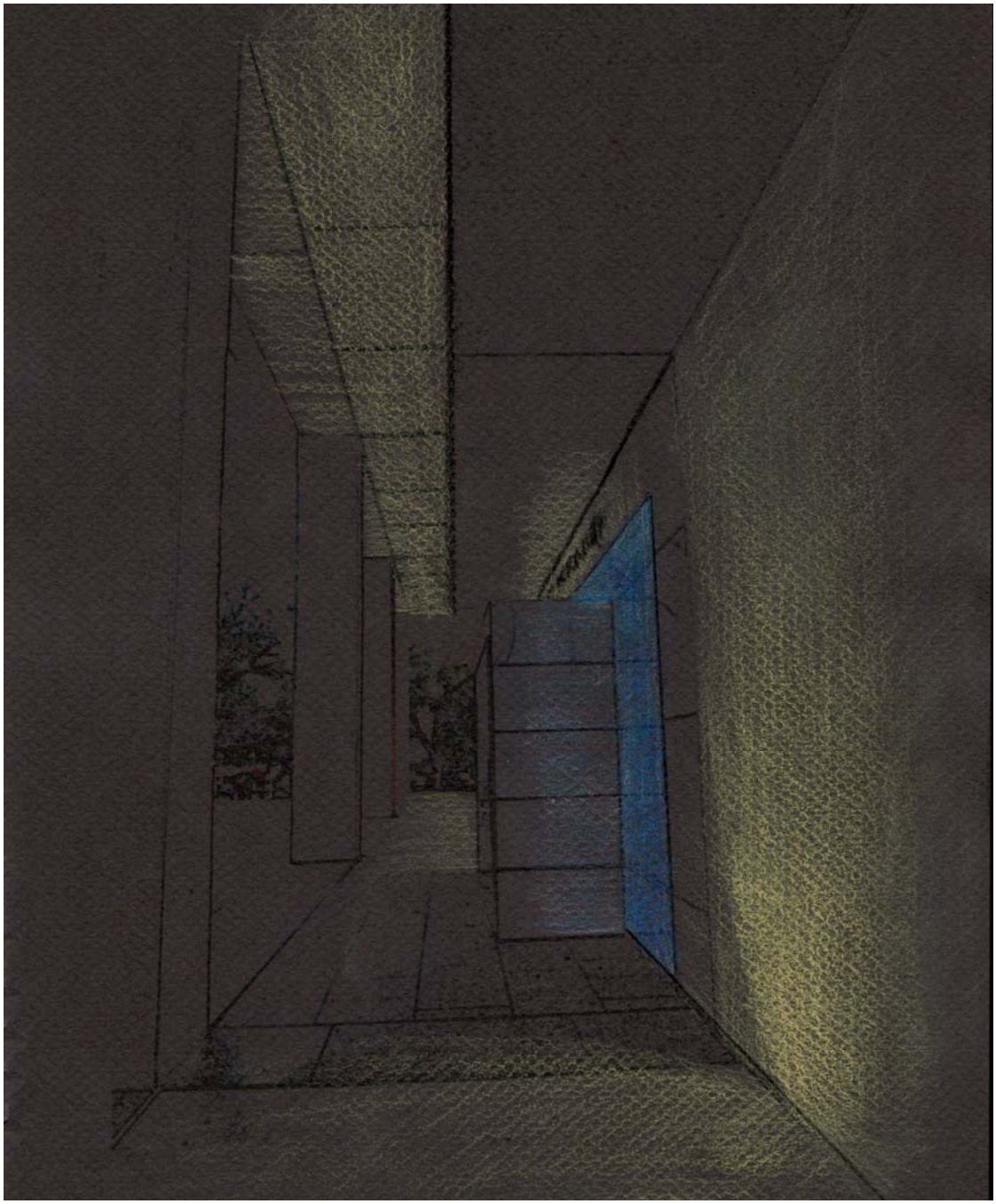
Sparkle/Desirable Reflected Highlights (important)

Where safe and appropriate, sparkle and highlights may be implemented to enhance the architecture of the building.

CONCEPT SKETCHES

Site Lighting Concept

Canopy Area Sketch with Illuminated Signature Wall



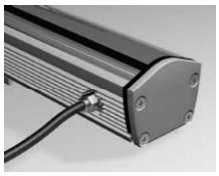
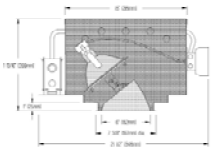
Rendering of Signature Wall Concept

Rendering of Signature Wall Concept

Concept Demonstration of Etched Glass Illumination

LIGHTING SYSTEM DATA

Fixture Schedule

	TYPE	DESCRIPTION	LAMP	FIXTURE WATTS
F16		**io Lighting Line 2.0** Floor recessed LED with 5 degree beam spread and window grazing filter.	5000K Cool White LED	10W/lf
F18		**io Lighting Line 0.75** Window mullion recessed linear LED system with 10 degrees beam spread.	5000K Cool White LED	8W/lf
F19		**Bega Linear Element** Linear fluorescent pole-mounted fixture 11'-6" high with adonized aluminum reflector and semi-specular internal louvers.	Philips F54T5HO/835	54W
F20		**Bega Linear Bollard** Stake-mounted linear fluorescent bollard with andonized aluminum reflector and semi-specular internal louvers.	Philips 24W T5HO/835	24W
F21		**Edison Price Archlite T6** Fully recessed exterior grade adjustable accent ceramic metal halide downlight with adjustable aiming.	Philips CDM35/T6830	39 W

Fixture Schedule (Continued)

F22		**WE-EF ETC-114** In-grade recessed halogen with 20 degrees assymetric lens and die-cast stainless steel housing.	30 W MR16 24 deg	30 W
F23		**Bega T5 Exterior Uplight** Surface recessed linear fluorescent uplight with constructed of cast aluminum alloy with machined stainless steel finish.	Philips F54T5HO/835	54W
F24		**Color Kinetics iColor Cove MX** Linear LED system recessed in transucent glass.	RGB LED	12W/lf

Light Loss Factors

Type	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Design Lumens per Luminaire	LLD	LDD	RSDD	LBO	BF	Total LLF
F19	III	Dirty, 24 months	5000	4750	0.95	0.75	n/a	1.00	0.99	0.71
F20	III	Very Dirty, 24 momths	2000	1900	0.95	0.69	n/a	1.00	1.02	0.67
F21	IV	Medium, 36 momths	3300	2600	0.79	0.62	n/a	0.90	1.00	0.44
F22	VI	Very Dirty, 24 months	370	350	0.95	0.69	n/a	0.90	1.00	0.59
F23	VI	Very Dirty, 24 months	5000	4750	0.95	0.69	n/a	0.90	0.99	0.58

Power Density Calculation for Theatre Lobby

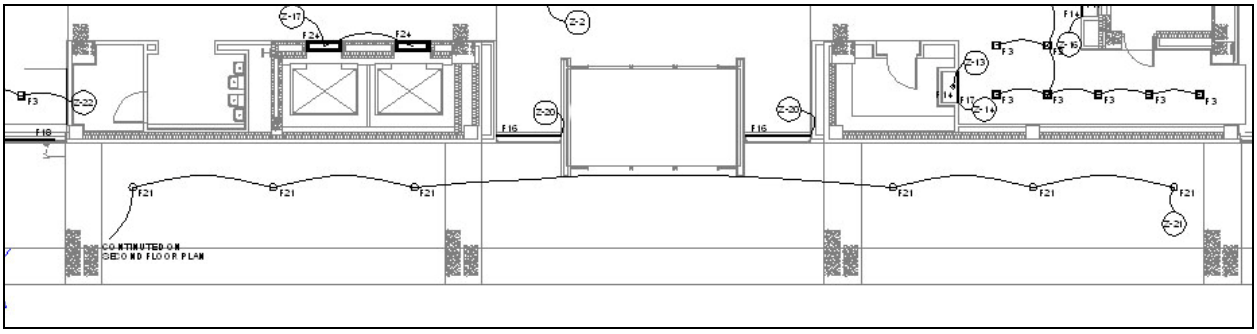
Type	Quantity	Watts/Fixture	Watts		
F19	4	62	248	**Total Watts Canopy Area**	714
F20	12	27	324	**Canopy Area (Sq.ft.)**	5880
F21	12	44	528	**Power Density**	0.12
F22	6	30	180		
F23	3	62	186	**Total Watts Walkway**	752.00
				Walkway Area (Sq.ft.)	3687
				Power Density	0.20

Power Density Allowances
ASHRAE 90.1-1999: 3.0 W/sq.ft. of canopied area, 0.25 W/sq.ft. other areas/facade
ASHRAE 90.1-2004: 1.25 W/sq.ft. of canopied area, 0.2 W/sq.ft. other areas/facade

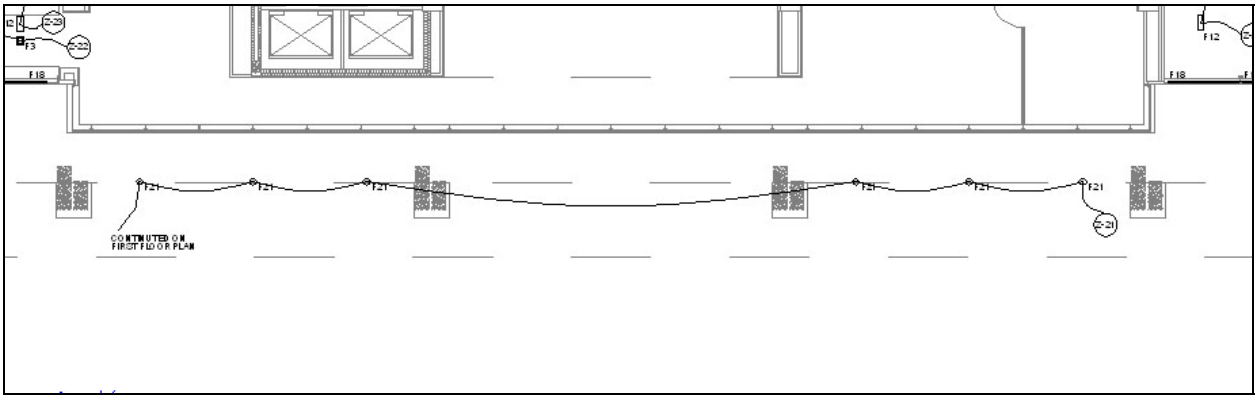
The exterior lighting systems meet ASHRAE 90.1 power density requirements.

LIGHTING LAYOUT

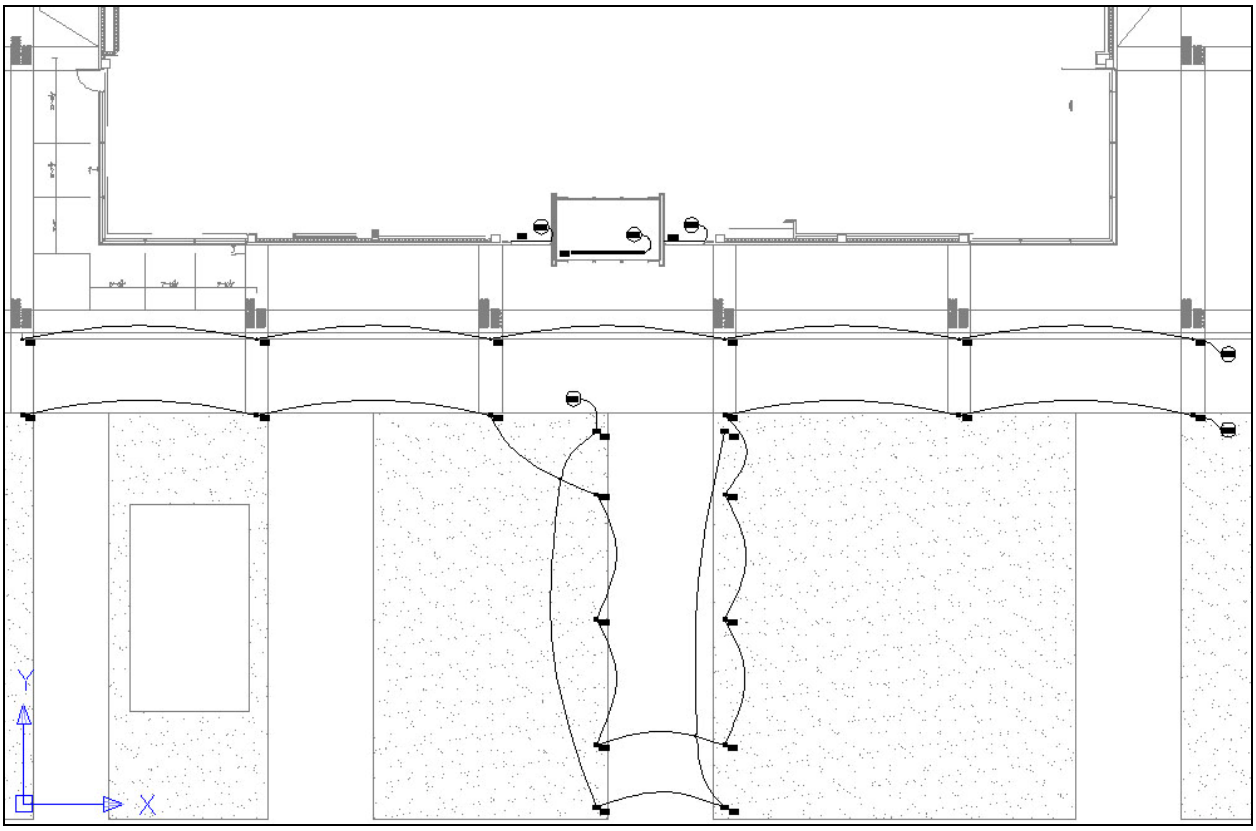
Canopy Lighting with Control Zones for First Floor Overhang



Canopy Lighting with Control Zones for Second Floor Overhang

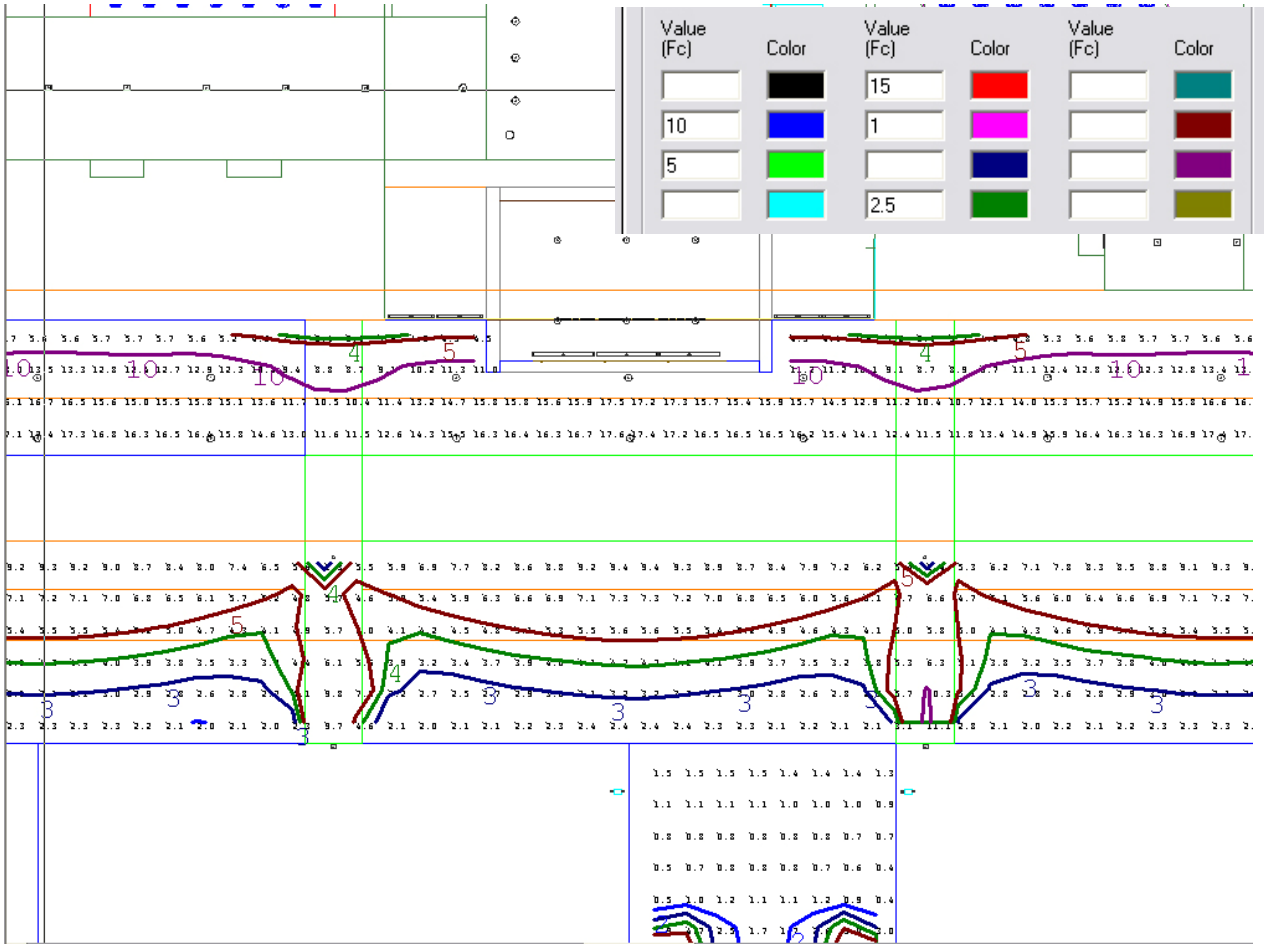


Site Lighting with Control Zones

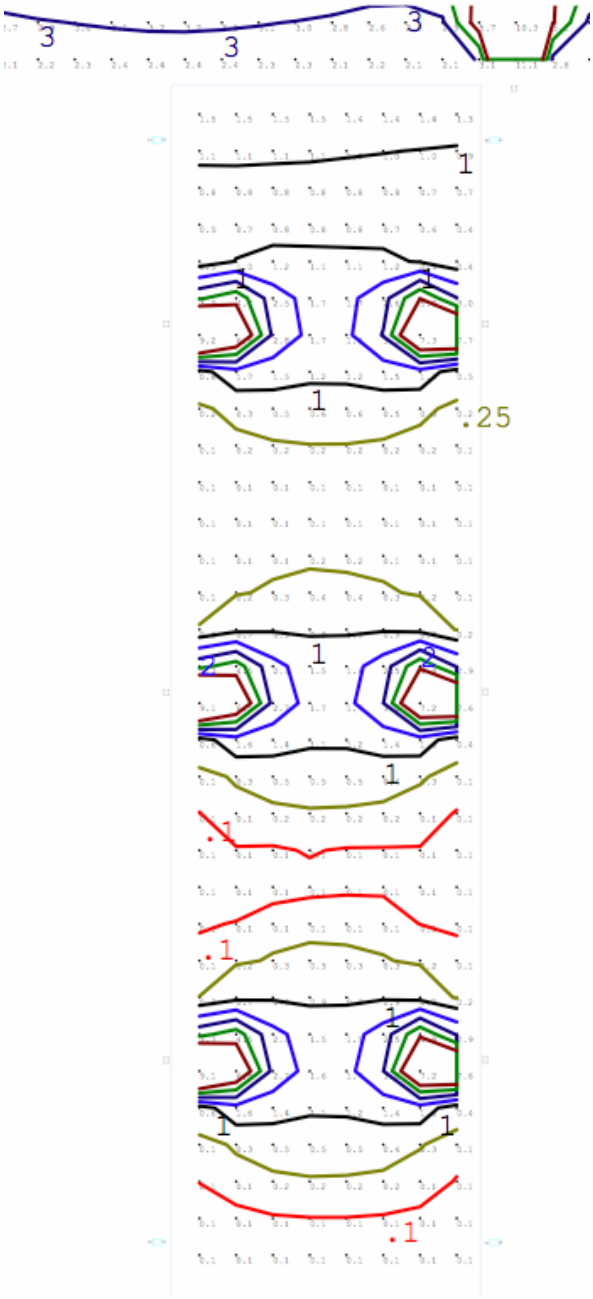


CALCULATIONS

Illuminance Calculations for Canopy and Pathway 1 (Fc)

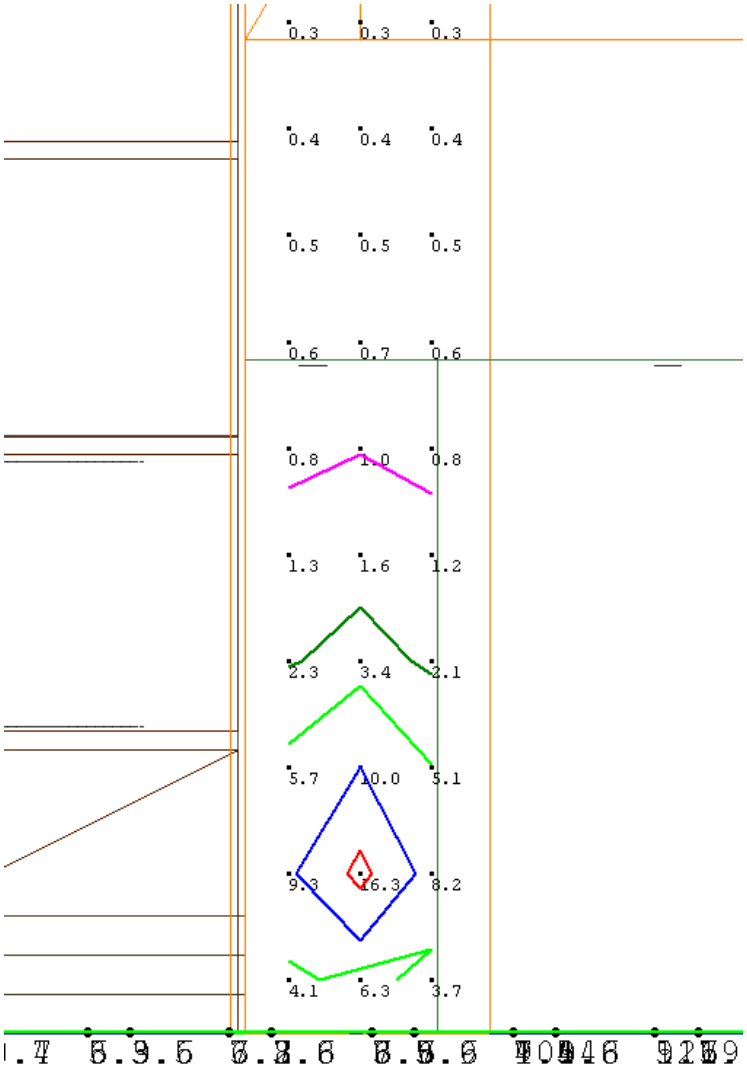


Illuminance Calculations for Pathway 2 (Fc)



Value (Fc)	Color	Value (Fc)	Color	Value (Fc)	Color
		15			
10		1			
5					
		2.5			

Illuminance Calculations for Sample Canopy Column (Fc)



RENDERINGS (AGI 32 SOFTWARE)

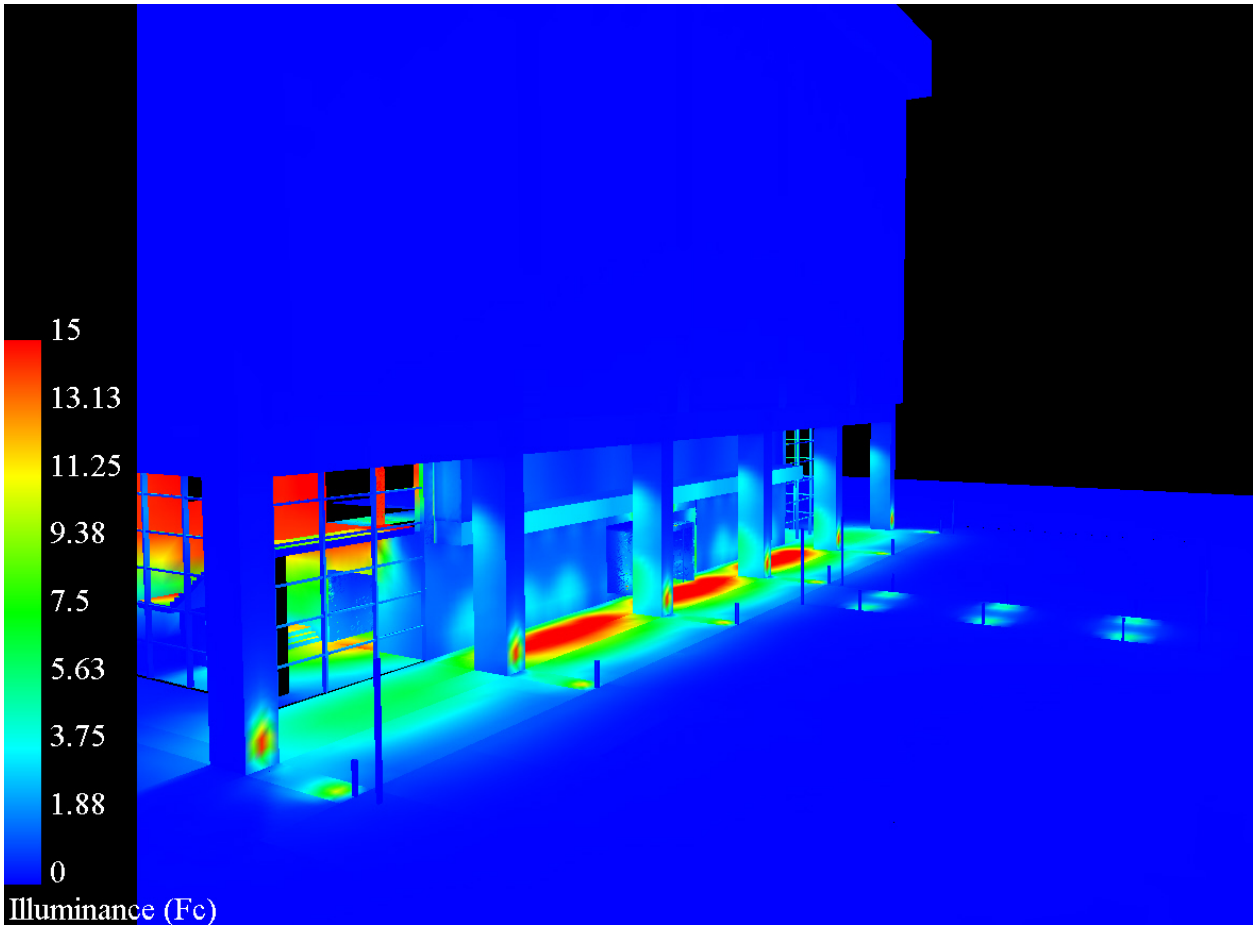
Entrance Area Rendering

Rendering Looking down Main Pathway

Exterior Rendering from Afar

Exterior Rendering Demonstrating Light Pollution

Pseudo Rendering



Calculation Summary Data

Canopy Pathway Illuminance (FC)	
Average	9.63
Maximum	17.60
Minimum	3.30
Avg/Min	2.92

Pathway 1 Illuminance (FC)	
Average	4.09
Maximum	11.1
Minimum	0.80
Avg/Min	5.11

Pathway 2 Illuminance (FC)	
Average	1.14
Maximum	9.2
Minimum	0.1
Avg/Min	11.40

Column Vertical Plane Illuminance (FC)	
Average	1.62
Maximum	16.3
Minimum	0.2
Avg/Min	8.10

DISCUSSION

The new exterior lighting systems provide excellent illumination of the major pathways without producing unnecessary light trespass. A simple maintenance schedule can be developed for the exterior site lighting with the lamps selected: long live ceramic metal halides are located in the high canopy ceiling, while T5 sources are used for the asymmetric sign illumination, bollards, and pathway fixtures. Replacement of in-grade MR16 sources is quick and simple. From a design standpoint, the new system provides a visually appealing exterior façade that helps direct people into the Ransom Center or down the main exterior pathways. A scale mock-up is required to determine whether the light grazing LED arrays on the etched glass façade is feasible. Sample fixtures were not available to asses the effectiveness of this design.