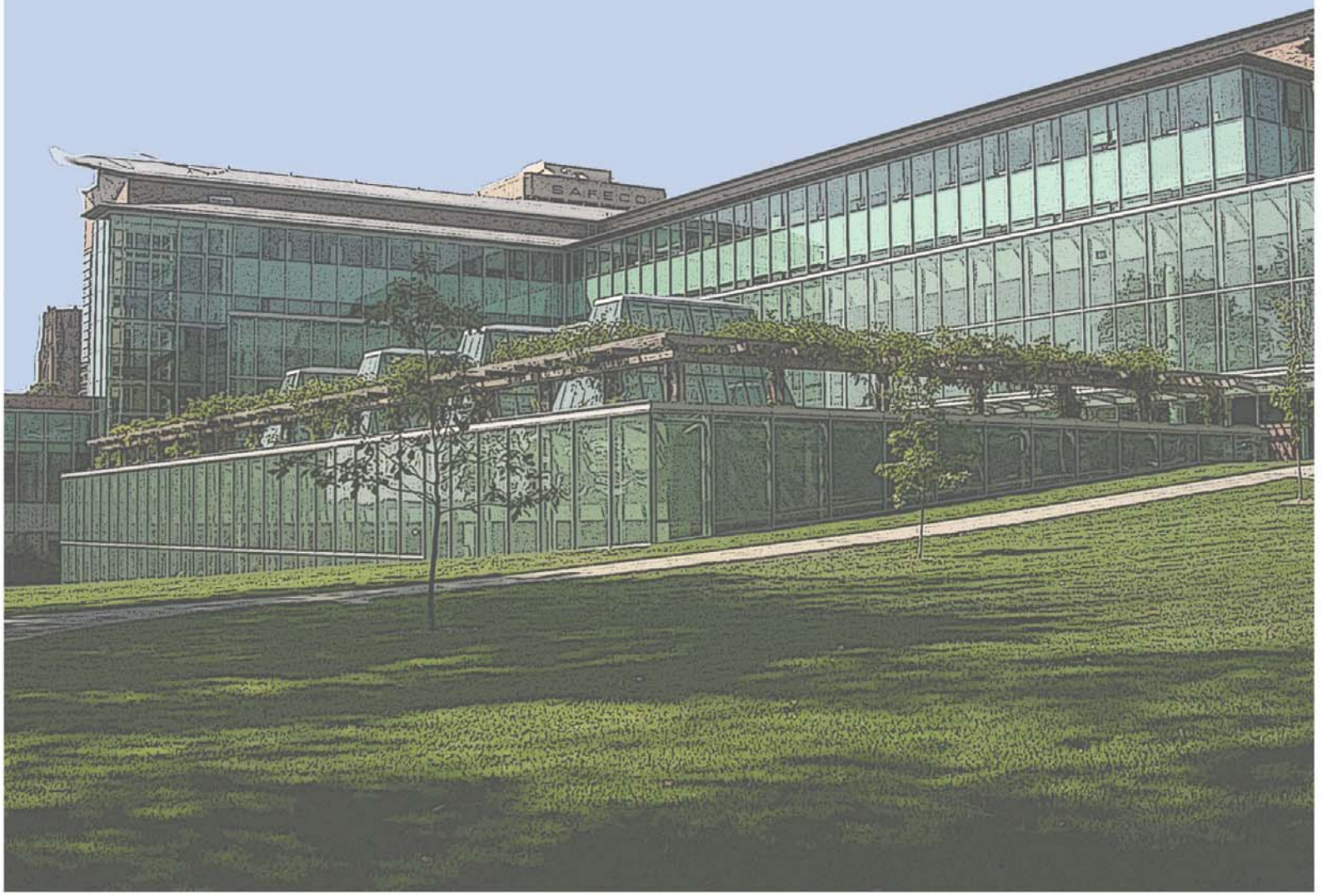
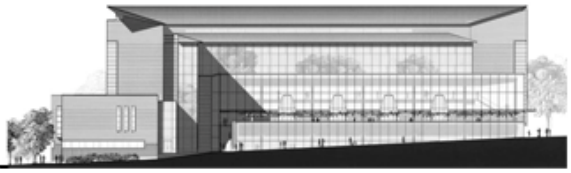
Lighting Depth





Introduction

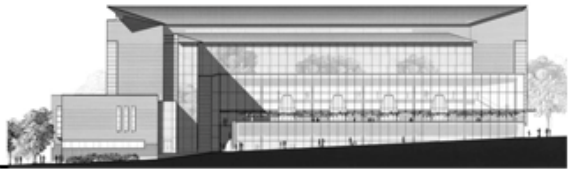
Serving as the new home for the University of Washington's School of Law, William H. Gates Hall provides a state of the art facility for students, faculty, and visitors alike. The new facility boasts architectural elements unlike any other on campus, in addition to providing students with many spaces unique to the law school. In order to foster the essence of tradition and excellence of the University of Washington Law School, a lighting design that is conducive to a productive learning atmosphere and complementary to the outstanding new facility is necessary. The building as a whole should make a strong, yet welcoming, statement among the surrounding campus.

The Lighting Depth focuses on creating lighting designs for several areas of the building that exemplify the uniqueness of the building. In addition to this, the lighting design also strives to provide user friendly applications through the use of controls and desirable light levels, while at the same time, minimizing the energy consumption of the systems. The four spaces for which the lighting is redesigned are the Jeffrey & Susan Brotman Galleria, the terrace, the Senator Warren G. Magnuson & Senator Henry M. Jackson Trial Courtroom, and the Marion Gould Gallagher Law Library (main reading area). For each of these spaces, the room characteristics, desired design concepts and criteria, appropriate illuminance levels, and allowable power densities are considered when developing the lighting design.

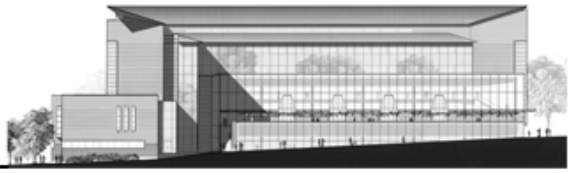
Additionally, daylighting considerations are taken into account and daylight studies are conducted for two of the spaces which incorporate a considerable usage of glazing within the space. These two spaces include the Jeffrey & Susan Brotman Galleria and the Marion Gould Gallagher Law Library. The daylighting studies include an evaluation of the daylight conditions in the space at three different times on three days throughout the year. These studies allow for recommendations or system adjustments that can maximize the use of daylight potential, while not compromising occupant comfort, to be made.

In determining an effective lighting design for each space, special considerations are given to create a design that provides a balance between visual aesthetics, system performance and energy efficiency. IESNA design criteria and performance parameters, as well as ASHRAE 90.1 power density allowances are used as basic guidelines in determining an appropriate system for each space. AGI32 is used in order to determine illuminance values, design performance, and produce computer renderings to allow for a thorough understanding of the impact of the lighting design on the space.

Katherine Jenkins
William H. Gates Hall
Seattle, WA



Jeffrey & Susan Brotman Galleria



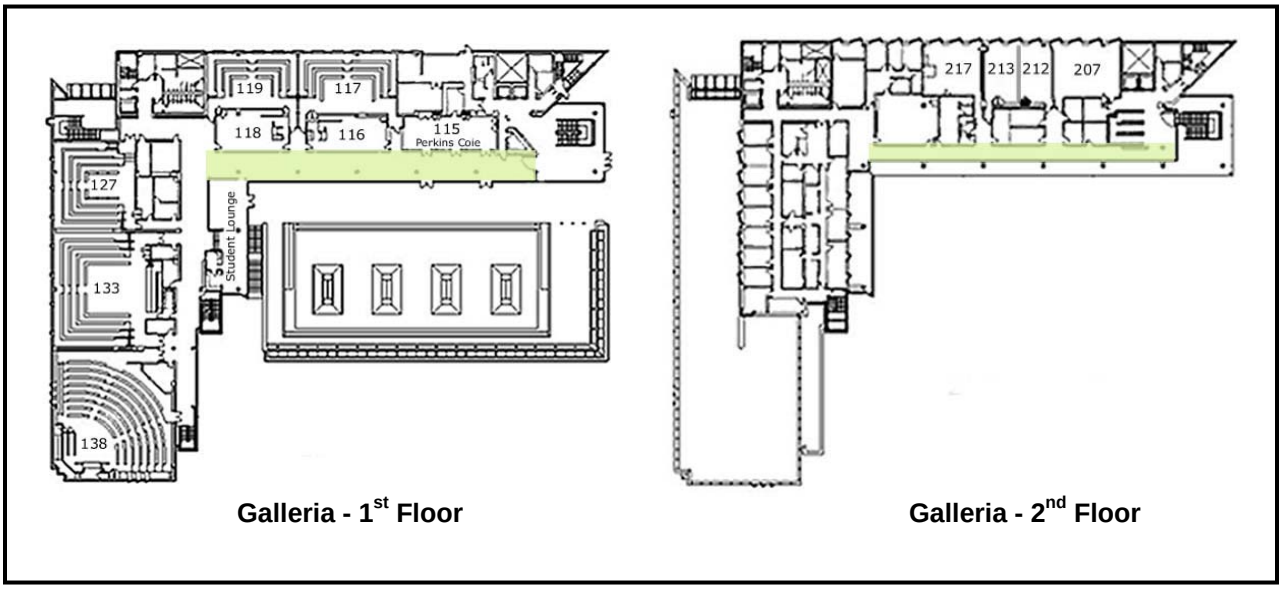
Introduction

Running the entire length of the building, the Jeffrey and Susan Brotman Galleria serves as the main circulation artery of the building. The two-storied space runs from the main entrance on the east end to the student commons area at the heart of the building, providing access to classrooms, seminar rooms and conference rooms. The most noticed and appreciated aspect of this space is the two-story glazed south-facing wall, separating the galleria from the terrace. The first floor of the galleria runs approximately 200 feet in length and is 15 feet wide. Half of this space lengthwise opens to the double-height ceiling above, while the other half is capped by the second floor galleria walkway. Accessed by the main staircase in the lobby, the second floor of the galleria also runs approximately 200 feet in length, but only spans around eight and half feet in width. At the east end of the galleria on the first floor is a glass enclosed display board, which is used to display information for occupants of the building.

Space Layout

The following figures are used to help show the location and layout of the galleria within the building. Figure 1.1.1 illustrates the galleria's location within the building on the first and second floors and Figure 1.1.2 shows the first and second floor dimensioned floor plans of the space.

Figure 1.1.1 – Galleria Location within William H. Gates Hall



Galleria - 1st Floor **Galleria - 2nd Floor**

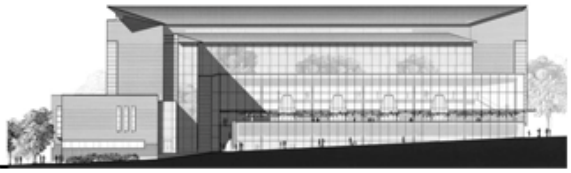
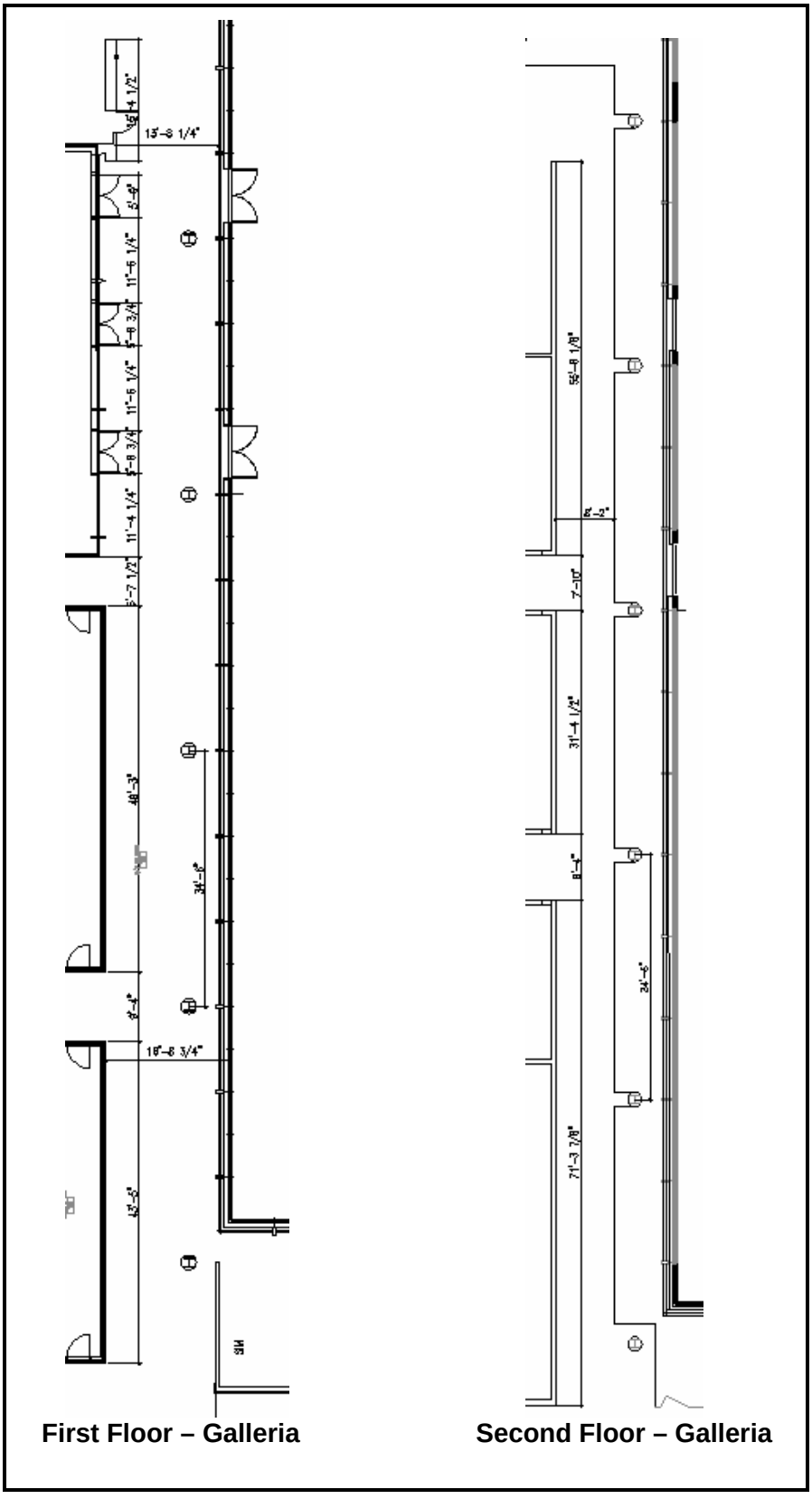
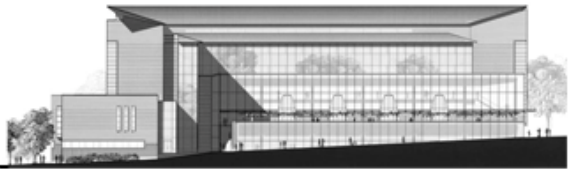


Figure 1.1.2 – Galleria Floor Plans

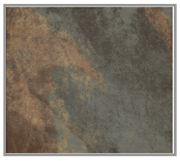




Architectural Finishes
Surface Materials & Reflectances

Floors

Carpet
Manufacturer: Prince Street Carpets
Color: Get Your Goat (Tan)
Reflectance: 17%



Slate Tile
Manufacturer: Vermont Structural Slate Co.
Color: Heathermore Clear Gray
Reflectance: 28%

Walls

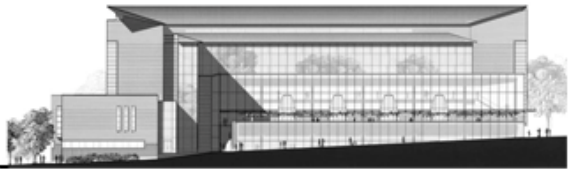
Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%

Birch Wood Paneling
Manufacturer:
Color: Birch
Reflectance: 30%

Ceilings

Acoustical Ceiling Tile
Manufacturer: Armstrong World Industries Inc.
Color: White
Reflectance: 89%

Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%



Glazing

PPG Sungate 100 Low-E- Glass

Transmittance			Reflectance		U-Value		K-Value		Shading Coeff.	Solar Heat Gain Coeff.	Light to Solar Gain
Ultra-violet %	Visible %	Total Solar Energy %	Visible Light %	Total Solar Energy %	Winter Night time	Summer Daytime	Winter Night time	Summer Daytime			
35	73	44	12	20	0.31	0.3	1.76	1.7	0.59	0.52	1.4

Daylight Study

The orientation of the building and the use of glass facades allows for William H. Gates Hall to receive ample amounts of daylight. The galleria, which boasts by a south facing glazed curtain wall, is the space that receives the most daylight in the building. This influx of daylight allows for high levels of natural lighting in the space, thus allowing electric light levels to be lower during daylight hours. The glass façade, which runs the entire length of the south wall, uses PPG Sungate low-emitting glass (noted above).

Daylighting Values and Renderings

The following daylighting study looks at daylight contribution and conditions within the space for different sky conditions at several times throughout the year: 10:00 AM and 1:00 PM on December 21, March 21, and June 21. For each of the days, times, and conditions the illuminance levels that the daylight provides are noted for the Galleria's first floor, second floor and vertical north wall.

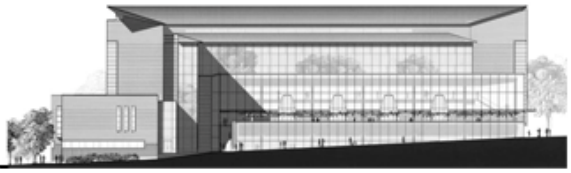


Table 1.1.1 - Daylight Illuminance Values (fc)

	December 21.											
	10:00 AM						1:00 PM					
	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
Clear Sky	Average	1028	Average	833.48	Average	2256	Average	1425	Average	1180	Average	3036
	Max	1599	Max	1083	Max	3131	Max	2283	Max	1564	Max	4091
	Min	250	Min	197	Min	501	Min	124	Min	178	Min	645
	Avg/Min	4.11	Avg/Min	4.24	Avg/Min	4.5	Avg/Min	11.45	Avg/Min	6.63	Avg/Min	4.7
	Max/Min	6.39	Max/Min	5.5	Max/Min	6.25	Max/Min	18.36	Max/Min	8.87	Max/Min	6.34
Partly Cloudy	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	315.47	Average	182.66	Average	536.07	Average	495.53	Average	317.457	Average	901.37
	Max	475	Max	262	Max	642	Max	758	Max	457	Max	1087
	Min	166	Min	58.4	Min	334	Min	133	Min	84.1	Min	507
	Avg/Min	1.91	Avg/Min	3.13	Avg/Min	1.61	Avg/Min	3.71	Avg/Min	3.78	Avg/Min	1.78
	Max/Min	2.87	Max/Min	4.48	Max/Min	1.92	Max/Min	5.68	Max/Min	5.43	Max/Min	2.15
Overcast	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	57.63	Average	27.08	Average	63.06	Average	74.03	Average	34.78	Average	81.01
	Max	85.1	Max	38.8	Max	67.9	Max	109	Max	49.9	Max	87.3
	Min	27.7	Min	13.2	Min	54.2	Min	35.7	Min	17	Min	69.6
	Avg/Min	2.08	Avg/Min	2.05	Avg/Min	1.16	Avg/Min	2.07	Avg/Min	2.05	Avg/Min	1.16
	Max/Min	3.07	Max/Min	2.94	Max/Min	1.25	Max/Min	3.06	Max/Min	2.94	Max/Min	1.25

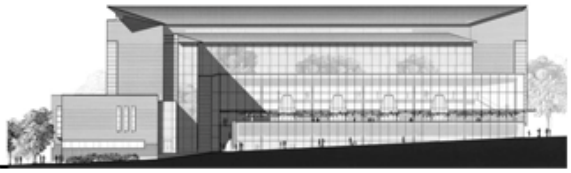
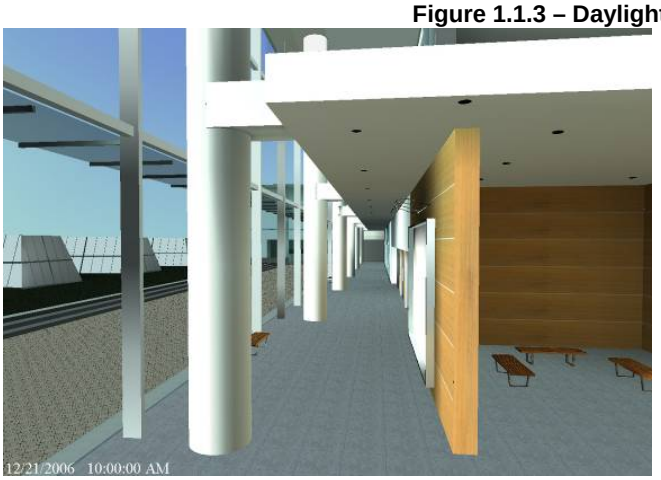


Figure 1.1.3 – Daylighting Study Renderings



December 21, 10:00 AM, Clear Sky

December 21, 1:00 PM, Clear Sky

December 21, 10:00 AM, Partly Cloudy

December 21, 1:00 PM, Partly Cloudy

December 21, 10:00 AM, Overcast

December 21, 1:00 PM, Overcast

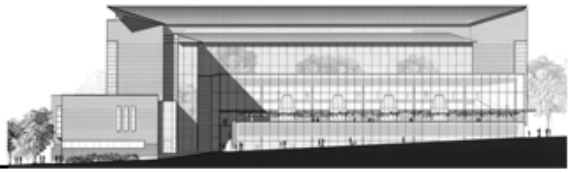


Table 1.1.2 - Daylight Illuminance Values (fc)

	March 21.											
	10:00 AM						1:00 PM					
Clear Sky	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	1338	Average	1354	Average	1040	Average	2769	Average	3117	Average	3435
	Max	2618	Max	2251	Max	2495	Max	4164	Max	3985	Max	4415
	Min	252	Min	157	Min	430	Min	311	Min	196	Min	613
	Avg/Min	5.31	Avg/Min	8.63	Avg/Min	2.42	Avg/Min	8.91	Avg/Min	15.91	Avg/Min	5.6
	Max/Min	10.4	Max/Min	14.34	Max/Min	5.8	Max/Min	13.39	Max/Min	20.34	Max/Min	7.2
Partly Cloudy	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	643.18	Average	497.25	Average	650.99	Average	1612	Average	1525	Average	2083
	Max	1043	Max	795	Max	1051	Max	2441	Max	2003	Max	2483
	Min	262	Min	103	Min	452	Min	393	Min	186	Min	775
	Avg/Min	2.46	Avg/Min	4.82	Avg/Min	1.44	Avg/Min	4.1	Avg/Min	8.22	Avg/Min	2.63
	Max/Min	3.98	Max/Min	7.71	Max/Min	2.33	Max/Min	6.21	Max/Min	10.79	Max/Min	3.2
Overcast	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	102.3	Average	48.06	Average	111.97	Average	154.06	Average	72.43	Average	168.56
	Max	151	Max	69	Max	121	Max	227	Max	104	Max	182
	Min	49.3	Min	23.5	Min	96.2	Min	74.2	Min	35.4	Min	145
	Avg/Min	2.08	Avg/Min	2.05	Avg/Min	1.13	Avg/Min	2.08	Avg/Min	2.05	Avg/Min	1.16
	Max/Min	3.06	Max/Min	2.94	Max/Min	1.25	Max/Min	3.06	Max/Min	2.94	Max/Min	1.25

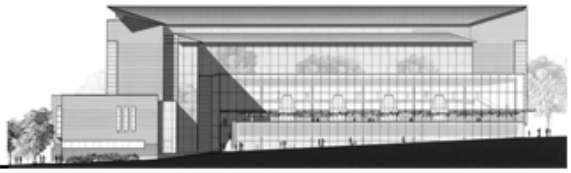
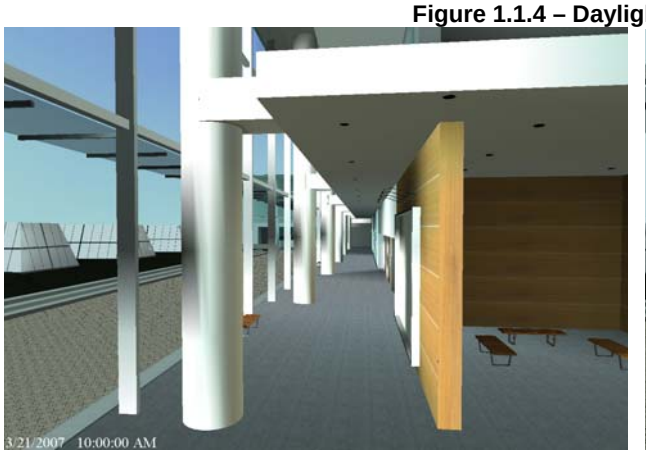


Figure 1.1.4 – Daylighting Study Renderings



March 21, 10:00 AM, Clear Sky

March 21, 1:00 PM, Clear Sky

March 21, 10:00 AM, Partly Cloudy

March 21, 1:00 PM, Partly Cloudy

March 21, 10:00 AM, Overcast

March 21, 1:00 PM, Overcast

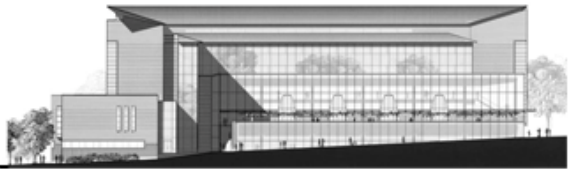


Table 1.1.3 - Daylight Illuminance Values (fc)

	June 21.											
	10:00 AM						1:00 PM					
Clear Sky	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	679.08	Average	118.23	Average	391.26	Average	3069	Average	141.65	Average	473.43
	Max	2891	Max	199	Max	422	Max	4871	Max	205	Max	515
	Min	150	Min	56.9	Min	346	Min	150	Min	72.9	Min	408
	Avg/Min	4.66	Avg/Min	2.08	Avg/Min	1.13	Avg/Min	20.47	Avg/Min	1.94	Avg/Min	1.16
	Max/Min	19.34	Max/Min	3.5	Max/Min	1.22	Max/Min	32.5	Max/Min	2.82	Max/Min	1.26
Partly Cloudy	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	644.32	Average	210.9	Average	579.37	Average	2080	Average	210.9	Average	579.37
	Max	1644	Max	315	Max	612	Max	3255	Max	315	Max	612
	Min	287	Min	95.9	Min	538	Min	323	Min	95.9	Min	538
	Avg/Min	2.25	Avg/Min	2.2	Avg/Min	1.08	Avg/Min	6.44	Avg/Min	2.2	Avg/Min	1.08
	Max/Min	5.73	Max/Min	3.29	Max/Min	1.14	Max/Min	10.08	Max/Min	3.29	Max/Min	1.14
Overcast	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	Average	162.9	Average	76.59	Average	178.28	Average	207.9	Average	97.68	Average	227.5
	Max	240	Max	110	Max	192	Max	307	Max	140	Max	245
	Min	78.5	Min	37.4	Min	153	Min	100	Min	47.6	Min	196
	Avg/Min	2.08	Avg/Min	2.05	Avg/Min	1.16	Avg/Min	2.08	Avg/Min	2.05	Avg/Min	1.16
	Max/Min	3.06	Max/Min	2.93	Max/Min	1.25	Max/Min	3.07	Max/Min	2.95	Max/Min	1.25

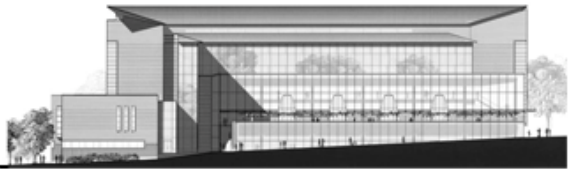
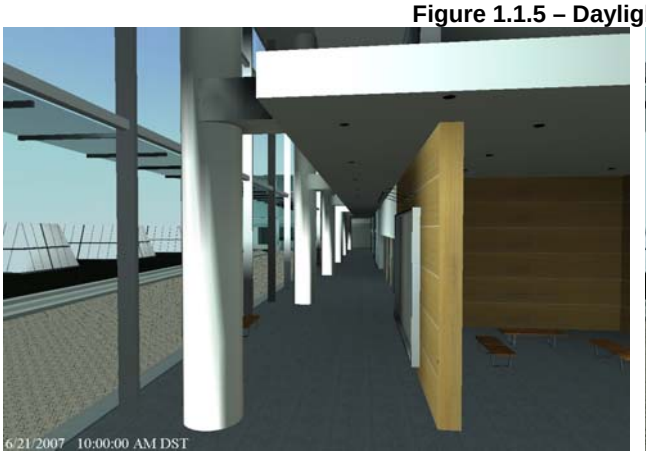
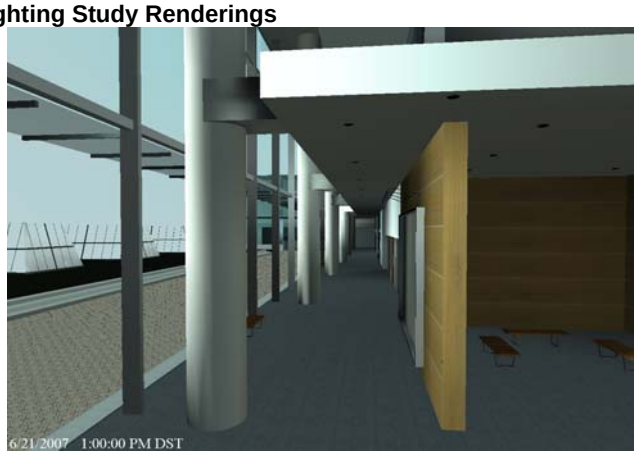


Figure 1.1.5 – Daylighting Study Renderings



June 21, 10:00 AM, Clear Sky



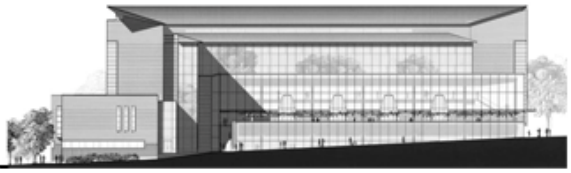
June 21, 1:00 PM, Clear Sky

June 21, 10:00 AM, Partly Cloudy

June 21, 1:00 PM, Partly Cloudy

June 21, 10:00 AM, Overcast

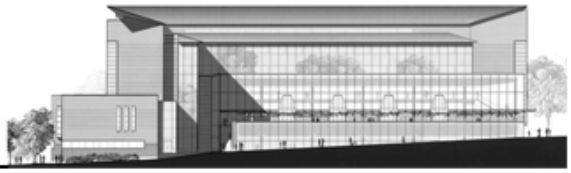
June 21, 1:00 PM, Overcast



Daylight Analysis

The daylight levels the galleria are extremely high during all sky conditions throughout the year. As observed in the daylight study, the glazed curtain wall provides high levels of direct and ambient light into the space, with higher light levels during the summer months but with a deeper penetration into the space during winter months when the sun is lower in the sky. This influx of daylight provides adequate light levels throughout the entire galleria that are required for general circulation purposes. IES design criteria outlines desired illuminance levels in circulation areas to be 5 footcandles for horizontal surfaces and 30 footcandles for vertical surfaces that require accenting. Both of these outlined criteria are met and exceeded during the daylighting times and conditions studied. This being said, this study indicates that minimal electric lighting will be required in this space during daylight hours.

In order to maximize on the potential energy savings that the daylight provides, the lighting system in this space should remain off during daylight hours. The system should only be used from sunset to sunrise and in other circumstances where either the light levels provided by daylight fall below the required 5 footcandles or additional light is desired. In order to achieve this control of the lighting system, the buildings existing low-voltage relay system will be utilized. This system will control the electric lighting on an astronomical time-clock basis, allowing the systems to be turned on and off at the proper times. In addition, local switching will be provided for the galleria lighting system in order to allow for localized control if light levels in the space should fall below the desired illuminance during daytime hours. More sophisticated daylight and dimming systems were considered for this space; however, due to the high levels of daylight and the lack of need for multiple levels of dimming, it is not essential to incorporate one of these dimming systems. By utilizing the existing relay system, we are able to elude the cost of incorporating a new and more sophisticated control system and associated dimming ballast and other equipment.



Design Option #1

Design Goals

As one enters William H. Gates Hall, they are required to travel through the Jeffrey & Susan Brotman Galleria to access the majority of the spaces in the building. Due to the high traffic flowing through this space it is important to incorporate a lighting design that allows for people to traverse through this space safely. In addition to providing adequate light levels, it is also important to create an interesting and inviting environment in the galleria due to its high exposure to the surrounding campus. Both the building's strategic location in a prominent area of campus and the two-story glass curtain wall that flanks the galleria sets this space up to be the viewing window into the building. Lastly, it is important to take into consideration the adjacent terrace when designing a lighting system for this space. The two spaces are separated only by a glass wall and it is important to integrate the two designs.

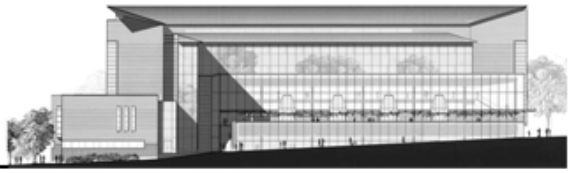
Design Concept

The lighting redesign of the galleria provides an opportunity to create a prominent focal point of the building, both from the inside and out. The blank white walls of the galleria will be transformed into a "glowing message of inspiration." By covering the lengths of the wall with backlit frosted glass that is screened with words that reflect the ideals and values of the law school, a level of interest is given to the space that can be appreciated by the occupants of the building and pedestrians on campus. The glowing walls of the galleria will give the space an inviting atmosphere, softening the linear and rigid elements of the building's architecture. In addition to this, compact fluorescent downlights will be provided along the length of the galleria to ensure adequate light levels for circulation purposes. At the eastern most end of the galleria, the glass enclosed display case will be lit using a more decorative accent light system.

Design Criteria

The following design parameters for the space are outlined in accordance with the IESNA design criteria.

- *Appearance of Space and Luminaires (Important)*
  The galleria is the most public space in the building and serves as the primary circulation corridor for the building. The space is lined with glass on one side and is capped with high ceilings. While luminaires should be appropriate for the architecture of the space, they should also be chosen for efficiency and aesthetics. In addition, this space provides a view into the building, and this should maintain a look and feel that is inviting to the campus community.



- *Color Appearance & Color Contrast*
  Color rendering is important for overall visual performance. While, color appearance is not critical in this space, a CRI of 80 should be maintained by all lamps in order to maximize color appearance and contrast of materials in the space. Special consideration should be given to the use of wood paneling within the space, so not to wash out the wood material. Warmer color temperatures should be used to avoid this.

- *Daylight Integration & Control (Very Important)*
  Given that the south and east-facing walls are flanked with glass in this space, daylight control and integration is very important. By utilizing daylight controls and photosensors, energy consumption within the space can be reduced. Special consideration should be given to the type of glazing materials used on the curtain wall as to help minimize negative effects of direct sunlight, while still allowing an influx of ambient light.

- *Direct Glare (Very Important)*
  The primary culprit of the direct glare in this space will be daylighting. Direct sunlight entering the space can potentially create an uncomfortable visual environment for pedestrians passing through the space.

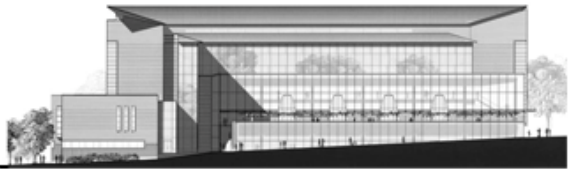
- *Light Distribution on Surfaces*
  Accents of light can be used within this space to create a visually interesting appearance, especially during night hours when the main wall of the galleria can be viewed from outside of the building.

- *Light Distribution on Task Plane (Uniformity)*
  Uniform distribution on the task plane, which in the galleria is the floor, is important to ensure safety of passage through the space.

- *Modeling of Faces or Objects (Important)*
  In order to insure safety in circulation through this space, adequate vertical illuminance levels for facial modeling and recognition should be provided.

- *Reflected Glare (Important)*
  Reflected glare in the space will become an issue during nighttime hours when luminaires are most likely to be reflected in the glass curtain wall. While not all glare can be avoided, special attention should be given to placement of luminaires.

- *Illuminance (Horizontal)*
  Illuminance levels on the floor should be maintained at a minimum of 5 footcandles for simple orientation. This illuminance level should be uniform throughout the length of the space. During daylight hours, these levels will be much higher due to the large influx of daylight in the space.
-



- *Illuminance (Vertical)*
  Minimum vertical illuminance level throughout the galleria should be 3 footcandles for facial modeling purposes. Illuminance levels of 30 should be provided on wall areas where items are being accented.

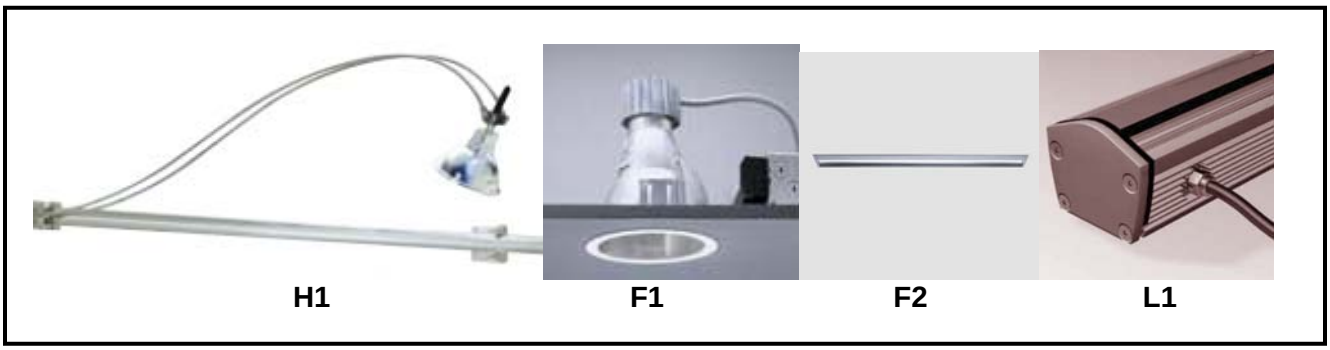
Luminaire Schedule

The following figure and table outline the luminaires that are to be used in the lighting design for the Jeffrey & Susan Brotman Galleria. Refer to Appendix A for all fixture, lamp, and ballast cut sheets.

Table 1.1.4 – Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
H1	Tech Lighting Halogen adjustable accent lights, Clamps to Wall MonoRail	Surface	1	50W MR16	N/A	-	3000	12/277	35	4
F1	Lightolier Compact Fluorescent downlight w/ vertical lamp, nominal 6" aperture	Recessed	1	CFTR32W	Electronic	82	3500	277	34	32
F2	Erco 48" Recessed wallwasher	Recessed	1	F28T5	Electronic	82	3500	277	30	12
L1	ioLighting 36" Symmetrical Linear LED Accent, 5 degree beam spread w/ grazing	Surface	1	F28T5	Integrated Driver	-	5000	277	32	63

Figure 1.1.6 – Luminaires Used in Galleria Lighting Design



Luminaire Layout

The following figure, Figure 1.1.7, shows the luminaire layout for the each of the two floors of the galleria. Luminaire type is shown according to the corresponding luminaire designation.

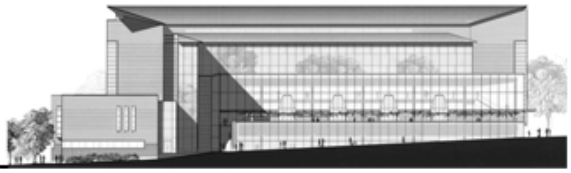
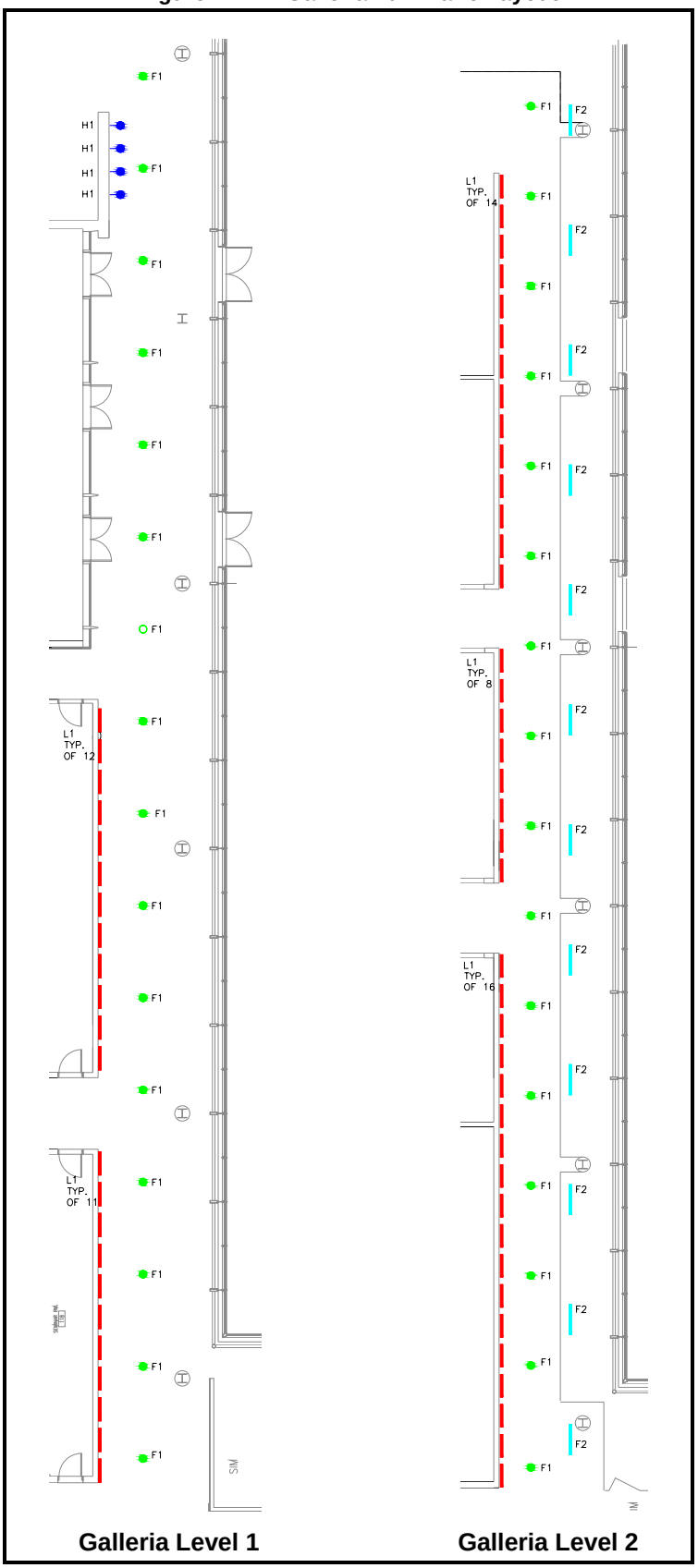
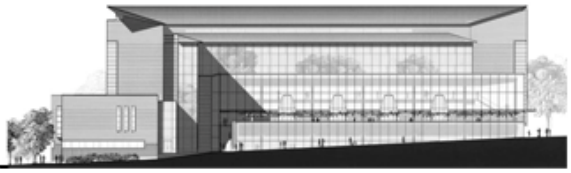


Figure 1.1.7 – Galleria Luminaire Layout



Galleria Level 1 **Galleria Level 2**



Controls

As discussed in the Daylight Study, there is a high influx of daylight into the space and there is virtually no need for electric light, even in overcast and cloudy conditions. In order to take advantage of this and the potential energy savings, all of the lights in the galleria will be placed on the building's existing low-voltage relay time clock system. This will allow the lights to turn off after sunrise and turn back on right before sunset. Additionally, a key-operated localized switch will be provided in order to allow building operators to turn on the lights during daytime hours, should the light levels fall below the desired illuminance.

Building operation hours will have some effect on the timing and use of lights within the space. Typically, access to most areas of the building is restricted to key card access after 6:00 P.M. Monday through Friday and all day Saturday and Sunday. Students have limited key card access after hours, while faculty and staff have access at all times. The building goes into an economize state (reduced HVAC, lighting, etc.) an hour after the library closes and restarts two hours before the library and law school open. Please refer to the table below for library hours which determine the times of operational cutbacks. In order to accommodate the changes in building operation, the luminaires incorporated into this design will be divided and controlled in two separate zones that coordinate with the buildings operational hours. The general down lighting provided along the length of the two levels of the galleria will remain on throughout all hours of the night to provide general and security lighting for those who enter the building during this time. The remainder of the lights in this space, including the LED's which backlight the glass wall and the display board accent lights will turn off during the building's economize state, one hour after the library closes until two hours before the law school and library open.

Table 1.1.5 – Library Hours

Library Hours	
Monday - Thursday	8 am - 11 pm
Friday	8 am - 6 pm
Saturday	11 am - 6 pm
Sunday	11 am - 11 pm

The first and second floors of the galleria will be controlled by spare relays from two different automated lighting control panels located on the first and second floors, respectively. The first floor will utilize spare relays R7 and R8 from automated lighting control panel ALC-1A. Likewise, luminaires on the second floor will use spare relays R7 and R8 from automated lighting control panel ALC-2A. Relays R7 from the first and second floor will remain on at all hours throughout the night and will also be provided with a localized switch to all for lights to be turned on during daytime hours if needed. The first floor relay R8 and second floor relay R8 will follow the building "economize" state as explained above.

The following tables show the automated lighting control schedules affected by the lighting design of this space. Note that relays highlighted in yellow are the relays that changed according to the galleria lighting design.

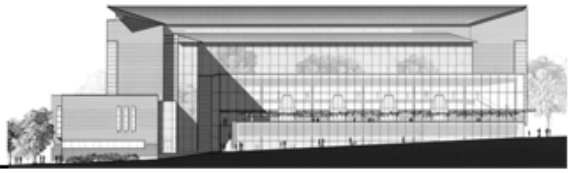


Table 1.1.6 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-1A					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NW01-N02-2	SW ROOMS	FL	2997	
R2	PCB-NW01-N02-4	NW ROOMS	FL	2030	
R3	PCB-NW01-N02-6	LOUNGE	FL	2131	
R4	PCB-NW01-N02-8	CORRIDOR	FL	2150	
R5	PCB-NW01-N02-10	SE EXTERIOR	FL	2420	
R6	PCB-NW01-N02-12	SE EXTERIOR	FL	2108	
R7	PCB-NW01-N02-16	GALLERIA	FL	340	
R8	RCB-NW01-N02-18	GALLERIA	FL	936	
R9					
R10					
R11					
R12					
R13					
R14					
R15					
R16					
R17					
R18-R32					SPARE RELAYS

Table 1.1.7 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-2A					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NW02-N02-2	WEST OFFICES	FL	2997	
R2	PCB-NW02-N02-4	SW CORRIDOR	FL	2030	
R3	PCB-NW02-N02-6	SW CORRIDOR	FL	2131	
R4	PCB-NW02-N02-8	CENT. CORRIDOR	FL	2306	
R5	PCB-NW02-N02-10	RESTROOMS	FL	2420	
R6	PCB-NW02-N02-12	CLEAR STORY	FL	2108	
R7	PCB-NW02-N02-14	GALLERIA	FL	340	
R8	PCB-NW02-N02-16	GALLERIA	FL	1640	
R9					
R10					
R11					
R12					
R13					
R14					
R15					
R16					
R17					
R18-R32					SPARE RELAYS

Refer to Figure 1.1.8 for luminaire layout circuiting and controls.

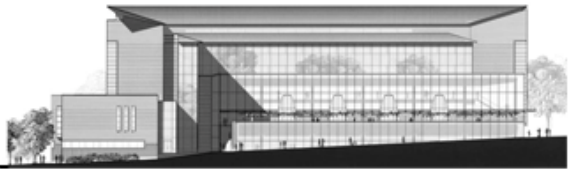
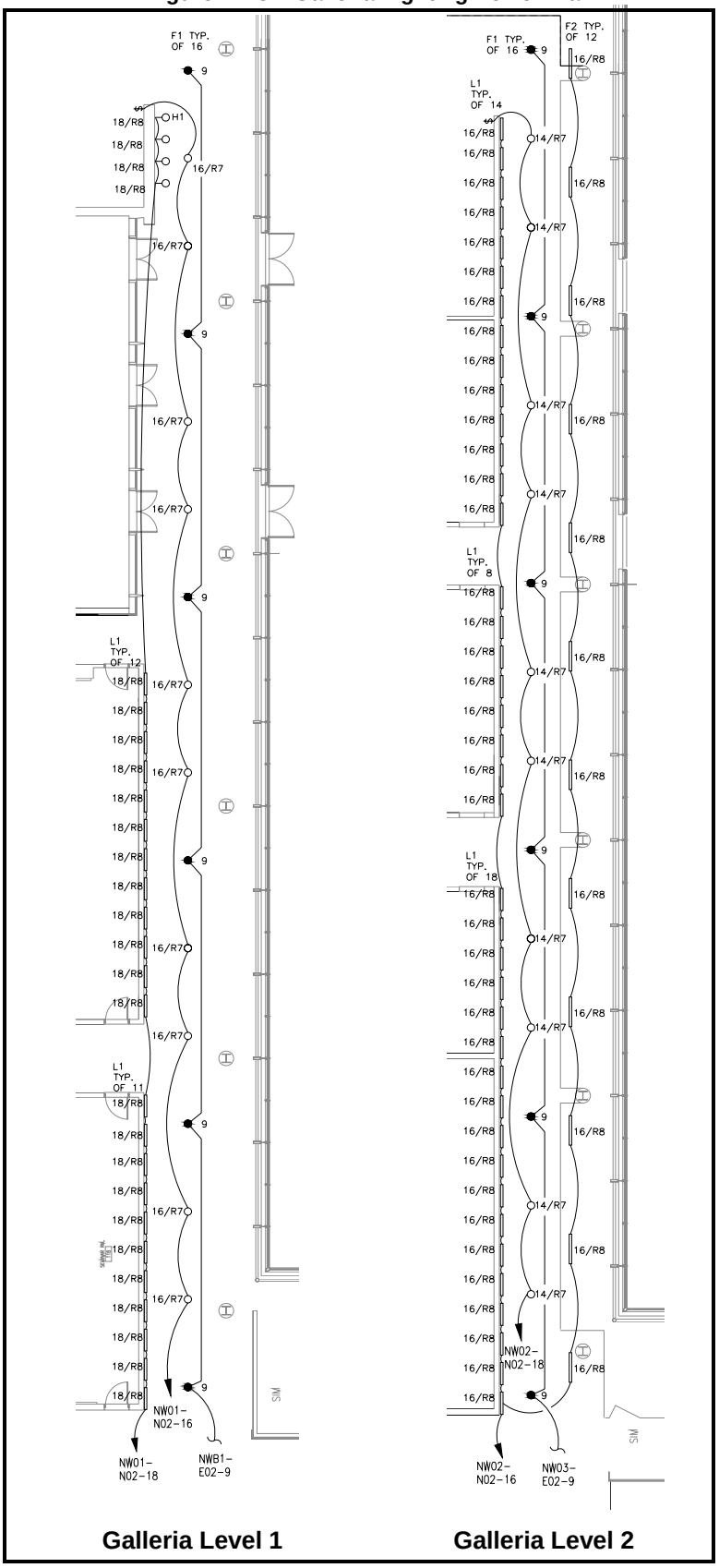
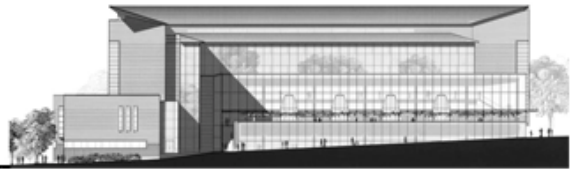


Figure 1.1.8 – Galleria Lighting Power Plan



Galleria Level 1 **Galleria Level 2**



Details

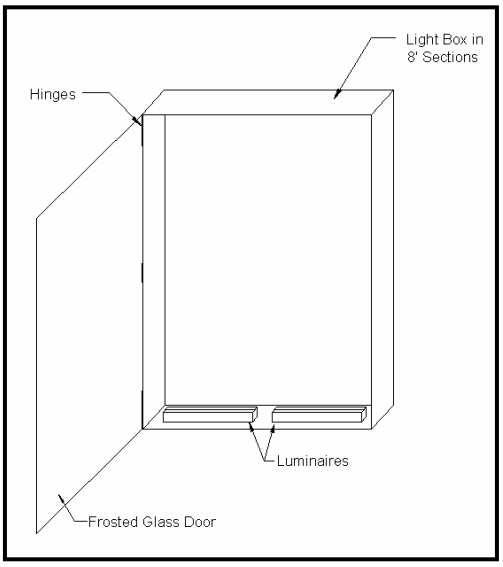


Figure 1.1.9 – Backlit Frosted Glass Detail

The backlit frosted glass wall with be composed of 8' sections. Each of these sections will act like a "light box" with a frosted glass door. In order to allow for maintenance of the luminaires, the glass of each section is hinged to the box; this will allow for the glass to be swung open when maintenance is required.

Light Loss Factors

The following table outlines the light loss factors for each of the luminaires used in the lighting design of the galleria. In determining these values it was assumed that the atmosphere was very clean, with a cleaning interval of twelve months.

Table 1.1.8 – Light Loss Factors

Luminaire Designation	Maintence Category	Room Atmosphere	Cleaning Interval	Initial Lumens/Luminaire	Design Lumens/Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
H1	IV	Very Clean	12 months	2050	2050	1	1.00	0.98	0.94	**0.92**
F1	IV	Very Clean	12 months	900	774	0.98	0.86	0.96	0.94	**0.76**
F2	VI	Very Clean	12 months	2900	2660	0.98	0.92	0.88	0.94	**0.74**
L1	VI	Very Clean	12 months	888	888	1	1.00	0.9	0.94	**0.85**

Power Density

The maximum allowable power density according to ASHRAE 90.1 for a galleria/circulation space is 0.8 W/sq ft. The following table shows the calculation of the power density for the proposed lighting design for the galleria.

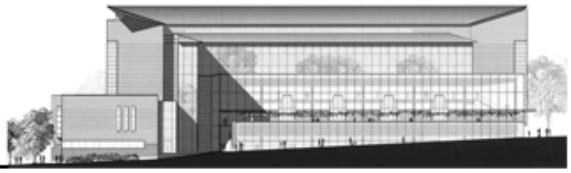


Table 1.1.9 –Power Density

Luminare	Input Watts	Quantity	Watts
H1	35	4	140
F1	34	32	1088
F2	30	12	360
L1	32	63	2016
		Total Watts	3464
		Area (sq ft)	6000
		Power Density	**0.58**

The power density of the galleria is 0.58 watts per square foot. This value is below the prescribed 0.8 watts per square foot. Therefore, the power density for this design is acceptable.

Design Performance

Illuminance levels throughout the galleria need to be maintained in order to allow for building occupants to circulate through the space safely. This is particularly important for the floor areas on the first and second floor. The IES criteria for illuminance levels in a circulation space require a minimum of 5 footcandles be maintained. The lighting for both the first and second floors of the galleria meet this required level with an average of 8.54 footcandles and 12.64 footcandles respectively. Even at their minimum, illuminance levels in both areas do not fall below the outlined 5 footcandles. The distribution of light along these surfaces is overall fairly uniform, as to provide a safe atmosphere for circulation throughout the building.

Vertical light levels throughout the space should be fairly uniform and maintain illuminance levels of 3 footcandles. The proposed design incorporates a backlit frosted glass wall along the length of the north wall. The distribution along these walls is fairly uniform, with light levels dropping slightly as it approaches the top of the wall (due to the fact that the wall is lit from the ground up). Vertical light levels for the first floor average approximately 3.6 footcandles and the second floor averages approximately 3.5 footcandles. These values meet the 3 footcandles requirement for vertical surfaces.

The display board at the east end of the galleria is accented with a series of MR16 accent lights. While it is important to provide enough light to easily read any material that might be posted on the board, it is also important to create a visual distinction between the display board and the rest of the wall in the space. By lighting this board to slightly higher illuminance levels, it allows the display board to stand out in comparison to the rest of the wall. The illuminance levels on the display board range between 4.3 footcandles and 35.7 footcandles. These levels are fairly low at certain points; however, the adjustable accent lights allows for adjustment in the field after installation to position the fixture in a way that will optimize its lighting potential.

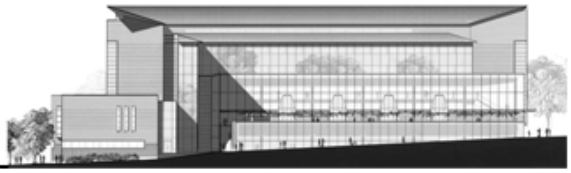
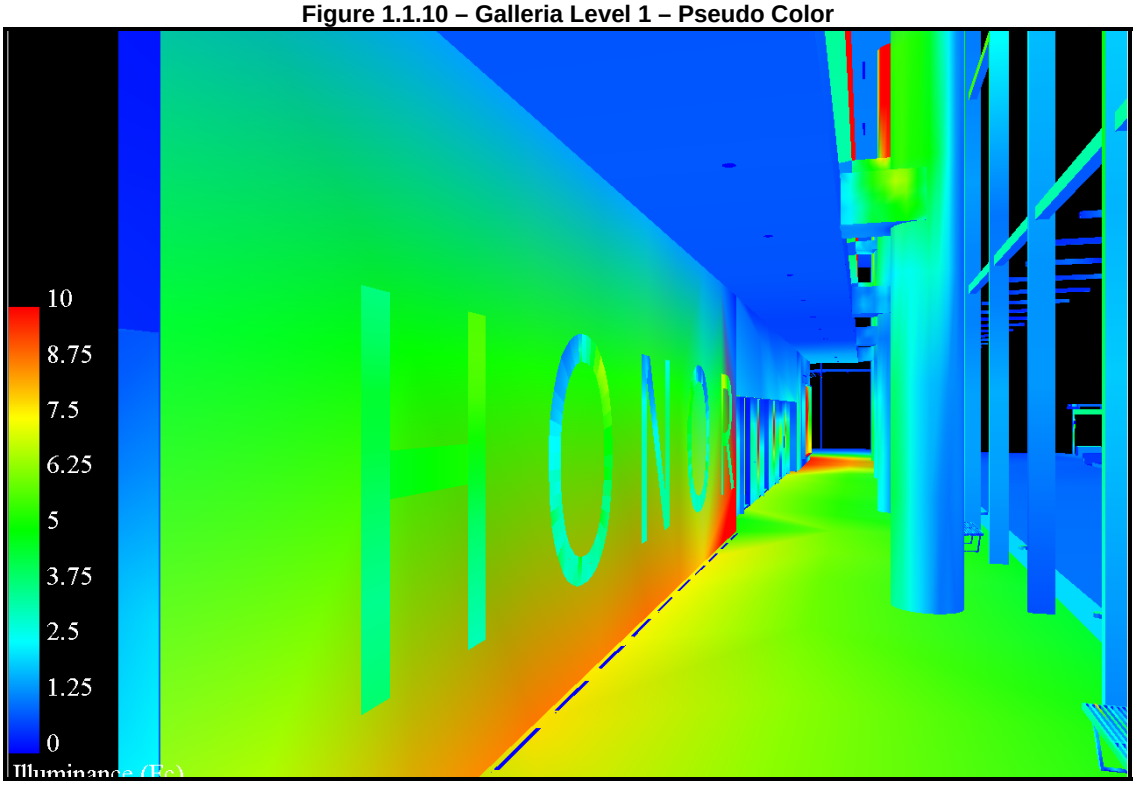


Table 1.1.10 - Illuminance Values (fc)

Galleria Level 1 Floor		Galleria Level 2 Floor		Galleria Level 1 Display Board (vertical)	
Average	8.54	Average	12.64	Average	12.3
Max	21.7	Max	15.3	Max	35.7
Min	7.1	Min	9.5	Min	4.3
Avg/Min	1.2	Avg/Min	1.33	Avg/Min	2.86
Max/Min	3.06	Max/Min	1.61	Max/Min	8.3
Galleria Level 1 Vertical Wall		Galleria Level 2 Vertical Wall			
Average	3.67	Average	3.54		
Max	8	Max	6.5		
Min	1.3	Min	2.1		
Avg/Min	2.82	Avg/Min	1.63		
Max/Min	6.15	Max/Min	3.1		

Figure 1.1.10 – Galleria Level 1 – Pseudo Color



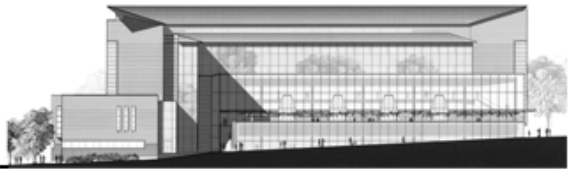


Figure 1.1.11 – Galleria Level 2 – Pseudo Color

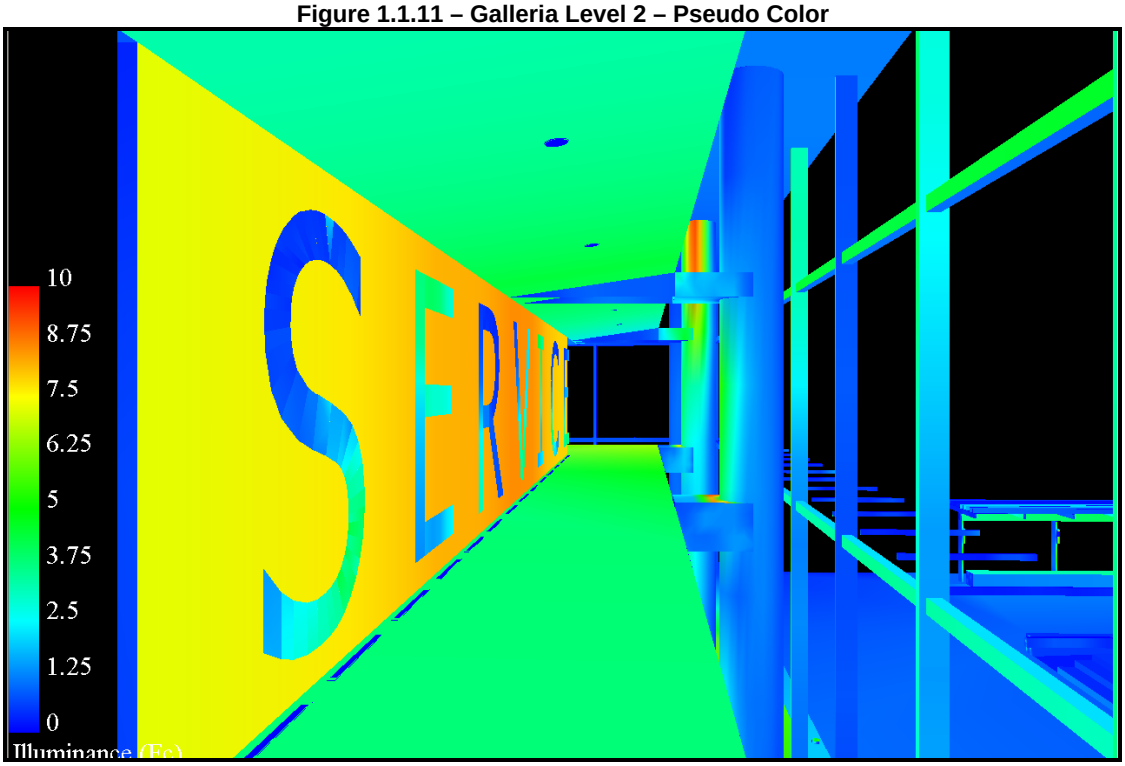
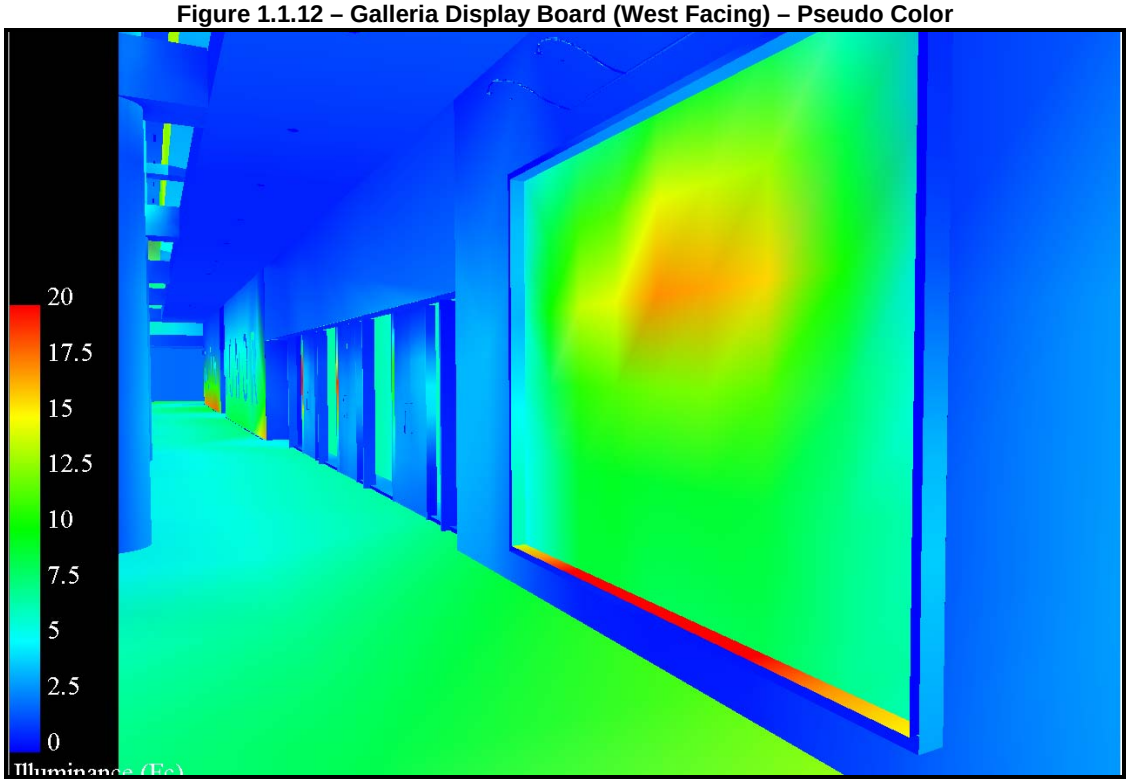
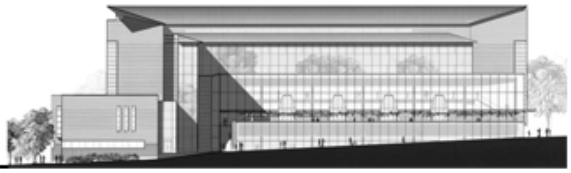


Figure 1.1.12 – Galleria Display Board (West Facing) – Pseudo Color

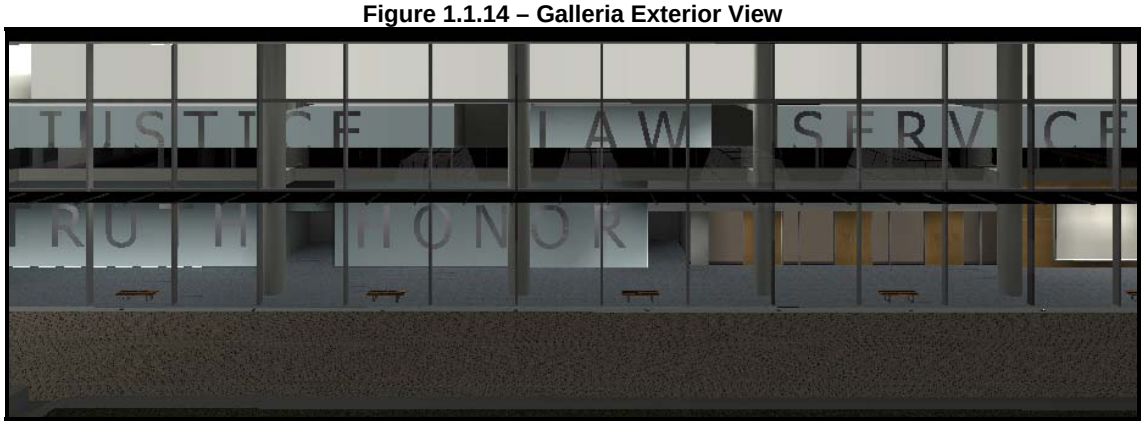




Renderings

Figure 1.1.13 – Galleria Exterior View

Figure 1.1.14 – Galleria Exterior View



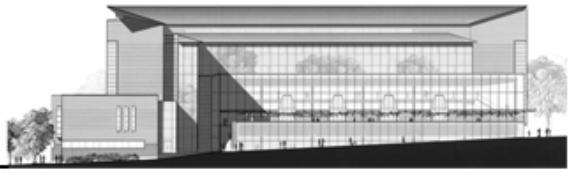
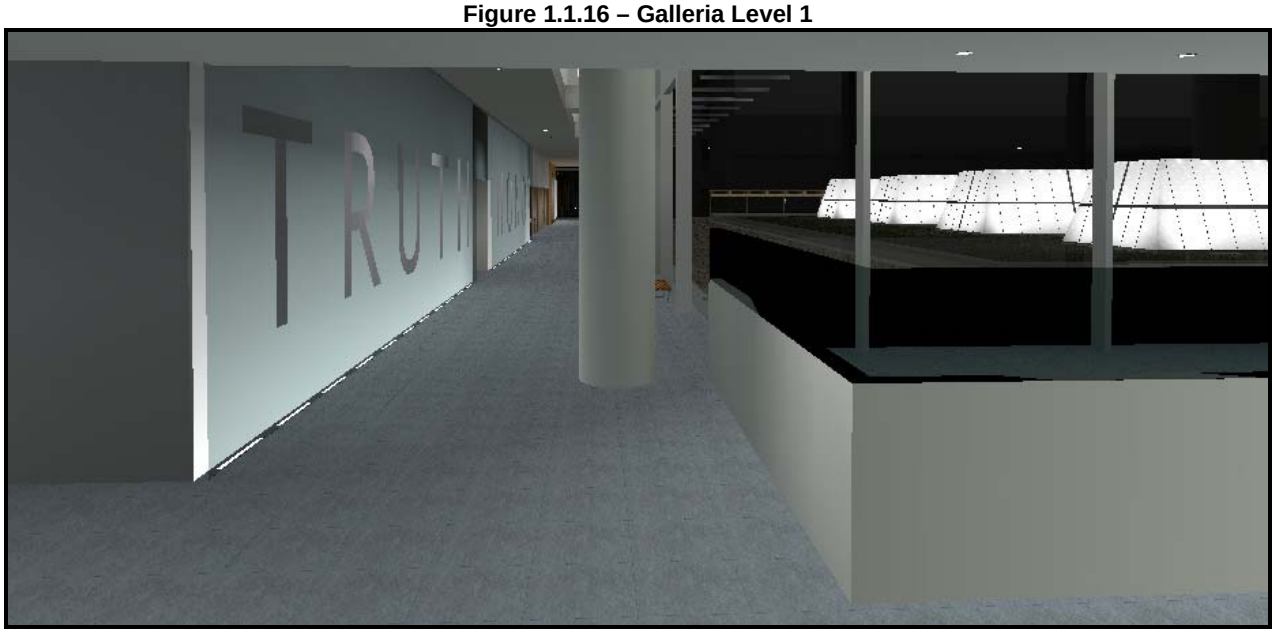


Figure 1.1.15 – Galleria Level 1

Figure 1.1.16 – Galleria Level 1



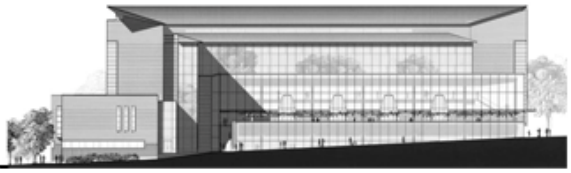
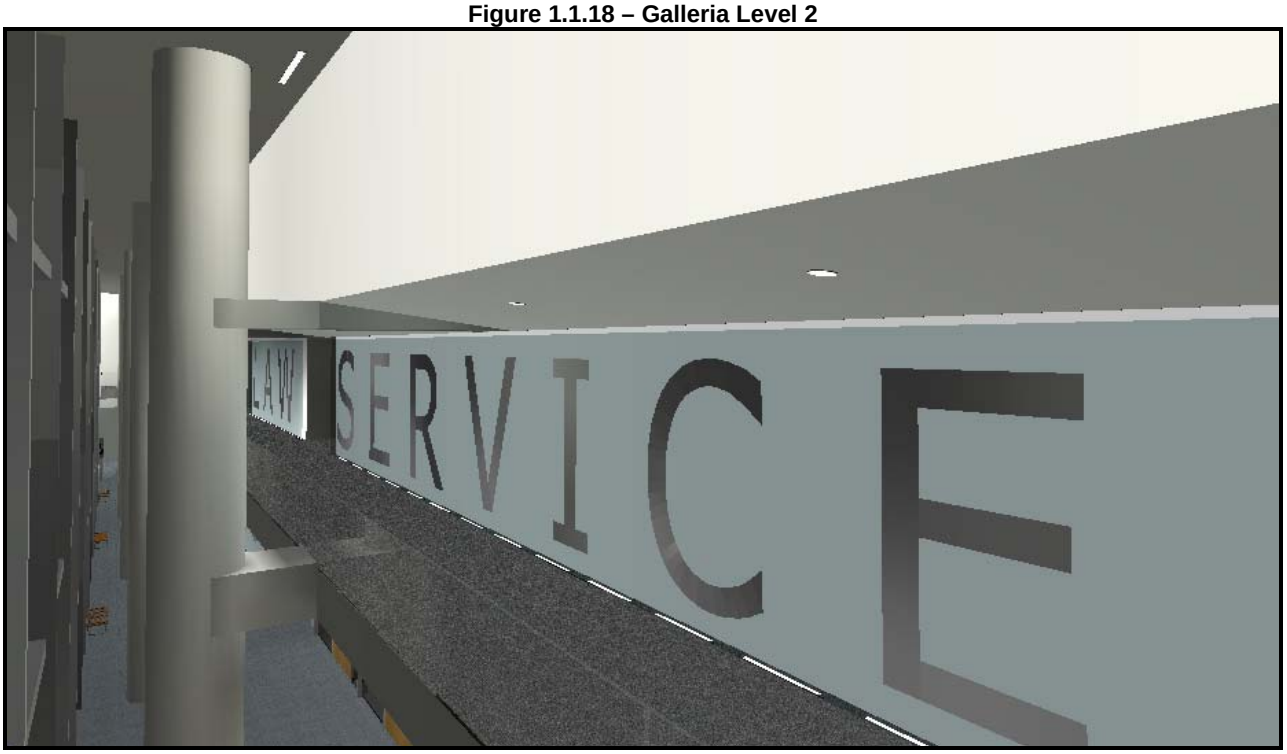


Figure 1.1.17 – Galleria Level 1

Figure 1.1.18 – Galleria Level 2



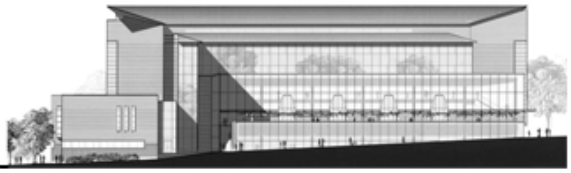
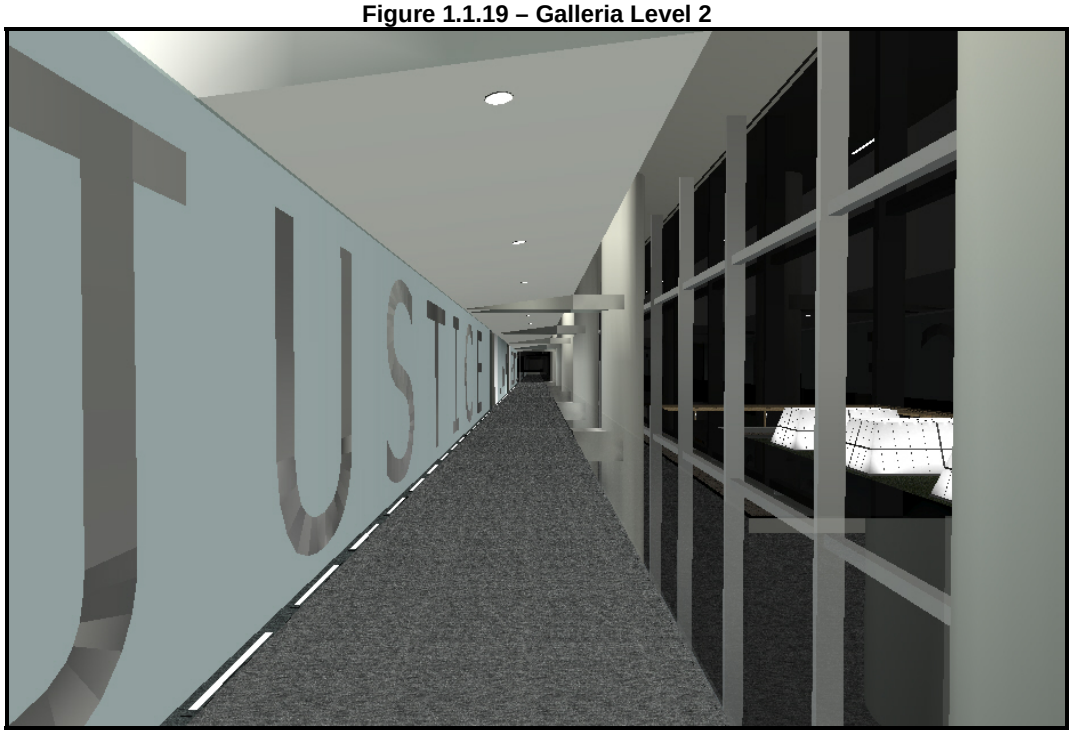
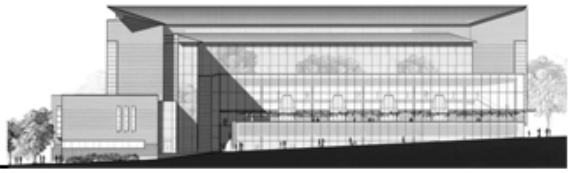


Figure 1.1.19 – Galleria Level 2



Conclusion

The galleria has been transformed into a glowing window of inspiration for both those traveling through the space and those passing through campus. From within, the space creates an interesting atmosphere while providing an environment that is safe for the occupants. The “glowing” galleria emphasizes the heart and most public space of the building, while providing adequate light levels for the safety of occupants.



Design Option #2

Design Goals

Please refer to the design goals outlined under Design Option #1.

Design Concept

The glass flanked galleria allows for the chance to design a lighting system that visible to not only those occupying the building, but also to pedestrians on campus. The lighting design for the galleria will strive to achieve an essence of a glowing lantern during nighttime hours, symbolizing the students throughout the building working into the long hours of the night. This concept integrates the glowing skylights located in the adjacent terrace with galleria. In order to create a glowing effect of this space, linear fluorescent wall washers will be used along the length of the galleria to light the walls. The lighting of the walls will also provide ambient light throughout the space in order to allow for safe circulation. Additionally, the columns will be highlighted using column-mounted up-down lights. The display board at the east end of the galleria will be accented using recessed compact fluorescent wall washers. This will allow for a soft accenting of the board, without provided extensive amounts of glare. By primarily using a wall washing effect throughout this space, a soft glow will be achieved throughout the galleria.

Design Criteria

Please refer to the design criteria outline under Design Option #1.

Luminaire Schedule

The following figure and table outline the luminaires that are to be used in the lighting design for the Jeffrey & Susan Brotman Galleria. Refer to Appendix A for all fixture, lamp, and ballast cut sheets.

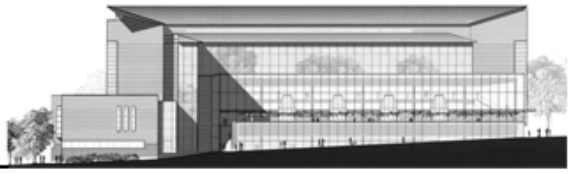
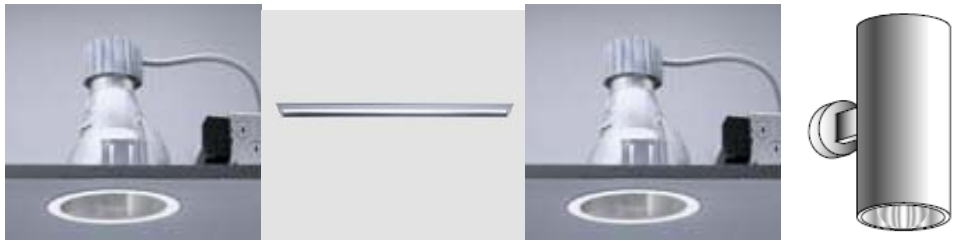


Table 1.1.11 – Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
F1	Lightolier Compact Fluorescent downlight w/ vertical lamp, nominal 6" aperture	Recessed	1	CFTR32W	Electronic	82	3500	277	34	3
F2	Erco 48" Recessed wallwasher	Recessed	1	F28T5	Electronic	82	3500	277	30	46
F9	Lightolier Compact Fluorescent wallwasher w/ vertical lamp, nominal 6" apperature	Recessed	1	CFTR32W	Electronic	82	3500	277	34	4
F10	Delray Lighting 8" Clyinder Vertical Lamp Up/Downlight	Surface (Column)	2	CFQ18W	Electronic	82	3500	277	36	6

Figure 1.1.20 – Luminaire to be Used in Galleria Lighting Design



F1 **F2** **F9** **F10**

Luminaire Layout

The following figure, Figure 1.1.21, shows the luminaire layout for the each of the two floors of the galleria. Luminaire type is shown according to the corresponding luminaire designation.

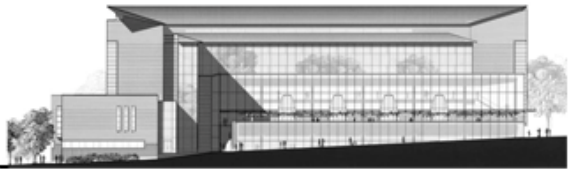
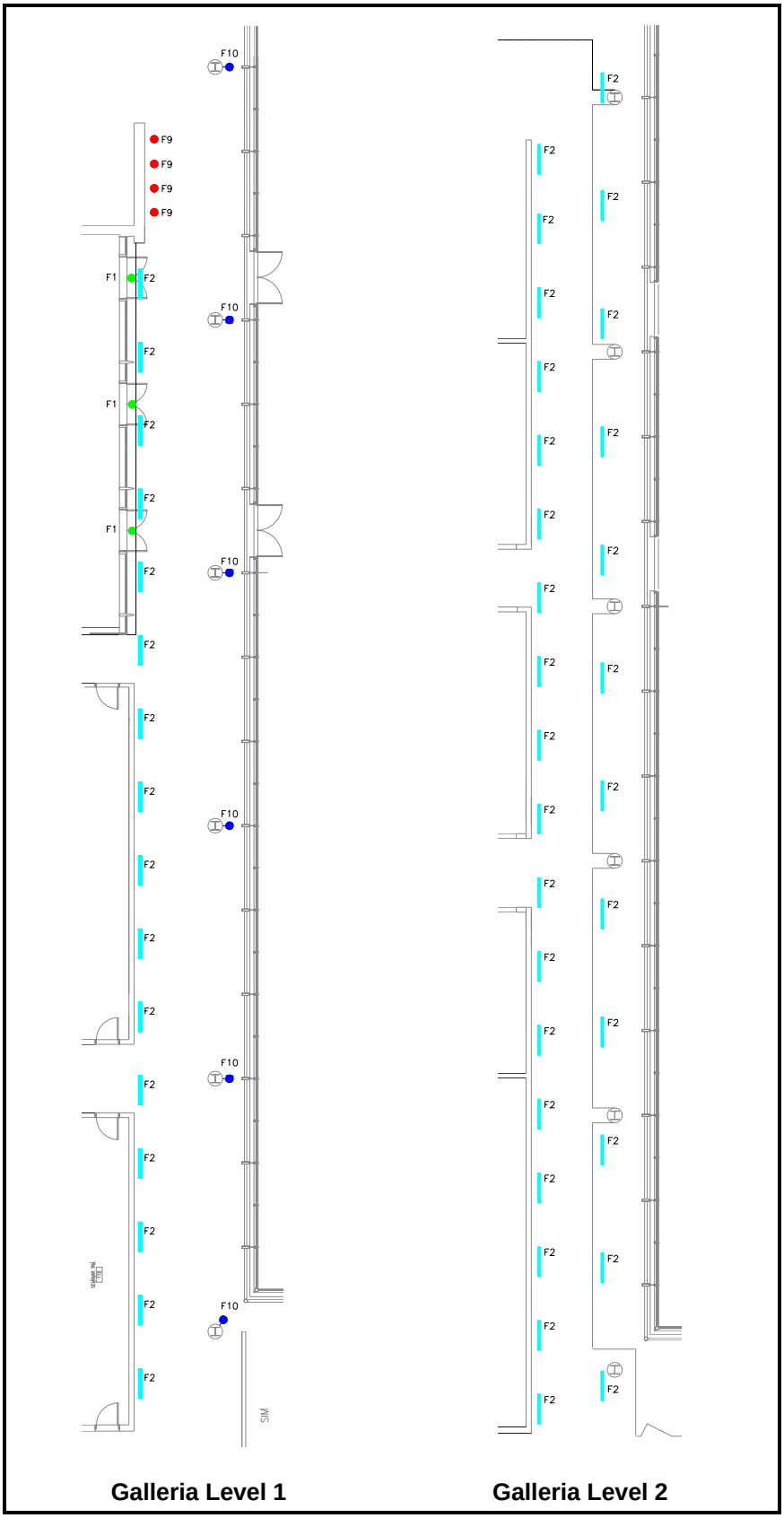
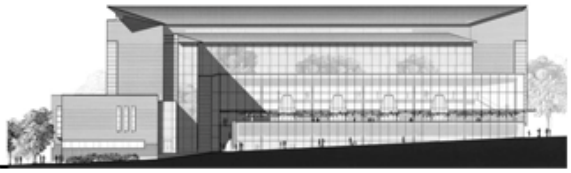


Figure 1.1.21 – Galleria Luminaire Layout





Controls

Due to the high influx of daylight into the galleria, the need for electric light during daylight ours is virtually eliminated. During all sky conditions throughout the year, the daylight levels in the space far exceed the required 5 footcandles. In order to take advantage of this and the potential energy savings, all of the lights in the galleria will be placed on the building's existing low-voltage relay time clock system. This will allow the lights to turn off after sunrise and turn back on right before sunset. Additionally, localized key-operated switching will be provided in order to allow building operators to turn on the lights during daytime hours, should the light levels fall below the desired illuminance.

The lighting within the space will be divided into zones to accommodate the operational hours and controls that were explained in Design Option #1. A general lighting system consisting of the linear wallwashers on the first and second levels of the galleria will remain on throughout the night for provide for general and security lighting. The remainder of the lights, including the column up-down lights, display board accent lights, the down lights highlighting the conference room entrance and the linear wall washers highlighting the wall above the second level of the galleria, will controlled according to the building economize conditions.

The first and second floors of the galleria will be controlled by spare relays from two different automated lighting control panels located on the first and second floors, respectively. The first floor will utilize spare relays R7 and R8 from automated lighting control panel ALC-1A. Likewise, luminaires on the second floor will use spare relays R7 and R8 from automated lighting control panel ALC-2A. Relays R7 from the first and second floor will remain on at all hours throughout the night and will also be provided with a localized switch for lights to be turned on during daytime hours if needed. First floor relayR8 and second floor relayR8 will follow the building "economize" state as explained in the "Controls" section for Design Option #1.

The following tables show the automated lighting control schedules affected by the lighting design of this space. Note that relays highlighted in yellow are the relays that changed according to the galleria lighting design.

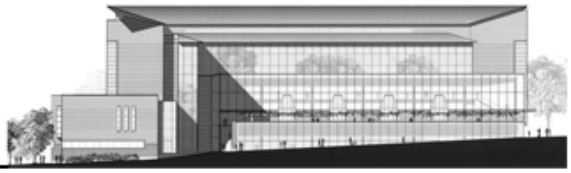


Table 1.1.11 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-1A					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NW01-N02-2	SW ROOMS	FL	2997	
R2	PCB-NW01-N02-4	NW ROOMS	FL	2030	
R3	PCB-NW01-N02-6	LOUNGE	FL	2131	
R4	PCB-NW01-N02-8	CORRIDOR	FL	2150	
R5	PCB-NW01-N02-10	SE EXTERIOR	FL	2420	
R6	PCB-NW01-N02-12	SE EXTERIOR	FL	2108	
R7	PCB-NW01-N02-16	GALLERIA	FL	300	
R8	RCB-NW01-N02-18	GALLERIA	FL	454	
R9					
R10					
R11					
R12					
R13					
R14					
R15					
R16					
R17					
R18-R32					SPARE RELAYS

Table 1.1.12 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-2A					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NW02-N02-2	WEST OFFICES	FL	2997	
R2	PCB-NW02-N02-4	SW CORRIDOR	FL	2030	
R3	PCB-NW02-N02-6	SW CORRIDOR	FL	2131	
R4	PCB-NW02-N02-8	CENT. CORRIDOR	FL	2306	
R5	PCB-NW02-N02-10	RESTROOMS	FL	2420	
R6	PCB-NW02-N02-12	CLEAR STORY	FL	2108	
R7	PCB-NW02-N02-14	GALLERIA	FL	330	
R8	PCB-NW02-N02-16	GALLERIA	FL	360	
R9					
R10					
R11					
R12					
R13					
R14					
R15					
R16					
R17					
R18-R32					SPARE RELAYS

Refer to Figure 1.1.8 for luminaire layout circuiting and controls.

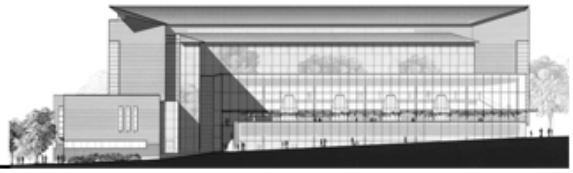
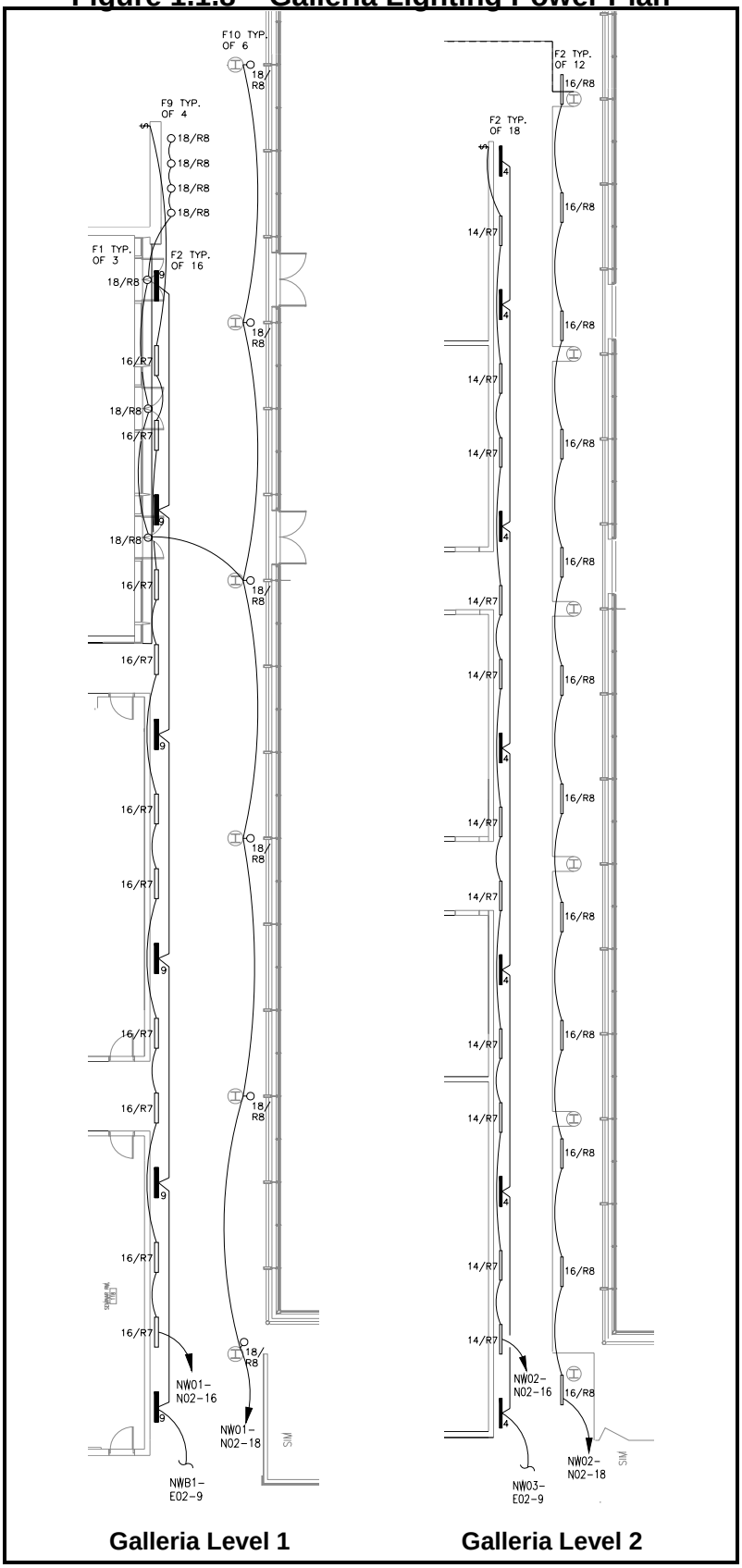
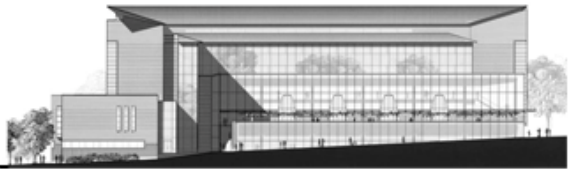


Figure 1.1.8 – Galleria Lighting Power Plan



Galleria Level 1 **Galleria Level 2**



Light Loss Factors

The following table outlines the light loss factors for each of the luminaires used in the lighting design of the galleria. In determining these values it was assumed that the atmosphere was very clean, with a cleaning interval of twelve months.

Table 1.1.13 – Light Loss Factors

Luminaire Designation	Maintence Category	Room Atmosphere	Cleaning Interval	Initial Lumens/Luminaire	Design Lumens/Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
F1	IV	Very Clean	12 months	2200	1850	0.98	0.84	0.96	0.94	**0.74**
F2	VI	Very Clean	12 months	2900	2660	0.98	0.92	0.96	0.94	**0.81**
F9	VI	Very Clean	12 months	2200	1850	0.98	0.84	0.96	0.94	**0.74**
F10	II	Very Clean	12 months	1200	970	0.95	0.81	0.94	0.94	**0.68**

Power Density

The maximum allowable power density according to ASHRAE 90.1 for a galleria/circulation space is 0.8 W/sq ft. The following table shows the calculation of the power density for the proposed lighting design for the galleria.

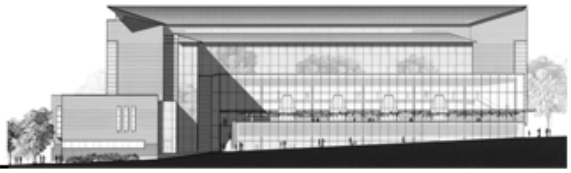
Table 1.1.14 – Power Density

Luminare	Input Watts	Quantity	Watts
F1	34	3	102
F2	30	46	1380
F9	34	4	136
F10	53	6	318
		Total Watts	1834
		Area (sq ft)	6000
		Power Density	**0.31**

The power density of the galleria is 0.31 watts per square foot. This value is below the prescribed 0.8 watts per square foot. Therefore, the power density for this design is acceptable.

Design Performance

Illuminance levels throughout the galleria need to be maintained at 5 footcandles in order to ensure the safety of building occupants circulating through this space. The proposed lighting design meets this criterion on both the first and second floors of the galleria. Illuminance levels on the first and second floors are approximately 9 footcandles. Even at their minimum, the illuminance levels in both of these areas do not fall below the outlined minimum of 5 footcandles. Additionally, the uniformity of light distribution in these two areas is fairly good. The light distribution is more uniform on the second floor than on the first, however, this is a



result of the higher ceiling height for the first floor of the galleria. While the distribution uniformity could be improved on the first floor, there lighting in this space still provides a safe atmosphere for circulation.

Throughout the galleria, the vertical light levels should be maintained at approximately 3 footcandles and should be fairly uniform. Illuminance levels on the first and second floor vertical surfaces in the galleria average 4.36 footcandles and 8.55 footcandles, respectively. The distribution uniformity could be improved, however, due to the method of lighting used and the heights of the walls, there is going to be a decrease in direct illuminance values as it approaches the floor levels.

The display board at the east end of the galleria is accented with recessed compact fluorescent wall washers. By using compact fluorescent downlights, the board is able to be highlighted, while not being washed out. The wall washing of the display board mimics the effect of the lighting schematic throughout the rest of the space. Illuminance levels on this board average approximately 8 footcandles. This is similar to the average illuminance levels elsewhere on the first floor of the galleria, allowing the wall washing effect to carry through the entire length of the space.

Table 1.1.10 - Illuminance Values (fc)

Galleria Level 1 Floor		Galleria Level 2 Floor		Galleria Level 1 Display Board (vertical)	
Average	9.92	Average	9.12	Average	8.37
Max	18.8	Max	11.5	Max	15.9
Min	5.2	Min	6.2	Min	3.8
Avg/Min	1.91	Avg/Min	1.47	Avg/Min	2.2
Max/Min	3.62	Max/Min	1.85	Max/Min	4.18
Galleria Level 1 Vertical Wall		Galleria Level 2 Vertical Wall			
Average	4.36	Average	8.55		
Max	14.4	Max	26.6		
Min	2.1	Min	4.5		
Avg/Min	2.08	Avg/Min	1.9		
Max/Min	6.86	Max/Min	5.91		

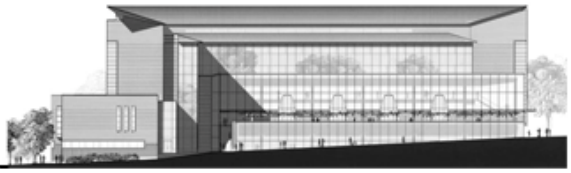


Figure 1.1.22 – Galleria Level 1 – Pseudo Color

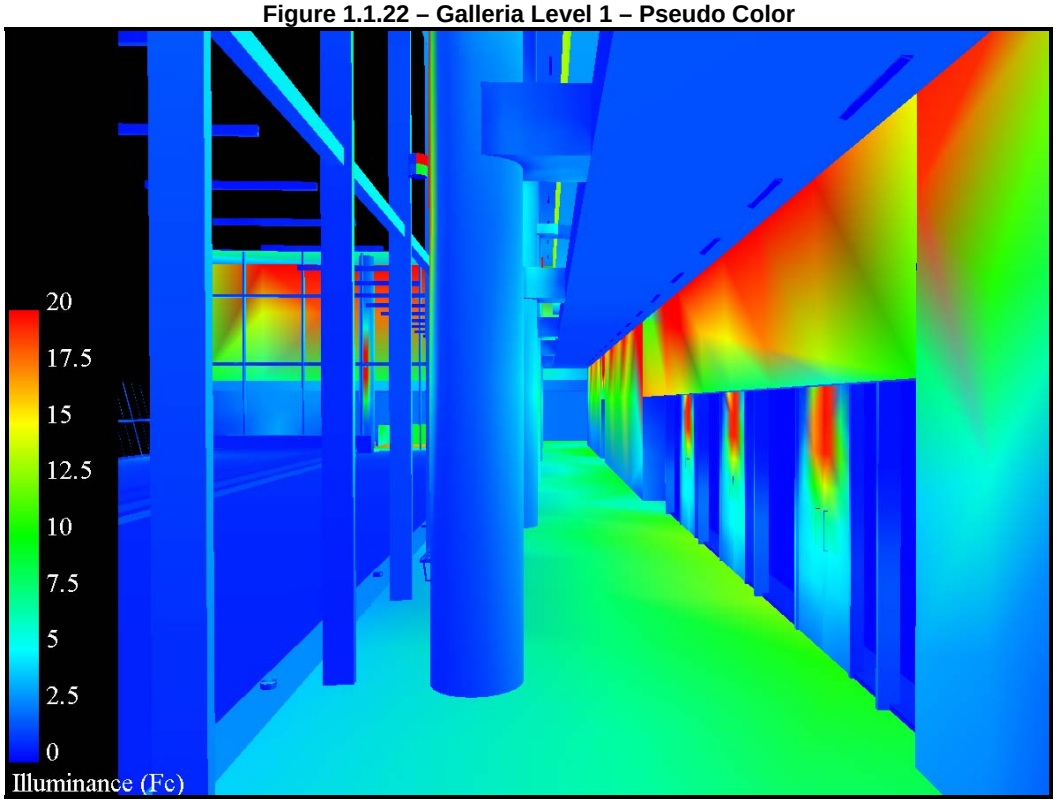
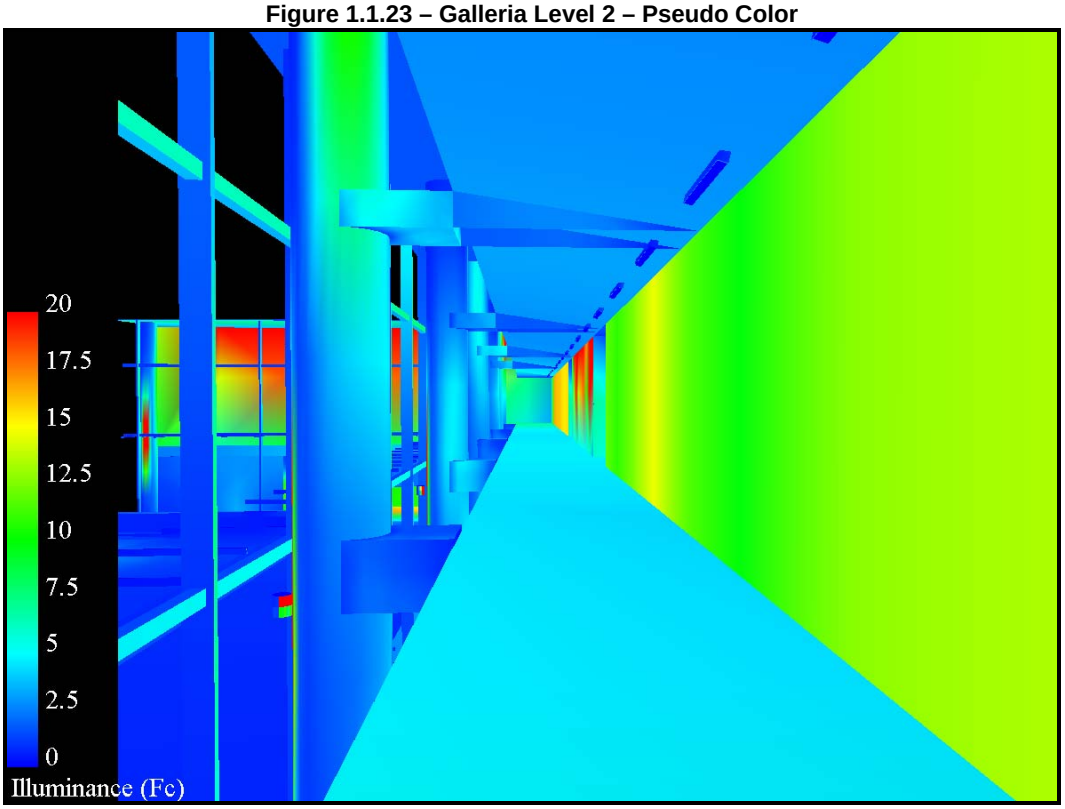
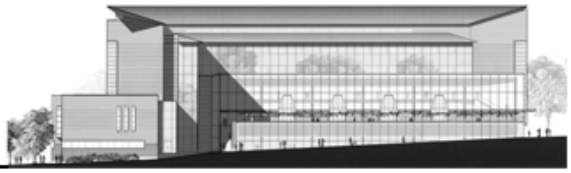


Figure 1.1.23 – Galleria Level 2 – Pseudo Color





Renderings

Figure 1.1.24 – Galleria Exterior View

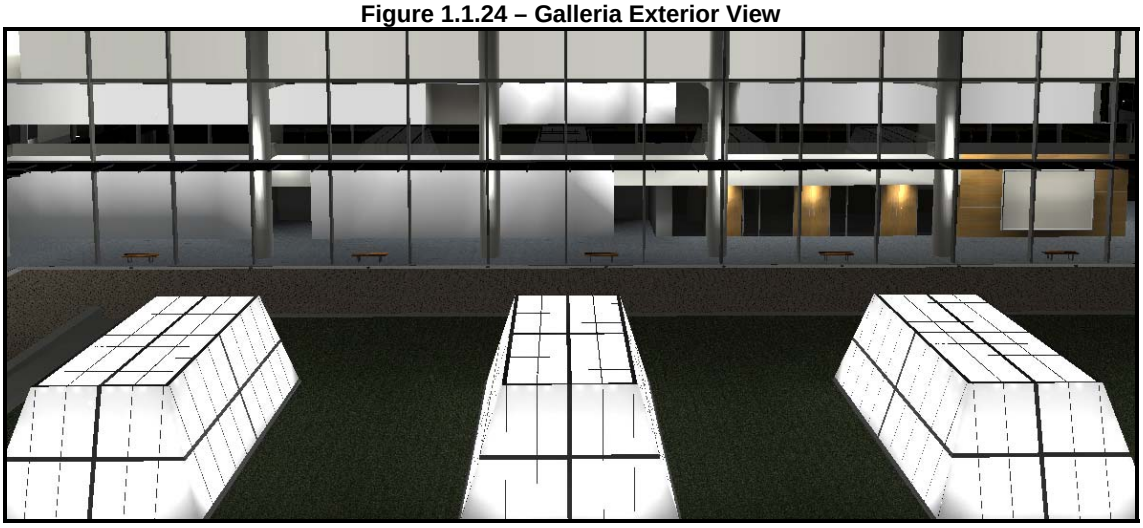
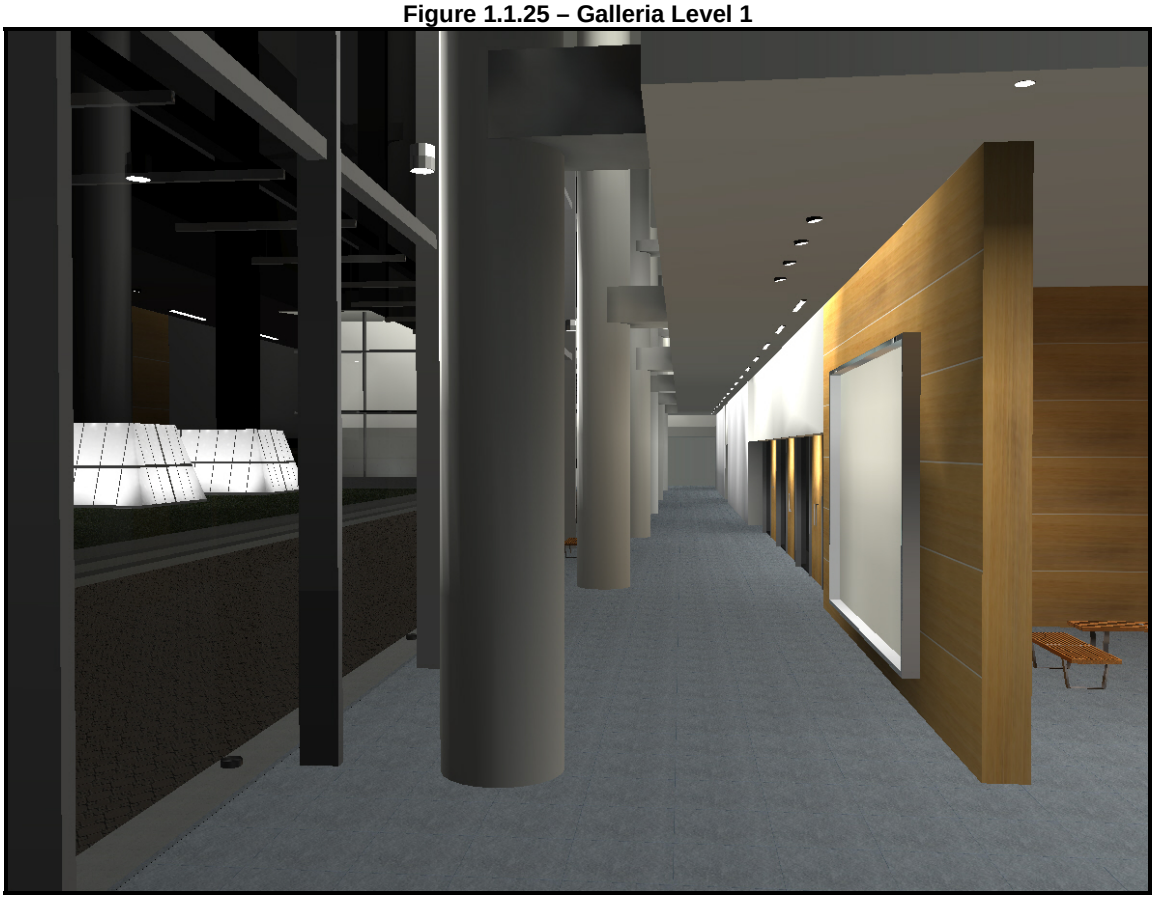


Figure 1.1.25 – Galleria Level 1



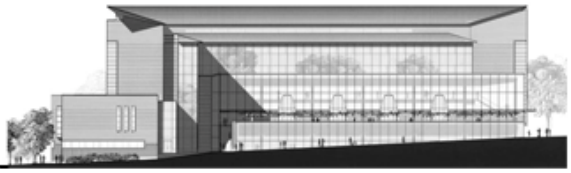
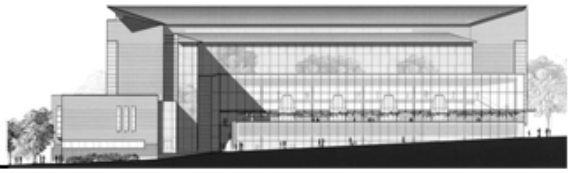


Figure 1.1.26 – Galleria Level 2

Conclusion

By lighting the walls along the length of the galleria, the space becomes a ‘glowing lantern’ that can be seen throughout the campus. The simple, yet functional, design mimics the architecture of the galleria, with the clean lines and linear elements, while creating a safe environment for building occupants to traverse throughout the building.

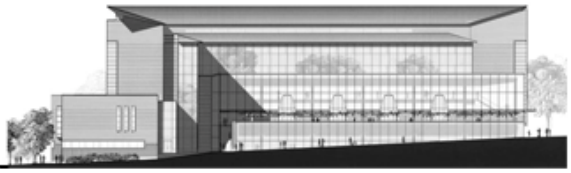


Comparison of Design Option #1 And Design Option #2

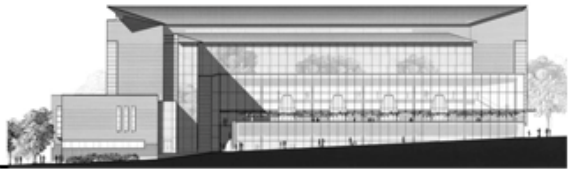
Two separate lighting designs have been proposed for the Susan and Jeffrey Brotman Galleria. Both of the designs address the lighting needs required throughout the space, while using different approaches to meet these requirements. Design Option #1 looks to utilize the length of the galleria walls as a blank canvas to paint with light. By utilizing a backlit frosted glass wall, this design is able turn the galleria into an inspirational message that highlights the ideals of the law school to the rest of the campus. Design Option #2 uses the method of lighting the walls along the length of the galleria, to create a glowing effect. While both designs provide a functional lighting design that meets the required illuminance levels for the space, Design Option #1 does so while increasing the level of visual interest. Visually, this design is more appealing and adds a level of uniqueness to the building.

While Design Option #1 may be more visually interesting, it is slightly more complicated when it comes to installation and maintenance. Design Option #2 uses standard ceiling recessed fixtures, which simplifies the installation and maintenance. However, there are important maintenance concerns of using the same color temperature replacement lamps. While Design Option #1 adds a level of complexity for the installation, it has been designed to allow for easy maintenance. The wall has been broken down into eight foot sections, each housing two light fixtures. The frost glass on each section is hinged on one side, allowing for the door to simply swing open when maintenance or cleaning is required. Additionally, because this backlit wall feature uses LED's, the lamp life is much longer than traditional fluorescent, and thus will decrease maintenance concerns.

The energy consumption of the two systems does vary somewhat significantly. Design Option #1 has a power density of 0.58 W/ft^2, almost twice that of Design Option #2, which has a power density of 0.31 W/ft^2. While the power density of the first design option is much higher, both designs have a power density that is below the maximum allowable power density of 0.8 W/ft^2.



Terrace



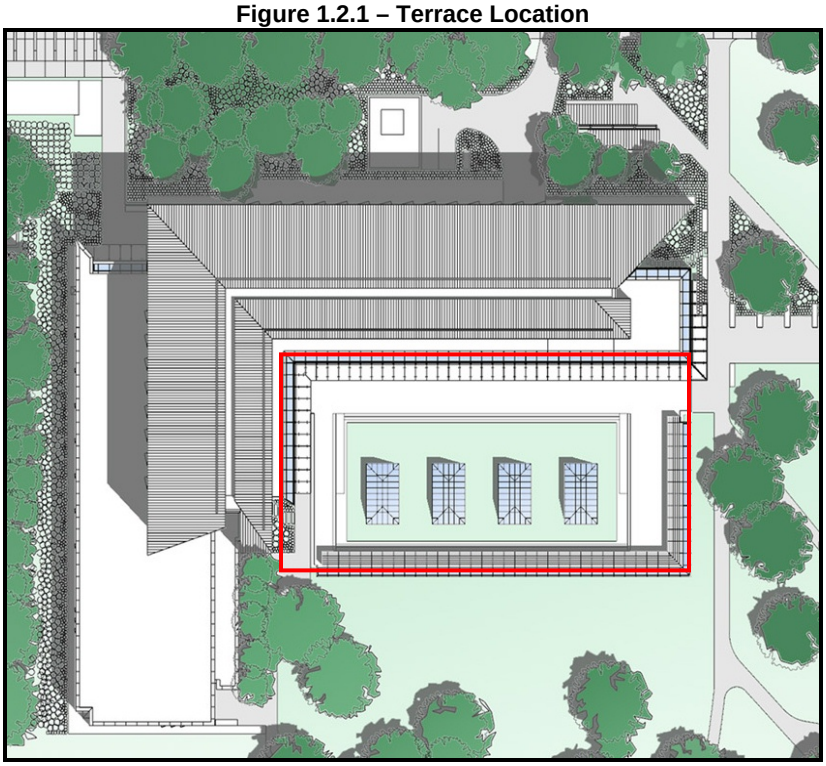
Introduction

The outdoor terrace can be considered the most unique and defining characteristic of William H. Gates Hall. Located above the library and encased by the surrounding building, the terrace interconnects the entire building on several levels. The most obvious and prominent feature of the terrace is the four trapezoidal skylights that protrude the terrace surface from the library below. These skylights are situated on a stepped-up grass area, and at night are lit from the library below. Surrounding this center piece is a concrete finished, traditional terrace: lined on the south and east by a trellis covered sitting bench, and on the north and west with the two-story glazing of the Brotman Galleria and student commons.

Space Layout

The following figures are used to help show the location and layout of the terrace. Figure 1.2.1 illustrates the terrace's location with respect to the building and Figure 1.2.2 shows the terrace's dimensioned floor plan.

Figure 1.2.1 – Terrace Location



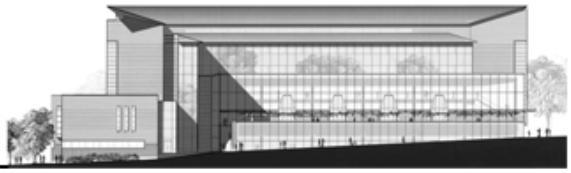
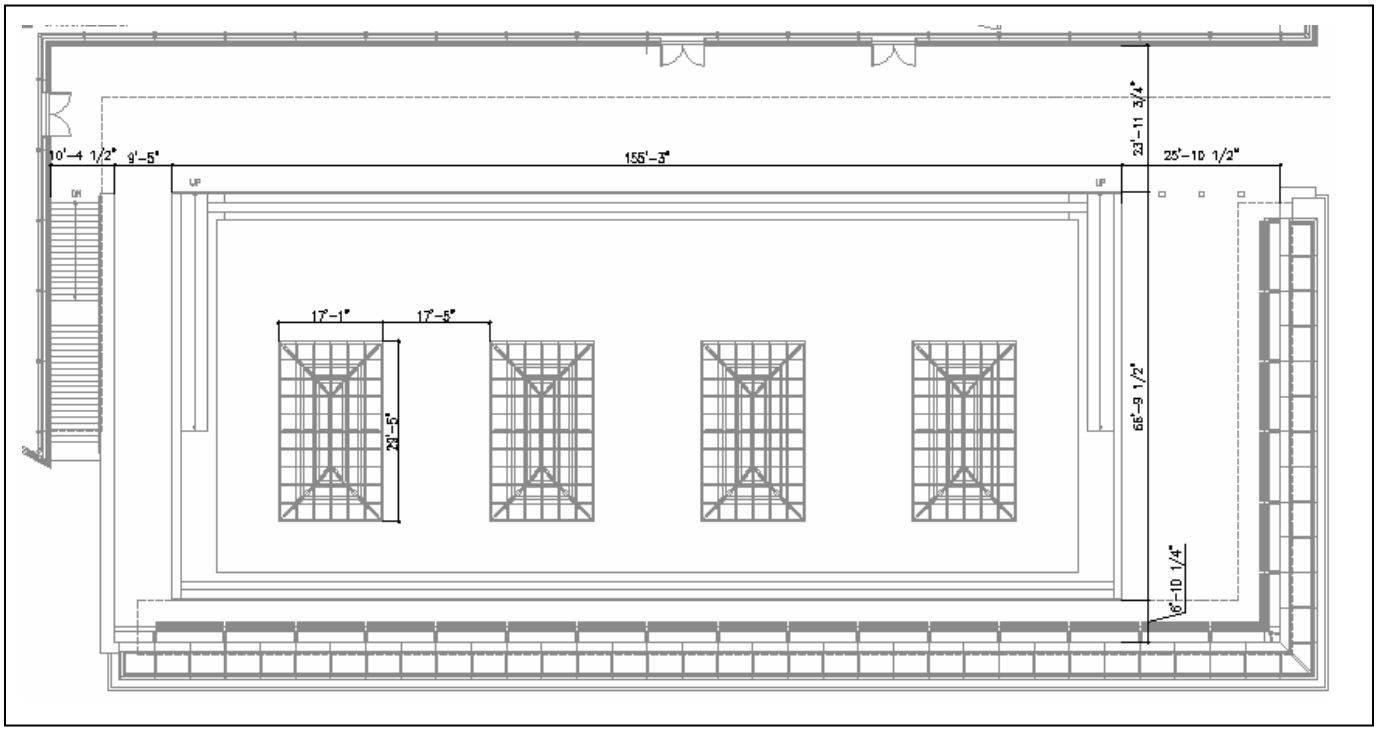


Figure 1.2.2 – Terrace Floor Plan

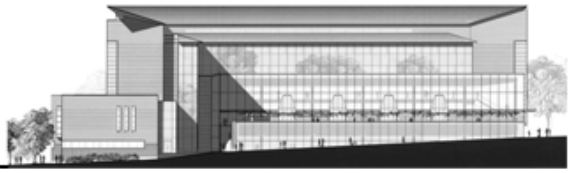


Architectural Finishes
Surface Materials & Reflectances

Wood Trellis
Color: Brown
Reflectance: 24%

Concrete
Color: Gray
Reflectance 35%:

Grass
Color: Green
Reflectance: 9%



Design Goals

The centrally located terrace contains architecturally significant elements that help to define the building. The lighting design of this space should help to accent these features, primarily the skylights. While during the day this space acts as a central gathering point for occupants of the building, during nighttime hours it serves more as a circulation space for those coming and leaving the building. With this in mind, the lighting design should allow for light levels that will allow pedestrians to cross through this space safely. Additionally, the adjacent galleria needs to be taken into consideration when designing a lighting system appropriate for the space. Given that light from the interior space will spill into the terrace through the glass curtain wall, it is important to consider the aesthetics of the lighting design in the galleria.

Design Concept

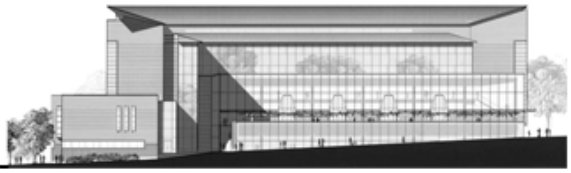
The lighting redesign of the terrace provides an opportunity for a pleasant night time scene. With the main focal point of the space being the four skylights, the design of the space will be centered around this. Using linear fluorescents lights from within the skylights will allow them to glow, creating a soft ambient glow throughout the rest of the space. In addition to this, the adjacent galleria will contribute to a glowing ambient light along the areas next to the curtain wall. The perimeter trellis is a secondary focal point to the space and will be accented with arm mounted sconces that are attached to the trellis structure. This will allow for lighting and accenting of the trellis, while also providing additional light for the adjacent areas. Lastly, to provide additional light in the area around the sky lights (not the main circulation path), recessed step lights will be used to provide adequate light levels.

Design Criteria

- *Color Appearance & Color Contrast*
  Color rendering is important for overall visual performance. While, color appearance is not critical in this space, a CRI of 70 should be maintained for ease in facial modeling. The desired mood of the outdoor space can be greatly affected by the color temperature.

- *Light Distribution on Surfaces (Very Important)*
  Light distribution on surfaces should be used to help accent specific architectural elements within the space, such as the skylights, in effort to make an overall artistic statement. Light distribution of exterior spaces should consider adjacent spaces and lighting, as well as the appearance of the surrounding community.

- *Modeling of Faces or Objects (Very Important)*
  Facial recognition is important to maintain safety within the area.



- *Shadows (Important)*
  In order to maintain a feeling of safety during the night within this space, dark shadows should be avoided, especially in the main circulation areas of the terrace.

Luminaire Schedule

The following figure and table outline the luminaires that are to be used in the lighting design for the Terrace. Refer to Appendix A for all fixture, lamp, and ballast cut sheets.

Table 1.2.1 – Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
F3	Focal Point Fluorescent Directional Cove Light	Surface	1	F28T5	Electronic	85	3500	277	30	64
F4	Se'lux Compact Fluorescent Wall Arm Mounted Sconce	Surface	1	CFQ26W	Electronic	82	3500	277	27	22
F5	WE-EF Rectangular Compact Fluorescent Step Light	Recessed	1	CFQ18W	Integral Electronic	82	3500	277	20	10
F6	WE-EF Circular Compact Fluorescent Step Light	Recessed	1	CFQ18W	Integral Electronic	82	3500	277	20	11
M1	Bega Metal Halide Low Profile Path Light	Semi-Recessed	1	39W T4	Magnetic	82	3000	277	53	14

Figure 1.2.3 – Luminaires Used In Terrace Design

F3 **F4** **F5** **F6** **M1**

Luminaire Layout

The following figure, Figure 1.2.4, shows the luminaire layout for the terrace. Luminaire type is shown according to the corresponding luminaire designation.

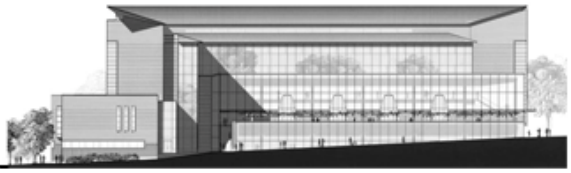
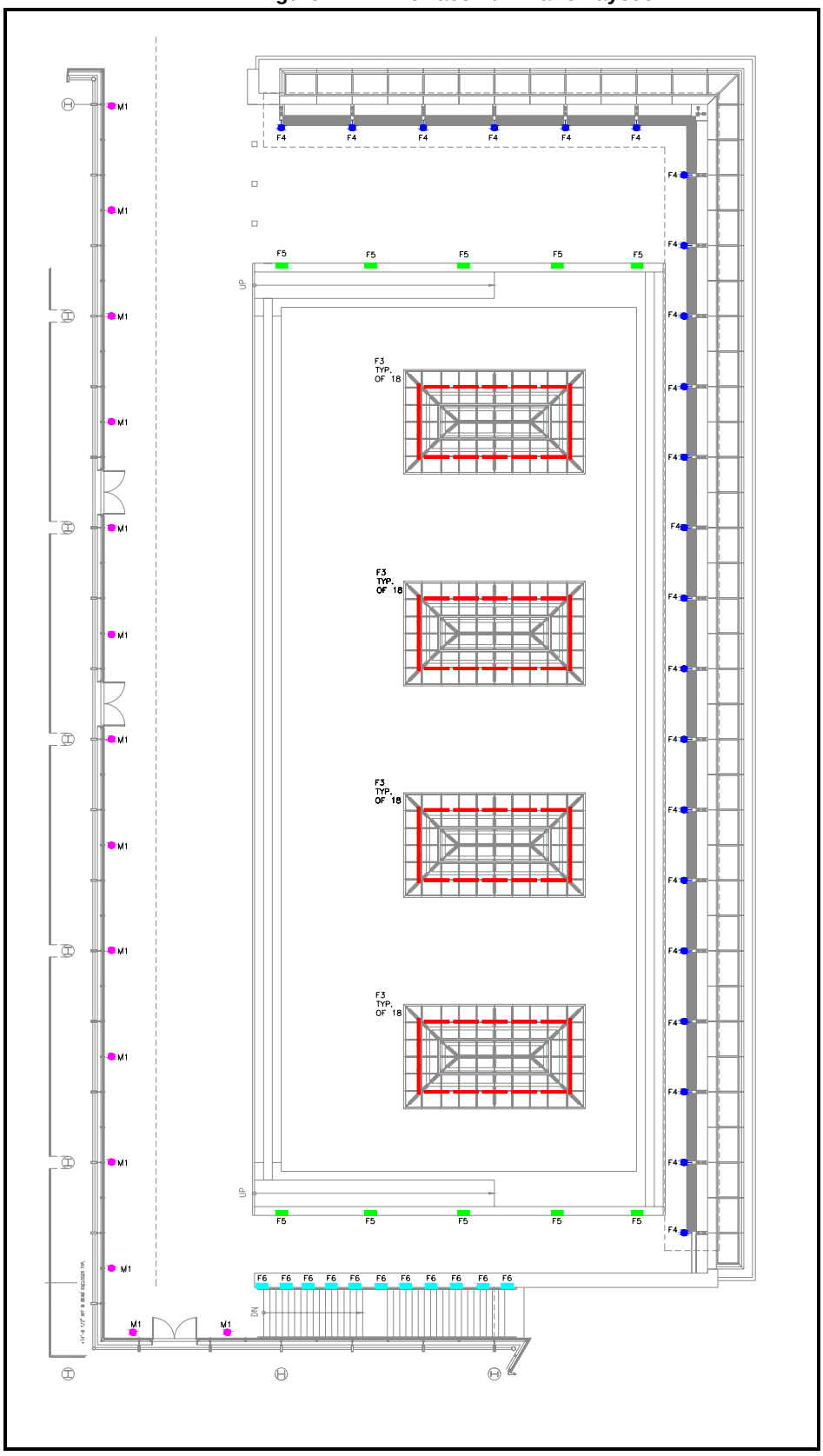
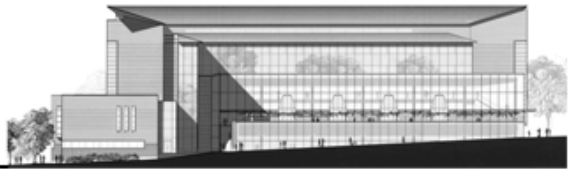


Figure 1.2.4 – Terrace Luminaire Layout





Controls

The lighting systems in the terrace will be controlled by the buildings existing relay, time clock system. During daytime hours, the lights in the space will remain off. From sunset to sunrise the lights will be turned on from this system, to allow for adequate light levels.

The lights in the terrace will be controlled by spare relays from automated lighting control panels ALC-1A, located on the first floor. The exterior fixtures will utilize spare relays R5 and R6 from panel ALC-1A.

The following table shows the automated lighting control schedule affected by the lighting design of this space. Note that relays highlighted in yellow are the relays that changed according to the terrace lighting design.

Table 1.2.2 - Automated Lighting Control Schedules

LIGHTING CONTROL PANEL ALC-1A					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NW01-N02-2	SW ROOMS	FL	2997	
R2	PCB-NW01-N02-4	NW ROOMS	FL	2030	
R3	PCB-NW01-N02-6	LOUNGE	FL	2131	
R4	PCB-NW01-N02-8	CORRIDOR	FL	2150	
R5	PCB-NW01-N02-10	TERRACE	FL	1920	
R6	PCB-NW01-N02-12	TERRACE	FL	1756	
R7	PCB-NW01-N02-16	GALLERIA	FL	300	
R8	RCB-NW01-N02-18	GALLERIA	FL	454	
R9					
R10					
R11					
R12					
R13					
R14					
R15					
R16					
R17					
R18-R32					SPARE RELAYS

Refer to Figure 1.2.5 for luminaire layout circuiting and controls.

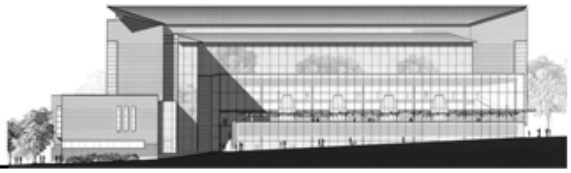
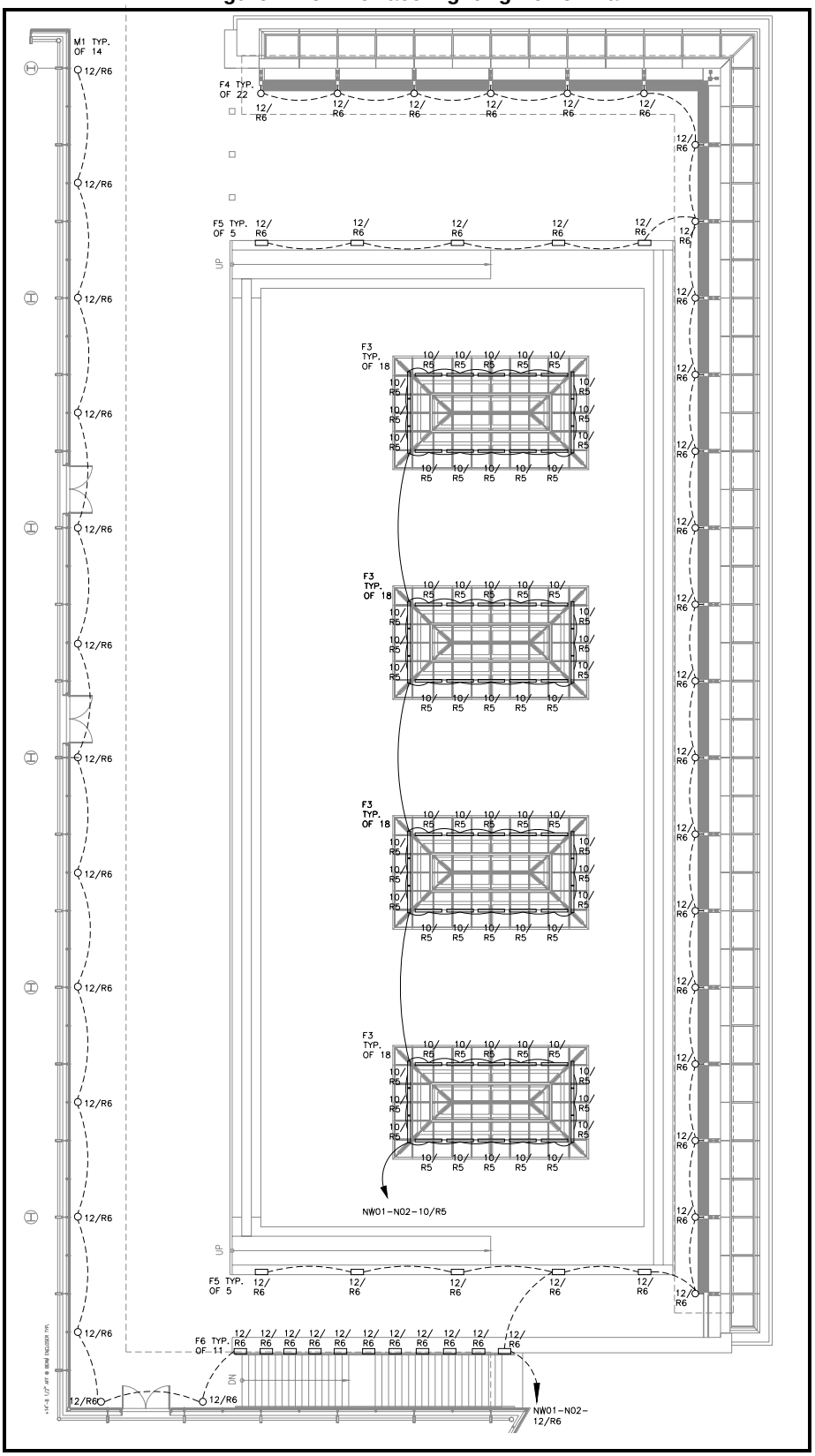
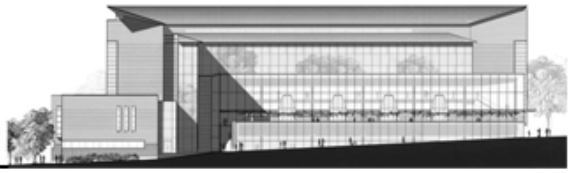


Figure 1.2.5 – Terrace Lighting Power Plan

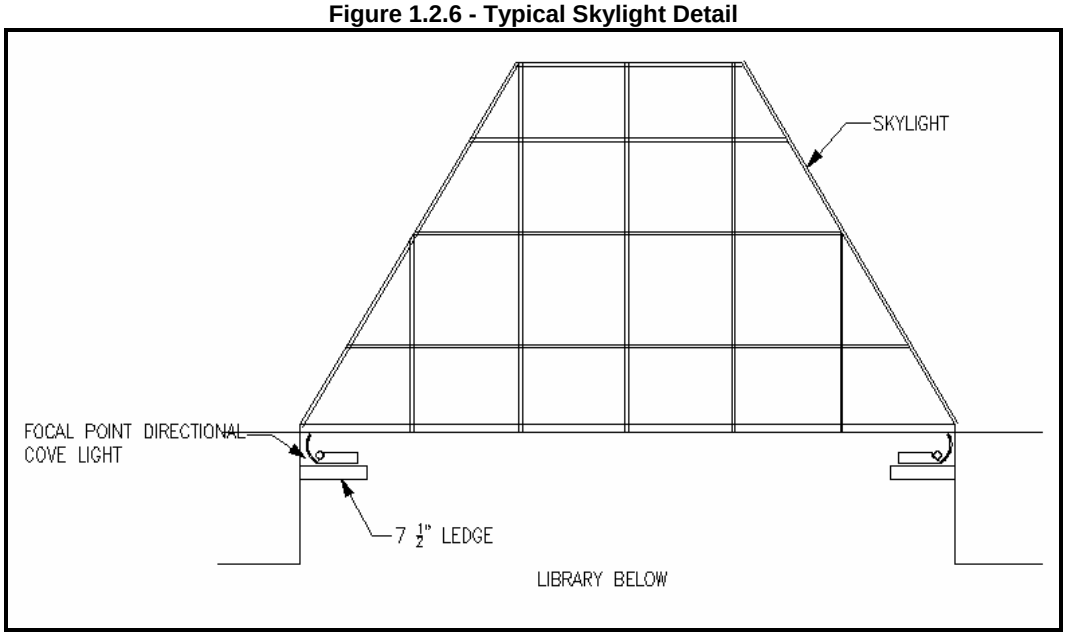




Details

The following detail shows the typical arrangement for the luminaires in the skylight and the ledge on which they are mounted.

Figure 1.2.6 - Typical Skylight Detail

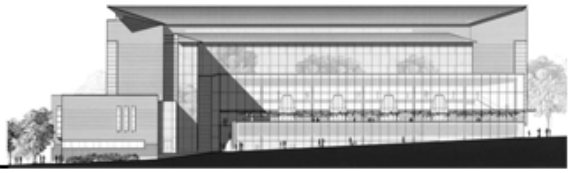


Light Loss Factors

The following table lists all of the light loss factors for the luminaire used in the design of the terrace. Since this is an outdoor space, the atmosphere is assumed to be dirty, with a cleaning interval of 12 months. Also, it is assumed for exterior lights the RSDD is 1.0. Lastly, since fixture F3 is located within the skylights, the exterior light loss factors applied to all other fixtures in this space do not apply.

Table 1.2.3 – Light Loss Factors

Luminaire Designation	Maintence Category	Room Atmosphere	Cleaning Interval	Initial Lumens/ Luminaire	Design Lumens/ Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
F3	I	Very Clean	12 months	2900	2660	0.98	0.92	0.9	0.94	**0.76**
F4	V	Dirty	12 months	1710	1440	1	0.84	1	0.78	**0.657**
F5	V	Dirty	12 months	1200	970	1	0.81	1	0.78	**0.631**
F6	V	Dirty	12 months	1200	970	1	0.81	1	0.78	**0.631**
M1	V	Dirty	12 months	3400	2600	1	0.76	1	0.78	**0.596**



Power Density

The maximum allowable power density according to ASHRAE 90.1 for a terrace space is 0.25 W/sq ft. The following table shows the calculation of the power density for the proposed lighting design for the galleria.

Table 1.2.4 – Power Density

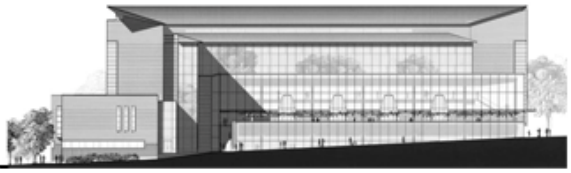
Luminare	Input Watts	Quantity	Watts
F3	30	64	1920
F4	27	22	594
F5	20	10	200
F6	20	11	220
M1	53	14	742
		Total Watts	3676
		Area (sq ft)	19450
		Power Density	**0.19**

The power density of the galleria is 0.19 watts per square foot. This value is below the prescribed 0.25 watts per square foot. Therefore, the power density for this design is acceptable.

Design Performance

During night time hours, when lighting is required in the terrace area, there is very little activity throughout the space. While the only occupants of this space may be a few pedestrians coming to and from the building, it is still necessary to provide light levels that will be conducive to a safe environment. The IES illuminance criteria recommends that light levels be maintain at 5 footcandles for terrace spaces. However, in this case, 5 footcandles would be high for this area considering the adjacent interior galleria needs only to be maintained at 5 footcandles. Providing light levels that are too high, especially in the main circulation area near the building, can cause safety issues and make it difficult for occupants of this area to see the rest of the space and be comfortable in their surroundings. This being said, the achieved illuminance level in the main circulation area of approximately 2 footcandles is adequate for this space. The combination of the light levels on the pathway and the ambient light that will spill from the adjacent galleria, allow for a safe environment.

The secondary circulation areas of the terrace, east, south and west of the skylights, maintains illuminance levels slightly lower than those in the main circulation area. In these areas, illuminance levels are maintained at an average of approximately one footcandle. Since these areas of the terrace will be rarely visited during night time hours, an average of 1 footcandle is adequate for general illumination of the space for safety purposes. Additionally, the glowing skylights will help to provide additional levels of ambient light through these areas.

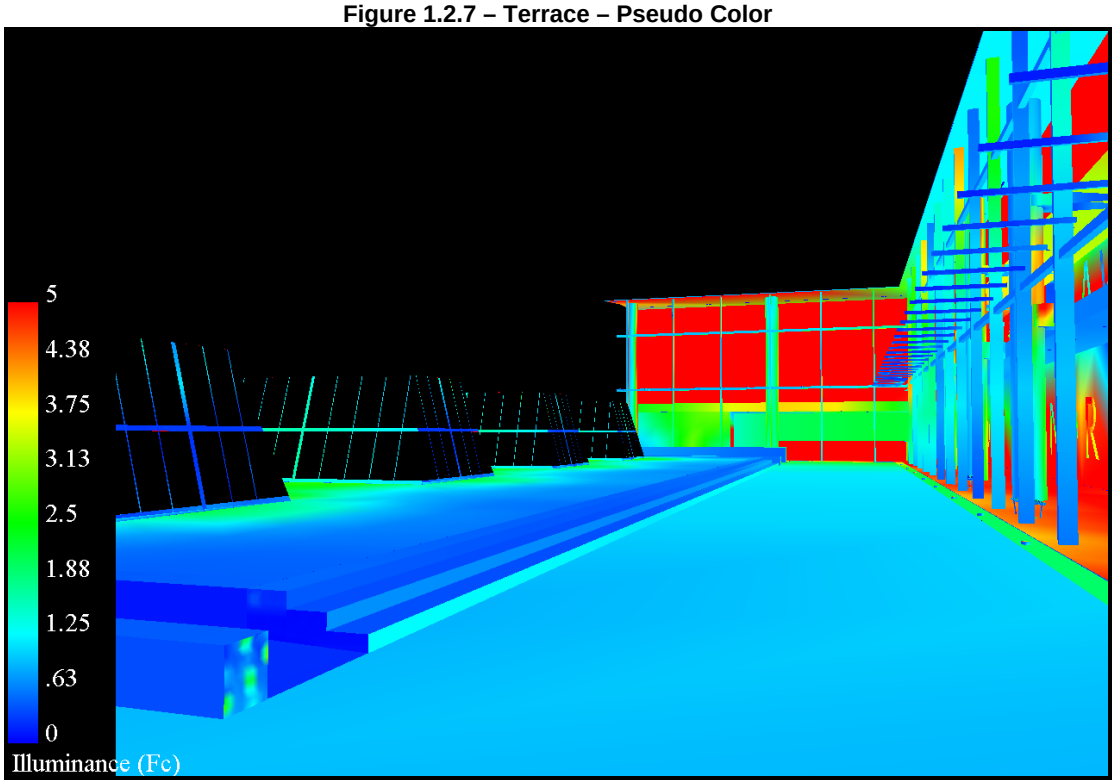


Illuminance levels on the stairs, located at the west end of the space, are maintained at an average of 1.4 footcandles. These light levels are adequate for allowing pedestrians to navigate the stairs safely. The step lights being used graze the surface of the stairs, making it easier to define each step as one goes through the area.

Table 1.2.5 - Illuminance Values (fc)

Main Circulation Area		Secondary Circulation Paths		Stairs	
Average	2.18	Average	0.88	Average	1.4
Max	19.8	Max	2.2	Max	2.1
Min	0.7	Min	0.4	Min	0.8
Avg/Min	3.11	Avg/Min	2.2	Avg/Min	1.75
Max/Min	28.29	Max/Min	5.5	Max/Min	2.63

Figure 1.2.7 – Terrace – Pseudo Color



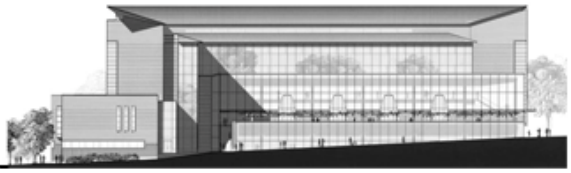
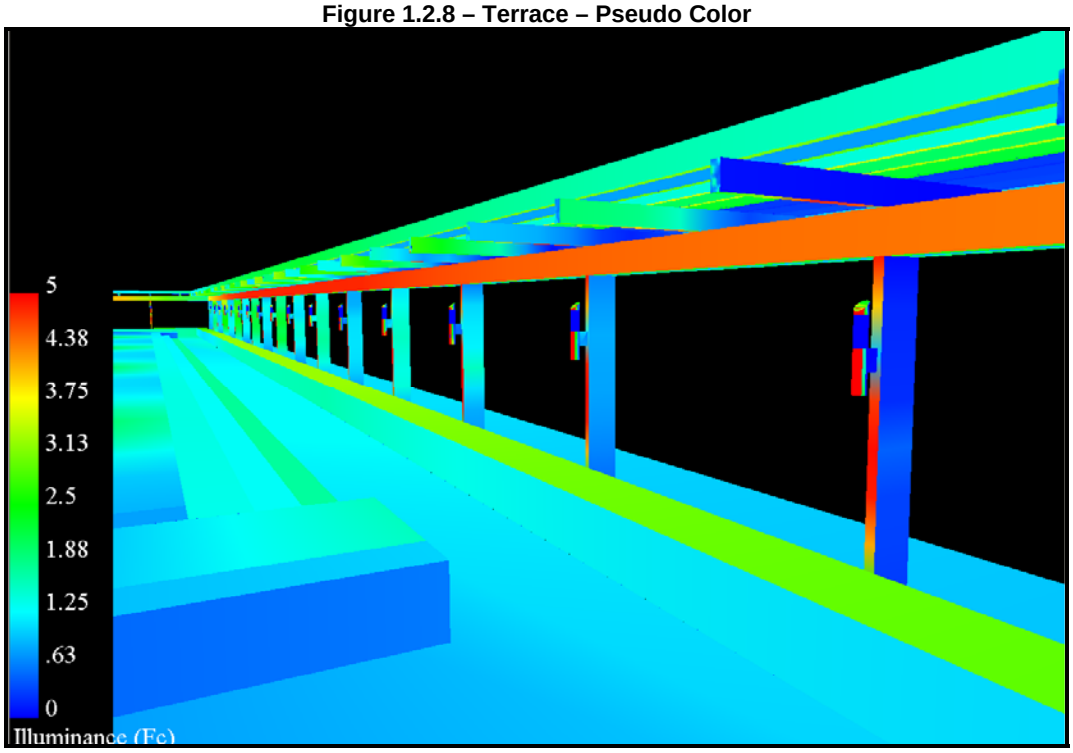
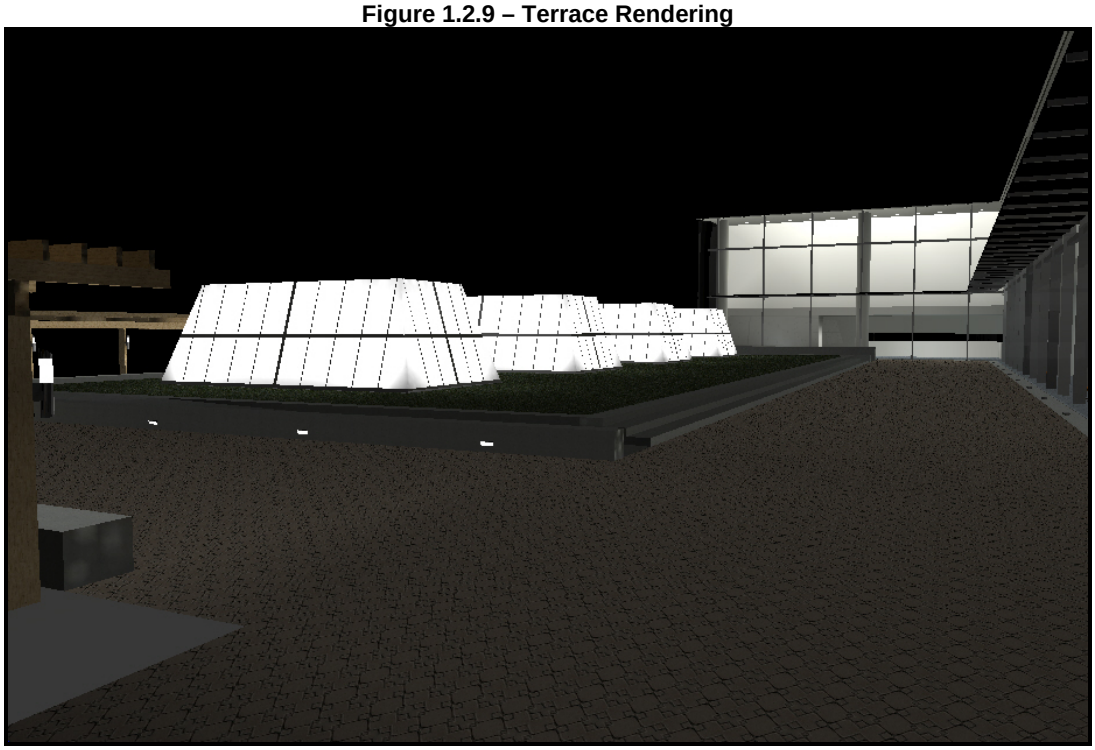


Figure 1.2.8 – Terrace – Pseudo Color



Renderings

Figure 1.2.9 – Terrace Rendering



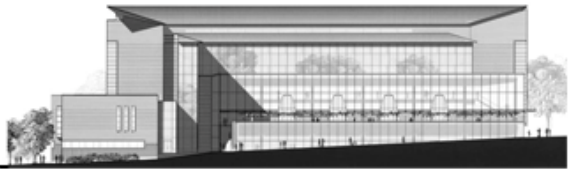


Figure 1.2.10 – Terrace Rendering

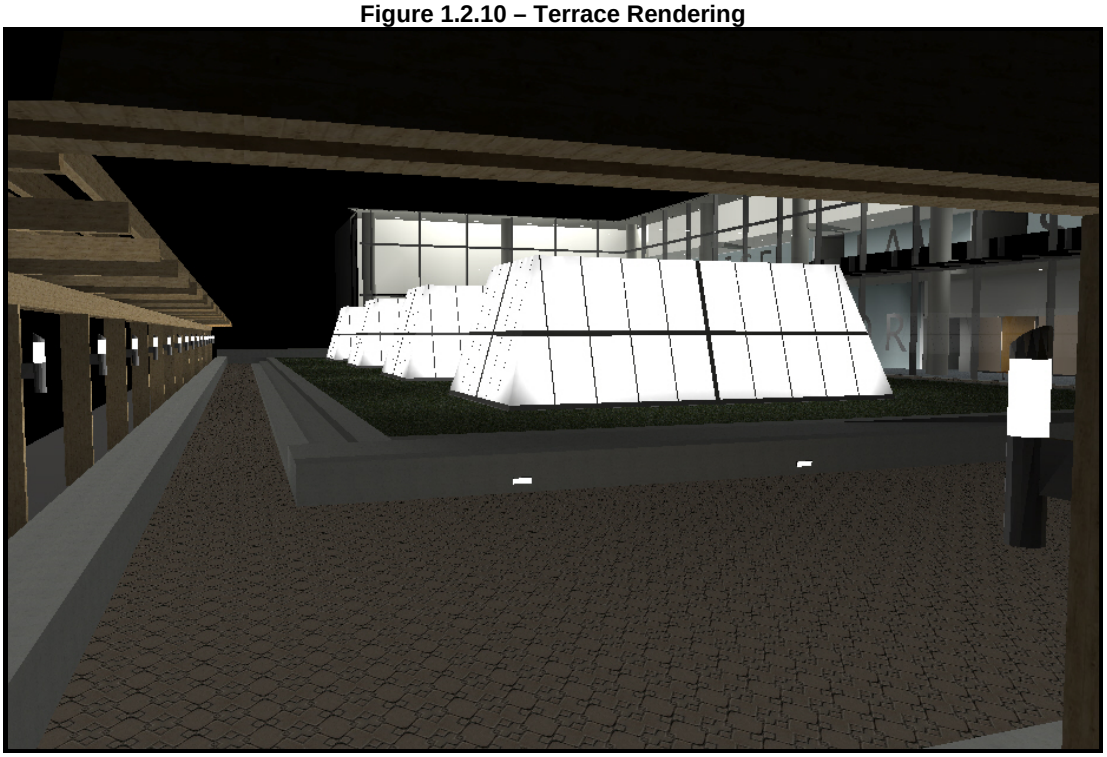


Figure 1.2.11 – Terrace Rendering

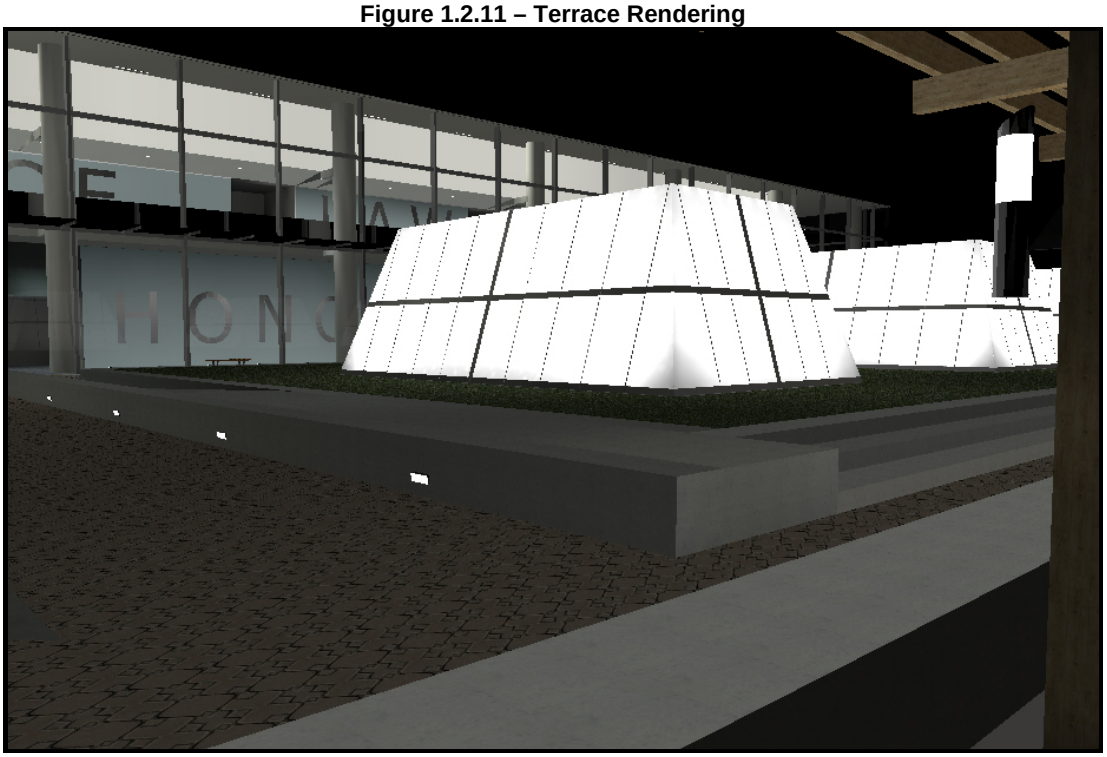


Figure 1.2.12 – Terrace Rendering

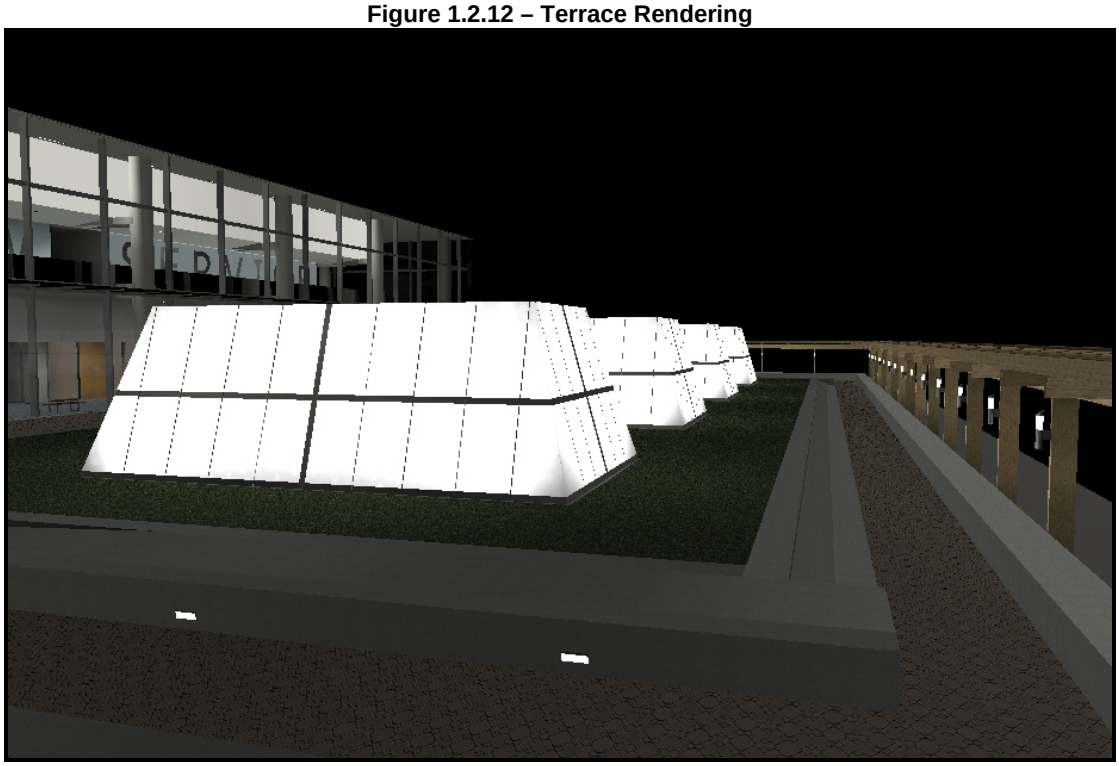
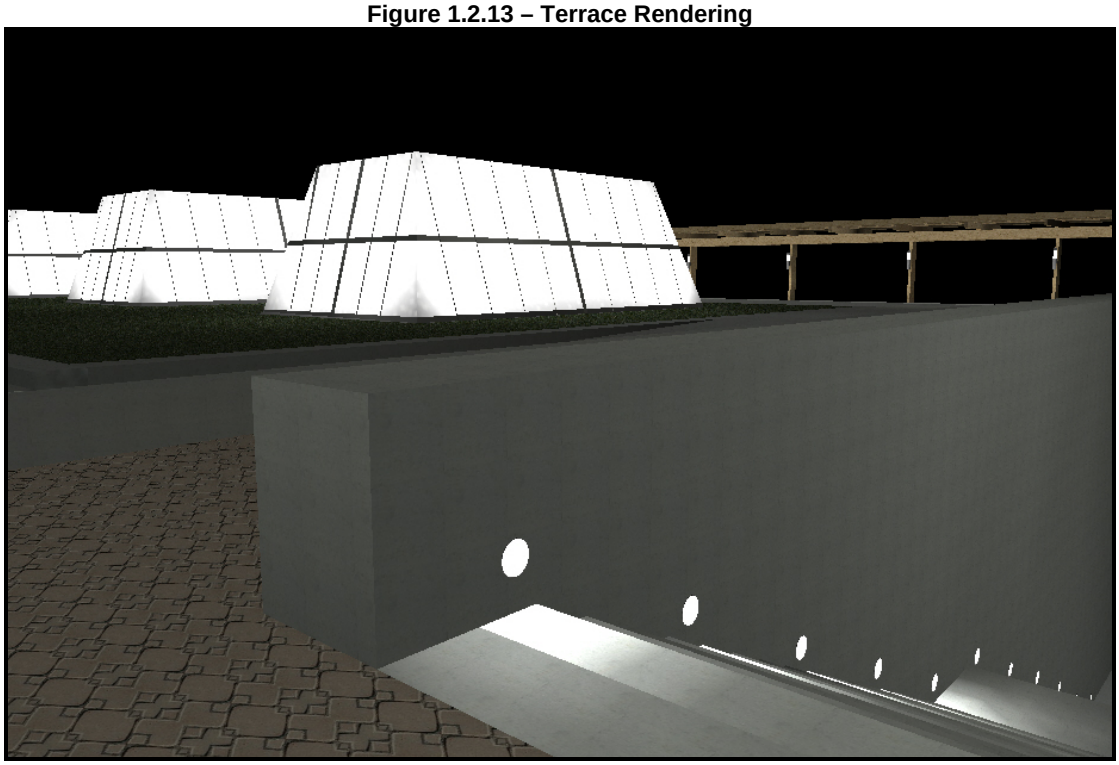
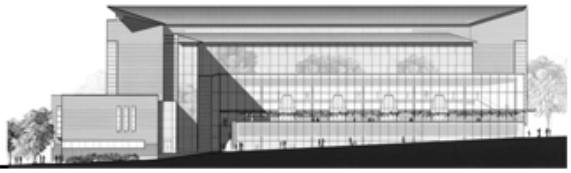


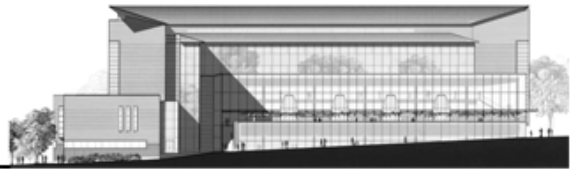
Figure 1.2.13 – Terrace Rendering



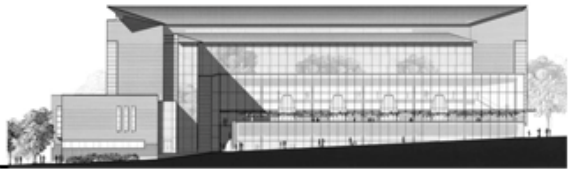


Conclusion

In developing a lighting system for the terrace area, creating a safe environment is the primary concern. By accenting pathways and stairs, occupants of the space can feel comfortable and safe when passing through the terrace. Additionally, by incorporating other lighting features that highlight and accent architectural features throughout the space, the lighting design creates an overall appearance that is inviting and interesting.



Senator Warren G. Magnuson & Senator Henry M. Jackson Trial Courtroom



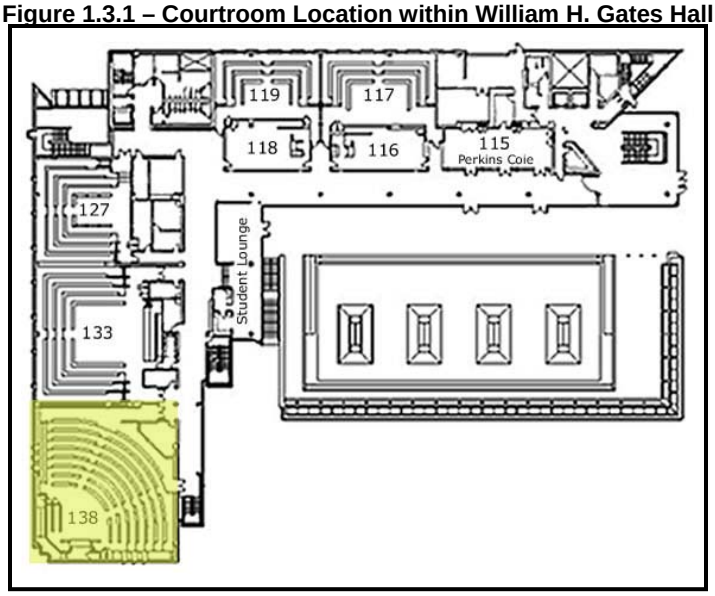
Introduction

The Senator Warren G. Magnuson & Senator Henry M. Jackson Trial Courtroom is located at the southwest corner of the first floor. Being the schools largest room at approximately 5000 square feet, this space serves as both a classroom and a mock courtroom, providing students with a realistic legal setting. At the front of the courtroom is an elevated witness/judge stand as well as an elevated jurors' stand. Extending radially from this area are rows of tiered built-in-desk. Each desk is equipped with power and data plugs for each seat. The ceiling mimics the radial extending tiered pattern of the floor. Above the "bench" area, the suspend ceiling features a built in cove for indirect lighting. The ceiling is finished with several different materials, including, acoustical metal panels, birch wood ceiling panels and acoustical ceiling tile. The walls, on all sides, are finished with cherry wood paneling as well as acoustical fabric paneling. Several small windows are located on both the south and west facing walls, proving some daylight. The space is also equipped with video projection equipment, including a motorized project screen at the front of the room.

Space Layout

The following figures are used to help show the location and layout of the courtroom within the building. Figure 1.3.1 illustrates the galleria's location within the building on the first and Figure 1.1.2 shows the dimensioned floor plan of the space.

Figure 1.3.1 – Courtroom Location within William H. Gates Hall



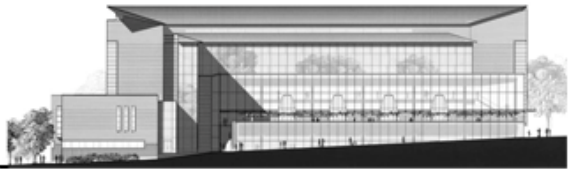
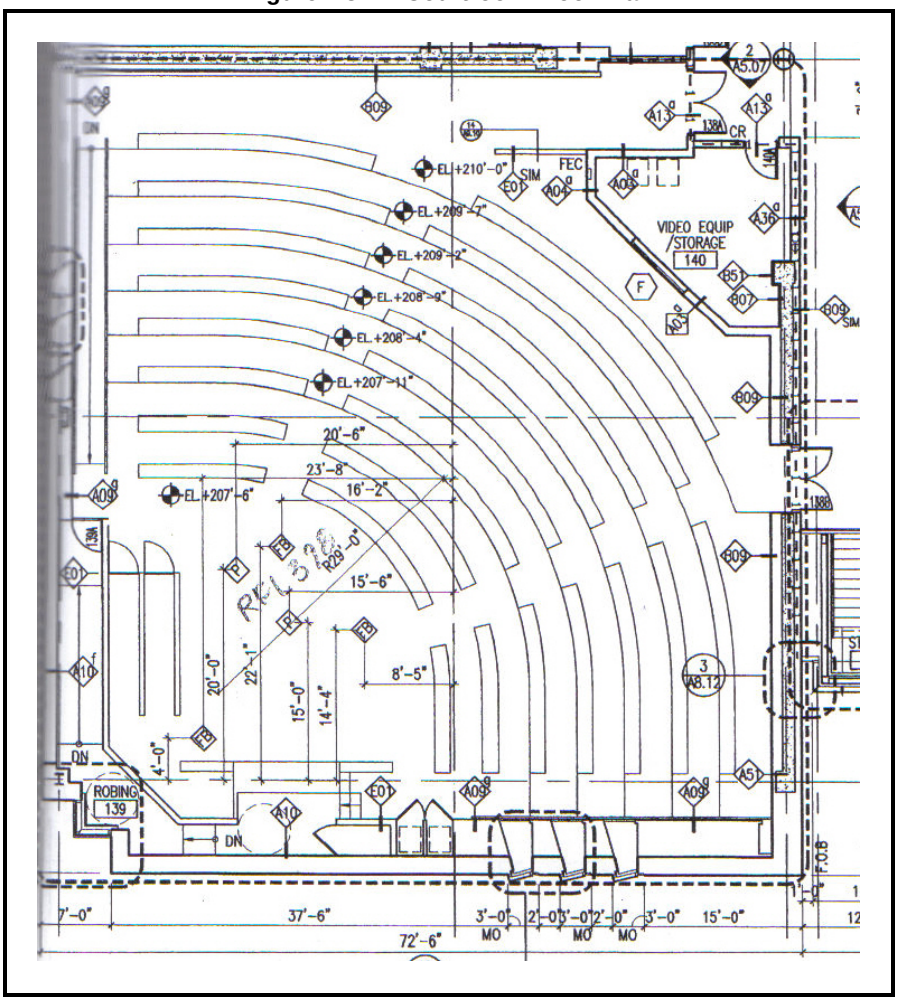


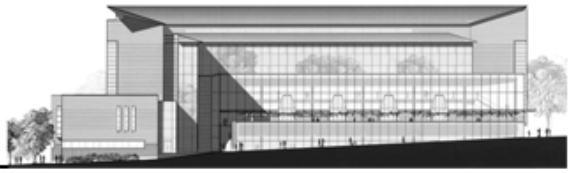
Figure 1.3.2 – Courtroom Floor Plan



Architectural Finishes
Surface Materials & Reflectances

Floors

Carpet
Manufacturer: Prince Street Carpets
Color: Get Your Goat (Tan)
Reflectance: 17%



Walls

Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%

Cherry Wood Paneling
Color: Cherry
Reflectance: 13%

Acoustic Fabric Panels
Manufacturer: Maharam
Color: Grey (008)
Reflectance: 23%

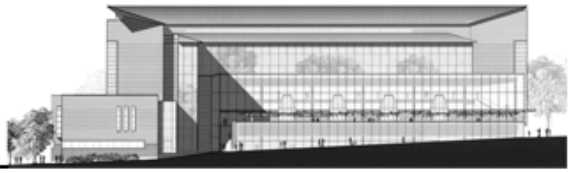
Ceilings

Acoustical Ceiling Tile
Manufacturer: Armstrong World Industries Inc.
Color: White
Reflectance: 89%

Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%

Design Goals

The Magnuson & Jackson Trial Courtroom acts as a teaching environment to mimic a real world setting. With this in mind, it is important to implement a lighting design that is realistic and appropriate to a courtroom setting. In order to emphasize this space and its functionality as a courtroom, the lighting design should create a visual hierarchy that draws the attention of the occupants to the front of the space where the judge's stand is located. Additionally, it is important to ensure that light levels and distribution throughout the space are adequate for classroom task. Light levels throughout the space should be sufficient for a variety of task, and the distribution along work plane surfaces should be fairly uniform as not to provide visual distraction or difficulty for the occupants. The versatility of this space allows it to be used for many tasks: mock trials, classes, presentations. The different tasks require varying lighting schemes throughout the space for visual clarity. For this reason, the lighting system



should have flexible controls that allow the user to adjust the system to meet their lighting needs.

Design Concept

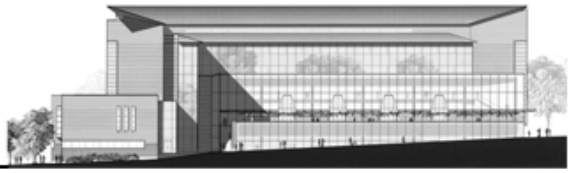
The lighting design in this space provides the opportunity to create a realistic courtroom setting. With the front 'litigation' area of the space being the most important, lighting is used in this area to create a visual hierarchy that will draw the occupant's attention and focus to this area. An architectural cove that follows the partially curved edges of this front area is created and will light the ceiling using linear fluorescent cove lights. Additional task lighting will be provided in this area with compact fluorescent downlights. The wood paneled wall behind the judges is accented using compact fluorescent wall washers in order to create an increased level of visual emphasis on the judge. The main seating area throughout the space is radially situated around the front of the space. The rows of desk are tiered upward as they get farther away from the front of the space, and the ceiling above mimics this radial, tiered pattern. The luminaires in this part of the ceiling should be recessed as not to compete with the architecture of the space and also not to interfere with any audio visual and projection equipment being used. The general task lighting for the space will be recessed, dimmable, linear fluorescent fixtures.

Design Criteria

- *Appearance of Space and Luminaires (Important)*
  The appearance of the space and luminaires is important in maintaining the desired image of the UW Law School. Luminaires should reflect the prestige and excellence of the school, while also complementing the architecture. Since the space seconds as a trial courtroom and will be visited by many professionals from the legal world, it is important to provide an impressive space that closely mimics the appearance of an actual courtroom.

- *Color Appearance & Color Contrast (Important)*
  Color rendering is important for overall visual performance. A color rendering index of 80 should be maintained by all lamps in order to maximize color appearance of materials within the space. Special consideration should be taken to the extensive use of wood paneling within the space, so not to wash out the wood material. Warmer color temperatures should be used to avoid this.

- *Daylight Integration & Control*
  There are minimal affects of daylighting within this space. There are only six small windows within the space which provide daylight and the levels provided are fairly minimal. For this reason, daylight integration and control is not necessary.



- *Direct Glare (Very Important)*
  This space doubles as both a classroom and trial courtroom, and will include many tasks such as reading, writing, VDT use, trials and presentations. For these reasons, direct glare is not acceptable in this space, as it will provide discomfort and be distracting to occupants of the space.

- *Light Distribution on Task Plane (Uniformity)(Very Important)*
  Uniform distribution on the task plane is important to ensure ease of any task. Bright spots and reflected glare from a specular table surface should be avoided. This is particularly important for not only the student desk but for the judge's stand and litigation table as well.

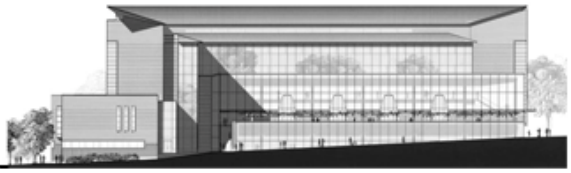
- *Luminances of Room Surfaces*
  Consideration should be taken in providing luminances on room surfaces that meet desired luminance ratios. The luminance ratio from VDT to adjacent surfaces should not exceed 3:1. In addition to this, a luminance ratio of 10:1 should not exceed for VDT to far background surfaces.

- *Modeling of Faces or Objects Very (Important)*
  Facial features should lit from angles and with illuminance levels that avoid unflattering shadows on the face, especially from the eye sockets. It is especially important to optimize facial modeling when the space is used for trial purposes. Avoiding shadows on the judge and clerk area, litigants table, podium and witness stand is ideal.

- *Reflected Glare (Very Important)*
  Reflected glare in the space should be avoided, especially with the use of VDT monitors. Luminaire cut-off angles should be located outside of the offending zone in order to avoid this.

- *Illuminance (Horizontal)*
  Illuminance levels on the task plane within the space should reach a minimum of 30 footcandles for classroom applications. This illuminance level should be uniform and provided on all task surfaces of space. During court trial applications, the horizontal illuminance should ideally reach levels of approximately 50 footcandles in the front area of the room near the judge's stand.

- *Illuminance (Vertical)*
  Maintaining adequate vertical illuminance levels is important for facial modeling in the front of the space and for trial applications. A vertical illuminance level of 20 fc should be maintained.



Luminaire Schedule

The following figure and table outline the luminaires that are to be used in the lighting design for the Magnuson & Jackson Trial Courtroom. Refer to Appendix A for all fixture, lamp, and ballast cut sheets.

Table 1.3.1 – Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
F1A	Lightolier Compact Fluorescent downlight w/ vertical lamp, nominal 6" aperture	Recessed	1	CFTR32W	Electronic Dimming	82	3500	277	34	44
F3A	Focal Point Fluorescent Directional Cove Light	Surface	1	F28T5	Electronic Dimming	85	3500	277	30	24
F7A	Focal Point Fluorescent Narrow Slot Downlight with Opaque Satin Lense	Recessed	1	F28T5	Electronic Dimming	85	3500	277	30	66
F8A	Lightolier Compact Fluorescent downlight w/ vertical lamp, nominal 4.5" aperture	Recessed	1	CFQ18W	Electronic Dimming	82	3500	277	20	7

Figure 1.3.3 – Luminaires Used in Trial Courtroom Lighting Design

Luminaire Layout

The following figure, Figure 1.3.4, shows the luminaire layout for the trial courtroom. Luminaire type is shown according to the corresponding luminaire designation.

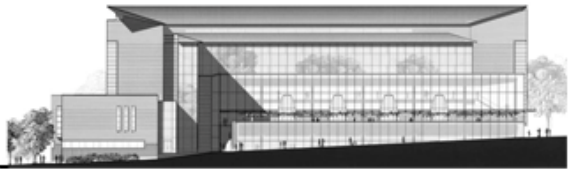
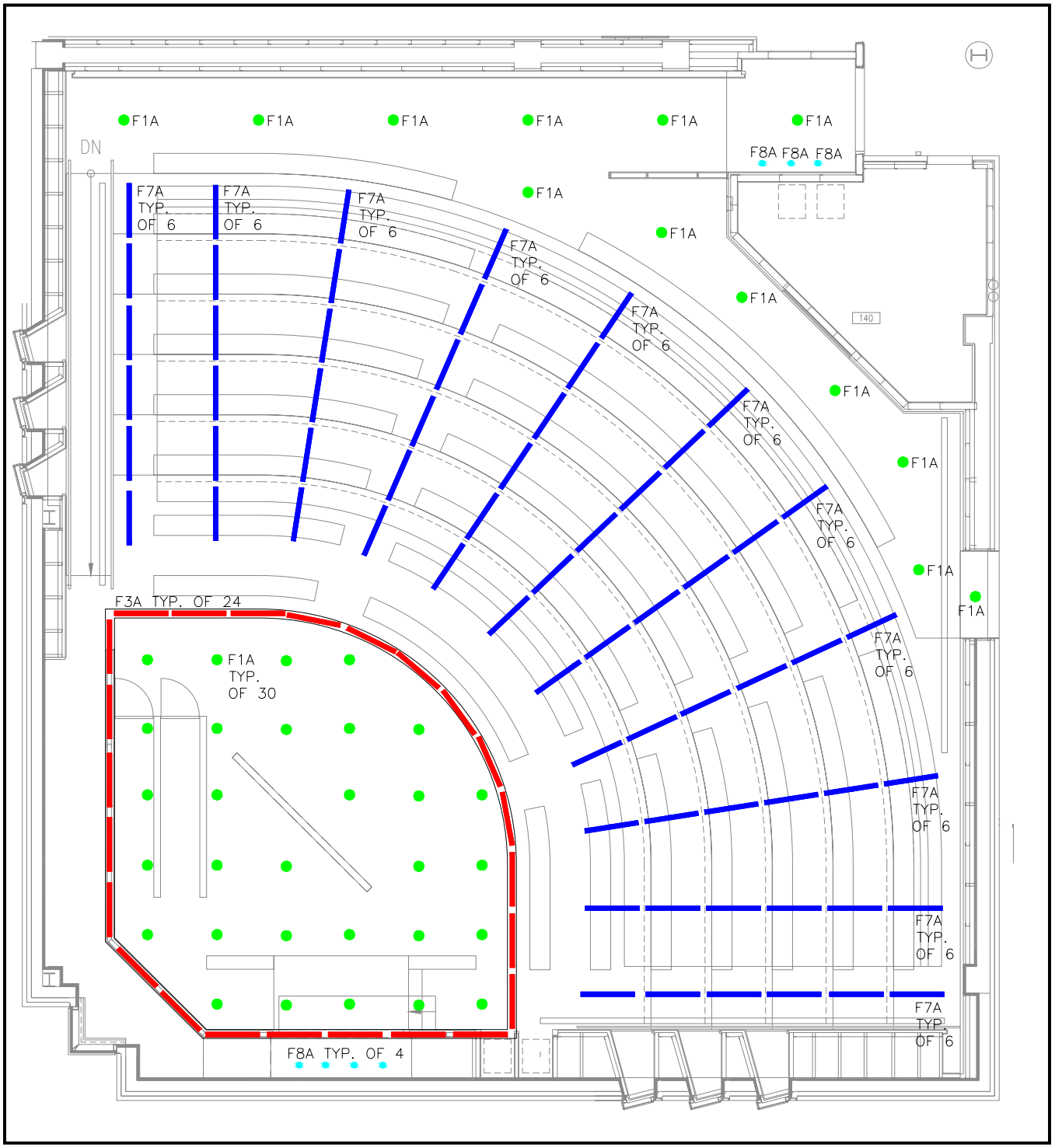
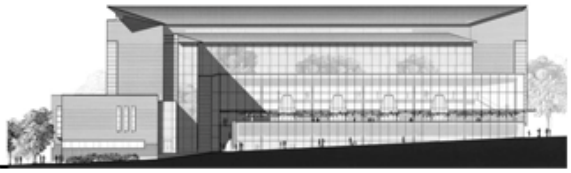


Figure 1.3.4 – Luminaires Layout





Controls

Being the largest single room in William H. Gates Hall, the courtroom is used for a variety of functions, from mock court trials, classes and presentations. Due to the versatility of this space, the lighting system control should also be versatile to accommodate for any use of the space. All of the light fixtures in the room will be equipped with dimming ballast as to allow for various light levels that may be needed. The room will be controlled with a Lutron Grafik Eye 4000 Dimming System, which will allow for multiple preset lighting scenes for the space. The luminaires will be divided and controlled in separate zones, each of which will be able to be dimmed to different levels for various scenes. The different scenes to be programmed into the system will include an all-on, all-off, court trial, note taking/classroom, and presentation scene. The room will be equipped with one primary control station located at the front of the room, near the judge's stand, and on-off switches for the system located by the two entrances to the space.

In order to power the Grafik Eye Dimming System, a Lutron Dimming Panel will also be used and will be located in the building's southwest electrical closet on the first floor.

Additionally, in order to satisfy lighting code requirements and to save energy on lighting during periods when the room is vacant, dual technology occupancy sensors will be installed in the space. There will be one occupancy sensor that will cover the main courtroom area, and a second located at the northern most entrance to the space.

Refer to Appendix A for manufacturer cut sheets for all control equipment, including the dimming system, dimming panel, on-off switches, and occupancy sensors.

The following tables show the dimmer circuit schedule and corresponding zones, as well as the preset scene programming.

Table 1.3.2 – Dimmer Schedule for Trial Courtroom

Dimmer Circuit No.	Zone No.	Fixture Type	Description	Source Type	Fixture Quantity	Unit Watts	Total Watts	Dim. Capacity
1	Z1	F7A	Downlight	FL	33	30	990	4500
2	Z1A	F7A	Downlight	FL	33	30	990	4500
3	Z2	F1A	Downlight	FL	30	34	1020	4500
4	Z3	F3A	Covelight	FL	24	30	720	4500
5	Z4	F1A	Downlight	FL	6	34	204	4500
6	Z5	F1A	Downlight	FL	7	34	238	4500
7	Z6	F8A	Wallwash	FL	3	20	60	4500
8	Z7	F8A	Wallwash	FL	4	20	80	4500

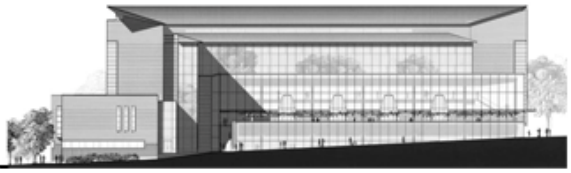


Table 1.3.3 – Dimming System Preset Scene Programming

Preset	Description	Zones	Percantage
1	All On	Z1	100%
		Z1A	100%
		Z2	100%
		Z3	100%
		Z4	100%
		Z5	100%
		Z6	100%
		Z7	100%
2	Trial	Z1	50%
		Z1A	50%
		Z2	100%
		Z3	100%
		Z4	50%
		Z5	50%
		Z6	100%
		Z7	100%
3	Notetaking	Z1	100%
		Z1A	100%
		Z2	100%
		Z3	0%
		Z4	100%
		Z5	100%
		Z6	100%
		Z7	0%
4	Presentation	Z1	10%
		Z1A	10%
		Z2	0%
		Z3	0%
		Z4	5%
		Z5	5%
		Z6	100%
		Z7	0%

The following figure, Figure 1.3.5 illustrates the luminaire layout circuiting, as well as the zone designations for dimming control.

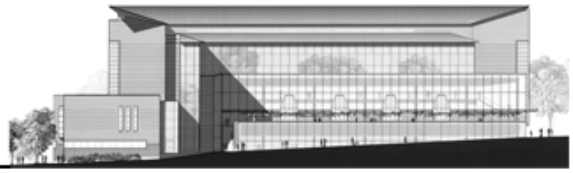
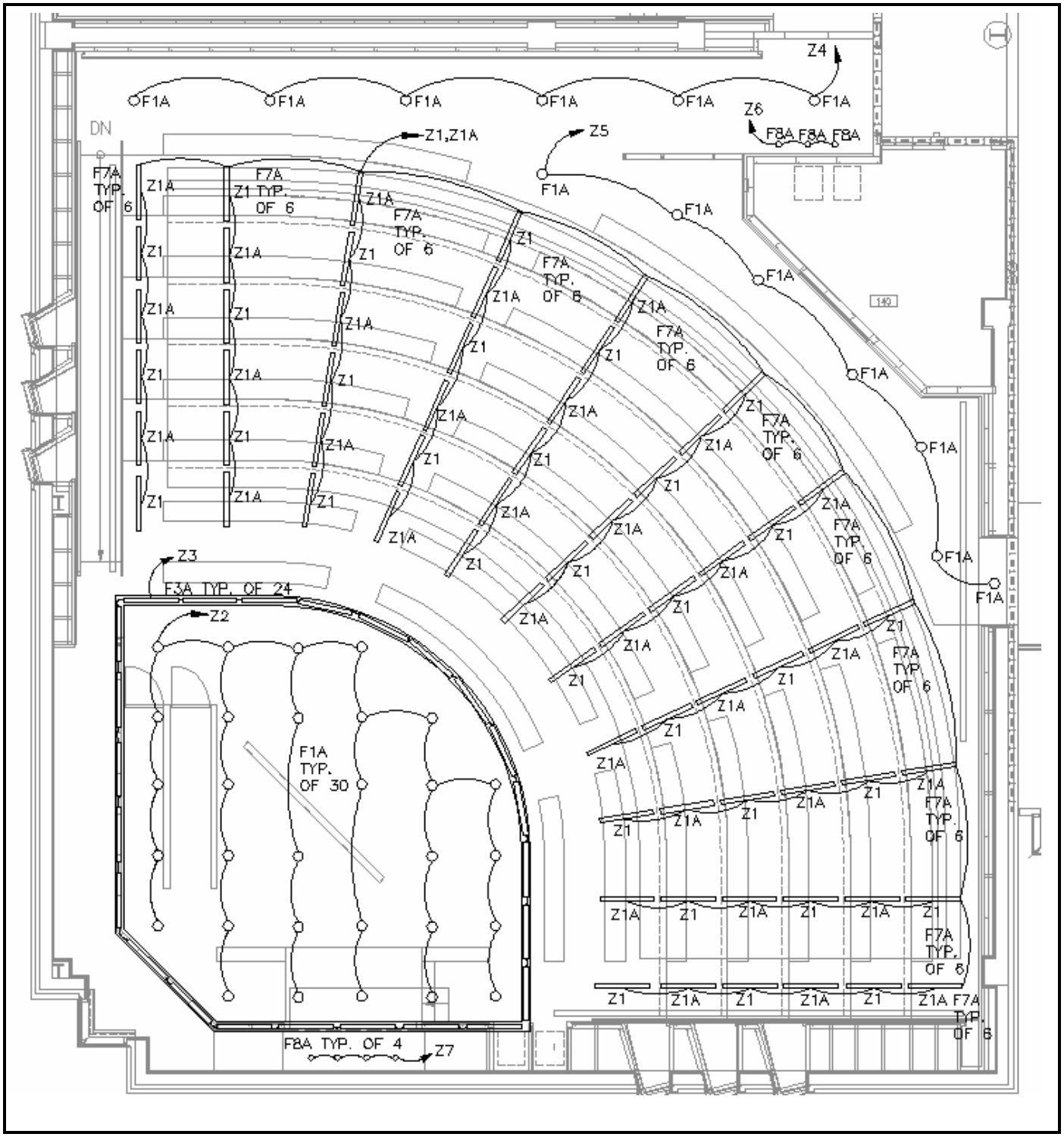
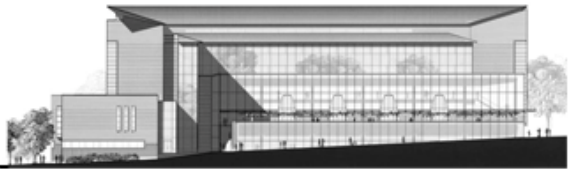


Figure 1.3.5 – Courtroom Circuiting and Controls Plan





Cove Detail

The following cove details show the location and dimensions of the cover to be installed over the front area of the room. While two of the sides of the cove follow the edges of the space, the curved edge mimics the curve of the stepped ceiling.

Figure 1.3.6 – Cove Location

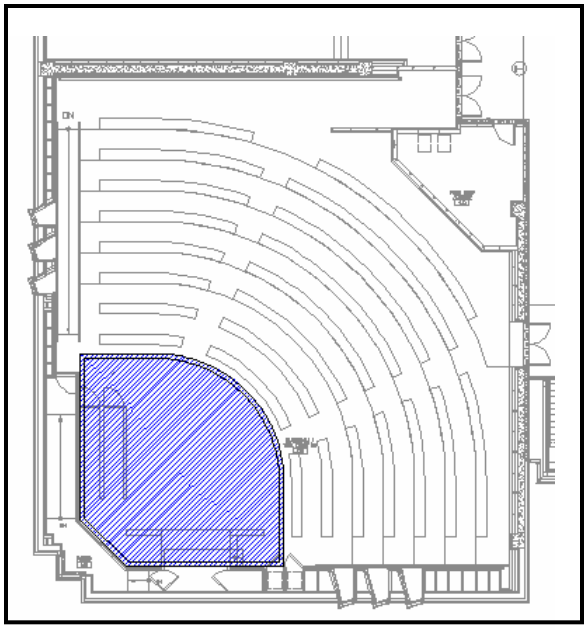
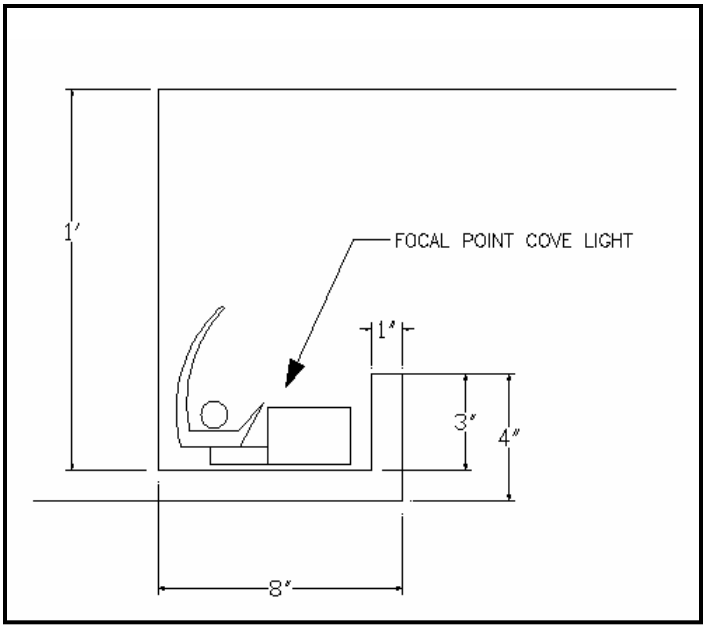


Figure 1.3.7 – Cove Detail with Dimensions

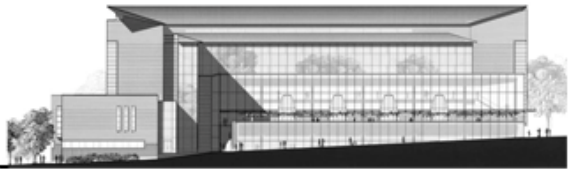


Light Loss Factors

The following table outlines the light loss factors for each of the luminaires used in the lighting design of the courtroom. In determining these values it was assumed that the atmosphere was very clean, with a cleaning interval of twelve months.

Table 1.3.4 – Light Loss Factors

Luminaire Designation	Maintence Category	Room Atmosphere	Cleaning Interval	Initial Lumens/ Luminaire	Design Lumens/ Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
F1A	IV	Very Clean	12 months	900	774	1.0	0.86	0.98	0.94	**0.792**
F3A	I	Very Clean	12 months	2900	2660	0.98	0.92	0.98	0.97	**0.854**
F7A	IV	Very Clean	12 months	2900	2660	0.98	0.92	0.98	0.97	**0.854**
F8A	IV	Very Clean	12 months	1200	970	1.0	0.81	0.98	0.94	**0.745**



Power Density

The maximum allowable power density according to ASHRAE 90.1 for a courtroom space is 2.0 W/sq ft. The following table shows the calculation of the power density for the proposed lighting design for the courtroom

Table 1.3.5 – Power Density

Luminare	Input Watts	Quantity	Watts
F1A	38	44	1672
F3A	30	24	720
F7A	30	66	1980
F8A	22	7	154
		Total Watts	4526
		Area (sq ft)	5000
		Power Density	**0.91**

The power density of the galleria is 0.91 watts per square foot. This value is below the prescribed 2.0 watts per square foot. Therefore, the power density for this design is acceptable.

Design Performance

While the visual aesthetics of the lighting system is important in the courtroom, the performance of the lighting design is critical to the success of the lighting for the space. Due to the task intensive nature of the courtroom, illuminance levels throughout must be high enough for the desired task and the distribution of light should be very uniform. Illuminance levels on the primary work plane (student desk area) average approximately 40 footcandles. This level is sufficient for classroom task, such as note taking, that would occur in this area. The illuminance levels in the front of the space are slightly higher, as to provide a visual hierarchy of the space. Levels on the judge's podium average almost 50 footcandles and the juror's area receives approximately 42 footcandles of illuminance. In addition, the uniformity of light distribution on all of these spaces is very good, with none exceeding a uniformity ratio of 3:1.

Vertical illuminance levels for facial modeling of the judge and presenters in the space are obtained at approximately 20 footcandles. These levels meet the desired illuminance level requirements outlined in the design criteria.

Table 1.3.6 outlines the obtained illuminance values on the primary surfaces throughout the space, including the work plane, judge's desk, jurors' area, floor, judge's face, and a speaker's face (if standing in the center of the front, litigation area).

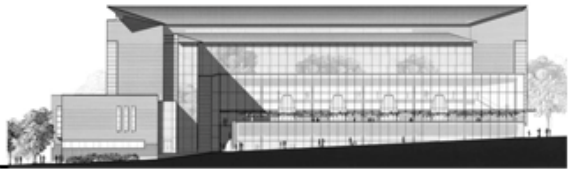
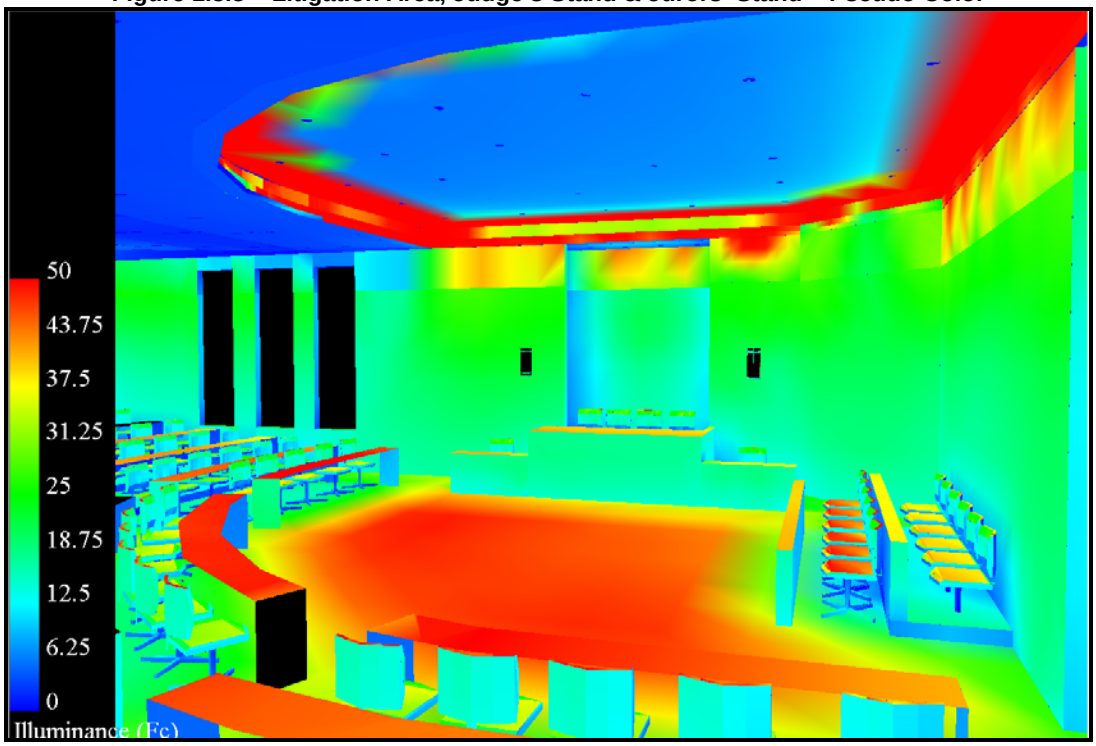


Table 1.1.10 - Illuminance Values (fc)

Workplane		Judge's Desk		Juror's Area	
Average	41.39	Average	49.52	Average	41.96
Max	53.3	Max	51.3	Max	44.9
Min	23.9	Min	48.7	Min	39.5
Avg/Min	1.73	Avg/Min	1.02	Avg/Min	1.06
Max/Min	2.23	Max/Min	1.05	Max/Min	1.14
Floor (Circulation)		**Judge's Face**		**Speaker's Face**	
Average	18.29	Average	19.5	Average	21.0
Max	25.5	Max	19.5	Max	21.0
Min	11.6	Min	19.5	Min	21.0
Avg/Min	1.58	Avg/Min	1.0	Avg/Min	1.0
Max/Min	2.2	Max/Min	1.0	Max/Min	1.0

Figure 1.3.8 – Litigation Area, Judge's Stand & Jurors' Stand – Pseudo Color



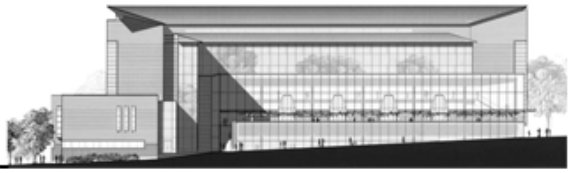
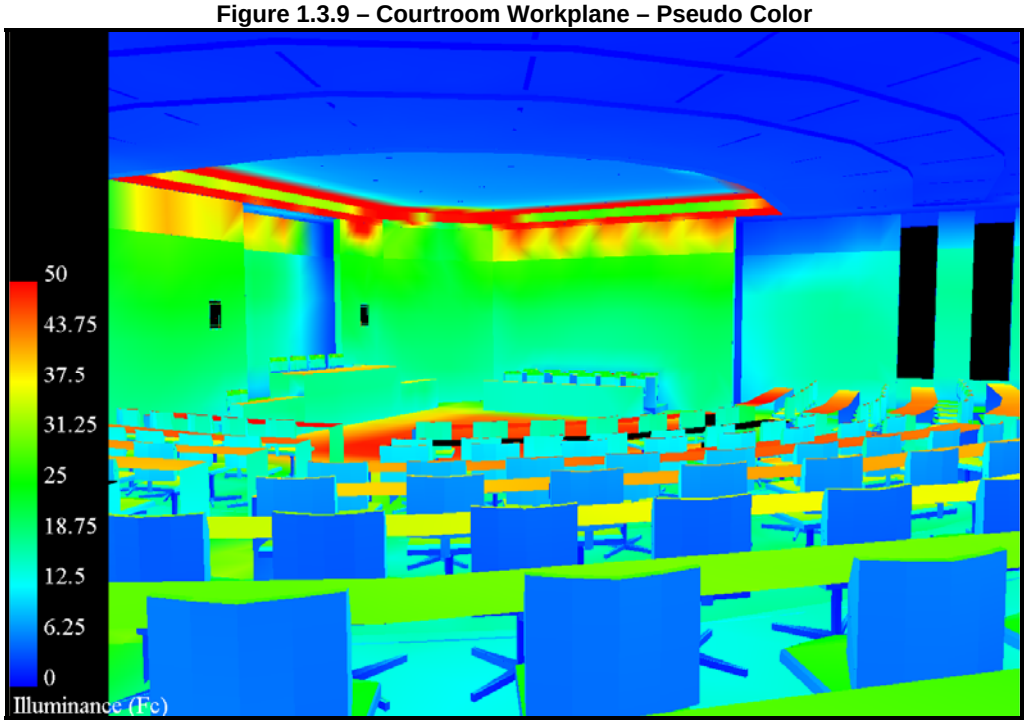


Figure 1.3.9 – Courtroom Workplane – Pseudo Color



Renderings

Figure 1.3.10 – Courtroom Rendering

Figure 1.3.11 – Courtroom Rendering

Figure 1.3.12 – Courtroom Rendering

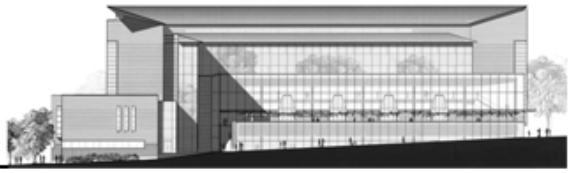
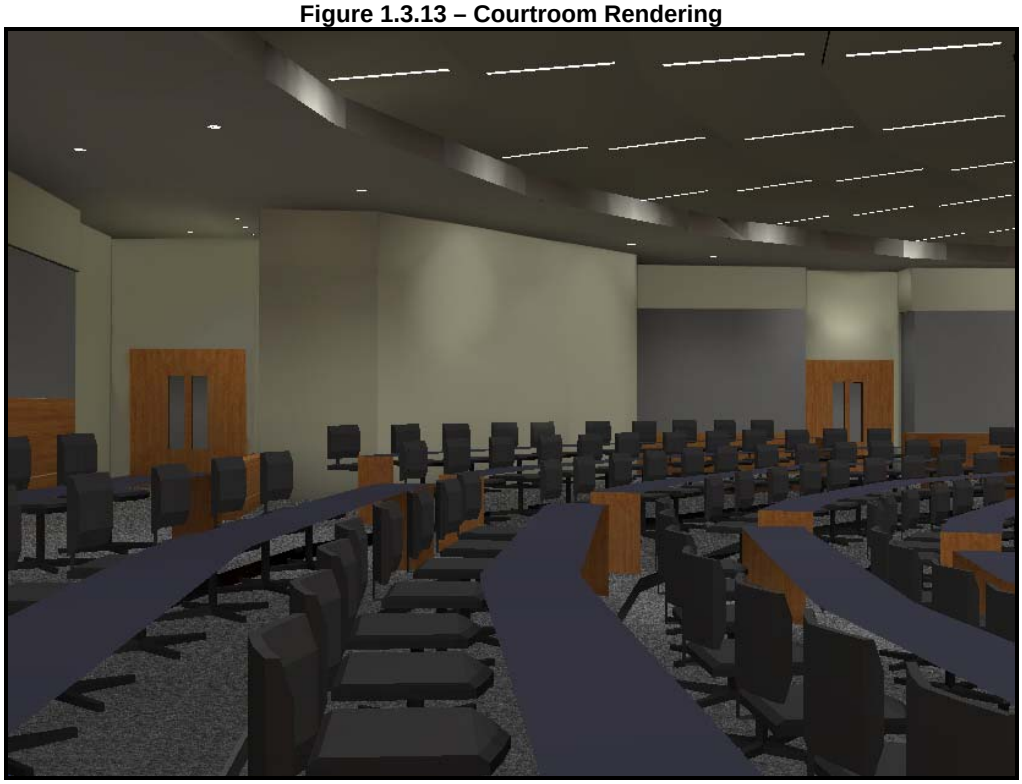
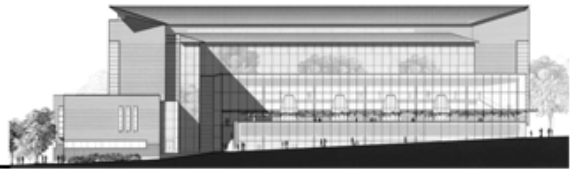


Figure 1.3.13 – Courtroom Rendering



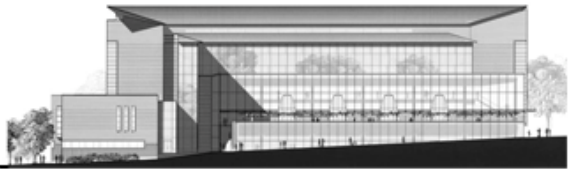
Conclusion

By utilizing luminaires that are flush with the ceiling, the lighting system allows for the architecturally unique ceiling of this space (which is unlike any other room in the building) to become a prominent feature of this room. The lighting design provides the illuminance levels required to allow for a visually productive space, while also playing off of the unique ceiling element to provide a more unconventional lighting design for a courtroom space. Additionally, the flexibility in lighting control will allow this space to be used for a wide variety of functions and to reach its maximum potential.



Marion Gould Gallagher Law Library

Reading Room



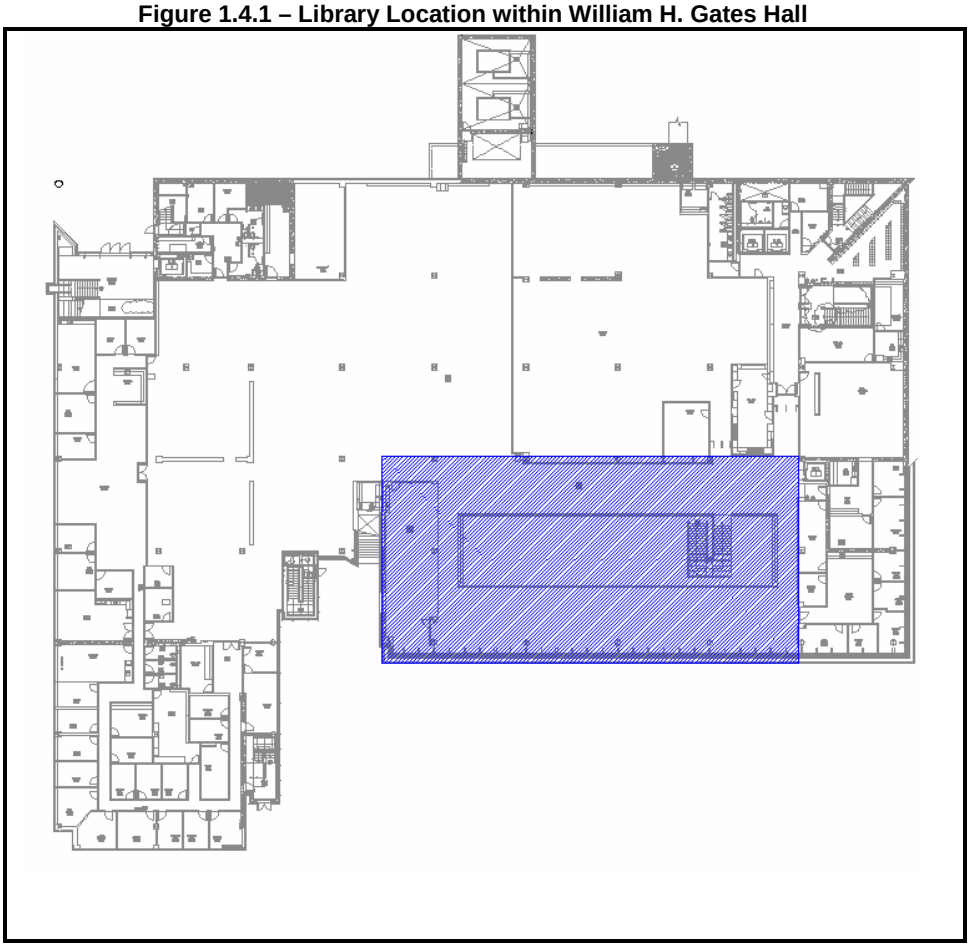
Introduction

Located two levels below grade, the Marion Gould Gallagher Law Library provides students with the largest law library in the Pacific Northwest. Spanning approximately 150 feet in length and 72 feet in width, this space is provides ample study and reading areas for students. As one enters the space, they instantly notice the four large skylights, providing daylight from the terrace above. Centered below the skylights is an opening in the L1 level to the L2 floor below. A stair case connecting these two levels floats in the middle of the open space. The upper level contains large tables with table lamps for studying on one side and several computers on the other. The lower level contains a reading area on the northern side and stacks on the south. In addition to the skylights, substantial levels of daylight enter the space through the partially-glazed exterior south-facing wall.

Space Layout

The following figures are used to help show the location and layout of the library within the building. Figure 1.4.1 illustrates the library's location within the building and Figure 1.4.2 shows the dimensioned floor plans of the space.

Figure 1.4.1 – Library Location within William H. Gates Hall



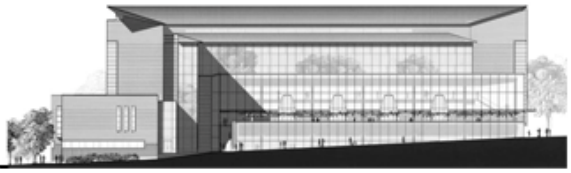
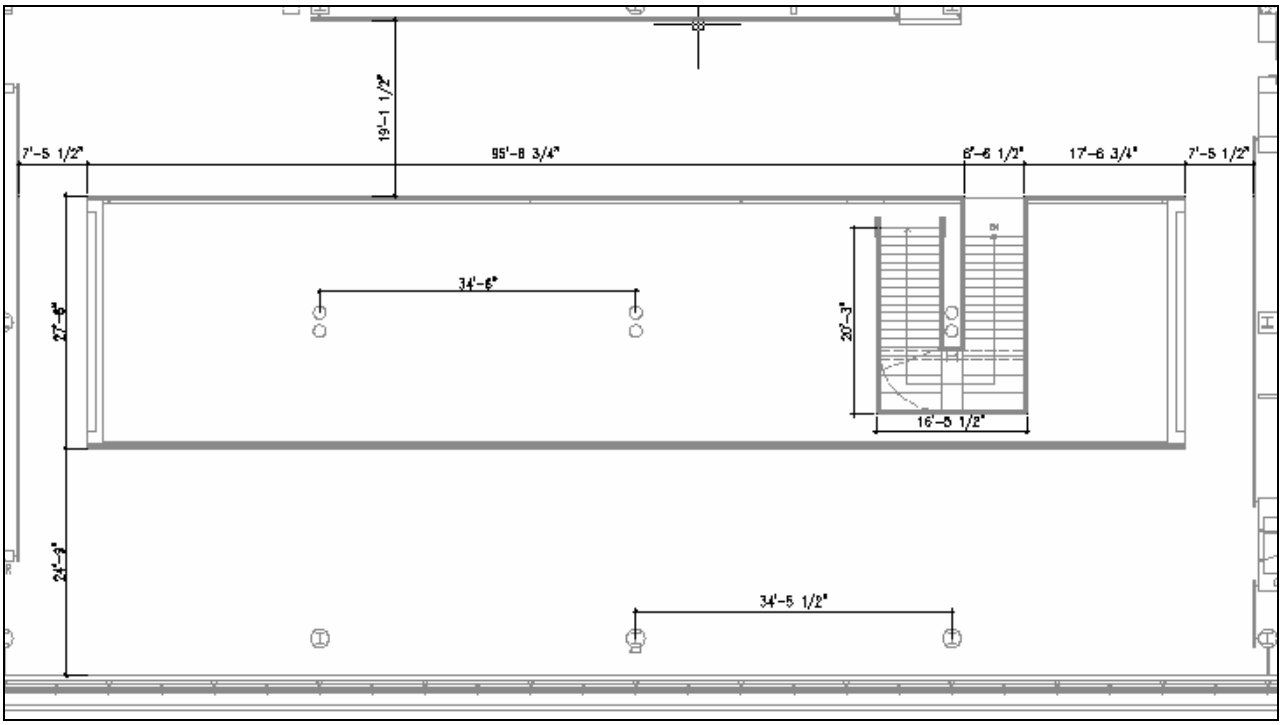
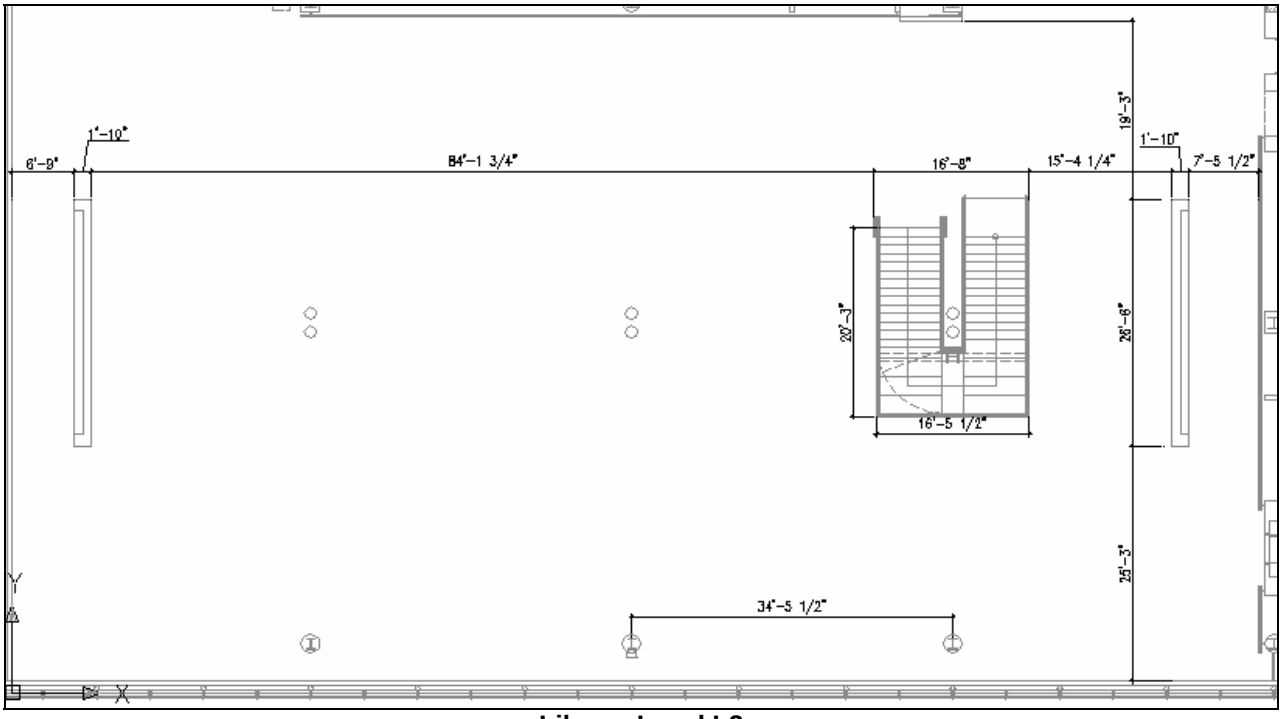


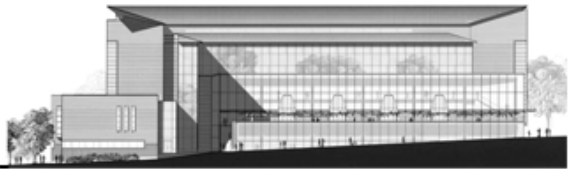
Figure 1.4.2 – Library Floor Plans



Library Level L1



Library Level L2

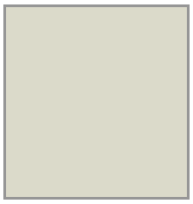


Architectural Finishes
Surface Materials & Reflectances

Floors

Carpet
Manufacturer: Prince Street Carpets
Color: Get Your Goat (Tan)
Reflectance: 17%

Walls



Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%

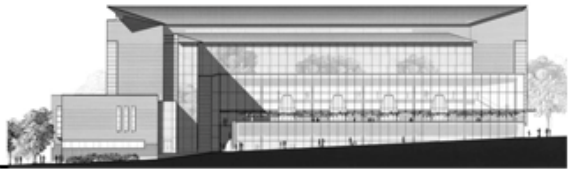
Ceilings

Acoustical Ceiling Tile
Manufacturer: Armstrong World Industries Inc.
Color: White
Reflectance: 89%

Glazing

PPG Sungate 100 Low-E- Glass

Transmittance			Reflectance		U-Value		K-Value		Shading Coeff.	Solar Heat Gain Coeff.	Light to Solar Gain
Ultra-violet %	Visible %	Total Solar Energy %	Visible Light %	Total Solar Energy %	Winter Night time	Summer Daytime	Winter Night time	Summer Daytime			
35	73	44	12	20	0.31	0.3	1.76	1.7	0.59	0.52	1.4



Daylight Study

The Marion Gould Gallagher Law Library incorporates several architectural elements that allow the space to receive ample amounts of daylight. The four skylights located centrally above the double-height space at the center of the reading room allow for direct and ambient light to enter the space. Additionally, the south facing windows on the upper level of the reading area allow for this space to be flooded with daylight. This influx of daylight allows for high levels of natural lighting in the space; however, it also creates potential issues with direct glare that are undesired with a task intensive space. The four skylights as well as the south facing windows use PPG Sungate low-emitting glass (noted above).

Daylighting Values and Renderings

The following daylighting study looks at daylight contribution and conditions within the space for different sky conditions at several times throughout the year: 10:00 AM and 1:00 PM on December 21, March 21, and June 21. For each of the days, times and conditions the illuminance levels that the daylight provides are noted for the upper Level (L1) reading area adjacent to the south facing windows and the lower level (L2) reading area located directly below the skylights.

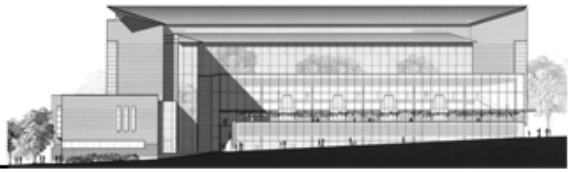


Table 1.4.1 - Daylight Illuminance Values (fc)

	December 21.							
	10:00 AM				1:00 PM			
Clear Sky	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	522.04	Average	123.92	Average	603.16	Average	125.97
	Max	1961	Max	1427	Max	1465	Max	178
	Min	46.3	Min	51.4	Min	54.2	Min	67.1
	Avg/Min	11.28	Avg/Min	2.41	Avg/Min	11.13	Avg/Min	1.88
	Max/Min	42.36	Max/Min	27.77	Max/Min	27.04	Max/Min	2.65
Partly Cloudy	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	166.99	Average	55.11	Average	319.03	Average	114.98
	Max	792	Max	90.5	Max	1098	Max	163
	Min	14.3	Min	25.7	Min	42.8	Min	62.2
	Avg/Min	11.68	Avg/Min	2.14	Avg/Min	7.45	Avg/Min	1.85
	Max/Min	55.35	Max/Min	3.52	Max/Min	25.65	Max/Min	2.62
Overcast	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	34.54	Average	25.5	Average	77.47	Average	57.2
	Max	125	Max	32.5	Max	280	Max	72.9
	Min	5.3	Min	17.7	Min	11.9	Min	39.8
	Avg/Min	6.52	Avg/Min	1.44	Avg/Min	6.51	Avg/Min	1.44
	Max/Min	23.53	Max/Min	1.84	Max/Min	23.5	Max/Min	1.83

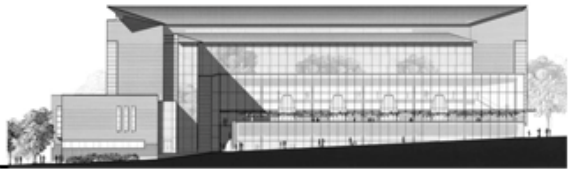
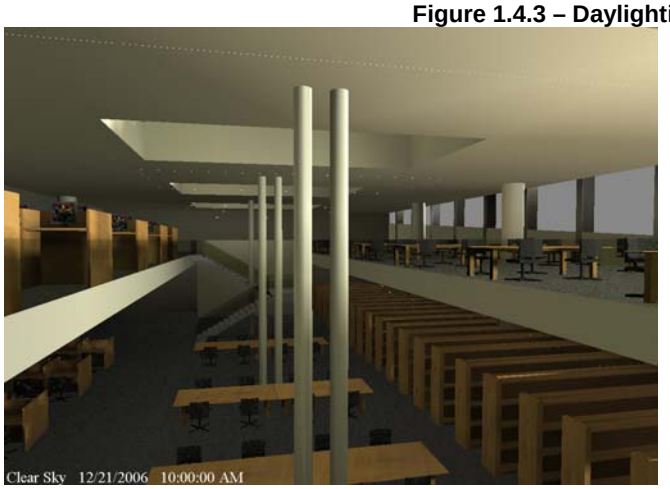
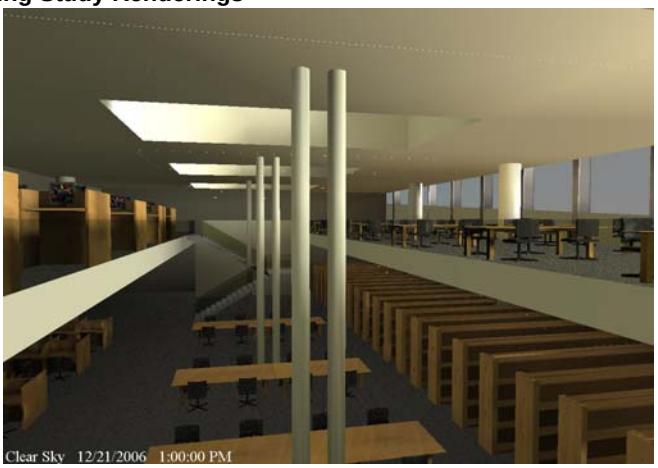


Figure 1.4.3 – Daylighting Study Renderings



December 21, 10:00 AM, Clear Sky



December 21, 1:00 PM, Clear Sky

December 21, 10:00 AM, Partly Cloudy

December 21, 1:00 PM, Partly Cloudy

December 21, 10:00 AM, Overcast

December 21, 1:00 PM, Overcast

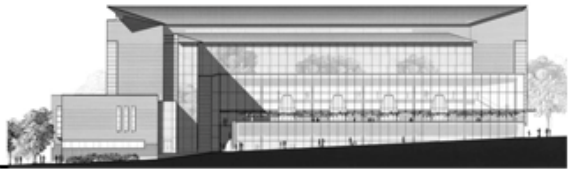


Table 1.4.2 - Daylight Illuminance Values (fc)

	March 21.							
	10:00 AM				1:00 PM			
Clear Sky	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	327.4	Average	144.06	Average	167.23	Average	669.7
	Max	1512	Max	191	Max	262	Max	3529
	Min	39.1	Min	79	Min	89.9	Min	48.7
	Avg/Min	8.37	Avg/Min	1.82	Avg/Min	1.86	Avg/Min	13.75
	Max/Min	38.68	Max/Min	2.42	Max/Min	2.91	Max/Min	72.46
Partly Cloudy	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	350.83	Average	128.05	Average	465.18	Average	221.02
	Max	1788	Max	663	Max	3547	Max	329
	Min	17.3	Min	72.9	Min	38.9	Min	124
	Avg/Min	20.28	Avg/Min	1.76	Avg/Min	11.96	Avg/Min	1.79
	Max/Min	103.38	Max/Min	9.09	Max/Min	91.17	Max/Min	2.66
Overcast	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	75.05	Average	101.63	Average	113.05	Average	153.07
	Max	95.7	Max	367	Max	144	Max	553
	Min	52.2	Min	15.5	Min	78.7	Min	23.5
	Avg/Min	1.44	Avg/Min	6.56	Avg/Min	1.44	Avg/Min	6.51
	Max/Min	1.83	Max/Min	23.68	Max/Min	1.83	Max/Min	23.52

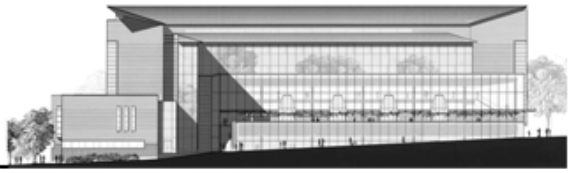
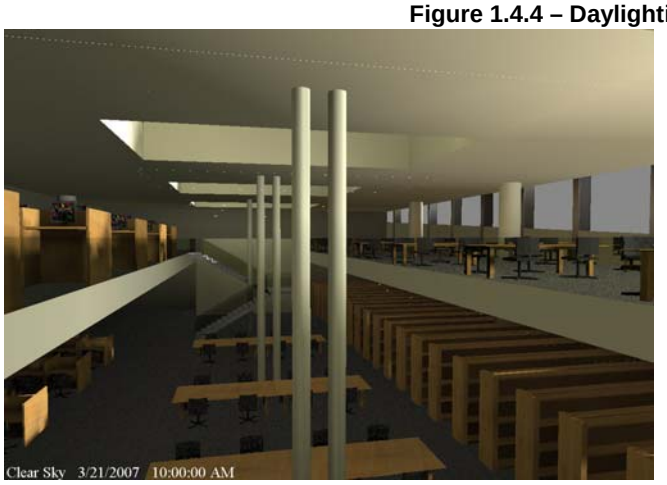
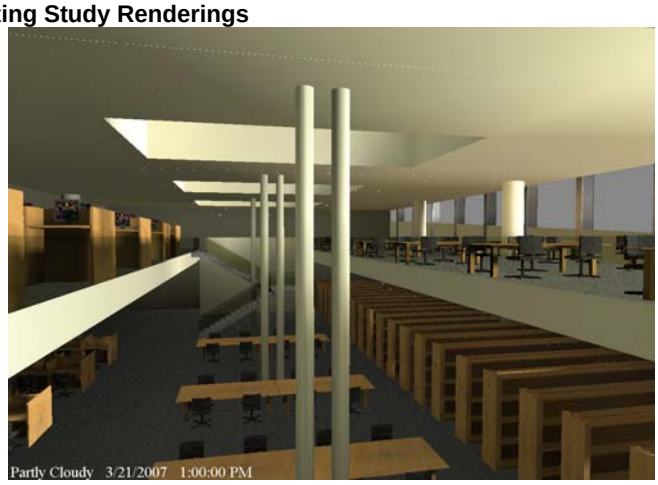


Figure 1.4.4 – Daylighting Study Renderings



March 21, 10:00 AM, Clear Sky



March 21, 1:00 PM, Clear Sky

March 21, 10:00 AM, Partly Cloudy

March 21, 1:00 PM, Partly Cloudy

March 21, 10:00 AM, Cloudy Sky

March 21, 1:00 PM, Cloudy Sky

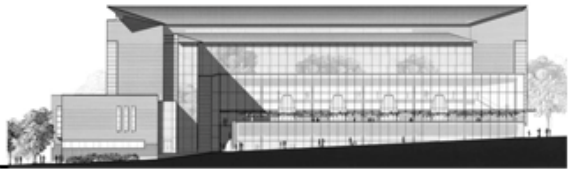


Table 1.4.3 - Daylight Illuminance Values (fc)

	June 21.							
	10:00 AM				1:00 PM			
Clear Sky	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	260.12	Average	592.52	Average	413.15	Average	1163
	Max	1192	Max	6355	Max	3352	Max	4312
	Min	35.1	Min	118	Min	35	Min	92.9
	Avg/Min	7.41	Avg/Min	5.03	Avg/Min	11.8	Avg/Min	12.51
	Max/Min	33.95	Max/Min	53.94	Max/Min	95.78	Max/Min	46.42
Partly Cloudy	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	289.02	Average	424.29	Average	441.73	Average	837.42
	Max	1730	Max	2963	Max	3926	Max	2566
	Min	36.6	Min	155	Min	63.9	Min	187
	Avg/Min	7.9	Avg/Min	2.74	Avg/Min	6.91	Avg/Min	4.47
	Max/Min	47.27	Max/Min	19.14	Max/Min	61.44	Max/Min	13.69
Overcast	Level L1 Reading Area		Level L2 Below Skylights		Level L1 Reading Area		Level L2 Below Skylights	
	Average	260.84	Average	593.45	Average	378.4	Average	1233
	Max	1192	Max	6355	Max	2197	Max	4393
	Min	35.4	Min	121	Min	149	Min	146
	Avg/Min	7.37	Avg/Min	4.9	Avg/Min	2.54	Avg/Min	8.44
	Max/Min	33.66	Max/Min	52.48	Max/Min	14.75	Max/Min	30.07

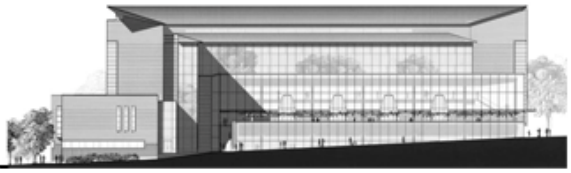
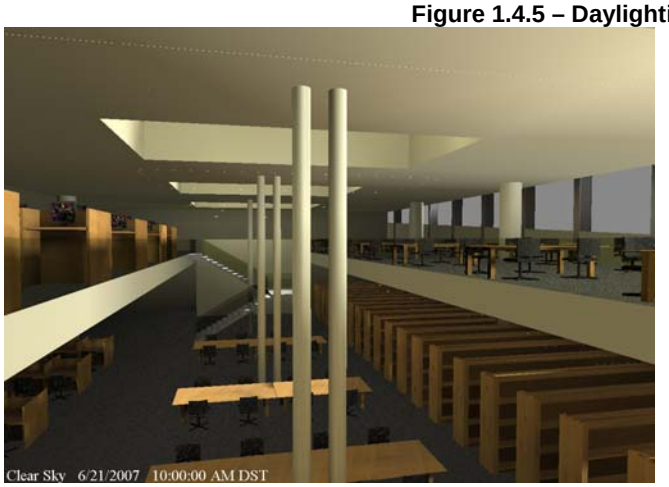
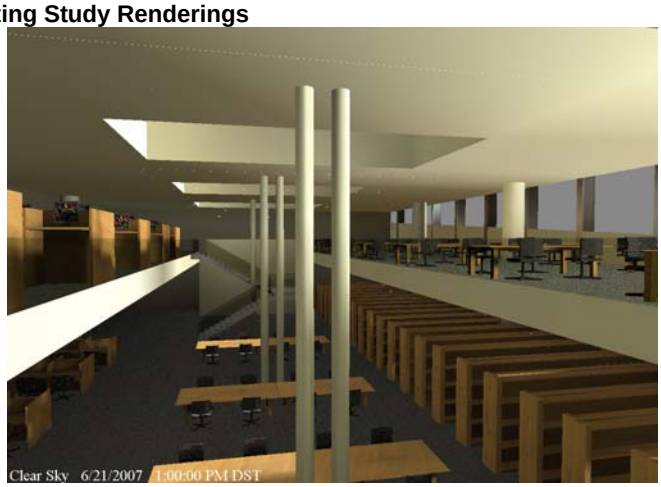


Figure 1.4.5 – Daylighting Study Renderings



June 21, 10:00 AM, Clear Sky



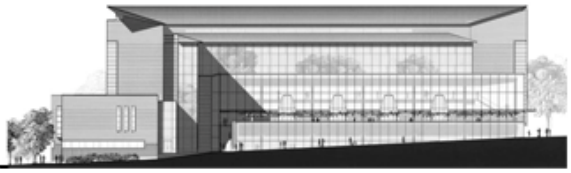
June 21, 1:00 PM, Clear Sky

June 21, 10:00 AM, Partly Cloudy

June 21, 1:00 PM, Partly Cloudy

June 21, 10:00 AM, Cloudy Sky

June 21, 1:00 PM, Cloudy Sky



Daylight Analysis

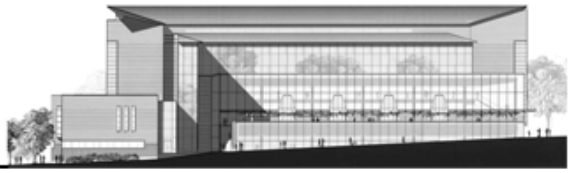
While the high influx of daylight within this space allows for potential energy savings by decreasing the need for electric light, it also creates some concerns about visual comfort for this task intensive space. Throughout the entire year, the space receives reasonable amounts of daylight, with the levels varying slightly depending on sky conditions and the sun's position in the sky. It is important to optimize the potential of this daylight, while also minimizing unwanted glare from the sun that will make it difficult to complete desired task.

The reading area located on the lower Level L2, directly below the skylights receives extremely high levels of daylight, especially during the summer months when the sun is higher in the sky and directly above the skylights. In order to help decrease the direct light levels in this area, while still allowing the ambient light from the skylights to flood the space, a ceramic frit glass will be incorporated into the skylights. A product such as Viracon Architectural Translucent Frit Glass will allow for sunlight to be diffused as it enters the space, still allowing the space to receive the daylight, but in a less harsh and direct manner. Additionally, incorporating a ceramic frit glass in the skylights will allow the skylights to "glow" when filled with light (refer to terrace lighting design).

Viracon Architectural Translucent Frit Glass
Simulated Sandblast V1086

Product	Transmittance			Reflectance			ASHRAE U-Value		Shading Coefficient	Relative Heat Gain	SHGC
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer			
V1086	55%	53%	28%	16%	14%	11%	1.09	1.07	0.73	161	0.63

The reading area located on the upper Level L1 also receives exceptionally high levels of daylight. While the daylight entering the space from these south facing windows, allows most of the upper floor to be flooded with desirable ambient daylight, the area directly adjacent to the windows becomes problematic with high levels of direct glare on the task plane, especially during months when the sun is located lower in the south sky. In order to control this glare, a shading system will be incorporated into the library in the area directly adjacent south facing windows, such as Lutron's Sivoia QED Roller 100. Localized controls will be provided for library workers at the main circulation desk. This will allow for workers to adjust the shades according to weather conditions outside and the amount of direct sunlight entering the space. As mentioned above, daylight issues arise from the south facing windows particularly in the winter months when the sun is lower in the sky; however, due to Seattle's vastly rainy and cloudy winters, the winter sun will be a limited issues. For this reason, photosensor control for the shades is not incorporated, as during the primary school year, direct sunlight is seldom an issue.



While a daylighting control system which incorporates a dimming aspect was considered, it is not economical to incorporate such a system here. Due to the region's weather pattern of long, cloudy and rainy winters, the use of a sophisticated dimming system would be hard to justify given the minimal amount of dimming that would likely be needed throughout the majority of the year.

Design Goals

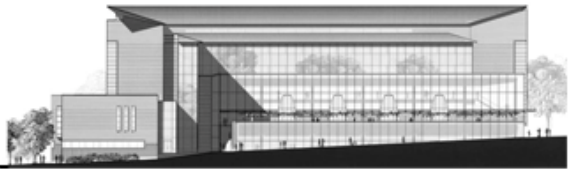
Located centrally in the heart of the building, the Marion Gould Gallagher Law Library provides students, faculty and staff with what is considered to be the finest law library in the Northwest. In order to allow occupants to be as productive as possible in this space, it is essential to provide a lighting design that is free of direct glare and provides appropriate light levels. Due to the task intensive nature of this space, achieving a quality of light that allows occupants to complete a multitude of task, such as reading, writing, and computer use, is vital. Additionally, the lighting design should help to create a visual appealing space that is interesting, yet not distracting. By implementing a lighting design that is visually appealing and conducive to a variety of task, the library will be able to truly shine as the finest law library in the Northwest.

Design Concept

Spanning two levels, the main reading area is the first thing one sees as they enter the library. The central area below the skylights is the only double-height space throughout the library and boasts the distinct trapezoidal skylights above. In order to accent this unique space in the library, a custom chandelier will hang below each skylight, and will contain linear fluorescent lights to wash to ceiling and well as multiple pendants suspended at two different heights. All of the single-height reading areas on the first and second floors will be lit with compact fluorescent downlights and will also use table lamps for additional task lighting as needed. Lastly, the stacks located at the south end of the lower level will utilize suspended linear fluorescent downlights to provide the necessary vertical illumination.

Design Criteria

- *Appearance of Space and Luminaires (Important)*
  The appearance of the space and luminaires is important in maintaining the desired image of the UW Law School. Luminaires should reflect the prestige and excellence of the school, while also complementing the architecture. The appearance of the space should merge together an essence of tradition with technology. Ultimately, quality of light is the most important consideration seeing that this is a very task intensive space.



- *Direct Glare (Very Important)*
  The library is a very task intensive space, whether this may be reading, writing or VDT use. For this reason, direct glare is not acceptable in this space as it will provide discomfort and be distracting to occupants of the space.

- *Light Distribution on Task Plane (Uniformity)(Important)*
  Uniform distribution on the task plane is important to ensure ease of any task. Bright spots and reflected glare from a specular table surface should be avoided.

- *Luminances of Room Surfaces*
  Consideration should be taken in providing luminances on room surfaces that meet desired luminance ratios. The luminance ratio from VDT to adjacent surfaces should not exceed 3:1. In addition to this, a luminance ratio of 10:1 should not exceed for VDT to far background surfaces.

- *Modeling of Faces or Objects (Important)*
  Facial features should be lit from angles and with illuminance levels that avoid unflattering shadows on the face, especially from the eye sockets.

- *Illuminance (Horizontal)*
  Illuminance levels on the task plane within the library should reach a minimum of 30 footcandles. This illuminance level should be uniform and provided on all task surfaces of space.

- *Illuminance (Vertical)*
  Maintaining adequate vertical illuminance levels are important in the stacks area of the library to allow for optimal recognition and ease of reading and finding desired materials from the shelves. A minimum vertical illuminance level of 30 footcandles should be maintained at all levels of the stacks.

Luminaire Schedule

The following figure and table outline the luminaires that are to be used in the lighting design for the Marion Gould Gallagher Law Library. Refer to Appendix A for all fixture, lamp, and ballast cut sheets.

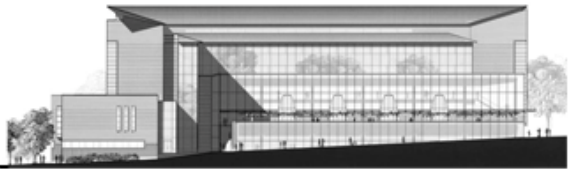
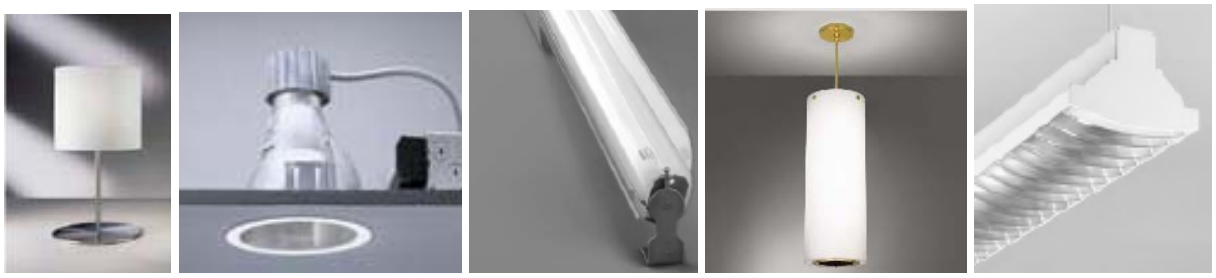


Table 1.4.4 – Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
H2	Leucos Incandescent Cylindrical Table Lamp	Table	1	100W A19	N/A	-	-	120	100	24
F11	Lightolier Compact Fluorescent Downlight w/ vertical lamp, nominal 8 3/4" aperture	Recessed	1	CFM42W	Electronic	82	3500	277	46	100
F12	Elliptipar Style 301 Assymetrical Linear Fluorescent Strip	Surface	1	F32T8	Electronic	85	3500	277	34	24
F13	Winona Lighting Decorative Cylindrical Pendant	Suspended	2	FT39W	Magnetic	85	3500	277	84	32
F14	Elliptipar 30/30 Fluorescent Stack Light	Suspended	1	F28T5	Electronic	85	3500	277	30	78

Figure 1.4.6 – Luminaires Used in Library Lighting Design



H2 **F11** **F12** **F13** **F14**

Luminaire Layout

The following figure, Figure 1.4.7, shows the luminaire layout for the each of the two floors of the library. Luminaire type is shown according to the corresponding luminaire designation.

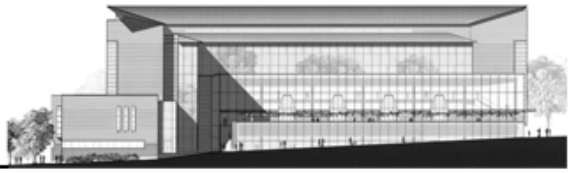
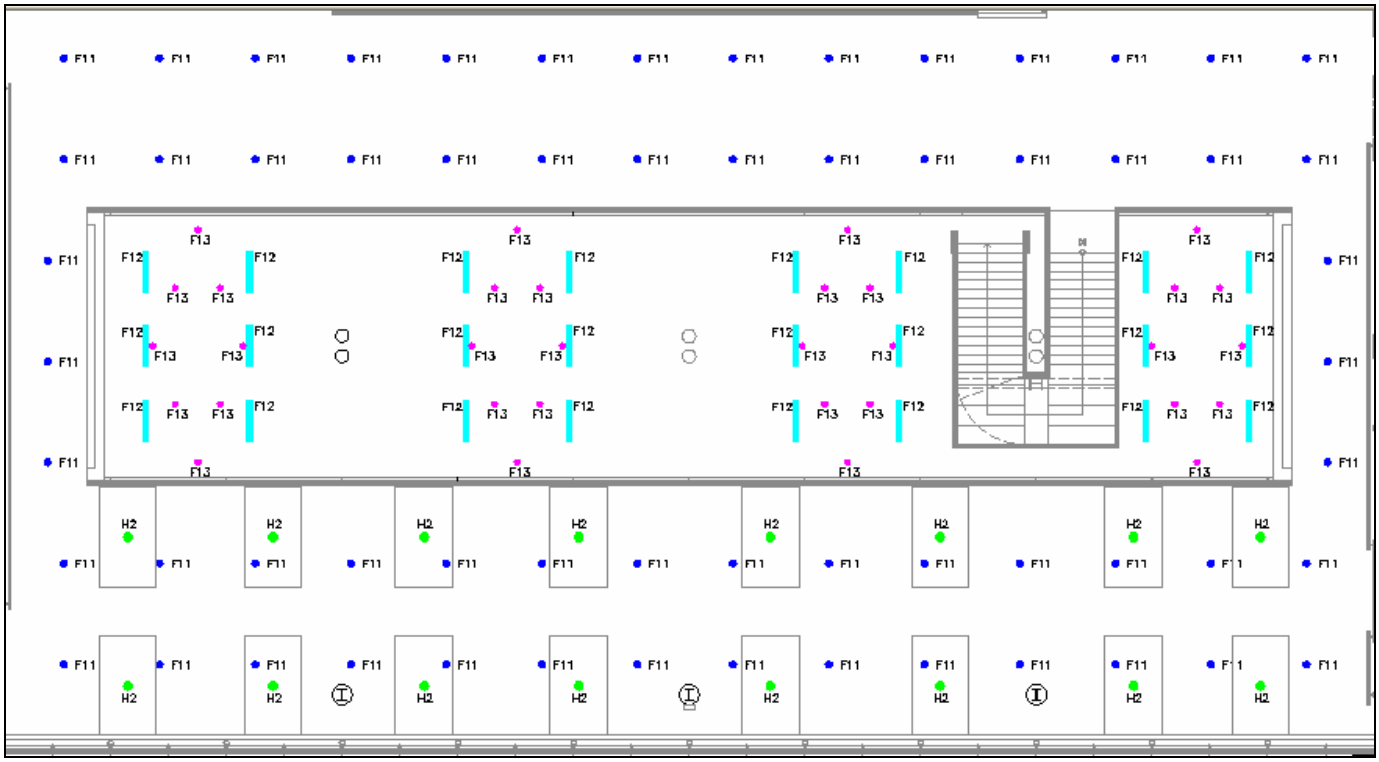
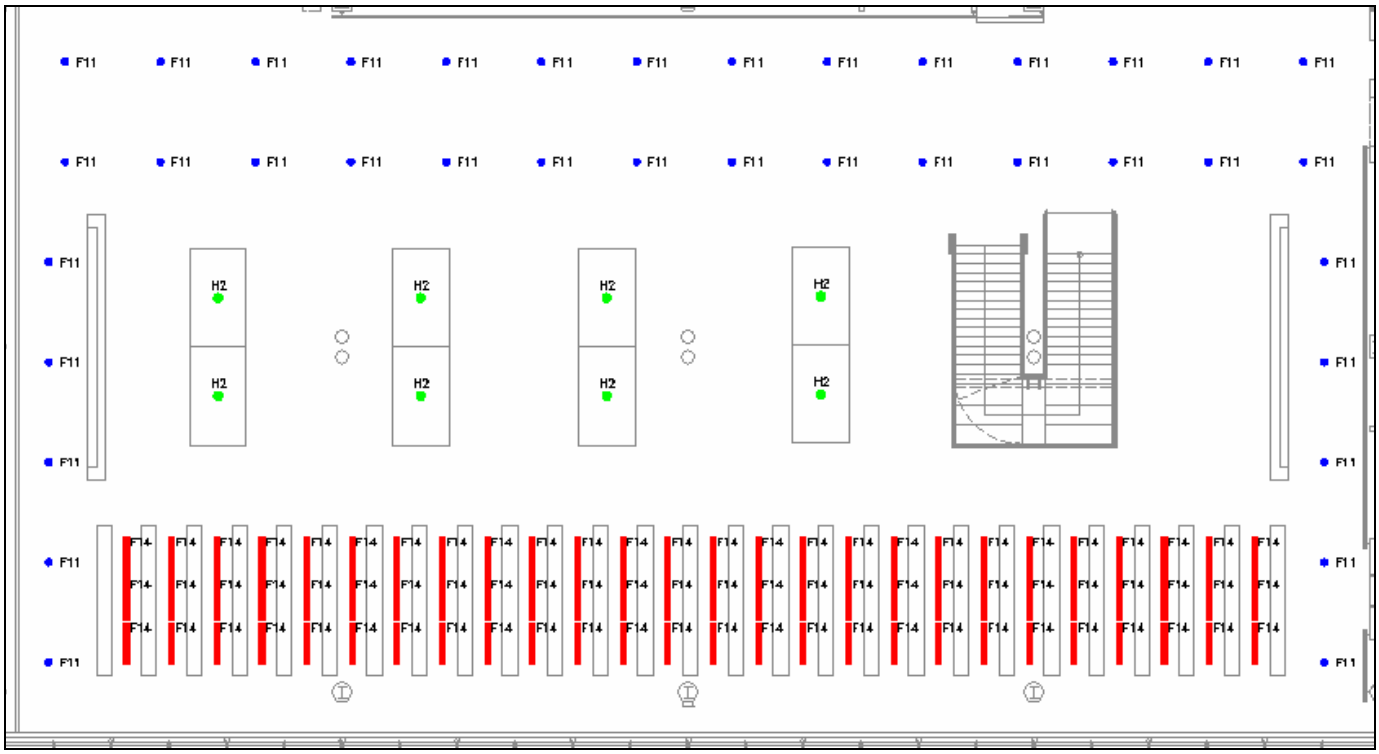


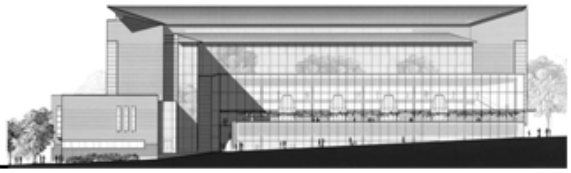
Figure 1.4.7 – Luminaire Layout



Library Level L1



Library Level L2



Controls

The lighting system throughout the library will be controlled through the building's existing low-voltage relay system. This system controls the lights based on the library's operational hours. Lights in the library area are turned on two hours before the library opens and turned off one hour after the library closes. Please refer to the following table for the library's hours of operation.

Table 1.4.5 – Library Operational Hours

Library Hours	
Monday - Thursday	8 am - 11 pm
Friday	8 am - 6 pm
Saturday	11 am - 6 pm
Sunday	11 am - 11 pm

Level L1 and Level L2 of the library will be controlled by spare relays from two different automated lighting control panels located on Levels L1 and L2, respectively. Level L1 will utilize spare relays R2, R4, R6 and R7 from automated lighting control panel ALC-L1B. Likewise, luminaires on Level L2 will use spare relays R2 and R16 from automated lighting control panel ALC-L2B.

The following tables show the automated lighting control schedules affected by the lighting design of this space. Note that relays highlighted in yellow are the relays that changed according to the galleria lighting design.

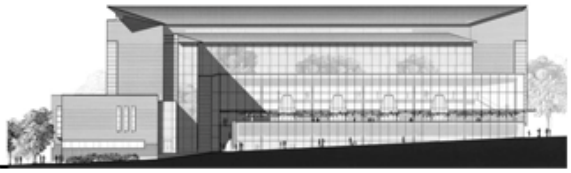


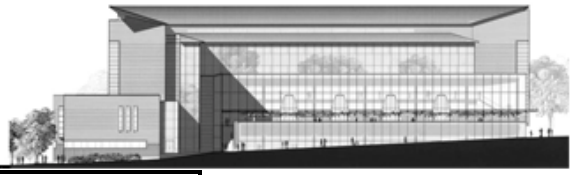
Table 1.4.6 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-L1B					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NEB1-N04-1	SE OFFICES	FL	3555	
R2	PCB-NEB1-N04-2	LIBR. RDG	FL	1196	
R3	PCB-NEB1-N04-3	STUDENT ALCOVE	A/FL	996	
R4	PCB-NEB1-N04-5	LIBR. RDG	FL	1196	
R5	PCB-NEB1-N04-7	LIBR. RDG EXT	FL	1280	
R6	PCB-NEB1-N04-9	LIBR. RDG	FL	1752	
R7	PCB-NEB1-N04-11	LIBR. RDG	FL	1752	
R8	PCB-NEB1-N04-4	STACKS	FL	2888	
R9	PCB-NEB1-N04-6	STACKS	FL	2971	
R10	PCB-NEB1-N04-8	STACKS	FL	3382	
R11	PCB-NEB1-N04-10	STACKS	FL	2888	
R12	PCB-NEB1-N04-12	STACKS	FL	2586	
R13	PCB-NEB1-N04-14	STACKS	FL	2954	
R14	PCB-NEB1-N04-16	NE ROOMS	FL	2620	
R15					
R16					
R17					
R18					
R19					
R20-R32					SPARE RELAYS

Table 1.4.7 – Automated Lighting Control Schedule

LIGHTING CONTROL PANEL ALC-L2B					
RELAY NO.	CIRCUIT NO.	AREA SERVCED	LOAD TYPE	WATTS	NOTES
R1	PCB-NWB2-NO8-2	SW STOR/CHECK	FL	1794	
R2	PCB-NWB2-NO8-4	SOUTH STACK	FL	2160	
R3	PCB-NWB2-NO8-6	SE OFFICES	FL	1993	
R4	PCB-NWB2-NO8-8	STACKS	FL	3446	
R5	PCB-NWB2-NO8-10	STACKS	FL	3348	
R6	PCB-NWB2-NO8-12	STACKS	FL	3348	
R7	PCB-NWB2-NO8-14	STACKS	FL	2852	
R8	PCB-NWB2-NO8-16	STACKS	FL	2046	
R9	PCB-NWB2-NO8-18	STACKS	FL	2745	
R10	PCB-NWB2-NO8-20	CORRIDOR	FL	1990	
R11	PCB-NWB2-NO8-22	NORTH ROOMS	FL	2912	
R12	PCB-NWB2-NO8-24	L202	FL	640	DOWNLIGHTS
R13	PCB-NWB2-NO8-24	L202	FL	350	UPLIGHTS
R14	PCB-NWB2-NO8-24	L201	FL	640	DOWNLIGHTS
R15	PCB-NWB2-NO8-24	L201	FL	350	UPLIGHTS
R16	PCB-NWB2-NO8-30	LIBR. RDG	FL	1380	
R17					
R20-R32					SPARE RELAYS

Refer to Figure 1.4.8 and Figure 1.4.9for luminaire layout circuiting and controls.



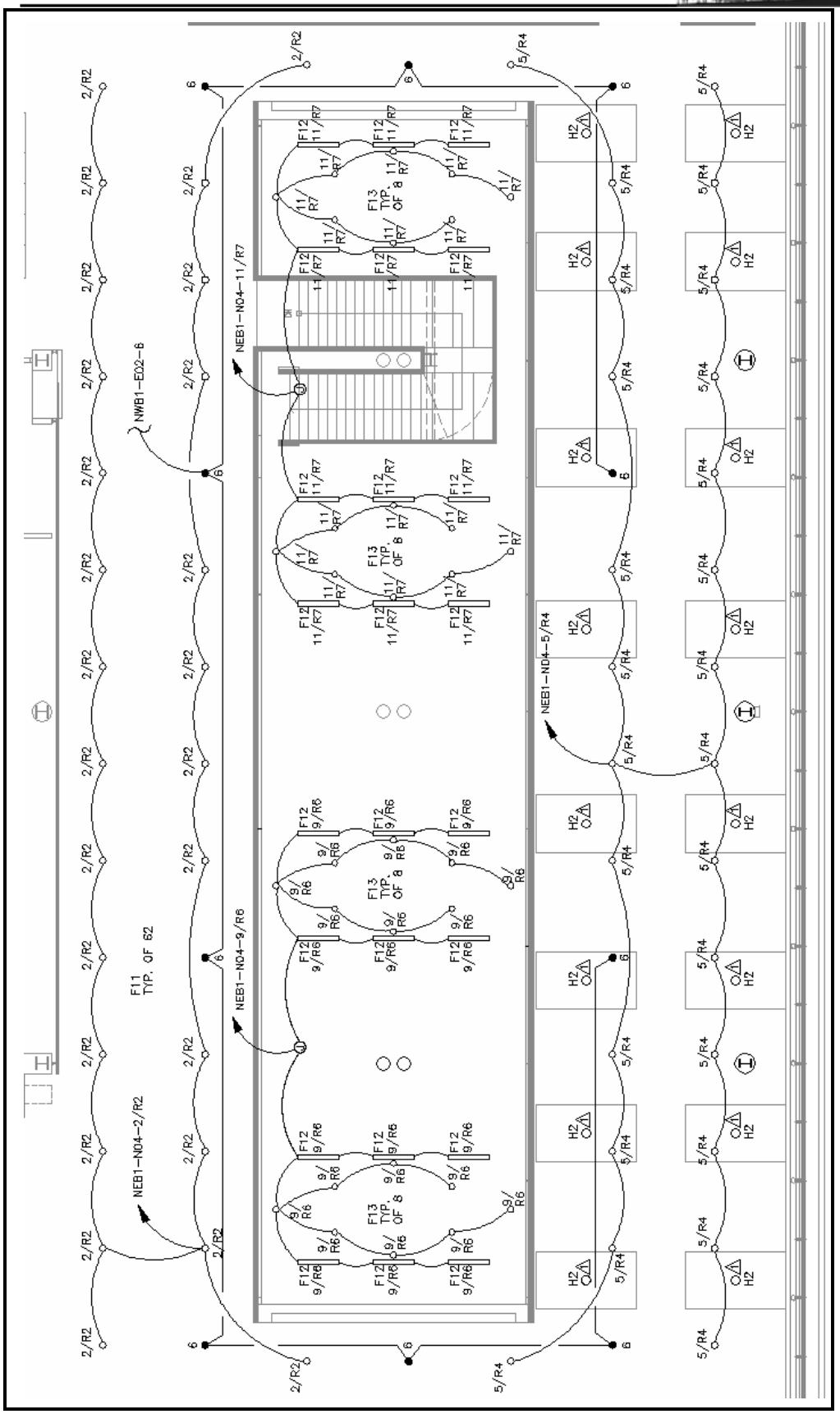
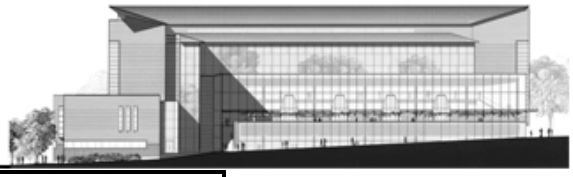


Figure 1.4.8 – Library Level L1 Lighting Power Plan

NOTE: △ All table lamps are controlled by a local switch and are incorporated into the existing floor box receptacles



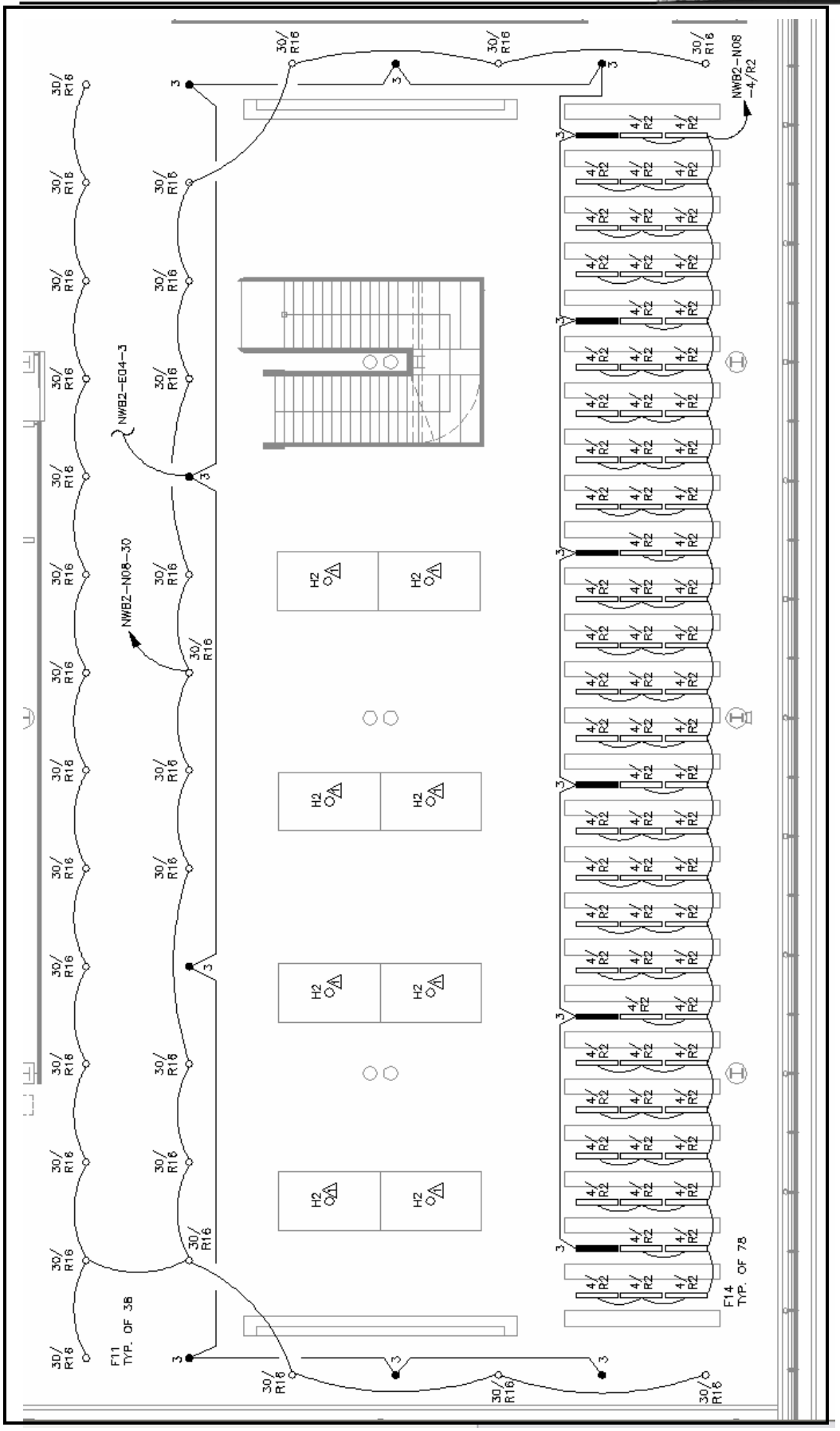
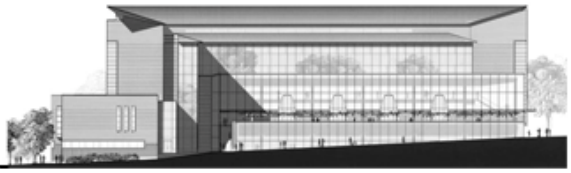


Figure 1.4.9 – Library Level L2 Lighting Power Plan

NOTE: △ All table lamps are controlled by a local switch and are incorporated into the existing floor box receptacles



Details

Figure 1.4.10 – Custom Fixture Detail

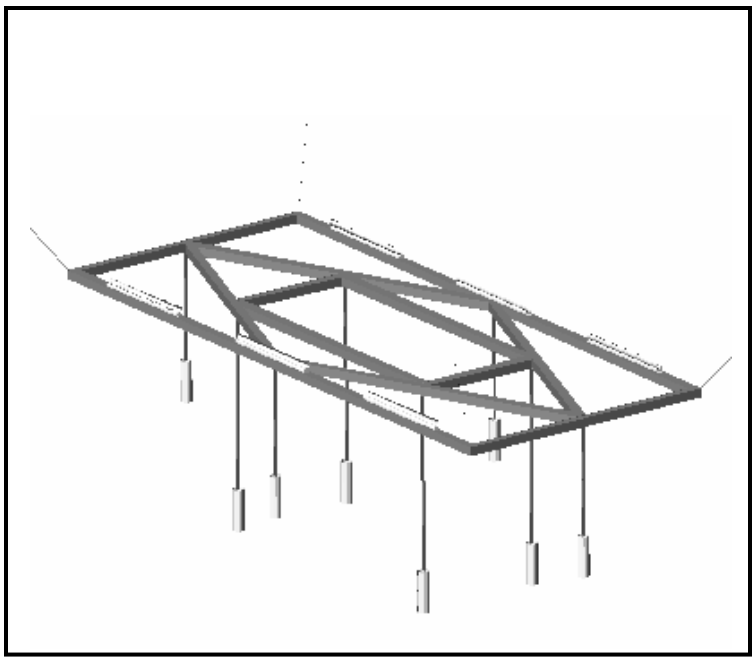


Figure 1.4.11 – Custom Fixture Detail (Plan)

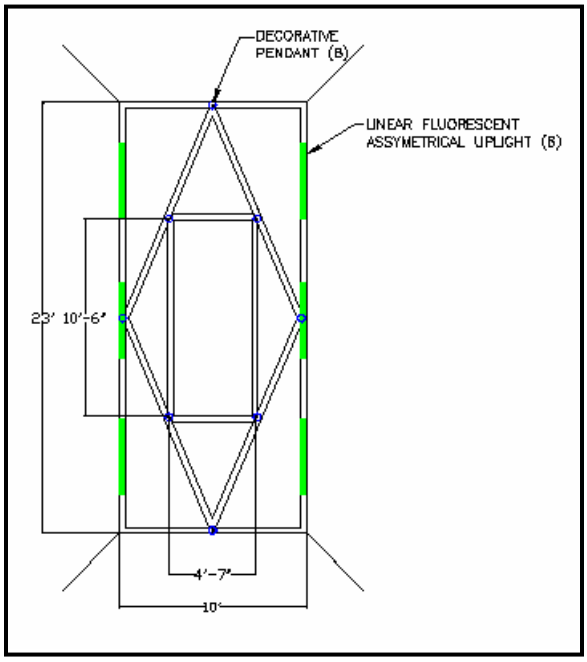
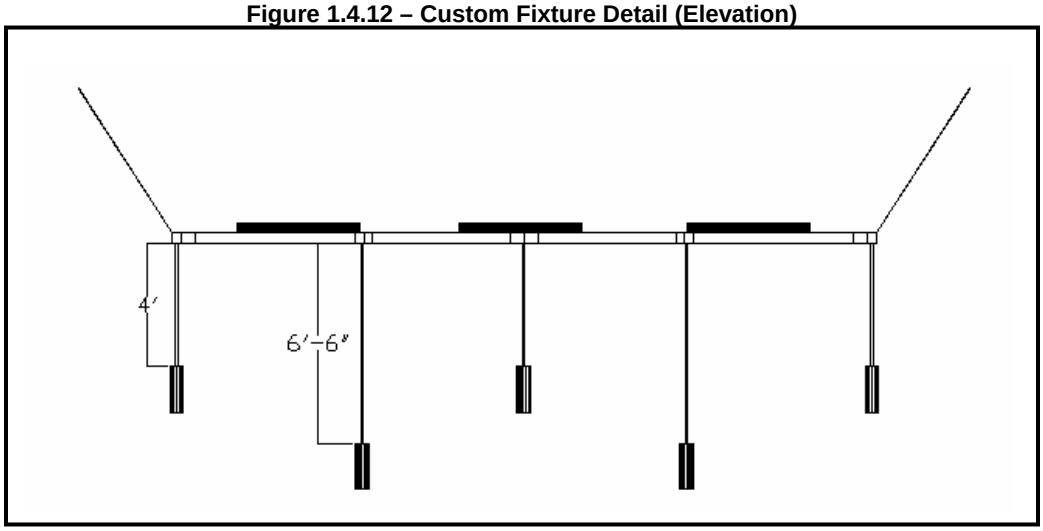
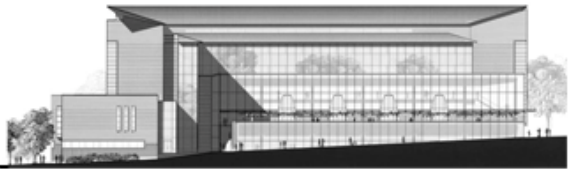


Figure 1.4.12 – Custom Fixture Detail (Elevation)



Figures 1.4.10 – 1.4.12 illustrate the custom chandelier fixtures that hang below each of the four skylights. The 4 inch aluminum tube frame is suspended from the four corners of the skylight opening in the ceiling by steel cable. The frame supports six linear fluorescent asymmetrical uplights, three on each of the long sides, in order to light the ceiling on either side of the skylights. Additionally, eight decorative cylindrical pendants are suspended from the structure at two different lengths.



Light Loss Factors

The following table outlines the light loss factors for each of the luminaires used in the lighting design of the library. In determining these values it was assumed that the atmosphere was very clean, with a cleaning interval of twelve months.

Table 1.4.8 – Light Loss Factors

Luminaire Designation	Maintence Category	Room Atmosphere	Cleaning Interval	Initial Lumens/ Luminaire	Design Lumens/ Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
H2	III	Very Clean	12 months	880	880	1	1.00	0.96	0.92	**0.88**
F11	IV	Very Clean	12 months	3200	2690	0.98	0.84	0.98	0.94	**0.76**
F12	VI	Very Clean	12 months	3100	2915	0.9	0.94	0.9	0.92	**0.70**
F13	III	Very Clean	12 months	3500	3220	0.91	0.92	0.96	0.92	**0.74**
F14	IV	Very Clean	12 months	2900	2660	0.98	0.92	0.98	0.94	**0.83**

Power Density

The maximum allowable power density according to ASHRAE 90.1 for a library space is 1.9 W/sq ft. The following table shows the calculation of the power density for the proposed lighting design for the galleria.

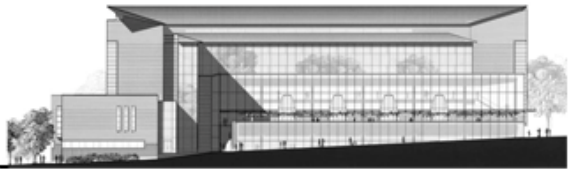
Table 1.4.9 –Power Density

Luminare	Input Watts	Quantity	Watts
H2	100	24	2400
F11	46	100	4600
F12	34	24	816
F13	84	32	2688
F14	30	78	2340
		Total Watts	12844
		Area (sq ft)	25,000
		Power Density	**0.51**

The power density of the library is 0.51 watts per square foot. This value is below the prescribed 0.8 watts per square foot. Therefore, the power density for this design is acceptable.

Design Performance

It is imperative that illuminance levels throughout the library be maintained in order to allow for occupants to complete any variety of tasks with visual ease. This is particularly important for any task places, such as reading tables or cubicles throughout the library. The IES criterion for illuminance levels on task planes throughout the library is 30 footcandles. The



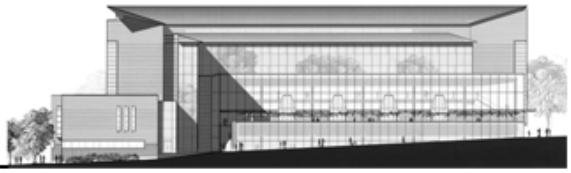
lighting design allows for this level to be met throughout the library, with an average of approximately 56 footcandles on the Level L1 reading tables and 51 footcandles on the Level L2 reading table. While these values go above and beyond the required 30 footcandles, they do include the light input from the table lamps, which can be turned on and off when the user desires. The uniformity ratio along the tables is very high, however, this is a result of the table lamp and the hot spot caused due to the close proximity of the light source to the table. Additionally, the light levels along the cubicles and computer station meet the required light levels, with average illuminance values of approximately 33 and 36 footcandles, respectively.

General illumination values in the circulation areas of the space average approximately 27 footcandles and have a uniformity ratio of 1.3:1. These illuminance values are more than adequate for the circulation areas and the very uniform light distribution allows for occupants to circulate safely throughout this space.

It is important to meet the outlined illuminance values for the vertical surfaces of the stacks in order to allow for ease in finding material. The IES criterion outlines that vertical illuminance levels should be maintained at 30 footcandles at all levels on the stacks. In this design, vertical light levels along the stacks average 23 footcandles. While this is slightly lower than the outlined 30 footcandles, slight adjustments of the suspension height above the stacks could improve these values.

Table 1.4.10 - Illuminance Values (fc)

Downstairs Tables		Upstairs Tables		Stacks (vertical)	
Average	55.97	Average	51.21	Average	23.08
Max	350	Max	335	Max	36.7
Min	14.6	Min	20	Min	10.4
Avg/Min	3.83	Avg/Min	2.56	Avg/Min	2.22
Max/Min	23.99	Max/Min	26.76	Max/Min	3.54
Cubicles		**Computer Stations**		**Floor**	
Average	32.6	Average	35.57	Average	27.0
Max	33.8	Max	68.7	Max	30.3
Min	26.3	Min	12.9	Min	23.3
Avg/Min	1.17	Avg/Min	2.8	Avg/Min	1.2
Max/Min	1.43	Max/Min	5.5	Max/Min	1.3



Renderings

Figure 1.4.13 – Library Rendering

Figure 1.4.14 – Library Rendering

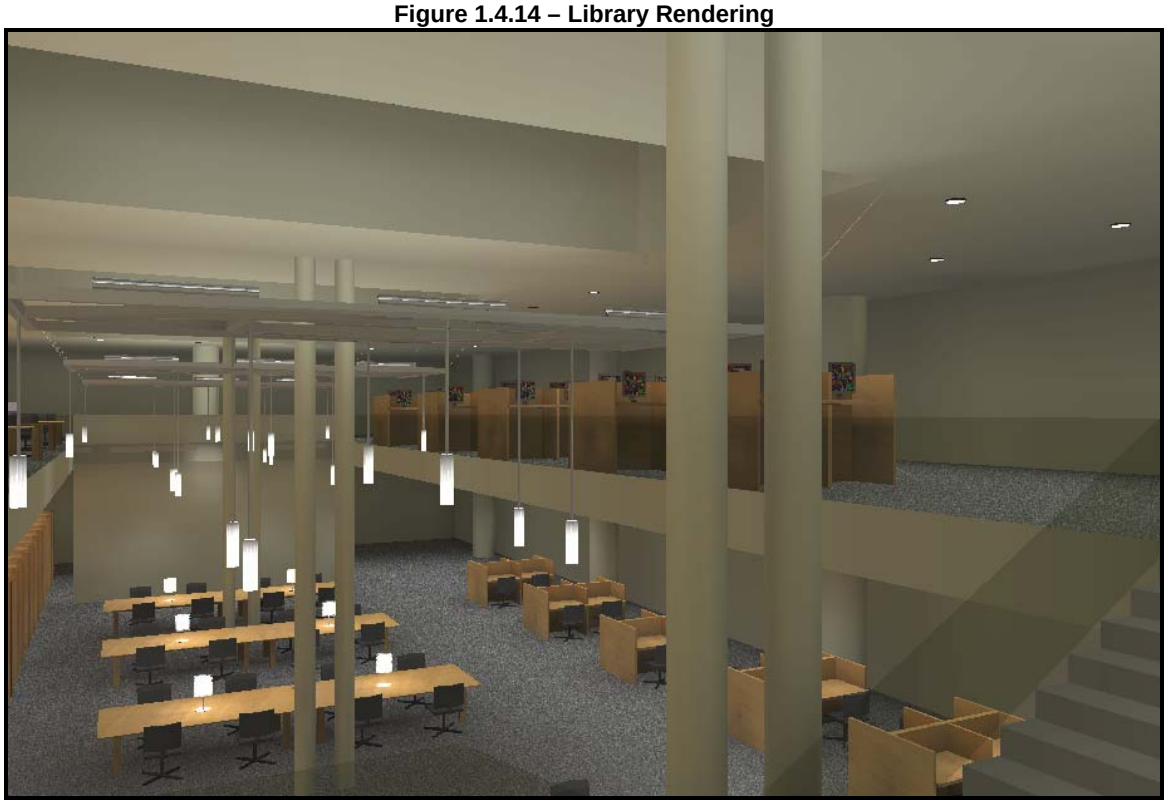


Figure 1.4.15 – Library Rendering

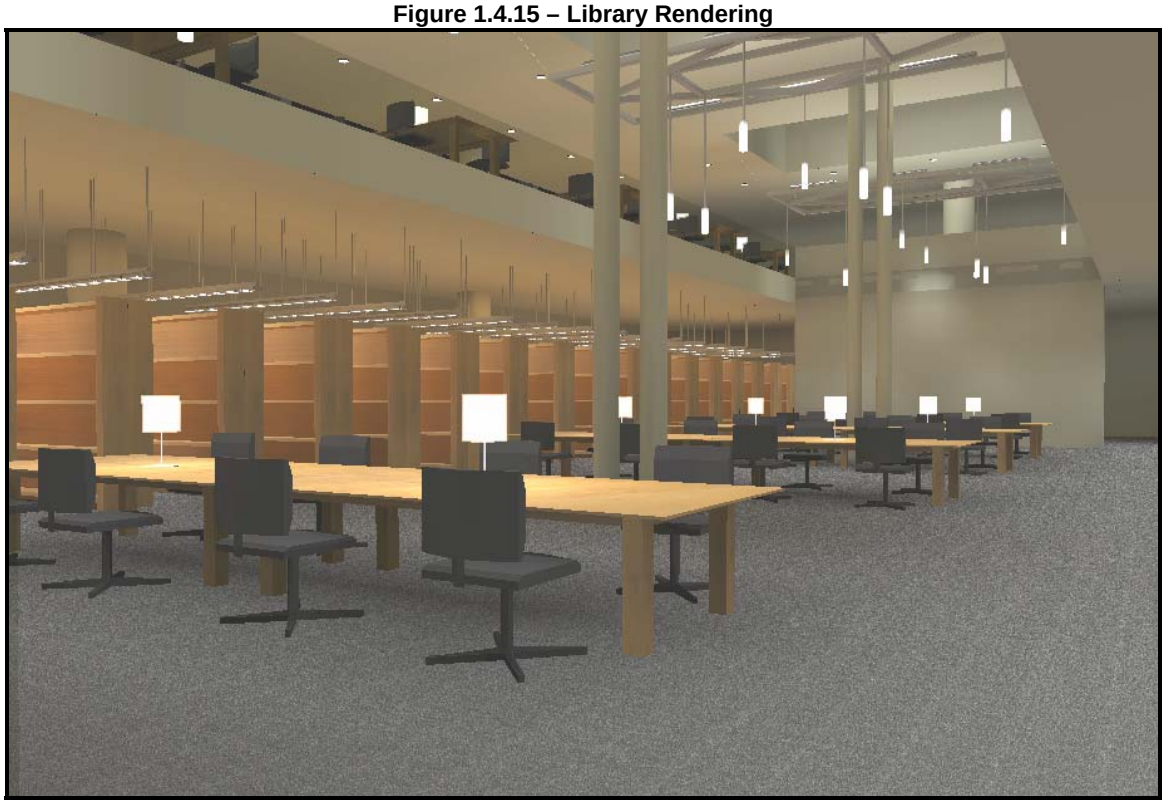
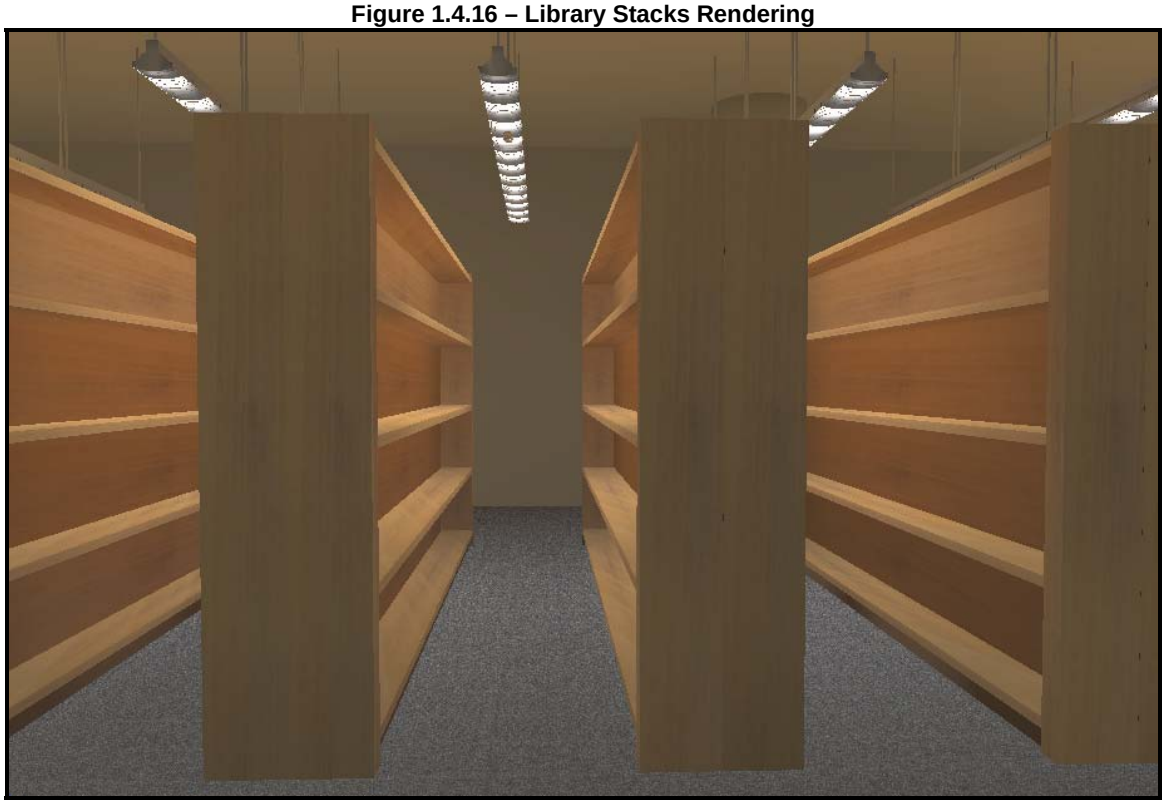


Figure 1.4.16 – Library Stacks Rendering



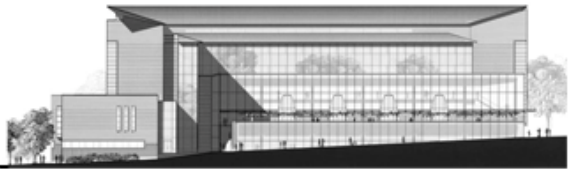
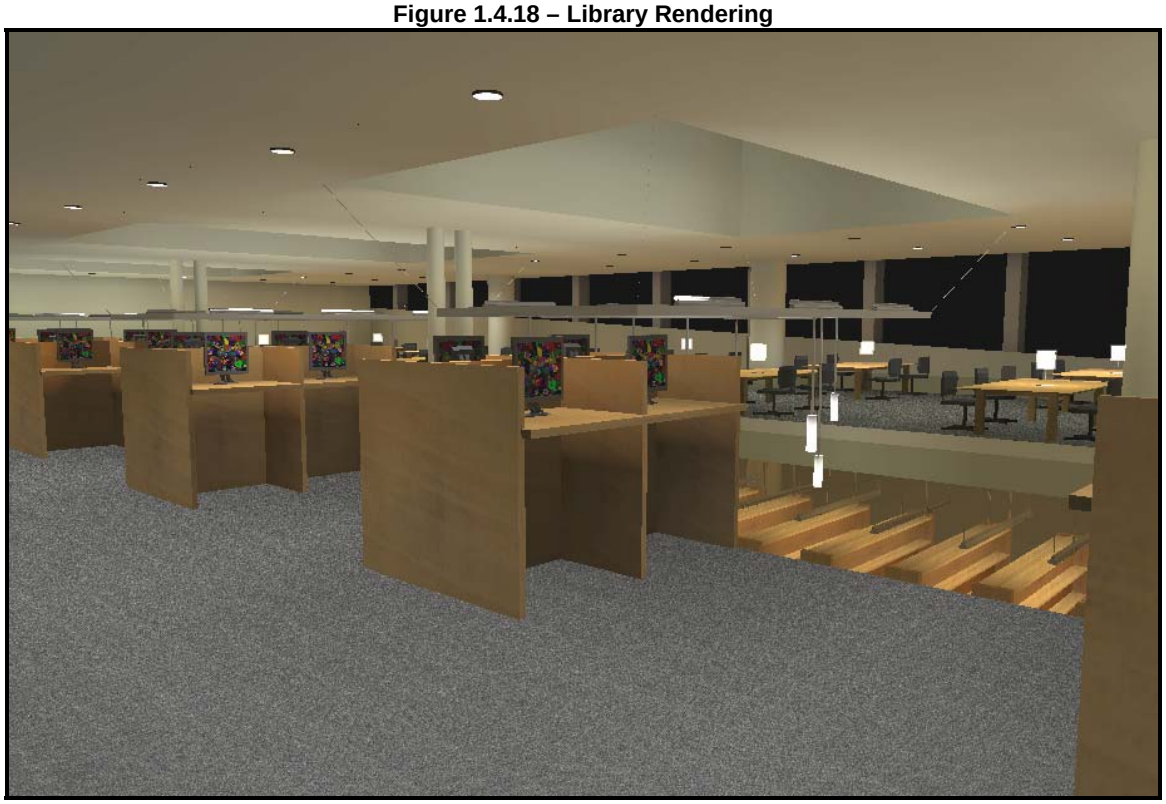


Figure 1.4.17 – Library Rendering

Figure 1.4.18 – Library Rendering



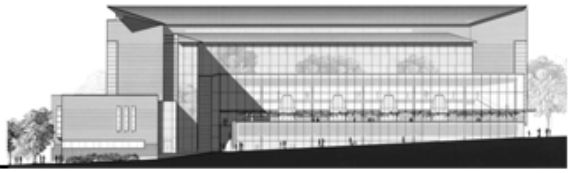
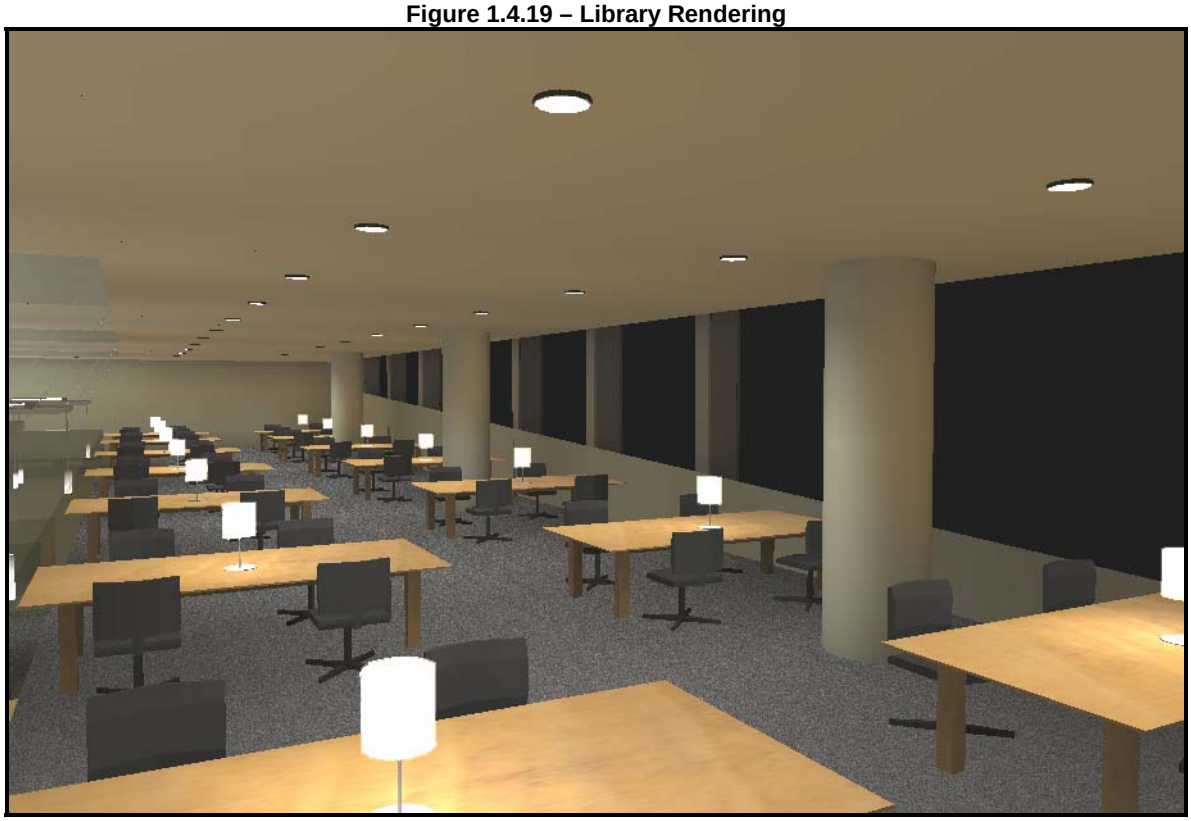


Figure 1.4.19 – Library Rendering



Conclusion

By utilizing a simple lighting design throughout the space and creating a central focal point in the double-height area below the skylights with a custom chandelier, the library lighting design provides the functionality required for this task intensive space, while also creating an area of visual interest. Occupants are given a functional space in which they can complete a variety of task. Additionally, the shading control and change in skylight material allows for the space to continue to be filled with natural light, but in a less harsh and distracting manner.