

Senior Thesis 2007
Mid-Semester Submission

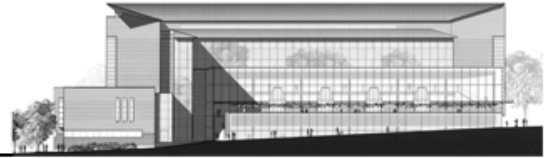


William H. Gates Hall
Seattle, WA

Katherine Jenkins
Lighting/Electrical Option

February 16, 2007

Faculty Advisor:
Dr. Mistrick
Ted Dannerth

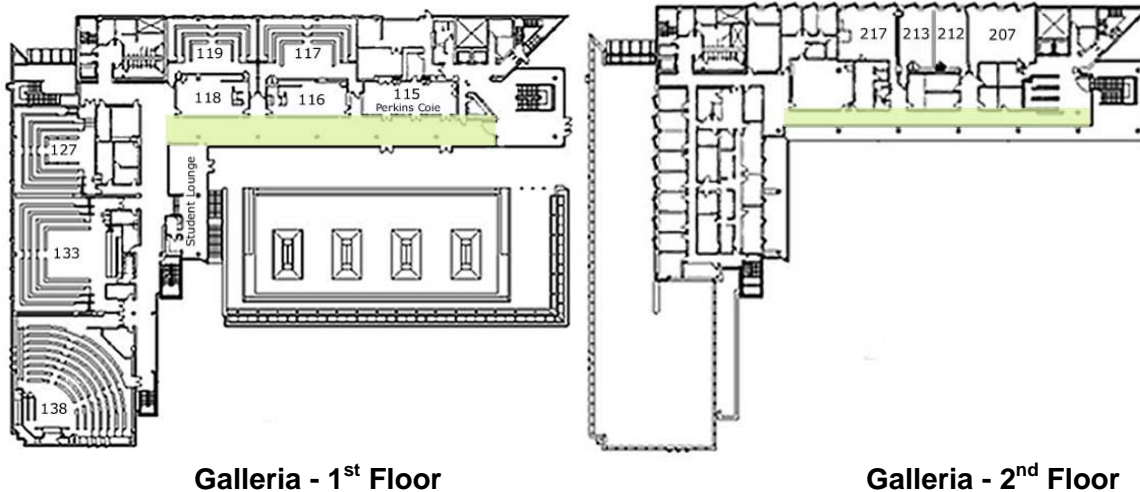


Jeffrey & Susan Brotman Galleria

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. Both levels of the galleria have birch wood paneling on the North wall. 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.

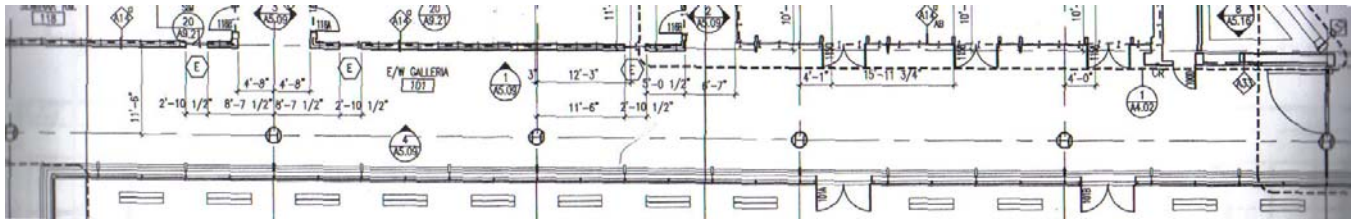
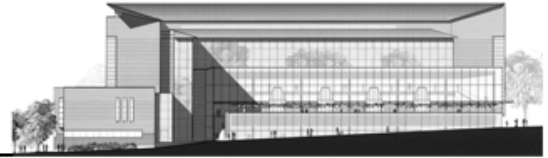
Space Layout



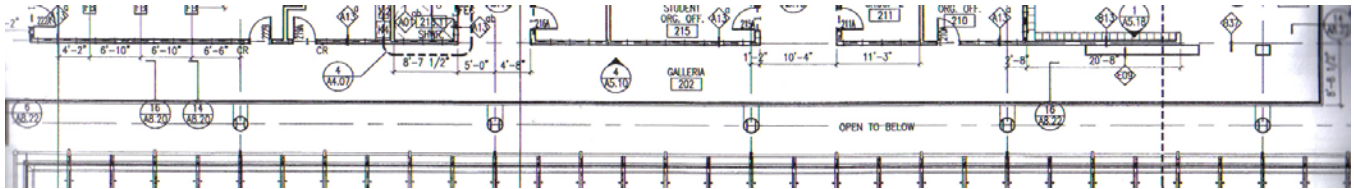
Galleria - 1st Floor

Galleria - 2nd Floor

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First Floor – Galleria



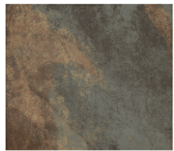
Second Floor – Galleria

Architectural Finishes Surface Materials & Reflectances

Floors

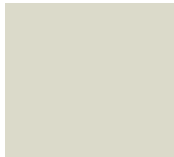


Carpet
Manufacturer: Prince Street Carpets
Color: Get Your Goat (Tan)
Reflectance: 17%



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

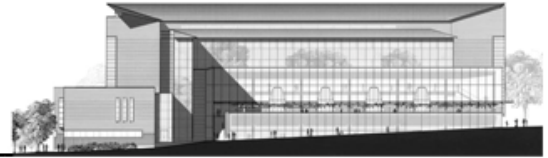
Walls



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%

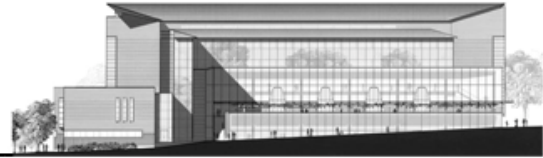
Design Intent

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 surround campus. Both the building's strategic location in a prominent area of campus and the two-story glass curtain wall that flanks the galleria set 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 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

- ◆ *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. When passing through this space, light levels should be high enough to provide a safe environment, while still providing a visual comfort. 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*

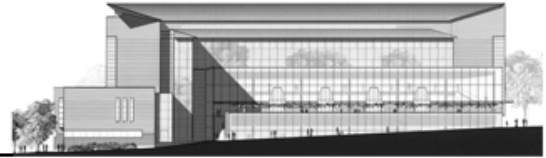
Color rendering is important for overall visual performance. While, color appearance is not critical in this space, a CRI of 80 should be maintained by all lamps in order to maximize color appearance and contrast of materials in the space. Special consideration should be given to the use of wood paneling 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 fc 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 fc for facial modeling purposes. Illuminance levels of 30 should be provided on wall areas where items are being accented.

Daylighting

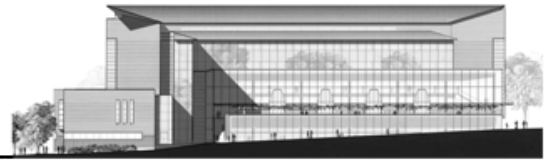
The following daylighting study will look at daylight contribution and conditions within the space at several times throughout the year: 10:00 AM and 1:00 PM on December 21, March 21, and June 21.

Daylighting Study to be completed

Controls

The lighting systems in the galleria space will be controlled by a relay, time clock system. During daytime hours, there is a massive influx of light 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 save energy, all of the lights in the galleria, with the exception of the accent lights, will be placed on this relay time clock system. This will allow the lights to turn off after sunrise and turn back on right before sunset.

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Luminaire Schedule

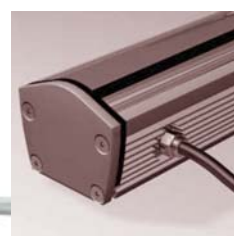
Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
FD1	Lightolier Compact Fluorescent downlight w/ vertical lamp, nominal 6" aperture	Recessed	1	CFTR32W	Electronic	82	3500	277	36	32
HA1	Tech Lighting Halogen adjustable accent lights, Clamps to Wall MonoRail	Surface	1	50W MR16	N/A	-	3000	12/277	50	4
LA1	Lo Lighting 36" Symmetrical Linear LED Accent, 5 degree beam spread w/ grazing	Surface	1	LED	Integrated Driver	-	5000	277	32	63
WW1	Erco 48" Recessed wallwasher	Recessed	1	F28T5	Electronic	82	3500	277	30	12



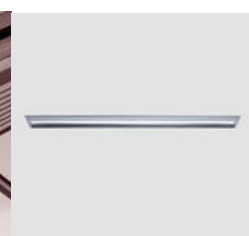
FD1



HA1

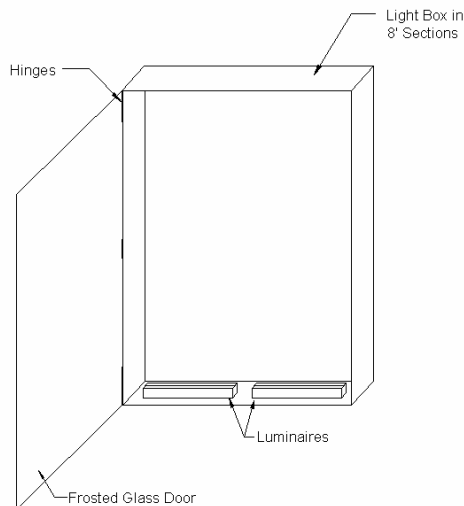


LA1



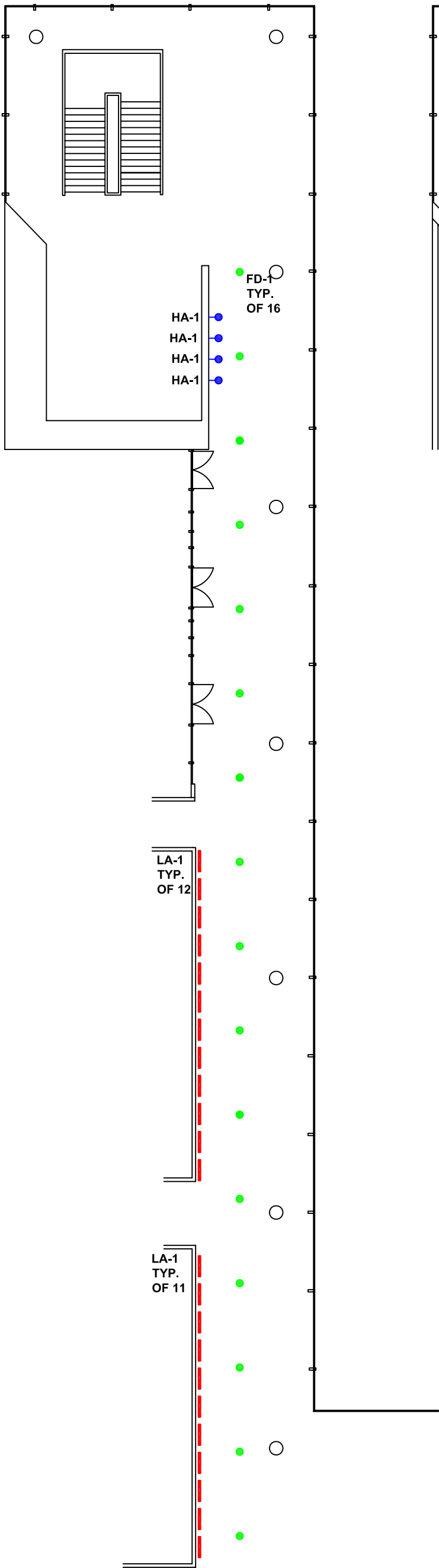
WW1

Details

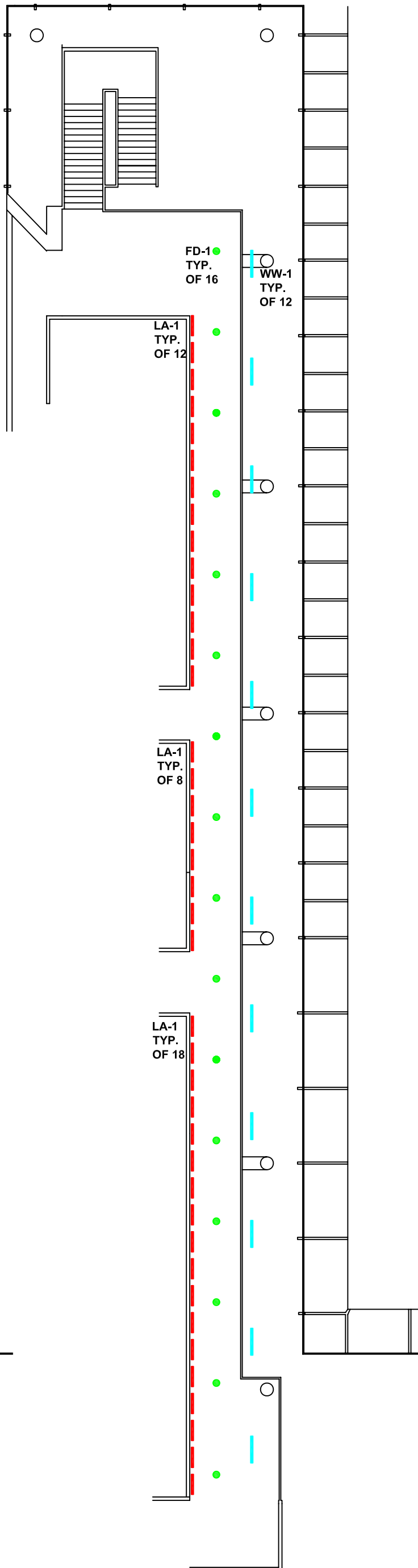


The backlit frosted glass wall will be composed of 8' sections. Each of these sections will act like a "light box" with glass door. In order to allow for maintenance of the luminaires, the glass of each section is hinged to the box; this will allow for the glass to simply be swung open when maintenance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

Lighting Plan

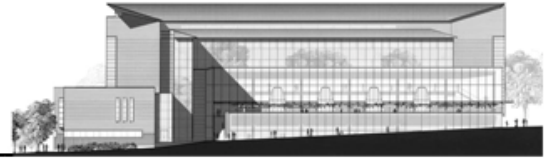


GALLERIA - 1ST FLOOR



GALLERIA - 2ND FLOOR

- FD-1
- HA-1
- LA-1
- WW-1



Light Loss Factors

Luminaire Designation	Maintenance Category	Room Atmosphere	Cleaning Interval	Initial Lumens/Luminaire	Design Lumens/Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
FD1	IV	Very Clean	12 months	900	774	0.98	0.86	0.96	0.94	0.76
HA1	IV	Very Clean	12 months	5700	5700	1	1.00	0.98	0.94	0.92
LA1	VI	Very Clean	12 months	1050	1050	1	1.00	0.9	0.94	0.85
WW1	IV	Very Clean	12 months	2900	2660	0.98	0.92	0.88	0.94	0.74

Power Density

ASHRAE 90.1 Allowable Power Density: 0.8 W/sq ft

Luminaire	Input Watts	Quantity	Watts
FD1	34	32	1088
HA1	50	4	200
LA1	32	63	2016
WW1	30	12	360
Total Watts			3664
Area (sq ft)			6000
Power Density			0.61

Power Density is Acceptable

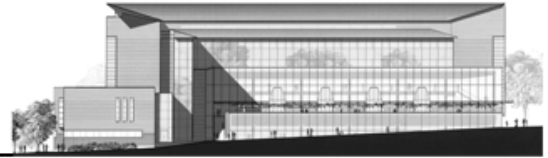
Design Performance

Illuminance Values (fc)

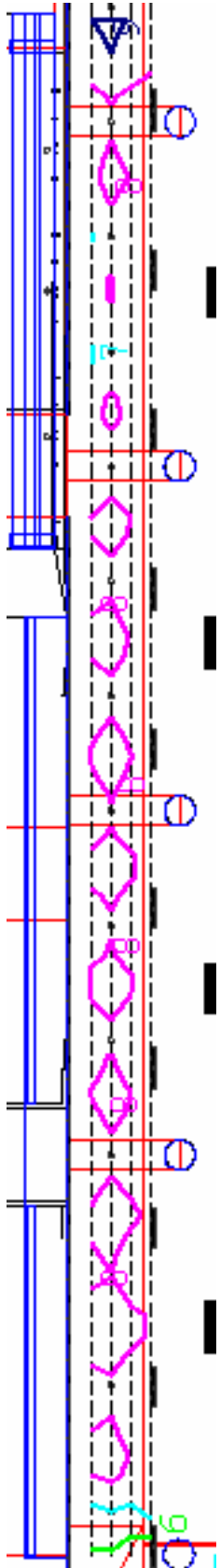
Galleria Level 1 Floor		Galleria Level 2 Floor		Galleria Level 1 Display Board (vertical)	
Average	7.72	Average	11.63	Average	17.36
Max	9.6	Max	19.8	Max	72.6
Min	5.4	Min	5.8	Min	5.4
Avg/Min	1.43	Avg/Min	2.01	Avg/Min	3.21
Max/Min	1.78	Max/Min	3.41	Max/Min	13.44

* The vertical illuminance levels on the display board seemed to be incorrect. There is one point which has a value much higher than the others. This will be investigated and changed for the final report

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 William H. Gates Hall
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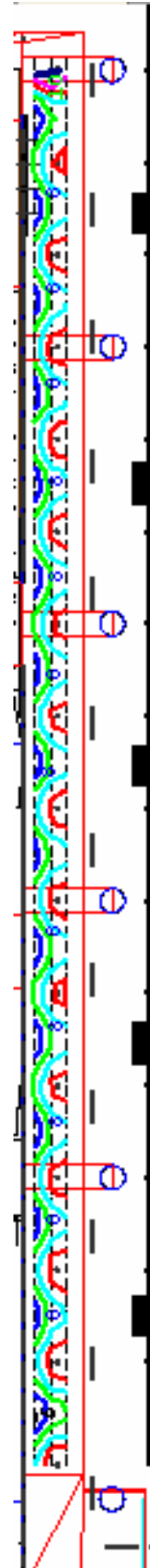


Galleria – 1st Floor



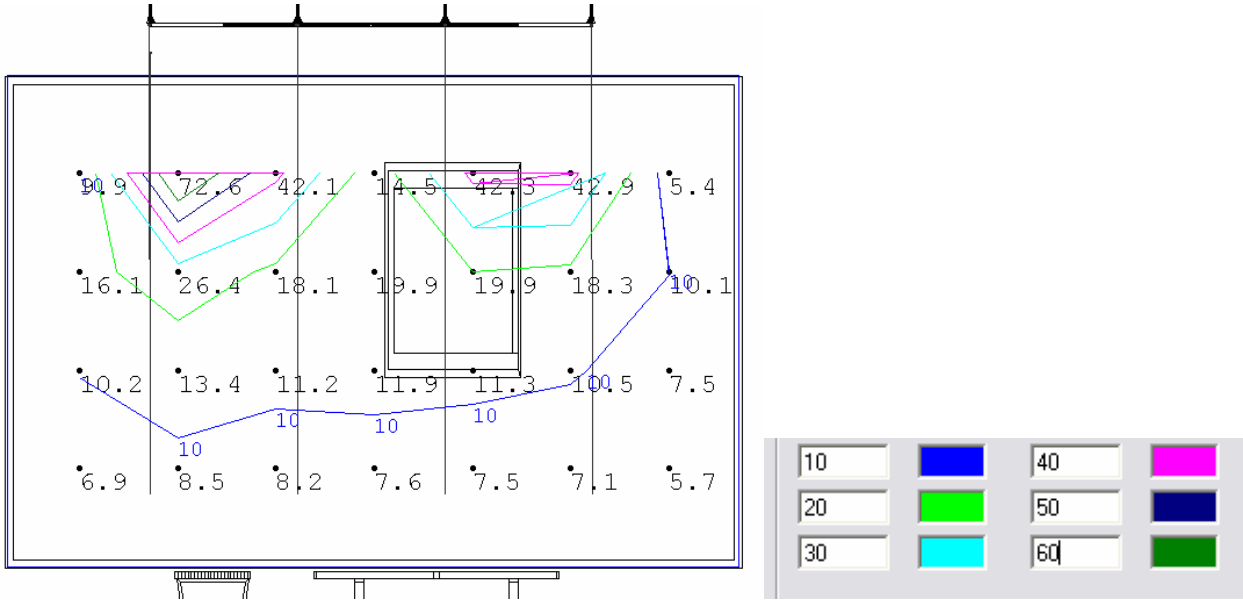
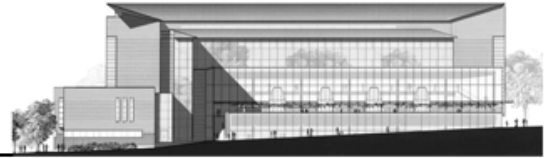
5	Blue	8	Magenta
6	Green	9	Dark Blue
7	Cyan		Dark Green

Galleria – 2nd Floor



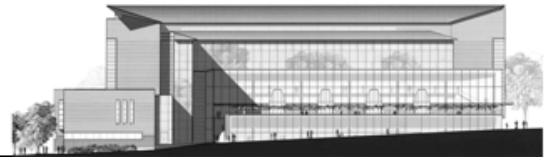
6	Black	14	Red
8	Blue	16	Magenta
10	Green	18	Dark Blue
12	Cyan	20	Dark Green

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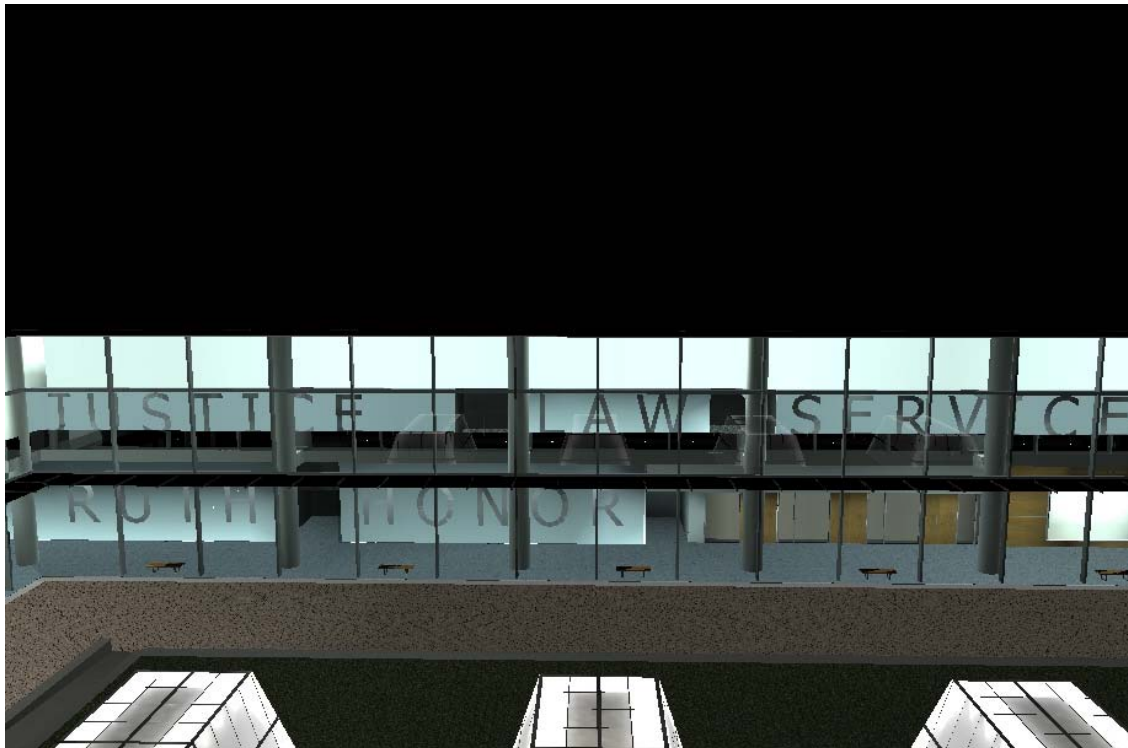
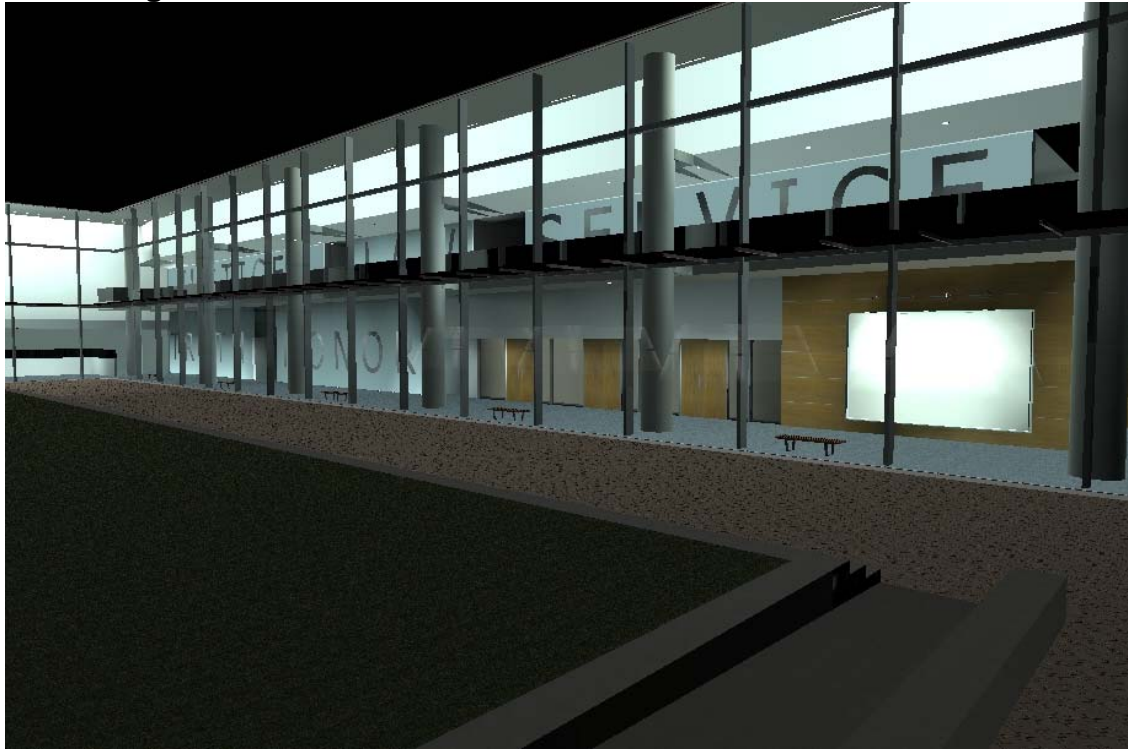


Galleria – Display Board

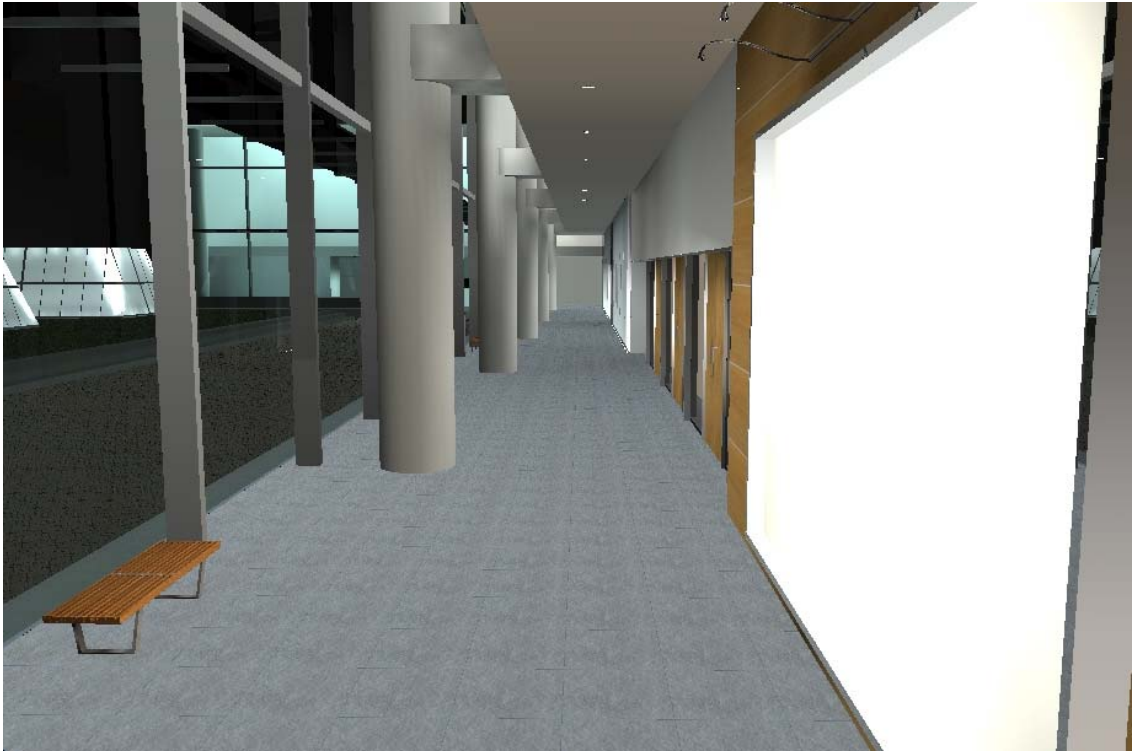
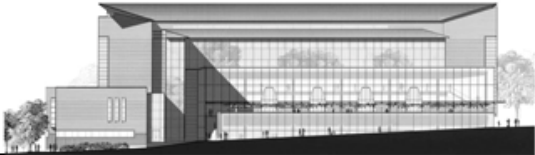
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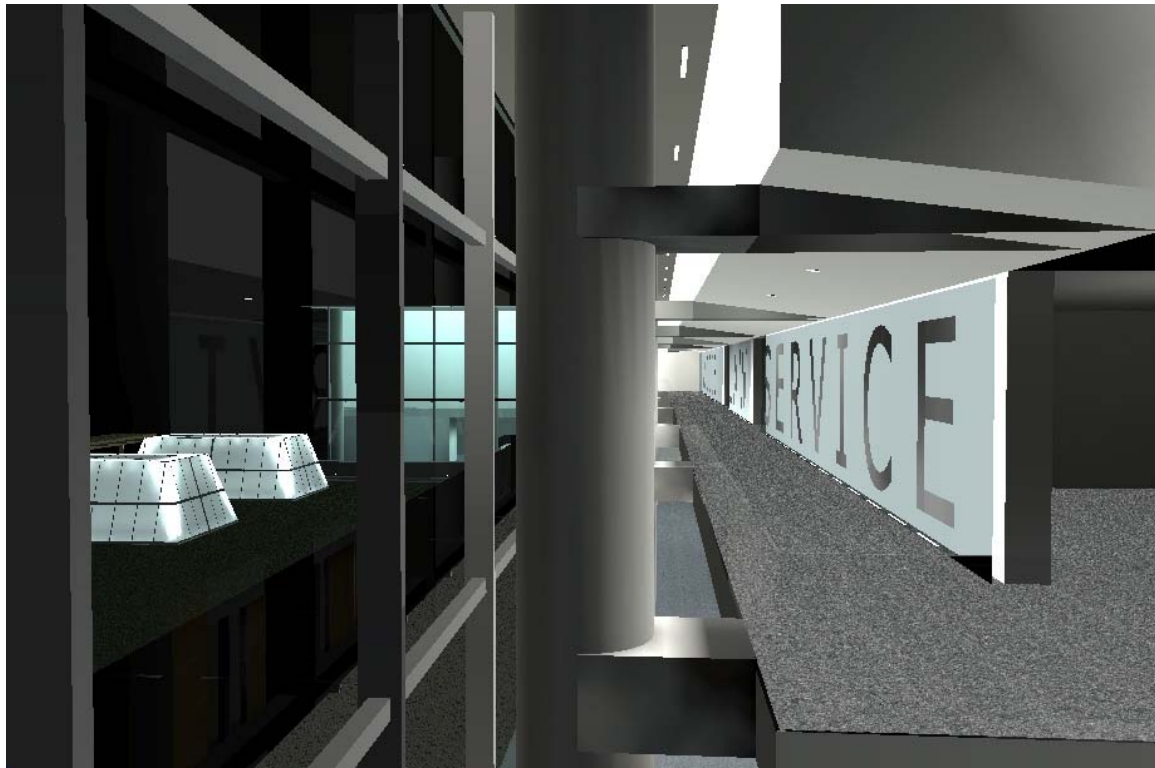
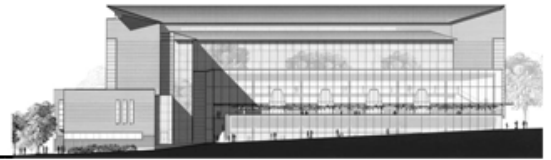
Renderings



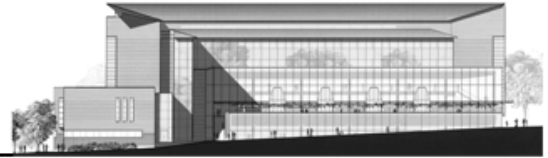
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Electrical Requirements

Panel Boards

NW01-N02

Circuits 8 to change

REDESIGN NW01-N02

Load removed from circuit 8 and different loads added

Circuit 16 and 18 - new

NW02-N02

Circuit 10/R4 to be deleted

REDESIGN NW02-N02

Circuit 10/R4 to change – loads removed

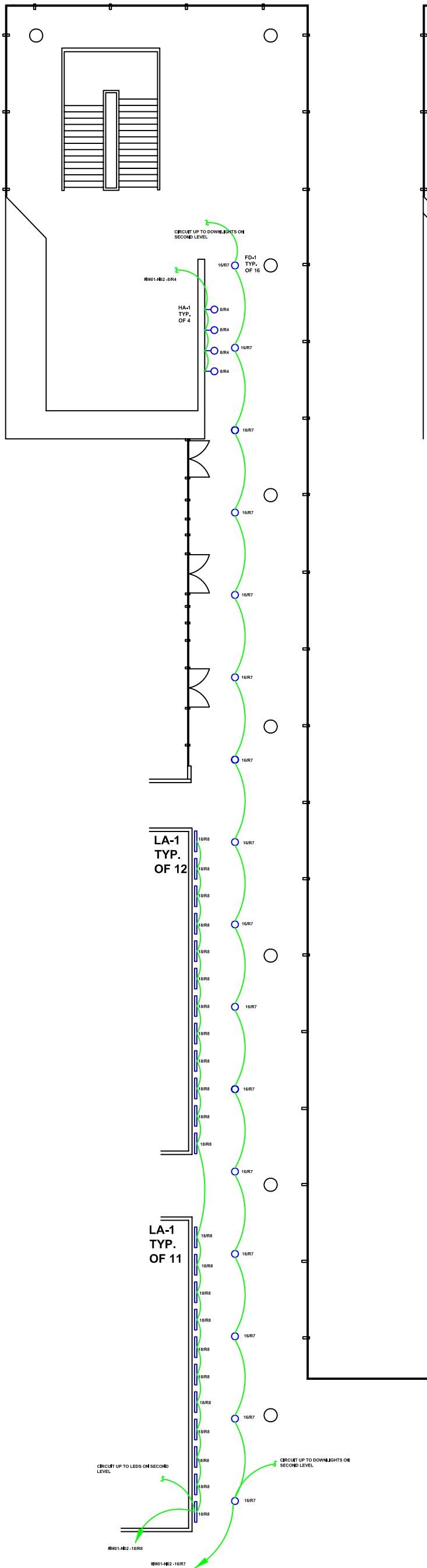
NE02-N04

Circuit 2 and 4 to change

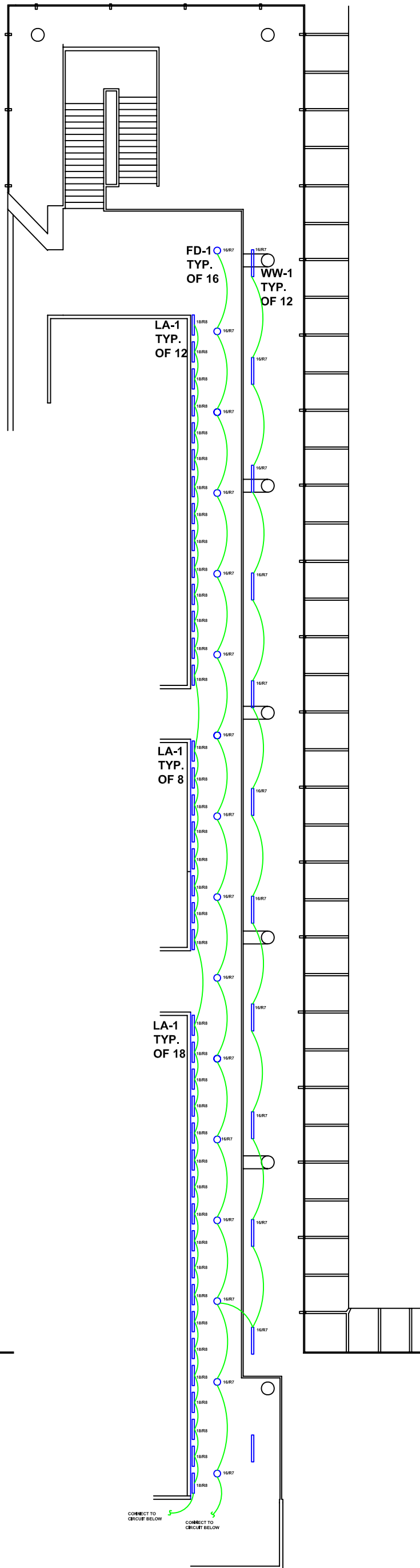
REDESIGN NE02-N04

Circuit 2 and 4 to change – delete circuits

Lighting Power Plan



GALLERIA - 1ST FLOOR



GALLERIA - 2ND FLOOR

PANELBOARD SCHEDULE

VOLTAGE: 277/480V SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: NW01-N02 PANEL LOCATION: Elec Rm. NW - Level 1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WAST	6300	20A/1P	1	*			2	20A/1P	3000	SW ROOMS	LIGHTING
MECH FTU	WEST	6400	20A/1P	3		*		4	20A/1P	1000	NW ROOMS	LIGHTING
MECH FTU	WEST	3200	20A/1P	5			*	6	20A/1P	2100	LOUNGE	LIGHTING
LIGHTING	RM 118	1300	20A/1P	7	*			8	20A/1P	3600	CORRIDOR	LIGHTING
SPARE	0	0	20A/1P	9		*		10	20A/1P	2400	SE EXTERIOR	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	2100	SE EXTERIOR	LIGHTING
MECH FTU	WEST	9500	20A/1P	13	*			14	20A/1P	500	Stacks	EQUIP ALC-1A
MECH FTU	WEST	9500	20A/1P	15		*		16	20A/1P	0	0	SPARE
MECH FTU	WEST	9500	20A/1P	17			*	18	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE	0	0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE	0	0	60/3P	37	*			38	20A/1P	0	0	SPARE
SPARE	0	0	--	39		*		40	20A/1P	0		SPARE
SPARE	0	0	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	24.20		TOTAL DESIGN LOAD (KW)	70.70
CONNECTED LOAD (KW) - B	19.30		POWER FACTOR	0.59
CONNECTED LOAD (KW) - C	16.90		TOTAL DESIGN LOAD (AMPS)	143

PANELBOARD SCHEDULE

VOLTAGE: 277/480V SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: REDESIGN NW01-N02 PANEL LOCATION: Elec Rm. NW - Level 1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 35K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WAST	6300	20A/1P	1	*			2	20A/1P	3000	SW ROOMS	LIGHTING
MECH FTU	WEST	6400	20A/1P	3		*		4	20A/1P	1000	NW ROOMS	LIGHITNG
MECH FTU	WEST	3200	20A/1P	5			*	6	20A/1P	2100	LOUNGE	LIGHTING
LIGHTING	RM 118	1300	20A/1P	7	*			8	20A/1P	2900	CORRIDOR	LIGHTING
SPARE	0	0	20A/1P	9		*		10	20A/1P	1380	SE EXTERIOR	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	0	0	Spare
MECH FTU	WEST	9500	20A/1P	13	*			14	20A/1P	500	ELEC RM NW	EQUIP ALC-1A
MECH FTU	WEST	9500	20A/1P	15		*		16	20A/1P	1510	GALLERIA	LIGHITNG
MECH FTU	WEST	9500	20A/1P	17			*	18	20A/1P	2016	GALLERIA	LIGHTING
SPARE	0	0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE	0	0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE	0	0	60/3P	37	*			38	20A/1P	0	0	SPARE
SPARE	0	0	--	39		*		40	20A/1P	0		SPARE
SPARE	0	0	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	23.50		TOTAL DESIGN LOAD (KW)	70.30
CONNECTED LOAD (KW) - B	19.79		POWER FACTOR	0.59
CONNECTED LOAD (KW) - C	16.82		TOTAL DESIGN LOAD (AMPS)	143

PANELBOARD SCHEDULE

VOLTAGE: 480 SIZE/TYPE BUS: 400A COPPER SIZE/TYPE MAIN: 400A/3P MLO	PANEL TAG: NW02-N02 PANEL LOCATION: ELEC RM NW - LEVEL2 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 35K OPTIONS:
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	3900	60A/3P	1	*			2	20A/1P	2700	WEST OFFICES	LIGHTING
MECH FTU	WEST	3200	--	3		*		4	20A/1P	1900	SW CORRIDOR	LIGHTING
MECH FTU	WEST	2400	--	5			*	6	20A/1P	1500	SW OFFICE	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	900	NW ROOMS	LIGHINTG
SPARE		0	20A/1P	9		*		10	20A/1P	2300	NTRAL CORRID	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	600	CLEARSTORY	LIGHTING
SPARE		0	60A/3P	13	*			14	20A/1P	0		SPARE
--		0	20A/1P	15		*		16	20A/1P	0		SPARE
--		0	20A/1P	17			*	18	20A/1P	0		SPARE
SPARE		0	20A/1P	19	*			20	20A/1P	0		SPARE
SPARE		0	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE		0	20A/1P	37	*			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		*		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	7.50		TOTAL DESIGN LOAD (KW)	24.06
CONNECTED LOAD (KW) - B	7.40		POWER FACTOR	0.70
CONNECTED LOAD (KW) - C	4.50		TOTAL DESIGN LOAD (AMPS)	42

PANELBOARD SCHEDULE

VOLTAGE: 480 SIZE/TYPE BUS: 400A COPPER SIZE/TYPE MAIN: 400A/3P MLO	PANEL TAG: Redesign NW02-N02 PANEL LOCATION: ELEC RM NW - LEVEL2 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 35K OPTIONS:
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	3900	60A/3P	1	*			2	20A/1P	2700	WEST OFFICES	LIGHTING
MECH FTU	WEST	3200	--	3		*		4	20A/1P	1900	SW CORRIDOR	LIGHTING
MECH FTU	WEST	2400	--	5			*	6	20A/1P	1500	SW OFFICE	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	900	NW ROOMS	LIGHINTG
SPARE		0	20A/1P	9		*		10	20A/1P	1400	CORRIDOR	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	600	CLEARSTORY	LIGHTING
SPARE		0	60A/3P	13	*			14	20A/1P	0		SPARE
--		0	20A/1P	15		*		16	20A/1P	0		SPARE
--		0	20A/1P	17			*	18	20A/1P	0		SPARE
SPARE		0	20A/1P	19	*			20	20A/1P	0		SPARE
SPARE		0	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE		0	20A/1P	37	*			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		*		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	7.50		TOTAL DESIGN LOAD (KW)	22.83
CONNECTED LOAD (KW) - B	6.50		POWER FACTOR	0.69
CONNECTED LOAD (KW) - C	4.50		TOTAL DESIGN LOAD (AMPS)	40

PANELBOARD SCHEDULE

VOLTAGE: 480 SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: NE02-N-4 PANEL LOCATION: ELEC RM NE - LEVEL 2 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B
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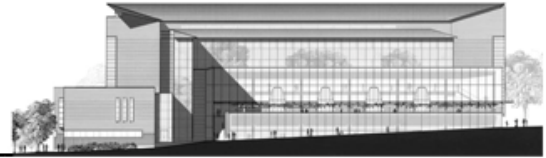
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	4800	20A/1P	1	*			2	20A/1P	1400	S. FOYER	LIGHTING
MECH FTU	WEST	7000	20A/1P	3		*		4	20A/1P	2400	S. FOYER	LIGHTING
MECH FTU	WEST	2600	20A/1P	5			*	6	20A/1P	3100	OFFICES	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	800	LOCKERS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	300	NE ROOMS	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	1300	E. FOYER	LIGHTING
SPARE		0	20A/1P	13	*			14	20A/1P	1900	217	LIGHTING
--		0	20A/1P	15		*		16	20A/1P	1300	213	LIGHTING
--		0	20A/1P	17			*	18	20A/1P	700	212	LIGHTING
SPARE		0	20A/1P	19	*			20	20A/1P	1700	222	LIGHTING
SPARE		0	20A/1P	21		*		22	20A/1P	500	ELEC. RM NE	EQUIP ALC-2B
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE		0	20A/1P	37	*			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		*		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	10.60		TOTAL DESIGN LOAD (KW)	36.88
CONNECTED LOAD (KW) - B	11.50		POWER FACTOR	0.71
CONNECTED LOAD (KW) - C	7.70		TOTAL DESIGN LOAD (AMPS)	63

PANELBOARD SCHEDULE

VOLTAGE: 480 SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: NE02-N-4 PANEL LOCATION: ELEC RM NE - LEVEL 2 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION	
MECH FTU	WEST	4800	20A/1P	1	*			2	20A/1P	0	0	SPARE	
MECH FTU	WEST	7000	20A/1P	3		*		4	20A/1P	0	0	SPARE	
MECH FTU	WEST	2600	20A/1P	5			*	6	20A/1P	3100	OFFICES	LIGHTING	
SPARE		0	20A/1P	7	*			8	20A/1P	800	LOCKERS	LIGHTING	
SPARE		0	20A/1P	9		*		10	20A/1P	300	NE ROOMS	LIGHTING	
SPARE		0	20A/1P	11			*	12	20A/1P	1300	E. FOYER	LIGHTING	
SPARE		0	20A/1P	13	*			14	20A/1P	1900	217	LIGHTING	
--		0	20A/1P	15		*		16	20A/1P	1300	213	LIGHTING	
--		0	20A/1P	17			*	18	20A/1P	700	212	LIGHTING	
SPARE		0	20A/1P	19	*			20	20A/1P	1700	222	LIGHTING	
SPARE		0	20A/1P	21		*		22	20A/1P	500	ELEC. RM NE	EQUIP ALC-2B	
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE	
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE	
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE	
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE	
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE	
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE	
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE	
SPARE		0	20A/1P	37	*			38	20A/1P	0		SPARE	
SPARE		0	20A/1P	39		*		40	20A/1P	0		SPARE	
SPARE		0	20A/1P	41			*	42	20A/1P	0		SPARE	
CONNECTED LOAD (KW) - A		9.20									TOTAL DESIGN LOAD (KW)		31.65
CONNECTED LOAD (KW) - B		9.10									POWER FACTOR		0.67
CONNECTED LOAD (KW) - C		7.70									TOTAL DESIGN LOAD (AMPS)		56

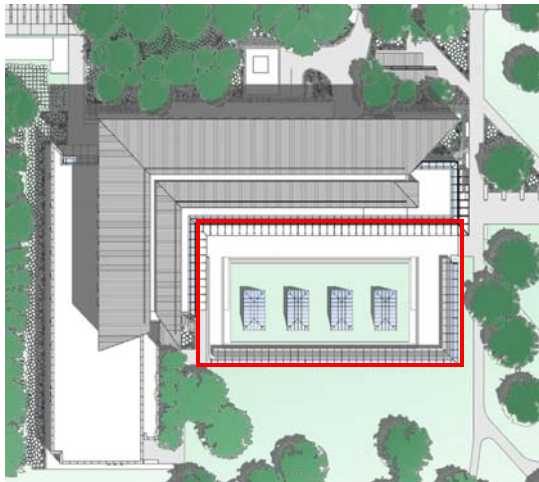


Terrace

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



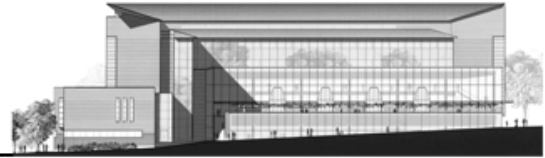
Architectural Finishes Surface Materials & Reflectances



Wood Trellis
Color: Brown
Reflectance: 24%



Concrete
Color: Gray
Reflectance 35%:



Grass
Color: Green
Reflectance: 9%

Design Intent

Design Goals

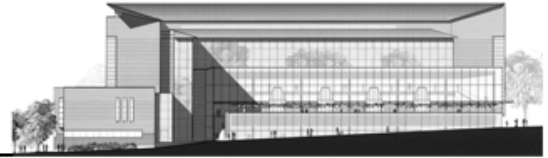
The centrally located terrace contains architecturally significant elements that help to define the building. The lighting design of this space should help to accent these features, primarily the skylights. While during the day this space acts as a central gathering point for occupants of the building, 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. While light from the interior space will spill into the terrace through the glass curtain wall, it is also important to consider the aesthetics of the lighting design in the galleria.

Design Concept

The lighting redesign of the terrace provides an opportunity to 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 LED lights from within the skylights will allow them to glow, created 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 accent with in-ground landscape lights. 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

- ◆ *Appearance of Space and Luminaires (Very Important)*
The terrace space is very typical of an outdoor terrace with a trellis-covered seating area lining a central, raised grass area around four trapezoidal skylights. In order to minimize the impact of the space, luminaires should be recessed into surfaces and all hardware hidden from visual sight.
- ◆ *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.

◆ *Reflected Glare*

Reflected glare of luminaires on glass curtain wall should be avoided. Luminaires should not be located or angled so that such reflections will occur.

◆ *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.

◆ *Illuminance (Horizontal)*

Illuminance levels in main circulation areas should be maintained at a minimum of 5 fc to maintain safety. Other areas, such as the areas east, south and west of the skylights should have minimum illuminance levels of 3 fc.

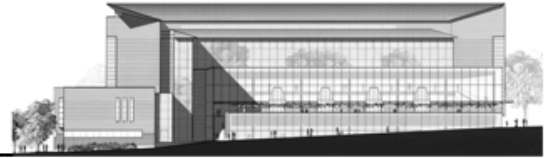
◆ *Illuminance (Vertical)*

A vertical illuminance of 3 fc should be maintained for facial rendering and safety.

Controls

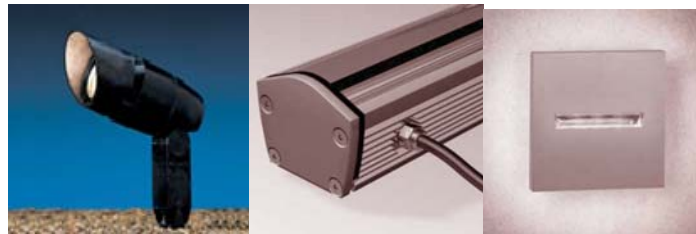
The lighting systems in the terrace will be controlled by a relay, time clock system. During daytime hours, the lights in the space will remain off. From sunset to sunrise the lights will be turned on from this system, to allow for adequate light levels.

Katherine Jenkins
 William H. Gates Hall
 Seattle, WA



Luminaire Schedule

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Voltages	Watts	Quantity
			#	Type						
HA2	Lumiere In-Ground Halogen Adjustable Landscape Light	In-Ground	1	50W MR16	N/A	-	3000	12/ 277	50	23
LA1	ioLighting 36" Symmetrical Linear LED Accent, 5 degree beam spread w/ grazing	Surface	1	LED	Integrated Driver	-	5000	277	32	112
LA2	ioLighting Recessed LED Step Light	Recessed	1	LED	Integrated Driver	-	5000	277	10	22



HA2

LA1

LA2

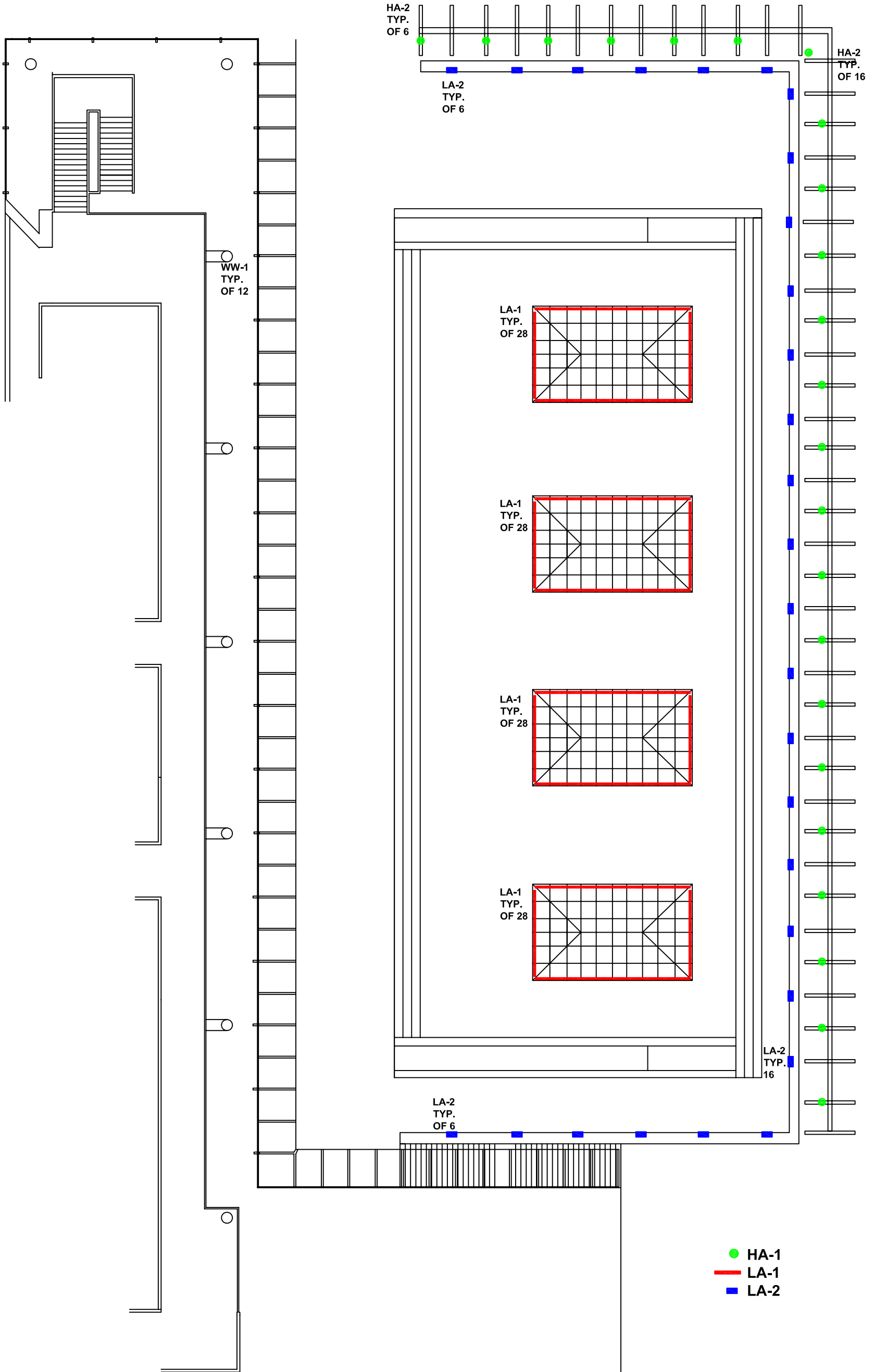
Light Loss Factors

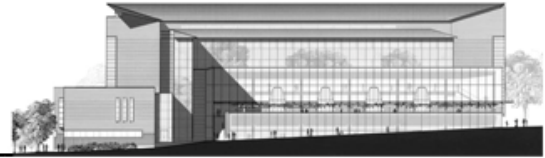
RSDD for exterior space is assumed to be 1.0

Fixture LA1 is located inside of the skylights (Exterior LLF's do not apply)

Luminaire Designation	Maintenance Category	Room Atmosphere	Cleaning Interval	Initial Lumens/Luminaire	Design Lumens/Luminaire	Ballast Factor	LLD	RSDD	LDD	LLF
HA2	V	Dirty	12 months	5700	5700	1	1.00	1	0.72	0.7
LA1	I	Very Clean	12 months	1050	1050	1	1.00	0.9	0.94	0.8
LA2	V	Dirty	12 months	750	750	1	1.00	1	0.72	0.7

Lighting Plan





Power Density

ASHRAE 90.1 Allowable Power Density: 0.25 W/sq ft

Luminaire	Input Watts	Quantity	Watts
HA2	50	23	1150
LA1	32	112	3584
LA2	10	28	280
Total Watts			5014
Area (sq ft)			19450
Power Density			0.25

Power Density is Acceptable

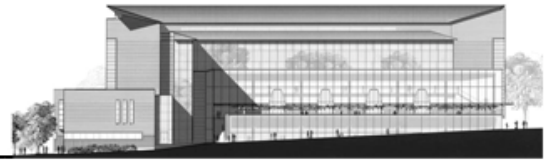
Design Performance

Illuminance Values (fc)

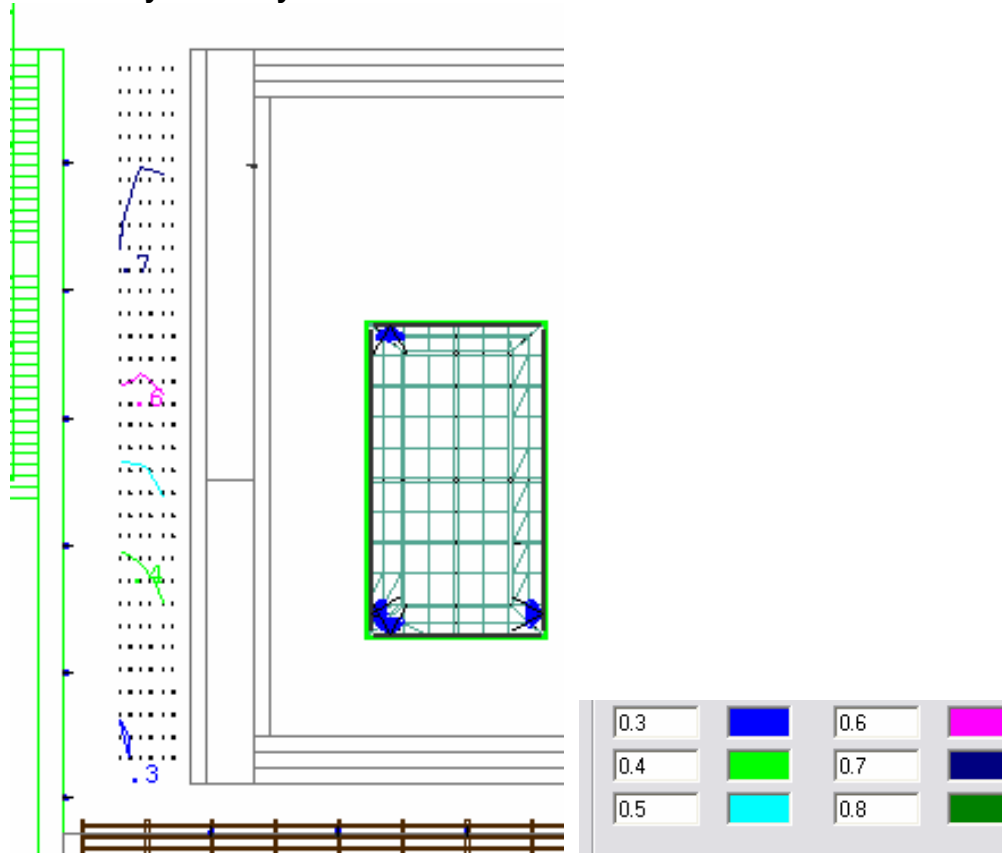
Galleria Level 1 Floor		Galleria Level 2 Floor	
Average	0.73	Average	0.54
Max	1.3	Max	0.8
Min	0.4	Min	0.3
Avg/Min	1.83	Avg/Min	1.8
Max/Min	3.25	Max/Min	2.67

- *Note: The design did not achieve the desired output. There were difficulties with getting the file to render correctly (i.e. – you will notice with the step lights, they worked in one area but not in the others). Continued work will be done on this space to bring up the light levels to an adequate level.*

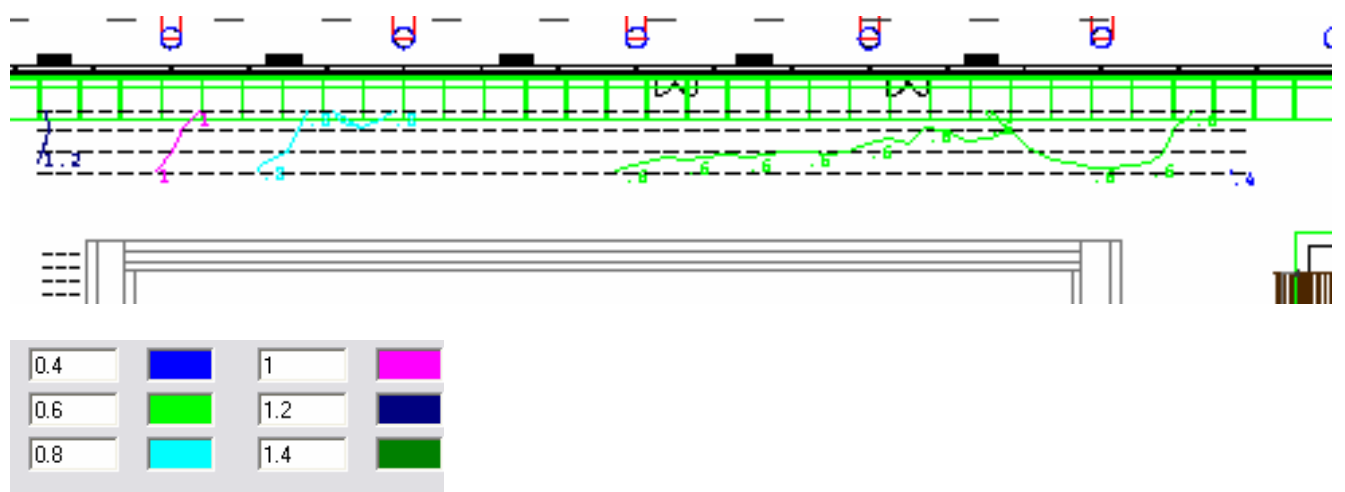
Katherine Jenkins
 William H. Gates Hall
 Seattle, WA



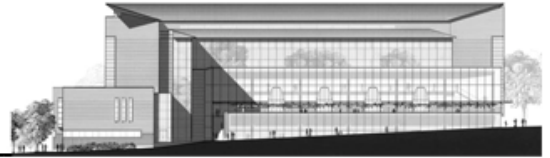
Secondary Walkway in Terrace Area



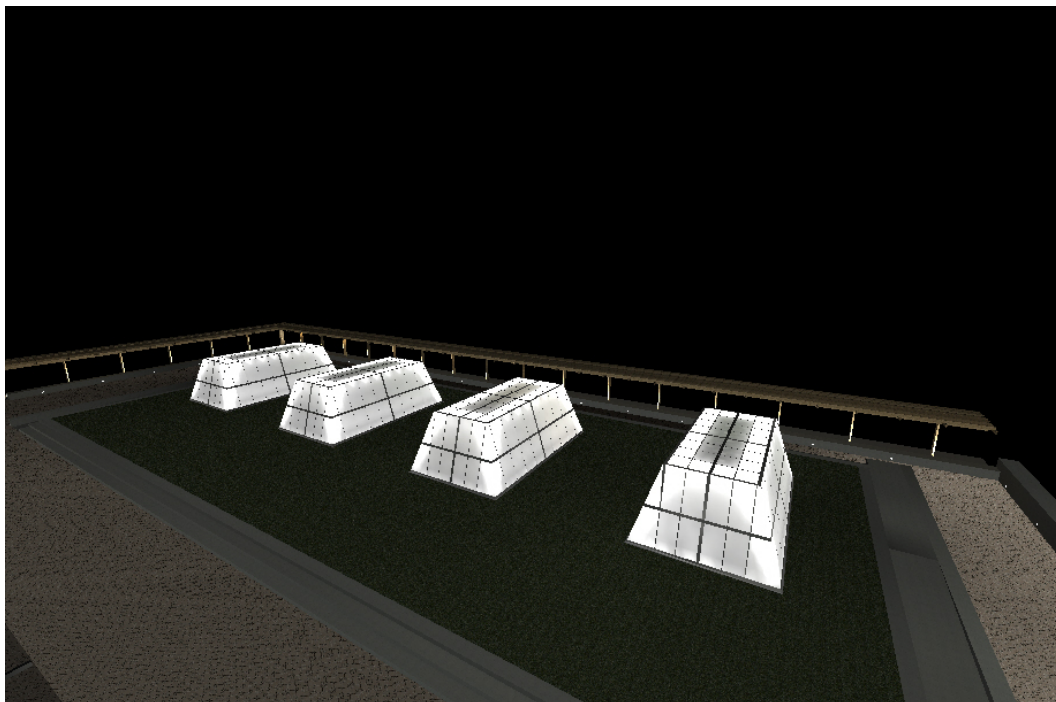
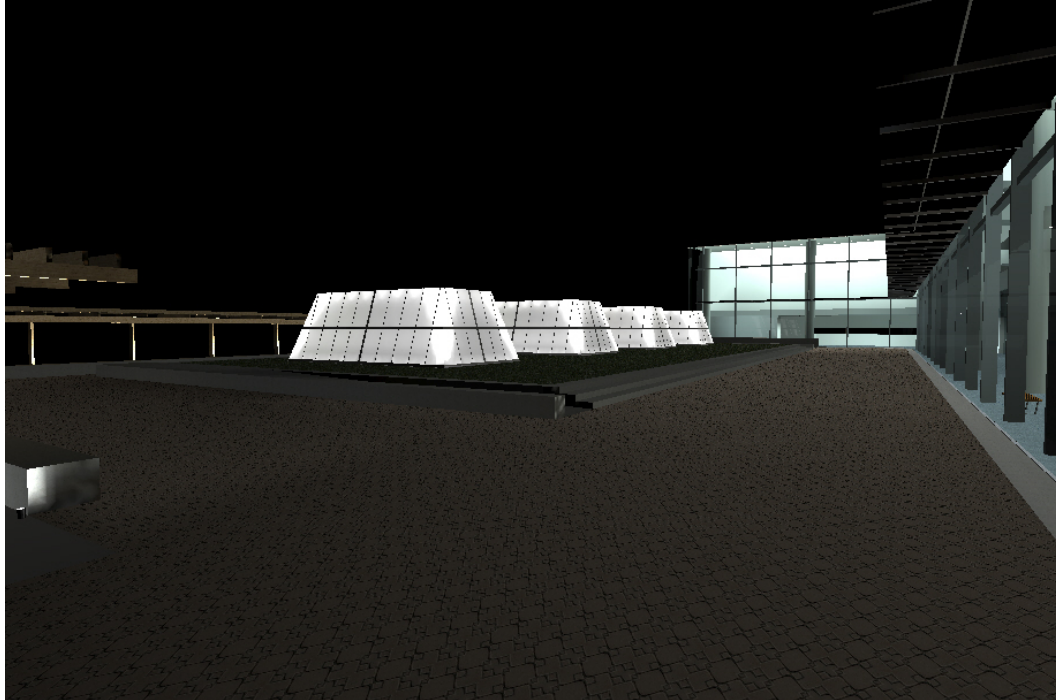
Terrace Main Circulation Area (Adjacent to Building)



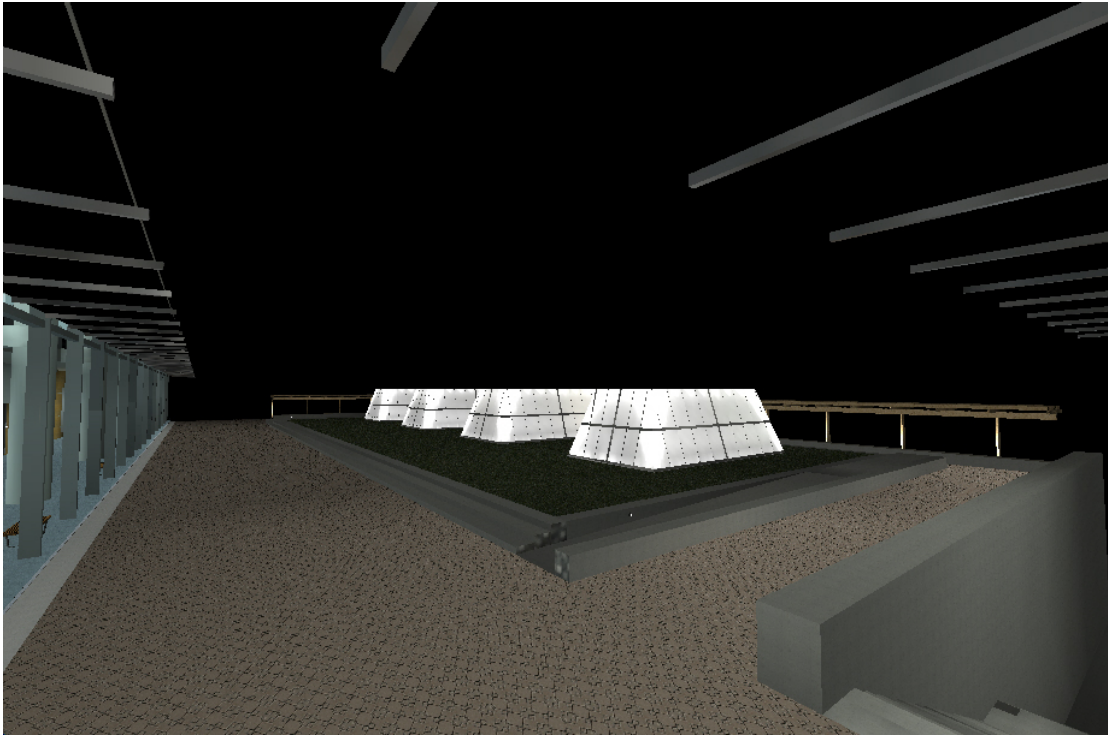
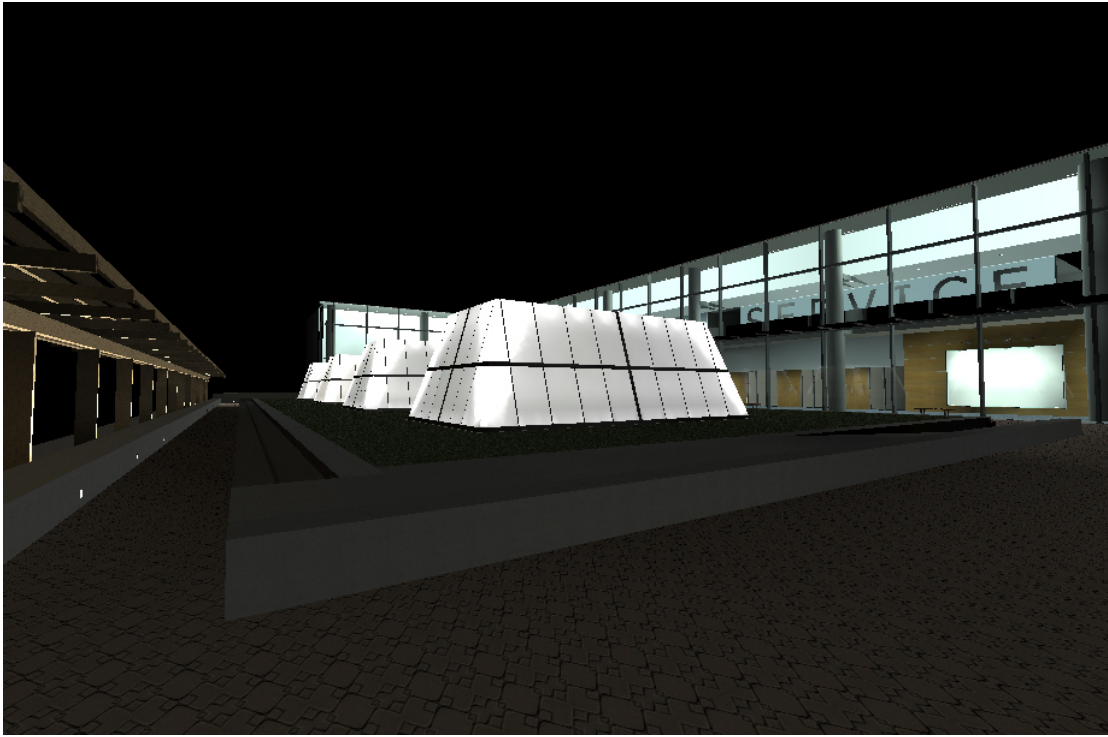
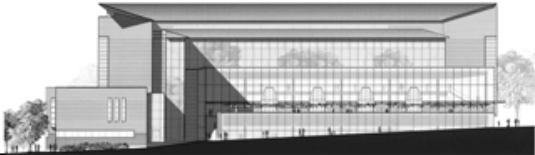
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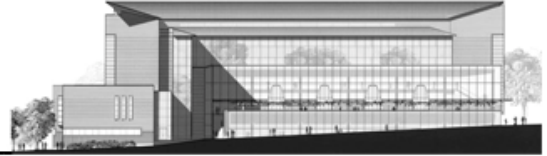
Renderings



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Electrical Requirements

Panelboards

NEB1-N04

Circuits 5 and 21 Change (Remove Lights, some existing to stay from other spaces)

REDESIGNED NEB1-N04

Circuits 5 and 21 Change (reduce load to account for lights taken off)
Circuit 23 –New

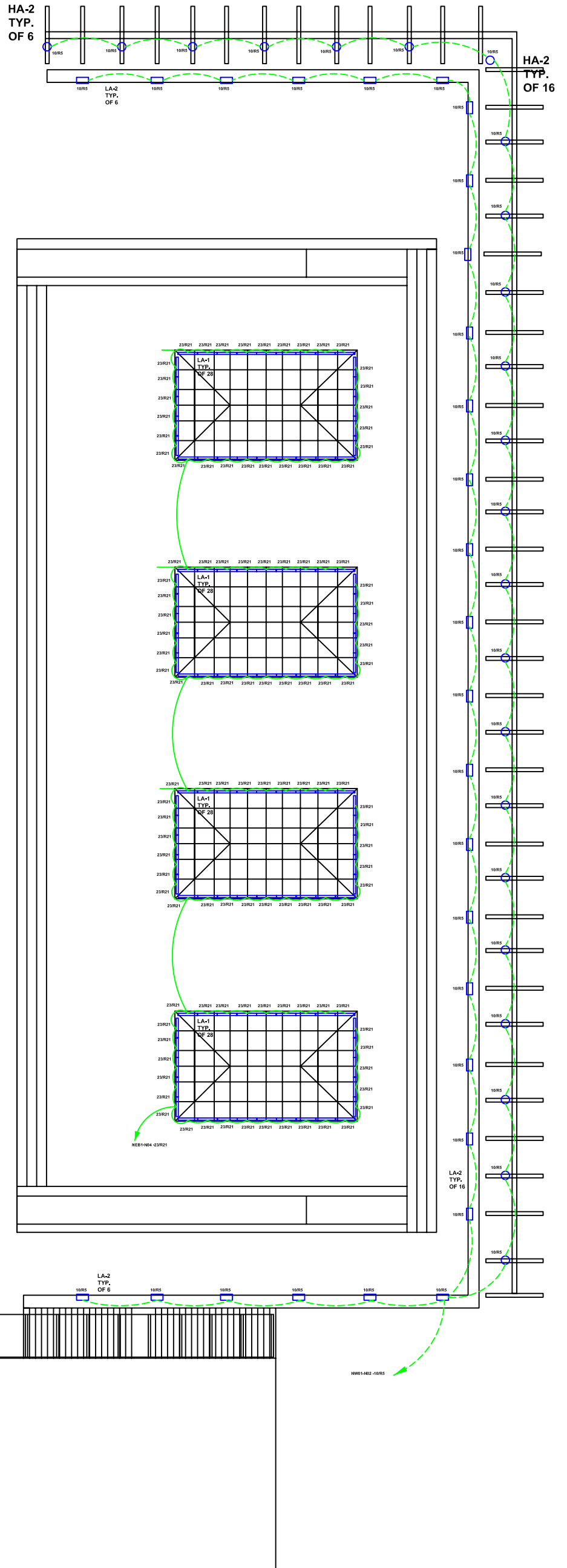
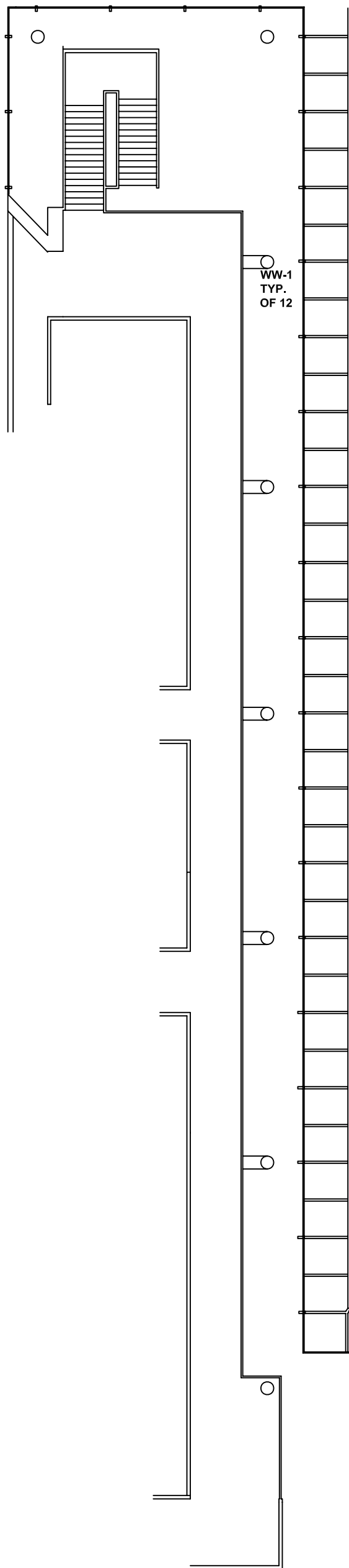
NW01-N02

Circuits 10 and 12 Deleted

REDESIGN NW01-N02

New circuit 10

Lighting Power Plan



P A N E L B O A R D S C H E D U L E

VOLTAGE: 277/480V SIZE/TYPE BUS: 400A COPPER SIZE/TYPE MAIN: 250A/3P MCB	PANEL TAG: NEB1-N04 PANEL LOCATION: Elec Rm. NE - Level B1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	SE Office	3600	20A/1P	1	*			2	20A/1P	3100	SE Wall	Lighting
Lighting	Student Alcove	1000	20A/1P	3		*		4	20A/1P	2900	Stacks	Lighting
Lighting	Lib. Reading	2300	20A/1P	5			*	6	20A/1P	3000	Stacks	Lighting
Lighting	Lib. Reading	1300	20A/1P	7	*			8	20A/1P	3400	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	9		*		10	20A/1P	2900	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	11			*	12	20A/1P	2600	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	13	*			14	20A/1P	3000	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	15		*		16	20A/1P	2600	NE Rooms	Lighting
Lighting	Lib. Reading	1800	20A/1P	17			*	18	20A/1P	500	Room 137	Equip ALC-L1B
Lighting	Lib. Reading	1800	20A/1P	19	*			20	20A/1P	0		Spare
Lighting	Lib. Reading	2300	20A/1P	21		*		22	20A/1P	0		Spare
Spare		0	20A/1P	23			*	24	20A/1P	0		Spare
Spare		0	20A/1P	25	*			26	20A/1P	0		Spare
Space		0	20A/1P	27		*		28	20A/1P	0		Spare
Space		0	20A/1P	29			*	30	20A/1P	0		Spare
Spare		0	20A/1P	31	*			32	20A/1P	0		Spare
Spare		0	20A/1P	33		*		34	20A/1P	0		Spare
Spare		0	20A/1P	35			*	36	20A/1P	0		Spare
Mech FTU East	East	6500	60/3P	37	*			38	20A/1P	0	0	Spare
Mech FTU East	East	4900	--	39		*		40	20A/1P	0		Spare
Mech FTU East	East	4200	--	41			*	42	20A/1P	0		Spare

CONNECTED LOAD (KW) - A	24.50		TOTAL DESIGN LOAD (KW)	77.13
CONNECTED LOAD (KW) - B	20.20		POWER FACTOR	0.82
CONNECTED LOAD (KW) - C	12.00		TOTAL DESIGN LOAD (AMPS)	113

PANELBOARD SCHEDULE

VOLTAGE: 277/480V SIZE/TYPE BUS: 400A COPPER SIZE/TYPE MAIN: 250A/3P MCB	PANEL TAG: Redesign NEB1-N04 PANEL LOCATION: Elec Rm. NE - Level B1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	SE Office	3600	20A/1P	1	*			2	20A/1P	3100	SE Wall	Lighting
Lighting	Student Alcove	1000	20A/1P	3		*		4	20A/1P	2900	Stacks	Lighting
Lighting	Lib. Reading	7150	20A/1P	5			*	6	20A/1P	3000	Stacks	Lighting
Lighting	Lib. Reading	1300	20A/1P	7	*			8	20A/1P	3400	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	9		*		10	20A/1P	2900	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	11			*	12	20A/1P	2600	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	13	*			14	20A/1P	3000	Stacks	Lighting
Lighting	Lib. Reading	1800	20A/1P	15		*		16	20A/1P	2600	NE Rooms	Lighting
Lighting	Lib. Reading	1800	20A/1P	17			*	18	20A/1P	500	Room 137	Equip ALC-L1B
Lighting	Lib. Reading	1800	20A/1P	19	*			20	20A/1P	0		Spare
Lighting	Lib. Reading	1750	20A/1P	21		*		22	20A/1P	0		Spare
Lighting	Skylights	3585	20A/1P	23			*	24	20A/1P	0		Spare
Spare		0	20A/1P	25	*			26	20A/1P	0		Spare
Space		0	20A/1P	27		*		28	20A/1P	0		Spare
Space		0	20A/1P	29			*	30	20A/1P	0		Spare
Spare		0	20A/1P	31	*			32	20A/1P	0		Spare
Spare		0	20A/1P	33		*		34	20A/1P	0		Spare
Spare		0	20A/1P	35			*	36	20A/1P	0		Spare
Mech FTU East	East	6500	60/3P	37	*			38	20A/1P	0	0	Spare
Mech FTU East	East	4900	--	39		*		40	20A/1P	0		Spare
Mech FTU East	East	4200	--	41			*	42	20A/1P	0		Spare

CONNECTED LOAD (KW) - A	24.50		TOTAL DESIGN LOAD (KW)	87.97
CONNECTED LOAD (KW) - B	19.65		POWER FACTOR	0.84
CONNECTED LOAD (KW) - C	20.44		TOTAL DESIGN LOAD (AMPS)	126

PANELBOARD SCHEDULE

VOLTAGE: 277/480V SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: NW01-N02 PANEL LOCATION: Elec Rm. NW - Level 1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 42K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WAST	6300	20A/1P	1	*			2	20A/1P	3000	SW ROOMS	LIGHTING
MECH FTU	WEST	6400	20A/1P	3		*		4	20A/1P	1000	NW ROOMS	LIGHTING
MECH FTU	WEST	3200	20A/1P	5			*	6	20A/1P	2100	LOUNGE	LIGHTING
LIGHTING	RM 118	1300	20A/1P	7	*			8	20A/1P	3600	CORRIDOR	LIGHTING
SPARE	0	0	20A/1P	9		*		10	20A/1P	2400	SE EXTERIOR	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	2100	SE EXTERIOR	LIGHTING
MECH FTU	WEST	9500	20A/1P	13	*			14	20A/1P	500	Stacks	EQUIP ALC-1A
MECH FTU	WEST	9500	20A/1P	15		*		16	20A/1P	0	0	SPARE
MECH FTU	WEST	9500	20A/1P	17			*	18	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE	0	0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE	0	0	60/3P	37	*			38	20A/1P	0	0	SPARE
SPARE	0	0	--	39		*		40	20A/1P	0		SPARE
SPARE	0	0	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	24.20		TOTAL DESIGN LOAD (KW)	70.70
CONNECTED LOAD (KW) - B	19.30		POWER FACTOR	0.59
CONNECTED LOAD (KW) - C	16.90		TOTAL DESIGN LOAD (AMPS)	143

PANELBOARD SCHEDULE

VOLTAGE: 277/480V SIZE/TYPE BUS: 200A COPPER SIZE/TYPE MAIN: 150A/3P MCB	PANEL TAG: REDESIGN NW01-N02 PANEL LOCATION: Elec Rm. NW - Level 1 PANEL MOUNTING: SURFACE	MIN. C/B AIC: 35K OPTIONS: SINGLE LUGS FOR PANELBOARD 1L1B
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DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WAST	6300	20A/1P	1	*			2	20A/1P	3000	SW ROOMS	LIGHTING
MECH FTU	WEST	6400	20A/1P	3		*		4	20A/1P	1000	NW ROOMS	LIGHITNG
MECH FTU	WEST	3200	20A/1P	5			*	6	20A/1P	2100	LOUNGE	LIGHTING
LIGHTING	RM 118	1300	20A/1P	7	*			8	20A/1P	2900	CORRIDOR	LIGHTING
SPARE	0	0	20A/1P	9		*		10	20A/1P	1380	SE EXTERIOR	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	0	0	Spare
MECH FTU	WEST	9500	20A/1P	13	*			14	20A/1P	500	ELEC RM NW	EQUIP ALC-1A
MECH FTU	WEST	9500	20A/1P	15		*		16	20A/1P	1510	GALLERIA	LIGHITNG
MECH FTU	WEST	9500	20A/1P	17			*	18	20A/1P	2016	GALLERIA	LIGHTING
SPARE	0	0	20A/1P	19	*			20	20A/1P	0		SPARE
SPACE	0	0	20A/1P	21		*		22	20A/1P	0		SPARE
SPACE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	20A/1P	25	*			26	20A/1P	0		SPARE
SPARE		0	20A/1P	27		*		28	20A/1P	0		SPARE
SPARE		0	20A/1P	29			*	30	20A/1P	0		SPARE
SPARE		0	20A/1P	31	*			32	20A/1P	0		SPARE
SPARE		0	20A/1P	33		*		34	20A/1P	0		SPARE
SPARE		0	20A/1P	35			*	36	20A/1P	0		SPARE
SPARE	0	0	60/3P	37	*			38	20A/1P	0	0	SPARE
SPARE	0	0	--	39		*		40	20A/1P	0		SPARE
SPARE	0	0	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	23.50		TOTAL DESIGN LOAD (KW)	70.30
CONNECTED LOAD (KW) - B	19.79		POWER FACTOR	0.59
CONNECTED LOAD (KW) - C	16.82		TOTAL DESIGN LOAD (AMPS)	143