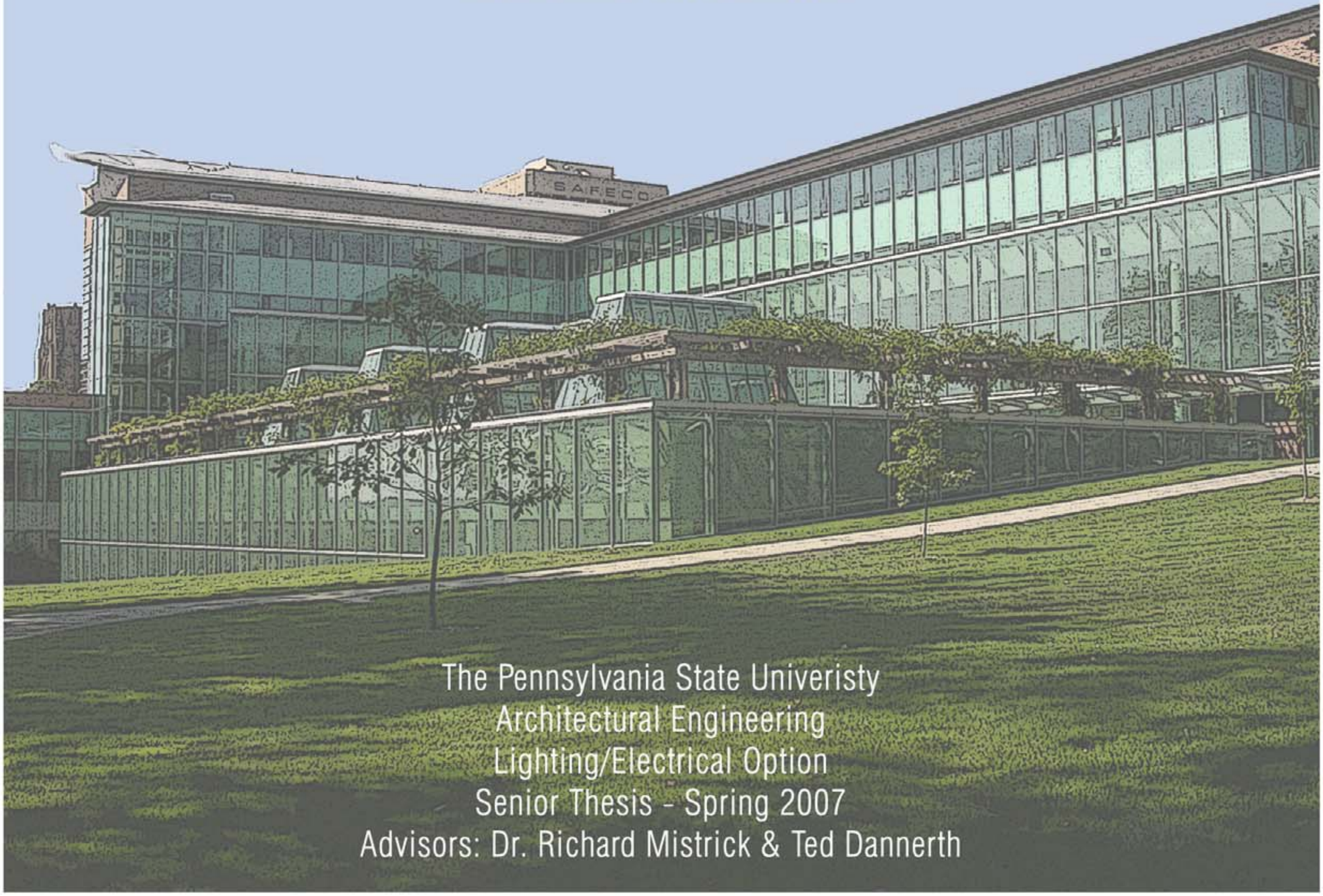
William H. Gates Hall

University of Washington School of Law
Seattle, WA

An Investigation of Alternative Lighting & Electrical Systems

With a Feasibility Study on Rainwater Catchment Systems

Katherine A. Jenkins



The Pennsylvania State Univeristy
Architectural Engineering
Lighting/Electrical Option
Senior Thesis - Spring 2007
Advisors: Dr. Richard Mistrick & Ted Dannerth

William H. Gates Hall Seattle, WA

University of Washington School of Law

Project Information

Project Name: William H. Gates Hall

Location: Seattle, WA

Size: 196,000 sq ft, 6 stories

Dates of Construction: July 30, 2001 – July 18, 2003

Building Cost: $82,679,787

Primary Design Team

Owner: University of Washington

Architect: Mahlum Architects

Structural Engineer: Magnusson Klemencic Associates

Mechanical Engineer: CBG Consulting Engineers

Electrical Engineer: Sparling

Architecture

- Two story below grade library and four above grade levels of classrooms, seminar rooms, mock courtrooms and offices
- Four trapezoidal sky lights provide day light from terrace to library below
- Two story glazed galleria serves as central circulation corridor
- Façade uses combination of glazed aluminum curtain wall and brick veneer

Lighting

- Recessed compact and linear fluorescent downlights and wallwashers in courtrooms
- Direct/Indirect fluorescent pendant lighting in classrooms & seminar rooms
- Lutron Grafik Eye Dimming System in seminar rooms, classrooms and courtrooms
- Day lighting of lobby and galleria spaces through two story glazed walls.

Electrical

- Two 13.8 KV campus primary feeders service a 15KV 3-section main switch board which switches the primary 2500/3333 KVA transformer
- The secondary serving voltage for the building is 480Y/277 volts, 3 phase, 4 wire and 7 step down transformers provide 208Y/120 V power
- Emergency power is tapped from the campus 2.4kV sysem

Mechanical

- Two centrifugal chillers, each with capacity of 275 tons
- Campus steam system extends to building on east side of site for space and domestic hot water heating
- Nine air handling units with capacity's ranging 10,080 cfm to 29,940 cfm
- Two 59,850 cfm cooling towers located in pit on north side of building

Structural

- Foundation system composed of 1'-4" foundation wall & spead footings
- Floor construction consist of 34'-6" by 34'-6" bays framed with steel beams and girders
- Steel composite beams with 3 ½" concrete slab on 3" metal deck
- Concrete shear walls 12" to 14" thick with two layers of reinforcment

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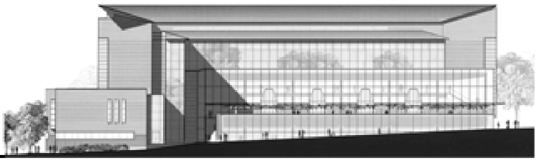
http://www.arche.psu.edu/thesis/eportfolio/2007/portfolios/kaj172



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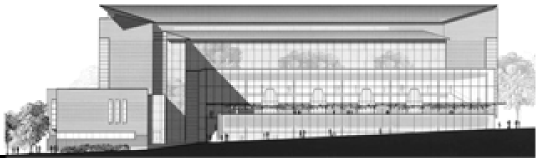


Executive Summary

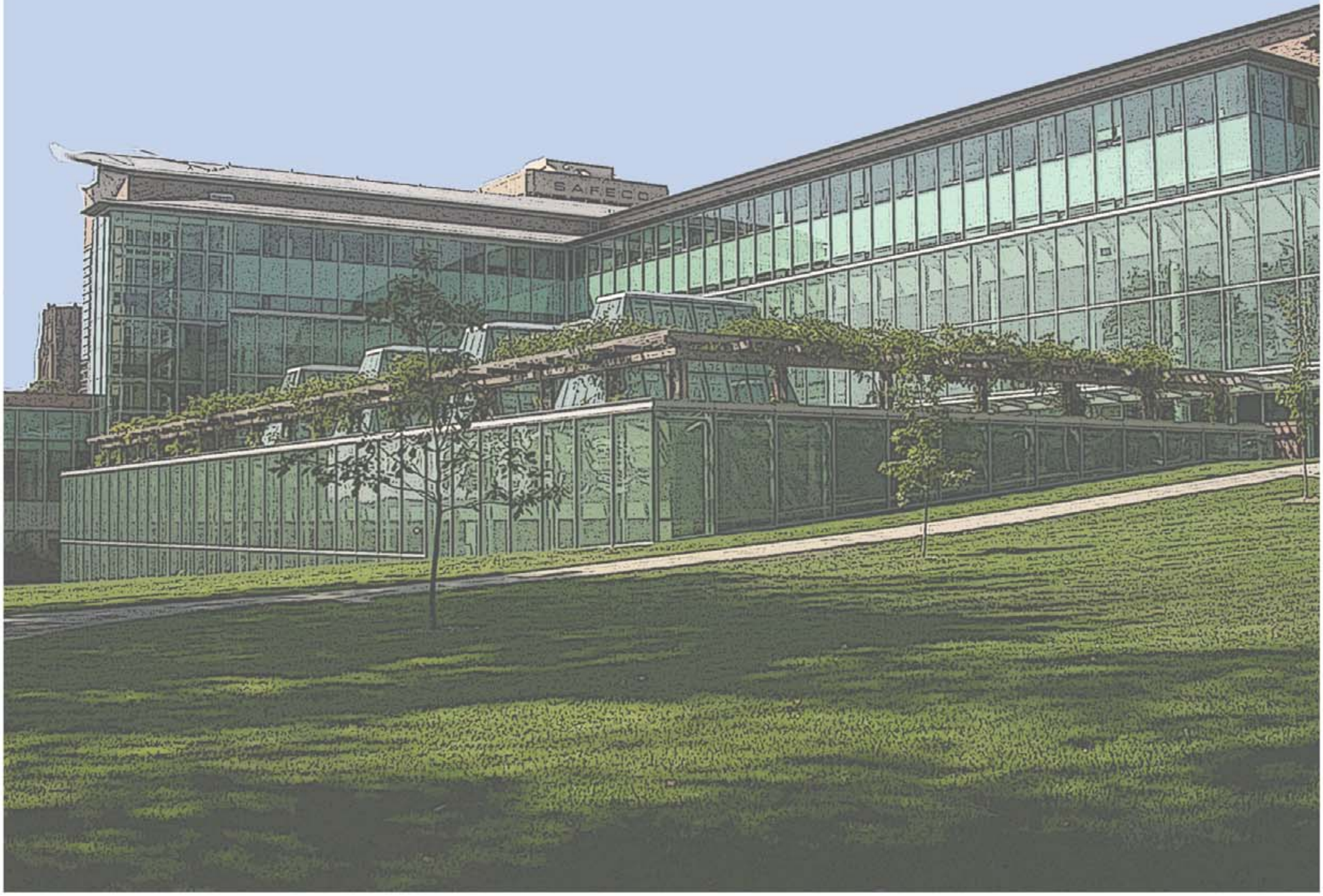
The William H. Gates Hall Thesis Project looks at several designs and studies of systems throughout the building and the potential effects they will have on the operation of the system, cost of construction and operation, and building energy and water consumption.

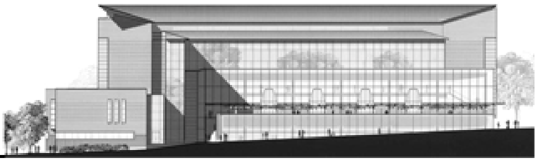
The Lighting Depth focuses on creating lighting designs for several areas of the building following the design criterion set forth by ISENA and the power density allowances allotted in ASHRAE 90.1. The lighting for four spaces throughout the building was designed; this includes the Jeffrey & Susan Brotman 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 lighting design strives to create an aesthetic that is complementary to the outstanding new facility and its architectural uniqueness, while providing a design that is conducive to a productive learning atmosphere and minimizes energy consumption in the building. Additionally, daylighting considerations are taken into account and daylight studies are conducted for two of the spaces to determine the how to maximize the buildings daylighting potential while ensuring comfort to building occupants.

Throughout the Electrical Depth there are several areas of study and design. First, a panelboard coordination that looks to ensure coordination between the lighting design and its corresponding loads on the panelboards is conducted. All new lighting loads are added to the panels, and in some instances, the panel size is able to be reduced. The Electrical Depth also includes a transformer redesign that looks to replace several of the building's larger, central transformers with smaller distributed transformers in order to decrease the overall system cost, primarily by reducing the size of copper wire running through the building. By redesigning the building transformers and its respective equipment and feeders, significant cost savings are able to be achieved. Additionally, a motor control center that allows for localized control of the building's air handling units was designed. Lastly, a protection device coordination study looks at the coordination of protection devices along a single feeder, and determines that the protection along the particular feeder being analyzed is not properly coordinated.

The breadth topics allow for the opportunity to explore other systems in the building and possible impacts or changes that will result. The LEED Breadth studies the feasibility of implementing a rain water catchment system to offset the cooling tower makeup water in the building. This study looks at the cooling tower's makeup water requirements along with the potential rain fall that could be collected in order to offset water usage, and determines approximately 1.1 million gallons of water a year can be saved. The Construction Management Breadth coincides with this feasibility study by providing a chance to analyze the system and water cost, to determine the extent of water savings and the payback period of this system. This breadth allows for concrete justification of implementing such a system, with a pay back period of 6 ½ years and a yearly water cost savings of approximately $5,000.

Introduction, Background & Building Overview





Introduction & Background

William H. Gates Hall provides a new state of the art facility for the University of Washington School of Law. Named after alumnus, Bill Gates, Sr., the building was designed and constructed to bring the law school facility back onto campus and provide students and faculty with a home that would meet and exceed all of their educational needs. With construction completed in September 2003, William H. Gates Hall is one of the new buildings on campus, and boasts several features that set it apart from any other building on campus. William H. Gates Hall is also home to the Marion Gould Gallagher Law Library, the largest public law library in the northwest.

General Building Overview

Building Name: William H. Gates Hall

Location & Site: University of Washington
Northeast 43rd St & 15th Ave NE
Seattle, WA

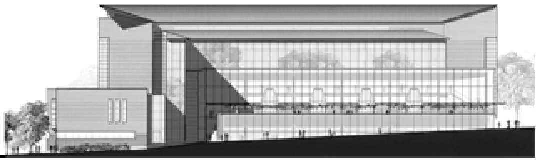
Building Occupant Name: UW School of Law

Occupancy or Function Types: Educational

Size: 196,000 sq. ft.

Number of Stories:
- Above Grade: 4
- Total Levels: 6

Primary Project Team:
- *Owner*: University of Washington, Seattle [www.washington.edu]
- *General Contractor*: Lease Crutcher Lewis, Seattle [www.lewisbuilds.com]
- *Construction Manager*: Lease Crutcher Lewis, Seattle [www.lewisbuilds.com]
- *Executive Architect*: Mahlum Architects, Seattle [www.mahlum.com]
- *Design Architect*: Kohn Pedersen Fox, New York [www.kpf.com]
- *Structural/Civil Engineer*: Magnusson Klemencic Associates, Seattle [www.mka.com]
- *Mechanical Engineer*: CBG Consulting Engineers, Portland
- *Electrical Engineer*: Sparling, Seattle [www.sparling.com]
- *Lighting Designer*: Candela, Seattle [www.candela.com]
- *Landscape Architect*: Murase Associates, Seattle [www.murase.com]
- *Acoustical Engineer*: The Greenbusch Group, Seattle [www.greenbusch.com]
- *Testing & Inspections*: Mayes Testing Engineers, Everett [www.mayestesting.com]
- *Geotechnical Engineer*: GeoEngineers, Seattle [www.geoengineers.com]



Dates Of Construction: July 30, 2001 – July 18, 2003

Actual Cost Information:

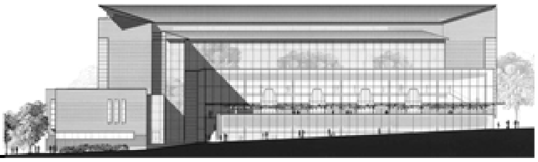
- Total Project Cost: $82,679,787
    - Consultant Services: $8,166212
    - Construction: $63,432,789
    - Equipment: $8,202,506
    - Project Management: $1,807,112
    - Other: $1,071,166

Project Delivery Method: Design-Bid-Build

Architecture:

Located on the northwest corner of the campus, the William H. Gates Hall provides a new home for the UW School of Law, bringing all the faculty and students under one roof for the first time in twenty years. Built on what previously was a parking lot, Gates Hall creates a strong presence at the 43rd St pedestrian corridor, linking to the campus' main entrance at Memorial Drive. The196,000 square foot building houses offices, lecture halls, classrooms, courtrooms, student commons and the Northwest's finest law library. Four soaring architectural skylights in the southwest plaza provide daylight to the law library and puncture onto the outdoor terrace that sits atop the library, giving the law school a distinguishing appearance.

William H. Gates Hall is designed and centered around the Marian Gould Gallagher Law Library, which is symbolically located at the "foundation" of the building. Providing 40,000 square feet of book stacks and 10,000 square feet of reading room, the Marian Gould Gallagher Law Library sits two floors below grade and is encapsulated by the terrace above and the main L-shaped structure on its north and west sides. With the four trapezoidal sky lights connecting the library to the outside world, the central terrace provides an outdoor gathering place for students and faculty. Linking the main structure and the terrace is a glazed two-story galleria, which serves as the main circulation corridor for building. The daylight infused Brotman Galleria provides access to classrooms and seminar rooms on the first and second floors. The main entrance of the building is located at the east end of the building, along Memorial drive and feeds into a double-height lobby. The modest "grand" staircase in the lobby provides access to the library below and the pro-bono law offices above. While the first two levels of the building primarily house courtrooms, classrooms and seminar rooms, the upper two levels accommodate mostly faculty and administrative offices.



Major Nation Model Codes:

- 1997 Uniform Building Code with City of Seattle Amendments
- National Fire Protection Association Codes
- National Electric Code (NFPA 70, 1996)

Local Codes

- 1997 Seattle Building Code
- 1997 Washington State Building Code
- 1997 Washington State Energy Code
- Washington State Electrical Code
- Seattle Electrical Code

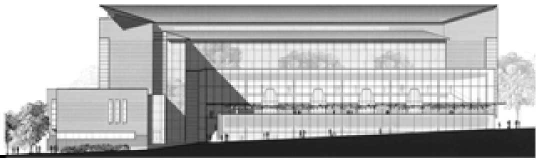
Building Envelope

The exterior walls of William H. Gates Hall are predominantly brick and glazed aluminum. The north and west facades of the building are mostly laid-in-place brick veneer over CMU backing wall, following the standard University of Washington barrier wall system. A Norman 2-3/4 by 12 brick module is used in a combination of colors to complement the campus' existing brick color palette. The South and East facades, including the entry lobby, gallery overlooking the terrace, and the perimeter walls of the library utilize a glazed aluminum curtain wall system. The stair wells and upper levels of the South facing perimeters use a glazed aluminum curtain wall with a different mullion pattern. Standard glazing throughout the building is insulated glazing units with low-E performance glass.

The main roofing system consist of standing seam roofing over insulation, supported on a 3" metal roof deck, which spans horizontally between steel beams that are parallel to the ridge. The lower, flat roof levels consist of gravel ballast over waterproofing membrane and insulation, also supported on 3" metal roof deck, supported by steel beams and girders.

Construction

Construction of William H. Gates Hall began in July 2001. Following a dedication ceremony, the building was opened to the public on September 12, 2003. The general contractor/construction manager (GC/CM) for the project was Lease Crutcher Lewis. By using GC/CM contracting approach for this job, Lewis was brought aboard early in design and helped provide a detailed analysis at every step of the project.



Electrical

William H. Gates Hall utilizes a radial system, in which the service is brought to the building through two 13.8 kV primary feeders tapped from the main campus distribution system. These two feeders enter the building in the Main Electric Room on level L2 and are connected to the three-bay primary switchgear. This then feeds a single-ended interior substation and the primary switch, which is rated at 15KV, 600 amperes, 500MVA short circuit duty, serves a 2500/3333 KVA fan cooled, dry type transformer. The secondary serving voltage for the building is a 480Y/277 volts, 3 phase, 4 wire grounded Wye system. The majority of the building's mechanical system and lighting loads are served at these voltages, and 120 and 208 volt loads are served through additional step-down transformers. The 4000 ampere bus in the main power center is protected by a 4000 ampere main circuit breaker. This power center further feeds two 215 KW chillers, a 400 A automatic transfer switch for emergency power, a 400 A elevator distribution panel, a 1600 A distribution panel, and five 480:208Y/120 volt dry type transformers.

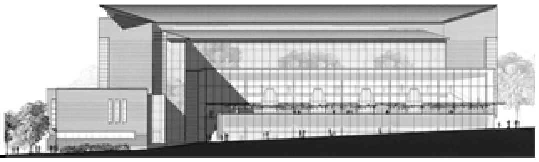
Lighting

In efforts to achieve desired design goals, the lighting throughout William H. Gales Hall primarily utilizes fluorescent lighting. Classrooms and seminar rooms make use of suspended indirect/direct fluorescent luminaires, as do the majority of the offices spaces, while the courtroom spaces uses primarily compact fluorescent downlighting. The circulation corridors also take advantage of compact fluorescent downlighting, as well as linear fluorescent wallwashers. Several areas make use of metal halide luminaires, primarily in the form of track fixtures and downlights.

Daylighting is utilized in several of the spaces, most noticeable the galleria corridor which runs through the heart of the building. The two story galleria is lined on one side by a two story glazed curtain wall. Daylighting is also incorporated in the library by four large skylights which protrude through to the terrace above.

Structural

The primary floor structural system consists of 34'6" by 34'6" composite bays with 3 ½" concrete slab on 3"metal decking and steel beams and girders. The foundation system is composed of spread footings with 1'-4" foundation walls. The system is supported laterally by concrete shear walls, varying between 12" to 14" thick, with two layers of reinforcement.



Mechanical

The University of Washington is served by a network of underground utilities, from which low pressure steam is extended to the building. The steam, steam condensate and compressed air enter William H. Gates Hall at Level L2 in the northeast corner of the building. Both domestic hot water and space heating are provided from this steam throughout the entire building.

Located on the top level (Level 4) in the fan room are nine air handling units with capacities ranging between 10,080 and 29,940 cfm. Air is distributed throughout the building by means of fan-powered terminal boxes with water source reheat coils.

The cooling utility is provided throughout the building my means of two 275 ton centrifugal chillers and two 59,850 cfm cooling towers.

Fire Protection

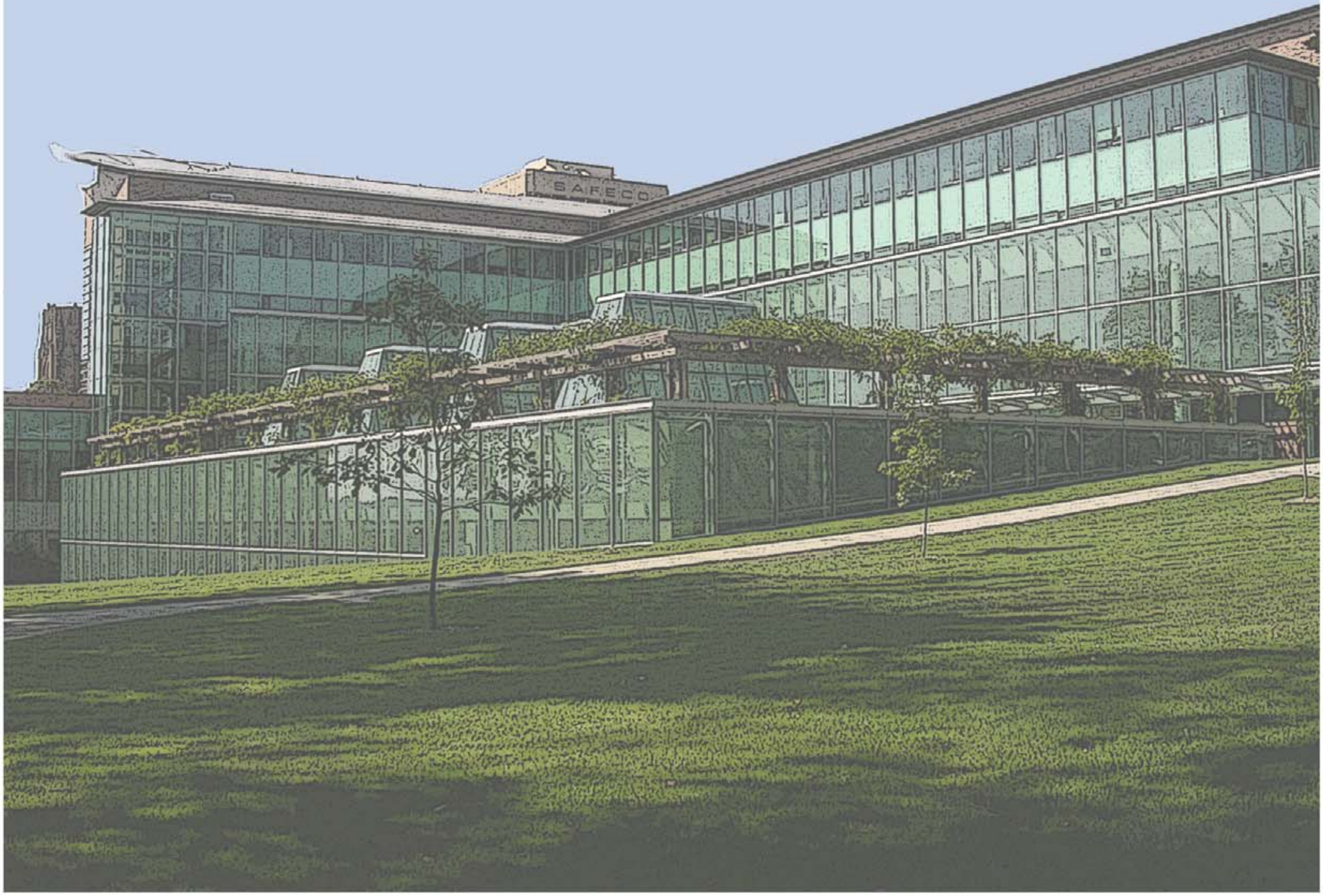
William H. Gates Hall is fully sprinklered and utilizes a multiplexed, analog addressable, annunciate, electrically supervised fire alarm system. Complying with University of Washington Facility Design Information Standards, as well as the Seattle Fire Code and ADA, the building contains all necessary fire alarm equipment and controls, including smoke detection in many public areas and HVAC supply and return plenums, pull stations, combination speaker/visual fire alarm devices, door releases, sprinkler system flow switches and fan shutdown circuitry.

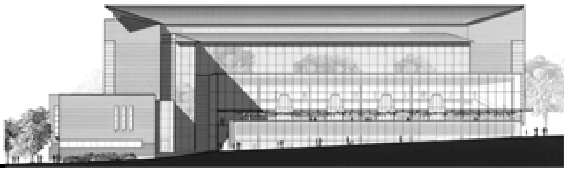
Telecommunications

A complete voice, data, and multimedia communications infrastructure system is provided throughout William H. Gates Hall. Student seating areas in classrooms are provided with underfloor raceway stub-ups and connections to multi-outlet assemblies for future use. In addition to this, flush floor junction boxes are placed at selected locations in the floor for access from podiums and future fixed arrangements.

There are various communications systems and related equipment located throughout the building. These include, but are not limited to: wireless access points mounted in the ceilings of all classrooms, seminar rooms and court rooms; communications receptacle outlets all throughout the building for phone and data connections; several cable television outlets; and data/video projector and recorder outlets.

Lighting Depth





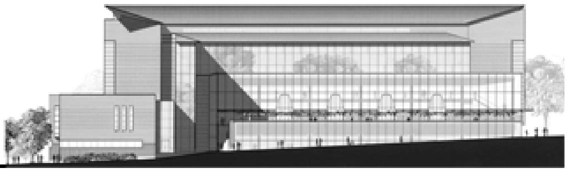
Introduction

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.

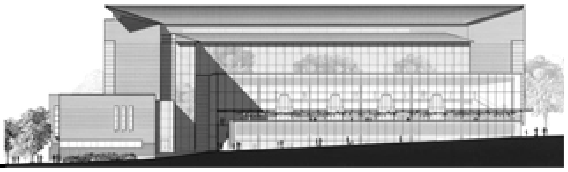
The Lighting Depth focuses on creating lighting designs for several areas of the building that exemplify the uniqueness of the building. In addition to this, the lighting design also strives to provide user friendly applications through the use of controls and desirable light levels, while at the same 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.



Jeffrey & Susan Brotman Galleria



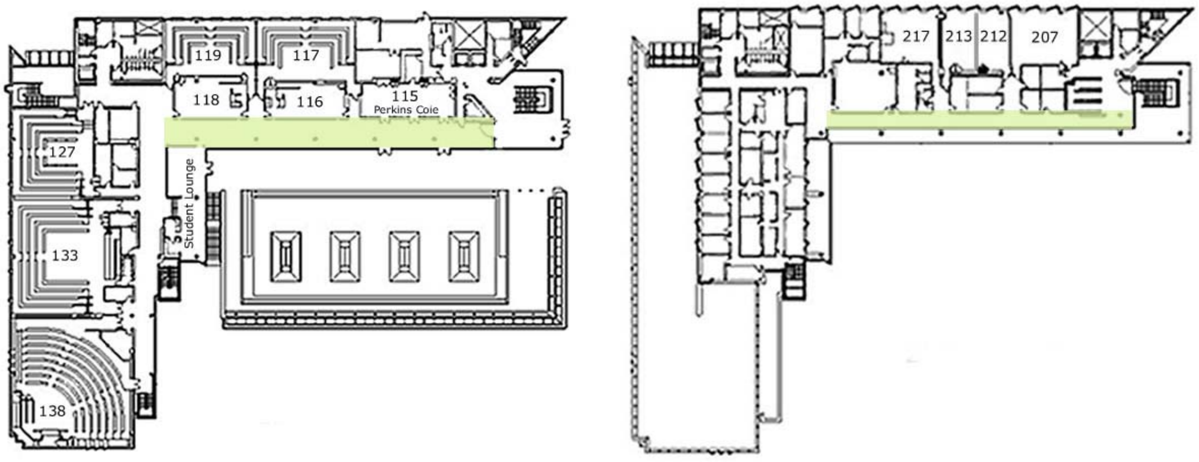
Introduction

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**

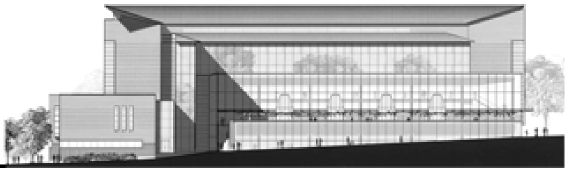
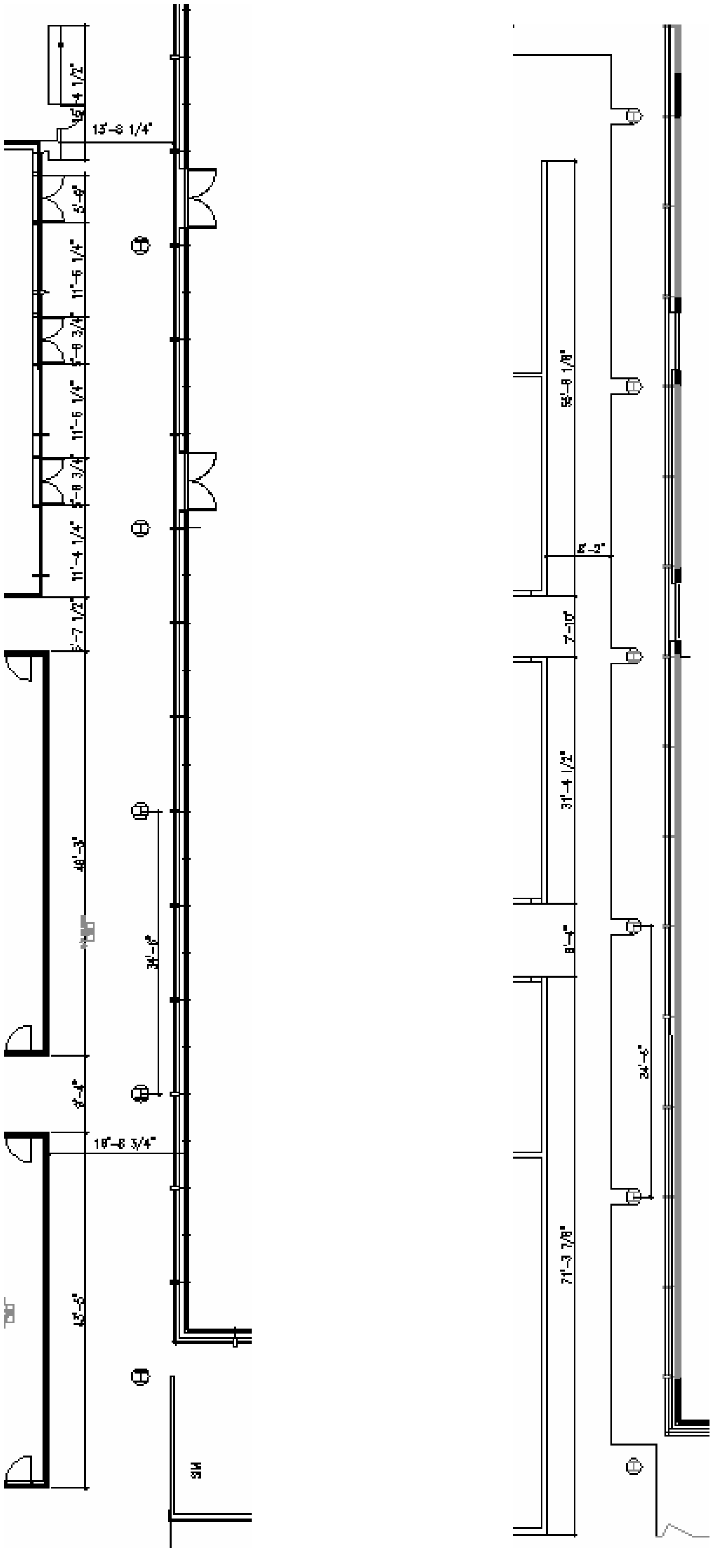
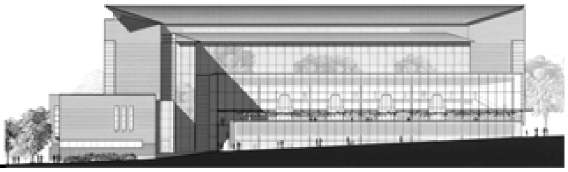


Figure 1.1.2 – Galleria Floor Plans



First Floor – Galleria **Second Floor – Galleria**

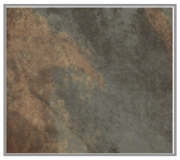


Architectural Finishes

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

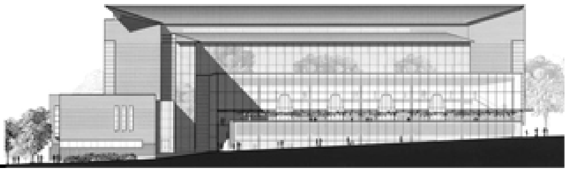
Paint
Manufacturer: Benjamin Moore
Color: Eggshell
Finish: Matte
Reflectance: 85%

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%



Glazing

PPG Sungate 100 Low-E- Glass

Transmittance			Reflectance		U-Value		K-Value				
Ultra-violet %	Visible %	Total Solar Energy %	Visible Light %	Total Solar Energy %	Winter Night time	Summer Daytime	Winter Night time	Summer Daytime	Shading Coeff.	Solar Heat Gain Coeff.	Light to Solar Gain
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.

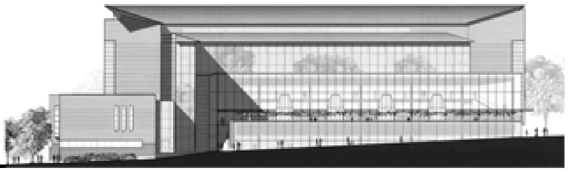


Table 1.1.1 - Daylight Illuminance Values (fc)

	December 21.											
	10:00 AM						1:00 PM					
Clear Sky	Galleria Level 1		Galleria Level 2		Galleria Vertical		Galleria Level 1		Galleria Level 2		Galleria Vertical	
	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

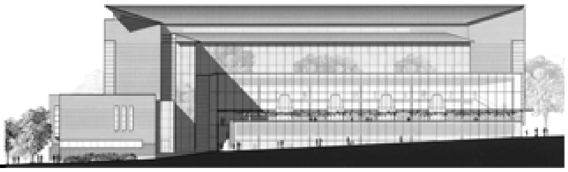


Figure 1.1.3 – Daylighting Study Renderings

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**

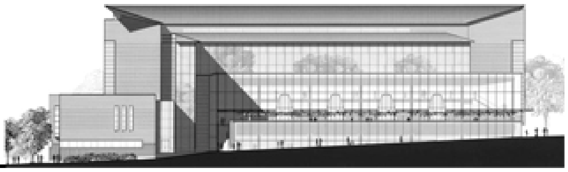
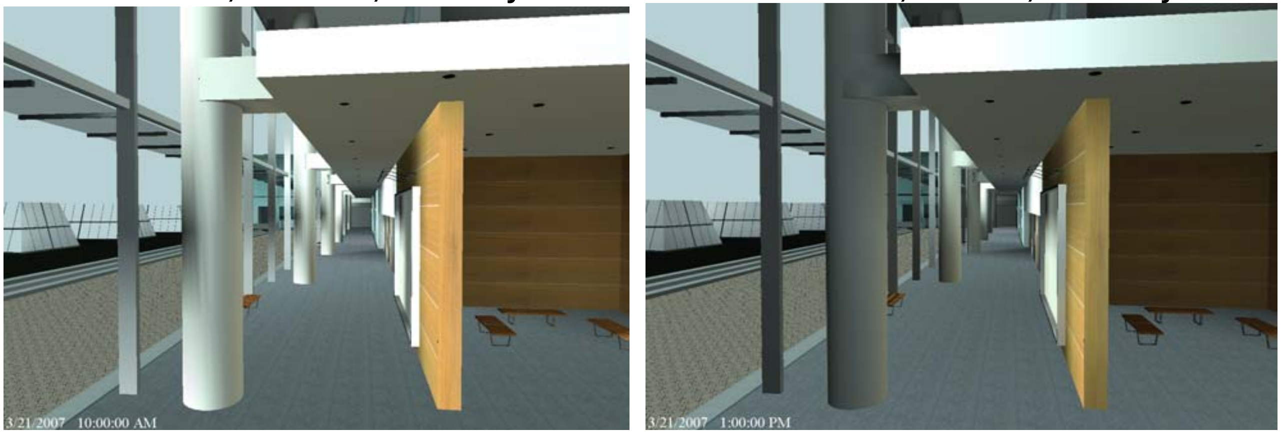


Table 1.1.2 - Daylight Illuminance Values (fc)

	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**

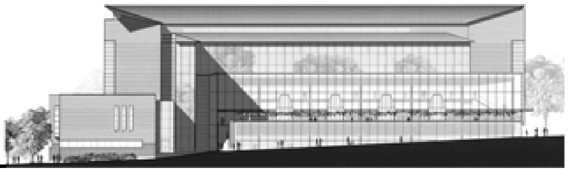


Table 1.1.3 - Daylight Illuminance Values (fc)

	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

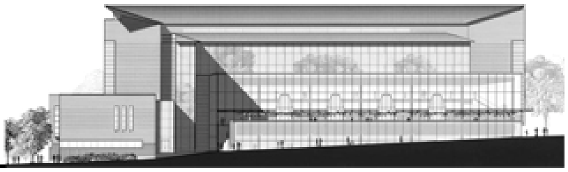
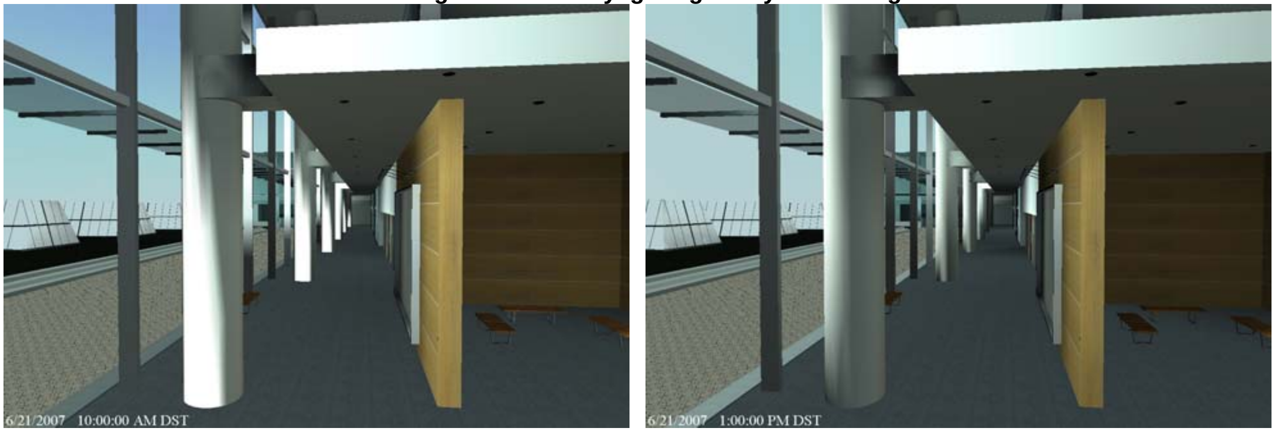
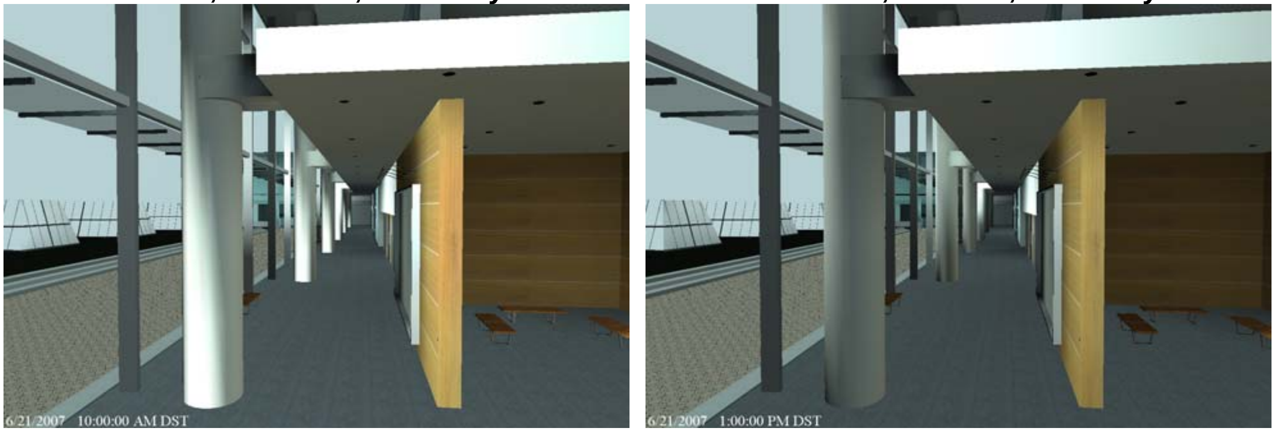


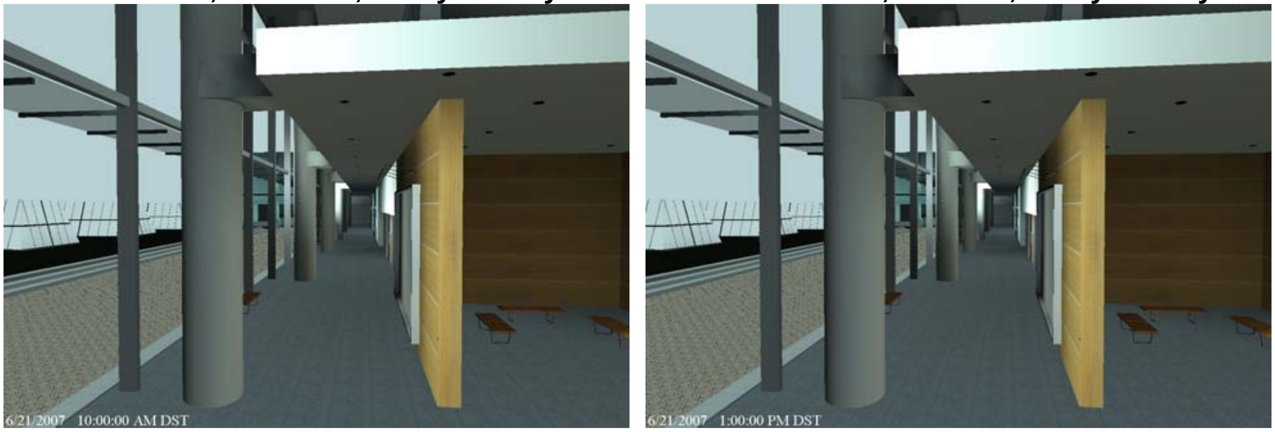
Figure 1.1.5 – Daylighting Study Renderings



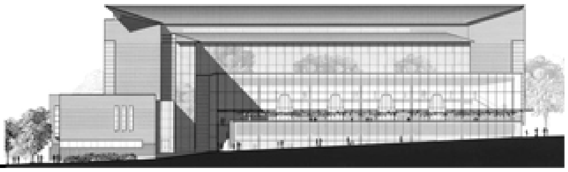
June 21, 10:00 AM, Clear Sky **June 21, 1:00 PM, Clear Sky**



June 21, 10:00 AM, Partly Cloudy **June 21, 1:00 PM, Partly Cloudy**



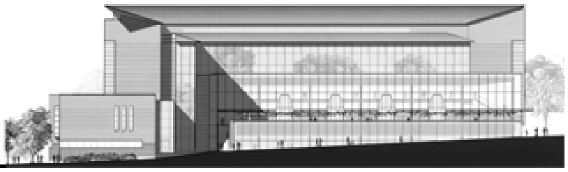
June 21, 10:00 AM, Overcast **June 21, 1:00 PM, Overcast**



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.

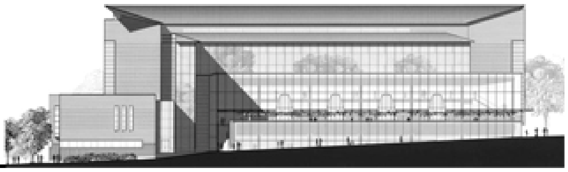
Design Concept

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.

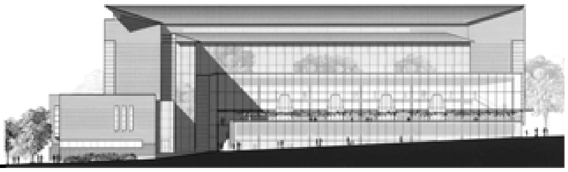
- *Light Distribution on Task Plane (Uniformity)*
  Uniform distribution on the task plane, which in the galleria is the floor, is important to ensure safety of passage through the space.

- *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.

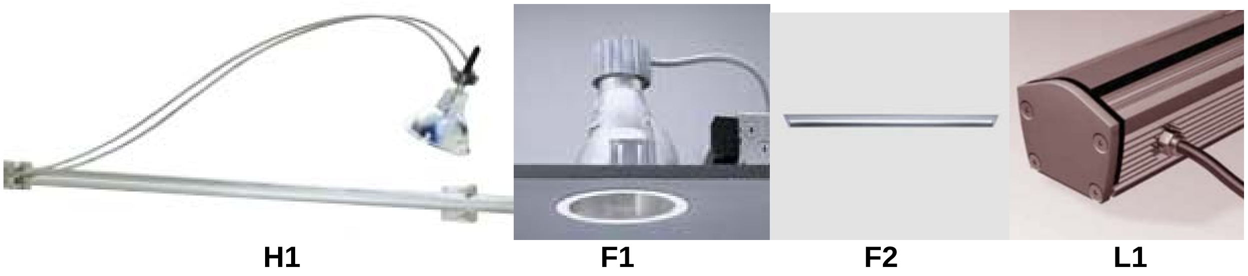
Luminaire Schedule

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.

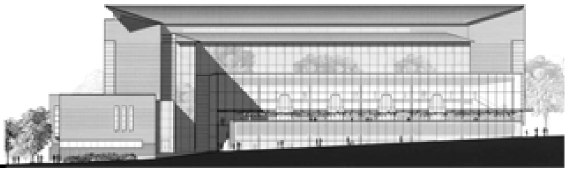
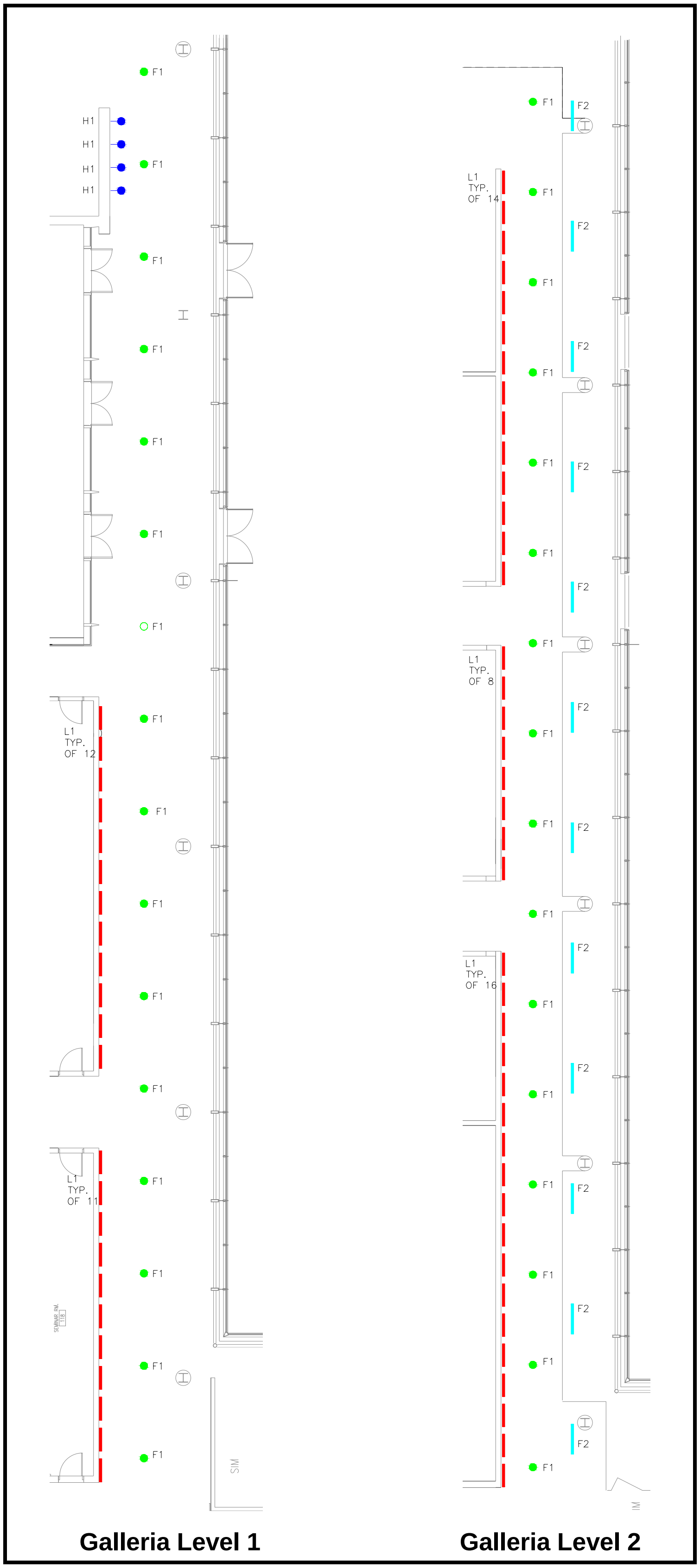
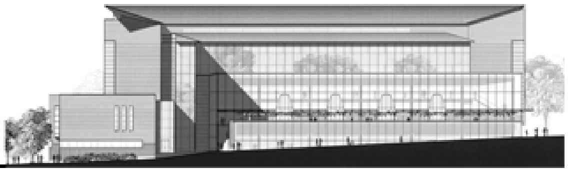


Figure 1.1.7 – Galleria Luminaire Layout





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.

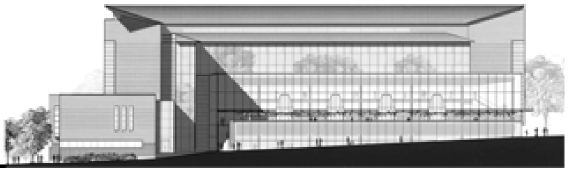


Table 1.1.6 – Automated Lighting Control Schedule

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.

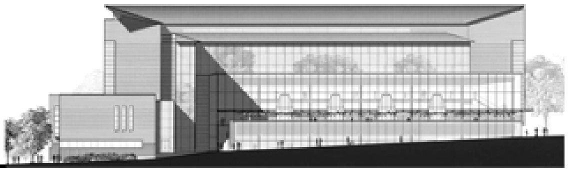
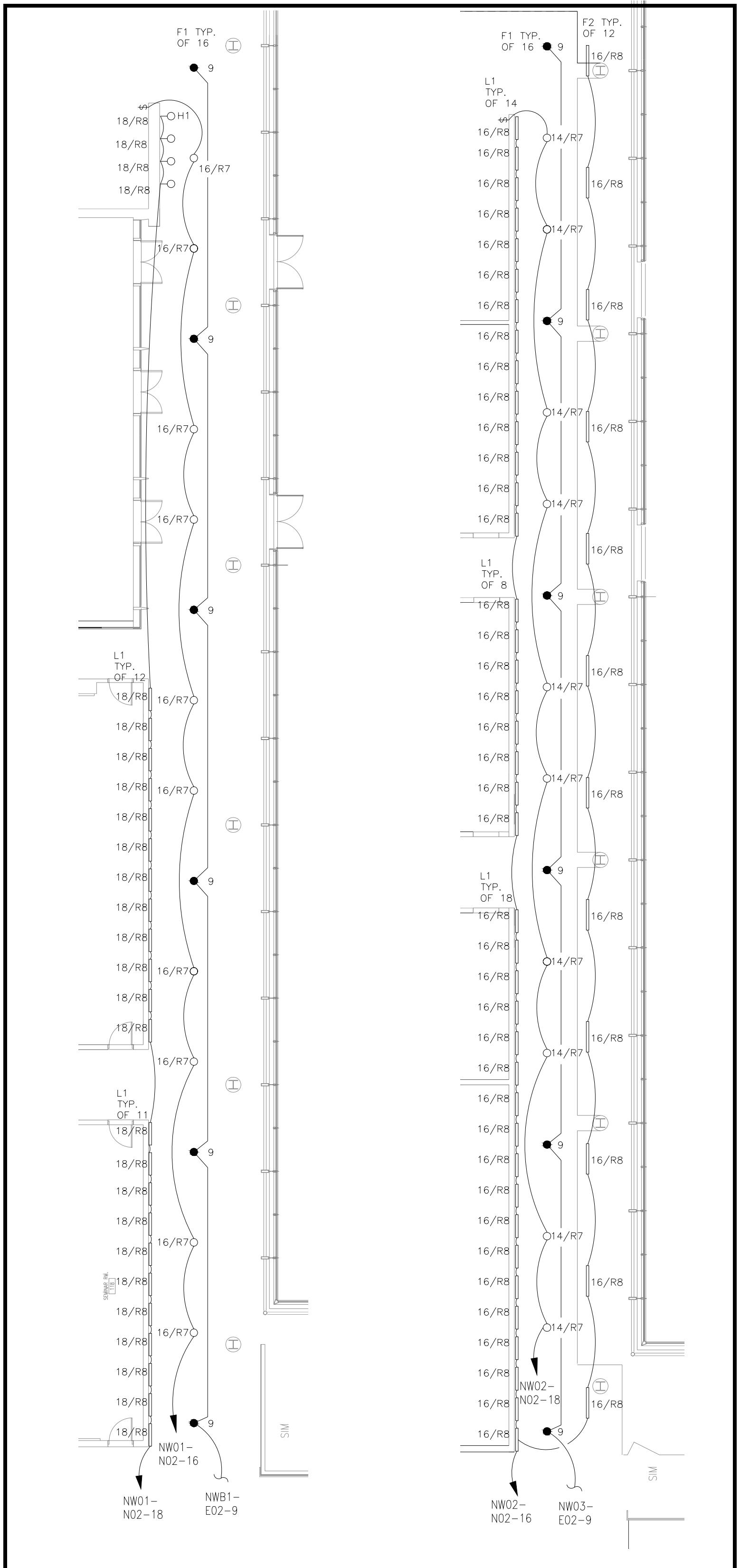


Figure 1.1.8 – Galleria Lighting Power Plan



Galleria Level 1 **Galleria Level 2**

Details

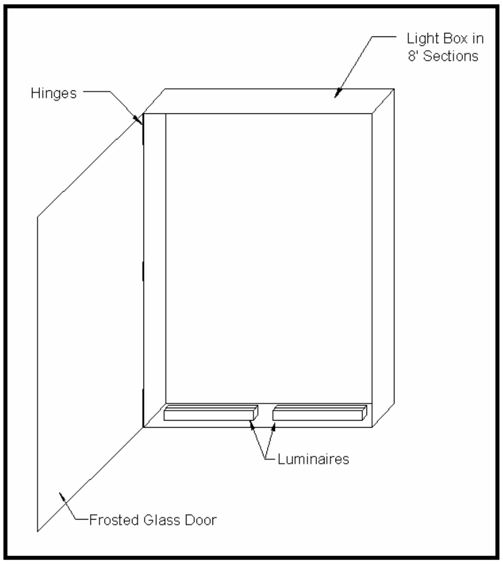


Figure 1.1.9 – Backlit Frosted Glass Detail

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.

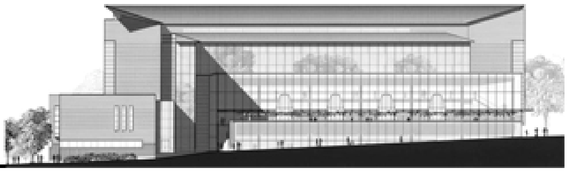


Table 1.1.9 –Power Density

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.

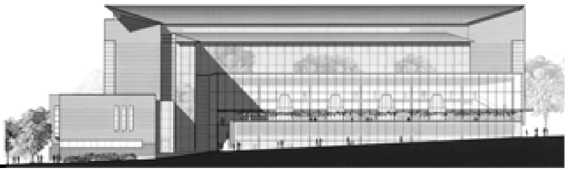


Table 1.1.10 - Illuminance Values (fc)

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

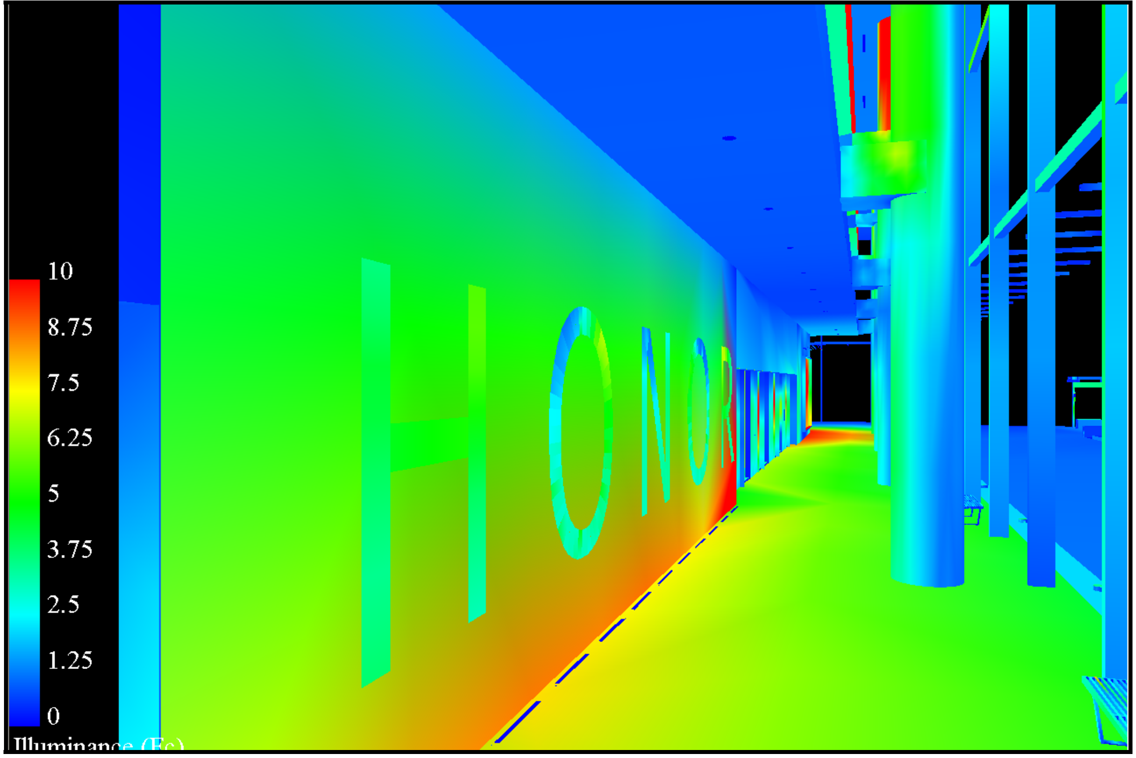


Figure 1.1.11 – Galleria Level 2 – Pseudo Color

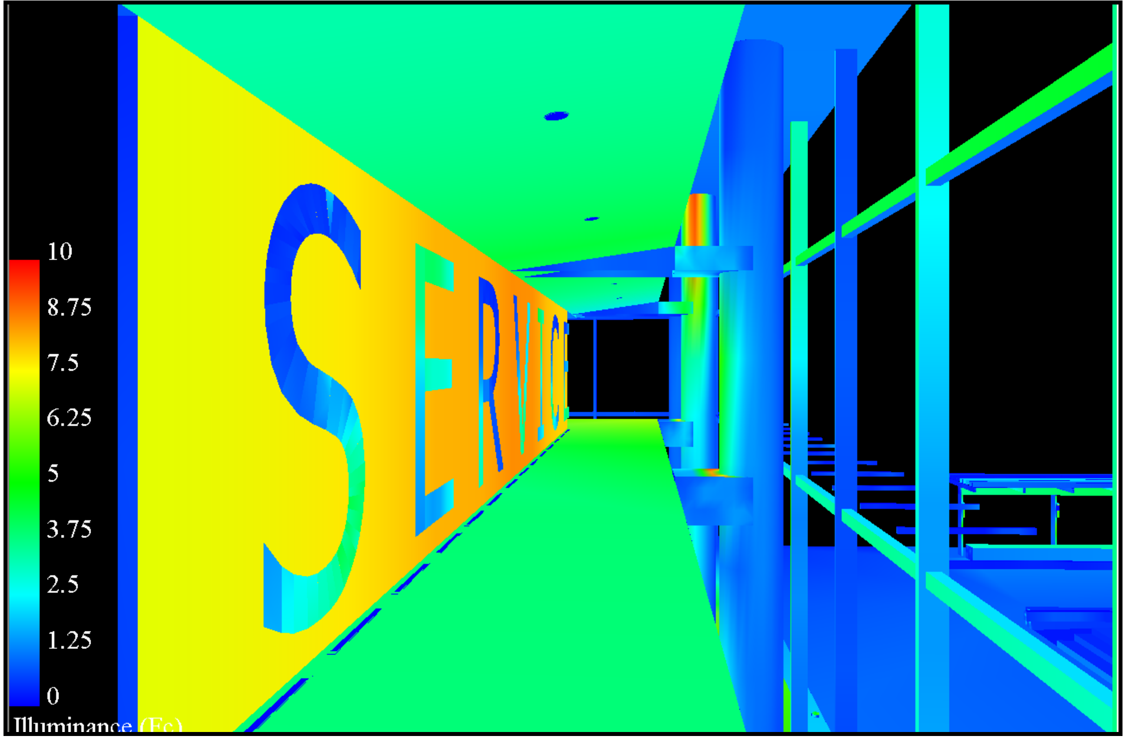
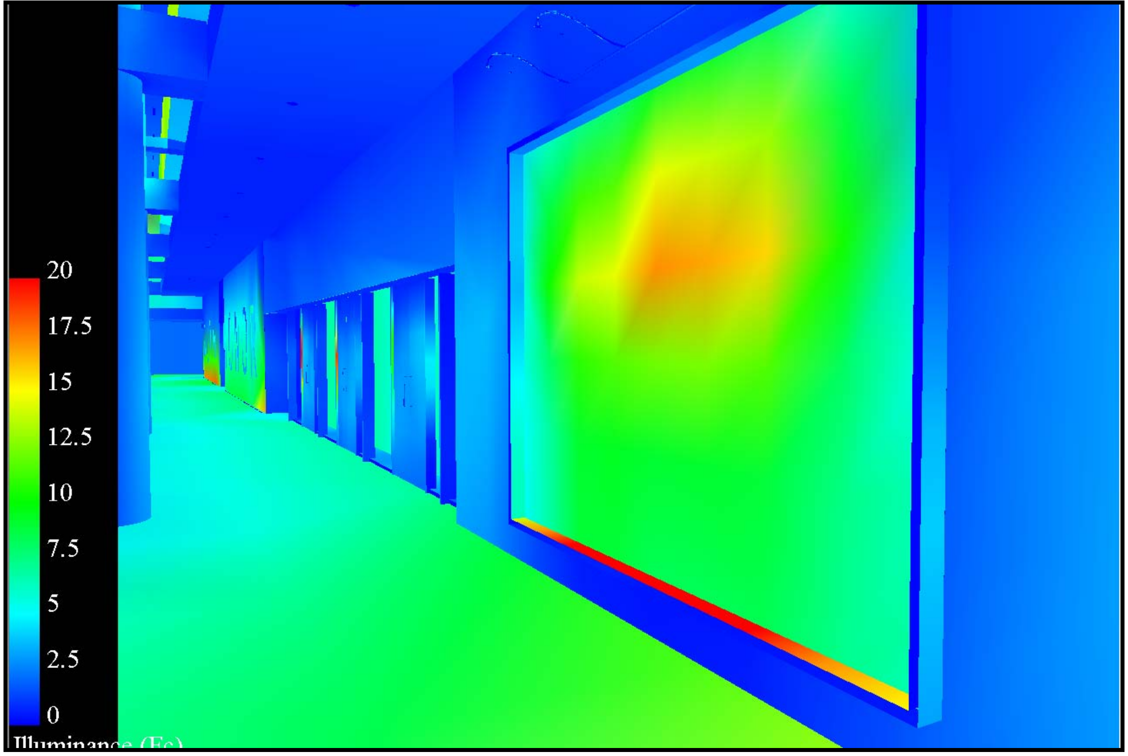
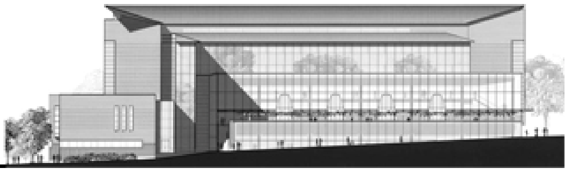


Figure 1.1.12 – Galleria Display Board (West Facing) – Pseudo Color





Renderings

Figure 1.1.13 – Galleria Exterior View

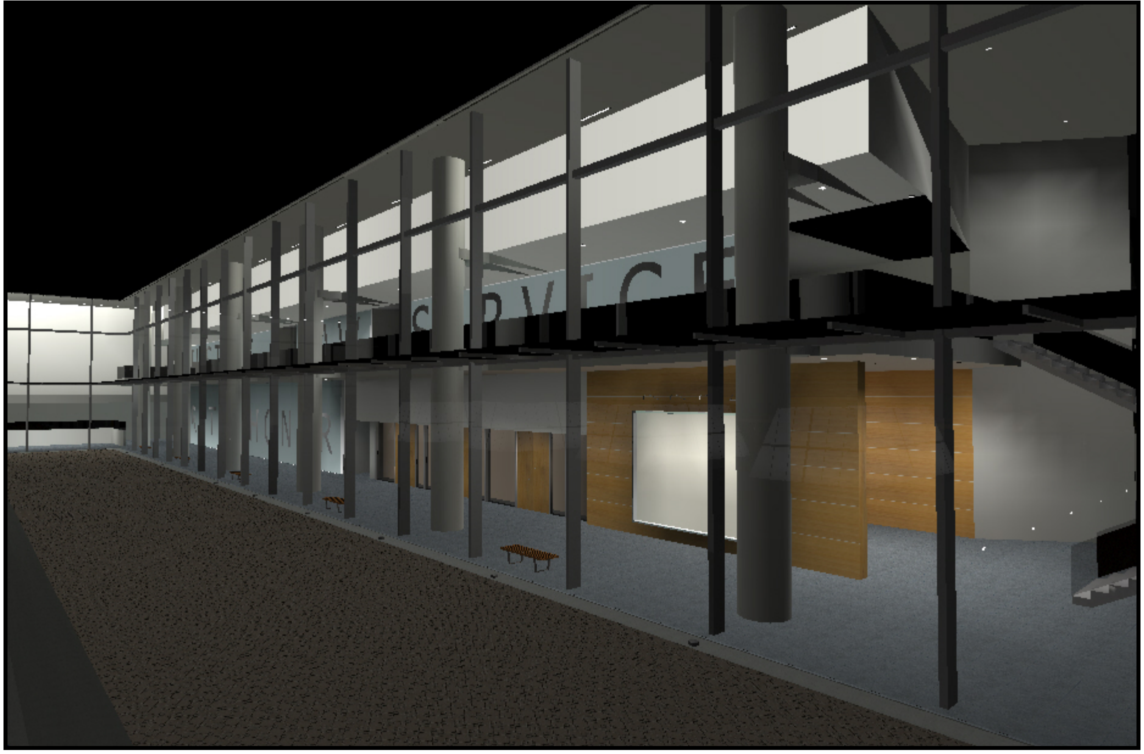


Figure 1.1.14 – Galleria Exterior View

Figure 1.1.15 – Galleria Level 1

Figure 1.1.16 – Galleria Level 1

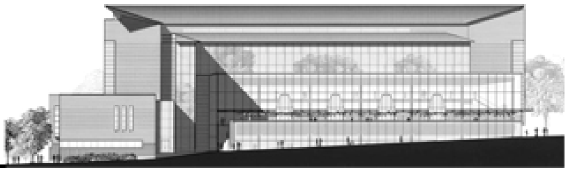
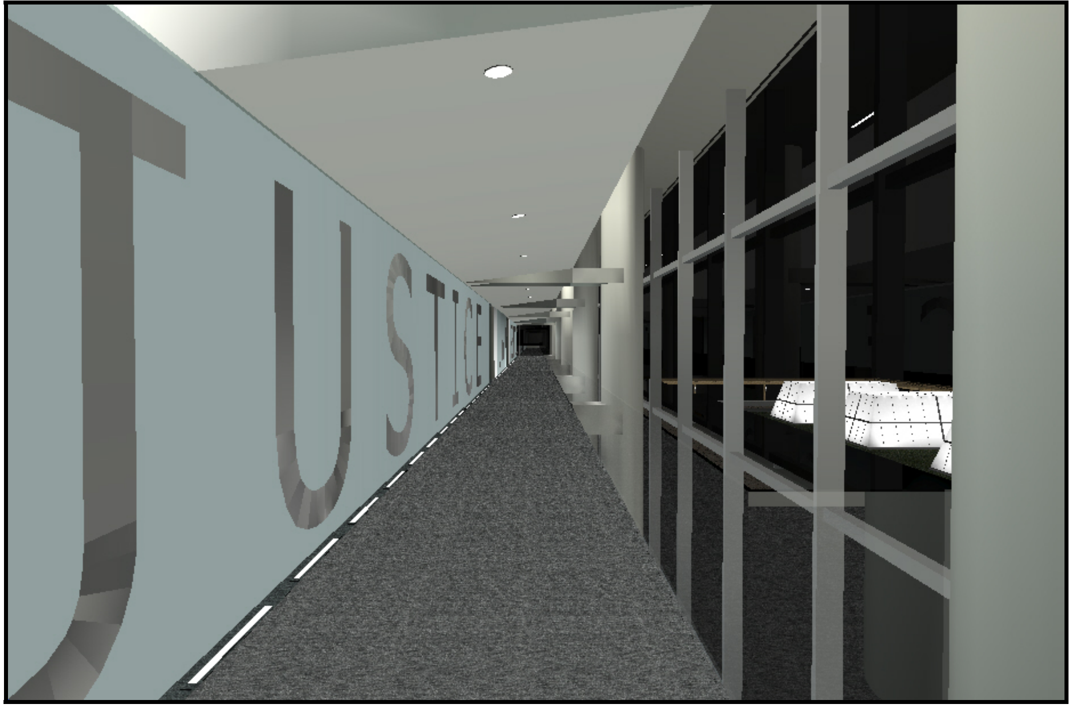


Figure 1.1.17 – Galleria Level 1

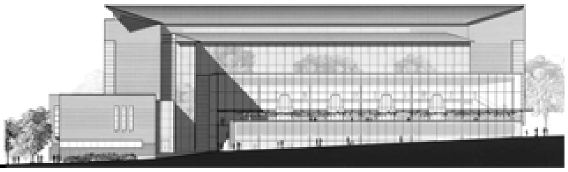
Figure 1.1.18 – Galleria Level 2

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.

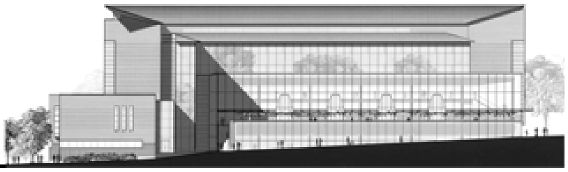
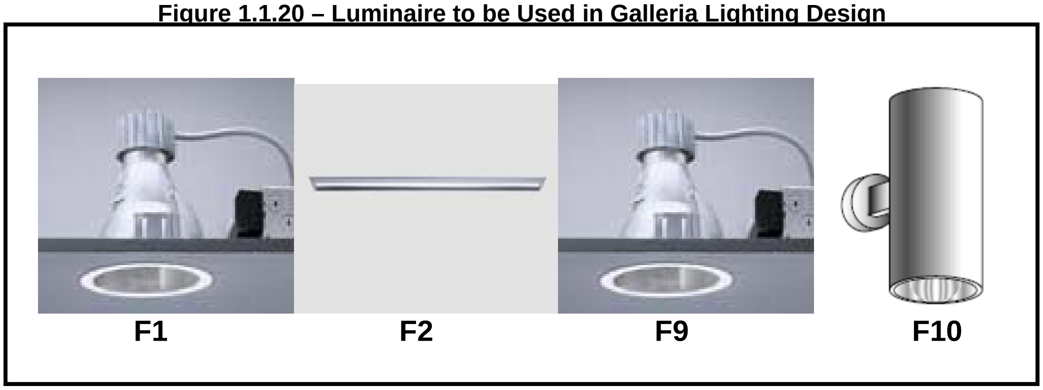


Table 1.1.11 – Luminaire Schedule

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



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.

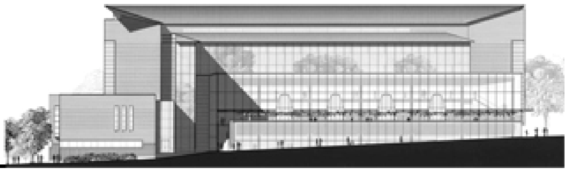
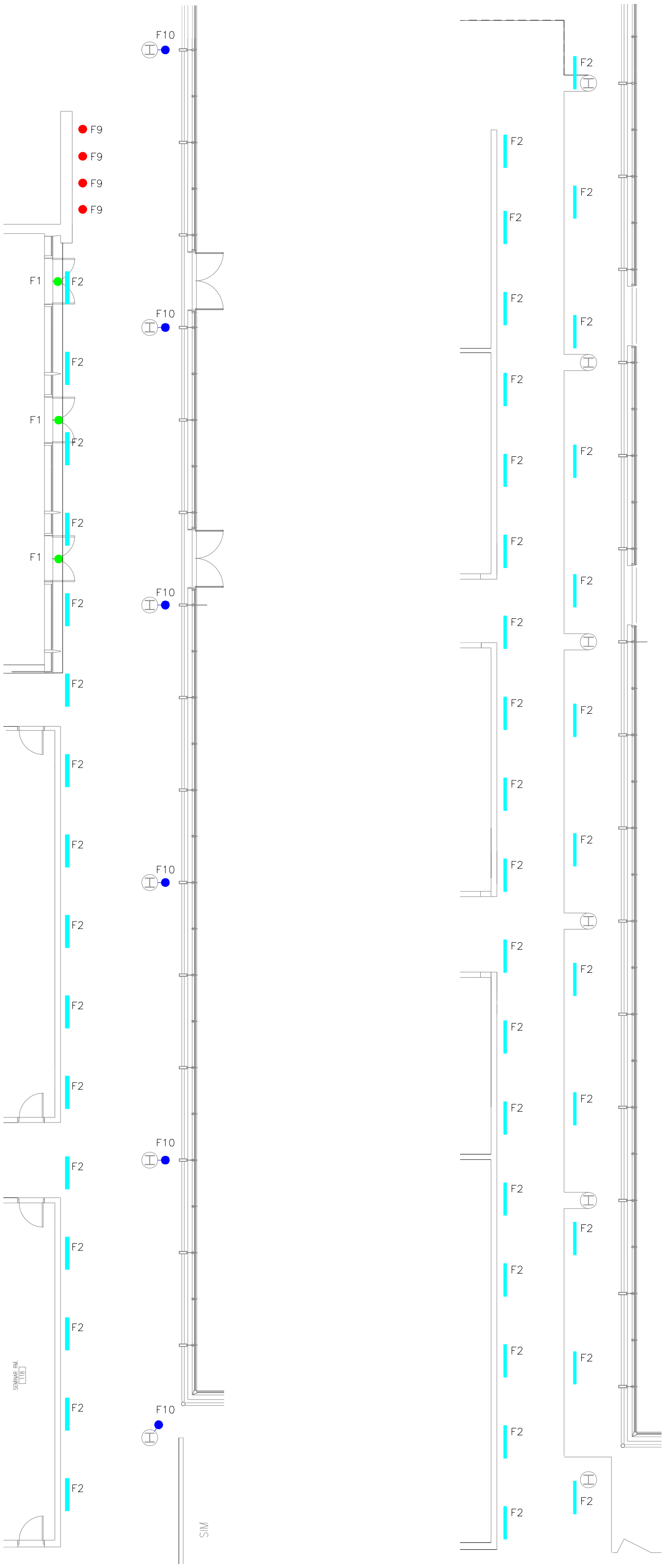
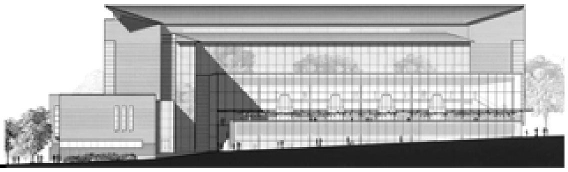


Figure 1.1.21 – Galleria Luminaire Layout



Galleria Level 1 **Galleria Level 2**



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.

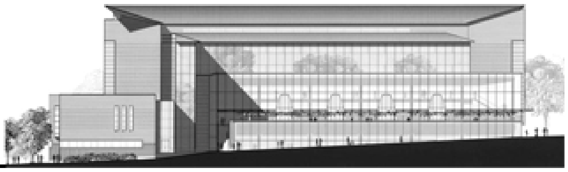


Table 1.1.11 – Automated Lighting Control Schedule

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.

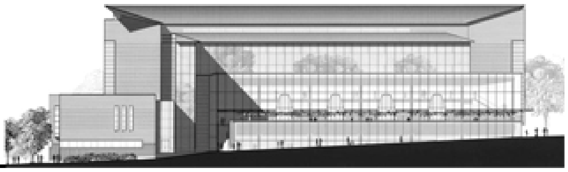
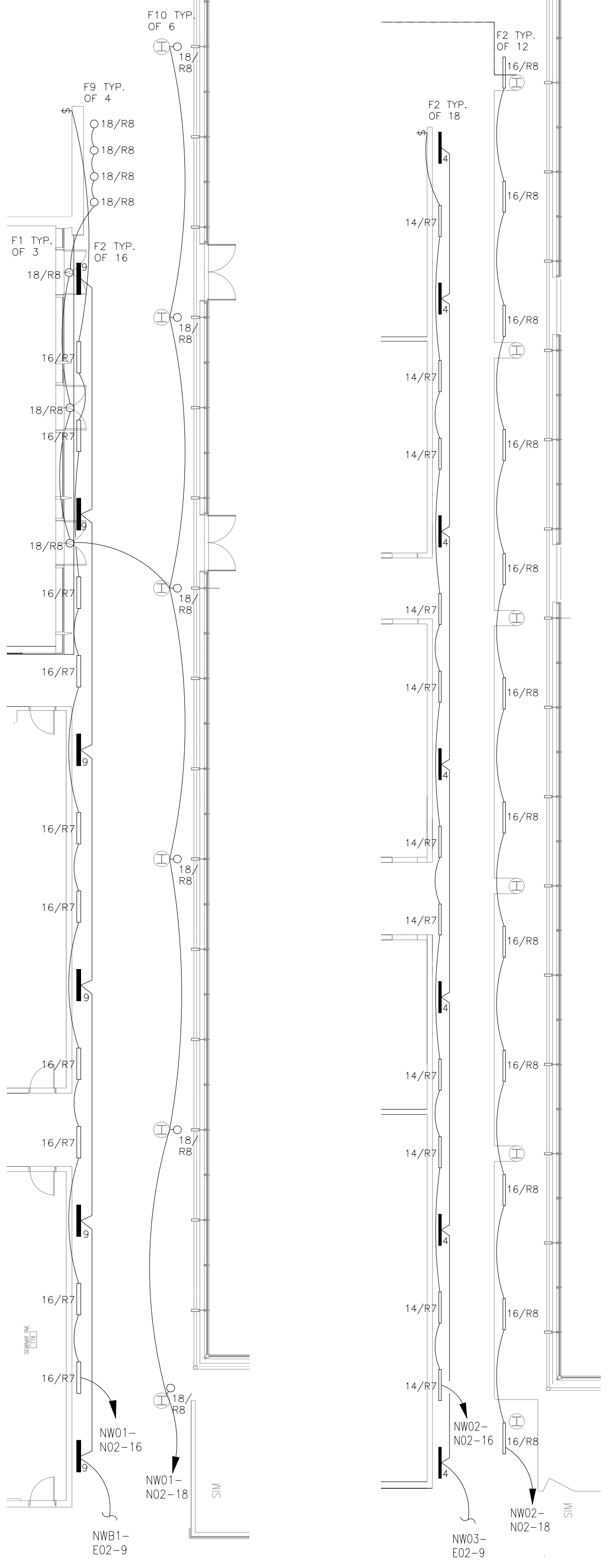
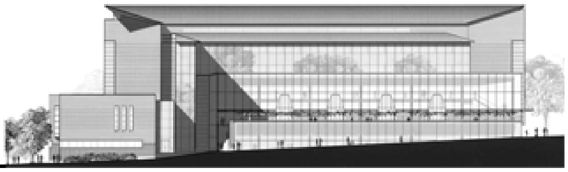


Figure 1.1.8 – Galleria Lighting Power Plan



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.

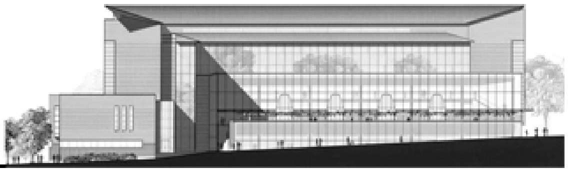
Table 1.1.14 – Power Density

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

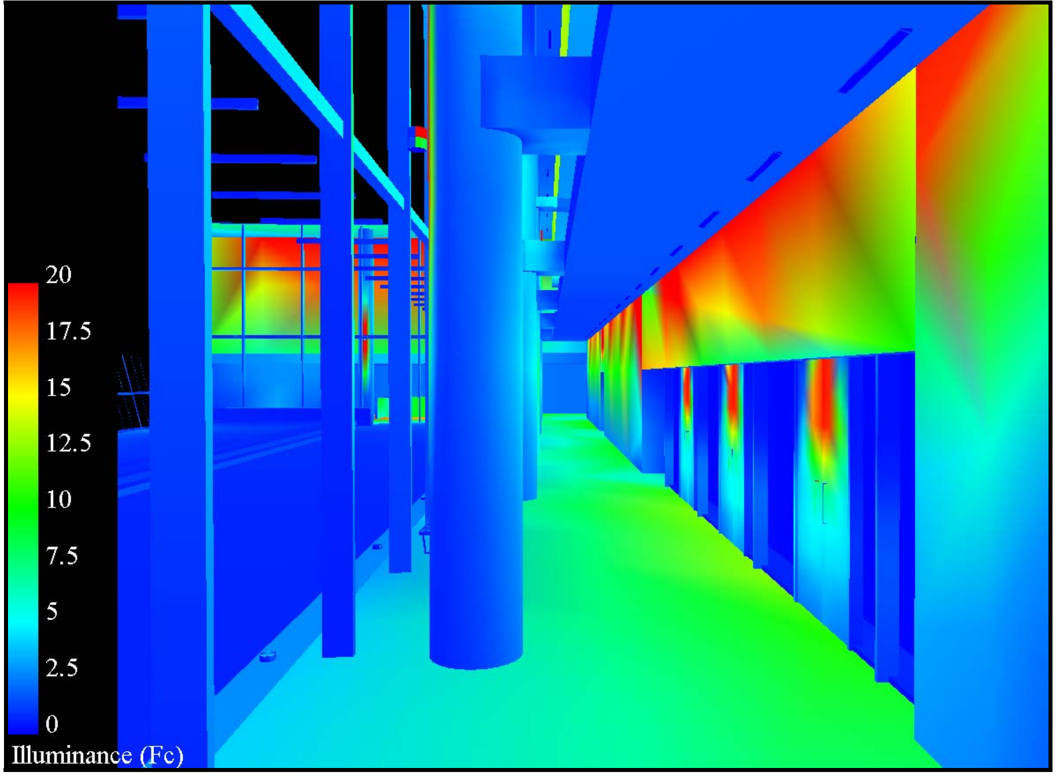
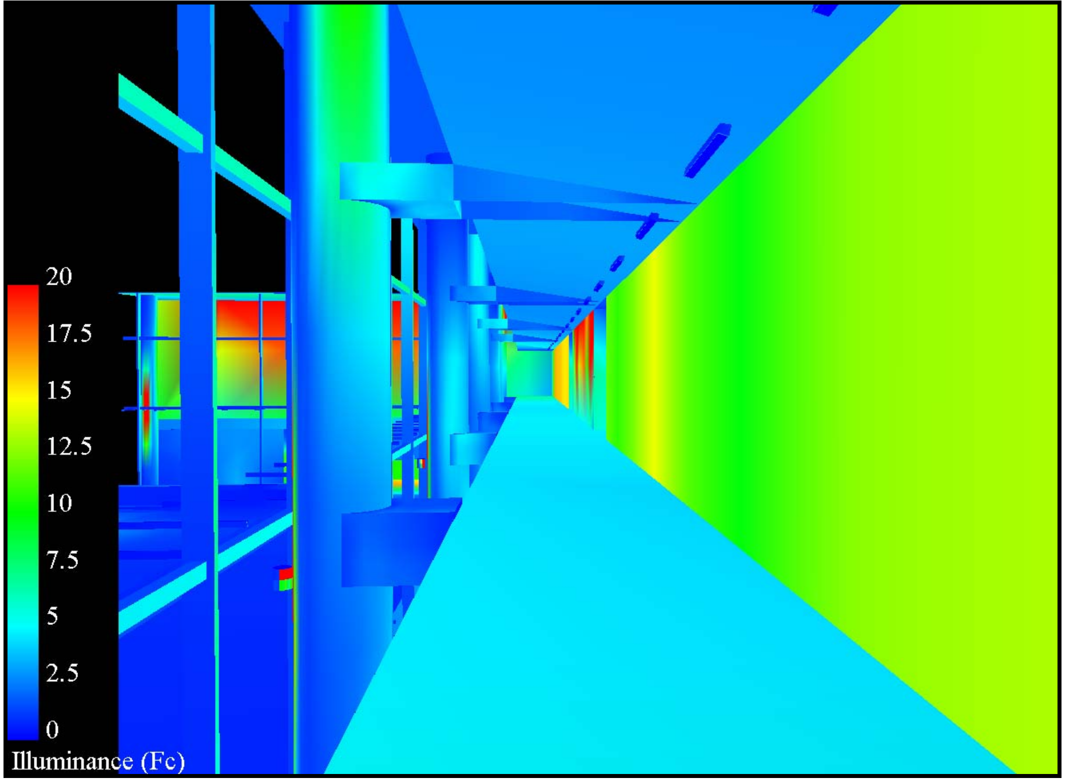
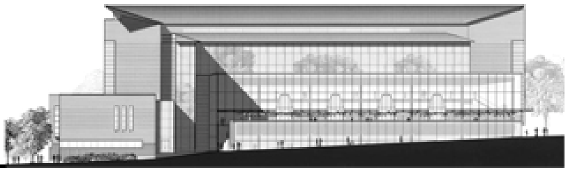


Figure 1.1.23 – Galleria Level 2 – Pseudo Color





Renderings

Figure 1.1.24 – Galleria Exterior View

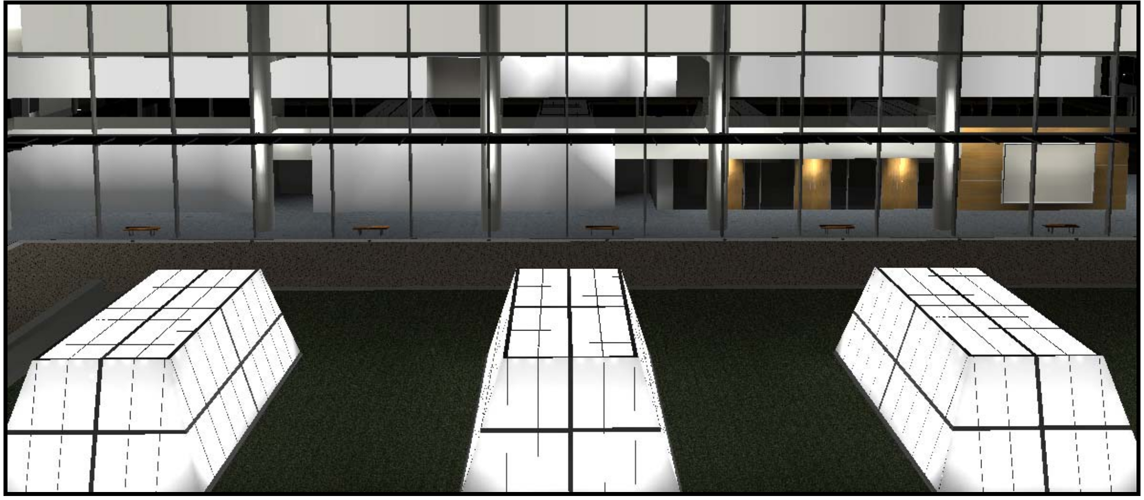
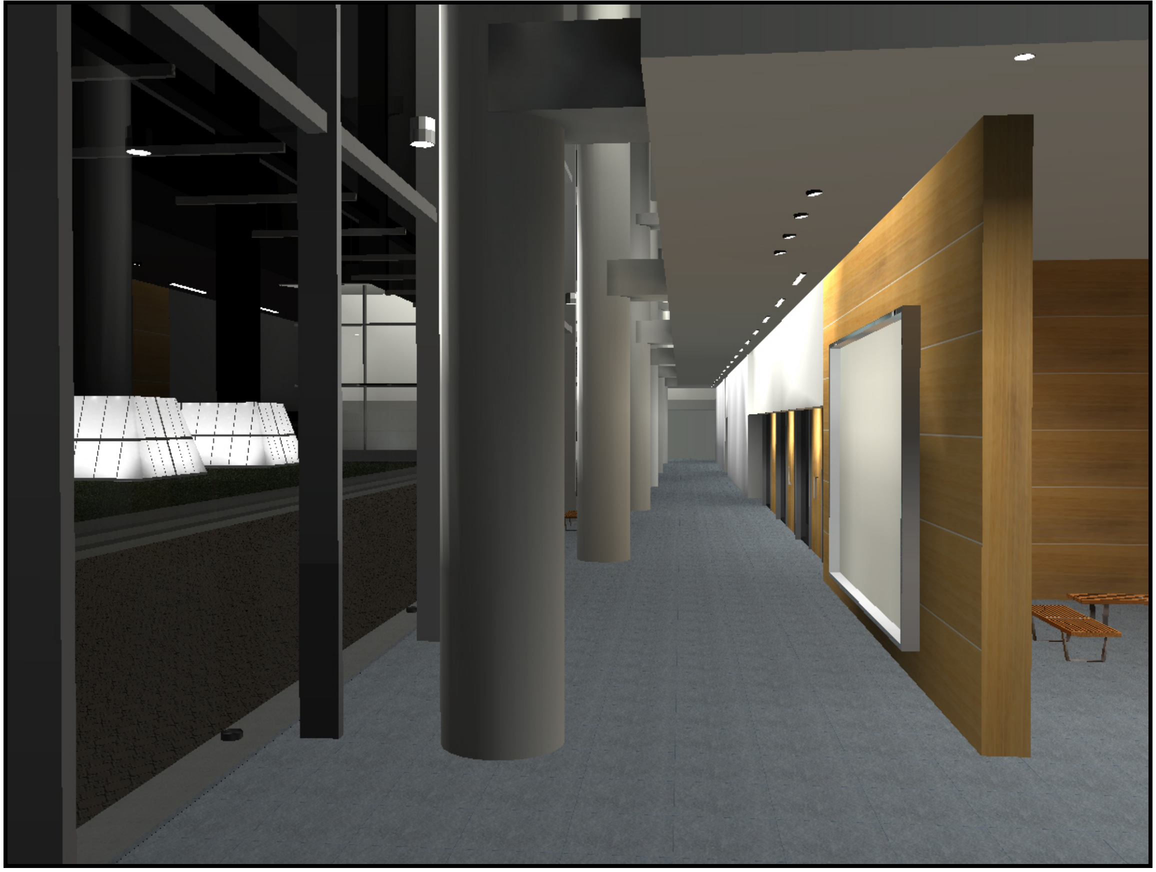


Figure 1.1.25 – Galleria Level 1



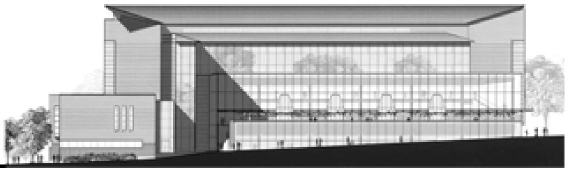
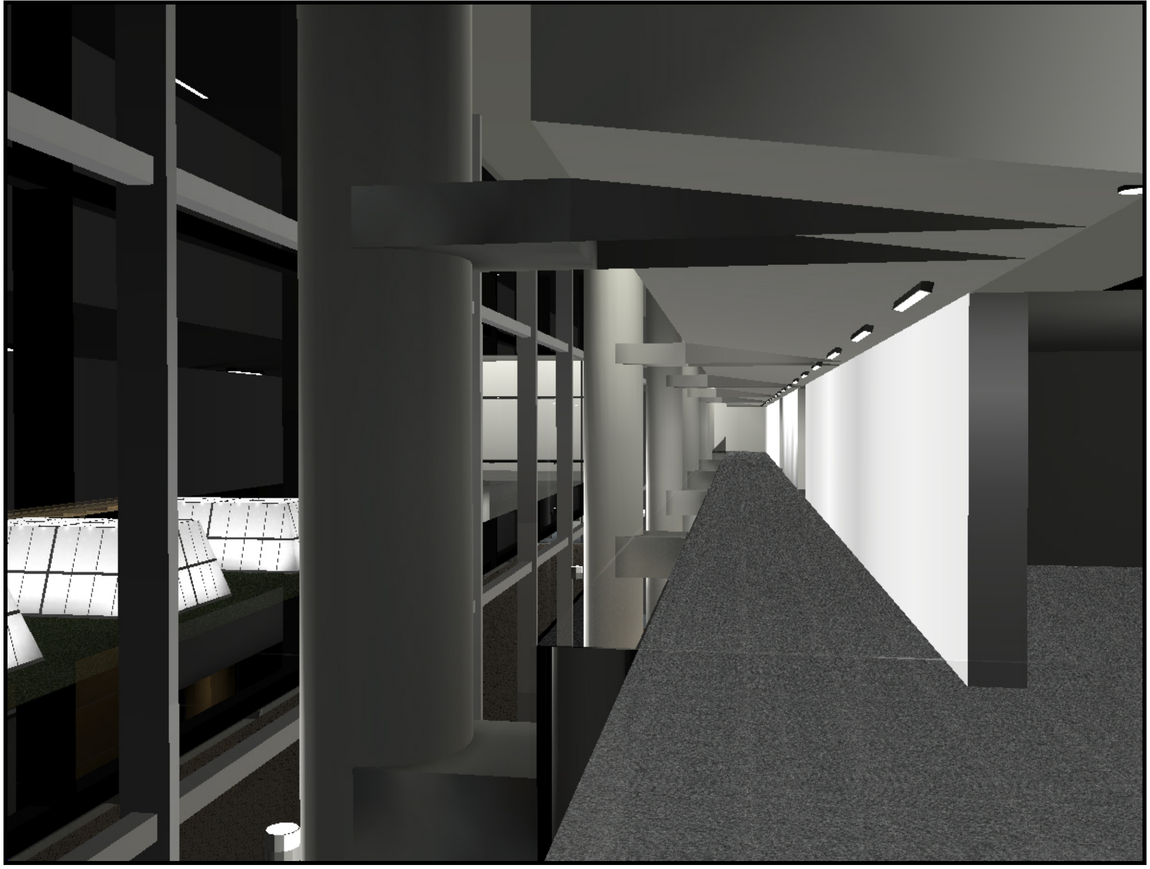
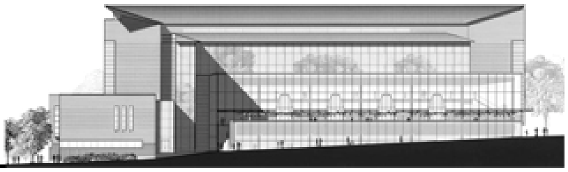


Figure 1.1.26 – Galleria Level 2



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.

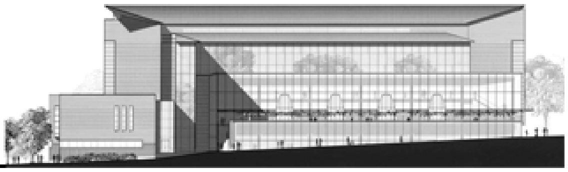


Comparison of Design Option #1 And Design Option #2

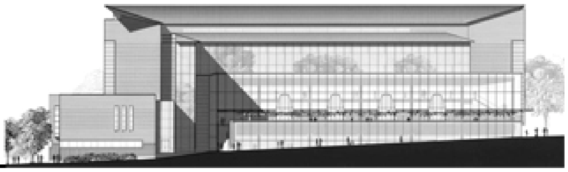
Two separate lighting designs have been proposed for the Susan and Jeffrey Brotman Galleria. Both of the designs address the lighting needs required throughout the space, while using different approaches to meet these requirements. Design Option #1 looks to utilize the length of the galleria walls as 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



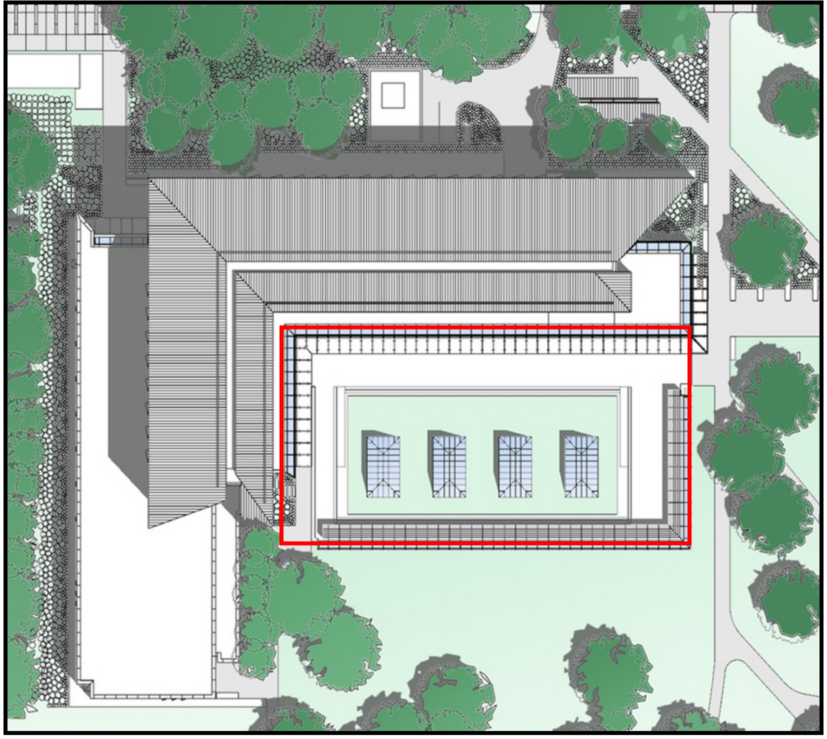
Introduction

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



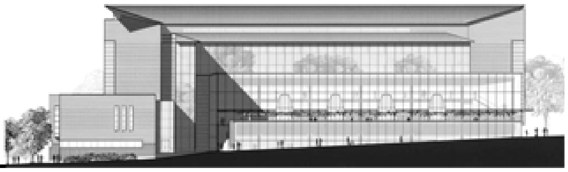
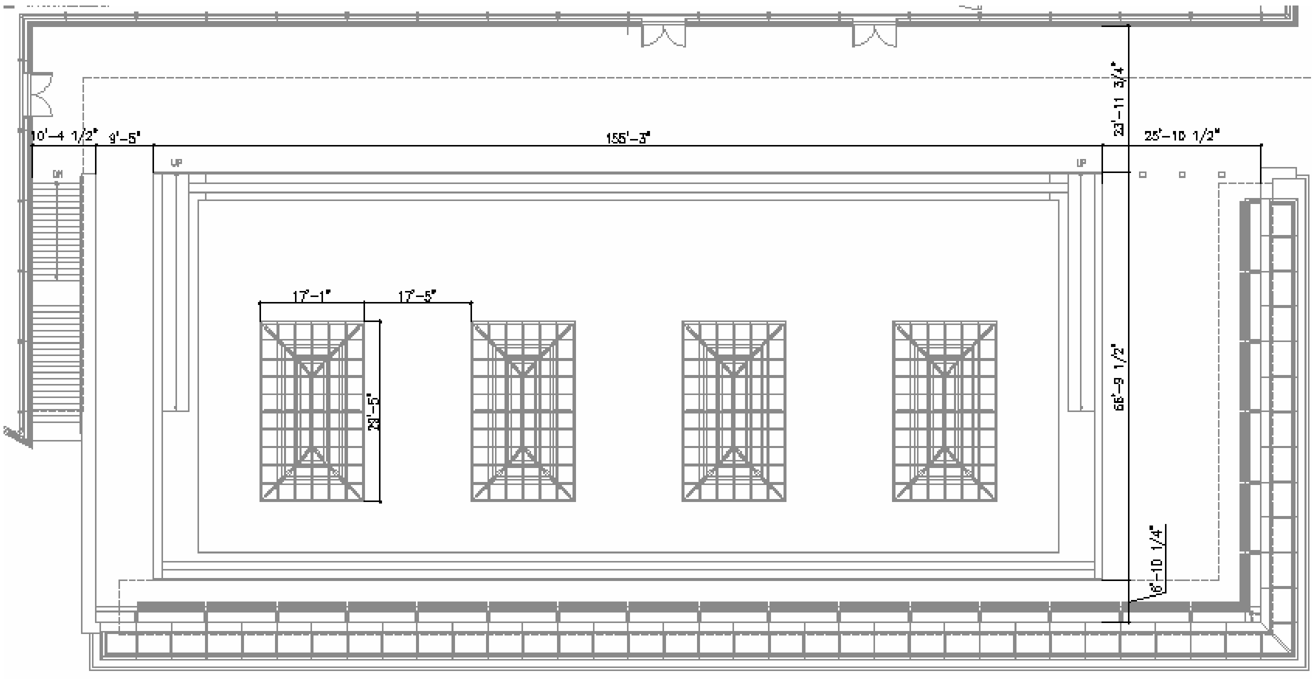


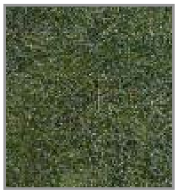
Figure 1.2.2 – Terrace Floor Plan



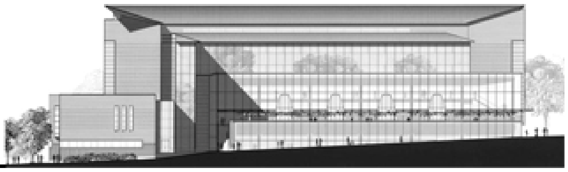
Architectural Finishes
Surface Materials & Reflectances

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.

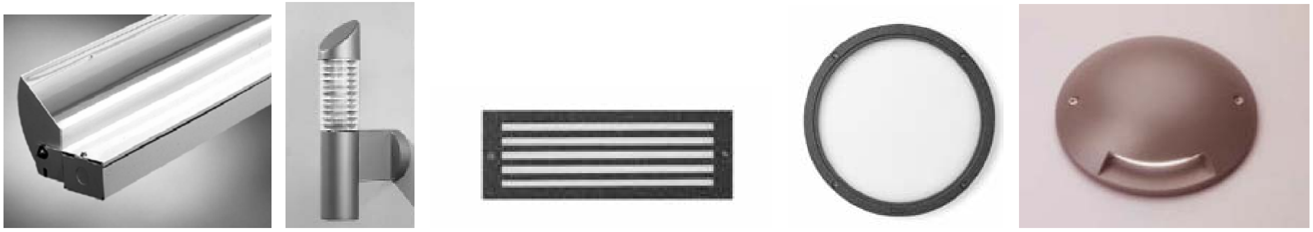
Luminaire Schedule

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.

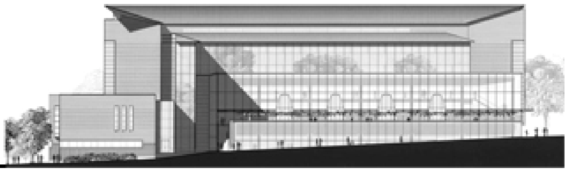
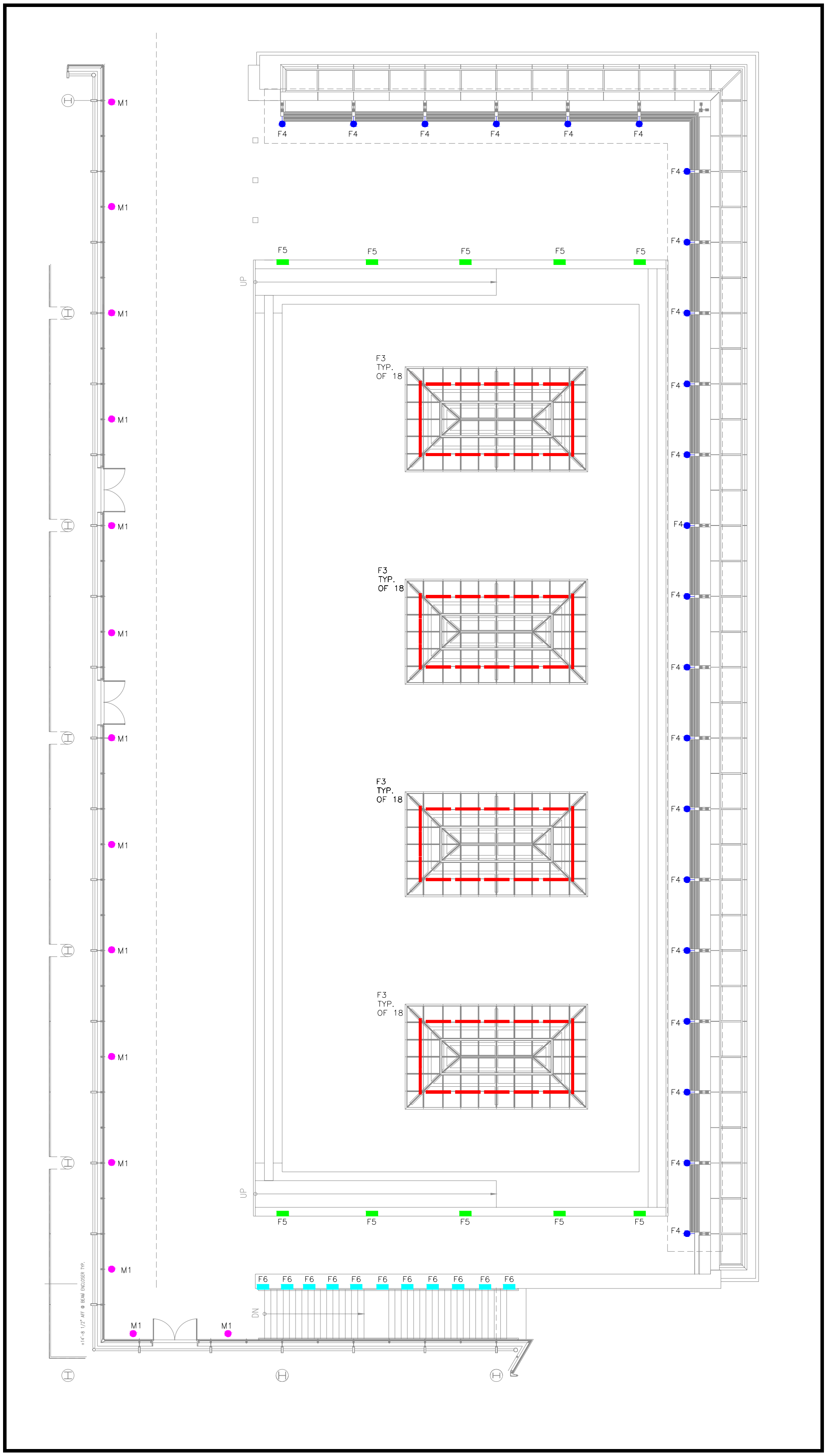
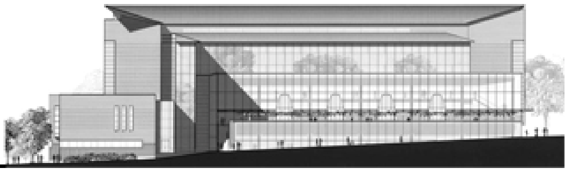


Figure 1.2.4 – Terrace Luminaire Layout





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.

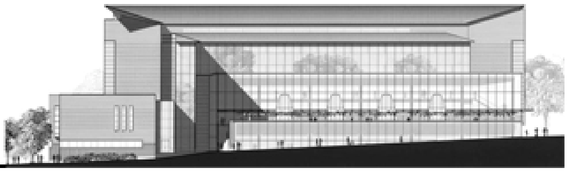
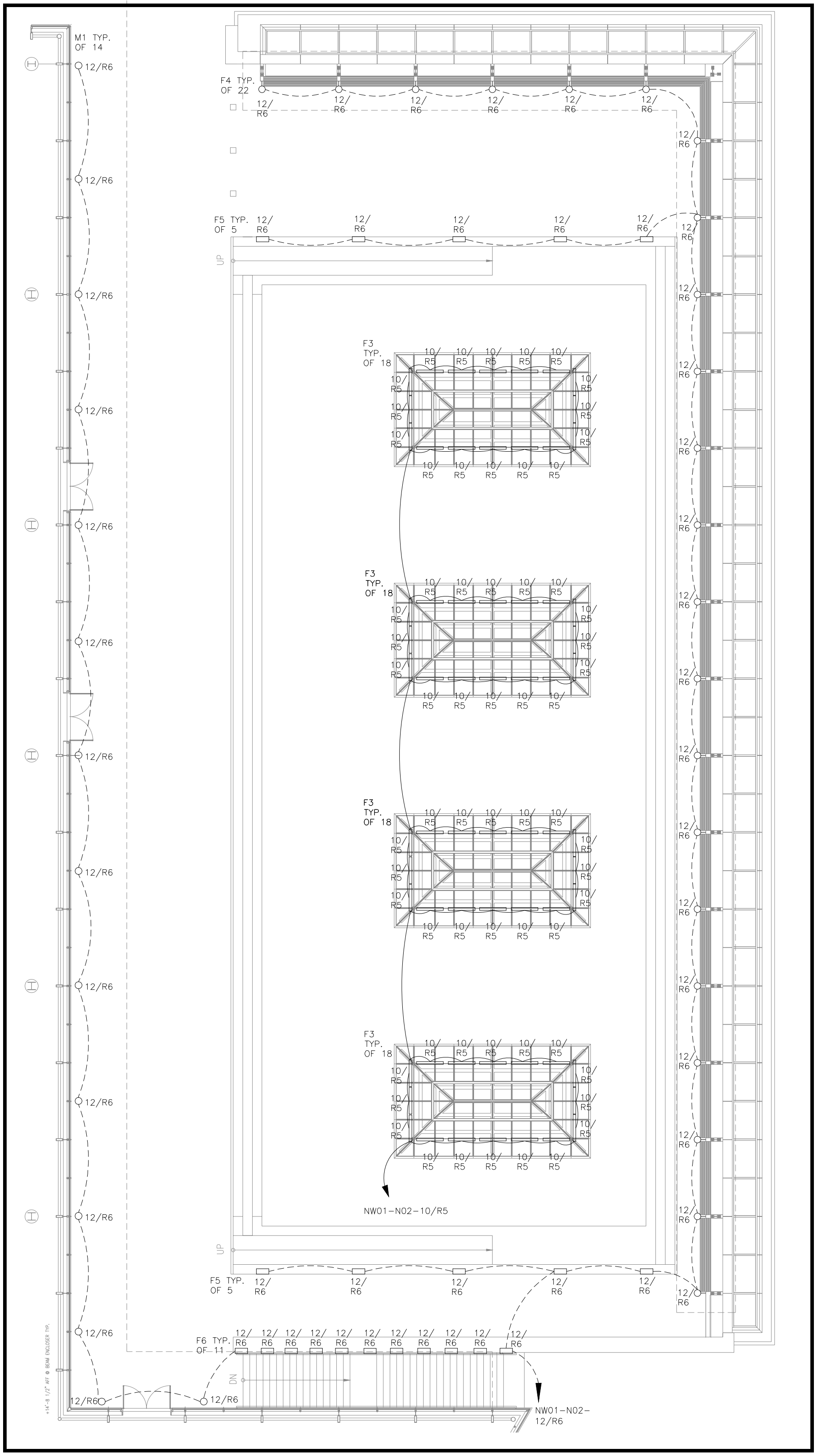
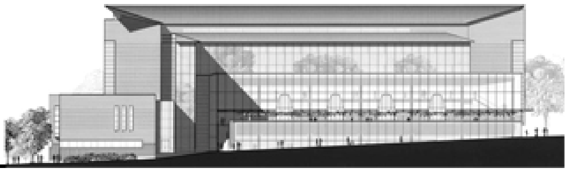


Figure 1.2.5 – Terrace Lighting Power Plan

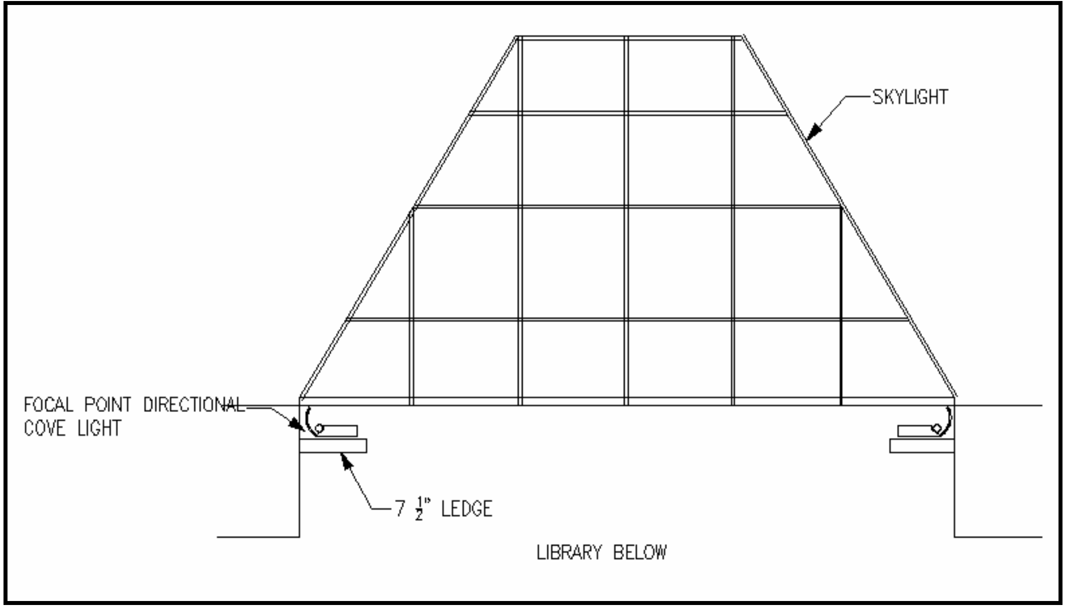




Details

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

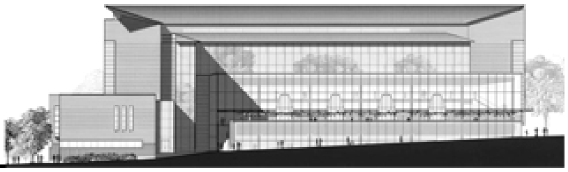


Light Loss Factors

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

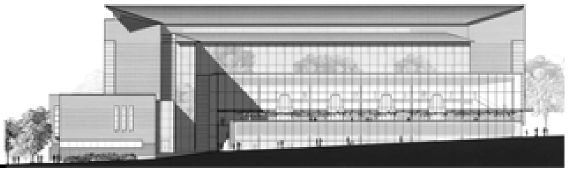
Luminare	Input Watts	Quantity	Watts
F3	30	64	1920
F4	27	22	594
F5	20	10	200
F6	20	11	220
M1	53	14	742
		Total Watts	3676
		Area (sq ft)	19450
		Power Density	**0.19**

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 Circuilation 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

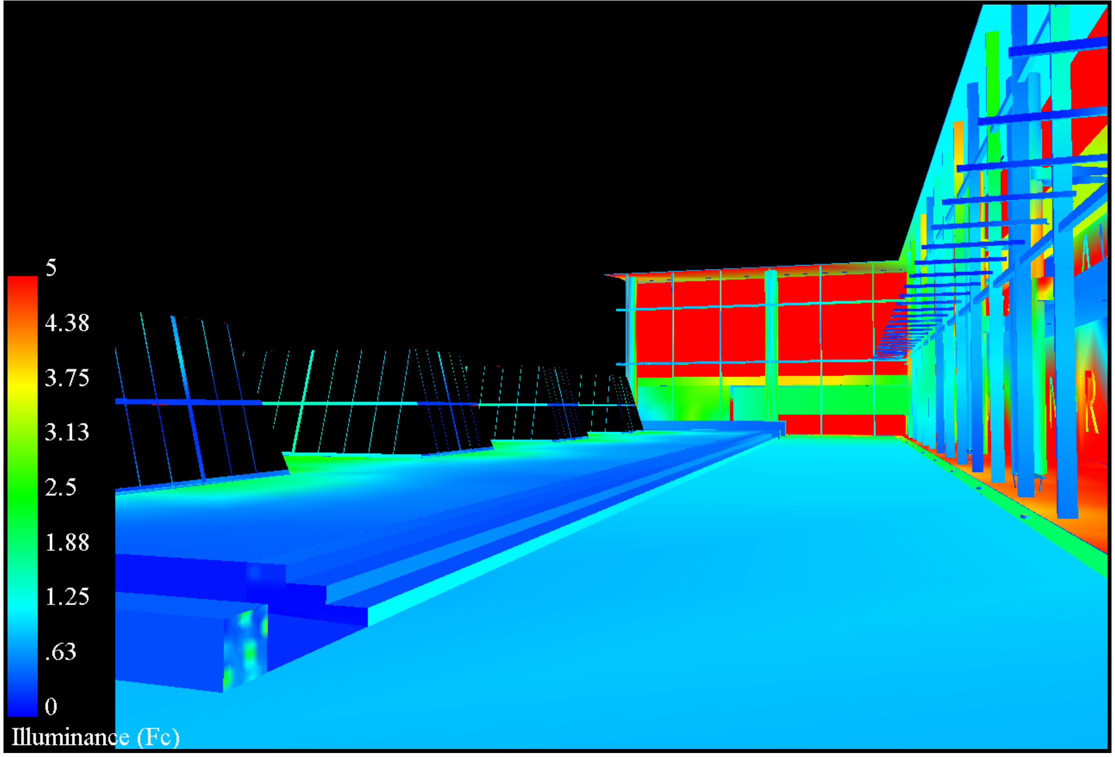
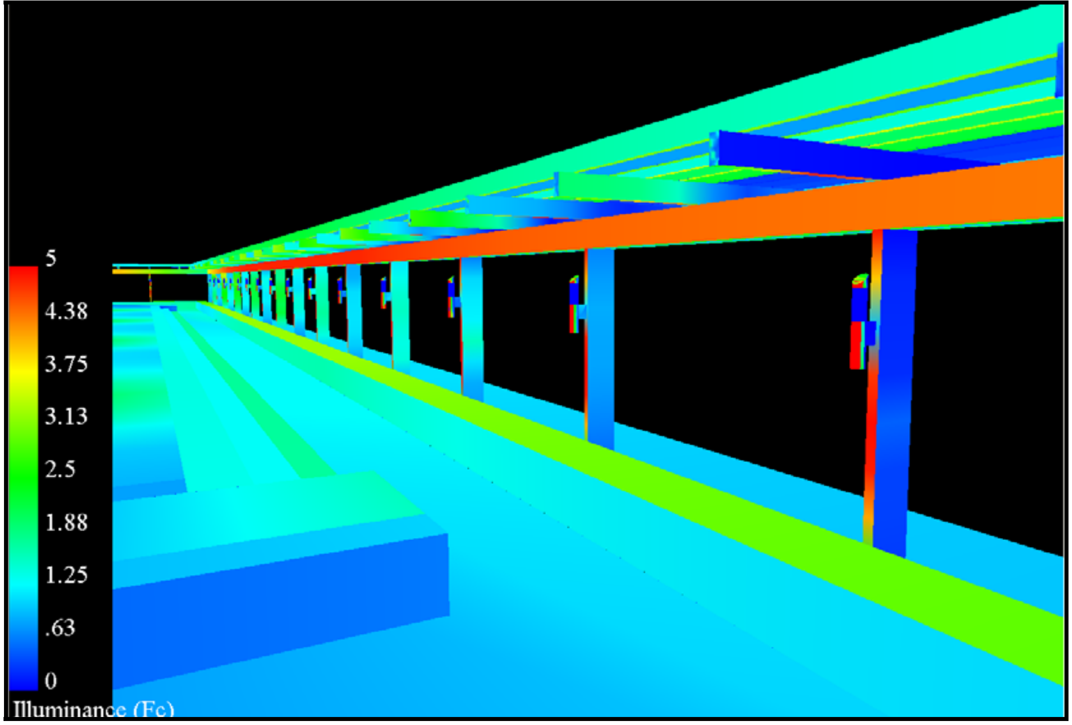
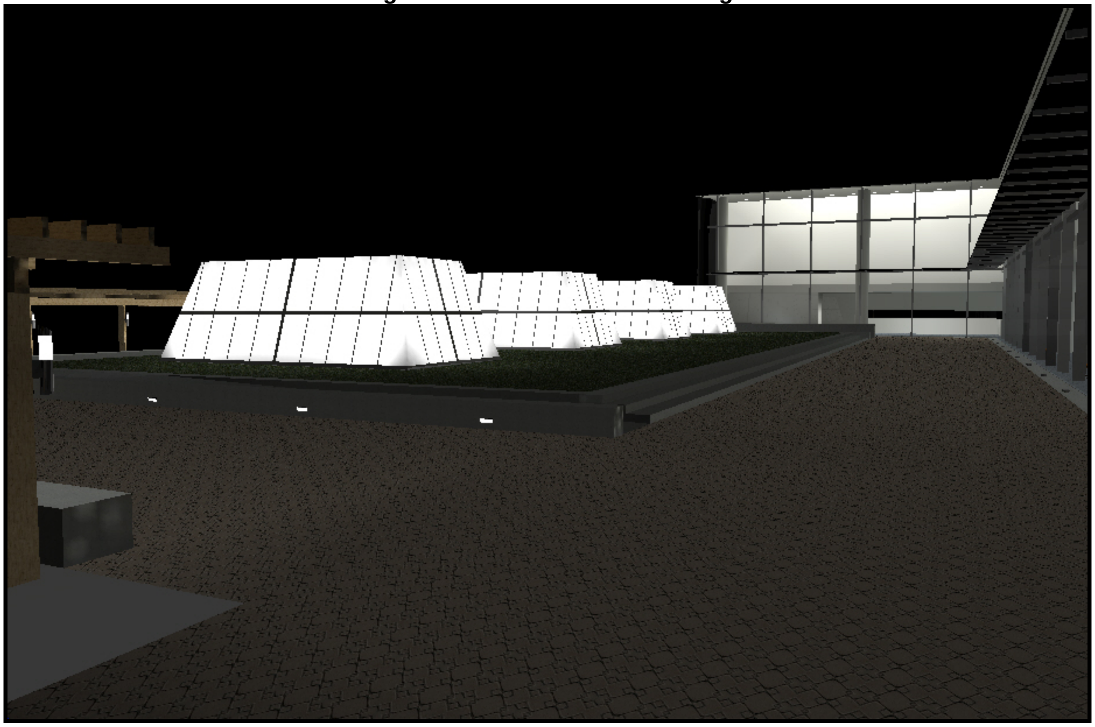


Figure 1.2.8 – Terrace – Pseudo Color



Renderings

Figure 1.2.9 – Terrace Rendering



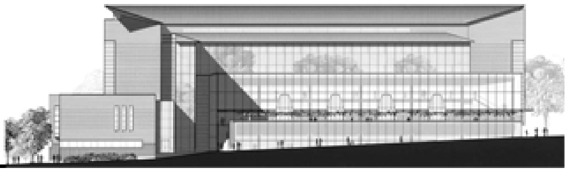


Figure 1.2.10 – Terrace Rendering

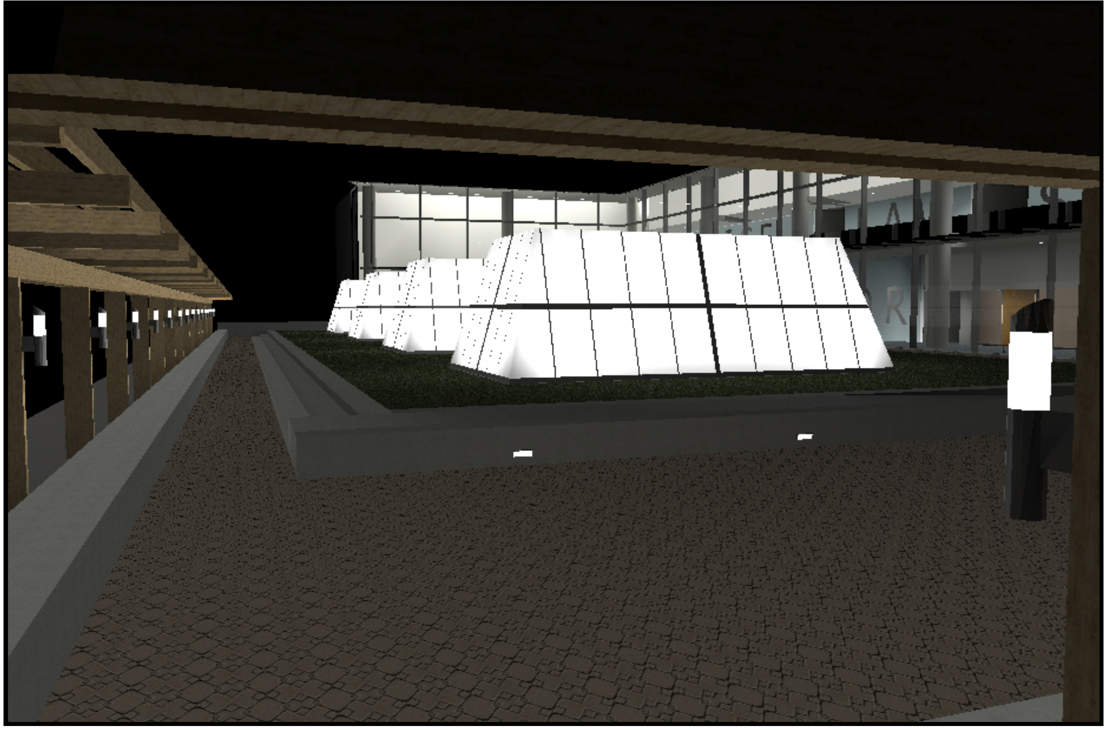
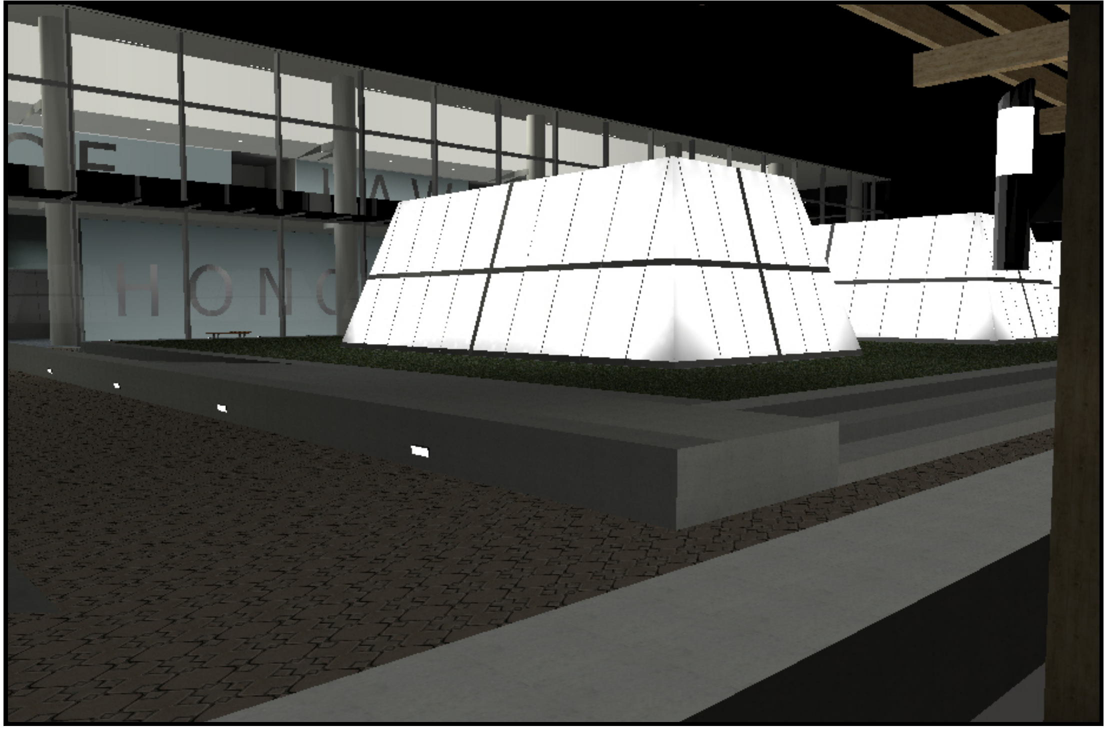


Figure 1.2.11 – Terrace Rendering



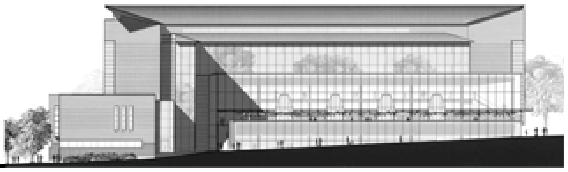


Figure 1.2.12 – Terrace Rendering

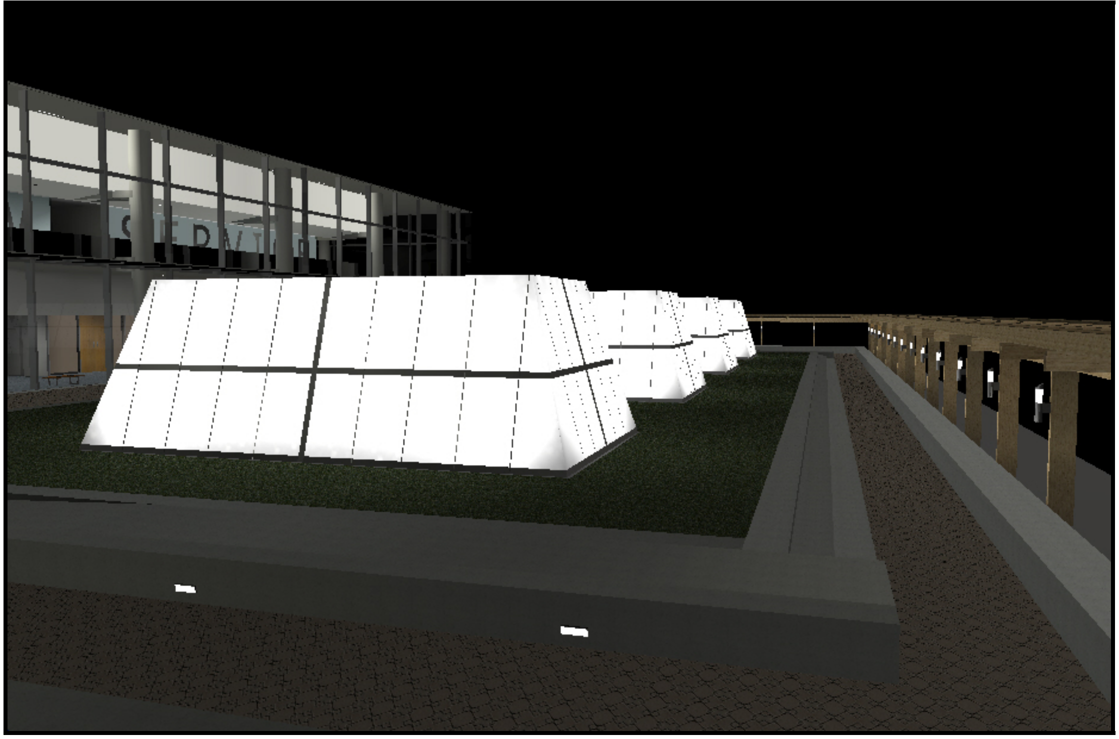
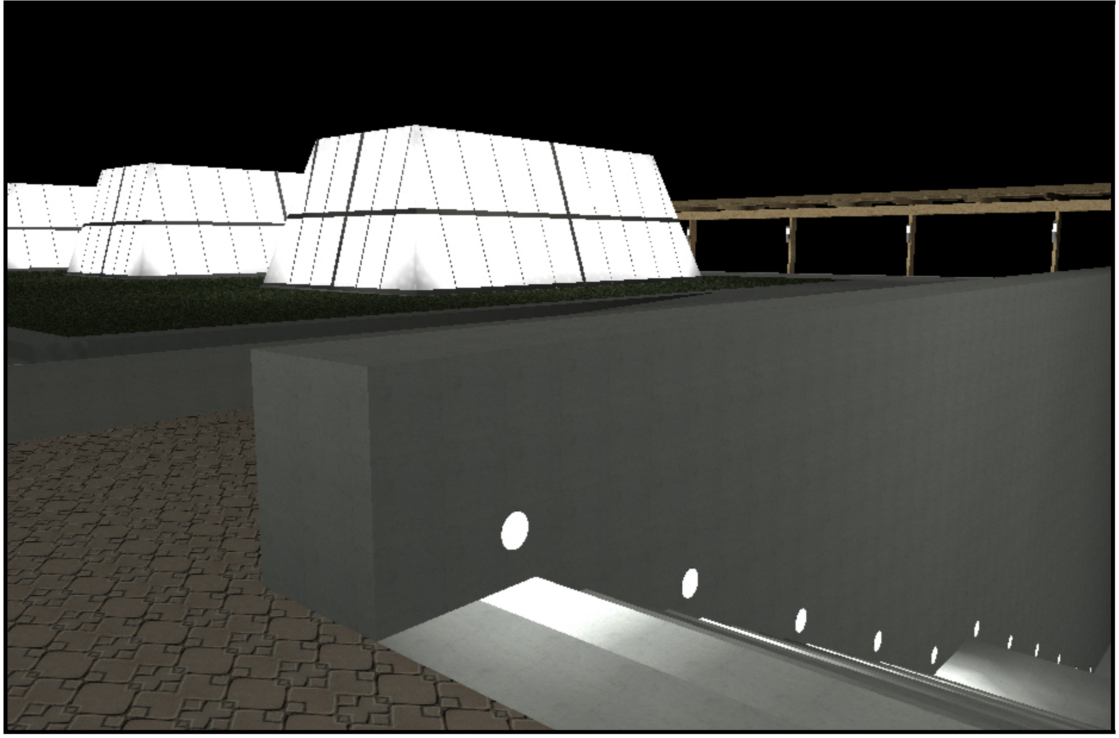
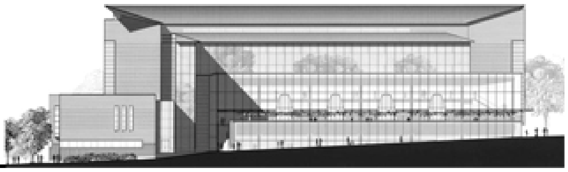


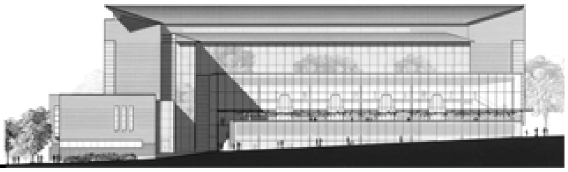
Figure 1.2.13 – Terrace Rendering



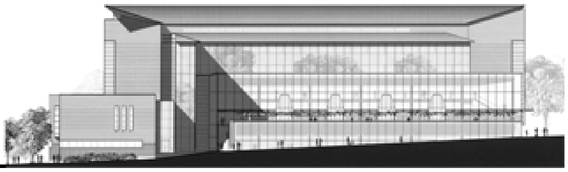


Conclusion

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



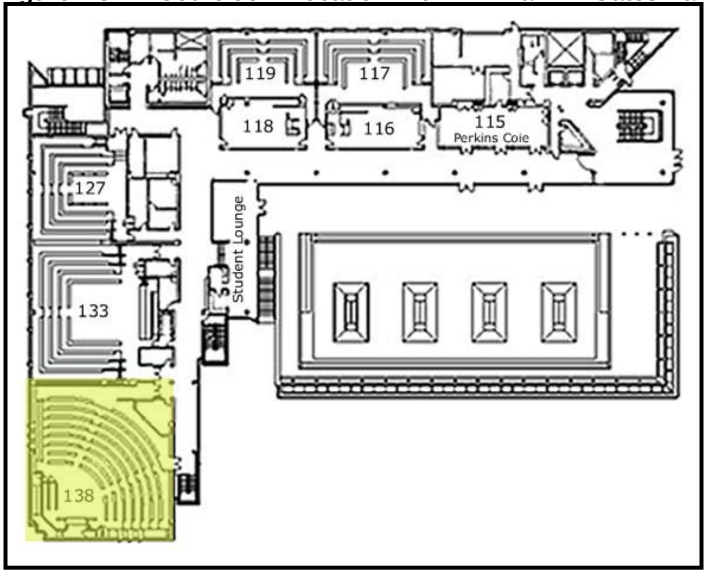
Introduction

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



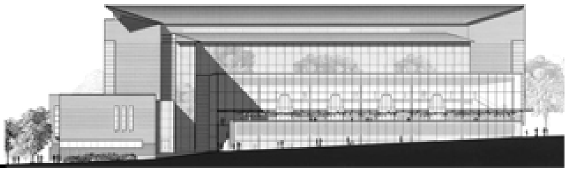
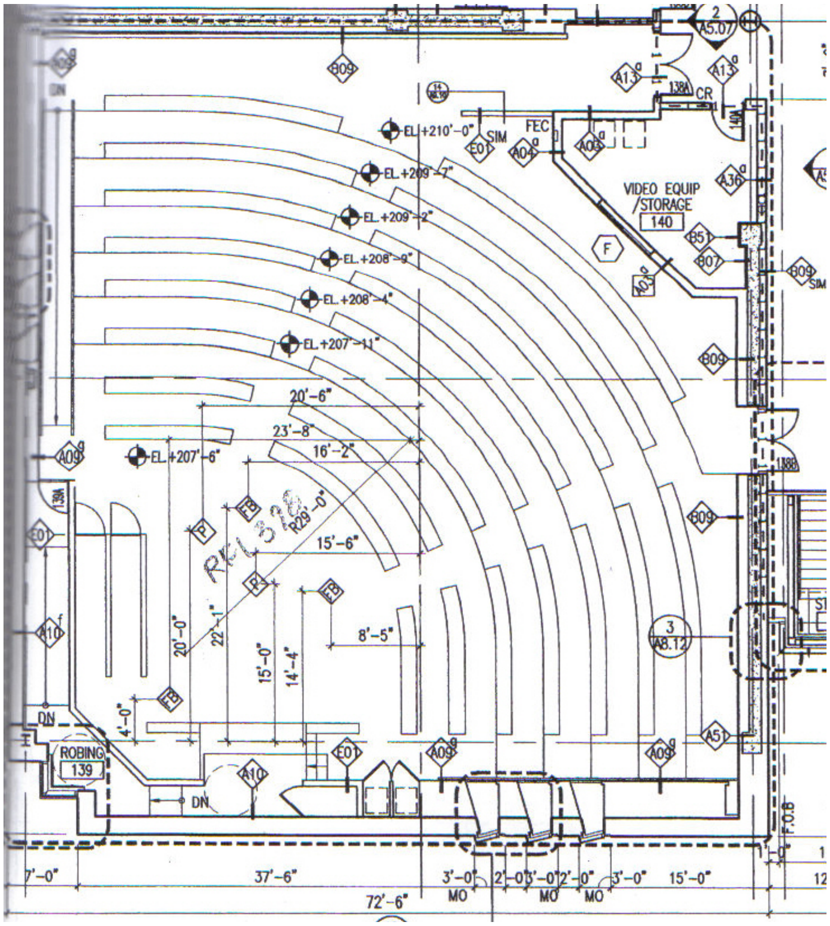


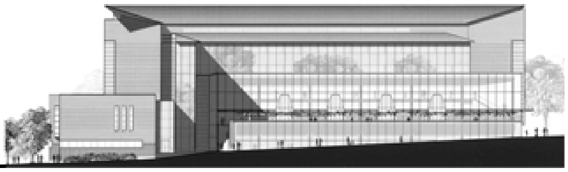
Figure 1.3.2 – Courtroom Floor Plan



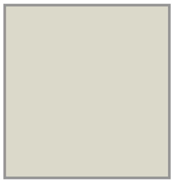
Architectural Finishes
Surface Materials & Reflectances

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%

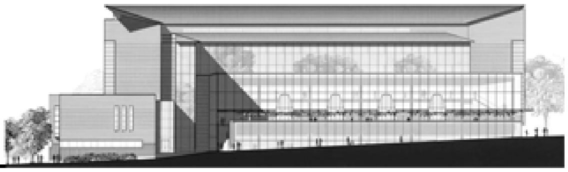
Ceilings

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

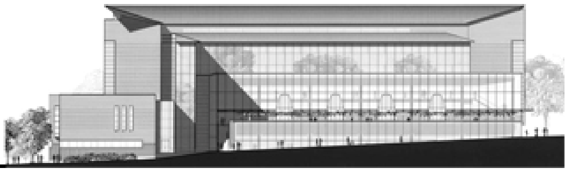
The lighting design in this space provides the opportunity to create a realistic courtroom setting. With the front 'litigation' area of the space being the most important, lighting is used in this area to create a visual hierarchy that will draw the occupant's attention and focus to this area. An architectural 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.

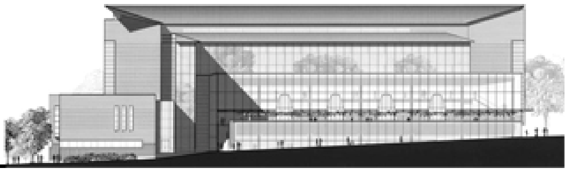
- *Luminances of Room Surfaces*
  Consideration should be taken in providing luminances on room surfaces that meet desired luminance ratios. The luminance ratio from VDT to adjacent surfaces should not exceed 3:1. In addition to this, a luminance ratio of 10:1 should not exceed for VDT to far background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



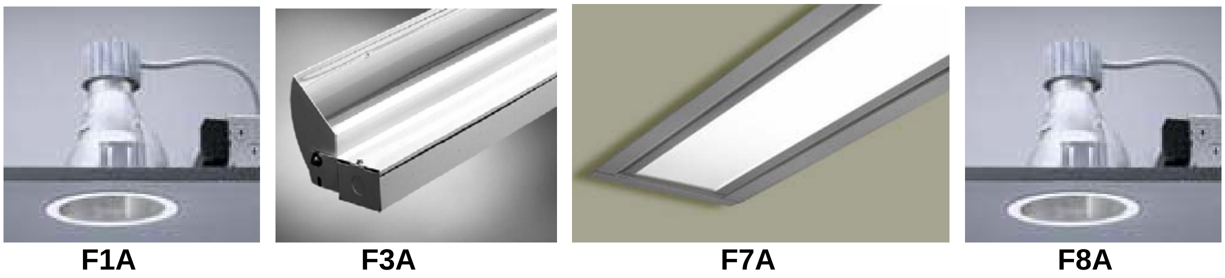
Luminaire Schedule

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

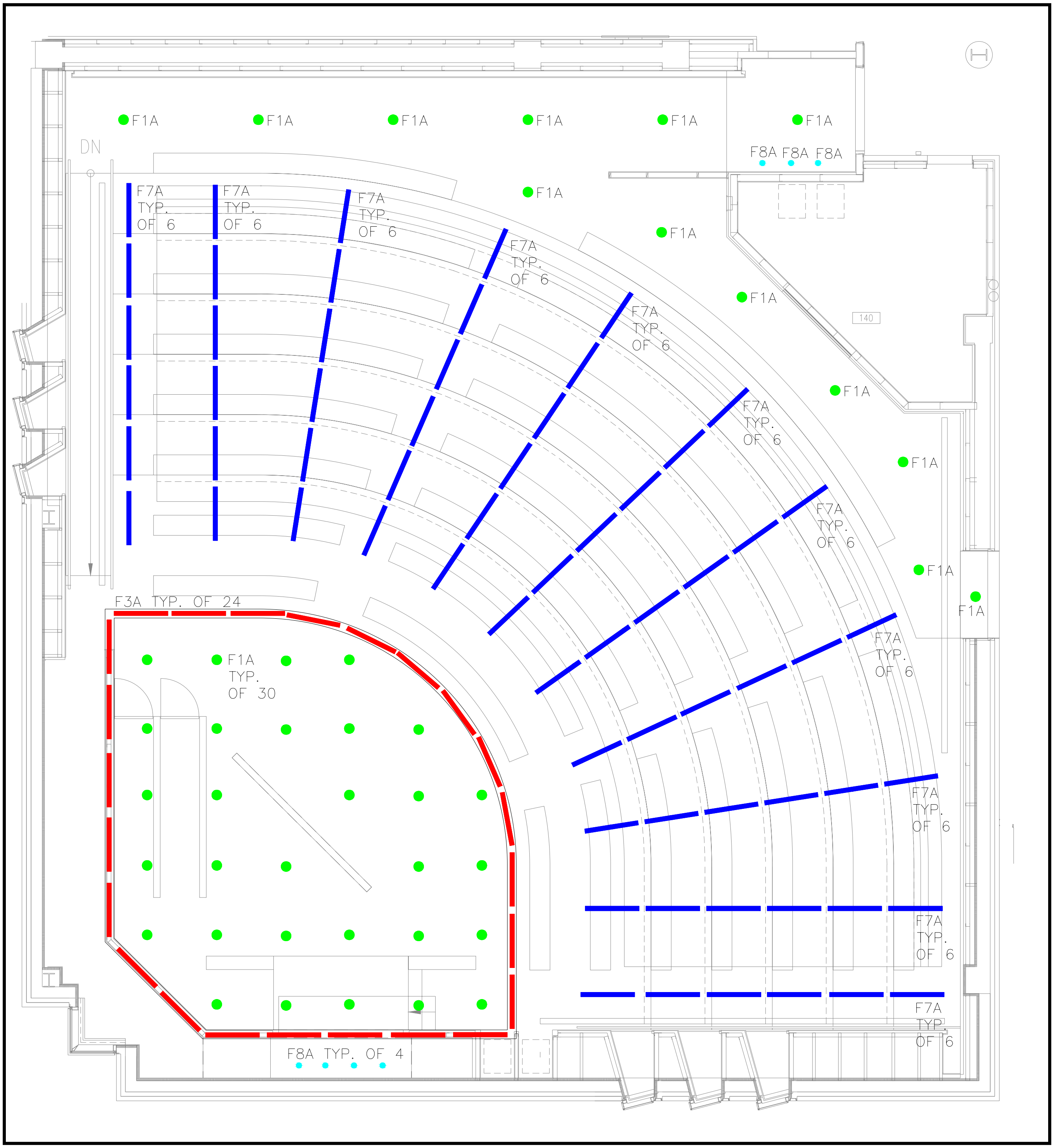
Figure 1.3.3 – Luminaires Used in Trial Courtroom Lighting Design

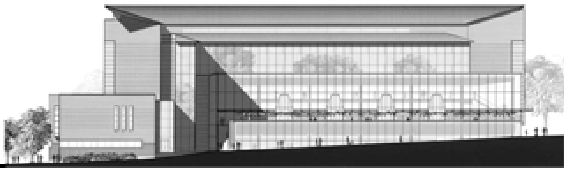


Luminaire Layout

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

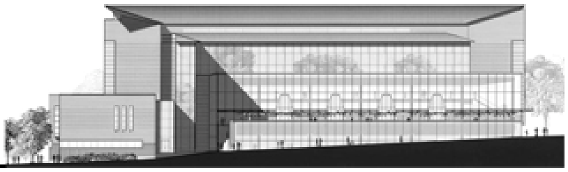


Table 1.3.3 – Dimming System Preset Scene Programming

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.

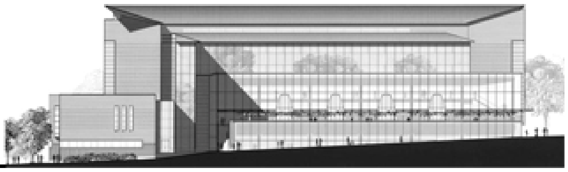
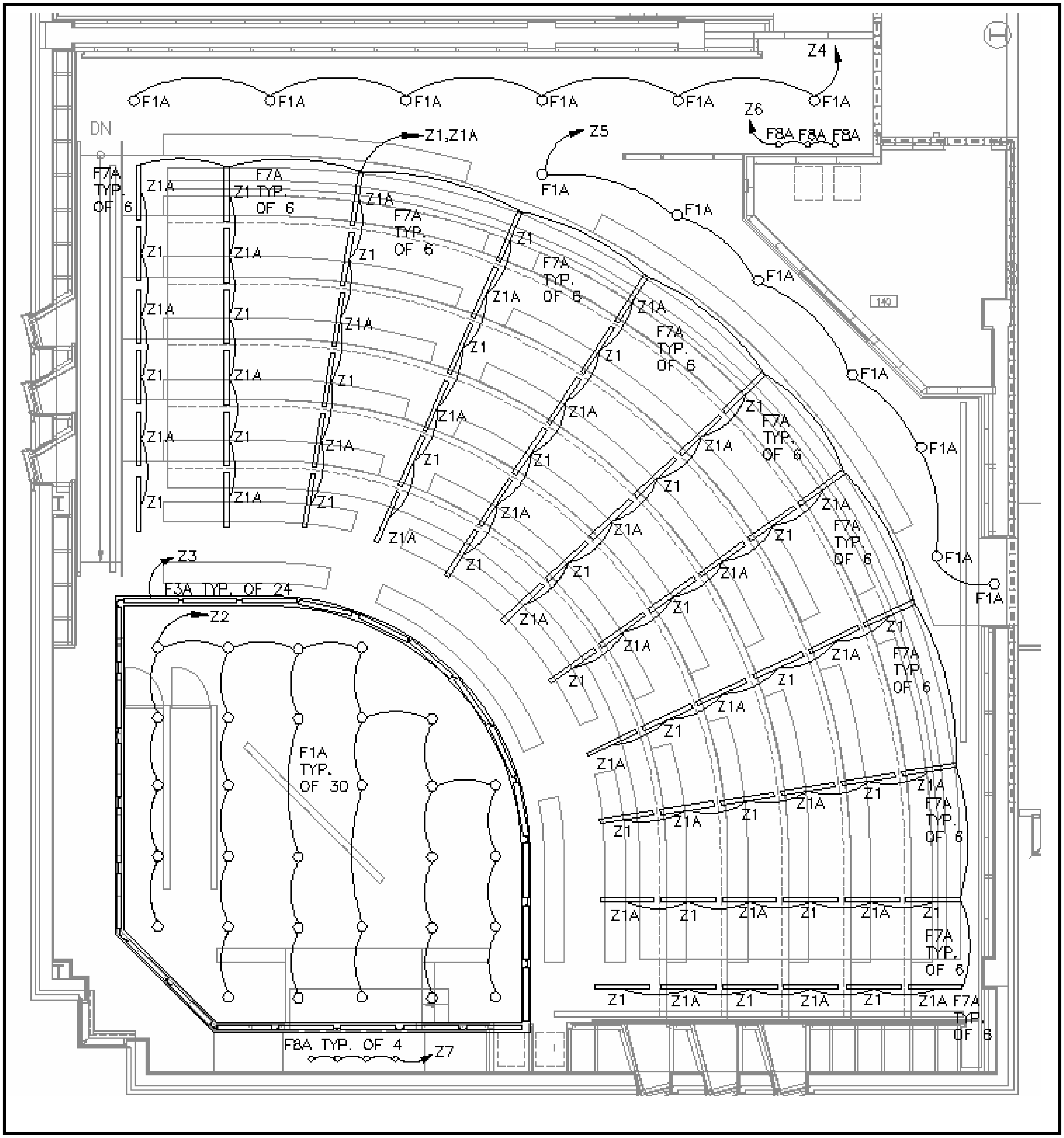
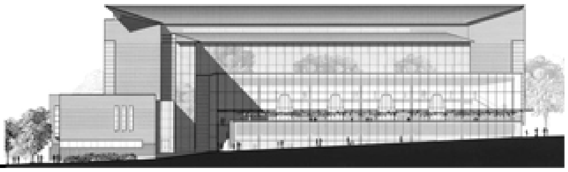


Figure 1.3.5 – Courtroom Circuiting and Controls Plan





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

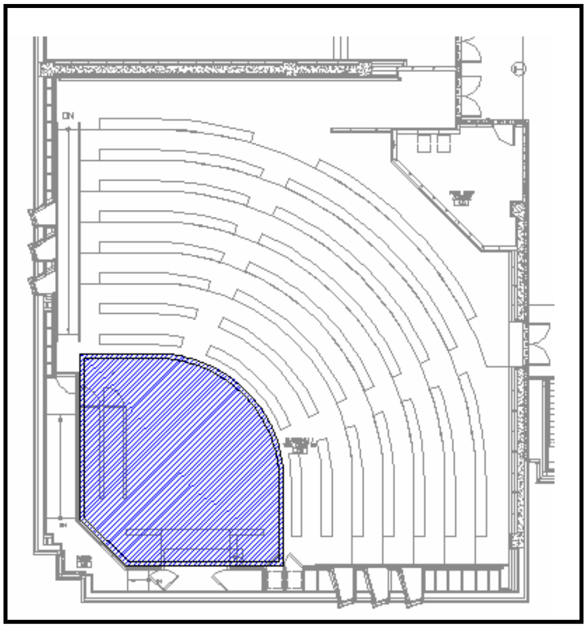
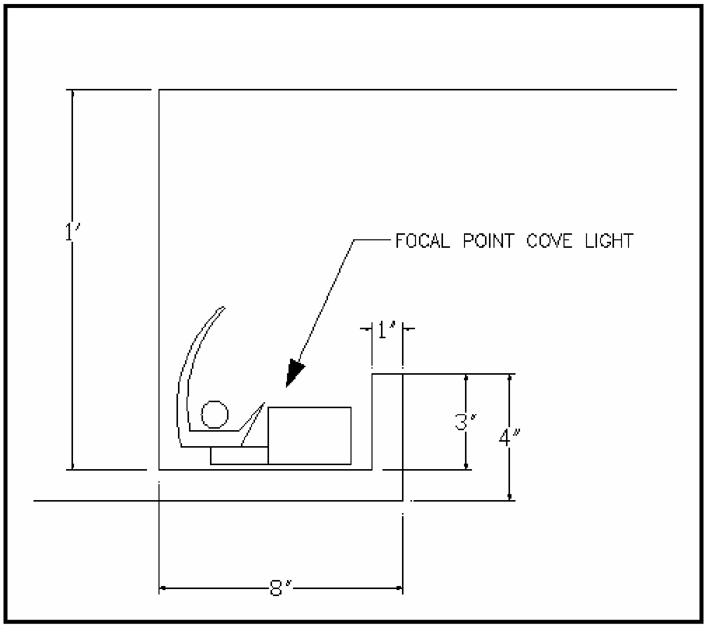


Figure 1.3.7 – Cove Detail with Dimensions

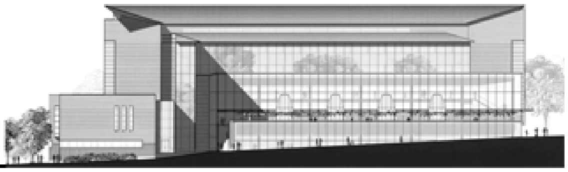


Light Loss Factors

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).

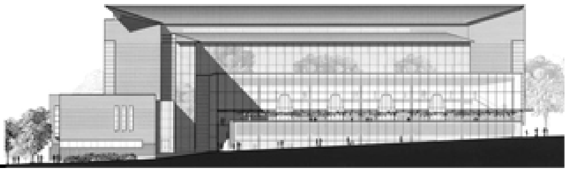


Table 1.1.10 - Illuminance Values (fc)

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

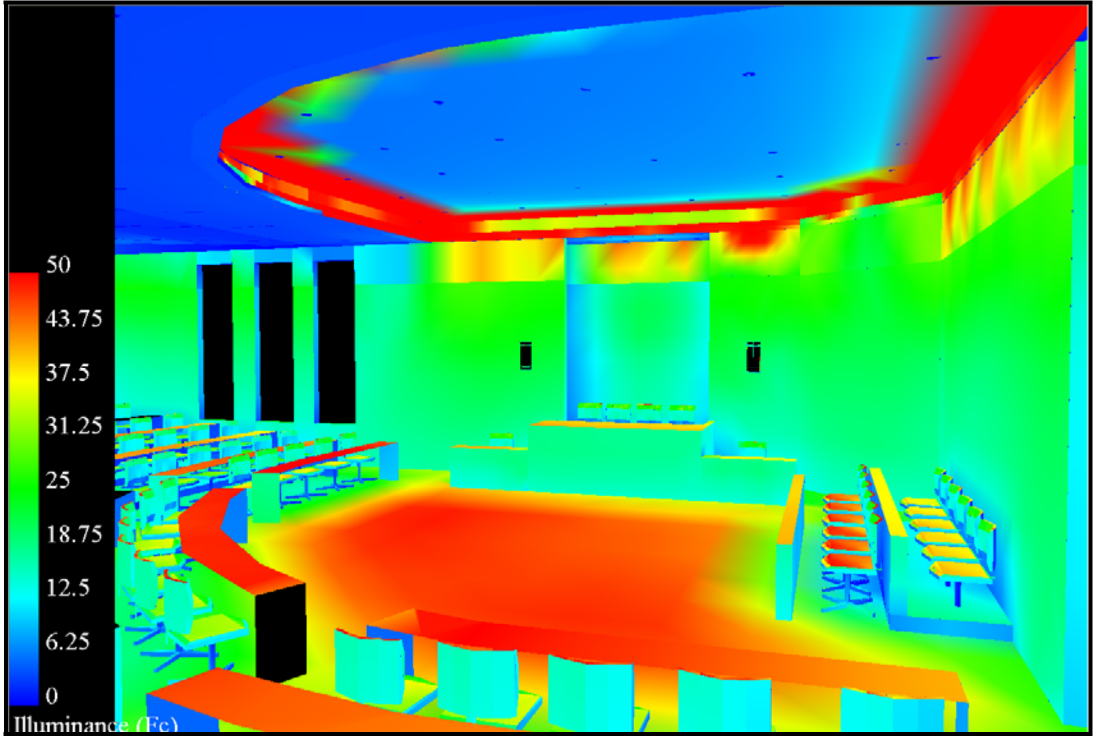
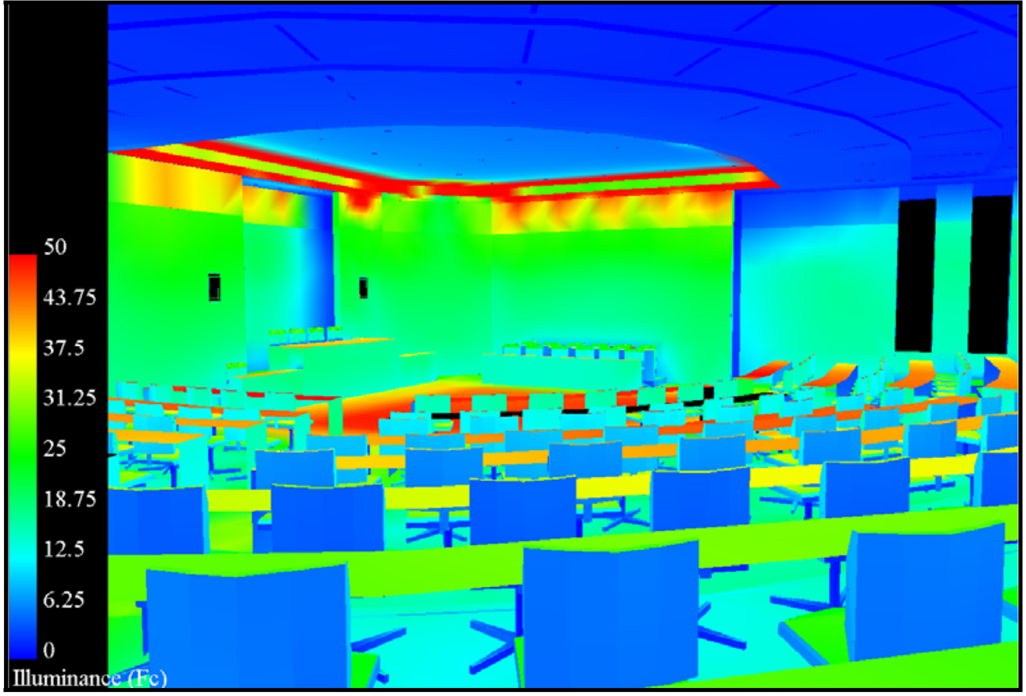


Figure 1.3.9 – Courtroom Workplane – Pseudo Color



Renderings

Figure 1.3.10 – Courtroom Rendering

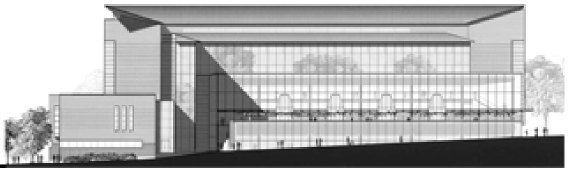


Figure 1.3.11 – Courtroom Rendering

Figure 1.3.12 – Courtroom Rendering

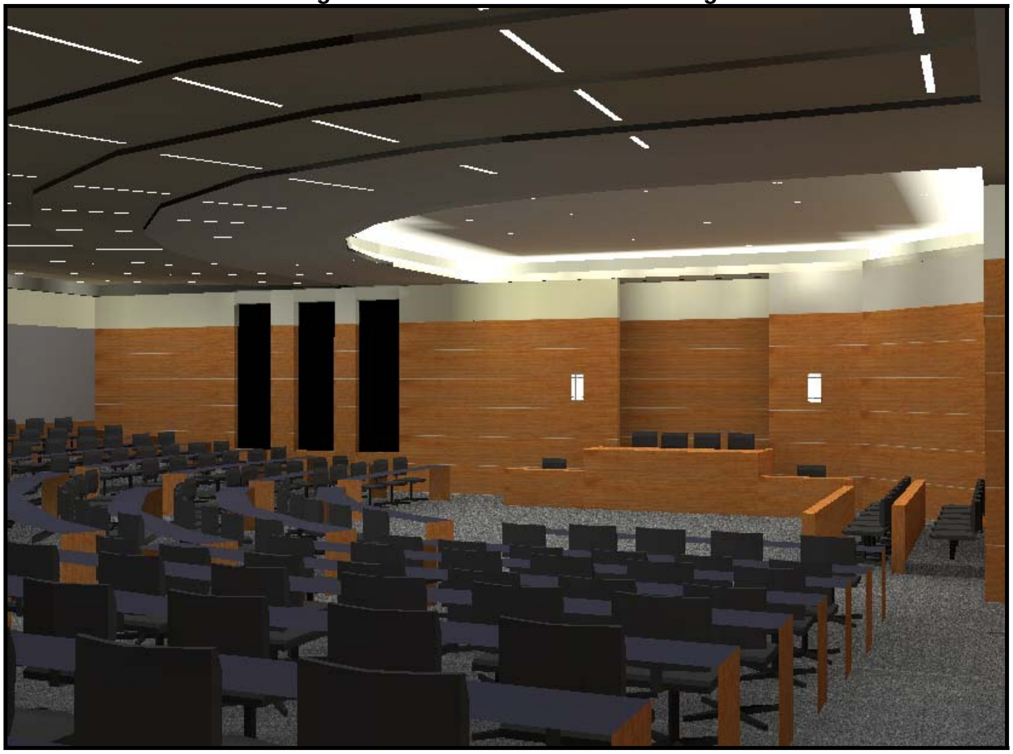
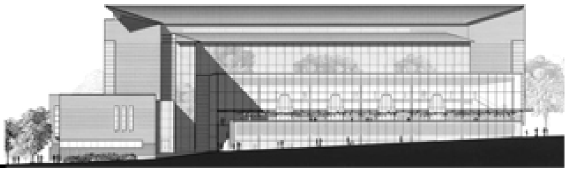


Figure 1.3.13 – Courtroom Rendering

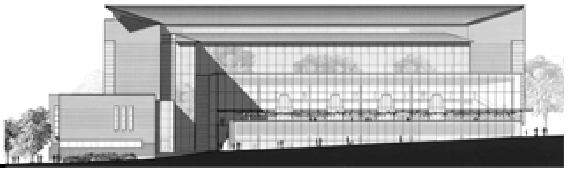
Conclusion

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



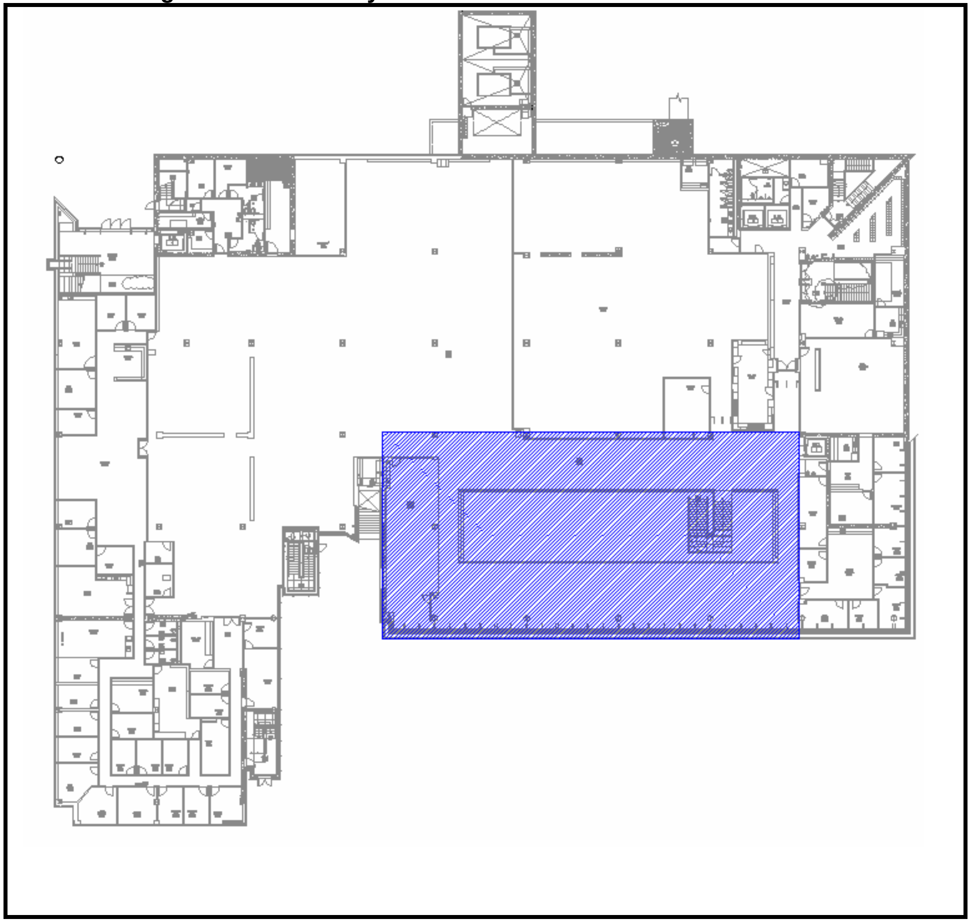
Introduction

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



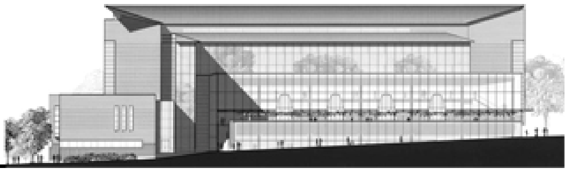
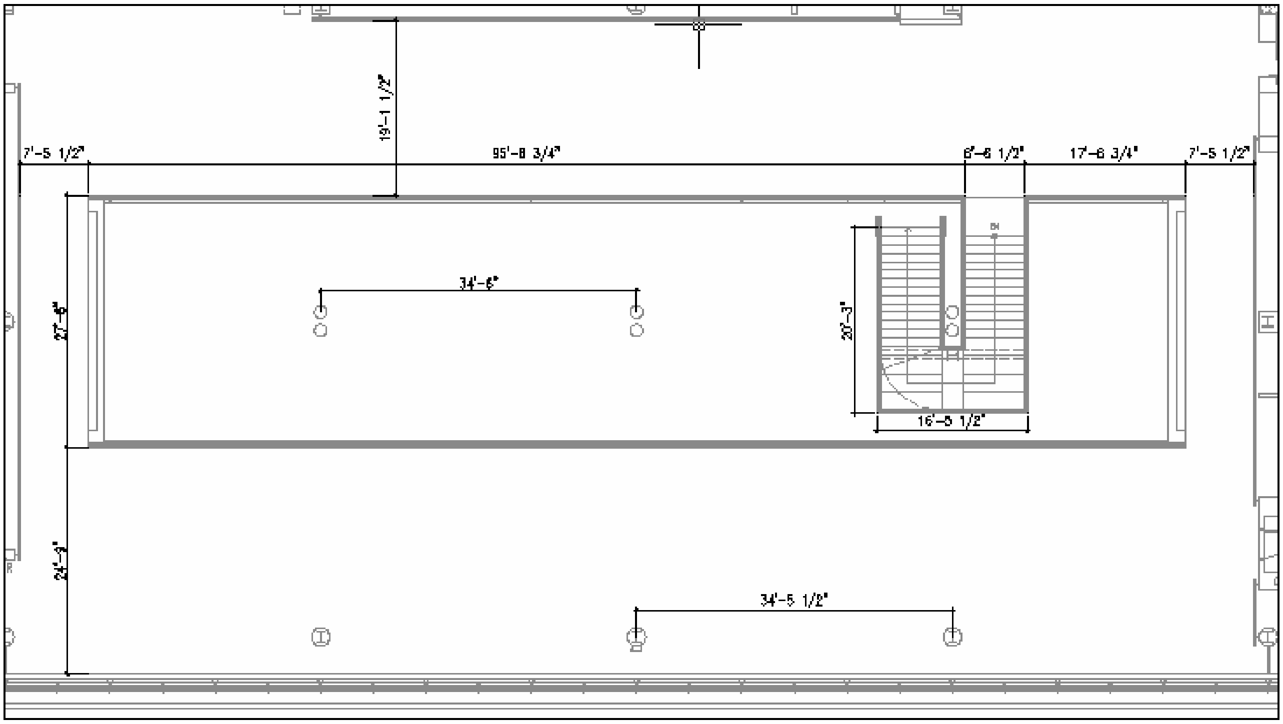
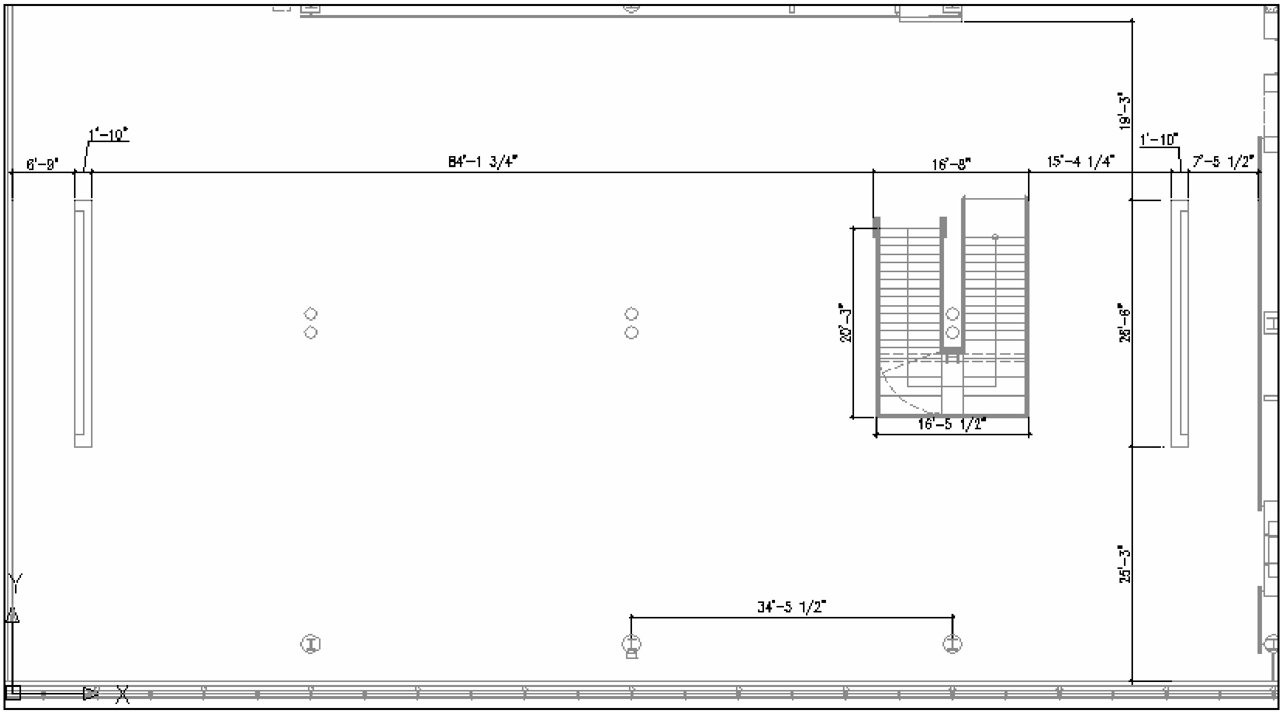


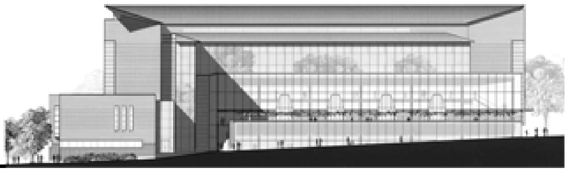
Figure 1.4.2 – Library Floor Plans



Library Level L1



Library Level L2



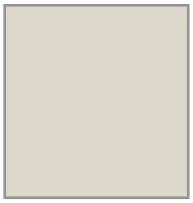
Architectural Finishes

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%

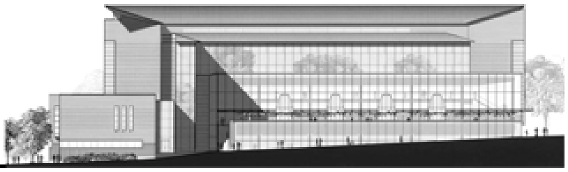
Ceilings

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.

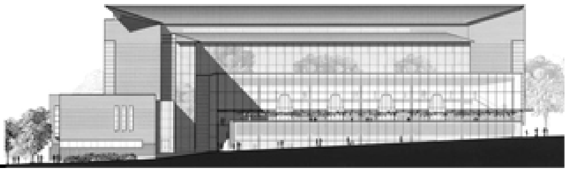


Table 1.4.1 - Daylight Illuminance Values (fc)

	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**

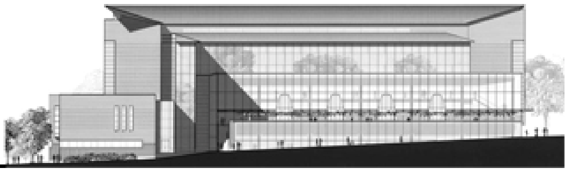


Table 1.4.2 - Daylight Illuminance Values (fc)

	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

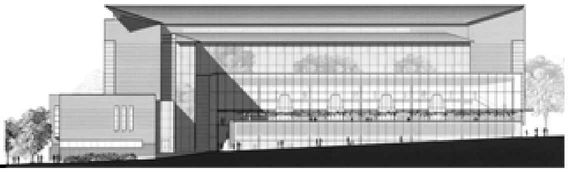


Figure 1.4.4 – Daylighting Study Renderings

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**

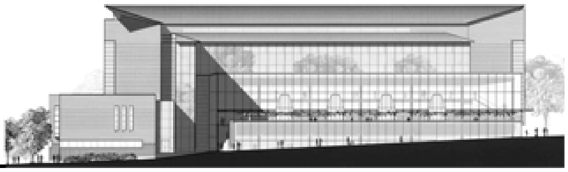


Table 1.4.3 - Daylight Illuminance Values (fc)

	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

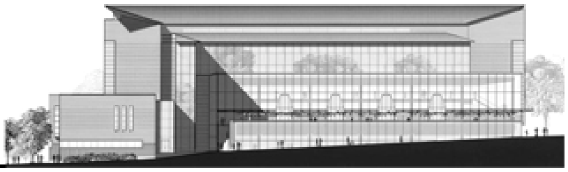
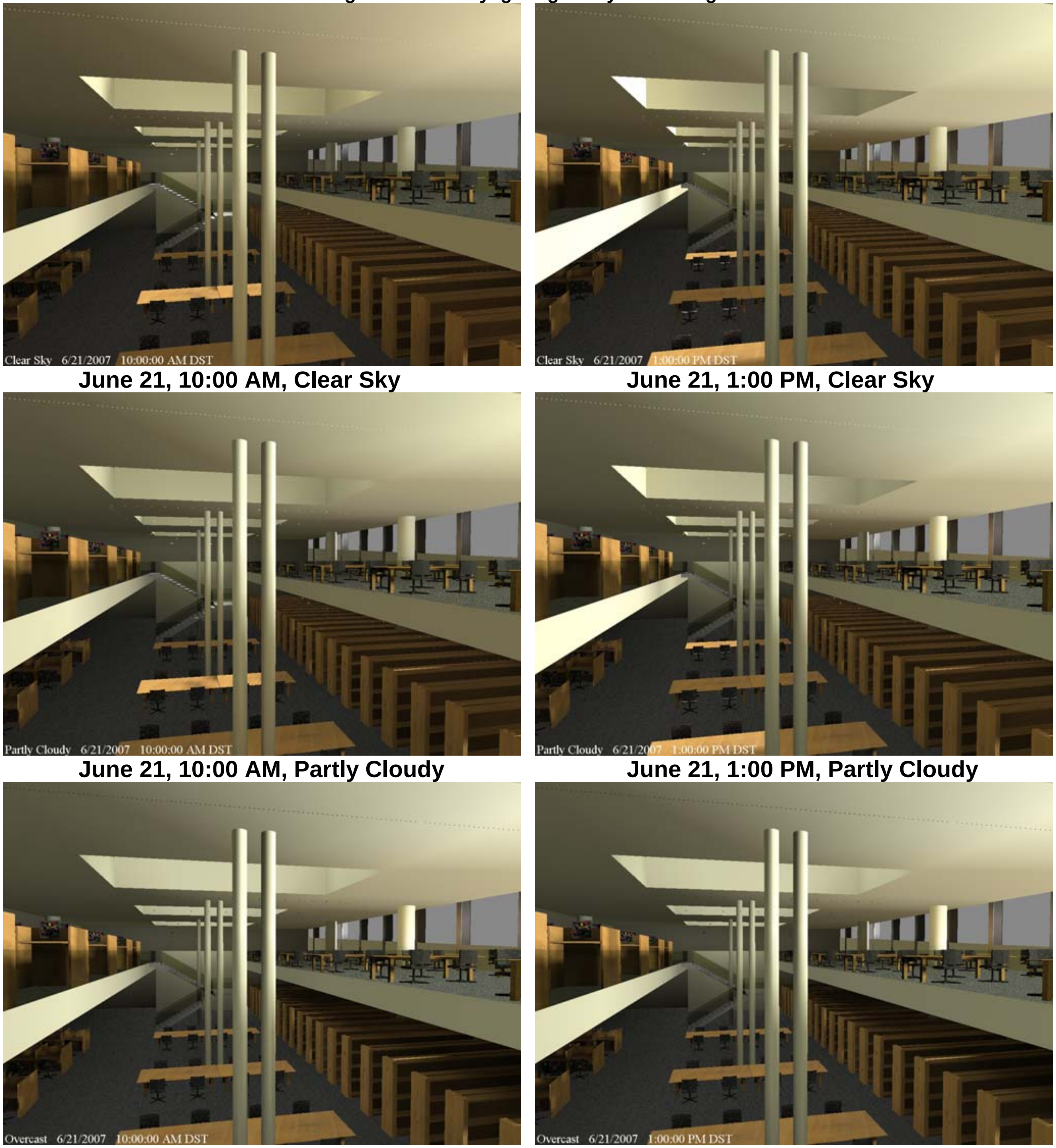


Figure 1.4.5 – Daylighting Study Renderings



June 21, 10:00 AM, Clear Sky

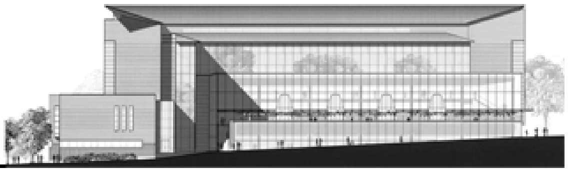
June 21, 1:00 PM, Clear Sky

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

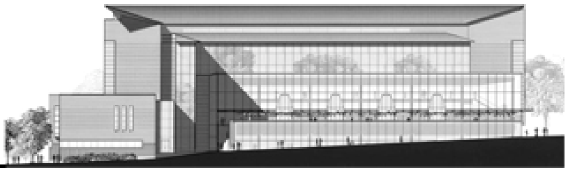
While the high influx of daylight within this space allows for potential energy savings by decreasing the need for electric light, it also creates some concerns about visual comfort for this task intensive space. Throughout the entire year, the space receives reasonable amounts of daylight, with the 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

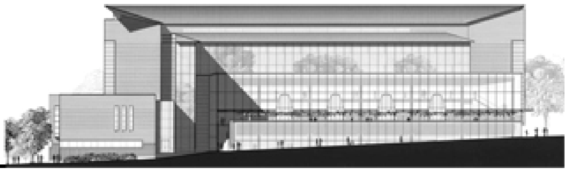
Located centrally in the heart of the building, the Marion Gould Gallagher Law Library provides students, faculty and staff with what is considered to be the finest law library in the Northwest. In order to allow occupants to be as productive as possible in this space, it is essential to provide a lighting 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.

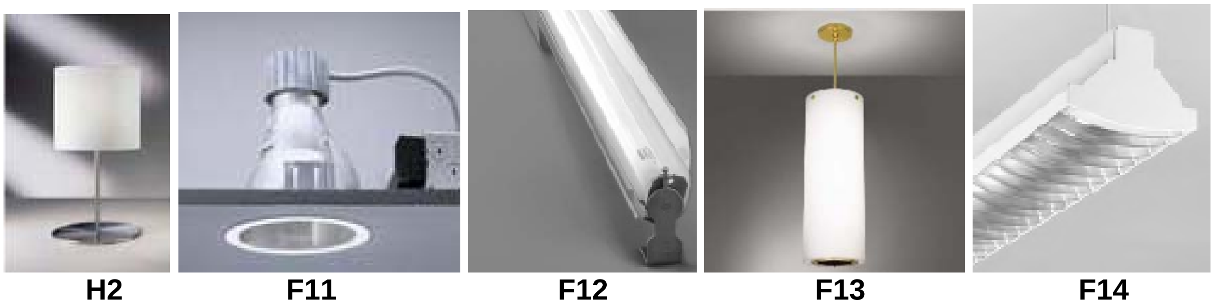
Luminaire Schedule

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



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.

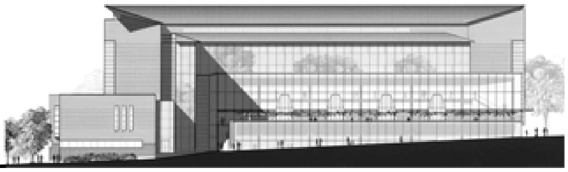
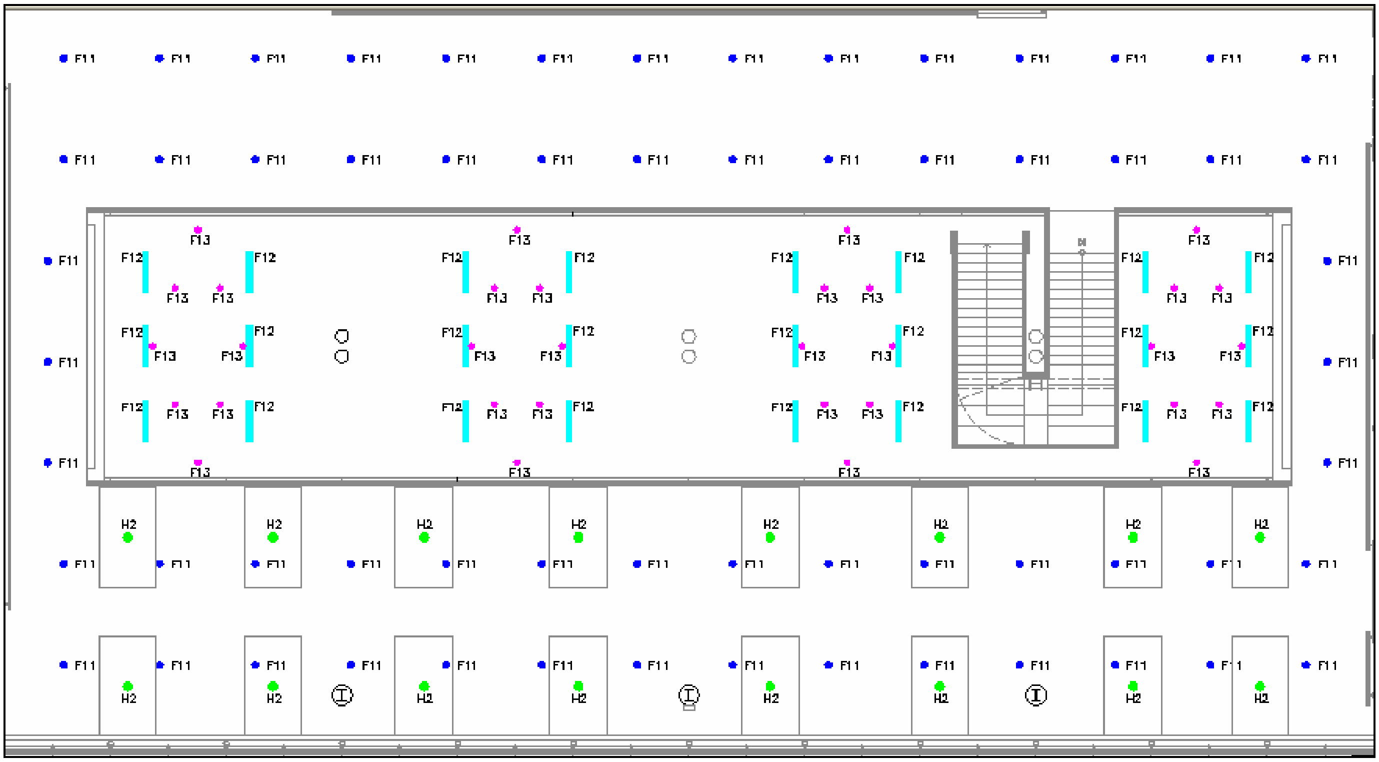
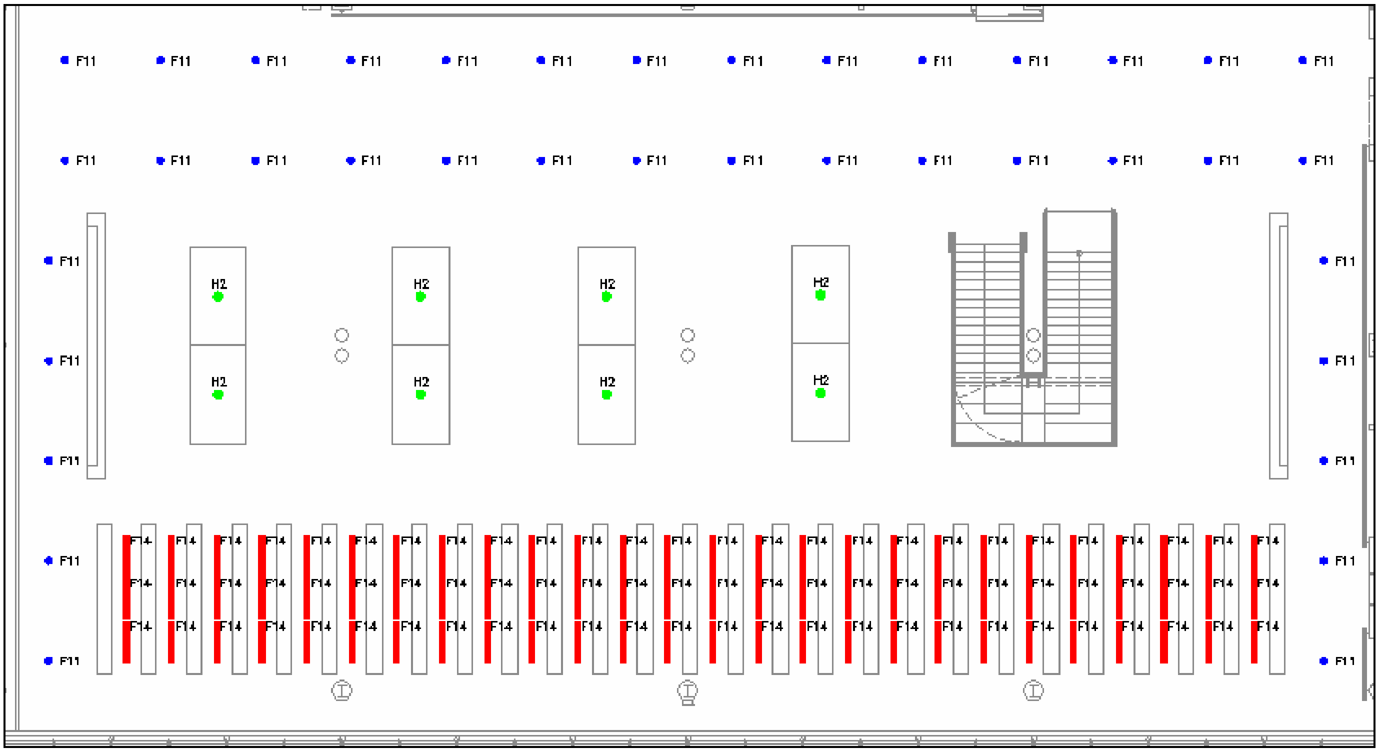


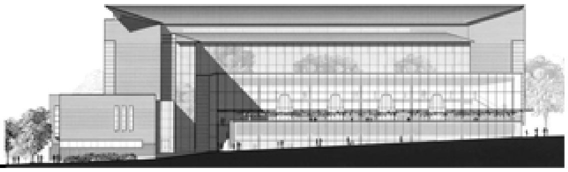
Figure 1.4.7 – Luminaire Layout



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.

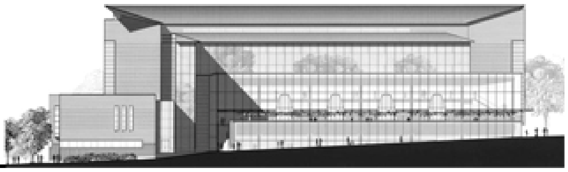


Table 1.4.6 – Automated Lighting Control Schedule

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.

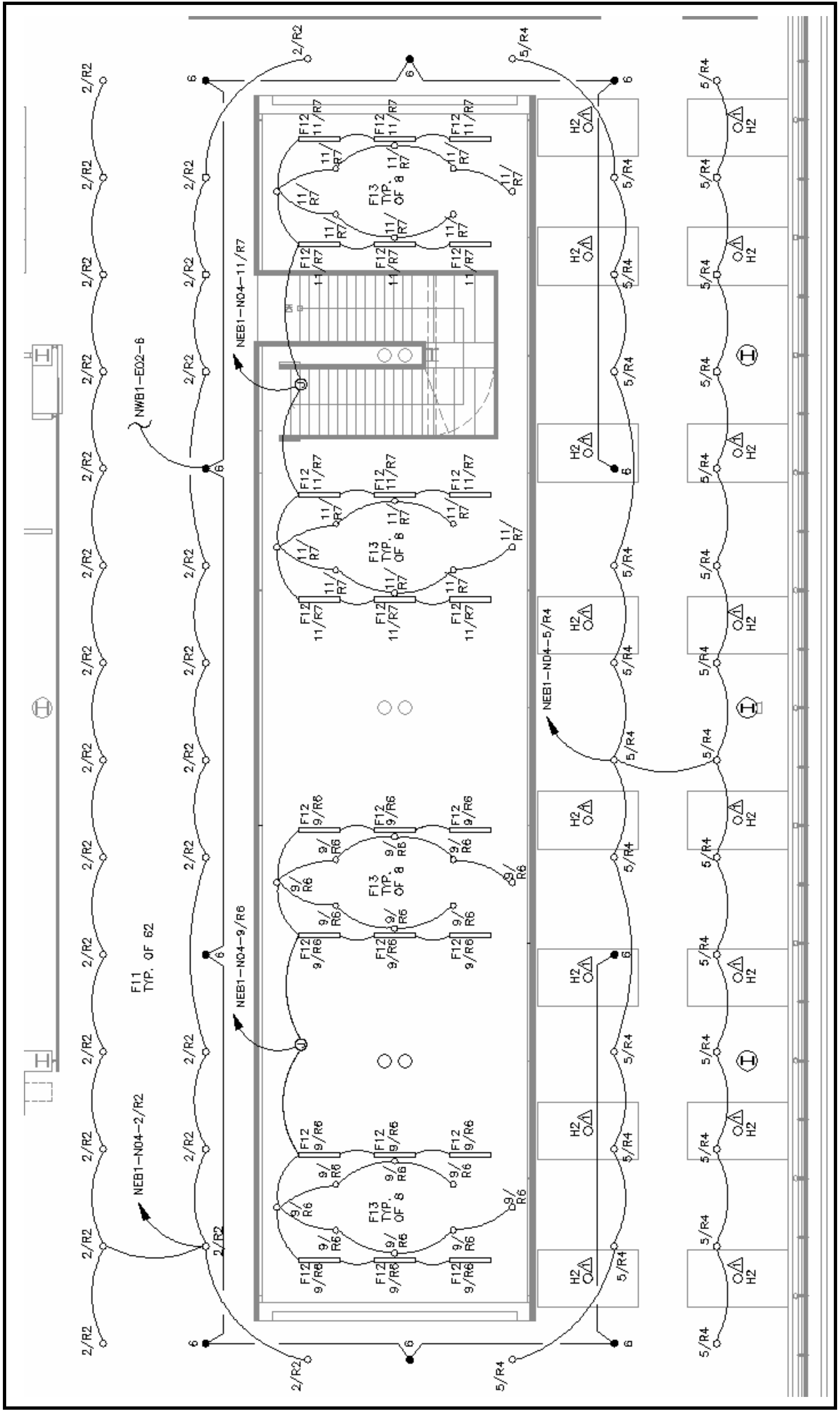
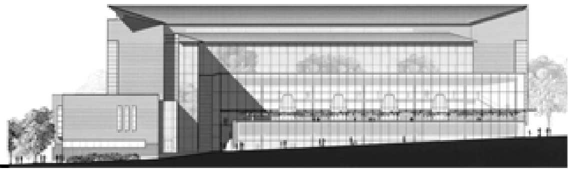


Figure 1.4.8 – Library Level L1 Lighting Power Plan

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



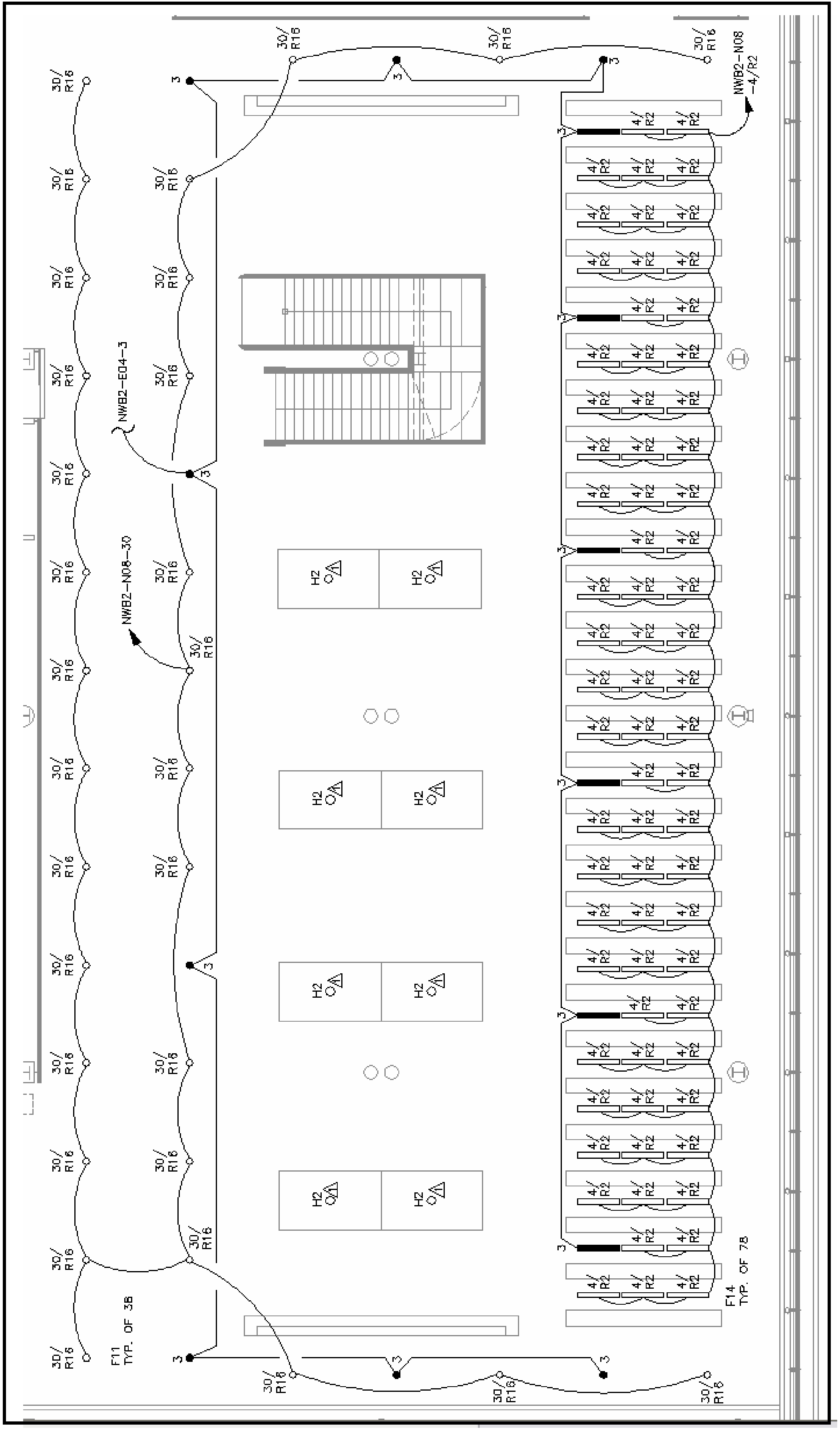


Figure 1.4.9 – Library Level L2 Lighting Power Plan

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

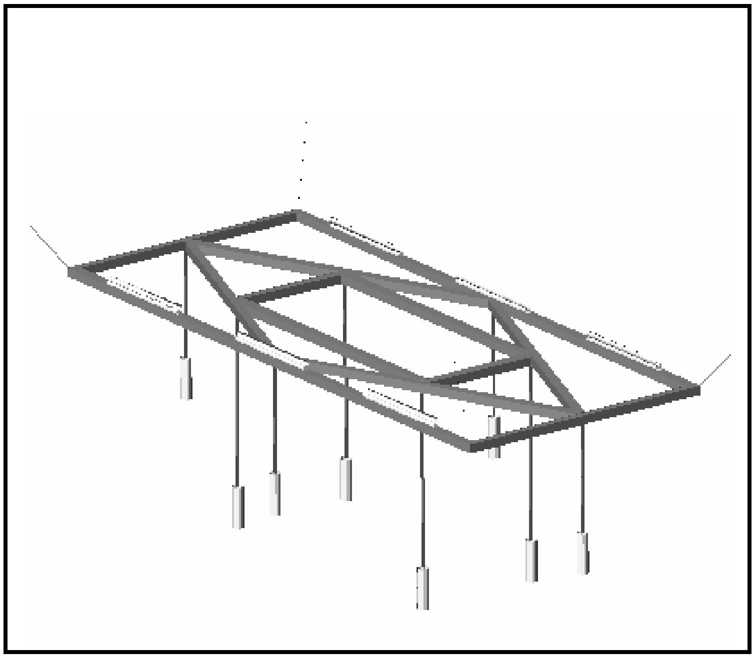


Figure 1.4.11 – Custom Fixture Detail (Plan)

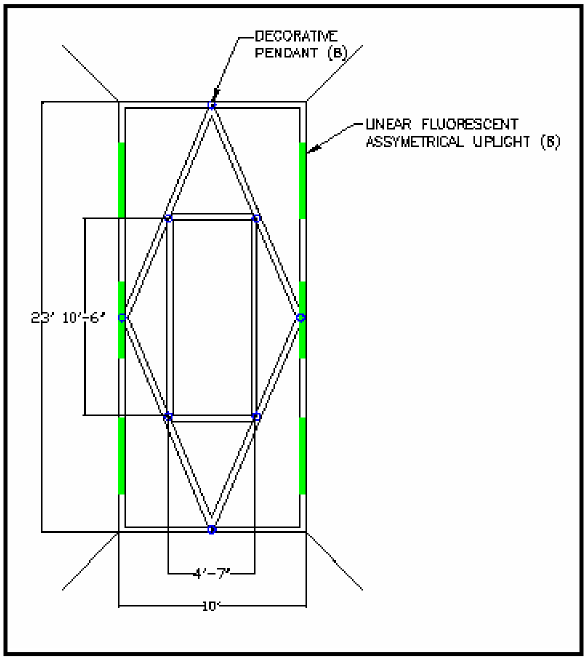
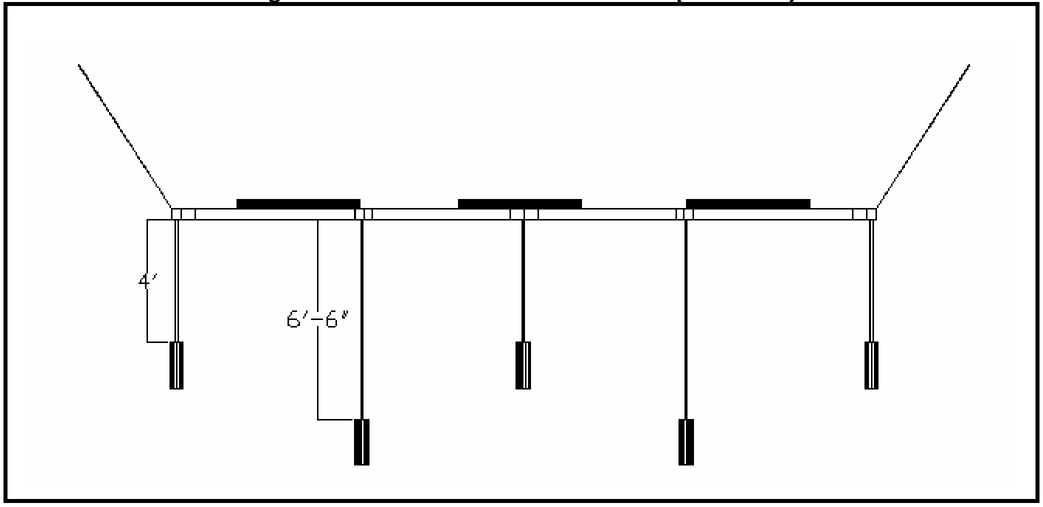
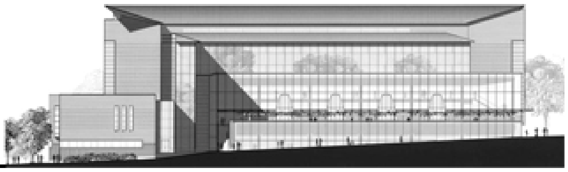


Figure 1.4.12 – Custom Fixture Detail (Elevation)



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.

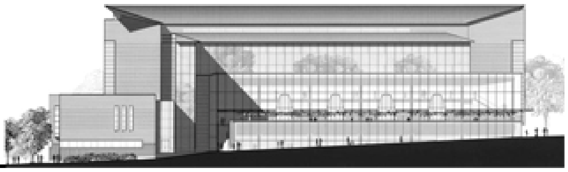
Table 1.4.9 –Power Density

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

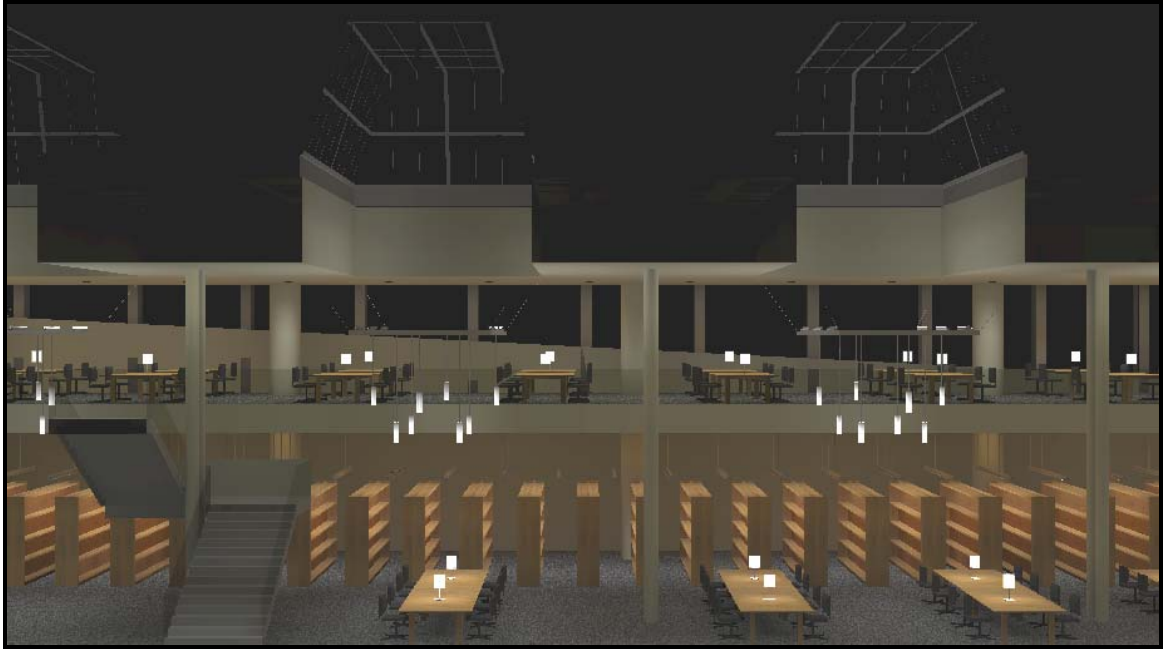


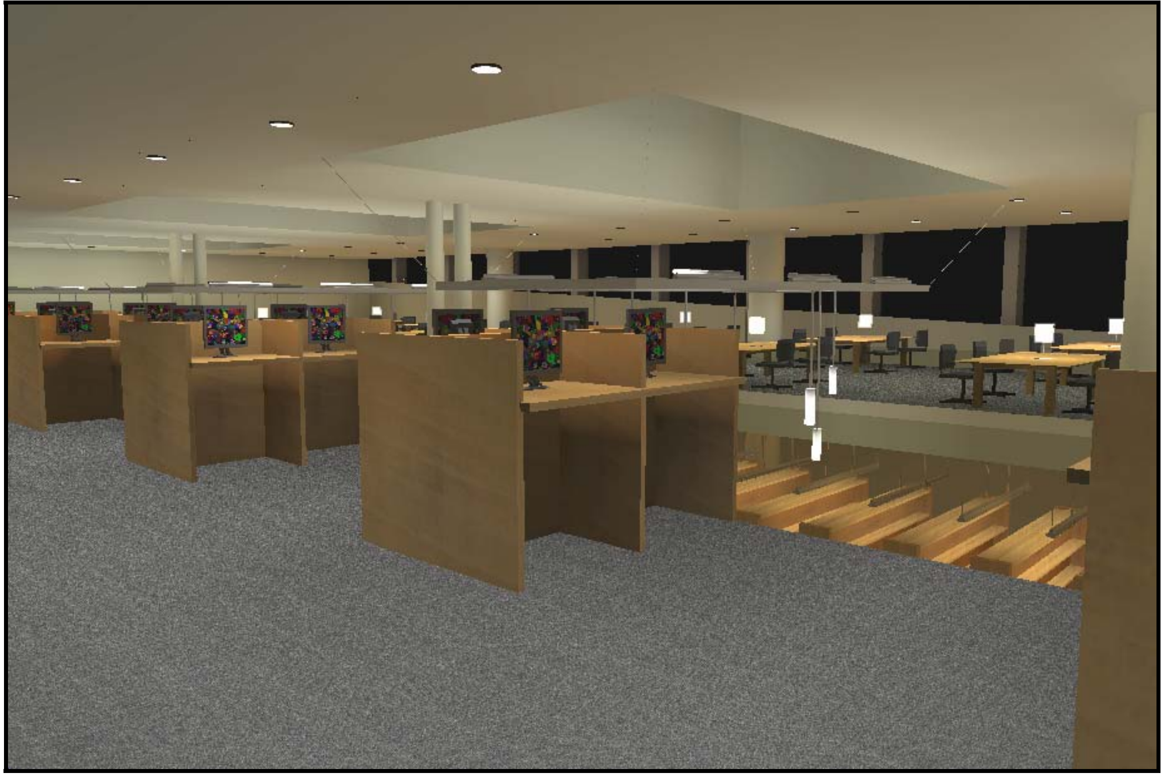
Figure 1.4.14 – Library Rendering

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



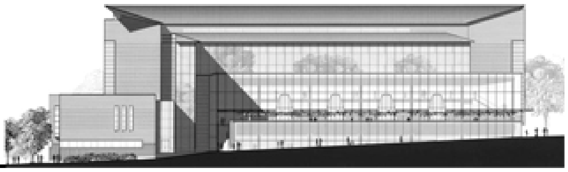
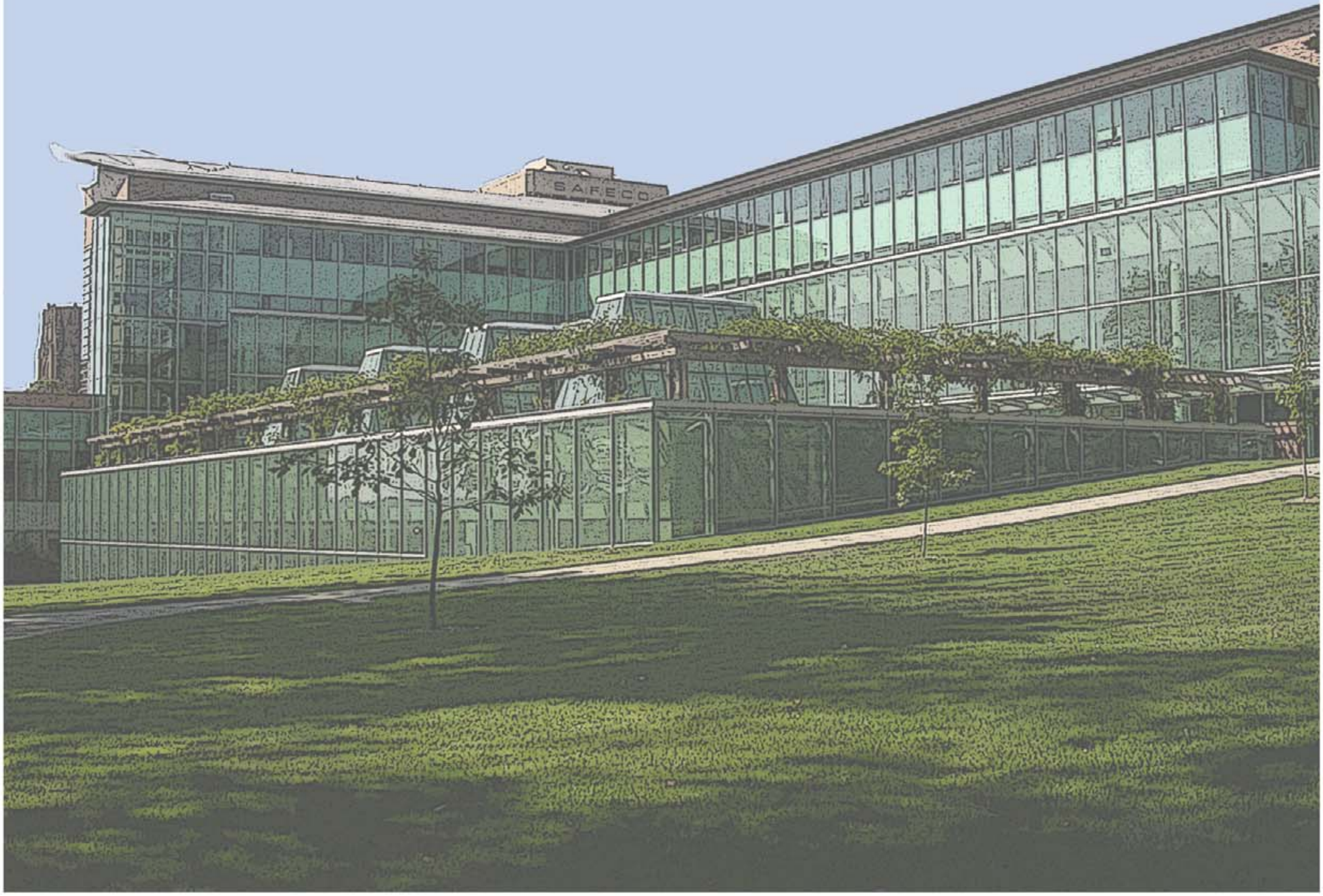


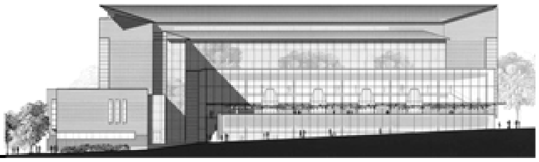
Figure 1.4.19 – Library Rendering

Conclusion

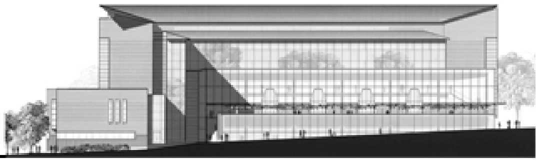
By utilizing a simple lighting design throughout the space and creating a central focal point in the double-height area below the skylights with a custom chandelier, the library lighting design provides the functionality required for this task intensive space, while also creating an area of visual interest. 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.

Electrical Depth





Electrical Coordination of Lighting Design



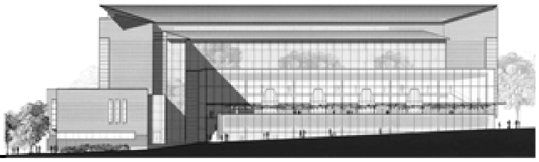
Introduction

The following study looks at the required electrical changes and coordination for the lighting designs proposed in the Lighting Depth. For each of the four spaces, the existing lighting loads and panelboards are evaluated and redesigned for the corresponding changes. Existing panelboards for each space are shown with the lighting loads and circuits to be removed or adjusted noted in yellow. The updated panelboard schedules reflect all lighting changes made in each of the spaces.

Demand factors used in creating panelboard design loads were determined according to those values used in the original design in order to keep panelboard calculations consistent. Please refer to Appendix B for all panel board worksheets that were used to help create the panelboards and determine connected and design loads.

A large majority of the existing panels in the building and those that are considered for the lighting redesign are extremely oversized. It is possible that the panels were oversized per the owner's request or to allow for future loads and building changes. While the reason for the original design criteria is unknown, this study will use this assumption that each of the panels will require a substantial spare capacity for future loads, but not to the extent that the panelboards were originally designed. In redesigning and resizing each of the panelboards, consideration is given to the fact that most of the panels are currently loaded very lightly and that future loads added to these panels could be fairly significant.

Feeder and conduit sizes for each revised panelboard are determined using the NEC 2005 Table 310.16 and NEC Chapter 9. Refer to Appendix B for conduit sizing worksheets.



Jeffrey & Susan Brotman Galleria

The existing lighting design of the two-story galleria utilizes circuits on five separate panelboards: one lighting panel and one emergency panel on the first floor and two lighting panels and one emergency panel on the second floor. These panels include panels PCB-NW01-N02 and PCB-NWB1-E02, which serve loads for the first level of the galleria, and panels PCB-NW02-N02, PCB-NE02-N04 and NW03-E02, which serve lighting loads for the galleria's second floor. Each of these panels will be used for the circuiting of the proposed lighting design in the galleria with the exception of the second lighting panel serving the second floor, panel PCB-NE02-N04.

All of the lighting loads, except the emergency lighting, will be placed on new lighting circuits dedicated to this area due to the desired control scheme for this space. Existing lighting loads for this area were circuited to all lighting loads in the main circulation areas on each respective floor. However, the new lighting design calls for the galleria lights to remain off during daytime hours due to the exceedingly high levels of daylight in the space, and therefore, these loads need to be circuited independently from the interior circulation areas. Two spare circuits from both panel PCB-NW01-N02 and panel PCB-NW02-N02 will be utilized to serve loads to the first and second floor, respectively.

Throughout the galleria, several luminaires will be integrated into the existing emergency circuit serving the space in order to meet emergency lighting requirements. The existing emergency loads in the galleria will be taken off of the circuits from panels PCB-NWB1-E02 and PCB-NW03-E02, and replaced with the emergency loads from the proposed lighting design.

As outlined in the Lighting Depth, each of the circuits serving the Galleria will be controlled via an automated relay system, with the exception of the emergency lighting circuit.

Please refer to the following Lighting Power Plan and Panelboard Schedules for further information on lighting circuitry and corresponding loads.

The following table outlines feeder and conduit sizes for each of the revised panelboards in the galleria.

Table 2.1 – Galleria Panelboard Feeder & Conduit Sizes

PANELBOARD	OVERCURRENT PROTECTION	FEEDER SIZE				CONDUIT SIZE
		NO. SETS	PHASE	NEUTRAL	GROUND	
PCB-NW01-N02	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NWB1-E02	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NE02-N04	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NW03-E02	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"

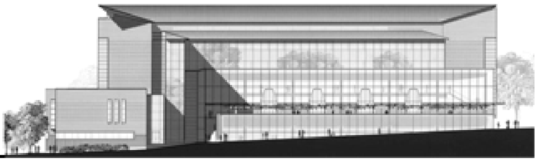
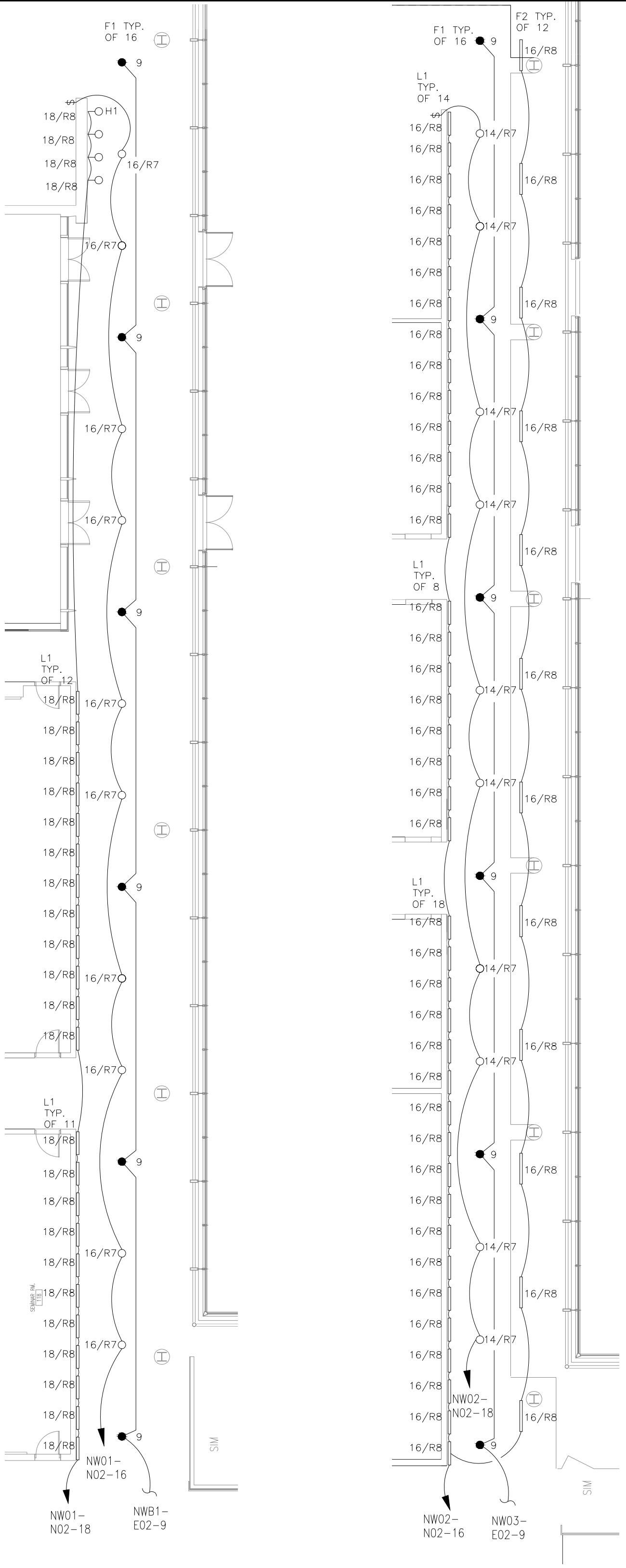


Figure 2.1 – Galleria Lighting Power Plan



Galleria Level 1 **Galleria Level 2**

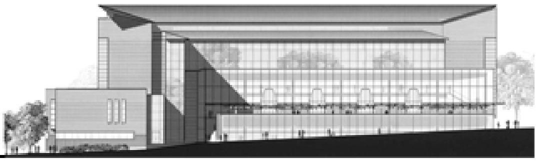


Figure 2.2 –Existing Panelboard Schedule PCB-NW01-N02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NW01-N02
PANEL LOCATION: ELEC. ROOM NW - LEVEL 01
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 35K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	6300	60A/3P	1	*			2	20A/1P	2850	SW ROOMS	LIGHTING
--	WEST	6400	--	3		*		4	20A/1P	950	NW ROOMS	LIGHTING
--	WEST	6200	--	5			*	6	20A/1P	1995	LOUNGE	LIGHTING
LIGHTING	RM 118	1235	20A/1P	7	*			8	20A/1P	3600	CORRIDOR	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	2280	SE EXTERIOR	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	1995	SE EXTERIOR	LIGHTING
MECH FTU	WEST	9500	60A/3P	13	*			14	20A/1P	500		ALC-1A
--	WEST	9500	--	15		*		16	20A/1P	0		SPARE
--	WEST	9500	--	17			*	18	20A/1P	0		SPARE
SPARE		0	60A/3P	19	*			20	20A/1P	0		SPARE
--		0	--	21		*		22	20A/1P	0		SPARE
--		0	--	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	23.99	TOTAL DESIGN LOAD (KW)	92.07
CONNECTED LOAD (KW) - B	19.13	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C	19.69	TOTAL DESIGN LOAD (AMPS)	112

Figure 2.3 –Revised Panelboard Schedule PCB-NW01-N02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NW01-N02
PANEL LOCATION: ELEC. ROOM NW - LEVEL 01
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	6300	60A/3P	1	*			2	20A/1P	2850	SW ROOMS	LIGHTING
--	WEST	6400	--	3		*		4	20A/1P	950	NW ROOMS	LIGHTING
--	WEST	6200	--	5			*	6	20A/1P	1995	LOUNGE	LIGHTING
LIGHTING	RM 118	1235	20A/1P	7	*			8	20A/1P	1967	CORRIDOR	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	1920	TERRACE	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	1756	TERRACE	LIGHTING
MECH FTU	WEST	9500	60A/3P	13	*			14	20A/1P	500	ELEC. RM	ALC-1A
--	WEST	9500	--	15		*		16	20A/1P	340	GALLERIA	LIGHTING
--	WEST	9500	--	17			*	18	20A/1P	936	GALLERIA	LIGHTING
SPARE		0	60A/3P	19	*			20	20A/1P	0		SPARE
--		0	--	21		*		22	20A/1P	0		SPARE
--		0	--	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	22.35	TOTAL DESIGN LOAD (KW)	90.58
CONNECTED LOAD (KW) - B	19.11	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C	20.39	TOTAL DESIGN LOAD (AMPS)	110

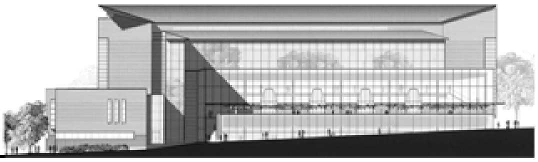


Figure 2.4 –Existing Panelboard Schedule PCB-NWB1-E02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NWB1-E02
PANEL LOCATION: ELEC. RM NW - LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 25K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	380	STAIR 1	LIGHTING
LIGHTING	EGRESS	3135	20A/1P	3		*		4	20A/1P	190	STAIR 4	LIGHTING
LIGHTING	MECH/ELEC	380	20A/1P	5			*	6	20A/1P	1425	L107	LIGHTING
LIGHTING	EXIT SIGNS	95	20A/1P	7	*			8	20A/1P	0		SPARE
LIGHTING	EGRESS L-01	1235	20A/1P	9		*		10	20A/1P	0		SPARE
LIGHTING	MECH/ELEC	380	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	40A/3P	0		SPARE
SPARE		0	20A/1P	33		*		34	--	0		--
SPARE		0	20A/1P	35			*	36	--	0		--
SPARE		0	20A/1P	37	*			38	40A/3P	0		SPARE
SPARE		0	20A/1P	39		*		40	--	0		--
SPARE		0	20A/1P	41			*	42	--	0		--

CONNECTED LOAD (KW) - A	0.57	TOTAL DESIGN LOAD (KW)	11.43
CONNECTED LOAD (KW) - B	4.56	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	2.19	TOTAL DESIGN LOAD (AMPS)	14

Figure 2.4 – Revised Panelboard Schedule PCB-NWB1-E02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NWB1-E02
PANEL LOCATION: ELEC. RM NW - LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	380	STAIR 1	LIGHTING
LIGHTING	EGRESS	3135	20A/1P	3		*		4	20A/1P	190	STAIR 4	LIGHTING
LIGHTING	MECH/ELEC	380	20A/1P	5			*	6	20A/1P	460	LIBRARY	LIGHTING
LIGHTING	EXIT SIGNS	95	20A/1P	7	*			8	20A/1P	0		SPARE
LIGHTING	EGRESS L-01	1116	20A/1P	9		*		10	20A/1P	0		SPARE
LIGHTING	MECH/ELEC	380	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	0.57	TOTAL DESIGN LOAD (KW)	13.63
CONNECTED LOAD (KW) - B	4.44	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	1.22	TOTAL DESIGN LOAD (AMPS)	17

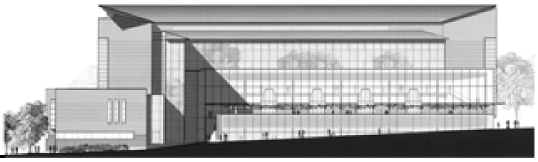


Figure 2.5 –Existing Panelboard Schedule PCB-NW02-N02

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NW02-N02	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	400A	PANEL LOCATION:	ELEC. RM NW LEVEL 02	OPTIONS:	
SIZE/TYPE MAIN:	400A MLO	PANEL MOUNTING:	SURFACE		

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	2565	WEST OFFICES	LIGHTING
--	WEST	3200	--	3		*		4	20A/1P	1805	SW CORRIDOR	LIGHTING
--	WEST	2400	--	5			*	6	20A/1P	1425	SW OFFICES	LIGHTING
SPARE	0	0	20A/1P	7	*			8	20A/1P	855	NW ROOMS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	2185	CENTRAL CORR	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	570	CLEAR STORY	LIGHTING
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
--		0	--	15		*		16	20A/1P	0		SPARE
--		0	--	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	7.32	TOTAL DESIGN LOAD (KW)	29.54
CONNECTED LOAD (KW) - B	7.19	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	4.40	TOTAL DESIGN LOAD (AMPS)	36

Figure 2.6 – Revised Panelboard Schedule PCB-NW02-N02

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NW02-N02	MIN. C/B AIC:	14K
SIZE/TYPE BUS:	150A	PANEL LOCATION:	ELEC. RM NW LEVEL 02	OPTIONS:	
SIZE/TYPE MAIN:	150A C/B	PANEL MOUNTING:	SURFACE		

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	2565	WEST OFFICES	LIGHTING
--	WEST	3200	--	3		*		4	20A/1P	1805	SW CORRIDOR	LIGHTING
--	WEST	2400	--	5			*	6	20A/1P	888	SW OFFICES	LIGHTING
SPARE	0	0	20A/1P	7	*			8	20A/1P	855	NW ROOMS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	2185	CENTRAL CORR	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	570	CLEAR STORY	LIGHTING
SPARE		0	20A/1P	13	*			14	20A/1P	340	GALLERIA	LIGHTING
--		0	--	15		*		16	20A/1P	1640	GALLERIA	LIGHTING
--		0	--	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	7.66	TOTAL DESIGN LOAD (KW)	38.15
CONNECTED LOAD (KW) - B	8.83	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	3.86	TOTAL DESIGN LOAD (AMPS)	47

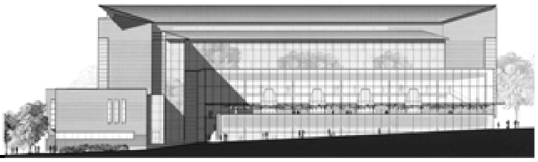


Figure 2.7 –Existing Panelboard Schedule PCB-NE02-N04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: PCB-NE02-N04	MIN. C/B AIC: 42K
SIZE/TYPE BUS: 150A	PANEL LOCATION: ELEC. RM NE -LEVEL 02	OPTIONS:
SIZE/TYPE MAIN: 150A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	EAST	4800	60A/3P	1	*			2	20A/1P	1330	S. FOYER	LIGHTING
--	EAST	700	--	3		*		4	20A/1P	2280	S. FOYER	LIGHTING
--	EAST	2600	--	5			*	6	20A/1P	2945	CENTRAL OFF.	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	760	LOCKERS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	285	NE ROOMS	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	1235	E. FOYER	LIGHTING
SPARE		0	60A/3P	13	*			14	20A/1P	1805	RM. 217	LIGHTING
--		0	--	15		*		16	20A/1P	1235	RM. 213	LIGHTING
--		0	--	17			*	18	20A/1P	665	RM. 212	LIGHTING
SPARE		0	20A/1P	19	*			20	20A/1P	1615	RM. 222	LIGHTING
SPARE		0	20A/1P	21		*		22	20A/1P	500	ELEC. CLOS	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	10.31	TOTAL DESIGN LOAD (KW)	35.40
CONNECTED LOAD (KW) - B	5.00	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	7.45	TOTAL DESIGN LOAD (AMPS)	44

Figure 2.8 – Revised Panelboard Schedule PCB-NE02-N04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W	PANEL TAG: PCB-NE02-N04	MIN. C/B AIC: 42K
SIZE/TYPE BUS: 150A	PANEL LOCATION: ELEC. RM NE -LEVEL 02	OPTIONS:
SIZE/TYPE MAIN: 150A/3P C/B	PANEL MOUNTING: SURFACE	

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	EAST	4800	60A/3P	1	*			2	20A/1P	0	0	SPARE
--	EAST	700	--	3		*		4	20A/1P	0	0	SPARE
--	EAST	2600	--	5			*	6	20A/1P	2945	CENTRAL OFF.	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	760	LOCKERS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	285	NE ROOMS	LIGHTING
SPARE	0	0	20A/1P	11			*	12	20A/1P	1235	E. FOYER	LIGHTING
SPARE		0	60A/3P	13	*			14	20A/1P	1805	RM. 217	LIGHTING
--		0	--	15		*		16	20A/1P	1235	RM. 213	LIGHTING
--		0	--	17			*	18	20A/1P	665	RM. 212	LIGHTING
SPARE		0	20A/1P	19	*			20	20A/1P	1615	RM. 222	LIGHTING
SPARE		0	20A/1P	21		*		22	20A/1P	500	ELEC. CLOS	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	8.98	TOTAL DESIGN LOAD (KW)	29.76
CONNECTED LOAD (KW) - B	2.72	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	7.45	TOTAL DESIGN LOAD (AMPS)	37

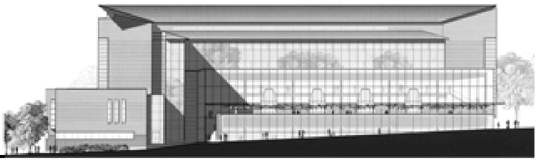


Figure 2.9 –Existing Panelboard Schedule PCB-NW03-E02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NW03-E02
PANEL LOCATION: ELEC. RM NW - LEVEL 03
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 25K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	95	EXIT SIGNS	LIGHTING
LIGHTING	EGRESS	1235	20A/1P	3		*		4	20A/1P	1615	EGRESS	LIGHTING
LIGHTING	MECH. EMER	285	20A/1P	5			*	6	20A/1P	285	MECH. EMER	LIGHTING
		0	20A/1P	7	*			8	20A/1P	0		
		0	20A/1P	9		*		10	20A/1P	0		
		0	20A/1P	11			*	12	20A/1P	0		
		0	20A/1P	13	*			14	20A/1P	0		
		0	20A/1P	15		*		16	20A/1P	0		
		0	20A/1P	17			*	18	20A/1P	0		
		0	20A/1P	19	*			20	20A/1P	0		
		0	20A/1P	21		*		22	20A/1P	0		
		0	20A/1P	23			*	24	20A/1P	0		
		0	20A/1P	25	*			26	20A/1P	0		
		0	20A/1P	27		*		28	20A/1P	0		
		0	20A/1P	29			*	30	20A/1P	0		
		0	20A/1P	31	*			32	20A/1P	0		
		0	20A/1P	33		*		34	20A/1P	0		
		0	20A/1P	35			*	36	20A/1P	0		
		0	20A/1P	37	*			38	20A/1P	0		
		0	20A/1P	39		*		40	20A/1P	0		
		0	20A/1P	41			*	42	20A/1P	0		

CONNECTED LOAD (KW) - A	0.19	TOTAL DESIGN LOAD (KW)	5.64
CONNECTED LOAD (KW) - B	2.85	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	0.57	TOTAL DESIGN LOAD (AMPS)	7

Figure 2.10 – Revised Panelboard Schedule PCB-NW03-E02

PANELBOARD SCHEDULE

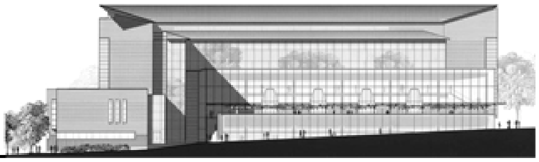
VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NW03-E02
PANEL LOCATION: ELEC. RM NW - LEVEL 03
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	95	EXIT SIGNS	LIGHTING
LIGHTING	EGRESS	1235	20A/1P	3		*		4	20A/1P	1549	EGRESS	LIGHTING
LIGHTING	MECH. EMER	285	20A/1P	5			*	6	20A/1P	285	MECH. EMER	LIGHTING
		0	20A/1P	7	*			8	20A/1P	0		
		0	20A/1P	9		*		10	20A/1P	0		
		0	20A/1P	11			*	12	20A/1P	0		
		0	20A/1P	13	*			14	20A/1P	0		
		0	20A/1P	15		*		16	20A/1P	0		
		0	20A/1P	17			*	18	20A/1P	0		
		0	20A/1P	19	*			20	20A/1P	0		
		0	20A/1P	21		*		22	20A/1P	0		
		0	20A/1P	23			*	24	20A/1P	0		
		0	20A/1P	25	*			26	20A/1P	0		
		0	20A/1P	27		*		28	20A/1P	0		
		0	20A/1P	29			*	30	20A/1P	0		
		0	20A/1P	31	*			32	20A/1P	0		
		0	20A/1P	33		*		34	20A/1P	0		
		0	20A/1P	35			*	36	20A/1P	0		
		0	20A/1P	37	*			38	20A/1P	0		
		0	20A/1P	39		*		40	20A/1P	0		
		0	20A/1P	41			*	42	20A/1P	0		

CONNECTED LOAD (KW) - A	0.19	TOTAL DESIGN LOAD (KW)	6.64
CONNECTED LOAD (KW) - B	2.78	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	0.57	TOTAL DESIGN LOAD (AMPS)	8



Terrace

The existing lighting design of the terrace utilizes circuits on two panelboards: NW01-N02 and NEB1-N04. The two existing circuits on panel NW01-N02 feed all of the exterior lights in the terrace area. The existing lights used to light up the skylights were located on the interior of the skylights and the loads are fed by two circuits on panel NEB1-N04.

The proposed lighting design will reuse the circuits on panelboard NW01-N02. One circuit on this panel will feed all of the exterior lighting loads, and the other will power the luminaires located on the interior of the skylights. No circuits from panelboard NEB1-N04 will be utilized in the lighting redesign of this space.

As explained in the Lighting Depth, each of the circuits in the terrace will be controlled via an automated relay system.

Please refer to the following Lighting Power Plan and Panelboard Schedules for further information on lighting circuitry and corresponding loads.

The following table outlines feeder and conduit sizes for each of the revised panelboards in the terrace.

Table 2.2 – Terrace Panelboard Feeder & Conduit Sizes

PANELBOARD	OVERCURRENT PROTECTION	FEEDER SIZE				CONDUIT SIZE
		NO. SETS	PHASE	NEUTRAL	GROUND	
PCB-NW01-N02	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NEB1-E04	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"

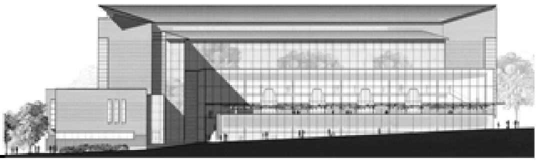
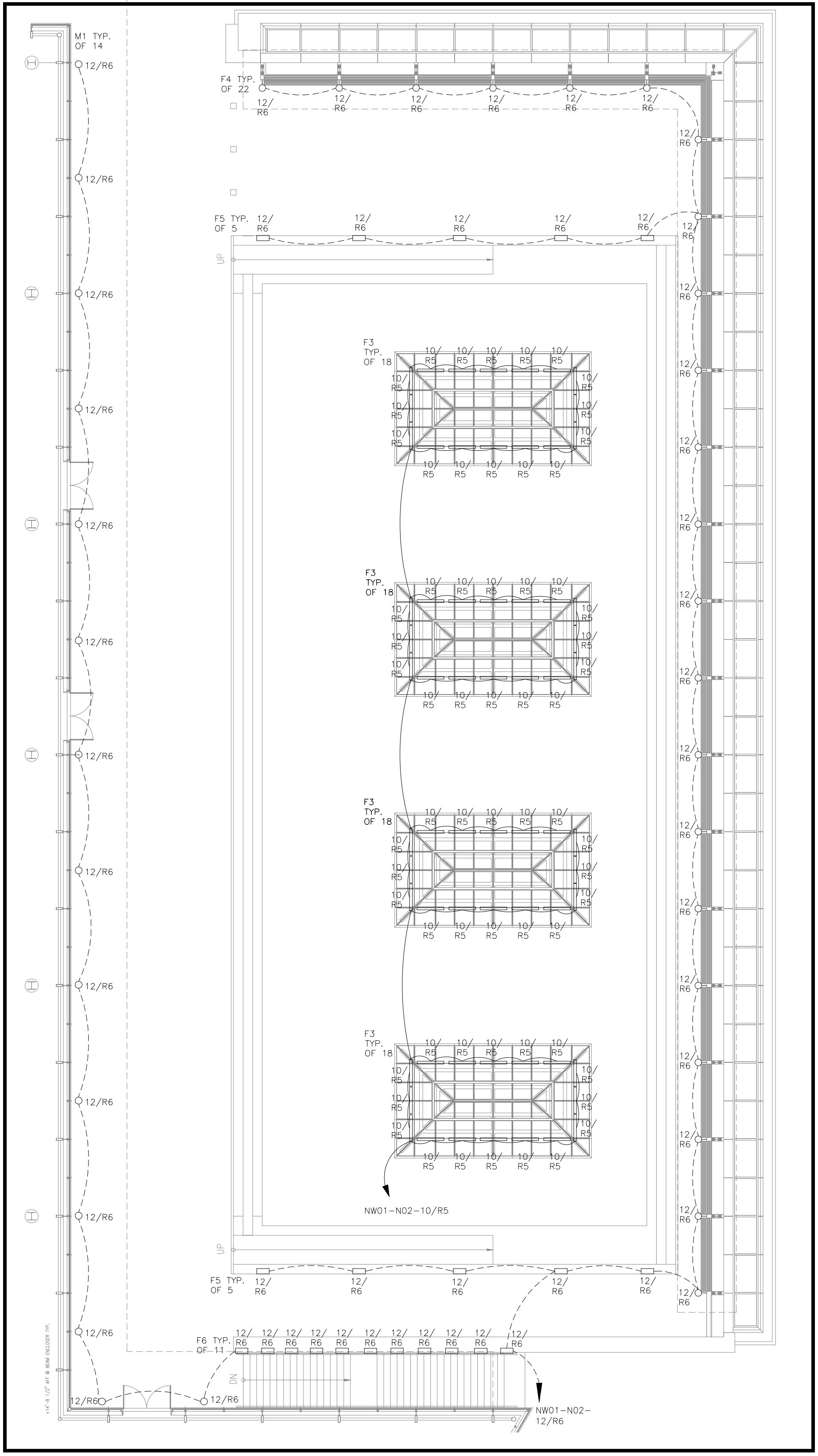


Figure 2.11 – Terrace Lighting Power Plan



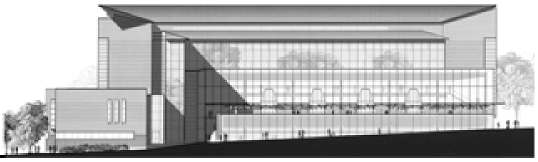


Figure 2.12 –Existing Panelboard Schedule PCB-NW01-N02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NW01-N02
PANEL LOCATION: ELEC. ROOM NW - LEVEL 01
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 35K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	6300	60A/3P	1	*			2	20A/1P	2850	SW ROOMS	LIGHTING
--	WEST	6400	--	3		*		4	20A/1P	950	NW ROOMS	LIGHTING
--	WEST	6200	--	5			*	6	20A/1P	1995	LOUNGE	LIGHTING
LIGHTING	RM 118	1235	20A/1P	7	*			8	20A/1P	3600	CORRIDOR	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	2280	SE EXTERIOR	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	1995	SE EXTERIOR	LIGHTING
MECH FTU	WEST	9500	60A/3P	13	*			14	20A/1P	500		ALC-1A
--	WEST	9500	--	15		*		16	20A/1P	0		SPARE
--	WEST	9500	--	17			*	18	20A/1P	0		SPARE
SPARE		0	60A/3P	19	*			20	20A/1P	0		SPARE
--		0	--	21		*		22	20A/1P	0		SPARE
--		0	--	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	23.99	TOTAL DESIGN LOAD (KW)	92.07
CONNECTED LOAD (KW) - B	19.13	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C	19.69	TOTAL DESIGN LOAD (AMPS)	112

Figure 2.13 – Revised Panelboard Schedule PCB-NW01-N02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NW01-N02
PANEL LOCATION: ELEC. ROOM NW - LEVEL 01
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FTU	WEST	6300	60A/3P	1	*			2	20A/1P	2850	SW ROOMS	LIGHTING
--	WEST	6400	--	3		*		4	20A/1P	950	NW ROOMS	LIGHTING
--	WEST	6200	--	5			*	6	20A/1P	1995	LOUNGE	LIGHTING
LIGHTING	RM 118	1235	20A/1P	7	*			8	20A/1P	1967	CORRIDOR	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	1920	TERRACE	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	1756	TERRACE	LIGHTING
MECH FTU	WEST	9500	60A/3P	13	*			14	20A/1P	500	ELEC. RM	ALC-1A
--	WEST	9500	--	15		*		16	20A/1P	340	GALLERIA	LIGHTING
--	WEST	9500	--	17			*	18	20A/1P	936	GALLERIA	LIGHTING
SPARE		0	60A/3P	19	*			20	20A/1P	0		SPARE
--		0	--	21		*		22	20A/1P	0		SPARE
--		0	--	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	22.35	TOTAL DESIGN LOAD (KW)	90.58
CONNECTED LOAD (KW) - B	19.11	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C	20.39	TOTAL DESIGN LOAD (AMPS)	110

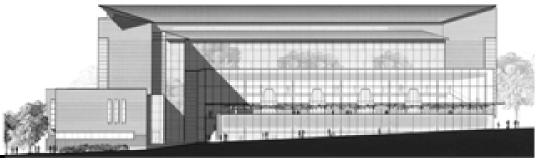


Figure 2.14 –Existing Panelboard Schedule PCB-NEB1-N04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NEB1-N04
PANEL LOCATION: ELEC. RM NE LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 42K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	SE OFFICES	3420	20A/1P	1	*			2	20A/1P	2945	S & SE WALL	LIGHTING
LIGHTING	ALCOVE	950	20A/1P	3		*		4	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	2185	20A/1P	5			*	6	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1235	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	9		*		10	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	11			*	12	20A/1P	2470	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	13	*			14	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	15		*		16	20A/1P	2470	NE ROOMS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	17			*	18	20A/1P	500	ELEC. RM	ALC-L1B
LIGHTING	LIBR. RDG	1710	20A/1P	19	*			20	20A/1P	0		SPARE
LIGHTING	LIBR. RDG	2185	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	60A/3P	25	*			26	20A/1P	0		SPARE
--		0	--	27		*		28	20A/1P	0		SPARE
--		0	--	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	6500	60A/3P	37	*			38	20A/1P	0		SPARE
--	EAST	4900	--	39		*		40	20A/1P	0		SPARE
--	EAST	4200	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	23.60	TOTAL DESIGN LOAD (KW)	91.50
CONNECTED LOAD (KW) - B	19.44	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	15.63	TOTAL DESIGN LOAD (AMPS)	114

Figure 2.15 – Revised Panelboard Schedule PCB- NEB1-N04

PANELBOARD SCHEDULE

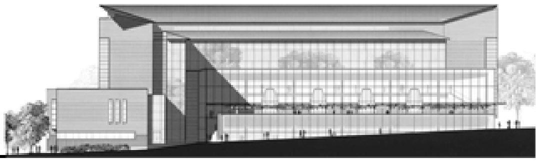
VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NEB1-N04
PANEL LOCATION: ELEC. RM NE LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	SE OFFICES	3420	20A/1P	1	*			2	20A/1P	2945	S & SE WALL	LIGHTING
LIGHTING	ALCOVE	950	20A/1P	3		*		4	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1093	20A/1P	5			*	6	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1235	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	9		*		10	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	11			*	12	20A/1P	2470	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	13	*			14	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	15		*		16	20A/1P	2470	NE ROOMS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	17			*	18	20A/1P	500	ELEC. RM	ALC-L1B
LIGHTING	LIBR. RDG	1710	20A/1P	19	*			20	20A/1P	0		SPARE
LIGHTING	LIBR. RDG	1093	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	60A/3P	25	*			26	20A/1P	0		SPARE
--		0	--	27		*		28	20A/1P	0		SPARE
--		0	--	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	6500	60A/3P	37	*			38	20A/1P	0		SPARE
--	EAST	4900	--	39		*		40	20A/1P	0		SPARE
--	EAST	4200	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	23.60	TOTAL DESIGN LOAD (KW)	88.09
CONNECTED LOAD (KW) - B	18.34	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	14.53	TOTAL DESIGN LOAD (AMPS)	110



Senator Warren G. Magnuson & Senator Henry Jackson Trial Courtroom

The lighting loads in the Trial Courtroom are controlled and powered by a preset scene dimming system and dimming panel. The existing lighting designing in this space is fed from a 208Y/120V, 3PH, 4W dimmer rack panel with 16 circuits. This panel is served from distribution panel PCD-SW01-N05. This dimmer rack panel will be replaced with a 480/277V, 3PH, 4W dimmer rack with 8 circuits, which will be fed from panel PCB-NWB2-N03(2). All existing feeders feeding to the existing dimmer rack will be removed and new feeders will be fed to the new dimming panel in the first floor southwest electrical room.

A Lutron GP Dimming Panel, model GP12-2774M60-20 will be utilized for control of this space. Please refer to the ‘Controls’ section of Appendix A for more information regarding the power requirements of this dimming panel.

As outlined in the Lighting Depth, the luminaires in the Trial Courtroom are divided into eight separate zones. Each of these zones characterizes a single circuit to the dimming panel.

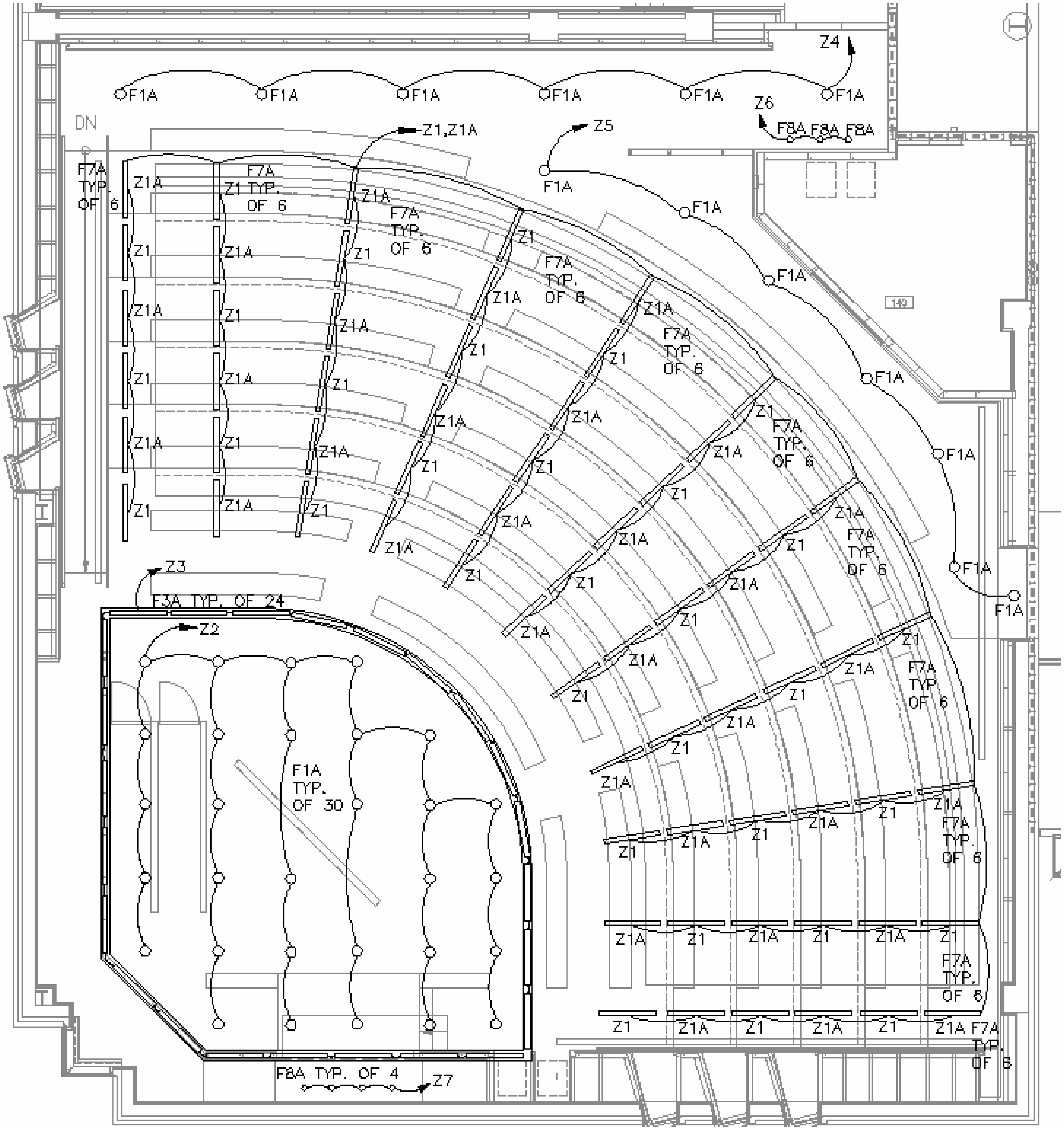
Please refer to the following Lighting Power Plan, Dimmer Rack Schedules, Panelboard/Distribution Panel Schedules and One-Line Diagrams for further information on the lighting power requirements. On the existing one-line diagram, the dimmer rack and associated feeder to be removed is noted it red. Likewise, on the revised one-line diagram the proposed new dimming rack and feeders are shown in blue.

The following table outlines feeder and conduit sizes for each of the revised panelboards in the courtroom.

Table 2.3 – Courtroom Panelboard Feeder & Conduit Sizes

PANELBOARD	OVERCURRENT PROTECTION	FEEDER SIZE				CONDUIT SIZE
		NO. SETS	PHASE	NEUTRAL	GROUND	
PCD-SW01-N05	225A 3P C/B	1	3#4/0	1#4/0	1#4	2 1/2"
PCB-NWB2-N03(2)	400A 3P C/B	2	3#3/0	1#3/0	1#2	2"
DIMMER RACK 1	60A 3P C/B	1	3#6	1#6	1#10	1"

Figure 2.16 – Trial Courtroom Lighting Power Plan



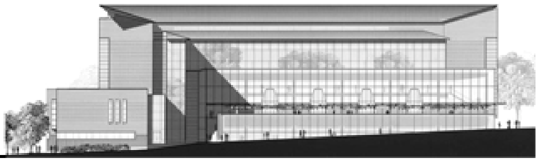


Figure 2.17 – Existing Dimmer Rack 1 Schedule

<table>
<tr><th colspan="8">Dimmer Rack 1 Schedule</th></tr>
<tr><th colspan="4" rowspan="2">Voltage: 208Y/120V, 3PH, 4W</th><th colspan="4">Size/Type Bus: 100A</th></tr>
<tr><th colspan="4">Size/Type Main: 100A MCB</th></tr>
<tr><th>Dimmer Circuit No.</th><th>Zone No.</th><th>Source Type</th><th>Fixture Quantity</th><th>Unit Watts</th><th>Total Watts</th><th>Dim. Capacity</th><th>C/B Size</th></tr>
<tr><td>1</td><td>Z1</td><td>FL</td><td>14</td><td>66</td><td>924</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>2</td><td>Z1A</td><td>FL</td><td>15</td><td>66</td><td>990</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>3</td><td>Z1B</td><td>FL</td><td>6</td><td>66</td><td>396</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>4</td><td>Z3</td><td>FL</td><td>7</td><td>66</td><td>462</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>5</td><td>Z4</td><td>FL</td><td>7</td><td>66</td><td>462</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>6</td><td>Z5</td><td>FL</td><td>10</td><td>44</td><td>440</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>7</td><td>Z6</td><td>FL</td><td>11</td><td>66</td><td>726</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>8</td><td>Z7</td><td>FL</td><td>4</td><td>66</td><td>264</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>9</td><td>Z8</td><td>FL</td><td>8</td><td>32</td><td>256</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>10</td><td>Z9</td><td>FL</td><td>13</td><td>32</td><td>416</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>11</td><td>Z10</td><td>FL</td><td>4</td><td>64</td><td>256</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>12</td><td>Z11</td><td>FL</td><td>24</td><td>32</td><td>768</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>13</td><td>Z11</td><td>FL</td><td>2</td><td>27</td><td>54</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>14</td><td>Z11</td><td>FL</td><td>2</td><td>19</td><td>38</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>15</td><td>Z13</td><td>FL</td><td>4</td><td>33</td><td>132</td><td>1900</td><td>20A/1P</td></tr>
<tr><td>16</td><td>Z16</td><td>FL</td><td>10</td><td>66</td><td>660</td><td>1900</td><td>20A/1P</td></tr>
</table>

Figure 2.18 – Existing Dimmer Rack 1 Schedule

<table>
<tr><th colspan="8">Dimmer Rack 1 Schedule</th></tr>
<tr><th colspan="4" rowspan="2">Voltage: 480Y/277V, 3PH, 4W</th><th colspan="4">Size/Type Bus: 60A</th></tr>
<tr><th colspan="4">Size/Type Main: 60A MCB</th></tr>
<tr><th>Dimmer Circuit No.</th><th>Zone No.</th><th>Source Type</th><th>Fixture Quantity</th><th>Unit Watts</th><th>Total Watts</th><th>Dim. Capacity</th><th>C/B Size</th></tr>
<tr><td>1</td><td>Z1</td><td>FL</td><td>33</td><td>30</td><td>990</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>2</td><td>Z1A</td><td>FL</td><td>33</td><td>30</td><td>990</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>3</td><td>Z2</td><td>FL</td><td>30</td><td>34</td><td>1020</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>4</td><td>Z3</td><td>FL</td><td>24</td><td>30</td><td>720</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>5</td><td>Z4</td><td>FL</td><td>6</td><td>34</td><td>204</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>6</td><td>Z5</td><td>FL</td><td>7</td><td>34</td><td>238</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>7</td><td>Z6</td><td>FL</td><td>3</td><td>20</td><td>60</td><td>4500</td><td>20A/1P</td></tr>
<tr><td>8</td><td>Z7</td><td>FL</td><td>4</td><td>20</td><td>80</td><td>4500</td><td>20A/1P</td></tr>
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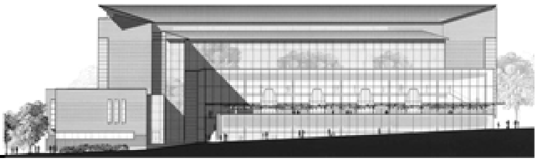


Figure 2.19 – Existing Distribution Panel Schedule PCD-SW01-N05

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

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	PCD-SW01-N05	MIN. C/B AIC:	22K
SIZE/TYPE BUS:	400A	PANEL LOCATION:	LEVEL 01	OPTIONS:	
SIZE/TYPE MAIN:	400A MLO	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	DIM. RACK 1	12730	20A/1P	1	*			2	20A/1P	9975	DIM. RACK 2	LIGHTING
LIGHTING	FUTURE DIM.	0	20A/1P	3		*		4	20A/1P	0	0	SPARE

CONNECTED LOAD (KW) - A	22.71		TOTAL DESIGN LOAD (KW)	35.48
CONNECTED LOAD (KW) - B	0.00		POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	0.00		TOTAL DESIGN LOAD (AMPS)	104

Figure 2.20 – Revised Distribution Panel Schedule PCD-SW01-N05

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

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	PCD-SW01-N05	MIN. C/B AIC:	22K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	LEVEL 01	OPTIONS:	
SIZE/TYPE MAIN:	225A MLO	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
SPARE	0	0	20A/1P	1	*			2	20A/1P	9975	DIM. RACK 2	LIGHTING
LIGHTING	FUTURE DIM.	0	20A/1P	3		*		4	20A/1P	0	0	SPARE

CONNECTED LOAD (KW) - A	9.98		TOTAL DESIGN LOAD (KW)	15.59
CONNECTED LOAD (KW) - B	0.00		POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	0.00		TOTAL DESIGN LOAD (AMPS)	47

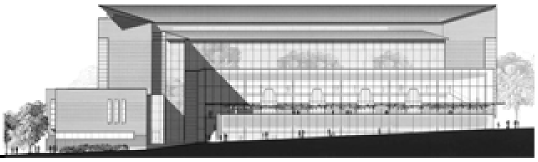


Figure 2.21 – Existing Panelboard Schedule PCB-NWB2-N03(2)

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NWB2-N03(2)	MIN. C/B AIC:	65K
SIZE/TYPE BUS:	600A	PANEL LOCATION:	PUMP ROOM	OPTIONS:	
SIZE/TYPE MAIN:	600A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FC-11	B2	800	20A/3P	1	*			2	60A/3P	0		SPARE
--	B2	800	--	3		*		4	--	0		--
--	B2	800	--	5			*	6	--	0		--
MECH FC-12	B2	800	20A/3P	7	*			8	60A/3P	0		SPARE
--	B2	800	--	9		*		10	--	0		--
--	B2	800	--	11			*	12	--	0		--
SPARE		0	60A/3P	13	*			14	60A/3P	0		SPACE
--		0	--	15		*		16	--	0		--
--		0	--	17			*	18	--	0		--
SPARE		0	60A/3P	19	*			20	60A/3P	0		SPACE
--		0	--	21		*		22	--	0		--
--		0	--	23			*	24	--	0		--
SPACE		0	60A/3P	25	*			26	60A/3P	0		SPACE
--		0	--	27		*		28	--	0		--
--		0	--	29			*	30	--	0		--
SPACE		0	60A/3P	31	*			32	60A/3P	0		SPACE
--		0	--	33		*		34	--	0		--
--		0	--	35			*	36	--	0		--
SPACE		0	60A/3P	37	*			38	60A/3P	0		SPACE
--		0	--	39		*		40	--	0		--
--		0	--	41			*	42	--	0		--

CONNECTED LOAD (KW) - A	1.60	TOTAL DESIGN LOAD (KW)	6.75
CONNECTED LOAD (KW) - B	1.60	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C	1.60	TOTAL DESIGN LOAD (AMPS)	8

Figure 2.22 – Revised Panelboard Schedule PCB-NWB2-N03(2)

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NWB2-N03(2)	MIN. C/B AIC:	14K
SIZE/TYPE BUS:	400A	PANEL LOCATION:	PUMP ROOM	OPTIONS:	
SIZE/TYPE MAIN:	400A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
MECH FC-11	B2	800	20A/3P	1	*			2	60A/3P	1430	LEVEL 01	DIMMER RACK 1
--	B2	800	--	3		*		4	--	1430		--
--	B2	800	--	5			*	6	--	1430		--
MECH FC-12	B2	800	20A/3P	7	*			8	60A/3P	0		SPARE
--	B2	800	--	9		*		10	--	0		--
--	B2	800	--	11			*	12	--	0		--
SPARE		0	60A/3P	13	*			14	60A/3P	0		SPACE
--		0	--	15		*		16	--	0		--
--		0	--	17			*	18	--	0		--
SPARE		0	60A/3P	19	*			20	60A/3P	0		SPACE
--		0	--	21		*		22	--	0		--
--		0	--	23			*	24	--	0		--
SPACE		0	60A/3P	25	*			26	60A/3P	0		SPACE
--		0	--	27		*		28	--	0		--
--		0	--	29			*	30	--	0		--
SPACE		0	60A/3P	31	*			32	60A/3P	0		SPACE
--		0	--	33		*		34	--	0		--
--		0	--	35			*	36	--	0		--
SPACE		0	60A/3P	37	*			38	60A/3P	0		SPACE
--		0	--	39		*		40	--	0		--
--		0	--	41			*	42	--	0		--

CONNECTED LOAD (KW) - A	3.03	TOTAL DESIGN LOAD (KW)	13.45
CONNECTED LOAD (KW) - B	3.03	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	3.03	TOTAL DESIGN LOAD (AMPS)	17

FIGURE 2.23 -EXISTIG ONE LINE DIAGRAM

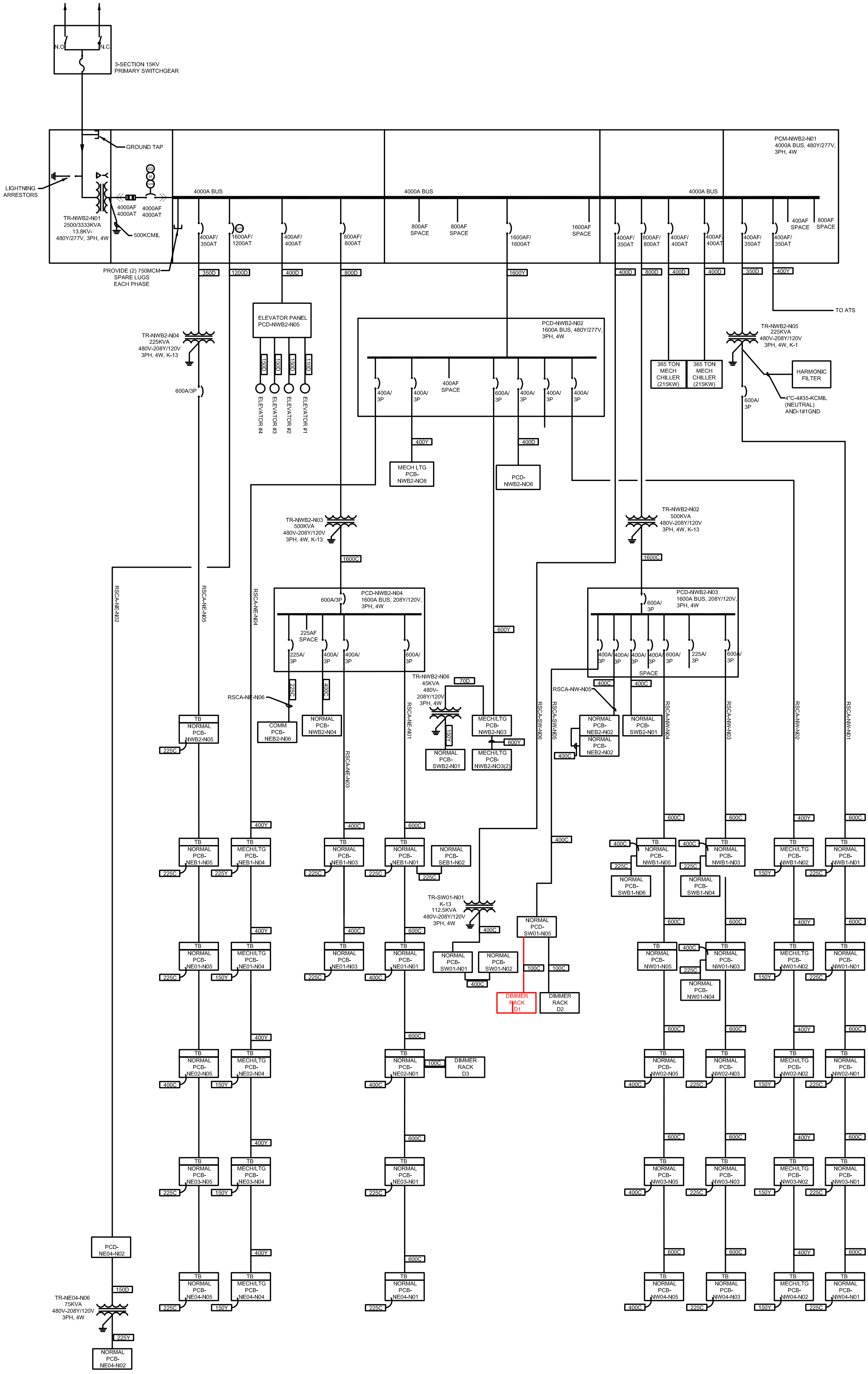
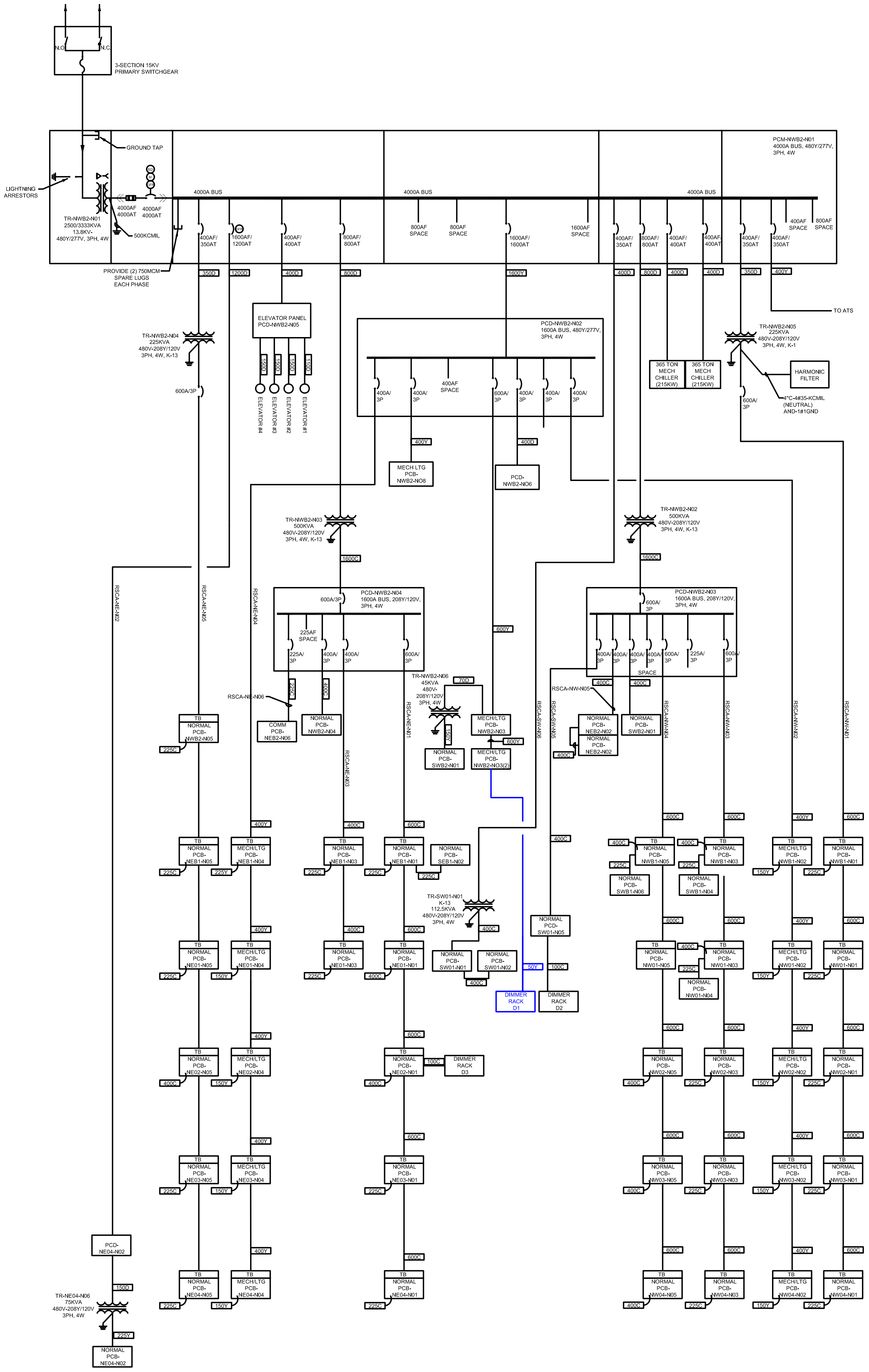
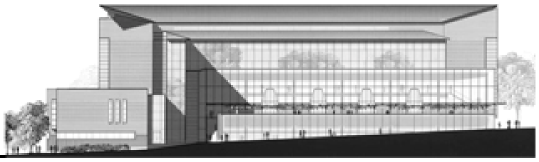


FIGURE 2.24 - REVISED ONE LINE DIAGRAM





Marion Gould Gallagher Law Library – Reading Room

The existing lighting design of the two-story library reading area utilizes circuits on four separate panelboards: one lighting panel and one emergency panel for each of the two floors. These panels include panels PCB-NWB1-N04 and PCB-NWB1-E02, which serve loads for the upper level of the library (Level L1), and panels PCB-NWB2-N08 and PCB-NWB2-E04, which serve lighting loads for the library's lower level (Level L2). Each of these panels will be used for the circuiting of the proposed lighting design in the library, however, several of the existing circuits on panelboard NWB1-N04 will not be reused and will become spare circuits.

The two levels of the library will be circuited independently to their respective panels. Lighting loads for general lighting on Level L1 will utilize two circuits on panel NEB1-N04. On the lower level of the library, two circuits on panel NWB2-N08 will be utilized; one circuit for the general lighting in this area and another circuit for the stack lighting in this space. Throughout the upper and lower levels of the library there are several table lamps which are locally switched. Each lamp is fed from a floor box receptacle located beneath each table. Table lamps are fed from general purpose receptacle circuits on panels SWB1-N02 and SWB1-N04 on the lower level and panelboards SWB1-N04 and SEB1-N02 on the upper level.

Throughout the both levels of the library, several luminaires will be integrated into the existing emergency circuit serving the space to meet emergency lighting requirements. The existing emergency loads in the library will be taken off of the circuits from panels PCB-NWB1-E02 and PCB-NWB2-E04, and replaced with the emergency loads from the proposed lighting design.

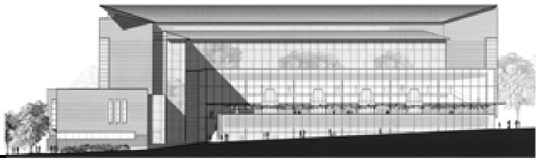
As outlined in the Lighting Depth, each of the circuits serving the library will be controlled via an automated relay system, with the exception of the emergency lighting circuit.

Please refer to the following Lighting Power Plan and Panelboard Schedules for further information on lighting circuitry and corresponding loads.

The following table outlines feeder and conduit sizes for each of the revised panelboards in the library.

Table 2.4 – Library Panelboard Feeder & Conduit Sizes

PANELBOARD	OVERCURRENT PROTECTION	FEEDER SIZE				CONDUIT SIZE
		NO. SETS	PHASE	NEUTRAL	GROUND	
PCB-NEB1-N04	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NWB1-E02	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NWB2-N08	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"
PCB-NWB2-E04	150A 3P C/B	1	3#1/0	1#1/0	1#6	1 1/2"



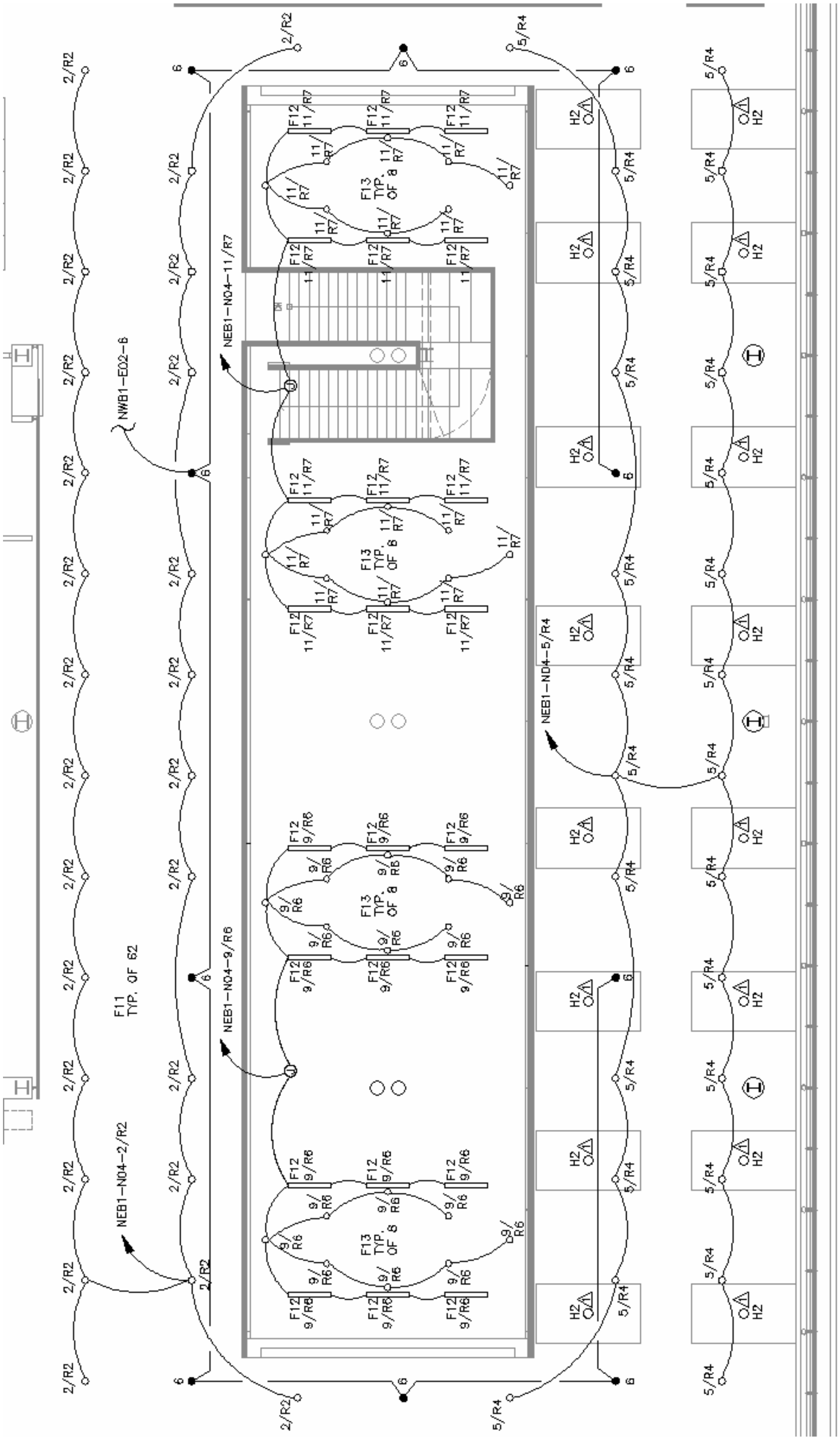


Figure 2.23 – Library Level L1 Lighting Power Plan

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

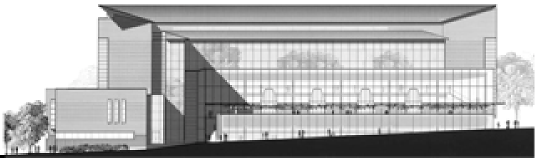
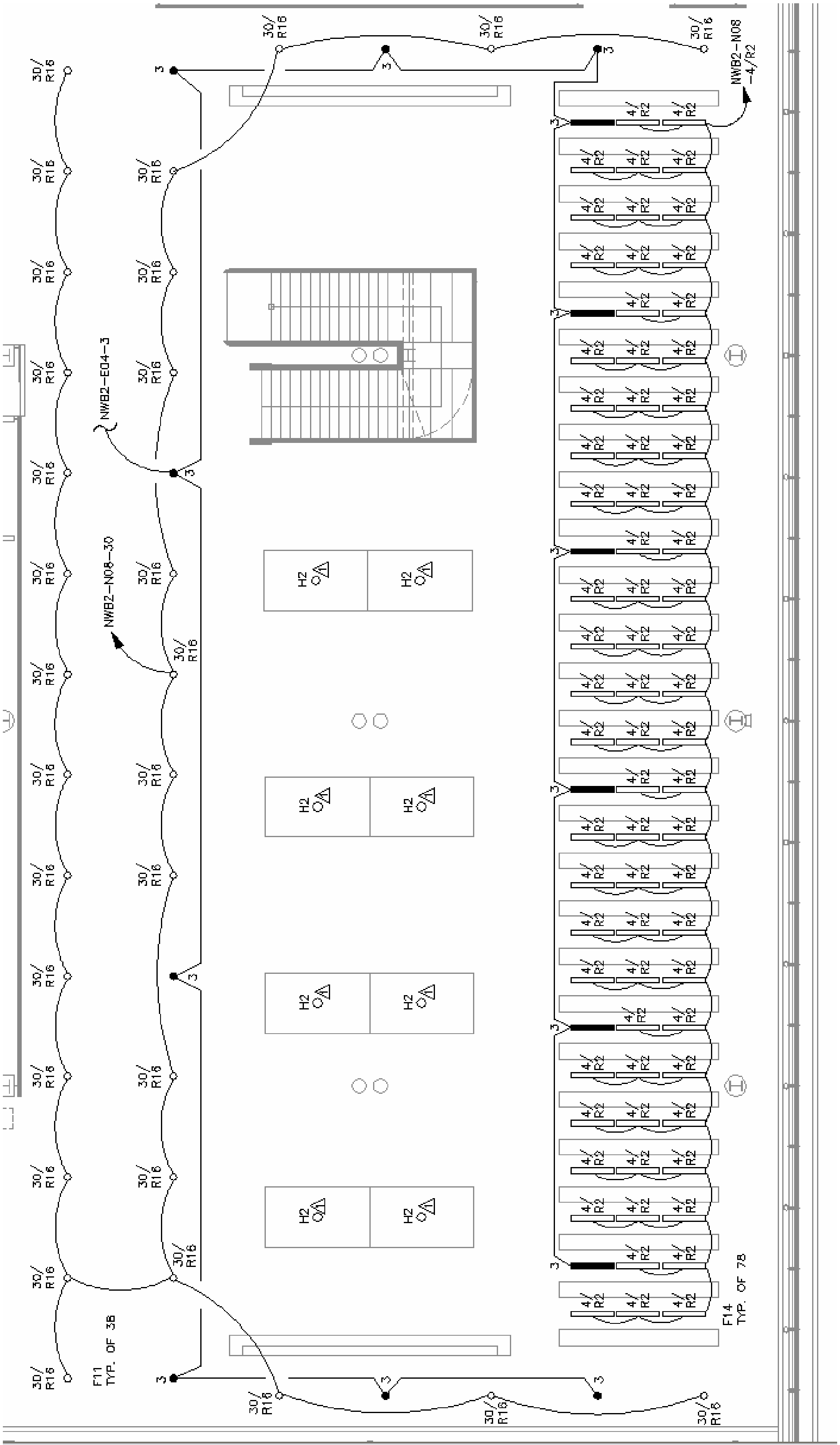


Figure 2.24 – Library Level L2 Lighting Power Plan



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

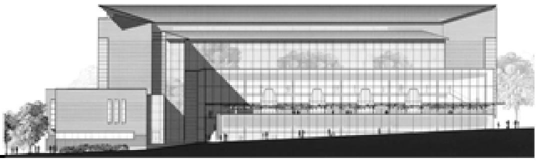


Figure 2.25 – Existing Panelboard Schedule PCB-NEB1-N04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NEB1-N04
PANEL LOCATION: ELEC. RM NE LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 42K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	SE OFFICES	3420	20A/1P	1	*			2	20A/1P	2945	S & SE WALL	LIGHTING
LIGHTING	ALCOVE	950	20A/1P	3		*		4	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1093	20A/1P	5			*	6	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1235	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	9		*		10	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	11			*	12	20A/1P	2470	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	13	*			14	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	15		*		16	20A/1P	2470	NE ROOMS	LIGHTING
LIGHTING	LIBR. RDG	1710	20A/1P	17			*	18	20A/1P	500	ELEC. RM	ALC-L1B
LIGHTING	LIBR. RDG	1710	20A/1P	19	*			20	20A/1P	0		SPARE
LIGHTING	LIBR. RDG	1093	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	60A/3P	25	*			26	20A/1P	0		SPARE
--		0	--	27		*		28	20A/1P	0		SPARE
--		0	--	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	6500	60A/3P	37	*			38	20A/1P	0		SPARE
--	EAST	4900	--	39		*		40	20A/1P	0		SPARE
--	EAST	4200	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	23.60	TOTAL DESIGN LOAD (KW)	88.09
CONNECTED LOAD (KW) - B	18.34	POWER FACTOR	0.96
CONNECTED LOAD (KW) - C	14.53	TOTAL DESIGN LOAD (AMPS)	110

Figure 2.26 – Revised Panelboard Schedule PCB-NEB1-N04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NEB1-N04
PANEL LOCATION: ELEC. RM NE LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	SE OFFICES	3420	20A/1P	1	*			2	20A/1P	1196	LIBRARY	LIGHTING
LIGHTING	ALCOVE	950	20A/1P	3		*		4	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBRARY	1196	20A/1P	5			*	6	20A/1P	2850	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1235	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1752	20A/1P	9		*		10	20A/1P	2755	STACKS	LIGHTING
LIGHTING	LIBR. RDG	1752	20A/1P	11			*	12	20A/1P	2470	STACKS	LIGHTING
SPARE	0	0	20A/1P	13	*			14	20A/1P	2850	STACKS	LIGHTING
SPARE	0	0	20A/1P	15		*		16	20A/1P	2470	NE ROOMS	LIGHTING
SPARE	0	0	20A/1P	17			*	18	20A/1P	500	ELEC. RM	ALC-L1B
SPARE	0	0	20A/1P	19	*			20	20A/1P	0		SPARE
SPARE	0	0	20A/1P	21		*		22	20A/1P	0		SPARE
SPARE		0	20A/1P	23			*	24	20A/1P	0		SPARE
SPARE		0	60A/3P	25	*			26	20A/1P	0		SPARE
--		0	--	27		*		28	20A/1P	0		SPARE
--		0	--	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	6500	60A/3P	37	*			38	20A/1P	0		SPARE
--	EAST	4900	--	39		*		40	20A/1P	0		SPARE
--	EAST	4200	--	41			*	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A	18.43	TOTAL DESIGN LOAD (KW)	73.25
CONNECTED LOAD (KW) - B	15.58	POWER FACTOR	0.97
CONNECTED LOAD (KW) - C	12.97	TOTAL DESIGN LOAD (AMPS)	91

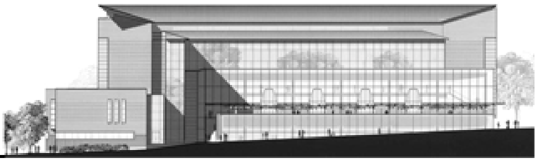


Figure 2.27 – Existing Panelboard Schedule PCB-NWB1-E02

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NWB1-E02
PANEL LOCATION: ELEC. RM NW - LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: PROVIDE FEED THROUGH LUGS
FOR PANELBOARD 1L1B

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	380	STAIR 1	LIGHTING
LIGHTING	EGRESS	3135	20A/1P	3		*		4	20A/1P	190	STAIR 4	LIGHTING
LIGHTING	MECH/ELEC	380	20A/1P	5			*	6	20A/1P	1425	L107	LIGHTING
LIGHTING	EXIT SIGNS	95	20A/1P	7	*			8	20A/1P	0		SPARE
LIGHTING	EGRESS L-01	1235	20A/1P	9		*		10	20A/1P	0		SPARE
LIGHTING	MECH/ELEC	380	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	40A/3P	0		SPARE
SPARE		0	20A/1P	33		*		34	--	0		--
SPARE		0	20A/1P	35			*	36	--	0		--
SPARE		0	20A/1P	37	*			38	40A/3P	0		SPARE
SPARE		0	20A/1P	39		*		40	--	0		--
SPARE		0	20A/1P	41			*	42	--	0		--

CONNECTED LOAD (KW) - A	0.57	TOTAL DESIGN LOAD (KW)	11.43
CONNECTED LOAD (KW) - B	4.56	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	2.19	TOTAL DESIGN LOAD (AMPS)	14

Figure 2.28 – Revised Panelboard Schedule PCB-NWB1-E02

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NWB1-E02
PANEL LOCATION: ELEC. RM NW - LEVEL B1
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	380	STAIR 1	LIGHTING
LIGHTING	EGRESS	3135	20A/1P	3		*		4	20A/1P	190	STAIR 4	LIGHTING
LIGHTING	MECH/ELEC	380	20A/1P	5			*	6	20A/1P	460	LIBRARY	LIGHTING
LIGHTING	EXIT SIGNS	95	20A/1P	7	*			8	20A/1P	0		SPARE
LIGHTING	EGRESS L-01	1116	20A/1P	9		*		10	20A/1P	0		SPARE
LIGHTING	MECH/ELEC	380	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	0.57	TOTAL DESIGN LOAD (KW)	13.63
CONNECTED LOAD (KW) - B	4.44	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	1.22	TOTAL DESIGN LOAD (AMPS)	17

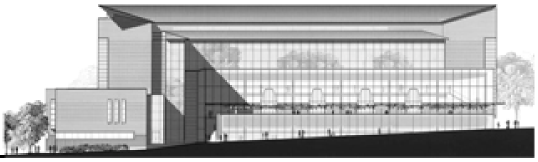


Figure 2.29 – Existing Panelboard Schedule PCB-NWB2-N08

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NWB2-N08	MIN. C/B AIC:	100K
SIZE/TYPE BUS:	400A	PANEL LOCATION:	ELEC. RM - LEVEL B2	OPTIONS:	
SIZE/TYPE MAIN:	400A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
SPARE		0	20A/1P	1	*			2	20A/1P	1710	SW STORAGE	LIGHTING
SPARE		0	20A/1P	3		*		4	20A/1P	3325	S. STACKS	LIGHTING
SPARE		0	20A/1P	5			*	6	20A/1P	1900	SE. OFFICES	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	3135	STACKS	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	3135	STACKS	LIGHTING
SPARE		0	20A/1P	13	*			14	20A/1P	2755	STACKS	LIGHTING
SPARE		0	20A/1P	15		*		16	20A/1P	1900	STACKS	LIGHTING
SPARE		0	20A/1P	17			*	18	20A/1P	2565	STACKS	LIGHTING
SPARE		0	20A/1P	19	*			20	20A/1P	3420	CORRIDOR	LIGHTING
SPARE		0	20A/1P	21		*		22	20A/1P	3325	N. ROOMS	LIGHTING
SPARE		0	20A/1P	23			*	24	20A/1P	1900	L201, L202	LIGHTING
SPARE		0	20A/1P	25	*			26	20A/1P	500	ELEC. RM	ALC-L2A
SPARE		0	20A/1P	27		*		28	20A/1P	500	ELEC. RM	ALC-L2B
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	11.62	TOTAL DESIGN LOAD (KW)	51.72
CONNECTED LOAD (KW) - B	12.19	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	9.50	TOTAL DESIGN LOAD (AMPS)	65

Figure 2.30 – Revised Panelboard Schedule PCB-NWB2-N08

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	PCB-NWB2-N08	MIN. C/B AIC:	14K
SIZE/TYPE BUS:	150A	PANEL LOCATION:	ELEC. RM - LEVEL B2	OPTIONS:	
SIZE/TYPE MAIN:	150A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
SPARE		0	20A/1P	1	*			2	20A/1P	1710	SW STORAGE	LIGHTING
SPARE		0	20A/1P	3		*		4	20A/1P	2160	S. STACKS	LIGHTING
SPARE		0	20A/1P	5			*	6	20A/1P	1900	SE. OFFICES	LIGHTING
SPARE		0	20A/1P	7	*			8	20A/1P	3230	STACKS	LIGHTING
SPARE		0	20A/1P	9		*		10	20A/1P	3135	STACKS	LIGHTING
SPARE		0	20A/1P	11			*	12	20A/1P	3135	STACKS	LIGHTING
SPARE		0	20A/1P	13	*			14	20A/1P	2755	STACKS	LIGHTING
SPARE		0	20A/1P	15		*		16	20A/1P	1900	STACKS	LIGHTING
SPARE		0	20A/1P	17			*	18	20A/1P	2565	STACKS	LIGHTING
SPARE		0	20A/1P	19	*			20	20A/1P	1900	CORRIDOR	LIGHTING
SPARE		0	20A/1P	21		*		22	20A/1P	3325	N. ROOMS	LIGHTING
SPARE		0	20A/1P	23			*	24	20A/1P	1900	L201, L202	LIGHTING
SPARE		0	20A/1P	25	*			26	20A/1P	500	ELEC. RM	ALC-L2A
SPARE		0	20A/1P	27		*		28	20A/1P	500	ELEC. RM	ALC-L2B
SPARE		0	20A/1P	29			*	30	20A/1P	1380	LIBR. RDG	LIGHTING
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	10.10	TOTAL DESIGN LOAD (KW)	59.62
CONNECTED LOAD (KW) - B	11.02	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	10.88	TOTAL DESIGN LOAD (AMPS)	75

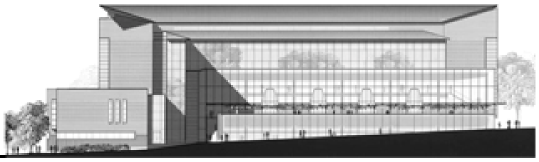


Figure 2.31 – Existing Panelboard Schedule PCB-NWB2-E04

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: PCB-NWB2-E04
PANEL LOCATION: MAIN ELEC. RM - LEVEL B2
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 65K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	760	STAIR 2	LIGHTING
LIGHTING	EGRESS	1710	20A/1P	3		*		4	20A/1P	570	STAIR 3	LIGHTING
LIGHTING	MECH/ELEC	1330	20A/1P	5			*	6	20A/1P	0		SPARE
SPARE		0	20A/1P	7	*			8	20A/1P	0		SPARE
SPARE		0	20A/1P	9		*		10	20A/1P	0		SPARE
SPARE		0	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	0.86	TOTAL DESIGN LOAD (KW)	6.98
CONNECTED LOAD (KW) - B	2.28	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	1.33	TOTAL DESIGN LOAD (AMPS)	9

Figure 2.32 – Revised Panelboard Schedule PCB-NWB2-E04

PANELBOARD SCHEDULE

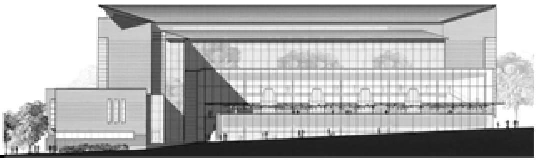
VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 150A
SIZE/TYPE MAIN: 150A/3P C/B

PANEL TAG: PCB-NWB2-E04
PANEL LOCATION: MAIN ELEC. RM - LEVEL B2
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 14K
OPTIONS:

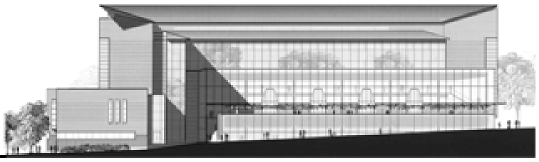
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING	EXIT SIGNS	95	20A/1P	1	*			2	20A/1P	760	STAIR 2	LIGHTING
LIGHTING	EGRESS	1805	20A/1P	3		*		4	20A/1P	570	STAIR 3	LIGHTING
LIGHTING	MECH/ELEC	1330	20A/1P	5			*	6	20A/1P	0		SPARE
SPARE		0	20A/1P	7	*			8	20A/1P	0		SPARE
SPARE		0	20A/1P	9		*		10	20A/1P	0		SPARE
SPARE		0	20A/1P	11			*	12	20A/1P	0		SPARE
SPARE		0	20A/1P	13	*			14	20A/1P	0		SPARE
SPARE		0	20A/1P	15		*		16	20A/1P	0		SPARE
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	0.86	TOTAL DESIGN LOAD (KW)	8.55
CONNECTED LOAD (KW) - B	2.38	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C	1.33	TOTAL DESIGN LOAD (AMPS)	11



Transformer Analysis

Central vs. Distributed Transformers



Introduction

The following portion of the Electrical Depth looks to redesign William H. Gates Hall's electrical distribution system incorporating the use of the distributed transformers. The building's existing distribution system utilizes four central step-down transformers. The Transformer Analysis will redesign the feeders and loads fed by these central transformers up the building electrical riser stack. Additionally, a cost analysis comparison will explore the cost implications of the two design options in order to help best determine the ideal transformer system for William H. Gates Hall

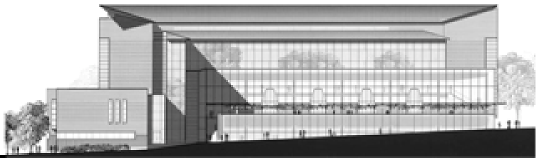
Existing System

The electrical design William H. Gates Hall utilizes a radial distribution system, in which the service is brought to the building through two 13.8 kV primary feeders tapped from the main campus distribution system. These two feeders enter the building in the Main Electric Room on level L2 and are connected to the three-bay primary switchgear. This then feeds a single-ended interior substation and the primary switch, rated at 15KV, 600 amperes, serving a 2500/3333 KVA fan cooled, dry type transformer. The secondary serving voltage for the building is a 480Y/277 volts, 3 phase, 4 wire grounded Wye system. The majority of the building's mechanical system and lighting loads are served at these voltages, and 208/120 volt loads are served through additional step-down transformers.

The current design of the electrical distribution system in William H. Gates Hall utilizes central step-down transformers located in the Main Electrical Room on Level L1. Four primary transformers are fed from the building switchgear and provide 208/120V power throughout the building. These four transformers include: TR-NWB2-N02, TR-NWB2-N03, TR-NWB2-N04 and TR-NWB2-N05. The following transformer schedule, Table 3.1, outlines all of the building's transformers. Additionally, please refer to Appendix C for information regarding the building existing electrical distribution system, the existing one-line diagram and a feeder schedule.

Table 3.1 – Existing Transformer Schedule

TRANSFORMER SCHEDULE							
TAG	**PRIMARY VOLTAGE**	**SECONDARY VOLTAGE**	**SIZE**	**TYPE**	**TEMP. RISE**	**MOUNTING**	**REMARKS**
TR-NWB2-N01	13.8 KV,3PH,3W	480Y/277V,3PH,4W	2500	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-4 RATED
TR-NWB2-N02	480V,3PH,3W.	208Y/120V,3PH,4W	500	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N03	480V,3PH,3W.	208Y/120V,3PH,4W	500	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N04	480V,3PH,3W.	208Y/120V,3PH,4W	225	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N05	480V,3PH,3W.	208Y/120V,3PH,4W	225	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N06	480V,3PH,3W.	208Y/120V,3PH,4W	45	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-SW01-N01	480V,3PH,3W.	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NE04-N06	480V,3PH,3W.	208Y/120V,3PH,4W	75	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED



Transformer Design Considerations

While there are no current design issues or concerns with the existing building distribution system and transformer design, there are several points to consider when designing the building transformer distribution. The current system of utilizing four larger central transformers to provide the building with 208/120 volt power allows for minimal equipment to be used and for the equipment to be centrally located. This allows for 208/120V to be fed up the electrical riser stack and directly to the required panels. While this type of power transformation requires less equipment, it also commonly increases wire sizes and cost throughout the building due to the decreased voltage.

An electrical distribution system that utilizes distributed transformers posses another set of design considerations. The use of smaller, distributed transformers on each floor requires for larger quantities of equipment to be purchased and installed. However, by locally stepping down the voltage to 208/120V, the main feeders running through the building riser are often able to be sized much smaller, and thus provide potential significant savings on wire. This is a very important consideration given the high cost of copper wire. In addition to the quantity and cost of equipment and materials required for each system, electrical room/closest space considerations must not be overlooked. There needs to be adequate space in many of the floors electrical closets for one or more transformers. These electrical closets are often small and overcrowded with equipment.

Additionally, the heat discharge of the transformers is an important issue that should be considered in designing building transformers. This is especially important with the use of distributed transformers that are often located in smaller electrical closets. The small spaces filled with different equipment, which often is generating heat, must have proper ventilation for these spaces. For the purpose of this report, it is assumed that each of the electrical closets allows for proper ventilation and the heat discharge of the transformers is not an issue.

Distributed Transformer Design

The redesign of the electrical distribution system using distributed transformers will look at four feeders that run the height of the building feeding the same 208/120V panelboards respective to each floor. The central transformers that steps down each of these feeders will be removed or resized depending on the components along the run of each individual feeder. For each of these vertical runs, all feeders and associated equipment, such as protection, panelboards, distribution panelboards and circuit breakers will be resized according to the changes made and transformers added to the system.

Transformers TR-NWB2-N02 and TR-NWB2-N03, whose secondary side directly feeds distribution panels, will not be removed from the new design; rather, they will be resized according to the distribution panels' design loads after the 208/120V feeders have been removed. Due to the uncertainty of the original design criteria the panelboards and loads fed directly from these distribution panels will remain connected in these locations.

Figure 3.1 highlights in red each of the feeders and the associated components on the existing one line diagram that will be considered in the redesign of the transformers.

In determining the locations and quantity of new transformers, the general rule of thumb of two panelboards per transformer was applied. In the case that only one panelboard from a specific feeder is located on each floor, an exception was made and three panelboards were fed from a transformer. This allows for transformers to be placed on one floor and feed panelboards on adjacent floors, directly above and/or below. Figure 3.2 shows the panelboard grouping used in adding distributed transformers.

Additionally, refer to Appendix C for manufacturer information on the transformers used in this redesign.

FIGURE 3.1 - TRANSFORMERS, FEEDERS & EQUIPMENT TO BE REDESIGNED

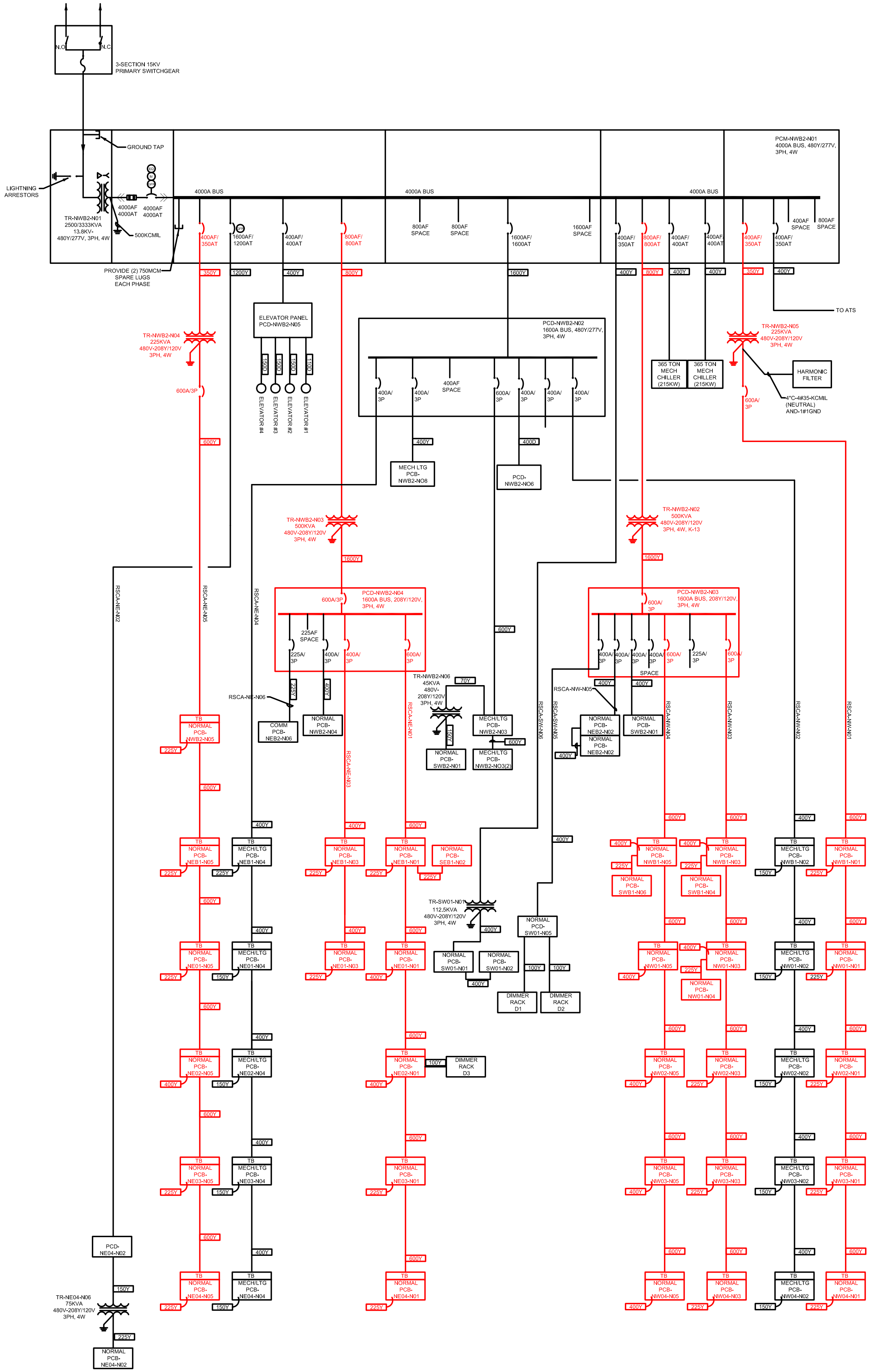
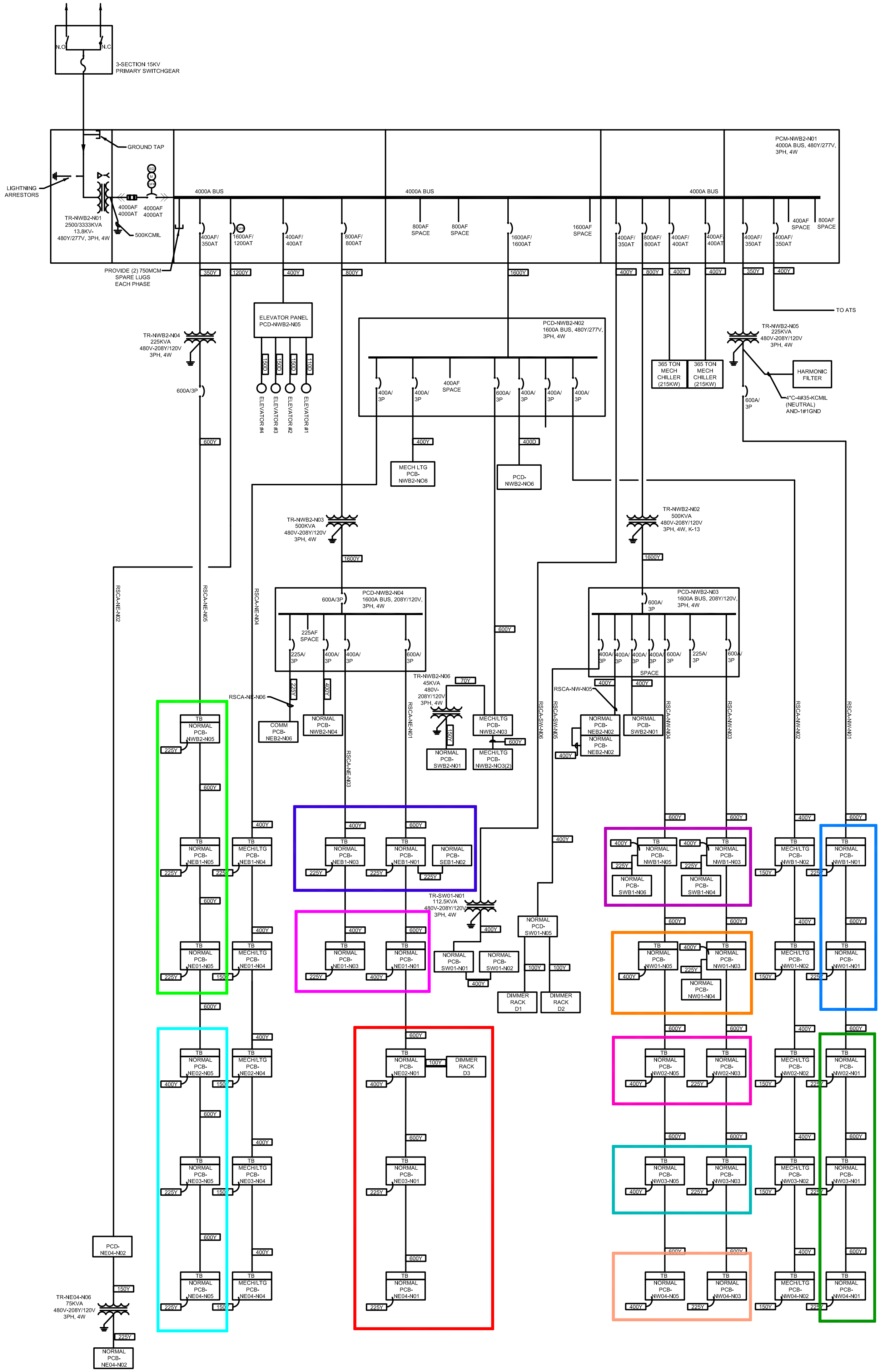
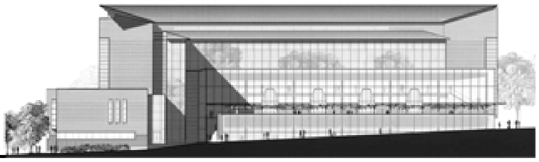


FIGURE 3.2 - PANELBOARD GROUPING





Transformer Sizing

The following tables outline all pertinent information in sizing the transformers, transformer protection and feeders.

To size transformers the following equation is used:

$$\text{Calculated KVA} = \text{Total Design Load} * 208 * \sqrt{3}$$

Primary protection is sized for each panel using the following equations:

Primary & Secondary Protection

$$\text{Primary Protection} = ((\text{Transformer KVA} * 1000) / (480 * \sqrt{3})) * 250\%$$

Primary Protection Only

$$\text{Primary Protection} = ((\text{Transformer KVA} * 1000) / (480 * \sqrt{3})) * 125\%$$

When secondary protection is required, protection was sized using the following equation:

$$\text{Secondary Protection} = \text{Total Design Load} * 125\%$$

Table 3.2 – Transformer Sizing

TR-NEB1-N05		**TR-NE03-N05**		**TR-NWB2-N03**	
Design Load		**Design Load**		**Design Load**	
PCB-NWB2-N05	48.65	PCB-NE02-N05	73	PCD-NWB2-N04	127.2
PCB-NEB1-N05	40	PCB-NE03-N05	26.25		
PCB-NE01-N05	40	PCB-NE04-N05	18		
Total Design Load	**128.65**	Total Design Load	**117.25**	Total Design Load	**127.2**
Transformer Size		**Transformer Size**		**Transformer Size**	
Calc. KVA	46.314	Calc. KVA	42.21	Calc. KVA	45.792
Transformer Size	**45 KVA**	Transformer Size	**45 KVA**	Transformer Size	**45 KVA**
Transformer Protection		**Transformer Protection**		**Transformer Protection**	
Primary		**Primary**		**Primary**	
Rating (Amps)	60.14	Rating (Amps)	60.14	Rating (Amps)	60.14
X 250%	150.36	X 250%	150.36	X 125%	75.18
Breaker Size	**225 A**	Breaker Size	**225 A**	Breaker Size	**100 A**
Secondary		**Secondary**		**Secondary**	
Rating (Amps)	148.65	Rating (Amps)	117.25	Rating (Amps)	NA
X 125%	185.8125	X 125%	146.5625	X 125%	NA
Breaker Size	**225A**	Breaker Size	**225 A**	Breaker Size	NA
Feeders		**Feeders**		**Feeders**	
Primary		**Primary**		**Primary**	
Phase Wire	3#4/0	Phase Wire	3#4/0	Phase Wire	3#3
Neutral	1#4/0	Neutral	1#4/0	Neutral	1#3
Ground	1#4	Ground	1#4	Ground	1#8
Conduit	2 1/2"	Conduit	2 1/2"	Conduit	1 1/4"
Secondary (To Each Panel)		**Secondary (To Each Panel)**		**Secondary**	
Phase Wire	3#4/0	Phase Wire	3#4/0	Phase Wire	SEE ONE-LINE
Neutral	1#4/0	Neutral	1#4/0	Neutral	SEE ONE-LINE
Ground	1#4	Ground	1#4	Ground	SEE ONE-LINE
Conduit	2 1/2"	Conduit	2 1/2"	Conduit	SEE ONE-LINE

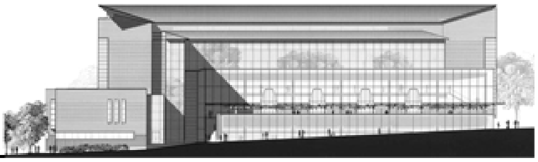


Table 3.2 – Transformer Sizing (cont'd)

TR-NEB1-N01		TR-NE01-N01		TR-NE03-N01	
Design Load		**Design Load**		**Design Load**	
PCB-NEB1-N03	54.9	PCB-NE01-N03	87.63	PCB-NE02-N01	128.9
PCB-NEB1-N01	138.2	PCB-NE01-N01	119	PCB-NE03-N01	70.75
PCB-SEB1-N02	82.1			PCB-NE04-N01	53.63
Total Design Load	**275.2**	Total Design Load	**206.63**	Total Design Load	**253.28**
Transformer Size		**Transformer Size**		**Transformer Size**	
Calc. KVA	99.072	Calc. KVA	74.3868	Calc. KVA	91.1808
Transformer Size	**112.5 KVA**	Transformer Size	**75 KVA**	Transformer Size	**112.5 KVA**
Transformer Protection		**Transformer Protection**		**Transformer Protection**	
Primary		**Primary**		**Primary**	
Rating (Amps)	135.32	Rating (Amps)	90.21	Rating (Amps)	135.32
X 125%	169.15	X 125%	112.77	X 250%	338.30
Breaker Size	**225A**	Breaker Size	**225**	Breaker Size	**400A**
Secondary		**Secondary**		**Secondary**	
Rating (Amps)	NA	Rating (Amps)	NA	Rating (Amps)	253.28
X 125%	NA	X 125%	NA	X 125%	316.6
Breaker Size	NA	Breaker Size	NA	Breaker Size	**400A**
Feeders		**Feeders**		**Feeders**	
Primary		**Primary**		**Primary (2 Sets)**	
Phase Wire	3#4/0	Phase Wire	3#4/0	Phase Wire	3#3/0
Neutral	1#4/0	Neutral	1#4/0	Neutral	1#3/0
Ground	1#4	Ground	1#4	Ground	1#6
Conduit	2 1/2"	Conduit	2 1/2"	Conduit	2"
Secondary		**Secondary**		**Secondary (2 Sets)**	
Phase Wire	SEE ONE-LINE	Phase Wire	SEE ONE-LINE	Phase Wire	3#3/0
Neutral	SEE ONE-LINE	Neutral	SEE ONE-LINE	Neutral	1#3/0
Ground	SEE ONE-LINE	Ground	SEE ONE-LINE	Ground	1#6
Conduit	SEE ONE-LINE	Conduit	SEE ONE-LINE	Conduit	2"

Table 3.2 – Transformer Sizing (cont'd)

TR-NWB2-N02	
Design Load	
PCD-NWB2-N03	346.3
Total Design Load	**346.3**
Transformer Size	
Calc. KVA	124.668
Transformer Size	**150 KVA**
Transformer Protection	
Primary	
Rating (Amps)	180.43
X 125%	225.53
Breaker Size	**225A**
Secondary	
Rating (Amps)	NA
X 125%	NA
Breaker Size	NA
Feeders	
Primary	
Phase Wire	3#4/0
Neutral	1#4/0
Ground	1#4
Conduit	2 1/2"
Secondary	
Phase Wire	SEE ONE LINE
Neutral	SEE ONE LINE
Ground	SEE ONE LINE
Conduit	SEE ONE LINE

TR-NWB1-N03	
Design Load	
PCB-NWB1-N03	135.5
PCB-NWB1-N05	94.7
Total Design Load	**230.2**
Transformer Size	
Calc. KVA	82.872
Transformer Size	**112.5 KVA**
Transformer Protection	
Primary	
Rating (Amps)	135.32
X 125%	169.15
Breaker Size	**225A**
Secondary	
Rating (Amps)	NA
X 125%	NA
Breaker Size	NA
Feeders	
Primary	
Phase Wire	3#4/0
Neutral	1#4/0
Ground	1#4
Conduit	2 1/2"
Secondary	
Phase Wire	SEE ONE LINE
Neutral	SEE ONE LINE
Ground	SEE ONE LINE
Conduit	SEE ONE LINE

TR-NW01-N03	
Design Load	
PCB-NW01-N03	235.25
PCB-NW01-N05	180.25
Total Design Load	**415.5**
Transformer Size	
Calc. KVA	149.58
Transformer Size	**150 KVA**
Transformer Protection	
Primary	
Rating (Amps)	180.43
X 125%	225.53
Breaker Size	**225A**
Secondary	
Rating (Amps)	NA
X 125%	NA
Breaker Size	NA
Feeders	
Primary	
Phase Wire	3#4/0
Neutral	1#4/0
Ground	1#4
Conduit	2 1/2"
Secondary	
Phase Wire	SEE ONE LINE
Neutral	SEE ONE LINE
Ground	SEE ONE LINE
Conduit	SEE ONE LINE

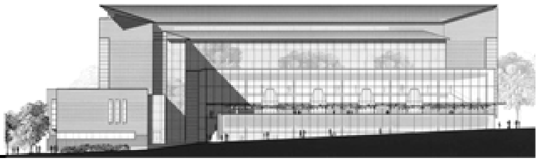


Table 3.2 – Transformer Sizing (cont'd)

TR-NW02-N03		TR-NW03-N03		TR-NW04-N03	
Design Load		**Design Load**		**Design Load**	
PCB-NW02-N03	84.5	PCB-NW03-N03	70.1	PCB-NW04-N03	40.46
PCB-NW02-N05	95.1	PCB-NW03-N05	96.5	PCB-NW04-N05	110.5
Total Design Load	**179.6**	Total Design Load	**166.6**	Total Design Load	**150.96**
Transformer Size		**Transformer Size**		**Transformer Size**	
Calc. KVA	64.656	Calc. KVA	59.976	Calc. KVA	54.3456
Transformer Size	**75 KVA**	Transformer Size	**75 KVA**	Transformer Size	**75 KVA**
Transformer Protection		**Transformer Protection**		**Transformer Protection**	
Primary		**Primary**		**Primary**	
Rating (Amps)	90.21	Rating (Amps)	90.21	Rating (Amps)	90.21
X 125%	112.77	X 125%	112.77	X 125%	112.77
Breaker Size	**225A**	Breaker Size	**225A**	Breaker Size	**225A**
Secondary		**Secondary**		**Secondary**	
Rating (Amps)	NA	Rating (Amps)	NA	Rating (Amps)	NA
X 125%	NA	X 125%	NA	X 125%	NA
Breaker Size	NA	Breaker Size	NA	Breaker Size	NA
Feeders		**Feeders**		**Feeders**	
Primary		**Primary**		**Primary**	
Phase Wire	3#4/0	Phase Wire	3#4/0	Phase Wire	3#4/0
Neutral	1#4/0	Neutral	1#4/0	Neutral	1#4/0
Ground	1#4	Ground	1#4	Ground	1#4
Conduit	2 1/2"	Conduit	2 1/2"	Conduit	2 1/2"
Secondary		**Secondary**		**Secondary**	
Phase Wire	SEE ONE LINE	Phase Wire	SEE ONE LINE	Phase Wire	SEE ONE LINE
Neutral	SEE ONE LINE	Neutral	SEE ONE LINE	Neutral	SEE ONE LINE
Ground	SEE ONE LINE	Ground	SEE ONE LINE	Ground	SEE ONE LINE
Conduit	SEE ONE LINE	Conduit	SEE ONE LINE	Conduit	SEE ONE LINE

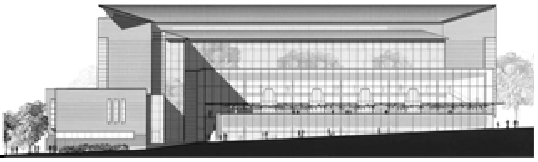


Table 3.2 – Transformer Sizing (cont'd)

TR-NWB1-N01	
Design Load	
PCB-NWB1-N01	105.1
PCB-NW01-N01	142.75
Total Design Load	**247.85**
Transformer Size	
Calc. KVA	89.226
Transformer Size	**112.5 KVA**
Transformer Protection	
Primary	
Rating (Amps)	135.32
X 250%	338.30
Breaker Size	**400A**
Secondary	
Rating (Amps)	247.85
X 125%	309.8125
Breaker Size	**400A**
Feeders	
Primary (2 Sets)	
Phase Wire	3#3/0
Neutral	1#3/0
Ground	1#6
Conduit	2"
Secondary (2 Sets)	
Phase Wire	3#3/0
Neutral	1#3/0
Ground	1#6
Conduit	2"

TR-NW03-N01	
Design Load	
PCB-NW02-N01	113.1
PCB-NW03-N01	68.2
PCB-NW04-N01	87.78
Total Design Load	**269.08**
Transformer Size	
Calc. KVA	96.8688
Transformer Size	**112.5 KVA**
Transformer Protection	
Primary	
Rating (Amps)	135.32
X 250%	338.30
Breaker Size	**400A**
Secondary	
Rating (Amps)	269.08
X 125%	336.35
Breaker Size	**400A**
Feeders	
Primary (2 Sets)	
Phase Wire	3#3/0
Neutral	1#3/0
Ground	1#6
Conduit	2"
Secondary (2 Sets)	
Phase Wire	3#3/0
Neutral	1#3/0
Ground	1#6
Conduit	2"

Transformer Schedules & One-Line Diagrams

The following transformer schedule, Table 3.3, outlines all new transformers, in addition to existing transformers. All new and existing transformers are K-13 rated, per the building design specifications. Additionally, please refer to Figure 3.3 – Proposed One Line Diagram, for more information regarding the proposed transformer system and distribution. For feeder sizes and information, please refer to Appendix C for a feeder schedule.

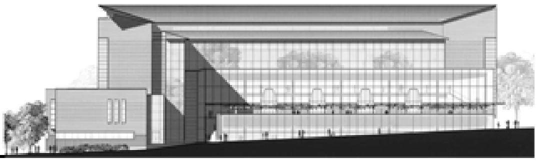


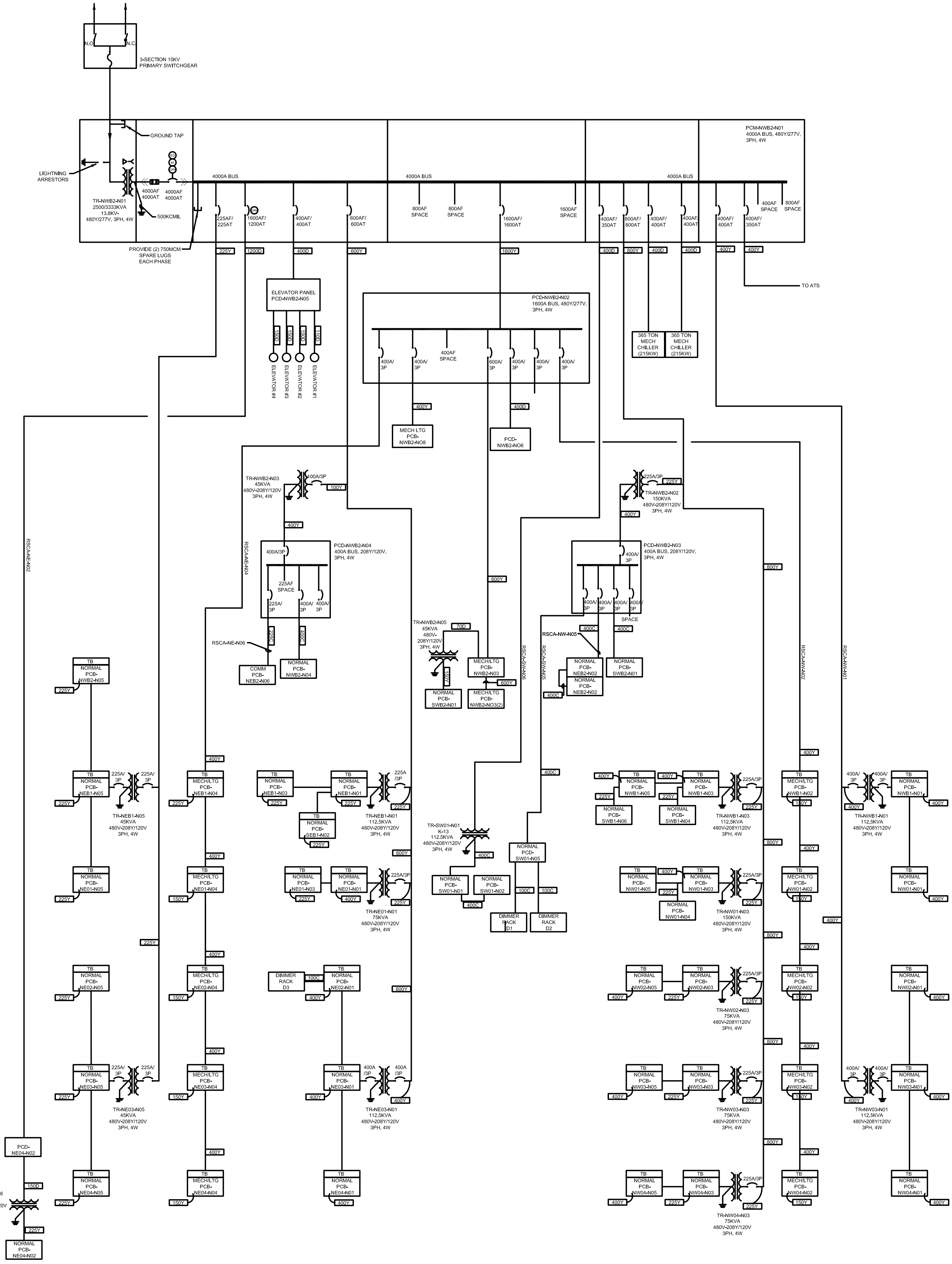
Table 3.3 – Transformer Schedule

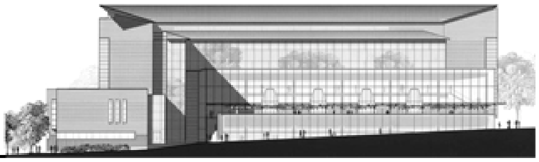
TRANSFORMER SCHEDULE

TAG	PRIMARY VOLTAGE	SECONDARY VOLTAGE	SIZE	TYPE	TEMP. RISE	MOUNTING	REMARKS
TR-NWB2-N01	*13.8 KV,3PH,3W*	*480Y/277V,3PH,4W*	*2500*	*DRY TYPE*	*150 DEGREE C*	*PAD MOUNTED ON FLOOR*	*K-4 RATED*
TR-NWB2-N02	480V,3PH,3W	208Y/120V,3PH,4W	150	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N03	480V,3PH,3W	208Y/120V,3PH,4W	50	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB2-N05	*480V,3PH,3W*	*208Y/120V,3PH,4W*	*45*	*DRY TYPE*	*150 DEGREE C*	*PAD MOUNTED ON FLOOR*	K-13 RATED
TR-NWB1-N01	480V,3PH,3W	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NWB1-N03	480V,3PH,3W	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NW01-N03	480V,3PH,3W	208Y/120V,3PH,4W	150	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NW02-N03	480V,3PH,3W	208Y/120V,3PH,4W	75	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NW03-N01	480V,3PH,3W	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NW03-N03	480V,3PH,3W	208Y/120V,3PH,4W	75	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NW04-N03	480V,3PH,3W	208Y/120V,3PH,4W	75	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NEB1-N01	480V,3PH,3W	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NEB1-N05	480V,3PH,3W	208Y/120V,3PH,4W	50	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NE01-N01	480V,3PH,3W	208Y/120V,3PH,4W	75	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NE03-N01	480V,3PH,3W	208Y/120V,3PH,4W	112.5	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NE03-N05	480V,3PH,3W	208Y/120V,3PH,4W	50	DRY TYPE	150 DEGREE C	PAD MOUNTED ON FLOOR	K-13 RATED
TR-NE04-N06	*480V,3PH,3W*	*208Y/120V,3PH,4W*	*75*	*DRY TYPE*	*150 DEGREE C*	*PAD MOUNTED ON FLOOR*	K-13 RATED
TR-SW01-N01	*480V,3PH,3W*	*208Y/120V,3PH,4W*	*112.5*	*DRY TYPE*	*150 DEGREE C*	*PAD MOUNTED ON FLOOR*	K-13 RATED

ITALICIZED ENTRIES ARE EXISTING TO REMAIN

FIGURE 3.3 - NEW ONE-LINE DIAGRAM INCLUDING DISTRIBUTED TRANSFORMERS

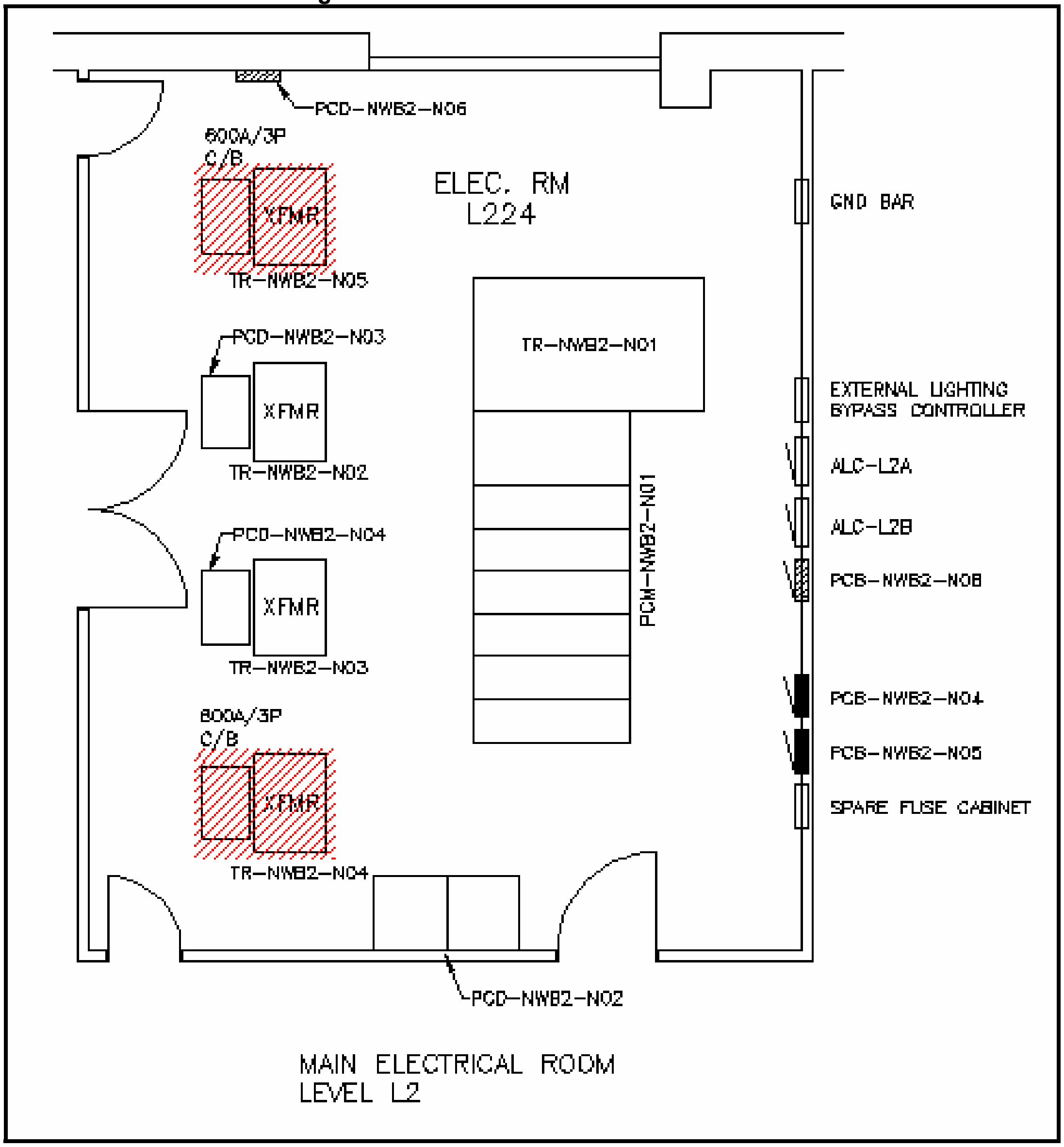


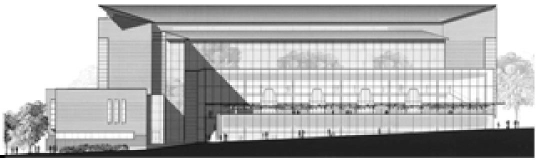


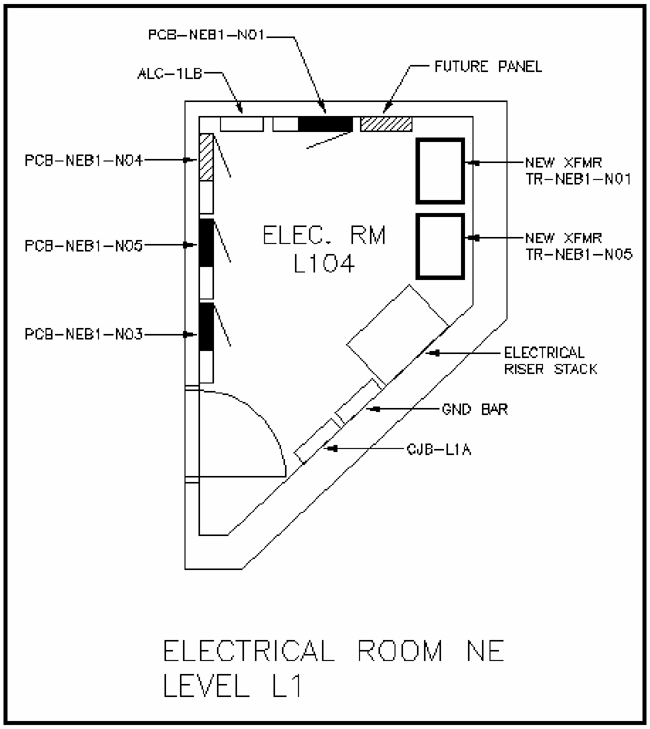
Electrical Room Layouts

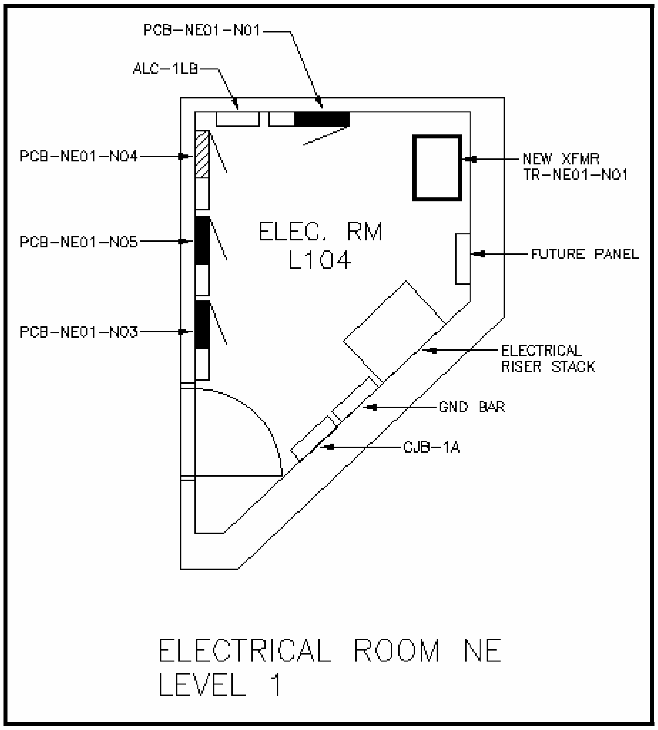
The following electrical room layouts show the proposed locations for each of the new transformers. Transformers are being located in the northeast and northwest electrical closest on all levels of the building. Transformers that are fed from the same feeder are placed in the same location in each electrical closet for the respective floors. Note that the transformers in the Main Electrical Room hatched in red are existing transformers that are to be removed.

Figure 3.4 – Main Electrical Room Level L2









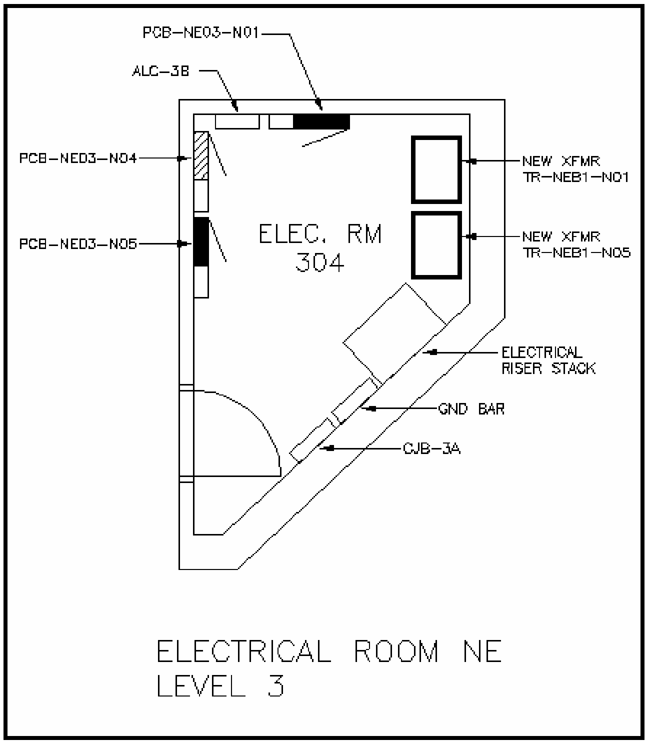


Figure 3.5 (Top Left) – Electrical Room NE Level L1
Figure 3.6 (Top Right) – Electrical Room NE Level 1
Figure 3.7 (Bottom Left) – Electrical Room NE Level 3

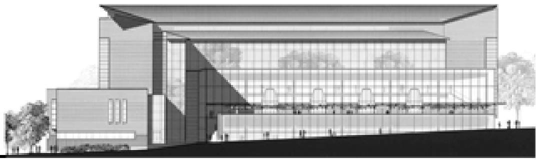


Figure 3.8 – Electrical Room NW Level L1

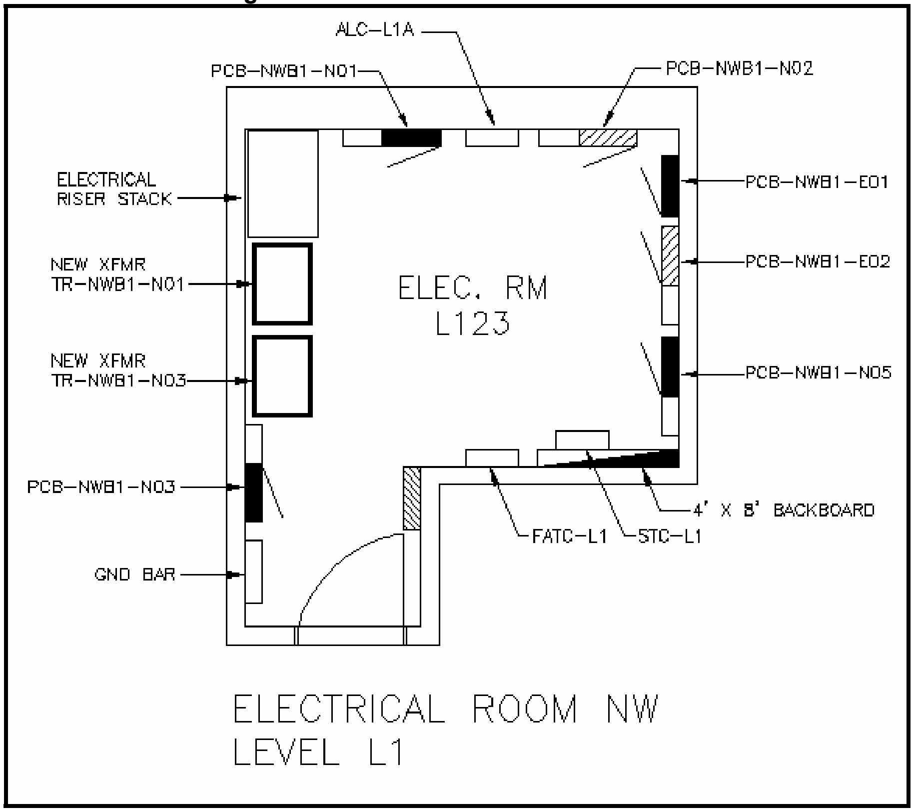
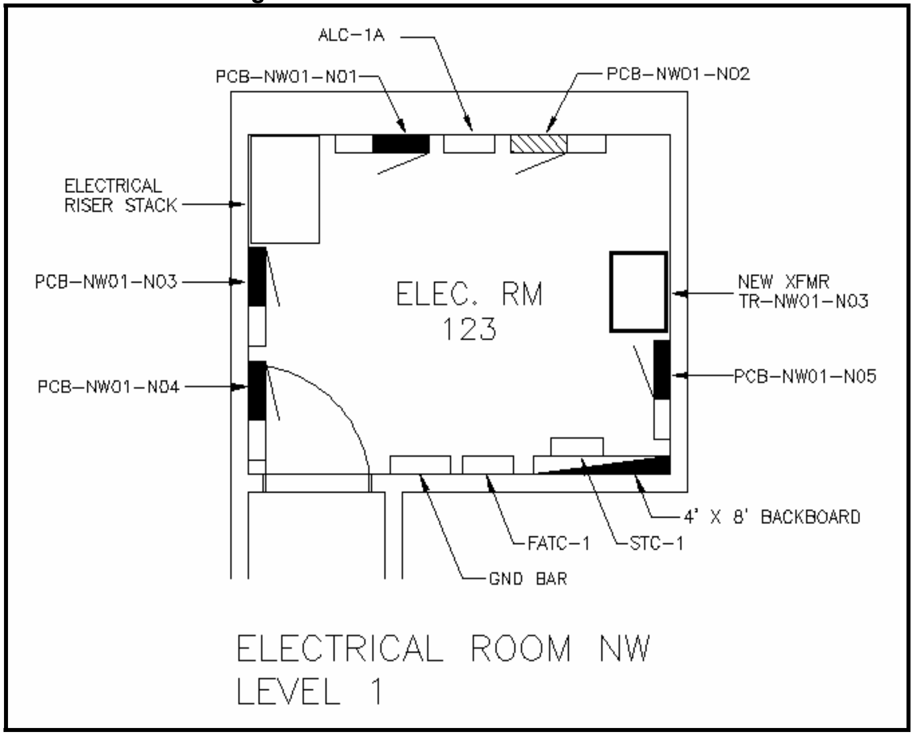


Figure 3.9 – Electrical Room NW Level 1



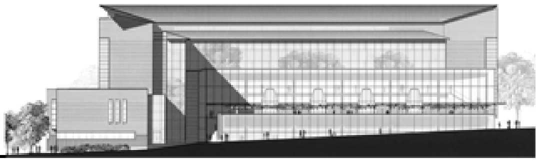


Figure 3.10 – Electrical Room NW Level 2

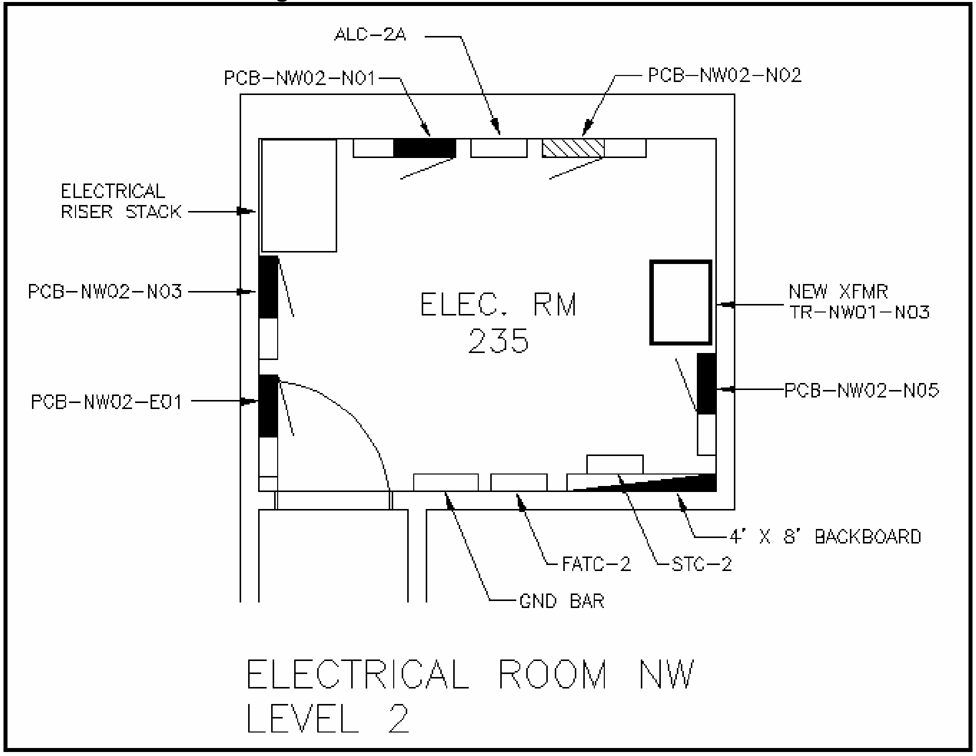
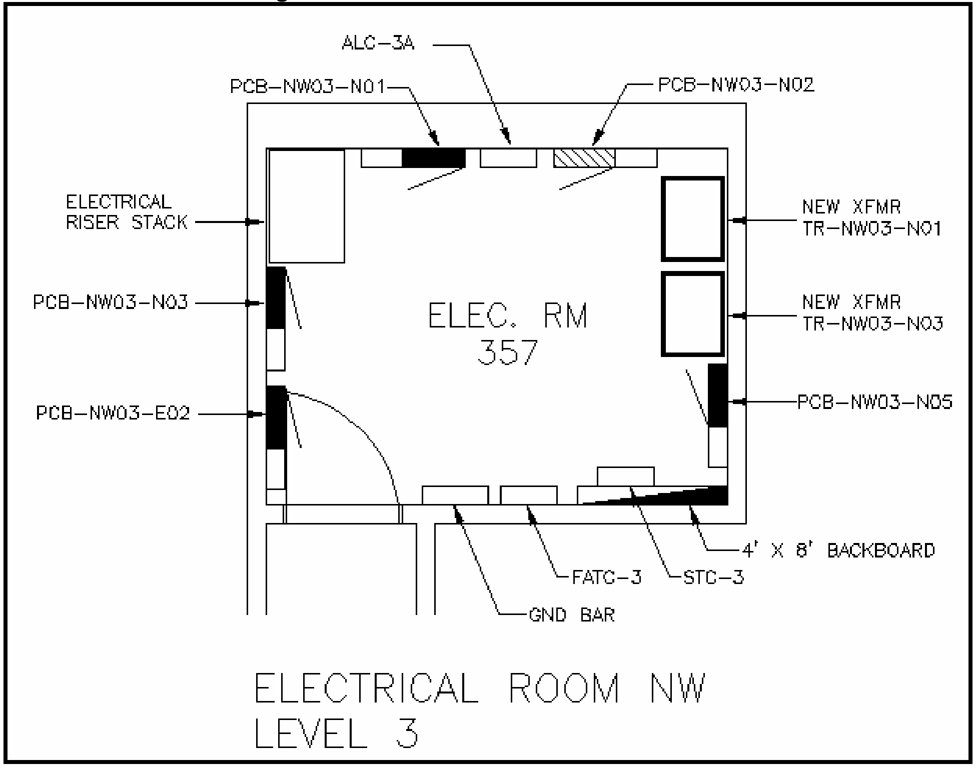


Figure 3.11 – Electrical Room NW Level 3



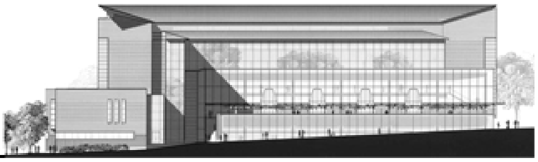
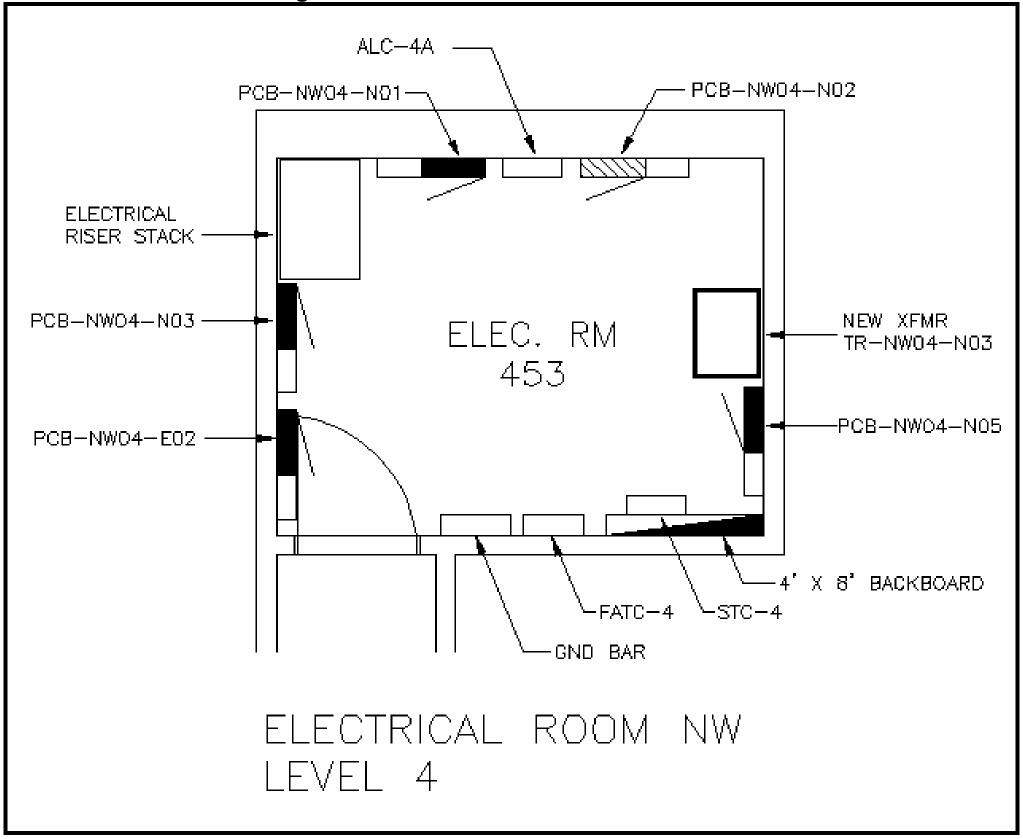


Figure 3.12 – Electrical Room NW Level 4



Cost Analysis

The following cost analysis looks at the cost associated with the existing central transformer system and the proposed distributed transformer system. The cost comparison accounts for all components on the feeders that were redesigned. This includes transformers, transformer protection, feeder protection, feeders, panelboards, distribution panels and circuit breakers.

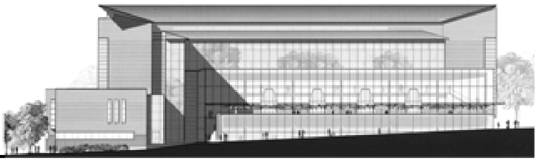


Table 3.4 – Existing System Cost

EXISTING SYSTEM				
TRANSFORMERS				
480-208/120V, 3 PH, 4W - K-13 RATED, VENTILATED				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
225 KVA	$18,100	EA.	2	$36,200
500 KVA	$37,200	EA.	2	$74,400
			SUBTOTAL	**$110,600**
TRANSFORMER PROTECTION				
ENCLOSED CIRCIT BREAKERS, NEMA 1				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
600A	$3,900	EA.	2	$7,800
			SUBTOTAL	**$7,800**
SWITCHGEAR BREAKERS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
400A	$3,775	EA.	2	$7,550
800A	$5,900	EA.	2	$11,800
			SUBTOTAL	**$19,350**
MOLDED CASE CIRCUIT BREAKERS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
400A	$3,775	EA.	1	$3,775
600A	$4,650	EA.	5	$23,250
			SUBTOTAL	**$27,025**
DISTRIBUTION PANEL				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
1600A	$4,850	EA.	2	$9,700
			SUBTOTAL	**$9,700**
PANELBOARDS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
225A	$2,025	EA.	23	$46,575
400A	$3,025	EA.	9	$27,225
			SUBTOTAL	**$73,800**

FEEDER & CONDUIT								
FEEDER DESIG.	**WIRE**	**NO. SETS**	**QUANTITY**	**SIZE**	**COST (INCL. O&P)**	**UNITS**	**LENGTH (L.F.)**	**TOTAL COST**
225Y	PHASE	1	3	4/0	$420.00	C.L.F.	595	$7,497.00
	NEUTRAL		1	4/0	$420.00	C.L.F.	595	$2,499.00
	GROUND		1	4	$136.00	C.L.F.	595	$809.20
	CONDUIT		1	2-1/2"	$17.60	L.F.	595	$10,472.00
350Y	PHASE	1	3	500 KCMIL	$765.00	C.L.F.	20	$459.00
	NEUTRAL		1	500 KCMIL	$765.00	C.L.F.	20	$153.00
	GROUND		1	2	$178.00	C.L.F.	20	$35.60
	CONDUIT		1	3"	$22.50	L.F.	20	$450.00
400Y	PHASE	2	3	3/0	$355.00	C.L.F.	324	$6,901.20
	NEUTRAL		1	3/0	$355.00	C.L.F.	324	$2,300.40
	GROUND		1	2	$178.00	C.L.F.	324	$1,153.44
	CONDUIT		1	2-1/2"	$17.60	L.F.	324	$5,702.40
600Y	PHASE	2	3	350 KCMIL	$595.00	C.L.F.	980	$34,986.00
	NEUTRAL		1	350 KCMIL	$595.00	C.L.F.	980	$11,662.00
	GROUND		1	1	$209.00	C.L.F.	980	$4,096.40
	CONDUIT		1	3"	$22.50	L.F.	980	$22,050.00
800Y	PHASE	3	3	300 KCMIL	$535.00	C.L.F.	20	$963.00
	NEUTRAL		1	300 KCMIL	$535.00	C.L.F.	20	$321.00
	GROUND		1	1/0	$250.00	C.L.F.	20	$150.00
	CONDUIT		1	3"	$22.50	L.F.	20	$450.00
1600Y	PHASE	5	3	500 KCMIL	$765.00	C.L.F.	10	$1,147.50
	NEUTRAL		1	500 KCMIL	$765.00	C.L.F.	10	$382.50
	GROUND		1	4/0	$420.00	C.L.F.	10	$210.00
	CONDUIT		1	3-1/2"	$27.50	L.F.	10	$275.00
					SUBTOTAL			**$115,125.64**
EXISTING SYSTEM TOTAL								**$363,400.64**

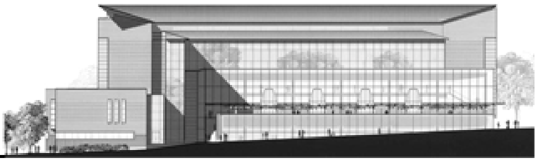


Table 3.5 – Proposed System Cost

PROPOSED SYSTEM				
TRANSFORMERS				
480-208/120V, 3 PH, 4W - K-13 RATED, VENTILATED				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
45 KVA	$4,300	EA.	3	$12,900
75 KVA	$5,750	EA.	4	$23,000
112.5 KVA	$10,500	EA.	5	$52,500
150 KVA	$12,500	EA.	2	$25,000
			SUBTOTAL	**$113,400**
TRANSFORMER PROTECTION				
ENCLOSED CIRCIT BREAKERS, NEMA 1				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
100A	$755	EA.	1	$755
225A	$1,575	EA.	12	$18,900
400A	$2,750	EA.	6	$16,500
			SUBTOTAL	**$36,155**
SWITCHGEAR BREAKERS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
225A	2850	EA.	1	$2,850
400A	$3,775	EA.	1	$3,775
600A	$4,650	EA.	1	$4,650
800A	$5,900	EA.	1	$5,900
			SUBTOTAL	**$17,175**
MOLDED CASE CIRCUIT BREAKERS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
400A	$3,775	EA.	2	$7,550
			SUBTOTAL	**$7,550**
DISTRIBUTION PANEL				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
400A	$2,550	EA.	2	$5,100
			SUBTOTAL	**$5,100**
PANELBOARDS				
SIZE	**COST (INCL. O&P)**	**UNITS**	**QUANTITY**	**TOTAL COST**
225A	$2,025	EA.	23	$46,575
400A	$3,025	EA.	9	$27,225
			SUBTOTAL	**$73,800**

FEEDER & CONDUIT								
FEEDER DESIG.	**WIRE**	**NO. SETS**	**QUANTITY**	**SIZE**	**COST (INCL. O&P)**	**UNITS**	**LENGTH (L.F.)**	**TOTAL COST**
100Y	PHASE	1	3	1	$209.00	C.L.F.	10	$62.70
	NEUTRAL		1	1	$209.00	C.L.F.	10	$20.90
	GROUND		1	8	$78.00	C.L.F.	10	$7.80
	CONDUIT		1	2"	$11.15	L.F.	10	$111.50
225Y	PHASE	1	3	4/0	$420.00	C.L.F.	892	$11,239.20
	NEUTRAL		1	4/0	$420.00	C.L.F.	892	$3,746.40
	GROUND		1	4	$136.00	C.L.F.	892	$1,213.12
	CONDUIT		1	2-1/2"	$17.60	L.F.	892	$15,699.20
400Y	PHASE	2	3	3/0	$355.00	C.L.F.	404	$8,605.20
	NEUTRAL		1	3/0	$355.00	C.L.F.	404	$2,868.40
	GROUND		1	2	$178.00	C.L.F.	404	$1,438.24
	CONDUIT		1	2-1/2"	$17.60	L.F.	404	$7,110.40
600Y	PHASE	2	3	350 KCMIL	$595.00	C.L.F.	206	$7,354.20
	NEUTRAL		1	350 KCMIL	$595.00	C.L.F.	206	$2,451.40
	GROUND		1	1	$209.00	C.L.F.	206	$861.08
	CONDUIT		1	3"	$22.50	L.F.	206	$4,635.00
800Y	PHASE	3	3	300 KCMIL	$535.00	C.L.F.	180	$8,667.00
	NEUTRAL		1	300 KCMIL	$535.00	C.L.F.	180	$2,889.00
	GROUND		1	1/0	$250.00	C.L.F.	180	$1,350.00
	CONDUIT		1	3"	$22.50	L.F.	180	$4,050.00
					SUBTOTAL		**$84,177.84**	
PROPOSED SYSTEM TOTAL							**$337,357.84**	

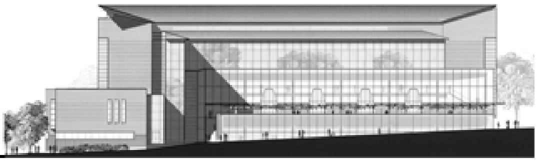


Table 3.6 – Cost Comparison

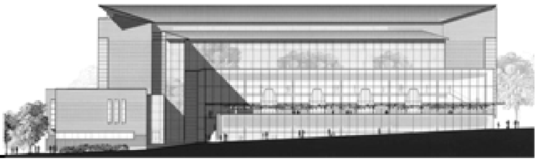
COST COMPARISON	
EXISTING SYSTEM COST	$363,400.64
PROPOSED SYSTEM COST	$337,357.84
SAVINGS	**$26,042.80**

This cost analysis compared to cost for the building’s existing transformer design, which utilizes central transformers and the proposed transformer design, which uses distributed transformers. The proposed distributed transformer system allows for a savings of approximately $26,042. Equipment and material prices for this analysis were obtained from R.S. Means. Methods by which material and equipment totals were obtained was kept consistent for both system take-offs to maintain consistency in the values obtained.

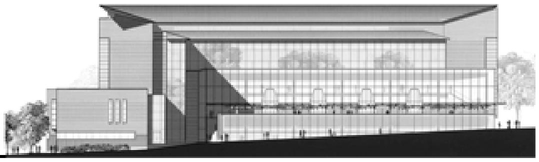
When comparing to cost of the two transformer systems, the prime area of cost savings of the proposed distributed transformer design is in feeders and conduits. While overall equipment cost for the proposed system is higher than the existing system, a lower system cost is achieved by using smaller feeders throughout the building due to the high price of copper wiring.

Conclusions

While there are several concerns surrounding the use of distributed transformers, such as an increased number of transformers required and space requirements in electrical closets, it does prove to be an effective design solution. By using distributed transformers throughout the building, feeder sizes running vertically through the building can be reduced, and thus, the high cost associated with copper feeders can be decreased significantly. While the number of step-down transformers in the buildings is increased from seven to seventeen, other equipment is able to be de-rated, feeders are sized smaller and the total cost of the system is decreased by approximately $26,000. In the case of the electrical system for William H. Gates Hall, distributed transformers are a good alternative to the existing central transformers and would be recommended for this building.



Motor Control Center Design



Introduction

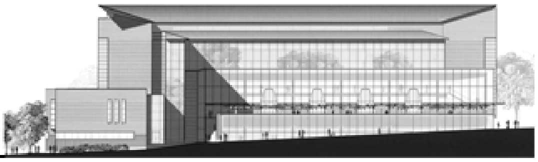
The Motor Control Center Design potion of the Electrical Depth looks to design a motor control center to control the motor starters for all nine of the air handling units, which are located in the fourth floor mechanical room of William H. Gates Hall. The design of the motor control center includes a system layout, equipment sizing and selection, and sizing of all required feeders and protection. Additionally, the space requirements in the fourth floor mechanical room are considered in order to ensure space for the motor control center.

Motor Control Center Loads

William H. Gates Hall's heating and cooling system is operated with the use of nine variable air volume air handling units. Each of these units is located in the fourth floor mechanical room, and range from 10,000 cfm to 29,940 cfm. A separate motor is used for the supply and return fans for each air handling unit. Motor sizes range from 20hp to 50hp for the supply fans motors and from 7.5hp to 15 hp for the return fan motors. Each of these motors is incorporated into the design of the motor control center. Additional information on each of the air handling units and their respective motors can be found in Table 4.1.

Table 4.1 – Air Handling Units

AIR HANDLING UNITS								
Designation	**Equipment Type**	**Phase (Φ)**	**Voltage**	**Motor**	**FLA**	**Power Factor**	**Controls**	**Load (KVA)**
AHU-1	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	100W	52.23
	RETURN FAN MOTOR			10 HP	14	0.95		
AHU-2	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	100W	52.23
	RETURN FAN MOTOR			10 HP	14	0.95		
AHU-3	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	100W	57.76
	RETURN FAN MOTOR			15 HP	21	0.95		
AHU-4	SUPPLY FAN MOTOR	3	480	20 HP	27	0.95	100W	30.11
	RETURN FAN MOTOR			7.5 HP	11	0.95		
AHU-5	SUPPLY FAN MOTOR	3	480	30 HP	40	0.95	100W	42.75
	RETURN FAN MOTOR			10 HP	14	0.95		
AHU-6	SUPPLY FAN MOTOR	3	480	50 HP	65	0.95	100W	68.02
	RETURN FAN MOTOR			15 HP	21	0.95		
AHU-7	SUPPLY FAN MOTOR	3	480	50 HP	65	0.95	100W	68.02
	RETURN FAN MOTOR			15 HP	21	0.95		
AHU-8	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	100W	57.76
	RETURN FAN MOTOR			15 HP	21	0.95		
AHU-9	SUPPLY FAN MOTOR	3	480	30 HP	40	0.95	100W	42.75
	RETURN FAN MOTOR			10 HP	14	0.95		



Motor Starters

Eighteen motors total are incorporated into the motor control center, two motors for each air handling unit. According to the specifications, all motor starters shall be full voltage non-reversing for NEMA size 3 and under. Starters that are larger than NEMA size 3 shall be autotransformer type. The following table outlines each motor's NEMA sizing and motor starter type.

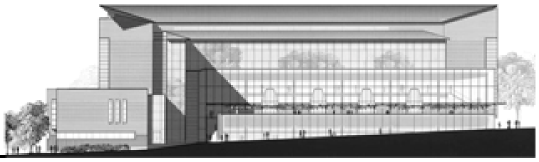
Table 4.2 – Motor Starter Type & Size

MOTOR STARTERS				
Designation	**Equipment Type**	**Motor**	**NEMA Starter Size**	**Motor Starter Type**
AHU-1	SUPPLY FAN MOTOR	40 HP	3	FVNR
	RETURN FAN MOTOR	10 HP	1	FVNR
AHU-2	SUPPLY FAN MOTOR	40 HP	3	FVNR
	RETURN FAN MOTOR	10 HP	1	FVNR
AHU-3	SUPPLY FAN MOTOR	40 HP	3	FVNR
	RETURN FAN MOTOR	15 HP	2	FVNR
AHU-4	SUPPLY FAN MOTOR	20 HP	2	FVNR
	RETURN FAN MOTOR	7.5 HP	1	FVNR
AHU-5	SUPPLY FAN MOTOR	30 HP	3	FVNR
	RETURN FAN MOTOR	10 HP	1	FVNR
AHU-6	SUPPLY FAN MOTOR	50 HP	3	FVNR
	RETURN FAN MOTOR	15 HP	2	FVNR
AHU-7	SUPPLY FAN MOTOR	50 HP	3	FVNR
	RETURN FAN MOTOR	15 HP	2	FVNR
AHU-8	SUPPLY FAN MOTOR	40 HP	3	FVNR
	RETURN FAN MOTOR	15 HP	2	FVNR
AHU-9	SUPPLY FAN MOTOR	30 HP	3	FVNR
	RETURN FAN MOTOR	10 HP	1	FVNR

FVNR - Full Voltage Non-Reversing

Motor Control Center Sizing

In order size the motor control center, the number of spaces required for each motor is established in order to properly configure the motor control center. In addition, the motor control center minimum ampacity is determined and the control center is sized.



Control Center Ampacity

In order to determine the ampacity of the motor control center's main bus, the minimum ampacity of the connected motor loads is determined. This value is determined using the full load ampacity based on the motor horsepower. Full-load currents were determined using NEC Table 430.250 –Full-Load Current, Three-Phase Alternating-Current Motors. Demand factors of 125% for the largest motor and 100% of the remaining motors are applied to these loads. The minimum ampacity is determined according to motor size in Table 4.3.

Table 4.3 – Motor Control Center Main Bus Ampacity

Motor Horsepower	Quantity	FLMA	Demand Factor	Amps
50	2	65	125% of Largest	146.25
40	4	52	100% of Remaining	208
30	2	40		80
20	1	27		27
15	4	21		84
10	4	14		56
7.5	1	11		11
			Minimum Ampacity	**612.25**

The minimum ampacity of all connected loads on the motor control center is 612.25 amps. Therefore, the main bus of the motor control center will be size at 800A in order to feed all of these loads.

Space Factors

Each of the motors controlled by the motor control center requires a certain number spaces within the control center, referred to as X-spaces. Space factors are determined according to motor starter type and the starter NEMA size. Spaces factors are then used in determining the layout and overall size of the motor control center. The control center will be composed of 20 inch wide sections that are 72 inches high. For each space factor, 6 vertical inches will be allotted for each motor. This allows for a total of twelve space factors per vertical section of the motor control center.

Table 4.4 shows the number of space factors required for each motor and the starter NEMA size, using full voltage non-reversing combination starters from Cutler Hammer's *Intelligent Technologies (IT)* Motor Control Centers. The number of spaces is determined by the motor's horsepower rating and NEMA size. Additional space in the motor control center must be considered for the main feeder and protection section of the center. The total number of space factors needed is used to determine the layout and size (according to number of vertical sections) of the motor control center. Refer to Appendix D for manufacturer information that was used in determining the required number of spaces factors.

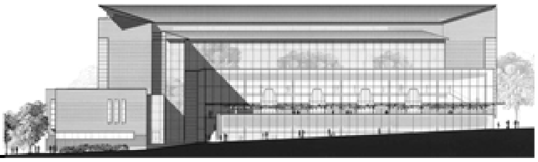


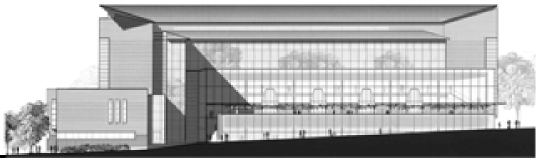
Table 4.4 – Motor Control Center Required Space Factors

REQUIRED SPACE FACTORS				
MOTORS STARTERS				
Designation	**Equipment Type**	**Motor Starter Type**	**NEMA Starter Size**	**X-Spaces**
AHU-1	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	1	1
AHU-2	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	1	1
AHU-3	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	2	1
AHU-4	SUPPLY FAN MOTOR	FVNR	2	1
	RETURN FAN MOTOR	FVNR	1	1
AHU-5	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	1	1
AHU-6	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	2	1
AHU-7	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	2	1
AHU-8	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	2	1
AHU-9	SUPPLY FAN MOTOR	FVNR	3	2
	RETURN FAN MOTOR	FVNR	1	1
			Subtotal	**26**
FEEDER				
Feeder	**Feeder Size Rating**	**Frame**	**Frame Rating**	**X-Spaces**
1	800A	HND	800	7
			Subtotal	**7**
TOTAL REQUIRED SPACE FACTORS				**33**

The total number of space factors needed for all of the motors in the control center is 33. From this number, the number of vertical sections and the layout of the motor control center is determined.

Maximum possible space factors per vertical section = 12
Minimum number of vertical sections = 33/12 = 2.75 → 3
*Total number of space factors = 3 * 12 = 36*
Number of space factors used = 33
Number of spare space factors = 3

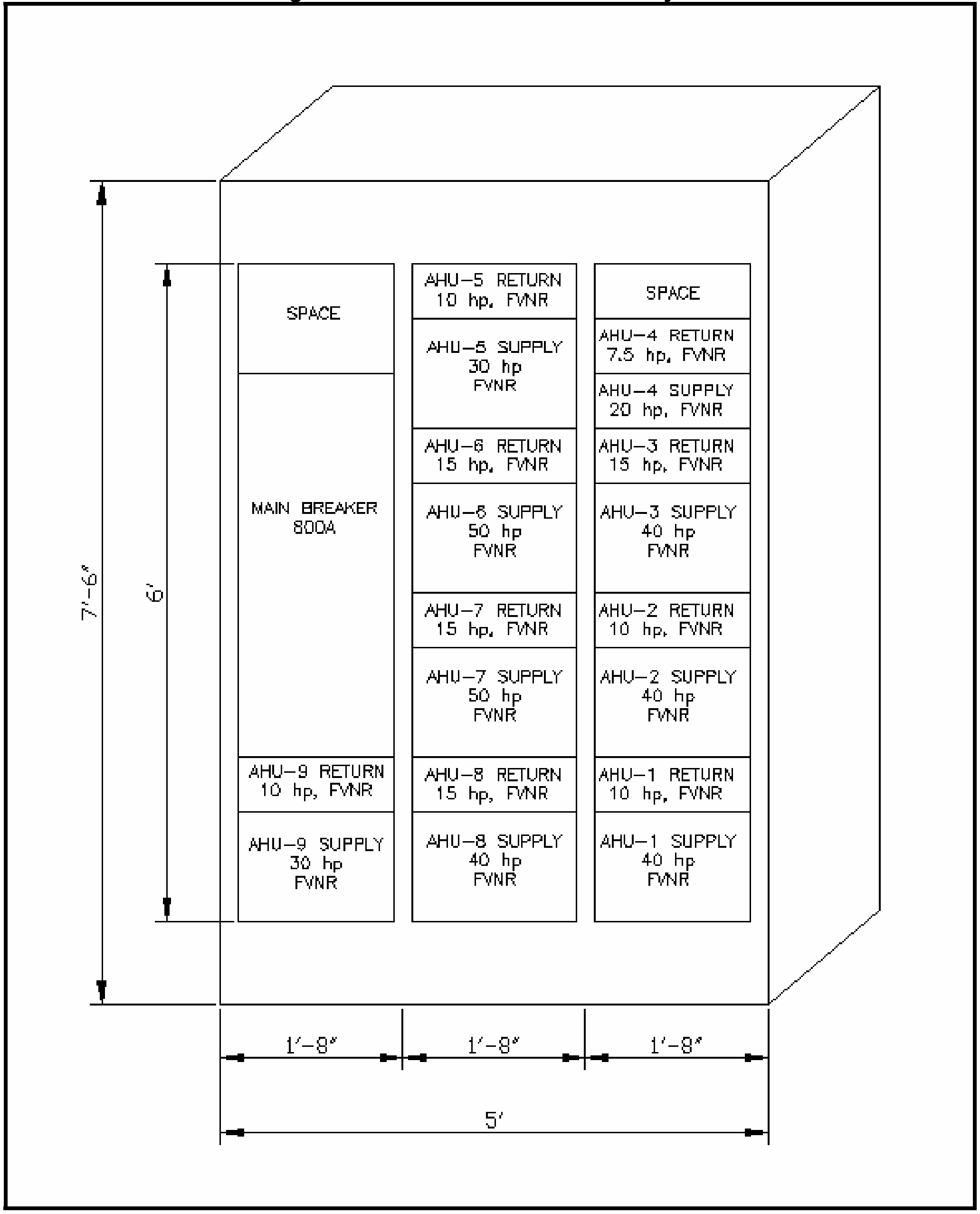
The motor control center will contain 3 vertical sections, with 3 spare space factors.

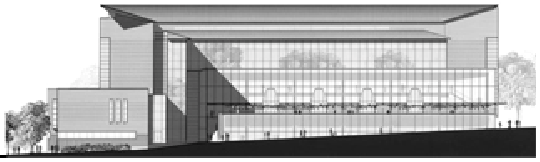


Motor Control System Layout

In designing the motor control center, an *Intelligent Technologies (IT)* Motor Control Center from Cutler Hammer will be used. Refer to Appendix D for product information. The motor control center is laid out according to the space factors previously determined. In each vertical section, the maximum amount of vertical space is utilized. The overall dimensions of the control center with three vertical sections are 90” high, 60” wide, and 16” deep. The layout of each motor starter section within the vertical columns is shown below in Figure 4.1.

Figure 4.1 – Motor Control Center Layout

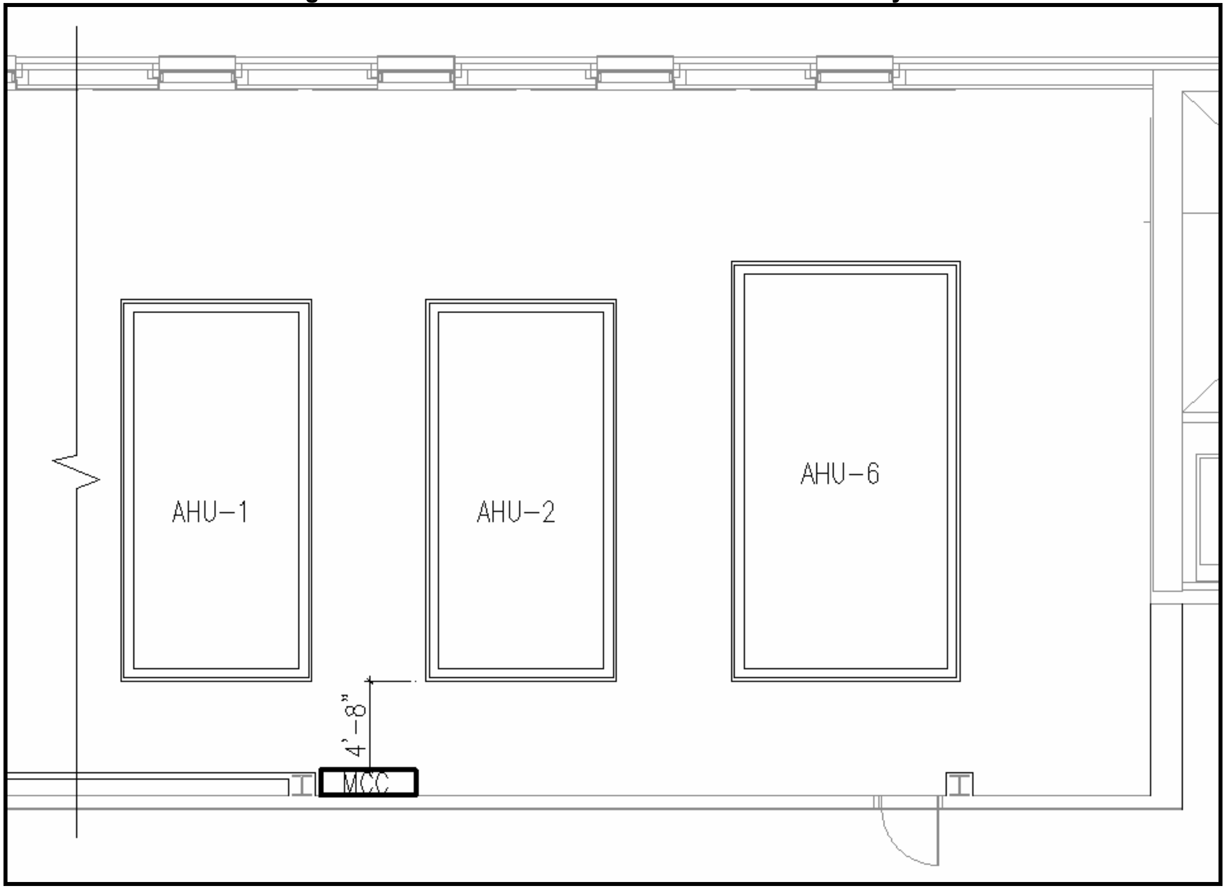




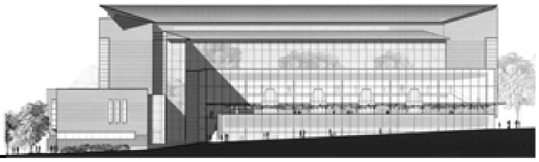
Motor Control Center Location

The motor control center will be located in the fourth floor mechanical room in order to allow for motor control as close as possible to the air handling units. The control center will be located along the south wall of the mechanical room next to the east entrance. Figure 4.2 shows the proposed location of the motor control center.

Figure 4.2 – Fourth Floor Mechanical Room Partial Layout



There is ample space in the mechanical room for the motor control center. For a motor control center operating at 480 volts, there must be a minimum clearance of 3 ½ feet from the front face of the unit to the nearest grounded surface. The location of the control center easily meets this requirement with 4 feet 8 inches of clearance between the unit and the closest air handling unit.



Motor Control Center Loads, Feeders and Protection

Main Feeder

In order to size the main feeder, the minimum ampacity calculation, performed previously in the Control Center Ampacity section of this Depth, is used to determine the appropriate feeder size. The minimum ampacity of all connected loads on the motor control center is 612.25 amps, and the motor control center main bus is rated at 800 amps. Using NEC table 310.16, the main feeder for this motor control center is sized to be 3 sets of (3) 300 kcmil in 2 ½" EMT conduit. The overcurrent protection for this unit rated at 800A.

The motor control center will be fed from an 800A spare in the main distribution panel and the feeder will run to the unit in fourth floor mechanical room. Refer to Appendix D for the one-line diagram.

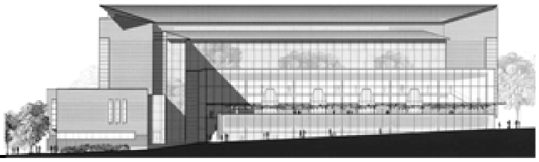
Branch Circuits

Each motor connected to the motor control center will require branch feeders and protection. Feeders for each of the motor starters are determined from the motor load. Table 4.5 outlines each of the connected equipments loads.

Table 4.5 – Motor Control Center Branch Circuit Loads

MOTOR CONTROL CENTER LOADS							
Designation	**Equipment Type**	**Phase (Φ)**	**Voltage**	**Motor**	**FLA**	**Power Factor**	**Load (KW)**
AHU-1	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	41.07
	RETURN FAN MOTOR	3	480	10 HP	14	0.95	11.06
AHU-2	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	41.07
	RETURN FAN MOTOR	3	480	10 HP	14	0.95	11.06
AHU-3	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	41.07
	RETURN FAN MOTOR	3	480	15 HP	21	0.95	16.59
AHU-4	SUPPLY FAN MOTOR	3	480	20 HP	27	0.95	21.33
	RETURN FAN MOTOR	3	480	7.5 HP	11	0.95	8.69
AHU-5	SUPPLY FAN MOTOR	3	480	30 HP	40	0.95	31.59
	RETURN FAN MOTOR	3	480	10 HP	14	0.95	11.06
AHU-6	SUPPLY FAN MOTOR	3	480	50 HP	65	0.95	51.34
	RETURN FAN MOTOR	3	480	15 HP	21	0.95	16.59
AHU-7	SUPPLY FAN MOTOR	3	480	50 HP	65	0.95	51.34
	RETURN FAN MOTOR	3	480	15 HP	21	0.95	16.59
AHU-8	SUPPLY FAN MOTOR	3	480	40 HP	52	0.95	41.07
	RETURN FAN MOTOR	3	480	15 HP	21	0.95	16.59
AHU-9	SUPPLY FAN MOTOR	3	480	30 HP	40	0.95	31.59
	RETURN FAN MOTOR	3	480	10 HP	14	0.95	11.06

Feeders and circuit protection are determined from the loads outlined above. For each motor the conductors, branch circuit protection, and motor overcurrent protection are sized. The convention used for sizing each of these elements is noted below.



Branch Circuit Protection:
Branch Circuit Protection for each motor is provided by inverse time delay molded-case circuit breakers. The maximum rating of the motor branch circuit protection for inverse time delay circuit breakers is 250%, per NEC table 430.52

*Maximum Breaker Size = 250% * FLA*

The next highest standard trip rating and a frame size is chosen according to this calculated value.

Branch Circuit Conductors:
Branch circuit conductors are sized according to 125% of a motor's full load current.

*Minimum Ampacity = 125% * FLA*

The feeder for each motor branch circuit is sized according to NEC Table 310.16. The conduits for these feeders are sized using the conduit sizing worksheet.

Motor Disconnect:
A means of motor disconnect is required for all motors, within sight, or 50 feet, from the motor and its driven equipment. The location of the motor control center within the mechanical rooms is within this 50 foot line of sight to several air handling units – AHU-1, AHU-2, AHU-6, AHU-8, and AHU-9. These air handling units, therefore, do not require a means of disconnect at the motor location. The remainder of the air handling units, AHU-3, AHU-4, AHU-5, and AHU-7, do require for a local disconnect. For the purpose of this design, disconnects for all air handling units are sized. Unfused disconnect switches are used for all air handlers. The three-pole motor switches are size according to the following rating standards shown in Table 4.6.

Table 4.6 – Standard Ratings of Three-Pole Motor Circuit Switches

	MAXMUM HORSEPOWER RATING
AMPERE RATING	UNFUSED
	480 VAC
30	15
60	30
100	60
200	100

The following table, Table 4.7, shows the sizing for all of branch circuit conductors, branch circuit protection devices, and motor disconnect switches.

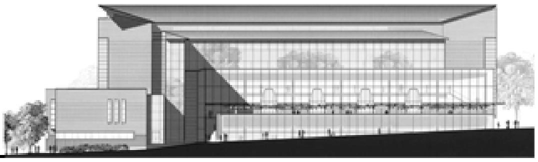
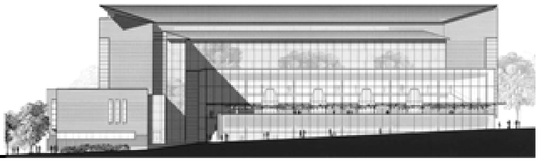


Table 4.7 – Motor Protection and Conductor Sizing

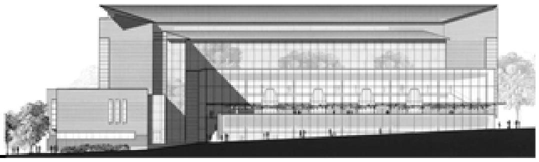
MOTOR	BRANCH CIRCUIT PROTECTION	BRANCH CIRCUIT CONDUCTORS			MOTOR DISCONNECT
		SETS	WIRE SIZE	CONDUIT SIZE	
AHU1 - SUPPLY	225AF/150AT	1	(3) #6	3/4"	100A
AHU1 - RETURN	150AF/40AT	1	(3) #12	3/4"	30A
AHU2 - SUPPLY	150AF/150AT	1	(3) #6	3/4"	100A
AHU2 - RETURN	100AF/40AT	1	(3) #12	3/4"	30A
AHU3 - SUPPLY	150AF/150AT	1	(3) #6	3/4"	100A
AHU3 - RETURN	100AF/60AT	1	(3) #10	3/4"	30A
AHU4 - SUPPLY	100AF/70AT	1	(3) #10	3/4"	60A
AHU4 - RETURN	100AF/40AT	1	(3) #12	3/4"	30A
AHU5 - SUPPLY	100AF/100AT	1	(3) #8	3/4"	60A
AHU5 - RETURN	100AF/40AT	1	(3) #12	3/4"	30A
AHU6 - SUPPLY	225AF/175AT	1	(3) #4	1"	100A
AHU6 - RETURN	100AF/60AT	1	(3) #10	3/4"	30A
AHU7 - SUPPLY	225AF/175AT	1	(3) #4	1"	100A
AHU7 - RETURN	100AF/60AT	1	(3) #10	3/4"	30A
AHU8 - SUPPLY	150AF/150AT	1	(3) #6	3/4"	100A
AHU8 - RETURN	100AF/60AT	1	(3) #10	3/4"	30A
AHU9 - SUPPLY	100AF/100AT	1	(3) #8	3/4"	60A
AHU9 - RETURN	100AF/40AT	1	(3) #12	3/4"	30A

Conclusion

The motor control center design includes motor starters for all nine of the air handling units located in the fourth floor mechanical room. From analyzing the motor loads, it was determined an 800A bus bar would be needed to feed all of the loads, and the motor control center will be fed from a spare 800A breaker in the main distribution panel. It was determined that the motor control center would need to contain three 20 inch vertical sections in order to house all of the motor starters, and incoming feed main circuit breaker. Additionally, there is ample space and clearance in the mechanical room for the control center at its determined size.



Protective Device Coordination Study



Introduction

The Protective Device Coordination Study looks at the coordination of protective devices along a single path through the distribution. This includes protection for a lighting/equipment panel, protection of the distribution panel feeding the lighting panel, and the protection of the distribution panel's respective feeder in the switchgear.

Protective Device Coordination

The three devices that are analyzed for this protective coordination study are: the 150 amp main circuit breaker of lighting panel PCB-NWB1-N02, the 400 amp lighting panel feeder protection in distribution panel PCD-NWB2-N02, and the 800 amp protection of the distribution panel, located in the main switchgear.

The time/current trip curves for each of these protection devices are overlaid to determine the coordination of these devices. Refer to Appendix E for protection device time/current trip curves.

Figure 5.1, on the following page, illustrates the overlay and coordination of these three devices. According to this overlay, the branch panel protection device and distribution panel are coordinated, as the branch panel protection curve is located to the left of the distribution panel protection curve (although, only slightly). However, the protection device located in the main switchgear is not coordinated with either other protection devices. The switchgear circuit breaker time/current curve is located to the left of both other curves.

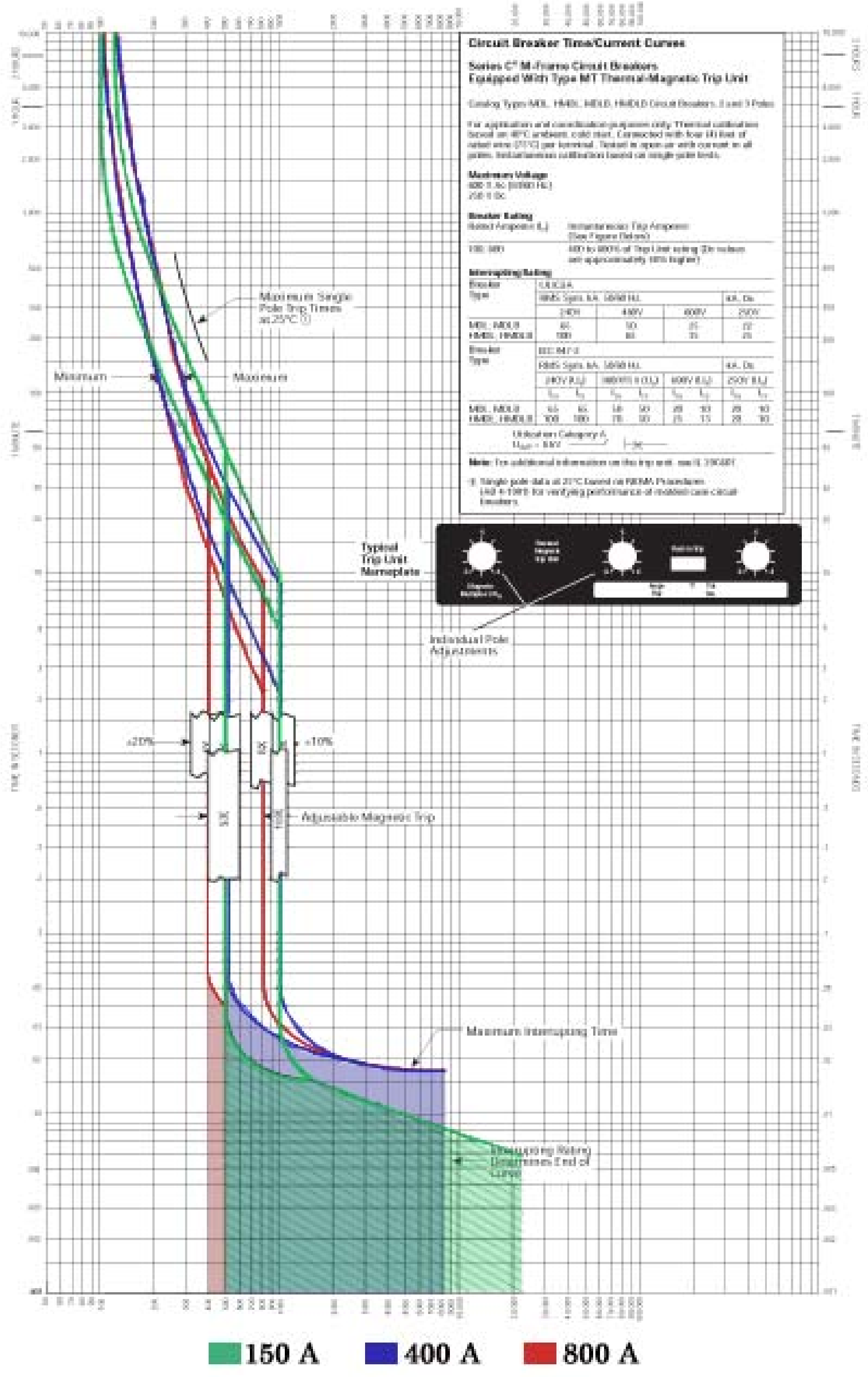
Short Circuit Current Calculations

Short circuit current calculations on the transformer secondary side and the switch board cannot be completed at this time due to the inability to obtain information on the utility/campus electrical distribution short circuit current.

Conclusion

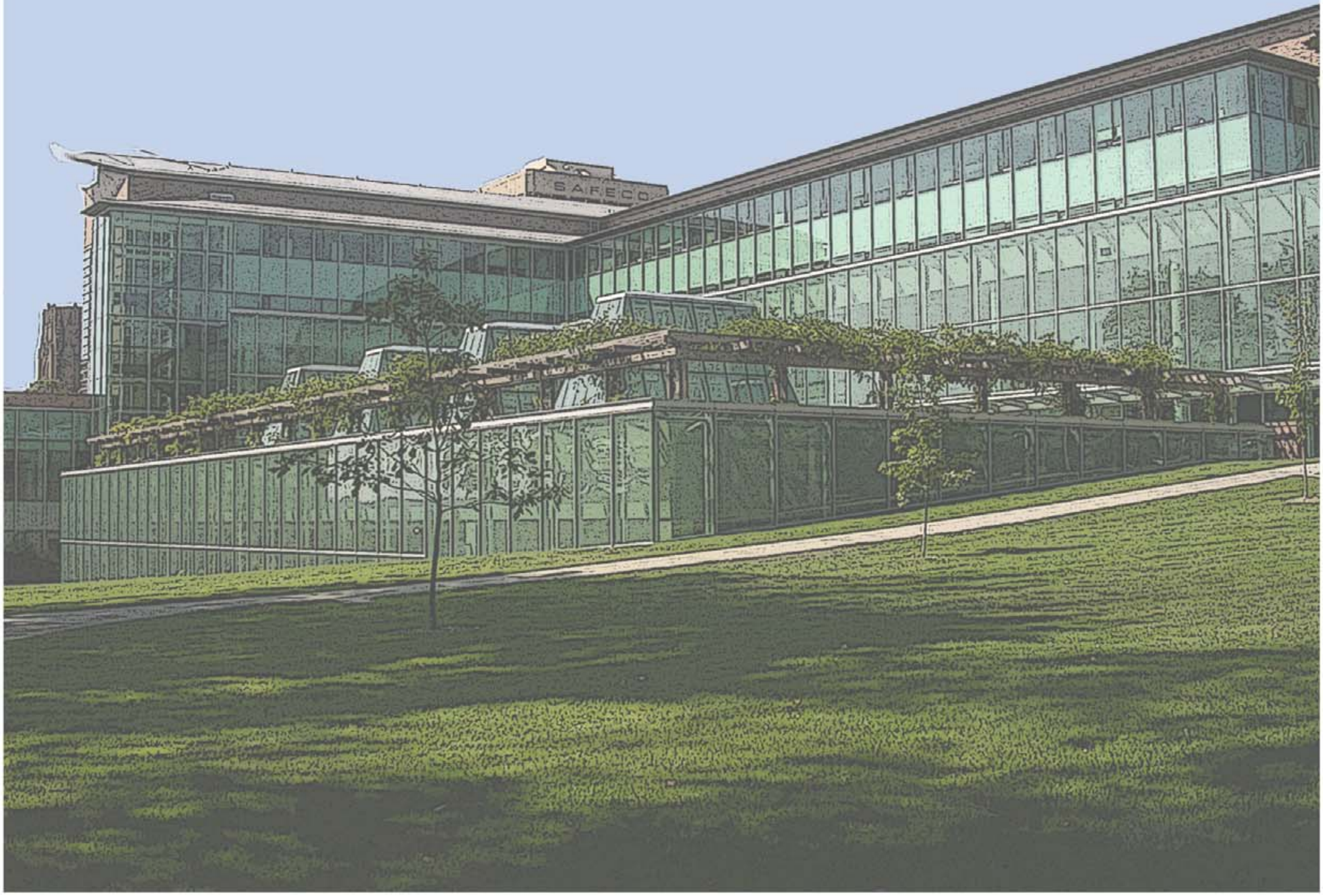
The protective device coordination study shows that the protection devices studied are not coordinated. The overlay of the protection time/current trip curves shows that the protective device on the main switchgear will trip before either the distribution panel or the branch circuit lighting and equipment panelboard.

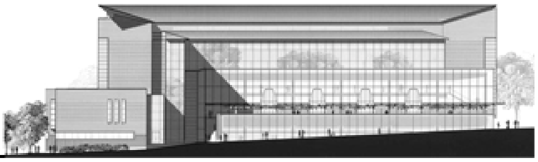
Figure 5.1 – Overlay of Time/Current Trip Curves



LEED Breadth

A Feasibility Study of Implementing a Rainwater Catchment System to Offset Cooling Tower Water Makeup





Introduction

With commercial buildings consuming approximately one-sixth of the world's potable water supply, it is important to investigate design considerations that will help to reduce a buildings dependency on the water supply. Due to the location of William H. Gates, in Seattle, Washington, and the region's notoriously rainy climate, making use of rainwater to supply the building's non-potable water demand lends itself well to such a system.

The LEED Breadth portion of the report looks at the feasibility of implementing a rainwater catchment system to help offset the cooling tower make up water requirements. This study will investigate the amount of water required to offset the cooling tower water makeup and the potential collectable rainfall per year. Additionally, the LEED Breadth will explore other requirements and equipment needed to implement such a system.

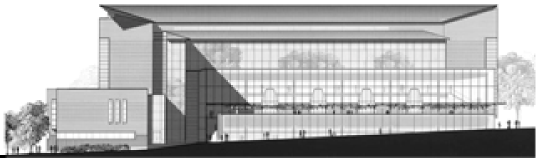
University of Washington's Commitment to Sustainability

In the University of Washington's 2004 Sustainability Report, the University states it's commitment to "environmentally sustainable principles that contribute to the long-term protection and enhancement of our environment, our economy, and the health of present and future generations." This commitment to sustainable building practices is evident in the university's declaration that all new buildings will be, at a minimum, LEED Silver-certified. Campus wide sustainability efforts have primarily focused on energy reductions and the use of renewable energy. Additionally, sustainable efforts focusing on water use and conservation have been made as well; however, are primarily concentrated toward reduction of water use in irrigation.

During the design and construction of William H. Gates Hall, which was opened in September 2003, the university had not yet adopted the LEED certified building initiative. While it is assumed that during the building's design process efforts were taken to incorporate energy efficient systems, there are no systems in the building that focus on utilizing natural resources and sustainable technologies. The architecture and systems design of the William H. Gates Hall is conducive to incorporating sustainable technologies and system in several areas, including daylighting integration and rainwater harvesting. This Breadth Study will focus on the potential of utilizing a rainwater catchment system to offset water usage in the building, specifically looking at the cooling tower makeup water requirements.

Cooling Towers

The current design of William H. Gates Hall utilizes two cooling towers for the building cooling system. The cooling towers, rated at 825 gallons per minute each, are located in a below grade pit on the north side of the building, adjacent to the chiller plant mechanical



room. Makeup water is supplied to the towers in 2” diameter pipes from the Seattle Public Utility.

Makeup Water

During the operation of the cooling towers there is a constant water loss from the cooling tower, which must be replaced in order for the system to run effectively. This replacement water is referred to as water makeup, and can be a significant source of water consumption in the building. The water lost from the cooling towers will be calculated as the result of three things: evaporation, drift and blow down. The sum of these three factors is the amount of water that must be constantly replenished to the system.

Evaporation:
Evaporation, which accounts for the greatest water loss from the cooling tower, is water evaporated from the circulating water into the atmosphere by the cooling process. This water amount is calculated according to the cooling capacity of the chillers.

275 tons * 12,000 Btu/hr = 3,300,000 Btu/hr

Heat vaporization of water = 2260 kJ/kg

3,300,00 Btu/hr * 1.055 kJ/Btu * 1/(2260 kJ/kg) = 1540.49 kg/hr

ρ_{water} at 1 atm, 90°F = 62.11 lb/ft3

62.11 lb/ft^3 * 0.4536 kg/lb * 1(7.481 gal/ft^3) = 3.766 kg/gal

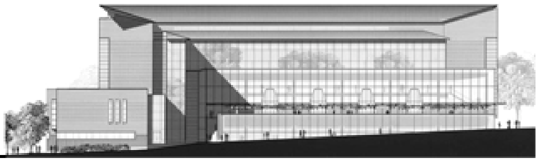
1540.49kg/hr * 1/(3.766 kg/gal) = 409 gal/hr

409 gal/hr * 1hr/60 min = 6.82 gpm

Evaporation = **6.82 gpm**

Drift:
Drift is water droplets that are carried out of the cooling tower with the exhaust air and is calculated as a small percentage of the cooling tower flow. According to the building specifications, drift is to be limited to 0.002% of the flow.

Drift = 805 gpm * .00002 = **0.0165 gpm**



Blowdown:
While trying to maintain the amount of dissolved solids and other impurities at an acceptable level, a portion of the circulation water is released from the cooling tower. In William H. Gates Hall the water is maintained at 8 to 10 cycles of concentration. For the purpose of this calculation, the worst case scenario of 8 cycles will be used.

$$\text{Blowdown} = \frac{\text{Evaporation Losses}}{\text{Cycles} - 1}$$

$$\text{Blowdown} = \frac{6.82\text{ gpm}}{(8-1)} = \mathbf{0.98\text{ gpm}}$$

Makeup Water:
The total makeup water required is the sum of evaporation, drift and blowdown.

$$\text{Makeup Water} = \text{Evaporation} + \text{Drift} + \text{Blowdown}$$

$$\text{Makeup Water} = 6.82\text{ gpm} + 0.0165\text{ gpm} + 0.98\text{ gpm}$$

Makeup Water = 7.82 gpm

The total makeup water required to the cooling towers is 7.82 gpm. A value of **8 gpm** will be used for the design of the system components.

Water Requirements

When operating at full capacity, the cooling towers require makeup water at a rate of 8 gpm. This value will vary depending on the cooling loads required and the outdoor air conditions, with less water required during cooler months when less building cooling is required. However, for the purpose of the feasibility study, the worst case scenario of the building operating at full cooling capacity year round will be assumed.

The following table outlines the monthly and yearly totals of the amount of water to be supplied to the cooling towers for makeup water. This table looks at both the makeup water amounts for one cooling tower, and also for the total building makeup water requirements with two cooling towers.

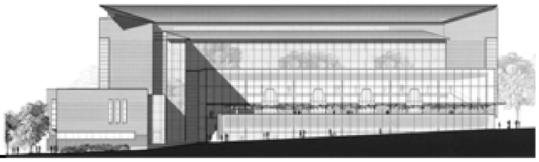


Table 6.1 – Cooling Tower Makeup Water Requirements

Month	Makeup Water Needed (GPM)	Days A Month	Makeup Water per Cooling Tower (Gallons)	Total Makeup Water (2 Cooling Towers)
January	8	31	357,120	714,240
February	8	28	322,560	645,120
March	8	31	357,120	714,240
April	8	30	345,600	691,200
May	8	31	357,120	714,240
June	8	30	345,600	691,200
July	8	31	357,120	714,240
August	8	31	357,120	714,240
September	8	30	345,600	691,200
October	8	31	357,120	714,240
November	8	30	345,600	691,200
December	8	31	357,120	714,240
		Total	**4,204,800**	**8,409,600**

With each cooling tower needing approximately 4.2 millions of water a year, William H. Gates Hall consumes approximately 8.4 millions of water each year on cooling tower water makeup. By developing a method to offset this water consumption, not only will the university incur lower water cost, but will also help to reduce the building's contribution to the depletion of fresh and potable water sources.

Rainwater Catchment

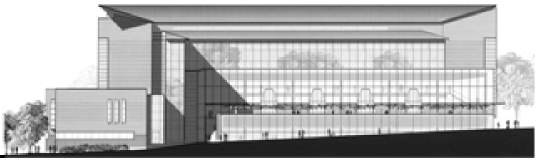
By implementing a rainwater catchment system, William H. Gates Hall can utilize rainwater to offset building water consumption. Due to the cooling towers high demand for water and the ability to use non-potable water, a rainwater catchment system is a good solution for this system. Additionally, Seattle's constant light rainfall makes this geographic area ideal for utilizing rain water catchment systems.

Collectible Rainfall

The rainwater catchment system will utilize a collectible roof area of approximately 48,500 square feet. Using monthly rainfall averages and the roof area of the building, the potential amount of water that can be caught monthly can be approximately by the equation:

*Roof Area Sent to Downspout (sq. ft) * Rainfall (in) * 0.6*

This equation is determined from the approximation that one inch of rain falling on a square foot of surface yields approximately 0.6 gallons of water. Monthly rainfall data is taken from



Seattle's monthly rain averages. Refer to Table 6.2 – Potential Monthly Rainwater Catchment below for monthly approximations of rainwater catchment.

Table 6.2 – Average Monthly Rainwater Catchment

Month	Monthly Rainfall (Inches)	Roof Surface Area (Sq. Ft.)	Monthly Catchment (Gallons)
January	5.4	48,500	157,140
February	4	48,500	116,400
March	3.8	48,500	110,580
April	2.5	48,500	72,750
May	1.8	48,500	52,380
June	1.6	48,500	46,560
July	0.9	48,500	26,190
August	1.2	48,500	34,920
September	1.9	48,500	55,290
October	3.3	48,500	96,030
November	5.7	48,500	165,870
December	6	48,500	174,600
		Total	**1,108,710**

Due to Seattle's typically dry summers and rainy winters, rainwater catchment amounts vary quite significantly between the summer and winter months. Potential monthly rainfall to be collected ranges from approximately 26,000 gallons to approximately 175,000 gallons.

Potential to Offset Cooling Tower Water Makeup

In a given year, the use of a rain water catchment system could provide William H. Gates Hall with approximately 1.1 million gallons of water. This water can help to offset approximately one eighth of the required cooling tower makeup water. However, due to the variation of rainfall and outdoor air conditions throughout the year, the actual amount of water that will be available and the amount of water that will be lost from the cooling towers will vary.

The following table outlines the potential monthly water savings by utilizing the water from a rain water catchment system.

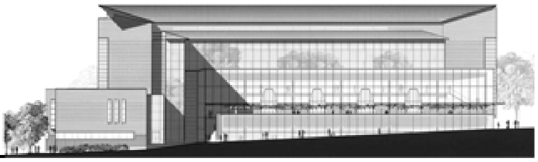


Table 6.3 – Potentially Monthly Water Savings

Month	Water Catchment (Gallons)	Makeup Water Required (Gallons)	Makeup Water Demand After Rainwater	Percentage of Water Use Offset
January	157,140	714,240	557,100	22.0%
February	116,400	645,120	528,720	18.0%
March	110,580	714,240	603,660	15.5%
April	72,750	691,200	618,450	10.5%
May	52,380	714,240	661,860	7.3%
June	46,560	691,200	644,640	6.7%
July	26,190	714,240	688,050	3.7%
August	34,920	714,240	679,320	4.9%
September	55,290	691,200	635,910	8.0%
October	96,030	714,240	618,210	13.4%
November	165,870	691,200	525,330	24.0%
December	174,600	714,240	539,640	24.4%

As noted above, these values assume the worst case scenario of the building operating at full cooling capacity year round. Therefore, the percentage of water offset may in actuality increase during fall and winter months, when lower cooling loads are required.

System Components

There are several components that need to be considered in implementing a rainwater catchment system, including water storage, required pumps, water filtration and treatment of the water. Each of these components is essential for the proper functioning of the system.

Water Storage

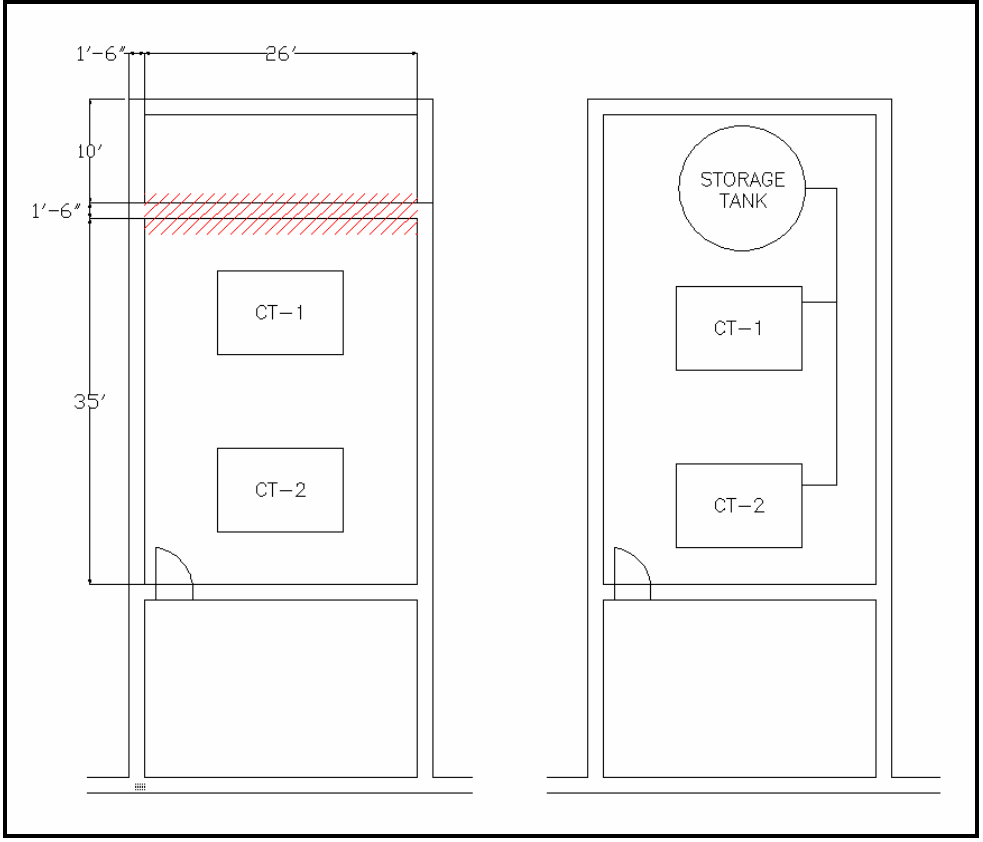
Upon collecting water from the roof it is essential to provide storage in order to retain the water for later use. Storage options are plentiful, as there are several types and materials of cisterns available. For the proposed rainwater catchment system for William H. Gates Hall, a fiberglass cistern will be used. Fiberglass tanks provide long durability and are easily maintained and repaired. Additionally, fiberglass cisterns are moveable, which will allow for the tank to be removed if need and not be a permanent fixture of the building. While fiberglass cisterns are slightly higher in initial cost as compared to some other types of storage tanks, their durability and dependability make them an attractive option.

The cistern for the rainwater catchment system in William H. Gates Hall will be 12 feet in diameter, 12 feet in height, with a capacity of 10,000 gallons. This size was chosen base on the expected storage needed, as well as the physical size of the tank and spatial limitations. When determining the appropriate capacity of the tank, average daily rainfalls were considered as well as record highs. An appropriate size between these two amounts was determined, both to ensure enough capacity for average rainfalls in addition to some spare capacity to take advantage of larger than average rainfalls.

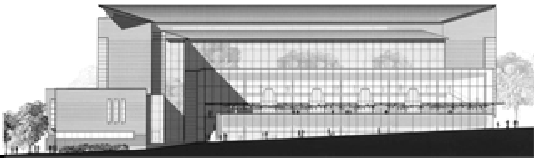
The cistern will be located below grade in the cooling tower pit. This will allow for the tank to be located as close as possible to the cooling towers to reduce the distance the water needs to be transported, as well as the required amount of piping. Additionally, by locating the cistern below grade, it is protected from direct sunlight and architecturally, there is no “eye sore.”

In order for the cistern to be located in the cooling tower pit, the pit will be extended ten feet at one end. This will allow for sufficient space for the cistern will still observing clearance requirements of the cooling towers. Refer to the following figure for storage tank location and cooling tower pit expansion.

Figure 6.1 – Cooling Tower Pit Layout and Modifications



Additionally, placing the cistern in this location raises question to possible structural concerns due to the extreme weight of the storage tank. An average cistern weighs approximately 8 pounds per gallon of water. A 10,000 gallon cistern filled to capacity the total weight would weigh 80,000 pounds, and over the 12 foot diameter will be approximately 710 lb/ft^2. The cistern is located on a 20 inch slab, which weighs 255 lb/ft^2 (150 lb/ft^3 for concrete * 20 in =



255 lb/ft^2), bringing the combined slab and system weight to total approximately 1,000 lb/ft^2, The cooling tower pit is located adjacent to, but outside of the building footprint, and incurs no other loads from additional stories. With an allowable bearing capacity of 10,000 lb/ft^2 and the bearing capacity for compacted fill of 4,000 lb/ft^2 the load of the system and slab are significantly below the allowable values, and therefore, there should not be any structural concerns regarding the weight of this addition.

First-Flush Diverters

A first-flush diverter is needed in order to prevent the first flow of water from the roof surface, which can pick up the dust, leaves, insects, and airborne residues that have collected on the room, from being deposited in the storage tank. This allows the system to rid itself of the small contaminants that have accumulated on the roof and been picked up by the rainfall.

Pump

Another consideration that needs to be taken into consideration for the rainwater catchment system is whether there is a need for a pump. If the pressure in the system is great enough, gravity will allow water to flow from the cistern into to cooling tower. Since both the cooling tower and storage tank will be located on the same surface at the same height, there is a possibility that a gravity system could be an option. The following calculations use the relationship between the kinematic pressure and static pressure to determine whether or not a pump is needed by finding the minimum height at which water in the cistern must be maintained in order for gravity to control the system.

$$8\text{ gpm} * .003785\text{ m}^3/\text{gal} * 1\text{ min}/60\text{ sec} = 5.05\text{ E }-10\text{ m}^3/\text{s} = V_{dot}$$

$$V_{dot} = VA \rightarrow V = V_{dot}/A$$

Assume that pipe size is 2” diameter

$$A = \pi r^{2 =} \pi * (1\text{ in})^2 = 3.14\text{ in}^2$$

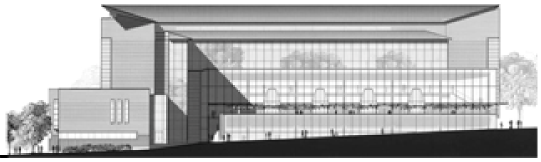
$$3.14\text{ in}^2 * .000645\text{ m}^2/\text{in}^2 = .00203\text{ m}^2$$

$$V = (5.05\text{ E }-10\text{ m}^3/\text{s})/ .00203\text{ m}^2 = 0.249\text{ m/s}$$

$$\rho gh = ½ \rho V^2$$

$$\cancel{\rho}gh = ½ \cancel{\rho}V^2$$

$$h = (½ * V^{2)}/ g$$



$$h = (½ * (0.249\ m/s)^2)/9.81\ m/s^2$$

$$h = .00316\ m$$

$$h = .00316\ m * 3.28\ ft/m = \mathit{0.01\ ft}$$

In order for gravity to run the system, the height of water in the cistern cannot fall below 0.01 feet. At all times, there will be greater than 0.01 feet of water in the tank, and therefore, no pump is needed for this system.

Filtration & Water Treatment

Filtration is required in order to remove unwanted particles and objects from the water. Leaf guards should be used on the roof at the roof drains to prevent leaves, twigs and insects from entering the pipes and the system. Additionally, filtering to remove smaller particles should occur before the water enters the cistern.

While the water from this catchment system is being used for non-potable sources, it is still necessary to chemically treat the water. This treatment helps to limit the growth of mineral and microbial deposits that can reduce the heat transfer efficiency of the cooling tower.

Additional Water Supply

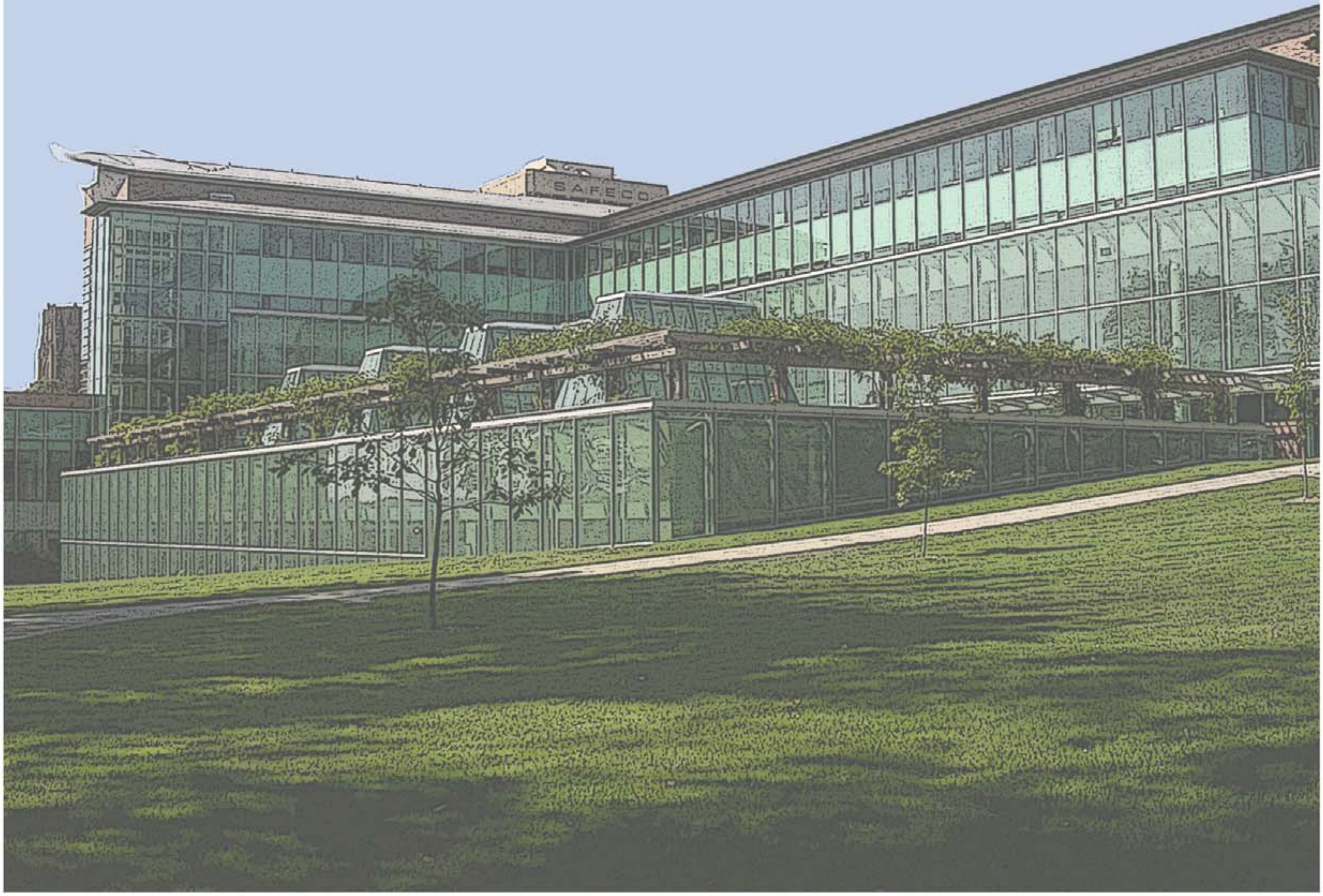
While the rainwater catchment system helps to offset the water demands of the cooling towers, a traditional water supply is still needed in order to reach the makeup water requirements. A water supply line will connect into the cistern and controlled with a float valve to maintain appropriate water levels in the tank at all times.

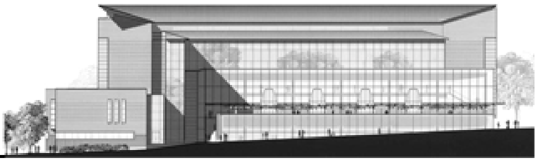
Conclusion

In order to implement a rainwater catchment system for William H. Gates Hall there are several system components that must be included and many areas of coordination and integration that need to be considered. By using a rainwater catchment system in this situation, cooling tower water makeup can be offset by approximately 1 million gallons a year, with the potential for more of an impact during the rainy, cool months than the dry, warm months. In addition, implementing a system can be done with minimal effects to other systems, with exceptions of the cooling tower pit expansion. Overall, the system is a feasible option for William H. Gates Hall and would be recommended depending on the life cycle cost, which are addressed in the Construction Management Breadth portion of this report.

Construction Managment Breadth

Cost Analysis of Rainwater Catchment System





Introduction

In the LEED Breadth portion of this report, the feasibility of implementing a rainwater catchment system to offset the cooling tower water makeup requirements in William H. Gates Hall was studied. This analysis looked at the how much such a system could offset the water demand of the cooling towers, as well as the other components that would be required for functional operation of the system. While the rainwater catchment system proved to offset the water required for the water makeup, the cost implications of such a system need to be analyzed to determine if the first cost are justifiable in the lifecycle of the system. The Construction Management Breadth examines these cost and the payback period of implementing a rainwater catchment system.

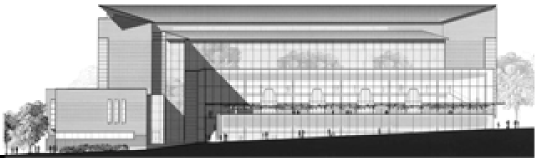
Rainwater Catchment System First Cost

The following table looks at the first cost for implementing the rainwater catchment, including both the cost of the actual components of the rainwater catchment system and the cost associated with increasing the size of the cooling tower pit, where the cistern will be located. All cost values were obtained from R.S. Means and include overhead and profit.

Table 7.1 – Rainwater Catchment System First Cost

Proposed System First Cost			
Rainwater Catchment System			
Component	**Quantity**	**Unit Cost**	**Cost**
Cistern - 10,000 gal	1	$10,000.00	$10,000.00
First Flush Diverter	1	$137.46	$137.46
PVC Piping - 2"	40 L.F.	$3.30	$132.00
		Subtotal	**$10,269.46**
Cooling Tower Pit Addition			
Component	**Size**	**Unit Cost**	**Cost**
Excavation	192.6 C.Y.	$11.40	$2,195.64
Slab On Grade	260 S.F.	$6.05	$1,573.00
Foundation Walls	51.1 C.Y.	$325.00	$16,607.50
(Including Formwork, Concrete, Reinforcement & Finishing)			
		Subtotal	**$20,376.14**
Total System First Cost			**$30,645.60**

This cost analysis of the rainwater catchment system incorporates only the costs that are unique and specific to this system. This creates a first cost that is generated when adding these extra components to a typical chilled water plant system and makeup water requirements. In determining the first cost for this system there are several assumptions that were made. First, roof drains and downspouts are assumed to already be considered into the cost of the building and the piping required to divert rain water to the cistern is negligibly different from the piping requirements of sending storm water to a storm water collection system. Additionally, it is also assumed that cooling tower water treatment and filtration



components are typical for supplying makeup water to the cooling towers, and a typical makeup water supply incorporates the same water treatment types at the water supply from the rain water catchment system.

Water Cost Savings

The following charts look at the total monthly and yearly water cost for a makeup water system using 100 percent supply water and the system utilizing rain water to offset a portion of the supply water. Additionally, the total potential yearly savings of water cost by offsetting a portion of the demand is determined.

Table 7.2 – Total Makeup Water Cost for !00% Supply Water

Month	Makeup Water (Gallons)	Cost per 100 gallons	Cost per Month
January	714,240	$0.43	$3,071.23
February	645,120	$0.43	$2,774.02
March	714,240	$0.43	$3,071.23
April	691,200	$0.43	$2,972.16
May	714,240	$0.43	$3,071.23
June	691,200	$0.43	$2,972.16
July	714,240	$0.43	$3,071.23
August	714,240	$0.43	$3,071.23
September	691,200	$0.43	$2,972.16
October	714,240	$0.43	$3,071.23
November	691,200	$0.43	$2,972.16
December	714,240	$0.43	$3,071.23
Total Yearly Makeup Water Cost			**$36,161.28**

Table 7.3 – Total Makeup Water Cost After Rainwater Contribution

Month	Makeup Water (Gallons)	Cost per 100 gallons	Cost per Month
January	557,100	$0.43	$2,395.53
February	528,720	$0.43	$2,273.50
March	603,660	$0.43	$2,595.74
April	618,450	$0.43	$2,659.34
May	661,860	$0.43	$2,846.00
June	644,640	$0.43	$2,771.95
July	688,050	$0.43	$2,958.62
August	679,320	$0.43	$2,921.08
September	635,910	$0.43	$2,734.41
October	618,210	$0.43	$2,658.30
November	525,330	$0.43	$2,258.92
December	539,640	$0.43	$2,320.45
Total Yearly Makeup Water Cost			**$31,393.83**

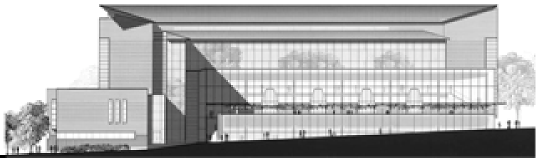


Table 7.4 – Water Cost Savings

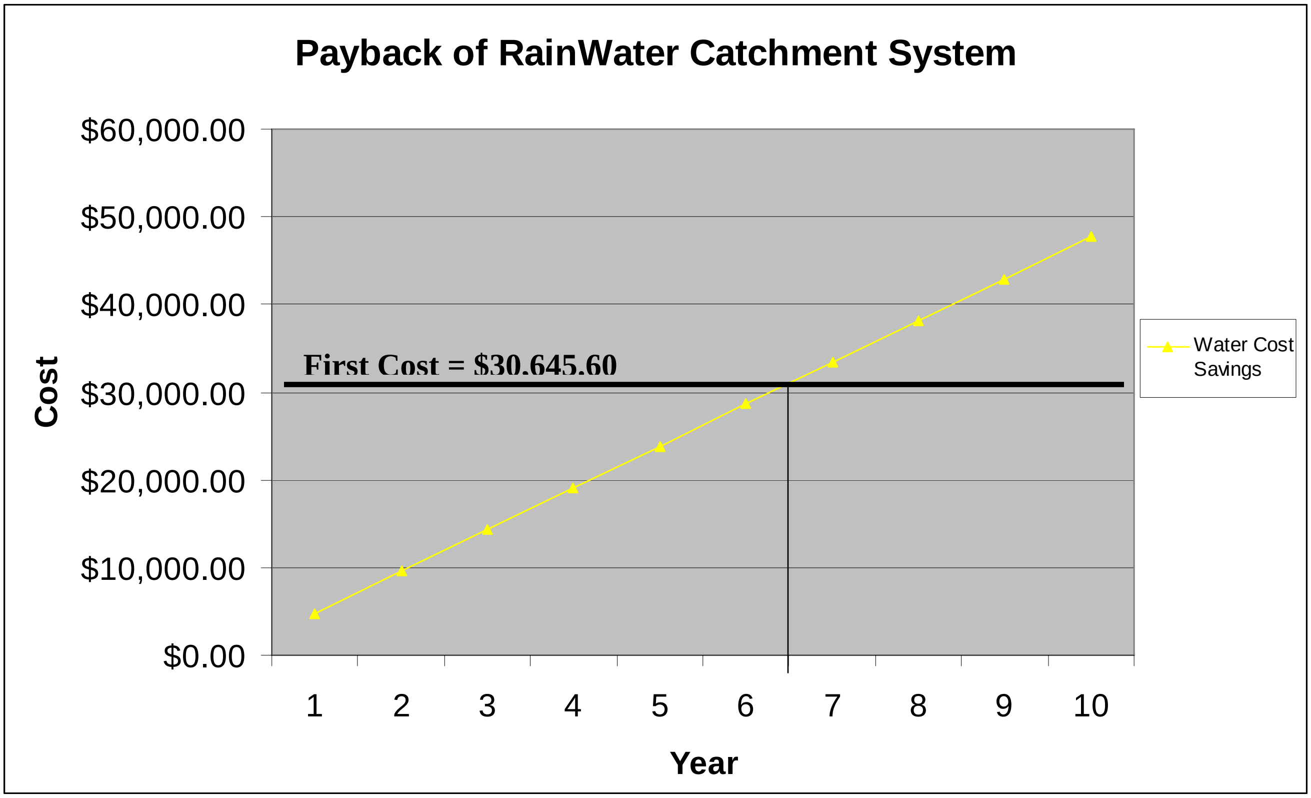
Yearly Water Cost Savings	
Existing System	$36,161.28
Proposed System	$31,393.83
Savings	**$4,767.45**

By using the total collectible rainwater each year and supplying it to the cooling tower water makeup, a total of $4,767. 45 can be saved each year in water cost.

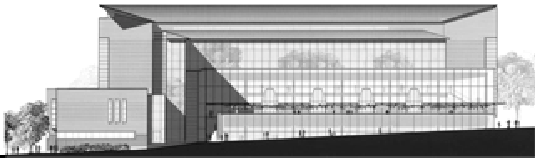
Payback Period

The following payback period looks at the length of payback of implementing a rainwater catchment system in William H. Gates Hall. The following figure and the payback analysis looks at how long the water savings from utilizing rain water takes to offset the initial increased cost of the rainwater catchment system.

Figure 7.1 – Payback Analysis of Rainwater Catchment System



As the graph indicates, the water savings pays back the increased initial cost of the system over a period of 6.5 years. This payback analysis assumes constant water rates throughout the entire period studied. In reality, water rates would most likely increase throughout this



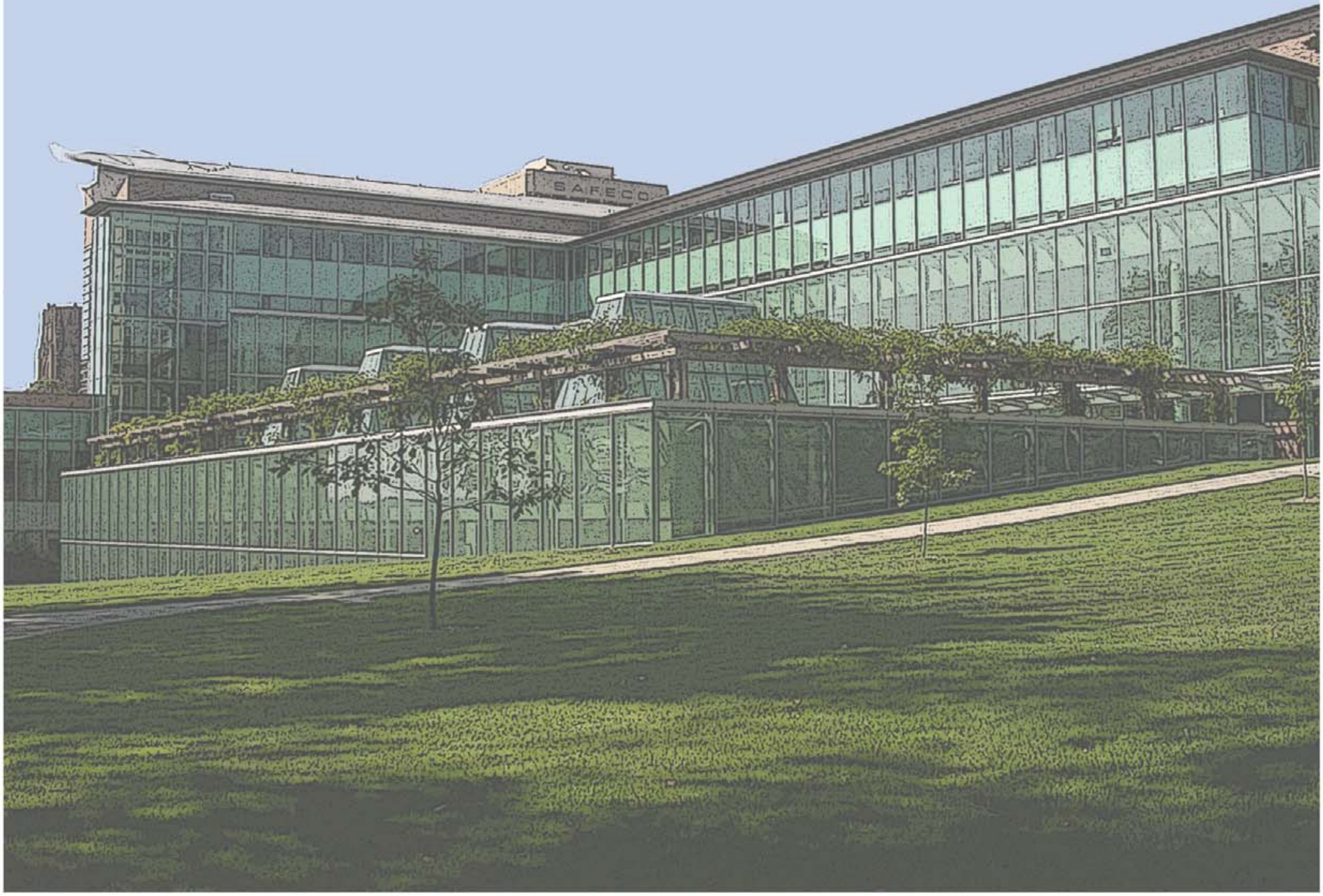
time period, which would increase the rate at which the rainwater catchment system reached its payback.

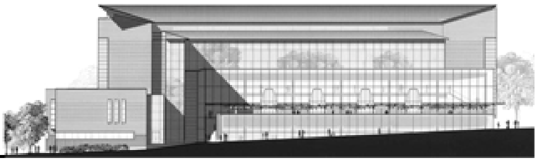
For the purpose of this analysis the projected life of the rainwater catchment system is 25 years. A payback period of 6.5 years with an estimated life of 25 years is reasonably acceptable for this system. The system will incur almost 19 years of savings on water cost at almost $5,000 dollars per year, for a total return on investment of approximately $95,500. This value will increase over time as water rates continue to rise.

Conclusion

When considering the feasibility of implementing a rain water catchment system for William H. Gates Hall to offset cooling tower water makeup requirements, both the initial system first cost and the payback period of the system are considered. The first cost of the system totals $30,645.60 and includes both components of the rainwater catchment system and the construction/structural components need to expand to cooling tower pit. Additionally, the amount of water conserved by utilizing the rainwater catchment system allows for financial savings of approximately $4,767 per year, when considered at the current water rate. When the system first cost and system’s resulting water savings are directly compared, it is determined that the rainwater catchment system has a payback period of approximately 6.5 years. This payback period is acceptable and allows for significant water cost savings throughout the life cycle of the system. It is recommended that a rain water catchment system be implemented in the design of William H. Gates Hall to offset the building non-potable water demands acquired by the cooling towers.

Summary & Conclusions





Summary & Conclusions

Lighting Depth

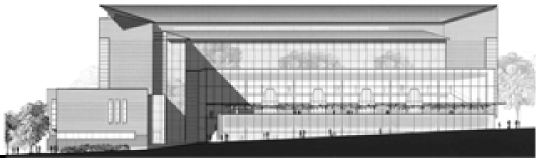
The Lighting Depth looked at the redesign of four different spaces in William H. Gates Hall. For each space, the design meets IESNA design criteria and ASHRAE 90.1 power density allowances. While the overall lighting goals were focused around creating a design conducive to learning and highlighting the building's unique architectural features, each space does so in very different ways. 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. By accenting pathways and stairs in the adjacent terrace, occupants of the space can feel comfortable and safe when passing through the terrace. The courtroom 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. Lastly, 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.

Electrical Depth

The Electrical Depth looked at several components of the electrical system including panelboard and load coordination, transformers, motor controls, and protective devices.

The panelboard coordination of the lighting changes made in the Lighting Depth adjusted panelboard loads according to the existing lighting loads that were removed and new lighting loads applied. In several circumstances, it was concluded it would be best to downsize some of the lighting panels, as they were significantly oversized. This downsizing, however, still left substantial space for future growth.

In the transformer redesign, the four existing central transformers and all loads and associated feeders were redesigned using distributed transformers. While there are several concerns surrounding the use of distributed transformers, such as an increased number of transformers required and space requirements in electrical closets, it does prove to be an effective design solution. By using distributed transformers throughout the building, feeder sizes running vertically through the building can be reduced, and thus, the high cost associated with copper feeders can be decreased significantly. While the number of step-down transformers in the buildings is increased from seven to seventeen, other equipment is able to be de-rated, feeders are sized smaller and the total cost of the system is decreased



by approximately $26,000. In the case of the electrical system for William H. Gates Hall, distributed transformers are a good alternative to the existing central transformers and would be recommended for this building.

The motor control center design portion of the Electrical Depth allowed for the motor starters for all nine of the air handling units located in the fourth floor mechanical room to be controlled from a motor control center. From analyzing the motor loads, it was determined an 800A bus bar would be needed to feed all of the loads, and the motor control center will be fed from a spare 800A breaker in the main distribution panel. It was determined that the motor control center would need to contain three 20 inch vertical sections in order to house all of the motor starters, and incoming feed main circuit breaker. Additionally, there is ample space and clearance in the mechanical room for the control center at its determined size. By using a motor control center, the motors for this equipment, which is located on the fourth floor while the majority of the mechanical equipment is located on Level L2, are able to be locally controlled.

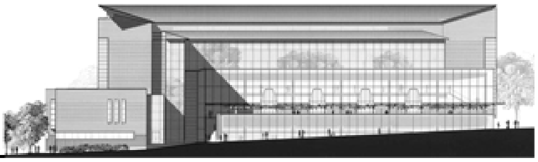
Lastly, a protective device coordination study was completed for a lighting panel main circuit breaker, the lighting panel's feeder protection in the distribution panel, and the distribution panel protection in the main switchgear. After comparing the time/current curves for each of these protection devices it was determined that the protection devices are not properly coordinated.

LEED Breadth

The LEED Breadth topic looked at the feasibility of implementing a rain water catchment system to offset cooling tower makeup water requirements. In order to implement a rainwater catchment system for William H. Gates Hall there are several system components that must be included and many areas of coordination and integration that need to be considered. By using a rainwater catchment system in this situation, cooling tower water makeup can be offset by approximately 1 million gallons a year, with the potential for more of an impact during the rainy, cool months than the dry, warm months. In addition, implementing a system can be done with minimal effects to other systems, with exceptions of the cooling tower pit expansion. Overall, the system is a feasible option for William H. Gates Hall and would be recommended depending on the life cycle cost, which are addressed in the Construction Management Breadth portion of this report.

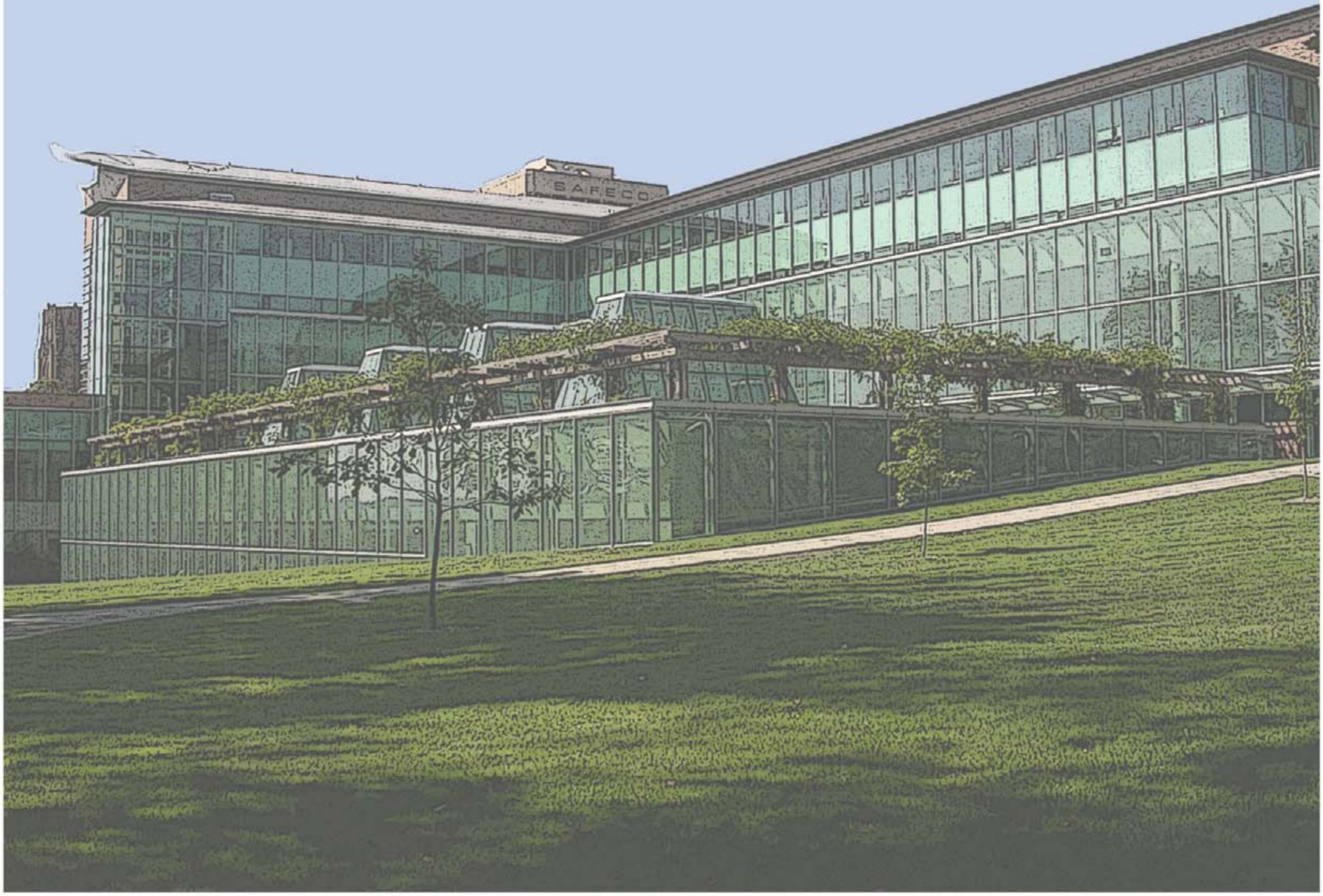
Construction Management Breadth

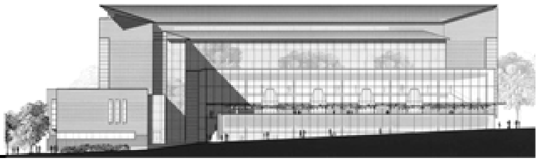
When considering the feasibility of implementing a rain water catchment system for William H. Gates Hall to offset cooling tower water makeup requirements in the Construction Management Breadth, both the system's first cost and the payback period of the system are considered. The first cost of the system totals $30,645.60 and includes both components of



the rainwater catchment system and the construction/structural components need to expand to cooling tower pit. Additionally, the amount of water conserved by utilizing the rainwater catchment system allows for financial savings of approximately $4,767 per year, when considered at the current water rate. When the system first cost and system’s resulting water savings are directly compared, it is determined that the rainwater catchment system has a payback period of approximately 6.5 years. This payback period is acceptable and allows for significant water cost savings throughout the life cycle of the system. It is recommended that a rain water catchment system be implemented in the design of William H. Gates Hall to help offset the building non-potable water demands acquired by the cooling towers and expand upon the university’s commitment to sustainable practices. .

References





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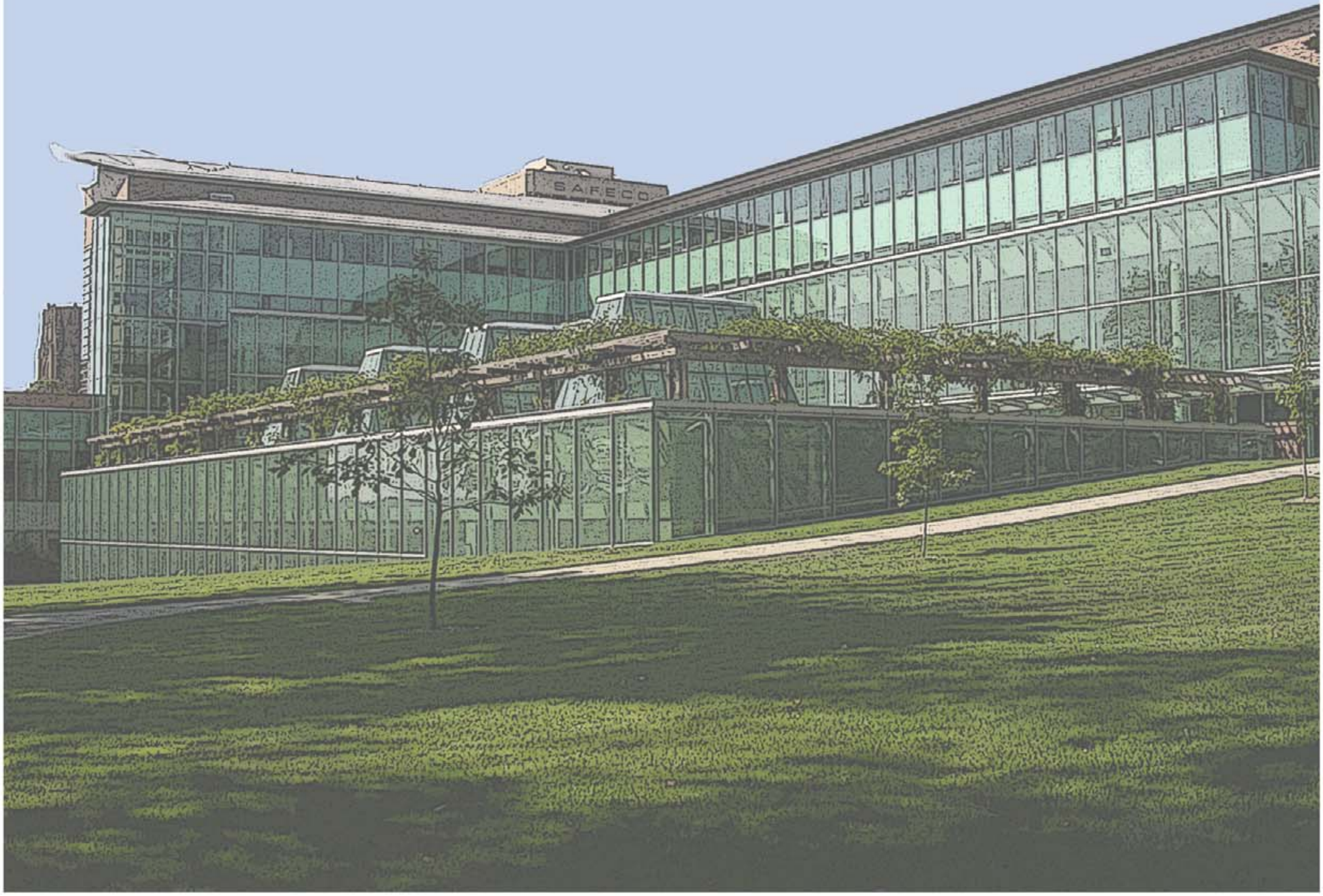
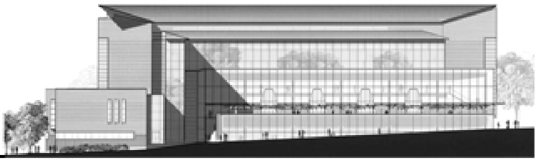
Acknowledgements





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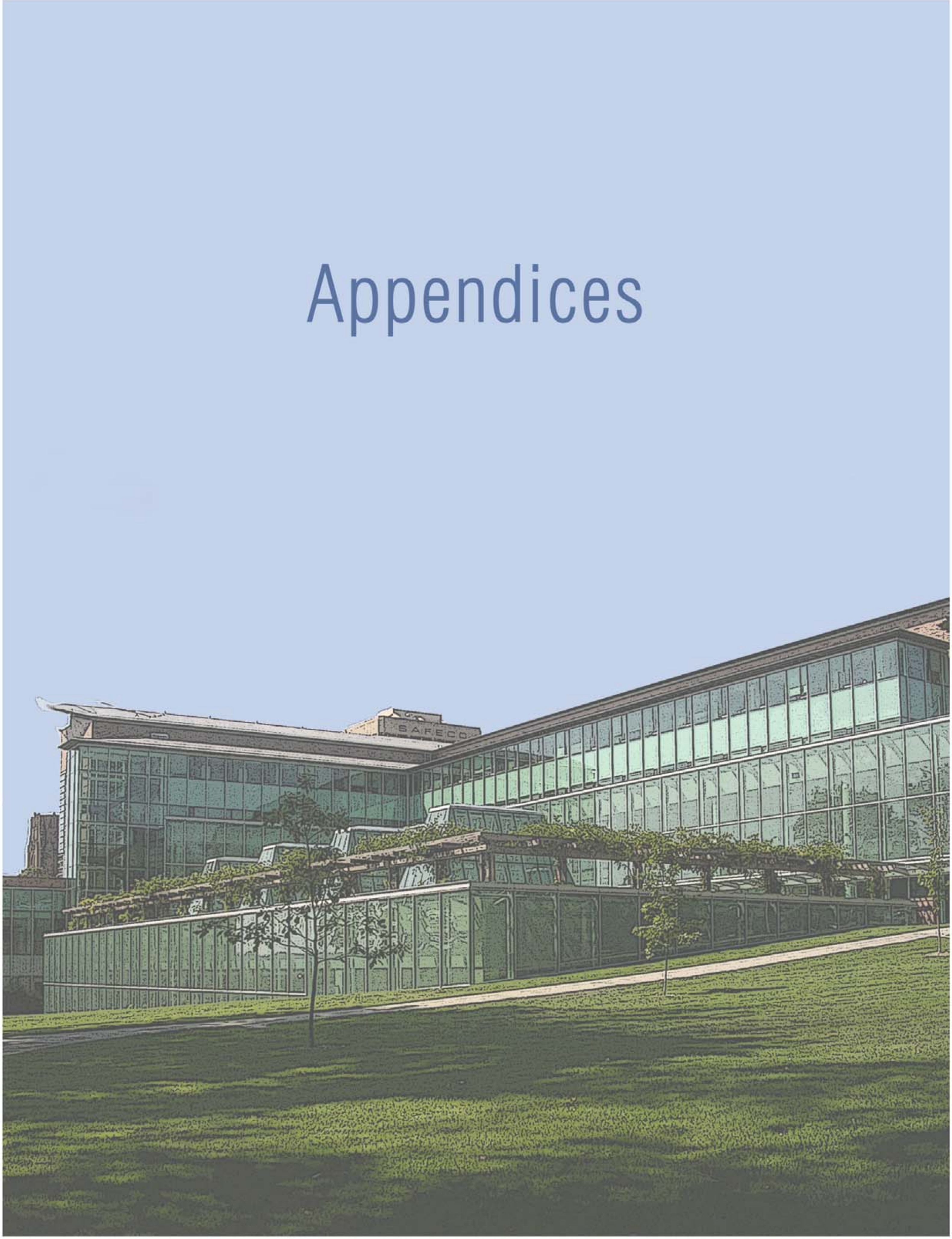
Appendices



Appendix A

Luminaire Designation	Description	Mounting	Lamp		Ballast	CRI	CCT	Volt.	Watts
			#	Type					
H1	Tech Lighting Halogen adjustable accent lights, Clamps to Wall MonoRail	Surface	1	35W MR16	N/A	-	3000	12/277	35
H2	Leucos Incandescent Cylindrical Table Lamp	Table	1	100W A19	N/A	-	-	120	100
F1	Lightolier Compact Fluorescent downlight w/ vertical lamp, 6" aperture	Recessed	1	CFTR32W	Electronic	82	3500	277	34
F1A	Lightolier Compact Fluorescent downlight w/ vertical lamp, 6" aperture	Recessed	1	CFTR32W	Electronic Dimming	82	3500	277	38
F2	Erco 48" Recessed wallwasher	Recessed	1	F28T5	Electronic	82	3500	277	30
F3	Focal Point Fluorescent Directional Cove Light	Surface	1	F28T5	Electronic	85	3500	277	30
F3A	Focal Point Fluorescent Directional Cove Light	Surface	1	F28T5	Electronic Dimming	85	3500	277	30
F4	Se'lux Compact Fluorescent Wall Arm Mounted Sconce	Surface	1	CFQ26W	Electronic	82	3500	277	27
F5	WE-EF Rectangular Compact Fluorescent Step Light	Recessed	1	CFQ18W	Integral Electronic	82	3500	277	20
F6	WE-EF Circular Compact Fluorescent Step Light	Recessed	1	CFQ18W	Integral Electronic	82	3500	277	20
F7A	Focal Point Fluorescent Narrow Slot Downlight with Opaque Satin Lense	Recessed	1	F28T5	Electronic Dimming	85	3500	277	30
F8A	Lightolier Compact Fluorescent Wallwasher w/ vertical lamp,4" aperture	Recessed	1	CFQ18W	Electronic Dimming	82	3500	277	22
F9	Lightolier Compact Fluorescent wallwasher w/ vertical lamp, nominal 6" apperature	Recessed	1	CFTR32W	Electronic	82	3500	277	34
F10	Delray Lighting 8" Clyinder Vertical Lamp Up/Downlight	Surface (Column)	2	CFQ18W	Electronic	82	3500	277	36
F11	Lightolier Compact Fluorescent Downlight w/ vertical lamp, nominal 8 3/4" aperture	Recessed	1	CFM42W	Electronic	82	3500	277	46
F12	Elliptipar Style 301 Assymetrical Linear Fluorescent Strip	Surface	1	F32T8	Electronic	85	3500	277	34
F13	Winona Lighting Decorative Cylindrical Pendant	Suspended	2	FT39W	Magnetic	85	3500	277	84
F14	Elliptipar 30/30 Fluorescent Stack Light	Suspended	1	F28T5	Electronic	85	3500	277	30
M1	Bega Metal Halide Low Profile Path Light	Semi-Recessed	1	39W T4	Magnetic	82	3000	277	53
L1	ioLighting 36" Symmetrical Linear LED Accent, 5 degree beam spread w/ grazing	Surface	1	F28T5	Integrated Driver	-	5000	277	32

Luminaire Cutsheets

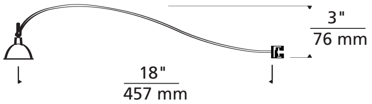
LOW-VOLTAGE ELEMENTS

Wall Georgi

FreeJack	MonoRail	Two-Circuit MonoRail	Wall MonoRail	Kable Lite	TwinRail	T~trak™
N/A	N/A	N/A	⊏	N/A	N/A	N/A

ARCHITECTURAL HEAD

Shown approximately 20% actual size.



DESCRIPTION

Clamps to Wall MonoRail. 18” long 3” high gentle curve. Pivots at head to direct the beam.

SYSTEM

Available for Wall MonoRail only.

FINISH

Antique bronze, chrome, gold, satin nickel.

LAMP

Low-voltage Halogen MR16 lamp up to 75 watts (not included).

ACCESSORIES & OPTICAL CONTROLS

Wild Thing, Sun Louver, Flight Paper, MR16 Snout, Round Glass Shield, Cone Glass Shield, Lil Egypt, Lil Wok, Barndoors, Snap Barndoors, Backlight Shield, Louver Lens Holder, Snap Louver Lens Holder, Eggcrate Louver, Glass Lens (sold separately).

WEIGHT

0.22 lb./0.10 kg. ±

wmo_wall_georgi_spec.pdf

ORDERING INFORMATION

700WMGRG

FINISH

Z	ANTIQUE BRONZE
C	CHROME
G	GOLD
S	SATIN NICKEL

August 2005 Specifications subject to change without notice.

700WMGRG S

FIXTURE TYPE: H1

JOB NAME: William H. Gates Hall

TECH LIGHTING®

7400 Linder Avenue
Skokie, Illinois 60077
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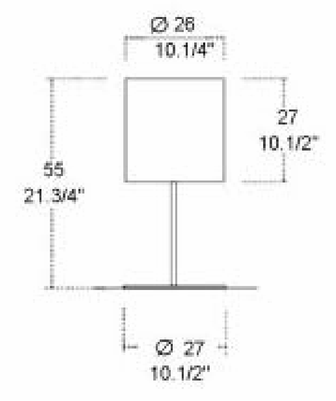
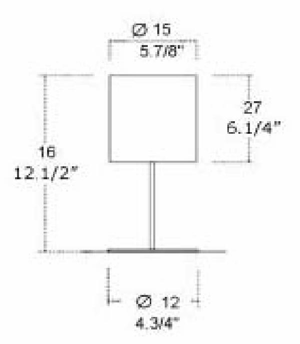
FIXTURE: F2

CELINE T-T15

LEUCOS INDUSTRIAL DESIGN TEAM



Celine T



Celine T15

DESCRIPTION: A simple drum-shaped, satin white diffuser unites the Celine design offering. Two sizes are available with incandescent light sources to provide diffused illumination.

CONSTRUCTION: Flat round bases and cleaned-lined stems in brushed nickel support the blown glass diffuser. On/Off switches are located on a black cord on all models. Dimmers are optional.

LIGHT SOURCE: T: 1 x 100 watt, incandescent, A-19, medium base (provided)
T15: 1 x 60 watt, incandescent, G-16 1/2, candelabra (provided)

FINISH: Stem and base details are in brushed nickel

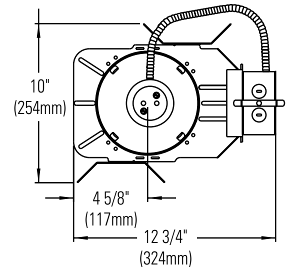
GLASS COLOR: Satin White

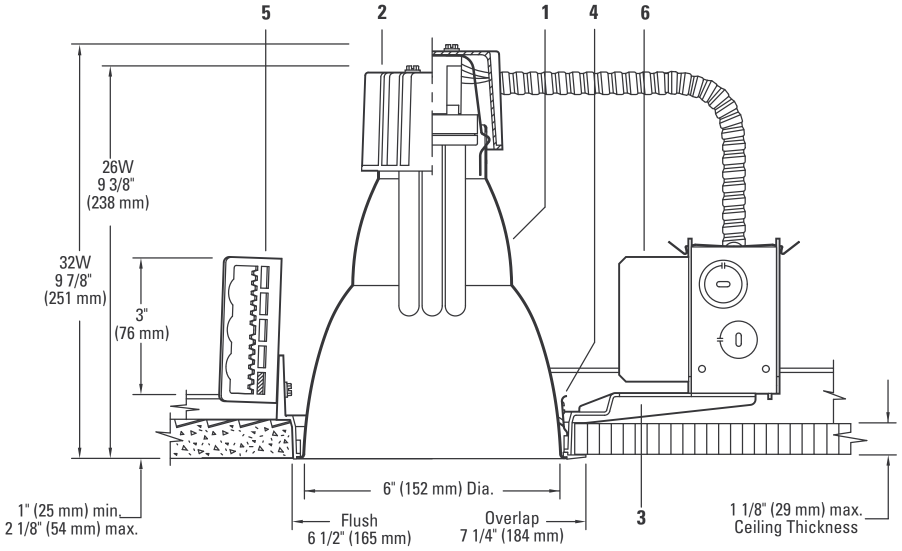
NET WEIGHT: T: 11 lbs.
T 15: 7 lbs.

Leucos USA, Inc.
11 Mayfield Avenue
Edison, NJ 08837
Tel: 732-225-0010
Fax: 732-225-0250
www.leucos.com

Calculite® Compact Fluorescent Open Downlighting **8021**

6" Aperture Triple Tube Vertical Lamp





Ceiling Cutout: 6 9/16" (167 mm) Dia.

Reflector Trim

8021 CCLW	Comfort Clear™, White Flange
8021 CCLP	Comfort Clear™, Polished Flange
8021 CCL	Comfort Clear™, Molded Trim Ring
8021 ☐	Add suffix. See options for other finishes.

Frame-In Kit			Lamp
S6132BU	Electronic	120V - 277V	**26 or 32W Triple Tube**
S6132BCU3	Universal Dimming	120V - 277V	4-Pin (Amalgam)
S6132BJUM7	Advance Mark7	120V - 277V	

Remodeler Frame-In Kit			Lamp
6132BURM	Electronic	120V - 277V	**26 or 32W Triple Tube** 4-Pin (Amalgam)

Features

1. **Reflector:** 16 ga. Alzak® aluminum, 50° visual cutoff to lamp and lamp image, medium distribution. Comfort Clear™ low iridescence finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Galvanized steel for dry or plaster ceilings. Accepts other 6" Triple Tube reflectors (see S6132BU Spec Sheet).
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4" or 1 1/2" lathing channel, 1/2" EMT, or optional mounting bars.
6. **Ballast/J-Box:** Electronic 120V-277V. UL listed for through branch circuit wiring with max of (8) No. 12 AWG, 90°c supply conductors. Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools.

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **"Ballast"** specification sheet for complete electrical data.

S6132BU, S6132BCU: UL listed for through branch circuit wiring with max of (8) No. 12 AWG, 90° C supply conductors.

6132BURM: UL listed for No. 12 AWG, 90° C supply conductors.

Options and Accessories

Comfort Clear™ Finishes[1]		Other Finishes	
Diffuse	**CCD**	White	**WH**
Champagne Bronze	**CCZ**		
Pewter	**CPW**		

[1]Specify desired flange. **W** White, **P** Polished, Blank - Molded Ring

Other Dimming:

S6132BJ1MX	Advance MarkX, 120V	**S6132BJ1LD3**	Lutron Hi-lume®, 120V
S6132BJ2MX	Advance MarkX, 227V	**S6132BJ2LD3**	Lutron Hi-lume®, 227V

Options and Accessories (continued)

Emergency Ltg. Kit	**FA EM3E*** **FA EM4***
Fuse (Slow Blow)	Add suffix **F**
Existing/Thk. Ceiling	**FA EC6***
Emergency	Add suffix **EM***
Chicago Plenum	Use 6132BULC

*See Spec. Sheets: FAEM, FAEC

Mounting Bars & Accessories; see Specification Sheet MBA.
Sloped Ceiling Adapters; see Specification Sheet SCA.

IC Frame available; see **C6CFL32** Specification Sheet.

Labels

UL Listed for damp locations.

Alzak® is a registered trademark of ALCOA.
US Patent Pending.

Job Information **Type:** F1 & F1A

Job Name: William H. Gates Hall

Cat. No.: 8021CCLP

Lamp(s): 1 CFT32W

Notes:

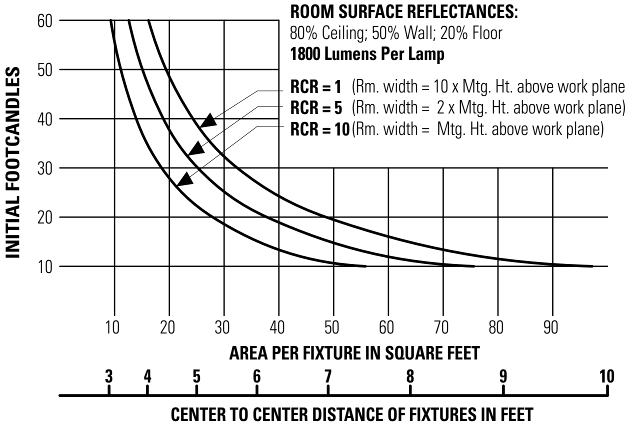
Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Calculite® Compact Fluorescent Open Downlighting **8021**

6" Aperture Triple Tube Vertical Lamp

26W

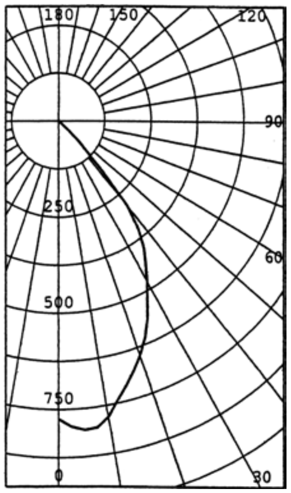
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt.- 26W TTT units with Comfort Clear™ reflector, for any level of illumination.

Spacing Ratio = 1.0

REPORT NO: LSI 14025
LIGHTOLIER RECESSED FLUORESCENT LUMINAIRE,
WITH COMFORT CLEAR™ REFLECTOR
ONE 26 WATT CPFL GE LAMP,
CAT# F26TBX/SPX35-835.
LUMEN RATING = 1800 LMS.



EFFICIENCY=48.1%
DATE: 4-23-99
CIE TYPE DIRECT
LUMINOUS DIAMETER: 6.000
THIS REPORT BASED ON LM-1 AND
OTHER PERTINENT IES PROCEDURES.

ZONAL SUMMARY

ANGLE	CP	LUMENS
0	775	
5	806	77
10	780	
15	708	199
20	646	
25	566	258
30	478	
35	402	245
40	285	
45	78	81
50	13	
55	4	4
60	2	
65	1	2
70	1	
75	1	1
80	0	
85	0	0

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	533	29.66	61.66
0-40	778	43.25	89.92
0-60	863	47.98	99.75
0-90	865	48.10	100.00
40-90	87	4.85	10.08
60-90	2	.12	.25
90-180	0	.00	.00
0-180	865	48.10	100.00

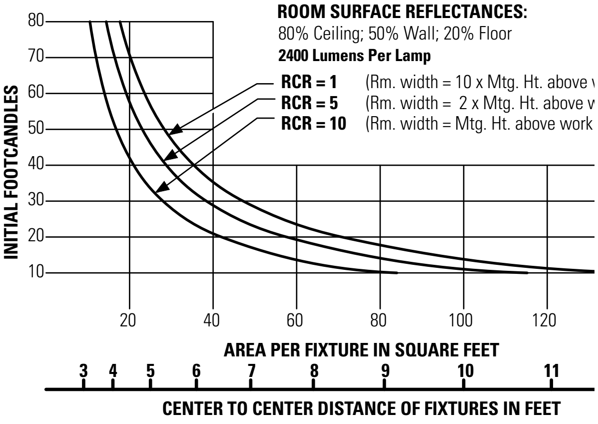
Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

	80			70			50			30			10			
	WALL OF REFLECTANCE															
ROOM CAVITY RATIO	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.54	.53	.52	.53	.52	.51	.51	.50	.49	.49	.48	.48	.47	.47	.46	.46
2	.50	.49	.47	.50	.48	.47	.48	.47	.46	.47	.46	.45	.45	.45	.44	.43
3	.47	.45	.44	.47	.45	.43	.46	.44	.43	.44	.43	.42	.43	.42	.41	.41
4	.45	.42	.40	.44	.42	.40	.43	.41	.40	.42	.41	.39	.41	.40	.39	.38
5	.42	.39	.37	.42	.39	.37	.41	.39	.37	.40	.38	.37	.39	.38	.36	.36
6	.40	.37	.35	.39	.37	.35	.39	.36	.35	.38	.36	.34	.37	.36	.34	.34
7	.37	.34	.33	.37	.34	.32	.36	.34	.32	.36	.34	.32	.35	.33	.32	.31
8	.35	.32	.30	.34	.32	.30	.34	.32	.30	.34	.31	.30	.33	.31	.30	.29
9	.33	.30	.28	.32	.30	.28	.32	.30	.28	.32	.29	.28	.31	.29	.28	.27
10	.31	.28	.26	.30	.28	.26	.30	.28	.26	.30	.27	.26	.29	.27	.26	.25

32W

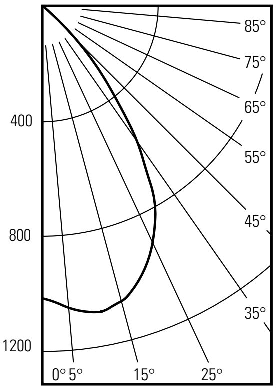
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt.- 32W TTT un with Comfort Clear™ reflector, for any level of illumination

Spacing Ratio = 1.1

REPORT PREPARED FOR: LIGHTOLIER 04-27-1999
REPORT NO: LRL 499-9G
LAMPS: 1 PLT-32 LUMENS: 2400
DESCRIP.: 6" DIA X 10" HT RECESSED DOWNLIGHT
WITH COMFORT CLEAR™ REFLECTOR. VERTICAL
LAMP.



EFFICIENCY=52.7%
DATE: 4-27-99
CIE TYPE DIRECT
LUMINOUS DIAMETER: 6.000
THIS REPORT BASED ON LM-1 AND
OTHER PERTINENT IES PROCEDURES.

ZONAL SUMMARY

ZONE DEG.	AVG* C.P.	ZONAL LUMENS
180	0	
175	0	0
165	0	0
155	0	0
145	0	0
135	0	0
125	0	0
115	0	0
105	0	0
95	0	0
90	0	0
85	1	1
75	1	1
65	3	3
55	9	8
45	99	77
35	563	354
25	904	418
15	1063	301
5	1066	102
0	1035	

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP	%LUMINAIRE
0–30	821	34.2	64.9
0–40	1175	49.0	92.9
0–60	1260	52.5	99.6
0–90	1265	52.7	100.0
40–90	90	3.8	7.1
60–90	5	0.2	0.4
90–120	0	0.0	0.0
90–150	0	0.0	0.0
90–180	0	0.0	0.0
0–180	1265	52.7	100.0

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

	80			70			50			30			10			
	WALL OF REFLECTANCE															
ROOM CAVITY RATIO	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.59	.58	.57	.58	.57	.56	.56	.55	.54	.54	.53	.53	.52	.52	.51	.50
2	.56	.54	.53	.55	.54	.52	.54	.52	.51	.52	.51	.50	.51	.50	.49	.48
3	.53	.51	.50	.53	.51	.49	.51	.50	.49	.50	.49	.48	.49	.48	.47	.46
4	.51	.48	.47	.50	.48	.46	.49	.47	.46	.48	.46	.45	.47	.46	.45	.44
5	.48	.46	.44	.48	.45	.44	.47	.45	.43	.46	.44	.43	.45	.44	.43	.42
6	.46	.43	.42	.46	.43	.41	.45	.43	.41	.44	.42	.41	.44	.42	.41	.40
7	.44	.41	.39	.43	.41	.39	.43	.41	.39	.42	.40	.39	.42	.40	.39	.38
8	.41	.39	.37	.41	.39	.37	.41	.38	.37	.40	.38	.37	.40	.38	.36	.36
9	.39	.36	.35	.39	.36	.35	.38	.36	.35	.38	.36	.34	.38	.36	.34	.34
10	.35	.32	.31	.35	.32	.31	.35	.32	.30	.34	.32	.30	.34	.32	.30	.30

Job Information **Type:** F1 & F1A

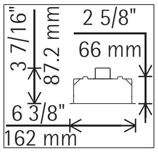
Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

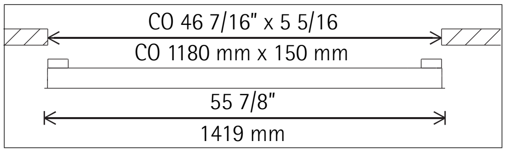
FIXTURE: F2

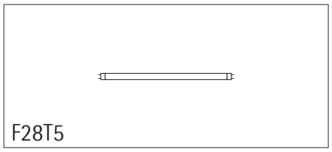
ERCO

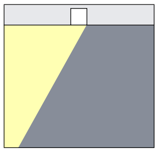
TFL Wallwasher

for fluorescent lamps









cULus Dry Damp Wet

Indoor

65040.023 Reflector silver
F28T5 28W Min. Bipin 2900lm
ECG

Product description
Housing: sheet metal, white (RAL9002) powder-coated. Screw-fastened end plates. Arrangement as continuous band of light possible. Mounting brackets with screw fixing: metal.
2 cable entries, through-wiring possible. 3-pole terminal block.
Electronic control gear 120V/277V, 60Hz, class P inside cast housing.
Wallwasher reflector: aluminum, satin matt anodized. Hinged cover for lamp replacement.
Type Non IC luminaire.
Insulation materials must be kept away from the luminaire by a minimum of 3". Suitable for damp location.
Max. ceiling thickness 3/4".
Weight 17.64lbs / 8.00kg

Technical Region: 120V/277V, 60Hz
Edition: 11.15.2006
Please download latest version from
www.erco.com/65040.023

ERCO

TFL Wallwasher

Planning Data

Illuminance (fc)
Specifications:
Number of luminaires n > 5
Light loss factor 0.80
Without indirect component
Without peripheral area
Wall height (ft) 10
F28T5 28W Min. Bipin 2900lm

Offset from wall (ft)	3		3		4		4	
Luminaire spacing (ft)	5		6		5		6	
Distance from ceiling (ft)	below the luminaire	between the luminaires	below the luminaire	between the luminaires	below the luminaire	between the luminaires	below the luminaire	between the luminaires
0.000	0	0	0	0	0	0	0	0
1.000	36	25	34	19	16	13	14	10
2.000	53	41	49	32	35	30	31	24
3.000	40	34	36	27	35	30	30	25
4.000	30	26	26	22	28	25	25	21
5.000	22	20	19	17	23	20	20	17
6.000	17	15	14	13	19	16	16	14
7.000	13	11	11	10	15	13	13	11
8.000	10	8	8	7	12	10	10	9
9.000	8	7	7	6	10	8	8	7
10.000	6	5	5	5	8	7	7	6

FOCAL POINT®

covelight™ 68

FEATURES

Intended for concealed cove installations where directional light requirements may change.

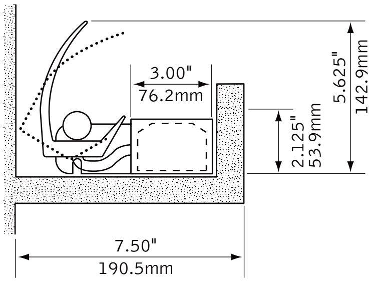
Multiple lamp configurations provide maximum flexibility.

Continuous row installations may be configured with combinations of 3' and 4' standard length units.

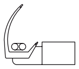
Adjustable asymmetric optical system adds flexibility and performance to any design.

august 2005

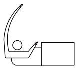
DIMENSIONAL DATA



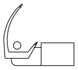
lamping options



BIAX LAMPS

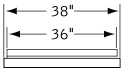


T8 LAMPS

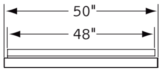


T5/T5HO LAMPS

fixture information



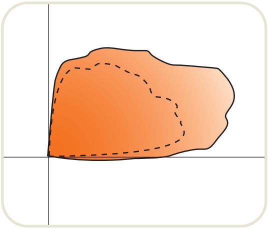
3' (3' 2")



4' (4' 2")

Overall luminaire length will exceed nominal length.

PERFORMANCE



1–Lamp T8
82% Efficiency
1242 cd @ 115°

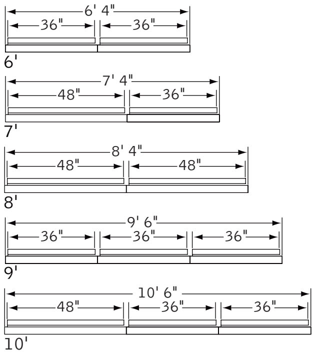
See **Photometric** section for additional performance data.

fixture type:

project name:

DETAILS

run information



Fixtures are always independent and never joined.
Overall luminaire length will exceed nominal length.
Consult factory for additional row length information.

SPECIFICATIONS

construction

20 Ga. steel reflector housing and remote ballast housing.
16 Ga. steel end plates attached to housing.
Luminaires available in 3' and 4' nominal lengths only.

3' unit weight:	12 lbs
4' unit weight:	16 lbs

optic

Die-formed .02" specular aluminum reflector.

electrical

Electronic ballasts are thermally protected and have a Class "P" rating.
Optional DALI and other dimming ballasts available.
Consult factory for dimming specifications and availability.
UL and cUL listed.

emergency

Emergency battery packs provide 90 minutes of one lamp illumination.
Initial lumen output for lamp types are as follows:

Biax Lamps:	Up to 650 lumens
T8 Lamps:	Up to 475 lumens
T5 Lamp:	Up to 550 lumens
T5HO Lamp:	Up to 825 lumens

Battery pack requires unswitched hot from same branch circuit as AC ballast.

finish

Polyester powder coat applied over a 5-stage pre-treatment.
Standard luminaire housing finished in High Reflectance White.

ORDERING

luminaire series

FCV

Covelight	FCV

profile

68

6" x 8"	68

lamping

1T5

40 Watt Biax	BX40
50 Watt Biax	BX50
55 Watt Biax	BX55
One Lamp T8	1T8
One Lamp T5	1T5
One Lamp T5HO	1T5HO

circuit

1C

Single Circuit	1C

voltage

277

120 Volt	120
277 Volt	277
347 Volt (Consult factory for availability)	347

ballast

S

Electronic Instant Start <20% THD (T8 Only)	E
Electronic Program Start <10% THD	S
Electronic Dimming Ballast (Consult factory for dimming availability)	D

mounting

CV

Cove	CV

factory options

Emergency Battery Pack	EM
HLR/GLR Fuse	FU
Include 3000K Lamp	L830
Include 3500K Lamp	L835
Include 4100K Lamp	L841

finish

HW

High Reflectance White	HW

luminaire length

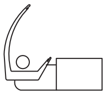
4'

3'	3'
4' (Overall luminaire length will exceed nominal length.)	4'

PERIMETER

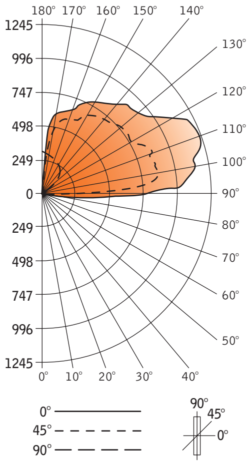
adjustable

covelight™ 68



Filename:	FCV681T8.IES
Catalog #:	FCV-68-1T8-1C-120-E-HW-4'
Efficiency:	82%
Test #:	8815.0

CANDLEPOWER DISTRIBUTION



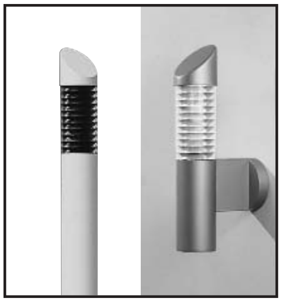
Vertical Angle	0°	Horizontal Angle 22.5°	45°	67.5°	90°	Zonal Lumens
0°	0	0	0	0	0	
5°	0	0	0	0	0	0
15°	0	0	0	0	0	0
25°	0	0	0	0	0	0
35°	0	0	0	0	0	0
45°	0	0	0	0	0	0
55°	17	8	0	0	0	2
65°	72	47	12	0	0	12
75°	243	208	103	1	0	55
85°	530	462	276	91	0	151
90°	903	813	557	201	0	
95°	1126	1030	728	307	8	365
105°	1215	1115	817	342	51	385
115°	1242	1122	741	413	89	381
125°	983	895	706	443	118	300
135°	907	847	688	455	142	255
145°	798	755	630	464	171	198
155°	691	658	590	390	183	130
165°	594	522	469	341	195	72
175°	295	283	254	219	195	20
180°	198	198	198	198	198	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	90°-120°	1131	39.7	48.7
	90°-130°	1431	50.2	61.6
	90°-150°	1884	66.1	81.0
	90°-180°	2105	73.9	90.6
Total Luminaire	0°-180°	2324	82	100.0

Go to www.focalpointlights.com for additional photometric data.

MTR* 90



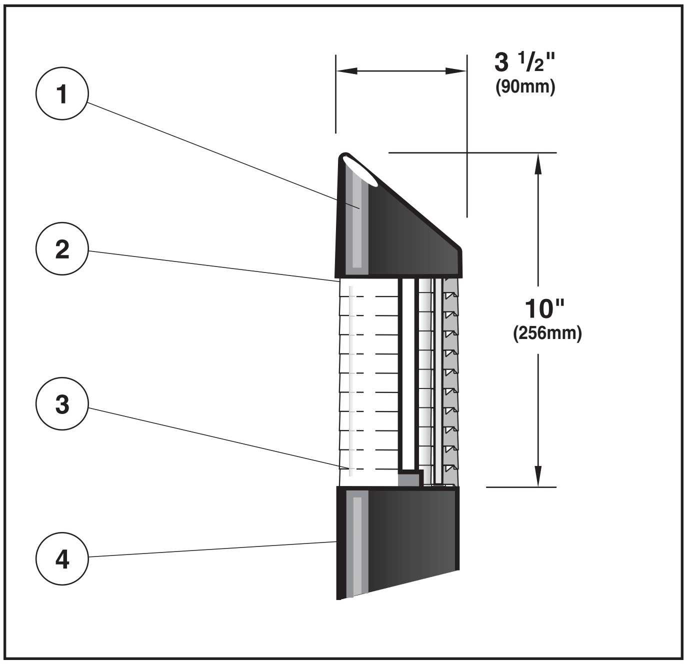
Project: William H. Gates Hall

Type: F4 **Qty:** 22

W90	–	2	–	Q26	–	BK	–	277	–	
Series		**Height**		**Lamp Type / Wattage**		**Finish**		**Voltage**		**Option**

Series	Height	Lamp Type / Wattage	Finish	Voltage	Options
B90 MTR*90 Bollard **W90** MTR*90 Wall	**2** 2' (.6m) **3** 3' (.9m) **4** 4' (1.2m) or specify custom height Wall Mounting see page 2	**T 13** 13w Twin tube fluorescent **Q 18** 18w Quad fluorescent **Q 26** 26w Quad fluorescent	**WH** White **BK** Black **BZ** Bronze **SV** Silver **SP** Specify RAL#	**120** **277** **347**	**HS** House Side Shield (180) Consult factory for details

* US Patent No. 4,669,034



1. Fixture Cover - Die-cast aluminum cover, with round angled form. Thick-walled aluminum cover is painted white on the interior for maximum luminaire efficiency. Removes by loosening two, vandal-resistant, stainless steel set screws for easy access to lamp chamber.

2. Gasketing - Continuous gaskets provide weather-proofing, dust, and insect control at shielding base, fixture cover and between MTR rings.

3. Shielding - Injection-molded acrylic multi-prisms for total reflection (MTR). MTR rings are patterned after the light bending characteristics of a prism. Rings are secured to die-cast aluminum fitter. Additional small reflector is available for asymmetrical light distribution. Consult factory for information.

4. Column - Extruded, thick-walled aluminum, minimum wall thickness 0.110" (3mm). Column houses cold weather ballast.

5. Column Fitter - (Not shown) Die-cast aluminum fitter holds ballast assembly and lamp socket. Fastened to column with three, vandal-resistant, stainless steel, countersunk screws. Column fitter removal allows access to ballast assembly.

6. Ballast - (Not shown) Electronic, high power factor, class P , type A sound rating. Specify 120v, 277v, or 347v. Consult factory for more detailed ballast information. Lamp provided by others.

7. Lamp - (Not shown) For use with compact fluorescent lamps. T13W single end 2 pin base GX23; and Q18w and Q26w single end 4 pin base G24q. Lamp by others.

8. Fixture Mount - (shown on p.2) Column is mounted to hot-dipped, galvanized steel, direct burial tube, anchored 12" deep for increased rigidity and strength.

Exterior Luminaire Finish - SELUX utilizes a high quality Polyester Powder Coating.
All SELUX luminaires and poles undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated and sealed. SELUX powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.
All products are tested in accordance with test specifications for coatings from ASTM and PCI.

Standard exterior colors are White (WH), Black (BK), Bronze (BZ), and Silver (SV). RAL colors (SP) are available, please specify RAL#.#.

Union Made
Affiliated with
IBEW *Local 363*

PO Box 1060, 5 Lumen Lane
Highland, NY 12528
TEL: (845) 691-7723
FAX: (845) 691-6749
E-mail: seluxus@selux.com
Web Site: www.selux.com/usa
MTR90-0403-01 (ss-V3.1)

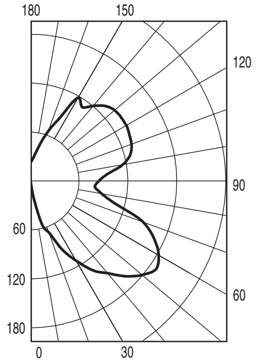
MTR 90

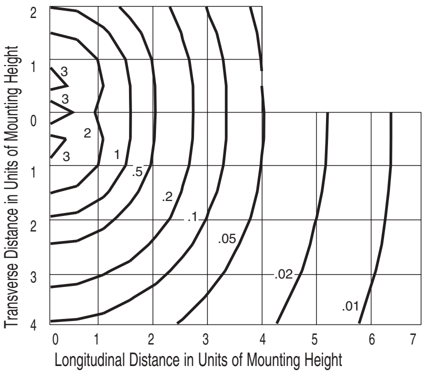
se'lux®

MTR Refractor

Catalog # B90-3-Q26
ITL Report # 40307

- Innovative multi-prisms for total reflection incorporates light-bending characteristics of a prism. US patent no. 4,669,034.
- Directs light precisely with minimum intensity at critical viewing angles.
- Blends efficiency with visual comfort.
- Maximum candela of 193 at 55° from vertical.





Lamp Prorate Table

Fluorescent

Wattage	Factor	Initial Lumens
13	0.50	900
18	0.69	1250
26	1.00	1800

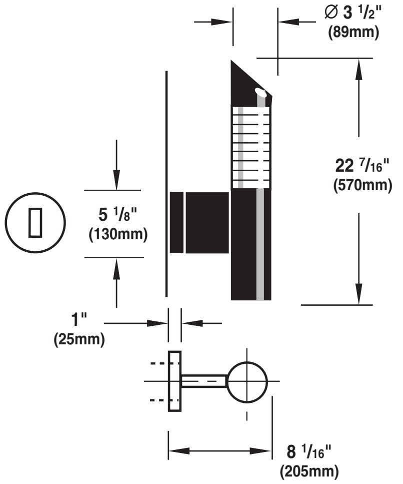
Conversion Chart

Values based on 3' (.9m) mounting height

Mounting Height	Multiply
2.0' (.6m)	2.25
2.5' (.8m)	1.44
3.0' (.9m)	1.00
3.5' (1.1m)	0.73
4.0' (1.2m)	0.56

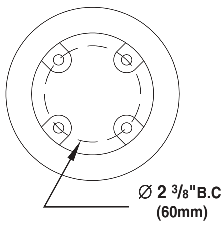
Wall Mount Information

Die cast aluminum wall mount arm with die-cast aluminum canopy. Secured to wall with 1/4" (6mm) threaded fasteners supplied by others.

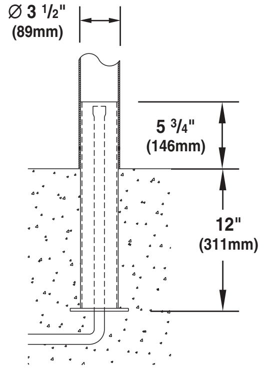


Wall Arm Mounting Detail

(Conduit and mounting hardware by others.)

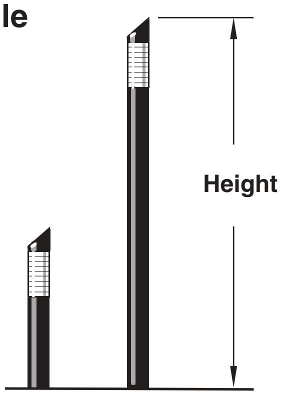


Anchorage Information



Concrete footing to be designed and installed by others.

Profile



In a continuing effort to offer the best product possible, we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product. Specification sheets found at www.selux.com/usa are the most recent versions and supercede all other printed or electronic versions.

ARCHITECTURAL LIGHTING
WALL LUMINAIRES/ RECESSED – STG259

Product Specification

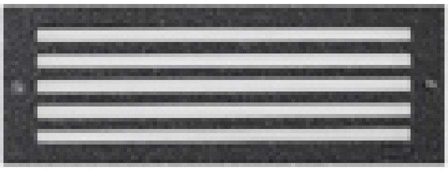
615-1231

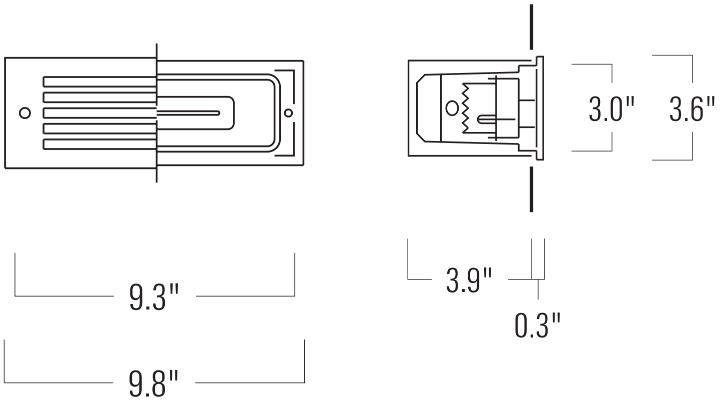
Compact fluorescent source.
Painted aluminium lens frame.
Shielded light source with five horizontal slots.

Project: William H. Gates Hall

Date:

Fixture Type: F5
WE-EF Cat. # : 615-1231
Voltage: 277
Finish: RAL 9004
Options:





Product ID. No.	Lamp/ base	Lumen
615-1231	CFQ18W / G24q-2	1200

Recessed wall luminaire with compact fluorescent lamp. Shielded light source with five horizontal slots.

Materials: Luminaire body and frame constructed of die-cast marine grade aluminum alloy.
Opal UV-stabilized polycarbonate diffuser (inside textured).
Durable high-temperature silicone weatherproof gasket.
PCS coated stainless steel hardware.

Electrical: Integral electronic CF ballast for 120 or 277 volt – ***Specify Voltage.***
Compact fluorescent lamp holder: G24q-2 base, 4 pin, CFQ18 watt lamp required (lamp by others).
Provided with ½ " conduit entry at both ends of luminaire body to facilitate thru-wiring. Maximum of four No. 12 AWG conductors (plus ground).

Mounting: Suitable for old, or new work utilizing a unique mounting system featuring two stainless steel claws for a fast and secure installation. Suitable for mounting within 3 feet of ground, and for all types of construction, including concrete pour installations. Refer to optional rough-in housing for concrete pour installations.
Weight: 2.5 lbs.
Rough-in dimensions: 9.5 " W x 3.25 " H x 4.2 " D.

Finish: Standard finish: Black RAL 9004, polyester powder coat with fine texture.
Optional finishes: White RAL 9016, polyester powder coat with fine texture.
Grey Metallic RAL 9007, polyester powder coat with fine texture.
Consult factory for special RAL color options. Specify finish.

Listing: **UL , c UL** listed for Wet locations.
ADA Compliant.
International Standards: IP55 dustproof/ jetproof.

Options: **697-8001:** Fusing (120V/ 277V). Specify.
Refer to mounting accessories for optional blockout for concrete pour installations.

Date: 10/15/04

ARCHITECTURAL LIGHTING
WALL LUMINAIRES/ RECESSED – TRO259

Product Specification

618-4630

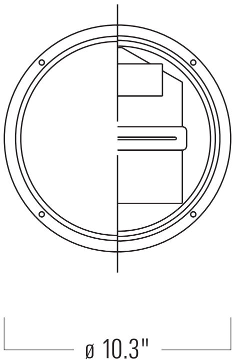
Compact fluorescent source.
Painted aluminium lens frame.
Opal lens.

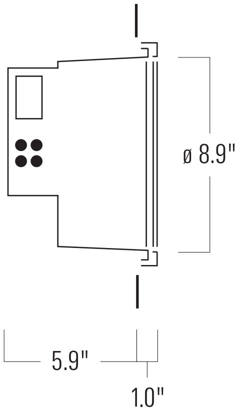
Project: William H. Gates Hall

Date:

Fixture Type: F5
WE-EF Cat. # : 615-1231
Voltage: 277
Finish: RAL 9004
Options:

Product ID. No.	Lamp/ base	Lumen
618-4630	CFQ18W / G24q-2	1200





Recessed wall luminaire with compact fluorescent lamp.

Materials: Luminaire body and frame constructed of die-cast marine grade aluminum alloy.
Opal UV-stabilized polycarbonate diffuser (inside textured).
Durable high-temperature silicone weatherproof gasket.
PCS coated stainless steel hardware.

Electrical: Two ½” conduit entries at bottom of luminaire body to facilitate thru-wiring capability. Maximum of four No. 12 AWG conductors. (plus ground). Suitable for 90 deg. C.
Integral electronic CF ballast for 120 or 277 volt – ***Specify Voltage.***
Compact fluorescent lamp holder: G24q-2 base, 4 pin, CFQ18 watt lamp required (lamp by others).

Mounting: Suitable for mounting within 3 feet of ground and for all types of construction, including concrete pour installations. Installation of housing using galvanized mounting straps included. Refer to optional rough-in housing for concrete pour installations. Weight: 9.0 lbs.
Rough-in dimensions: 9.25 “ diameter x 6.16 “ D.

Finish: Standard finish: Black RAL 9004, polyester powder coat with fine texture.
Optional finishes: White RAL 9016, polyester powder coat with fine texture.
Grey Metallic RAL 9007, polyester powder coat with fine texture.
Consult factory for special RAL color options. Specify finish.

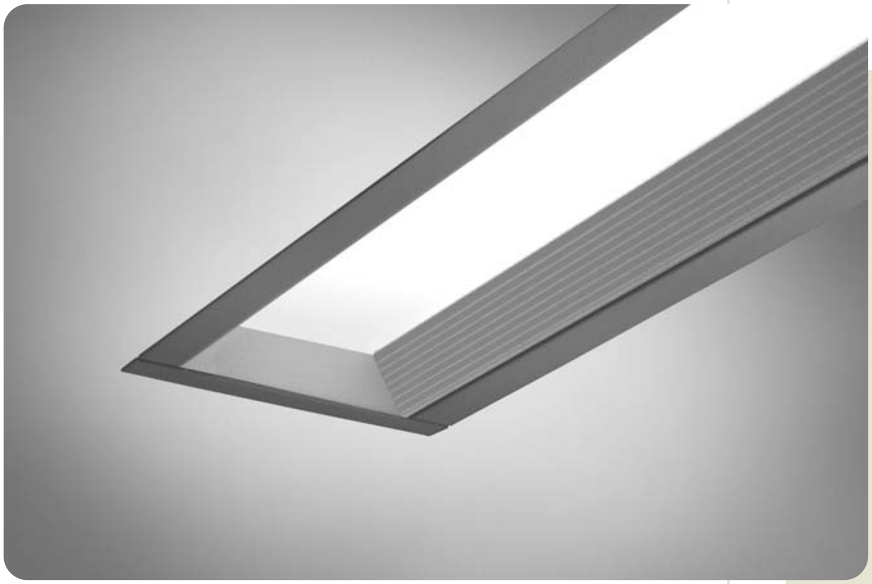
Listing: **UL , c UL** listed for Wet locations.
ADA Compliant.
International Standards: IP55 dustproof/ jetproof.

Options:
697-8001: Fusing (120V/ 277V). Specify.
618-9325: BTR25. Rough-in housing to serve as block-out for concrete pour installations. Specify.

Date: 10/15/04

FOCAL POINT®

avenue® b



FEATURES

Narrow 3" slot T5 fluorescent with opaque satin lens.

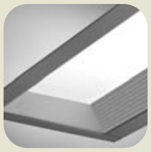
Shielding options include corrugated, solid regressed trim, concave louver as well as flush lens.

Universal mounting allows compatibility for multiple grid types.

Drywall installation is available, which allows for both individual or continuous row mount capability.

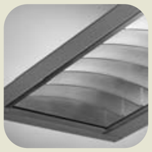
Avenue® B is a great solution for general illumination in a narrow aperture.

shielding options

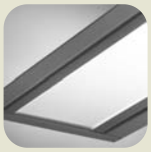


corrugated regress trim

solid regress trim

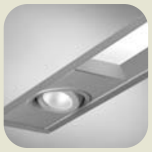


concave louver

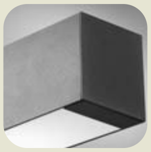


flush lens

companion luminaire



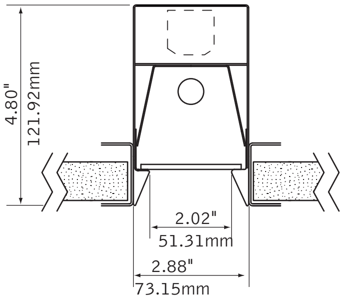
mr16



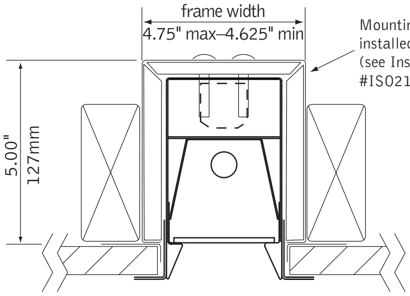
linear

DIMENSIONAL DATA

Grid Mount (Regress Trim Shown)

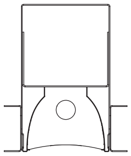


Drywall Flange (Regress Trim Shown)

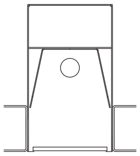


Mounting yoke must be installed before drywall. (see Instruction Sheet #IS0217 for details)

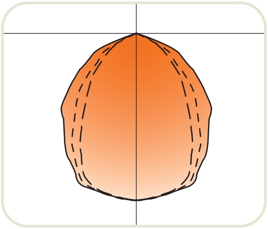
Louver



Flush Lens



PERFORMANCE



1–Lamp T5
62% Efficiency
1466 cd @ 0°

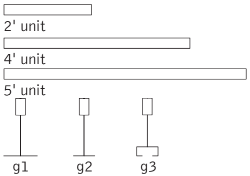
See **Photometric** section for additional performance data.

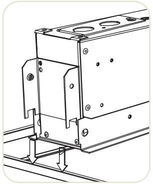
fixture type:

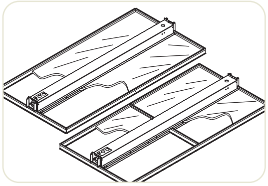
project name:

DETAILS

grid

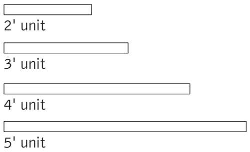






Luminaires cannot be installed in T-bar ceiling systems over 1.5".

drywall



Drywall flange version provided with mounting yoke.

SPECIFICATIONS

construction

One-piece 20 Ga. steel housing

Corrugated and solid regress trim constructed of 6063-T5 extruded aluminum finished in Matte Satin White.

Grid luminaires include 20 Ga. steel, .5" wide universal flange rail finished in Matte Satin White.

Drywall flange option is provided with 20 Ga. steel, .5" wide flange kit and 20 Ga. galvanized steel mounting yoke.

Surface mount 20 Ga. housing is also available.

2' unit weight:	5 lbs.
3' unit weight:	6 lbs.
4' unit weight:	7 lbs.
5' unit weight:	8 lbs.

optic

22 Ga. steel reflectors finished in High Reflectance White powder coat.

Acrylic lens diffuser .118" thick, frosted clear.

Concave parabolic louver: 1"H x 1" frequency fabricated of low iridescent, semi-specular premium grade aluminum.

Louver can be specified with matte white finish.

electrical

Luminaires are individually wired for specified circuits.

Thru-wiring not available.

Electronic ballasts are thermally protected and have a Class "P" rating.

Optional DALI and other dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

emergency

Emergency battery packs provide 90 minutes of illumination.

Initial lumen output for lamp types are as follows:

T5 Lamp:	Up to 550 lumens
T5HO Lamps:	Up to 825 lumens

Battery pack requires unswitched hot from same branch circuit as AC ballast.

finish

Polyester powder coat applied over a 5-stage pre–treatment.

Standard luminaire housing finished in Matte Satin White.

ORDERING

luminaire series

FAVB

Avenue B	FAVB

shielding

1T5

Corrugated Regressed Trim with Lens	CR
Solid Regressed Trim with Lens	SR
Flush Lens	FL
Concave Parabolic Louver	PL
White Concave Parabolic Louver	PW

lamping

277

One Lamp T5	1T5
One Lamp T5HO	1T5HO

circuits

1C

Single Circuit	1C

voltage

S

120 Volt	120
277 Volt	277
347 Volt	347

(Consult factory for availability)

ballast

Electronic Program Start <10% THD	S
Electronic Dimming Ballast	D

(Consult factory for dimming availability)

mounting

15/16" Grid	G1
9/16" Grid	G2
9/16" Slot Tee	G3
Drywall Flange	F

Cut out dimensions:
2': 3.5" x 23.6"
3': 3.5" x 35.6"
4': 3.5" x 47.6"
5': 3.5" x 59.6"

factory options

Chicago Plenum	CP
Emergency Circuit	EC
Emergency Battery Pack (3' & 4' Luminaires Only)	EM
Seismic Brackets	EQ
HLR/GLR Fuse	FU
Include 3000K Lamp	L830
Include 3500K Lamp	L835
Include 4100K Lamp	L841

4'

finish

WH

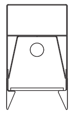
Matte White Housing	WH

luminaire length

2' Nominal Housing	2'
3' Nominal Housing	3'
4' Nominal Housing	4'
5' Nominal Housing	5'

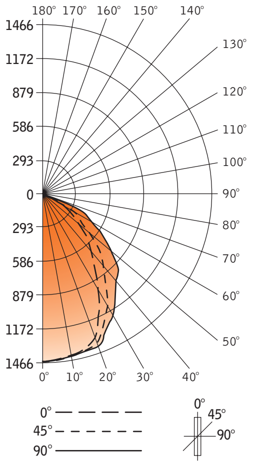
(Dimming not available with 5' lamps)
(For continuous row mount in drywall ceiling, specify luminaire run length, ie 24')

regress with lens
avenue® b



Filename: FAVBSR1T5HO.IES
Catalog #: FAVB-SR-1T5HO-1C-120-S-G1-WH-4'
Efficiency: 62%
Test #: 12914.0

CANDLEPOWER DISTRIBUTION



Spacing 1.2
Criterion: 1.1

Vertical Angle	0°	Horizontal Angle 22.5°	45°	67.5°	90°	Zonal Lumens
0°	1466	1466	1466	1466	1466	
5°	1457	1457	1456	1456	1456	139
15°	1432	1428	1417	1399	1393	401
25°	1311	1299	1254	1187	1150	575
35°	1102	1073	958	837	793	599
45°	934	866	701	586	553	565
55°	649	578	426	357	335	416
65°	404	328	232	187	174	257
75°	184	133	77	60	58	103
85°	39	21	19	18	17	24
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	1115	22.3	36.2
	0°-40°	1714	34.3	55.7
	0°-60°	2695	53.9	87.5
	0°-90°	3078	61.6	100.0
Total Luminaire	0°-180°	**3078**	**62**	**100.0**

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	16467	12359	9750
55°	14106	9259	7281
65°	11918	6844	5133
75°	8863	3709	2794
85°	5579	2718	2432

CO–EFFICIENTS OF UTILIZATION

Floor	20													
Ceiling	80				70			50		30		10		00
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00
RCR 0	73	73	73	73	72	72	72	68	68	65	65	63	63	62
1	68	66	64	62	67	65	61	62	59	60	57	58	56	54
2	63	59	56	53	62	58	52	56	51	54	50	52	49	48
3	59	53	49	46	57	52	45	51	45	49	44	48	43	42
4	54	48	43	40	59	47	40	46	39	45	39	43	38	37
5	50	43	38	35	49	42	34	41	34	40	34	39	33	32
6	46	39	34	31	45	39	30	37	30	36	30	36	30	29
7	43	35	31	27	42	35	27	34	27	33	27	32	26	25
8	40	32	27	24	39	32	24	31	24	30	23	29	23	22
9	37	29	24	21	36	29	21	28	21	27	21	27	20	19
10	34	26	22	19	33	26	19	25	18	25	18	24	18	17

Numbers indicate percentage values of reflectivity.

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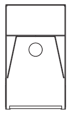
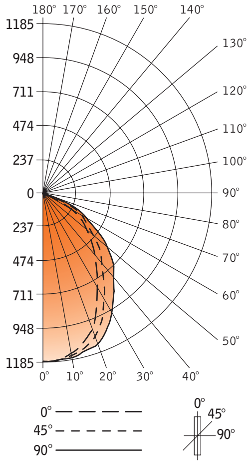
flush lens
avenue® b



Filename: FAVBFL1T5.IES
Catalog #: FAVB-FL-1T5HO-1C-120-S-G1-WH-4'
Efficiency: 51%
Test #: 12915.0

CANDLEPOWER DISTRIBUTION



Spacing 1.2
Criterion: 1.0

Vertical Angle	0°	Horizontal Angle 22.5°	45°	67.5°	90°	Zonal Lumens
0°	1187	1187	1187	1187	1187	
5°	1182	1182	1178	1176	1176	113
15°	1158	1150	1126	1102	1091	319
25°	1053	1030	696	914	891	450
35°	870	835	749	684	660	476
45°	706	660	571	516	498	455
55°	478	444	383	349	338	355
65°	291	269	234	218	213	242
75°	133	124	111	106	105	122
85°	28	29	28	28	28	31
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	881	17.6	34.4
	0°-40°	1357	27.1	53.0
	0°-60°	2168	43.4	84.6
	0°-90°	2561	51.2	100.0
Total Luminaire	0°-180°	**2561**	**51**	**100.0**

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	12448	10067	8780
55°	10390	8325	7347
65°	8584	6903	6283
75°	6406	5347	5058
85°	4005	4005	4005

CO–EFFICIENTS OF UTILIZATION

Floor	20													
Ceiling	80				70			50		30		10		00
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00
RCR 0	61	61	61	61	60	60	60	57	57	54	54	52	52	51
1	57	55	53	51	55	53	50	51	49	49	47	48	46	45
2	52	49	46	43	51	48	43	46	42	44	41	43	40	39
3	48	44	40	37	47	43	37	41	36	40	36	39	35	34
4	45	39	35	32	44	39	32	37	32	36	31	35	31	30
5	41	35	31	28	40	35	28	33	27	33	27	32	27	26
6	38	32	28	25	37	31	24	30	24	30	24	29	24	23
7	35	29	25	22	34	28	22	28	21	27	21	26	21	20
8	33	26	22	19	32	26	19	25	19	24	19	24	19	18
9	30	23	19	17	29	23	17	23	16	22	16	21	16	15
10	28	21	17	15	27	21	15	21	15	20	15	20	15	14

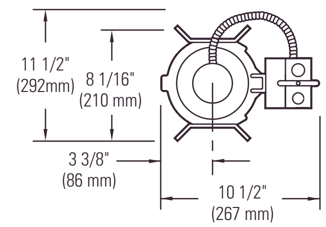
Numbers indicate percentage values of reflectivity.

Go to www.focalpointlights.com for additional photometric data.

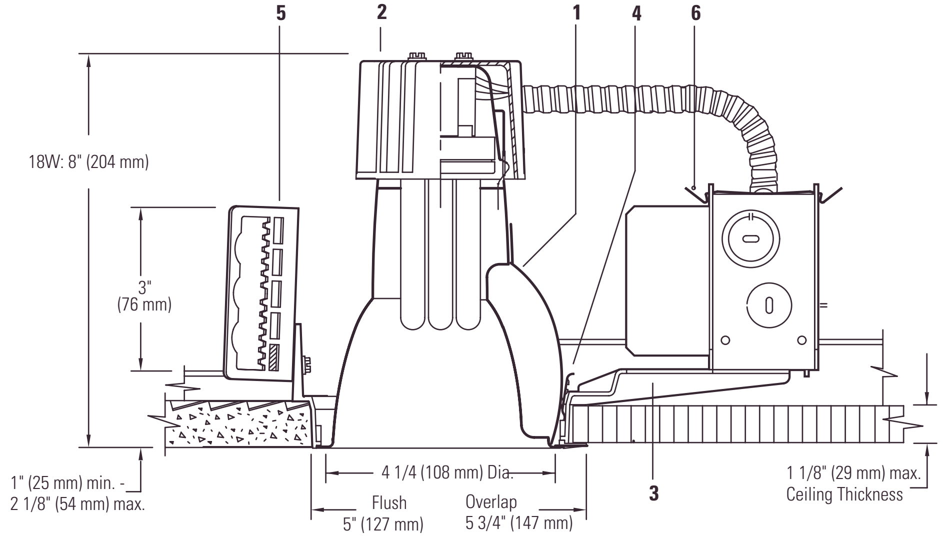
Calculite® Compact Fluorescent Open Wall Washer **8011WW**

Page 1 of 2

4” Aperture Triple Tube Vertical Lamp



Top View



Ceiling Cutout: 5 1/16” (129 mm) Dia.

Reflector Trim

8011WW CCLW	Comfort Clear™, White Flange
8011WW CCLP	Comfort Clear™, Polished Flange
8011WW CCL	Comfort Clear™, Molded Trim Ring
8011WW ☐	Add suffix. See options for other finishes.

Frame-In Kit

4118VU	Electronic	120V - 277V

Lamp

18W Triple Tube
4-Pin (Amalgam)

Features

1. **Downlight/Wall Washer Reflector:** 16 ga. Alzak® aluminum. 50° lamp cutoff and lamp image. Provides vertical surface wall wash and downlighting. Comfort Clear™ low iridescence finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Die-cast aluminum cup effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Die-cast aluminum for dry or plaster ceilings. Accepts other 4" triple tube reflectors.
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4” or 1 1/2” lathing channel, 1/2” EMT, or optional mounting bars.
6. **Ballast/J-Box:** Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools. Provides vertical surface wall wash and downlighting.

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **“Ballast”** specification sheet for complete electrical data.

UL Listed for through branch circuit wiring with max of (8) No. 12 AWG, 90°C supply conductors.

Options and Accessories

Comfort Clear™ Finishes[1]		**Other Finishes**	
Diffuse	**CCD**	White	**WH**
Champagne Bronze	**CCZ**		
Pewter	**CPW**		

[1] Specify desired flange
W White, **P** Polished
Blank - Molded Ring

Options and Accessories (continued)

Emergency	Add suffix **EM***
Chicago Plenum	Add suffix **LC**
Emergency Ltg. Kit	**FA EM3E*** **FA EM4E***
Fuse (Slow Blow)	Add suffix **F**

*See Spec. Sheets: FAEM

Mounting Bars & Accessories; see Specification Sheet MBA.
Sloped Ceiling Adapters; see Specification Sheet SCA.

IC Frame available; see **C4CFL18** Specification Sheet.

Labels

UL Listed for damp locations, I.B.E.W.

Alzak® is a registered trademark of ALCOA.
US Patent Pending.

Job Information **Type:** F8A

Job Name: William H. Gates Hall

Cat. No.: 8011WW CCLP

Lamp(s): 18W Triple Tube

Notes:

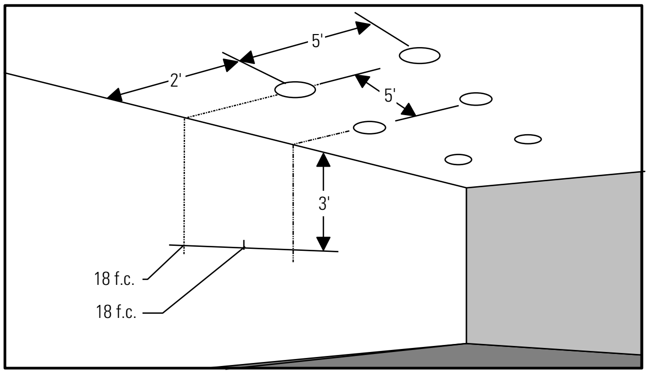
Lightolier a Genlyte Thomas Company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Calculite® Compact Fluorescent Open Wall Washer **8011WW**

4″ Aperture Triple Tube Vertical Lamp

Lighting Data

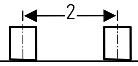
Footcandles On Wall: Multiple 18W Triple Tube Units



Example: With multiple clear reflector units located 2' from wall and spaced 2' on center (matching downlights 5' on center), the illumination on the wall 3' down from ceiling will be 14 f.c. beneath units and 18 f.c. between units.

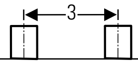
Footcandle values are averaged and rounded off and are based on a minimum of five units.

2′ From Wall-2′ On Center



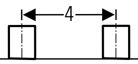
Distance From Ceiling in Feet			
1	14	12	14
2	17	16	17
3	$\boxed{18}$	$\boxed{18}$	$\boxed{18}$
4	16	16	16
5	12	12	12
6	10	10	10
7	7	7	7
8	6	6	6
9	4	4	4

2′ From Wall-3′ On Center



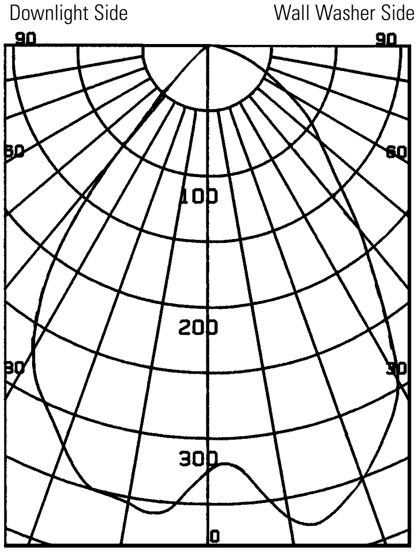
Distance From Ceiling in Feet			
1	11	6	11
2	14	9	14
3	12	12	12
4	10	11	10
5	8	8	8
6	7	7	7
7	5	5	5
8	4	4	4
9	3	3	3

2′ From Wall-4′ On Center



Distance From Ceiling in Feet			
1	11	3	11
2	13	5	13
3	11	7	11
4	8	8	8
5	6	6	6
6	5	5	5
7	4	4	4
8	3	3	3
9	3	3	3

Candlepower Distribution Downlight Spacing Ratio 1.3



Coefficients of Utilization

	% EFFECTIVE CEILING CAVITY REFLECTANCE															
	80			70			50			30			10			0
	WALL REFLECTANCE															
ROOM CAVITY RATIO	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.46	.45	.44	.45	.44	.43	.43	.43	.42	.42	.41	.41	.40	.40	.39	.39
2	.43	.41	.39	.42	.40	.39	.41	.39	.38	.39	.38	.37	.38	.37	.37	.36
3	.40	.37	.36	.39	.37	.36	.38	.36	.35	.37	.36	.34	.36	.35	.34	.33
4	.37	.35	.33	.36	.34	.33	.36	.34	.32	.35	.33	.32	.34	.33	.31	.31
5	.34	.32	.30	.34	.32	.30	.33	.31	.30	.32	.31	.29	.32	.30	.29	.28
6	.32	.30	.28	.32	.29	.28	.31	.29	.27	.31	.29	.27	.30	.28	.27	.26
7	.30	.27	.26	.30	.27	.25	.29	.27	.25	.28	.26	.25	.28	.26	.25	.24
8	.28	.25	.23	.27	.25	.23	.27	.25	.23	.27	.25	.23	.26	.24	.23	.22
9	.26	.23	.22	.26	.23	.22	.25	.23	.21	.25	.23	.21	.24	.23	.21	.21
10	.24	.22	.20	.24	.22	.20	.24	.21	.20	.23	.21	.20	.23	.21	.20	.19

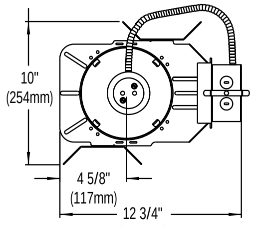
20% FLOOR CAVITY REFLECTANCE

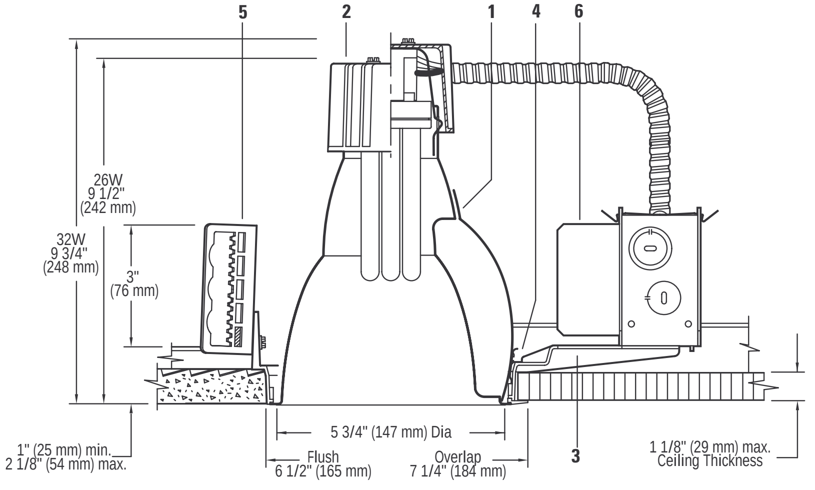
Job Information	**Type:** F8A

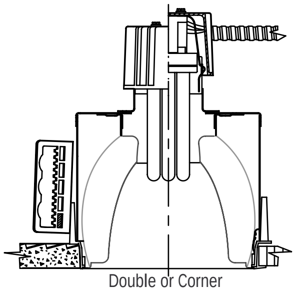
Lightolier a Genlyte Thomas Company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Calculite® Compact Fluorescent Open Wall Washer **8021WW**

6” Aperture Triple Tube Vertical Lamp







Double or Corner
Wall Washer

Ceiling Cutout: 6 9/16" (167mm) Dia.

Reflector Trim

Single Wall Washer	Double Wall Washer	Corner Wall Washer
8021WW CCLW Comfort Clear™, White Flange	**8021DW CCLW**	**8021CW CCLW**
8021WW CCLP Comfort Clear™, Polished Flange	**8021DW CCLP**	**8021CW CCLP**
8021WW CCL Comfort Clear™, Molded Trim Ring	**8021DW CCL**	**8021CW CCL**
8021WW ☐ Add suffix. See options for other finishes.		

Frame-In Kit

S6132BU	Electronic, 120V - 277V	
S6132BCU	Universal Dimming, 120V - 277V	
S6132BUM7	Advance Mark7, 120V - 277V	

Lamp

26 or 32W Triple Tube
4-Pin (Amalgam)

Features

1. **Downlight/Wall Washer Reflector:** 16 ga. Alzak® aluminum. 50° lamp cutoff and lamp image. Provides vertical surface wall wash and downlighting. Comfort Clear™ low iridescence finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Galvanized steel for dry or plaster ceilings. Accepts other 6” Triple Tube reflectors (see S6132BU Spec Sheet).
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4" or 1 1/2" lathing channel, 1/2" EMT, or optional mounting bars.
6. **Ballast/J-Box:** Electronic 120V-277V. UL listed for through branch circuit wiring with max of (8) No. 12AWG, 90°c supply conductors. Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools. Provides vertical surface wall wash and downlighting.

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **“Ballast”** specification sheet for complete electrical data.

Options and Accessories

Comfort Clear™ Finishes[1]		**Other Finishes**	
Diffuse	**CCD**	White	**WH**
Champagne Bronze	**CCZ**		
Pewter	**CPW**		

[1] Specify desired flange. **W** White, **P** Polished, Blank - Molded Ring

Other Dimming:

S6132BJ1MX	Advance MarkX, 120V	**S6132BJ1LD3**	Lutron Hi-lume®, 120V
S6132BJ2MX	Advance MarkX, 227V	**S6132BJ2LD3**	Lutron Hi-lume®, 227V

Options and Accessories (continued)

Emergency	Add suffix **EM***
Chicago Plenum	Use 6132BULC
Fuse (Slow Blow)	Add Suffix **F**
Emergency Ltg. Kit	**FA EM3E*** **FA EM4E***

*See Spec. Sheet: FAEM

Mounting Bars & Accessories; see Specification Sheet MBA.
Sloped Ceiling Adapters; see Specification Sheet SCA.

IC Frame available; see **C6CFL32** specification sheet.

Labels

UL Listed for damp locations.

Alzak® is a registered trademark of ALCOA.
US Patent Pending.

Job Information Type: F9

Job Name: William H. Gates Hall

Cat. No.: 8021WW CCLP

Lamp(s): CFTR32W

Notes:

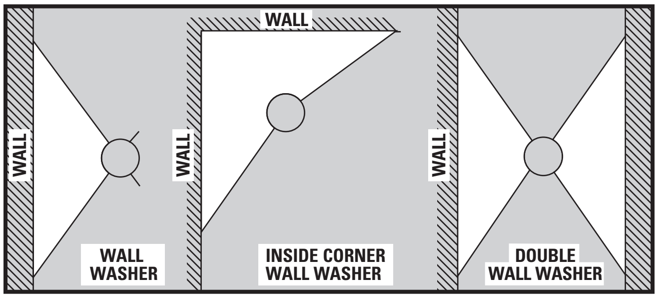
Lightolier a Genlyte Thomas Company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710
We reserve the right to change details of design, materials and finish.

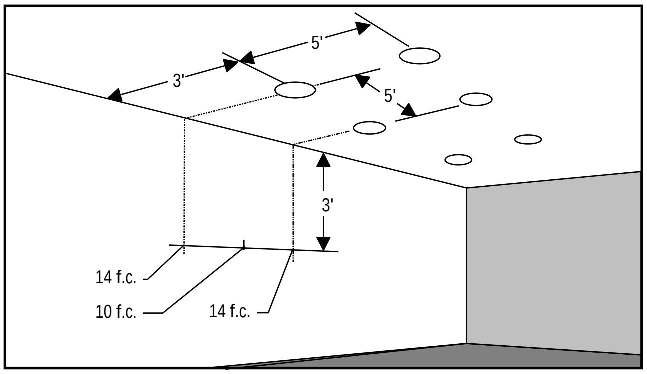
Calculite® Compact Fluorescent Open Wall Washer 8021WW

6” Aperture Triple Tube Vertical Lamp

Lighting Data

Footcandles On Wall: Multiple 32W Triple Tube Units





2′ From Wall-2′ On Center

Distance From Ceiling in Feet		2	
1	35	34	35
2	44	44	44
3	47	41	47
4	38	35	38
5	29	27	29
6	22	22	22
7	17	17	17
8	13	13	13
9	11	11	11

2′ From Wall-3′ On Center

Distance From Ceiling in Feet		3	
1	28	18	28
2	32	27	32
3	30	30	30
4	26	24	26
5	19	20	19
6	15	15	15
7	12	12	12
8	10	10	10
9	8	8	8

2′ From Wall-4′ On Center

Distance From Ceiling in Feet		4	
1	26	18	26
2	29	16	29
3	25	22	25
4	20	19	20
5	15	15	15
6	11	12	11
7	9	10	9
8	7	8	7
9	6	7	6

Example: With multiple clear reflector units located 3' from wall and spaced 5' on center (matching downlights 5' on center), the illumination on the wall 3' down from ceiling will be 14 f.c. beneath units and 10 f.c. between units.

Footcandle values are averaged and rounded off and are based on a minimum of five units.

Conversion Factor 26WTTT: (Clear), f.c. x 0.8.

3′ From Wall-3′ On Center

Distance From Ceiling in Feet		3	
1	11	11	11
2	18	18	18
3	20	20	20
4	22	19	21
5	20	18	20
6	17	16	17
7	15	13	14
8	12	11	12
9	11	10	10

3′ From Wall-4′ On Center

Distance From Ceiling in Feet		4	
1	9	8	9
2	14	13	14
3	16	15	16
4	16	16	16
5	15	14	15
6	13	12	13
7	11	11	11
8	10	9	10
9	8	8	8

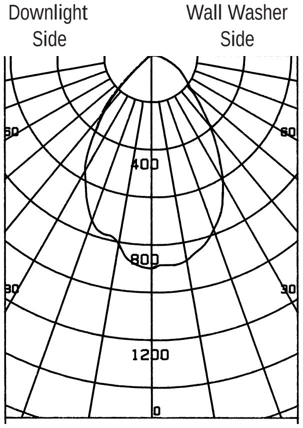
3′ From Wall-5′ On Center

Distance From Ceiling in Feet		5	
1	9	5	9
2	13	9	13
3	14	10	14
4	13	13	13
5	12	12	12
6	11	10	11
7	9	9	9
8	8	8	8
9	7	7	7

3′ From Wall-6′ On Center

Distance From Ceiling in Feet		6	
1	9	3	9
2	13	6	13
3	13	7	13
4	13	9	13
5	11	10	11
6	9	9	9
7	8	7	8
8	7	7	7
9	5	6	5

Candlepower Distribution Downlight Spacing Ratio 1.1



Coefficients of Utilization

% Effective Ceiling Cavity Reflectance

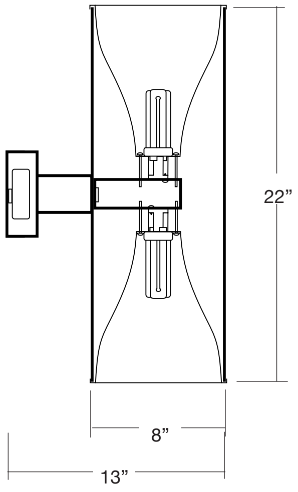
	80			70			50			30			10			0
	Wall Reflectance															
	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
Room Cavity Ratio 1	.58	.56	.55	.57	.55	.54	.54	.53	.53	.52	.52	.51	.51	.50	.49	.49
2	.53	.51	.49	.53	.50	.49	.51	.49	.48	.49	.48	.47	.48	.47	.46	.45
3	.49	.47	.45	.49	.46	.44	.47	.45	.44	.46	.44	.43	.45	.43	.42	.41
4	.46	.43	.41	.46	.43	.40	.44	.42	.40	.43	.41	.40	.42	.41	.39	.38
5	.43	.40	.37	.42	.39	.37	.41	.39	.37	.40	.38	.36	.40	.38	.36	.35
6	.40	.37	.34	.40	.36	.34	.39	.36	.34	.38	.36	.34	.37	.35	.33.	.33
7	.37	.34	.31	.37	.34	.31	.36	.33	.31	.35	.33	.31	.35	.32	.31	.30
8	.34	.31	.29	.34	.31	.29	.34	.31	.29	.33	.30	.28	.32	.30	.28	.28
9	.32	.29	.26	.32	.29	.26	.31	.28	.26	.31	.28	.26	.30	.28	.26	.25
10	.30	.27	.24	.30	.27	.24	.29	.26	.24	.29	.26	.24	.28	.26	.24	.23

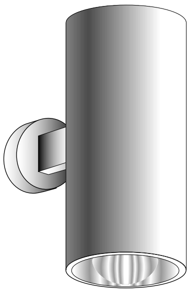
20% Floor Cavity Reflectance

Job Information	Type: F9

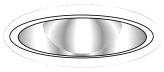
Lightolier a Genlyte Thomas Company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

8" CYLINDER VERTICAL LAMP UP/DOWNLIGHT

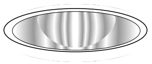




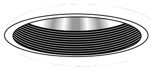
Wall mount
Cylinder



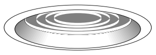
Clear Alzak®



Gold Alzak®



Black Baffle



Splay with
Fresnel Lens

SPECIFICATION INFORMATION

CYLINDER HOUSING

Wall mounted cylinder is constructed of seamless extruded aluminum with a powder coat finish. Fixture mounts to standard juction box.

REFLECTOR

Reflector is available in thirty degree cutoff **.30**. Finishes are Clear **A** or Gold **G** Alzak for anodized, specular, durable and anti-iridescent reflectors.

TRIM OPTIONS

B black baffle
G gold Alzak
SP splay fesnel lens

BALLAST

Electronic enclosed F-can, class P, HPF is supplied standard in 120V or 277V. Ballasts use 4 pin lamps and provide rapid start, .99 power factor with THD<10%.

ELECTRICAL

Ballast mounted in canopy for easy access. U.L. listed for use in damp locations. For wet locations fixture is provided with convex lens; specify **WL** .

ACCESSORIES

B black baffle
R retro-fit for existing cylinder (consult factory)
WL for wet location

FINISHES

BM brushed metal
BZ bronze
K black
W white

ORDERING INFORMATION

LAMP	120V ELECT.	277V ELECT.
2-18 18 watt quad tube	**CUV8218.1E** 18watt quad tube	**CUV8218.2E** 18watt quad tube
2-26 26 watt quad tube	**CUV8226.1E** 26watt quad tube	**CUV8226.2E** 26watt quad tube
2-32 32 watt triple tube	**CUV8232.1E** 32watt triple tube	**CUV8232.2E** 32watt triple tube
2-42 42 watt triple tube	**CUV8242.1E** 42watt triple tube	**CUV8242.2E** 42watt triple tube

SUBMITTAL INFORMATION

TYPE: F10

PROJECT: Gates Hall

NOTES:

DESCRIPTION: CUV8218.2E

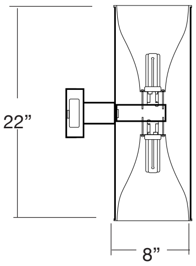
DELRAY
LIGHTING
INCORPORATED

CUV8200

BURBANK,
CALIFORNIA,
91505
WWW.
DELRAY
LIGHTING.
COM

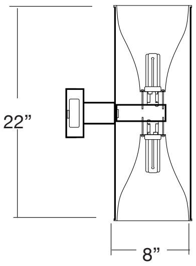
CLEAR ALZAK 30°

CUV8218



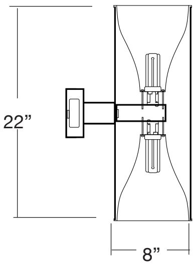
CLEAR ALZAK 30°

CUV8226



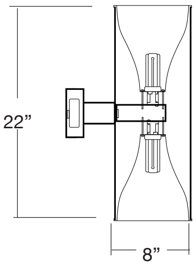
CLEAR ALZAK 30°

CUV8232



CLEAR ALZAK 30°

CUV8242



CONE OF LIGHT

MTG. HT.	FC/0•	DIA.
4’	65	3.7
6’	29	5.5
8’	17	7.3
10’	11	9.2
12’	8	11.0

50% FC at edge

MTG. HT.	FC/0•	DIA.
4’	81	3.7
6’	39	5.5
8’	19	7.3
10’	12	9.2
12’	9	11.0

50% FC at edge

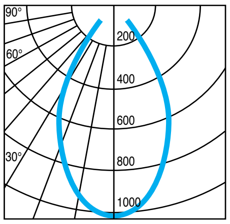
MTG. HT.	FC/0•	DIA.
4’	95	4.2
6’	42	6.4
8’	24	8.5
10’	15	10.7
12’	11	12.8

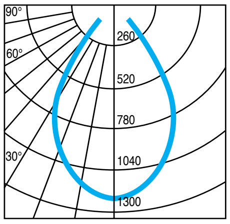
50% FC at edge

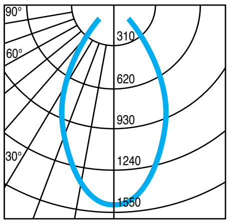
MTG. HT.	FC/0•	DIA.
4’	123	4.3
6’	54	6.6
8’	31	8.8
10’	19	10.9
12’	14	12.9

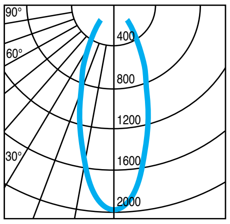
50% FC at edge

CP DISTRIBUTION









COEFFICIENTS OF UTILIZATION

% CEILING 80	**(20% FLOOR)**		
% WALL	**70**	**50**	**30**
0	75	75	75
1	72	71	70
2	70	67	65
3	67	64	61
4	64	60	58
5	62	57	54
6	59	55	52
7	57	52	49
8	54	49	46
9	52	47	43
10	50	44	41

% CEILING 80	**(20% FLOOR)**		
% WALL	**70**	**50**	**30**
0	71	71	71
1	69	67	66
2	66	63	61
3	63	60	57
4	61	57	54
5	58	53	50
6	55	51	48
7	53	48	45
8	50	45	42
9	48	43	39
10	46	40	37

% CEILING 80	**(20% FLOOR)**		
% WALL	**70**	**50**	**30**
0	84	84	84
1	80	78	77
2	77	74	71
3	73	69	66
4	70	65	62
5	67	61	57
6	63	58	54
7	60	54	50
8	57	50	46
9	54	47	43
10	51	44	40

% CEILING 80	**(20% FLOOR)**		
% WALL	**70**	**50**	**30**
0	79	79	79
1	76	74	73
2	73	70	67
3	69	66	63
4	66	62	58
5	63	58	55
6	60	55	51
7	57	51	48
8	54	48	44
9	51	45	41
10	49	42	39

NOTES

CUV8218
1-18 watt quad tube
G24q-2 electronic socket
Total lumens-1250
Spacing criteria-.9
Gold Alzak x.90

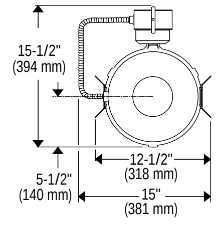
CUV8226
1-26 watt quad tube
G24q-3 electronic socket
Total lumens-1800
Spacing criteria-.9
Gold Alzak x.90

CUV8232
1-32 watt triple tube
G24q-3 electronic socket
Total lumens-2400
Spacing criteria-.9
Gold Alzak x.90

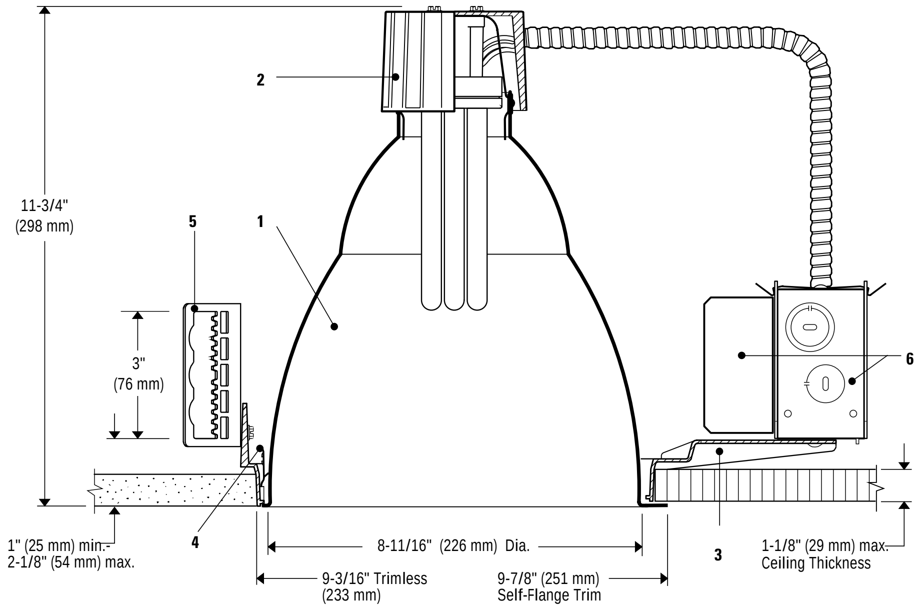
CUV8242
1-42 watt triple tube
G24q-4 electronic socket
Total lumens-3200
Spacing criteria-.9
Gold Alzak x.90

Calculite® Compact Fluorescent Open Downlight **8023**

8 3/4" Aperture Triple Tube Vertical Lamp



Top View



Ceiling Cutout: 9 1/4" (235 mm) Dia.

Reflector Trim

8023 CCLW	Comfort Clear™, White Flange
8023 CCLP	Comfort Clear™, Polished Flange
8023 CCL	Comfort Clear™, Molded Trim Ring
8023 ☐	Add suffix. See options for other finishes.

Frame-In Kit

Note: Add **S** for Steel frame: ex. **S8142VU -** Steel Frame
Without **S**- Die Cast: ex. **8142VU -** Die Cast

			Lamp
S8142VU	Electronic	120V - 277V	**42W Triple Tube**
S8142VCU3	PowerSpec® Dimming	120V - 277V	4-Pin (Amalgam)

Remodeler Frame-In Kit

			Lamp
8142VURM	Electronic	120V - 277V	Same as 8142VU

Features

1. **Reflector:** 16 ga. Alzak® aluminum, 50° visual cutoff to lamp and lamp image, medium distribution. Comfort Clear™ low iridescence finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Die-cast aluminum cup effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Die-cast aluminum for dry or plaster ceilings.
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4" or 1 1/2" lathing channel, 1/2" EMT, or optional mounting bars.
6. **Ballast/J-Box:** Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools.

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **"Ballast"** specification sheet for complete electrical data.

8142VU, 8142VCU: UL listed for through branch circuit wiring with max of (8) No. 12 AWG, 90° C supply conductors.

8142VURM: UL listed for No. 12 AWG, 90° C supply conductors.

Options and Accessories

Comfort Clear™ Finishes[1]

Diffuse	**CCD**
Champagne Bronze	**CCZ**
White	**WH**

[1] Specify desired flange
W White, **P** Polished
Blank - Molded Ring

Options and Accessories (continued)

Emergency	Add suffix **EM***
Chicago Plenum	Add suffix **LC**
Emergency Ltg. Kit	**FA EM3E***
	FA EM4E*
Fuse (Slow Blow)	Add suffix **F**

*See Spec. Sheets: FAEM

Mounting Bars & Accessories; see Specification Sheet MBA. Sloped Ceiling Adapters; see Specification Sheet SCA.

Labels

UL listed for damp locations.

Alzak® is a registered trademark of ALCOA.
US Patent Pending

Job Information Type: F11

Job Name: William H. Gates Hall

Cat. No.: 8023 CCLP

Lamp(s): 42W Triple Tube

Notes:

Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

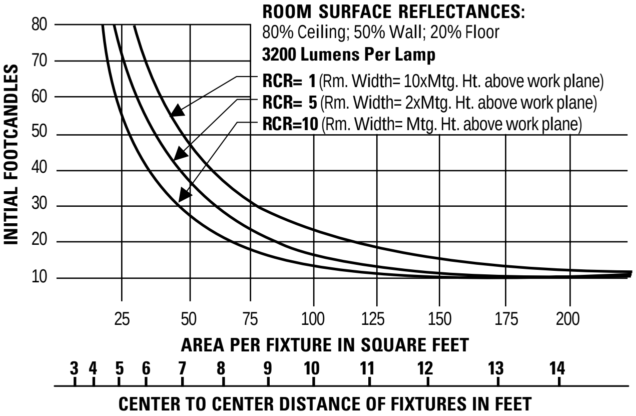
We reserve the right to change details of design, materials and finish.

LIGHTOLIER®

Calculite® Compact Fluorescent Open Downlight **8023**

8 3/4” Aperture Triple Tube Vertical Lamp

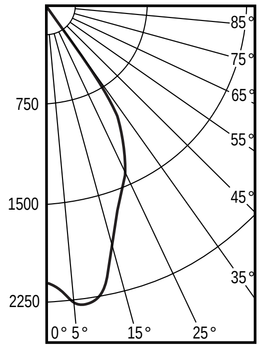
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt. 42W PL-T units with clear reflector, for any level of illumination.

Spacing Ratio = 0.9

CERTIFIED TEST REPORT NO. 0701FR
COMPUTED BY LSI PROGRAM **TEST LITE**
CALCULITE 8 3/4” DIA. APERTURE RECESSED
COMPACT FLUORESCENT OPEN DOWNLIGHT.
COMFORT CLEAR™ REFLECTOR 1-42W PLT TRIPLE
TUBE LAMP. LUMEN RATING = 3200 LMS.



EFFICIENCY=63.1%

DATE: MAR. 31, 99

TESTED ACCORDING TO IES PROCEDURES. TEST DISTANCE EXCEEDS FIVE TIMES THE GREATEST LUMINOUS OPENING OF LUMINAIRE.

CANDLEPOWER SUMMARY

ANGLE	MEAN CP	LUMENS
0	1982	
5	2098	196
10	2051	
15	1817	510
20	1507	
25	1323	610
30	1124	
35	830	511
40	470	
45	211	180
50	36	
55	6	11
60	3	
65	1	1
70	0	
75	0	0
80	0	
85	0	0
90	0	

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	1316	41.14	65.17
0-40	1827	57.11	90.47
0-60	2018	63.08	99.93
0-90	2019	63.12	100.00
40-90	192	6.02	9.53
60-90	1	.04	.07
90-180	0	.00	.00
0-180	2019	63.12	100.00

Coefficients Of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

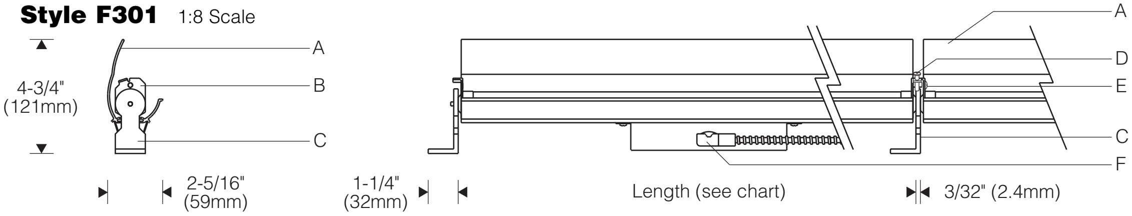
	80			70			50			30			10			
	WALL REFLECTANCE															
ROOM CAVITY RATIO	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.71	.69	.68	.69	.68	.67	.67	.66	.65	.64	.64	.63	.62	.62	.61	.60
2	.67	.64	.62	.65	.63	.62	.63	.62	.60	.62	.63	.59	.60	.59	.58	.57
3	.63	.60	.58	.62	.59	.57	.60	.58	.56	.59	.57	.56	.57	.56	.55	.54
4	.59	.56	.54	.59	.56	.54	.57	.55	.53	.56	.54	.52	.55	.53	.52	.51
5	.56	.53	.50	.55	.52	.50	.54	.52	.50	.53	.51	.49	.52	.50	.49	.48
6	.46	.43	.42	.52	.49	.47	.51	.49	.47	.51	.48	.46	.50	.48	.46	.45
7	.44	.41	.39	.49	.46	.44	.49	.46	.44	.48	.45	.43	.47	.45	.43	.42
8	.41	.39	.37	.46	.43	.41	.46	.43	.41	.45	.43	.41	.45	.42	.40	.40
9	.39	.36	.35	.44	.41	.38	.43	.40	.38	.43	.40	.38	.42	.40	.38	.37
10	.35	.32	.31	.41	.38	.36	.41	.38	.36	.40	.37	.35	.40	.37	.35	.35

Job Information	Type: F11

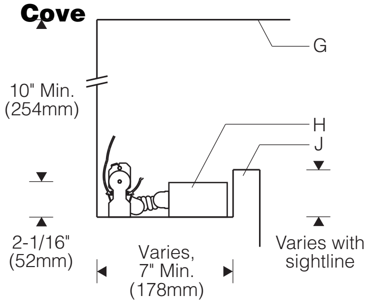
Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710
We reserve the right to change details of design, materials and finish.

Style 301

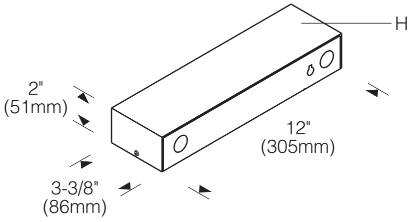
Style F301 1:8 Scale



Cove



Remote Ballast



Lamp Length	*Luminaire Length*
1 x 2'	24-1/2" (622mm)
1 x 3'	36-1/2" (927mm)
1 x 4'	48-1/2" (1231mm)
1 x 5'	60-3/8" (1533mm)
2 x 3'	73" (1854mm)
2 x 4'	97" (2464mm)
2 x 5'	120-3/4" (3067mm)

Note: Finish interior of cove matte white for best results.

Specifications

A Specular extruded aluminum reflector

B Stainless steel lamp-holder/support brackets

C Aluminum L-shaped mounting brackets

D Rotation locking screw

E Joiner/alignment screw

F Flexible metal conduit with 90° connector

G Ceiling

H Remote ballast in aluminum enclosure

J Architectural cove (for design guidance, see Applications Section)

Finish:
Reflector - extruded high purity aluminum with clear anodized specular finish. Mounting brackets and ballast enclosure - mill finish aluminum. All luminaire hardware - stainless steel.

Mounting:
L-shaped mounting brackets can be base or wall mounted. Two brackets are supplied for each reflector. Reflectors can be mounted individually or joined together to form a continuous row. When mounted in a row, one bracket supports adjacent reflectors for minimum spacing.

Reflector aiming is adjustable and is fixed in position by rotation locking screws at each mounting bracket. When mounted in a continuous row, joiner screws lock reflectors together allowing all in the row to be aimed together.

Standard:
UL listed or CSA certified for damp locations.
(Style 151 smooth painted model with gasketed lens recommended for damp location use; see Outdoor Section.)

Electrical:
Use 90°C wire for supply connections. 5' (1.5m) wire leads exit center of reflector. 90° connector and 4' (1.2m) of flexible metal conduit are provided. Connector can be reversed in field from front of reflector to back.

Remote electronic HPF thermally protected class P ballast. Aluminum ballast enclosure includes four 7/8" diameter entries and a knockout for an accessory fuse. **Maximum wire length between electronic ballast and fixture is 12' for two-lamp reflectors and 15' for one-lamp reflectors.** Magnetic ballast is available for remote distances up to 55'.

Optional electronic dimming ballast dims to 5% of full light output. **Maximum wire length between dimming ballast and fixture is 1' for two-lamp reflectors and 4' for 1-lamp reflectors.** Compatible dimmer switch is required (by others). Consult local sales representative for specifications.

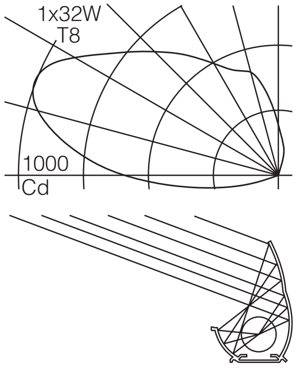
For complete ballast specifications, see Accessories Section.

Features

- *Compact and flexible - effective indirect cove lighting for malls, offices, lobbies, conference rooms and corridors*
- *Adjustable - all reflectors in a row join and aim together; rotation locking screws secure position*
- *Create rows of any length - modules from 2' to 10'*
- *Durable - all parts are aluminum or stainless steel*

Performance

Two parabolic reflector sections drive light across the ceiling from one edge. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



For complete photometrics, visit www.elliptipar.com

To Order

Style 301

To form a Catalog Number

1	2	3	4	5	6	7	8
F	3 0 1	A132	S	0 0	2	00	0

1 Source

F = Linear fluorescent

2 Style

301 = Small concealed, **remote** ballast

3 Lamp

Note: To order by overall row length, enter **ROW CODE** in place of Lamp Code below (see Row Charts on page C-11.2). Row Code specifies a row complete with all necessary reflectors, brackets and remote ballasts

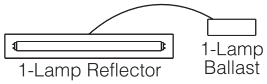
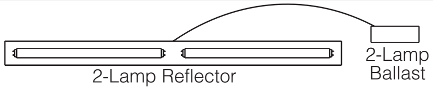
A 1 32 = **Lamp Code** (to specify individual units)

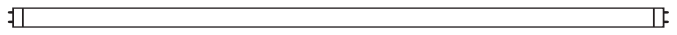
Lamp Wattage (see chart below)

Reflector Configuration, specify **1**, **2** or **3** (see chart below)

Example: **A232** = two 32W T8 lamps in nominal 8' reflector; one 2-lamp ballast

Reflector Configuration

1	
2	
3	

Lamp Wattage	*Lamp Length*	*Lamp Number*
T8 Fluorescent		
17	2'	F17T8
25	3'	F25T8
32	4'	F32T8
40	5'	F40T8

For complete lamp and ballast information, see Accessories Section. T8 lamps by others.

Project: William H. Gates Hall

4 Mounting

S = L-shaped brackets for wall or base mounting

5 Finish

00 = Bright anodized reflector; mill finish brackets and ballast enclosure

6 Voltage/Ballast

Electronic	*Dimming**
1 = 120V	**T** = 120V
2 = 277V	**V** = 277V
3 = 347V (Canada)	

* Dimming available for 3' F25T8 and 4' F32T8 (lamp codes **A125**, **A225**, **A132** and **A232**). For other T8 lamp lengths, consult sales representative. Dimming not available for Reflector Configuration **3**.

7 Option (see Accessories Section for specifications)

00 = No options
0E = Remote emergency battery pack. Consult factory if dimming is also required.
0Y = Modified to comply with New York City code
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Example

F301 - A225 - S - 00 - 1 - 000

Small concealed fluorescent unit consisting of one nominal 6' reflector for use with two 25W T8 lamps. Remote 120V electronic 2-lamp ballast. L-shaped mounting brackets. UL.

Type: F12

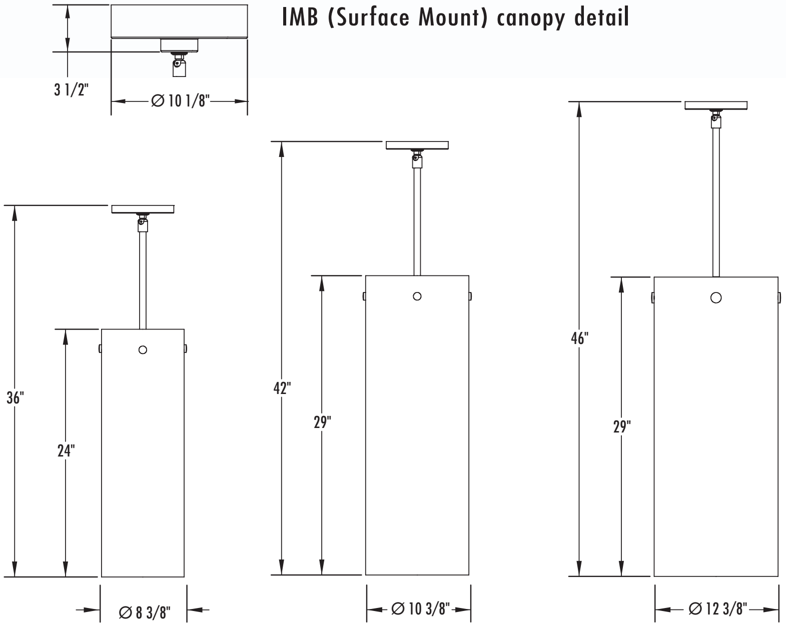
Accessories

Order separately. See Accessories Section for specifications.

AFK000X ☐ = Ballast **fuse** kit
0 = UL
J = CSA

elliptipar
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **www.elliptipar.com**

IMB (Surface Mount) canopy detail



FIXTURE: F13

5400
BADE

SUBMITTAL SPECIFICATIONS:

5400 -	-	-	-	-	-	-
CATALOG NUMBER	LAMPING	VOLTAGE	LENS OPTION	FINISH	BALLAST	SPECIAL

PRODUCT SPECIFICATIONS:

Catalog#:	**5400-8, 5400-10, 5400-12**		
Lamping:	5400-8*	**F -**	(2) FT39W/2G11
		F/H75-	(2) FT39W/2G11 and (1) 75W Par 38 Halogen Downlight
		F/MH70-	(2) FT39W/2G11 and (1) 70W Par 38 Metal Halide Downlight
	5400-10	**F -**	(4) FT40W/2G11
		F/H100-	(4) FT40W/2G11 and (1) 100W Par 38 Halogen Downlight
		F/MH100-	(4) FT40W/2G11 and (1) 100W Par 38 Metal Halide Downlight
	5400-12	**F -**	(4) FT50W/2G11
		F/H250-	(4) FT50W/2G11 and (1) 250W Par 38 Halogen Downlight
		F/MH100-	(4) FT50W/2G11 and (1) 100W Par 38 Metal Halide Downlight
Voltage:		**120V or 277V**	(when using Halogen Downlight 120V only)
Lens Option:		**OA-**	Extruded Opal Acrylic – Etched (Shown)
FAH is our Hand Painted Acrylic. See page 13 for an example or visit our website for more information.		**FAH4-**	White Vein Hand Painted Faux Alabaster
		FAH5-	Antique (Beige) Hand Painted Faux Alabaster
		FAH6-	Gray Vein Hand Painted Faux Alabaster
		FAH7-	Beige Vein Hand Painted Faux Alabaster
Finishes:	Standard	**PB-**	Polished Brass (Shown)
		PN-	Polished Nickel
		SGW-	Semi Gloss White
	Custom	**CPF-**	Custom Painted Finish (Consult Factory)
		CMF-	Custom Metal Finish (Consult Factory)
Ballast:	Metal Halide	**IMB-**	Integral Electronic (See Surface Mount Canopy Detail)
		RMB-	Remote Mount Magnetic
	Fluorescent**	**DIM-**	Dimming (Lutron ECO 10)
	Fluorescent/Metal Halide**	**DIM/IMB-**	Dimming (Lutron ECO 10) / Integral Electronic (See Surface Mount Canopy Detail)
		DIM/RMB-	Dimming (Lutron ECO 10) / Remote Mount Electronic
Special:		**STD-**	Standard
		MOD-	Modified Standard
Weight:		**F-**	**8-** 10 lbs. **10-** 15 lbs. **12-** 25 lbs.
		F/H-	**8-** 12 lbs. **10-** 18 lbs. **12-** 28 lbs.
		F/MH-	**8-** 20 lbs. **10-** 25 lbs. **12-** 35 lbs.

*** Dimming NOT Available for 5400-8** **** Dimming option for Fluorescent lamps only.**

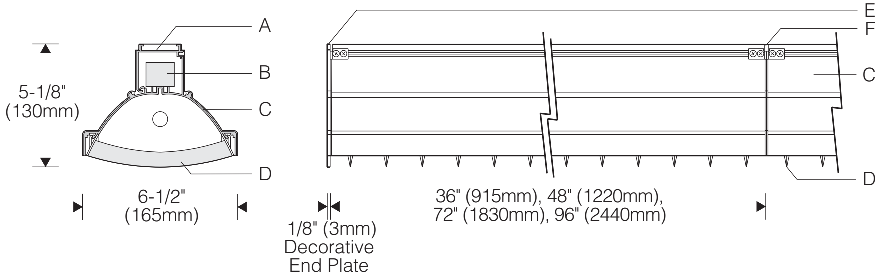
Lutron ECO-10 ballast's offer 100% to 10% dimming. ECO-10 ballast's are fully compatible with Lutrons complete line of 3-wire fluorescent controls.

5250 / CISCO COMPLIMENTARY WALL BRACKET - SEE PAGE 14 FOR BRACKET SPECIFICATIONS

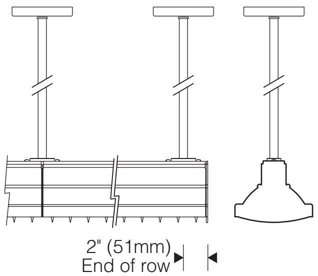
T5 Fluorescent

30|30 STACK LIGHT™ Style 3030

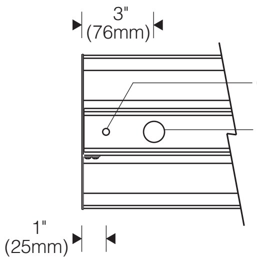
Style 3030 1:8 Scale



Pendant Stems (X mount)

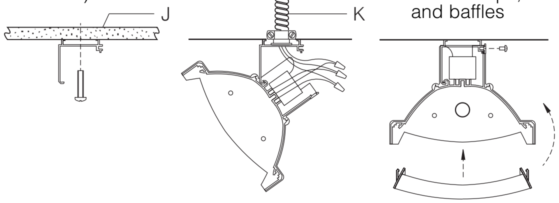


Top View (S mount)

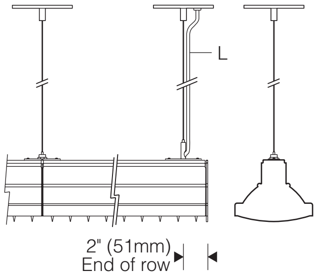


Installation (S mount)

1. Secure mounting plate to ceiling (fasteners by others)
2. Hang housing, connect supply
3. Hinge up, secure with screws. Install lamps, and baffles



Cables (X mount)



Specifications

A	Extruded aluminum mounting plate
B	Electronic ballast
C	Specular extruded aluminum reflector housing
D	Snap-in semi-specular parabolic cross-baffle, blades 1-1/2" o.c., 25° shielding
E	Aluminum decorative end plate (3 profiles - order separately)
F	Aluminum joiner/ reveal plates
G	Mounting holes, 9/32" (7mm) dia. (**S** mount)
H	Knockout, (2) 7/8" (22mm) dia. (**S** mount)
J	Structure, fasteners (by others)
K	Conduit, connector (by others)
L	18/3 cord with cable clips (cable mount)

Finish:
Painted surfaces - 6 stage pretreatment and electrostatically applied thermoset powder coat for stable, long lasting and corrosion resistant finish.

Reflector - extruded high purity aluminum with clear anodized specular finish. All luminaire hardware - stainless steel.

Cross-baffle - injection molded high-impact polycarbonate with metalized semi-specular finish.

Mounting:
S mount - mounting plate fastens flush to ceiling. Unit hinges on plate for hands-free access to wiring.

X mount - stems, cables **ordered separately**

Pendant stem - 11/16" O.D. aluminum, internally threaded. 5" dia. aluminum canopy.

Cable - 1/16" dia. 7x7 aircraft cable, field adjustable length. Crossbar with 1/4-20 stud and 5" dia. canopy.

When mounted in rows, clips are provided to align and space the mounting plates.

For bridge mount (shelf supported), consult factory.

Electrical:
Use 90°C wire for supply connections and through wire.

S mount - 7/8" (22mm) dia. knockouts at ends of mounting plate for conduit feed (by others).

X mount - electrical feed hanger mounts over recessed outlet box (by others) and **must be located at end of row**.

Housing hinges down for access to ballast and wiring. Optional #14 AWG prewired modular through wiring with quick connectors.

Integral electronic HPF thermally protected class P ballast with end-of-life protection.

Optional integral emergency battery operates one lamp. Separate unswitched supply is required.

Standard:
UL listed or CSA certified.

REV. 2/06 **Patents Pending**

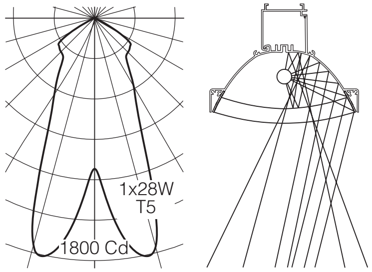
Features

- *Single T5 exceeds IESNA recommended light level - 30fc vertical at 30" AND complies with energy standards*
- *Precise extruded reflector drives light to the bottom shelf - maximizes visibility of books and shelf utilization*
- *Parabolic cross-baffle - 25° lengthwise shielding*
- *Electronic ballast - programmed start for long life*

S
1.0

Performance

Multiple reflector segments drive light to the lowest shelves. Unique cross-baffle redirects a portion of the lamp energy that otherwise goes directly to the floor back into the main beam while providing lengthwise shielding. The result is high beam efficiency and superior surface uniformity in tall, narrow stacks.



For complete photometrics, visit www.elliptipar.com.

elliptipar

To Order

30|30 STACK LIGHT™ Style 3030

To form a Catalog Number

3 0 3 0 -	T 128 -	X -	02 -	2 -	00 -	0
1	2	3	4	5	6	7

1 Style

3030 = Stack light, integral ballast

2 Lamp

T ___ ___ = **T5 Fluorescent Lamp Code**

Lamp Wattage (see chart below)

Number of Lamps in Length, specify **1** or **2**

Example: **T228** = 8' (2.4m) housing with two 28W T5 lamps

Lamp Code	*Length*	*Lamps*
T5 Fluorescent		
T121	36" (915mm)	1 x F21T5
T128	48" (1220mm)	1 x F28T5
T221	72" (1830mm)	2 x F21T5
T228	96" (2440mm)	2 x F28T5

For complete lamp and ballast information, see Accessories Section. Standard T5 lamp color is 3000K / 80+ CRI.

3 Mounting

S = Ceiling (surface) mount
X = For use with pendant stem or cable hangers
Note: Order hangers separately

For bridge mount (shelf supported) consult factory.

4 Finish

02 = Semi-gloss white
99 = Custom RAL or computer matched color to be specified, consult sales representative

5 Voltage/Ballast

Electronic
1 = 120V
2 = 277V

For 347V (Canada), consult factory.

6 Option (See Accessories Section for specifications)

00 = No option
0E = Integral emergency battery pack with indicator lamp and test button. Operates one lamp. **Note:** For **X** mount, order one additional electrical feed stem or cable for unswitched feed to battery.
0K = Prewired modular #12 AWG thru wiring w/ connectors
XX = For modification not listed, include detailed description. Consult factory prior to specification.

Project: William H. Gates Hall

7 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Example

3030 - T228 - X - 02 - 1 - 0K0

Stack light for use with two 4' F28T5 lamps. 96" long housing (not including decorative end plates). For use with pendant stem or cable hangers (order separately). Semi-gloss white. Integral 120V electronic 2-lamp ballast. UL. Optional modular wiring. Order decorative end plates separately.

If cable mounted (up to 48"), order (1) VER02480 non-electrical plus (1) VES02480 electrical feed hanger. For each additional unit in a row, order (1) additional VER02480 non-electrical hanger. See Hangers.

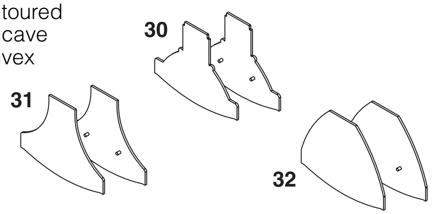
Accessories

Order separately. See Accessories Section for specifications.

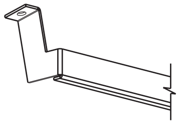
ADE ___ ___ **0** = **Decorative end plates**, pair, white, or custom color to match housing. **Note**: required for each row or single unit. Adds 1/4" (6mm) to length.

4

30 = Contoured
31 = Concave
32 = Convex



ARS30 ___ **0** = **Roomside shield,** increases crosswise shielding from 25° to 35° (for end stack) attaches internally alongside lamp. Consult factory for additional information.



36 = 36" (T121 lamp)
48 = 48" (T128 lamp)
72 = 72" (T221 lamp)
96 = 96" (T228 lamp)

AFK000X ___ = Ballast **fuse** kit

0 = UL
J = CSA

Type: F14

Hangers

Order separately. See Accessories Section for specifications.

Singles - order one non-electrical and one electrical feed hanger for each unit (**X** mount).

Rows - order one non-electrical hanger for each unit (**X** mount) plus one electrical feed for each row.

Note: For each single or row with emergency battery (option code **0E**), order one additional electrical feed and subtract one non-electrical hanger.

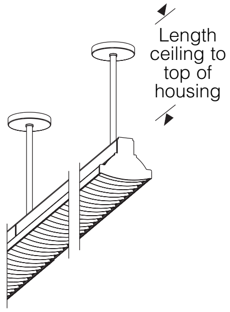
Electrical feed(s) must be located at an end of row.

VE ___ ___ ___ **0** = **Pendant stem**, 11/16" O.D.

Length in inches, up to 60" (1.5m), 6" minimum

02 = White
99 = Custom RAL or computer matched color to be specified, consult sales representative

F = Non-electrical
G = Electrical feed, with (3) #14 AWG leads

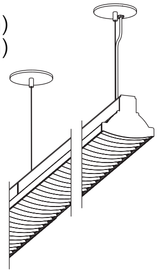


VE ___ ___ ___ **0** = **Cable support**, field adjustable

48 = up to 48" (1.2m)
96 = up to 96" (2.4m)

02 = White canopy, cord
99 = Custom RAL or computer matched color to be specified, consult sales representative

R = Non-electrical
S = Electrical feed, 18/3 cord



Drive over luminaires for special applications

Type: M1
BEGA Product #: 8853MH
Project: WILLIAM H. GATES HALL
Voltage: 277
Color:
Options:
Modified:

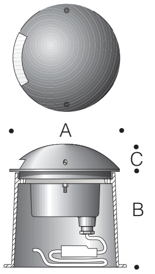
Outer housing: Constructed of high tensile strength, copper free die cast aluminum alloy.
Inner housing: Constructed of copper free die cast aluminum alloy, die cast aluminum clamping ring/cover/guard, removable for relamping, secured together with four (4) heavy stainless steel bolts which provide a pressure seal to gasket and glass. Two (2) captive socket head stainless steel screws secure inner housing cover to outer housing.
Enclosure: One piece heavy die cast aluminum cover with clear borosilicate focusing lens with cast aluminum guard. Molded, one piece, high temperature silicone rubber gasket.

Electrical: G 8.5 porcelain bi-pin lampholder with stainless steel contacts. Magnetic HPF ballast available 120V or 277V - specify.
Inner housing pre-wired with three (3) feet of 18/3 waterproof cable, cable clamp, and waterproof cable gland entry into housing. A separate waterproof wiring box for power supply must be provided (by contractor).

Finish: Standard finish is an eight step process consisting of two coats of gray high solids, UV stabilized polyurethane, one with light texture over a phosphate base. Custom colors are not available.

U.L. listed, suitable for wet locations and vehicle drive over.
Protection class: IP 67.

Luminaires are designed to withstand loads of up to 8,800 lbs. at speeds up to 12 mph when installed on a proper foundation. Proper drainage must be provided.



High strength aluminum alloy, stainless steel, and bronze construction. Optical lens made from clear borosilicate glass. U.L. listed, suitable for wet locations. IP 67.
Finish: Gray.

		Lamp	Lumen	A	B	C
8853MH	Single 60°	1 39W T4 G8.5	3300	8 11/16	6 7/8	2 3/16

BEGA/US 1000 BEGA Way, Carpinteria, CA 93013 [P] 805·684·0533 [F] 805·684·6682

BEST IN SHOW LIGHTFAIR INTERNATIONAL 2004

line™

series 2.0

PROGRESS Report 2004 SELECTION

5°, 30°, 60°

PATENT PENDING

Application

io Lighting's line series 2.0 is approximately 2" x 2" in cross section which allows for luminous accents to be delivered from "tight" architectural details. This low voltage linear floodlight luminaire utilizes high brightness LEDs and may be specified for interior or exterior applications. Nominal lengths include: 18", 36", 54", and 72". Precise beam spreads (5°, 30°, 60°) along the perpendicular axis of the fixture are well suited for building grazing or wall washing effects. Individual units may be placed end to end to create continuos rows without obvious shadows between fixtures. Similar to halogen light sources, LEDs are point sources that offer superior definition to three dimensional objects and sparkle to reflective surfaces. Average rated life for series 2.0 is 50,000 hours. Lamp Lumen depreciation at 50,000 hrs is 30%.

Light Output

series 2.0's superior optical assemblies offer fixture efficiencies that range from 85% to almost 100%. Refer to light output tables for foot candle values at various distances. IES format files may be obtained from the factory or downloaded from iolighting.com.

- Warm White (3000° K): 177 lms/ft
- Cool White (5000° K): 296 lms/ft

Construction

Heavy-duty aluminum housing provides recommended heat sink requirements for LEDs. Precision optics are composed of a customized acrylic material offering excellent light transmission and UV stability. High strength adhesive bonds the housing and optical assembly. series 2.0 is UL listed for wet locations.

Mounting Options

series 2.0 may be surface mounted, side surface mounted or surface mounted with field adjustability and lockable aiming.

Electrical

All fixtures are pre-wired and pre-assembled for easy installation. 8'-0", 18 AWG electrical feed is side mounted to enable continuous row mounting. Universal 120v or 277v supply required for remote driver. Driver enclosures for interior or exterior applications may be provided by io. Drivers may be remotely located up to 18'-0" (w/18 AWG), 46'-0"(w/14 AWG) and 71'-0" (w/12 AWG). Dimming is available, consult factory for details.

Individual units *may* be daisy chained and fed from a high capacity driver. Consult factory for more information.

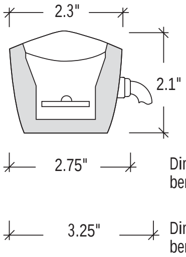
Power Consumption

- standard: 10 w/ft

Finish

Anodized aluminum finish is standard. Custom anodized finishes available upon request.

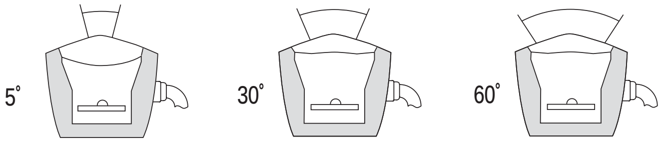
Dimensions



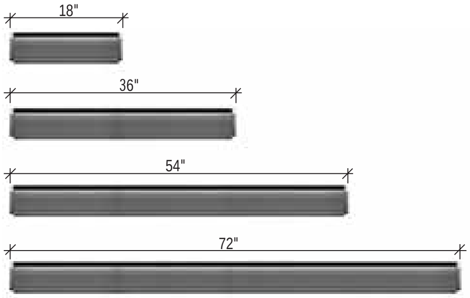
Dimension includes electrical feed and wire bending radius for interior applications.

Dimension includes electrical feed and wire bending radius for exterior applications.

Beam Spread Options



Individual Unit Lengths



io

line™

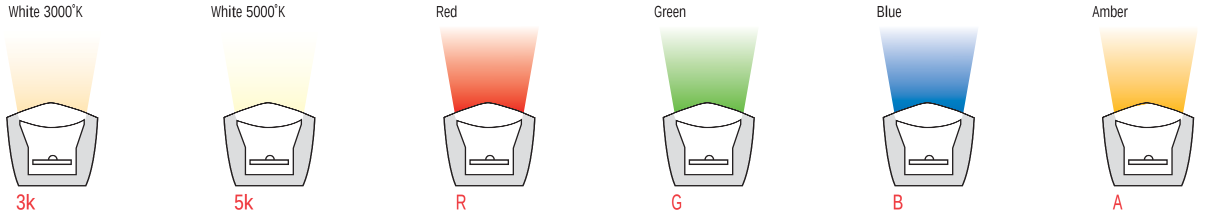
series 2.0

5˚, 30˚, 60˚

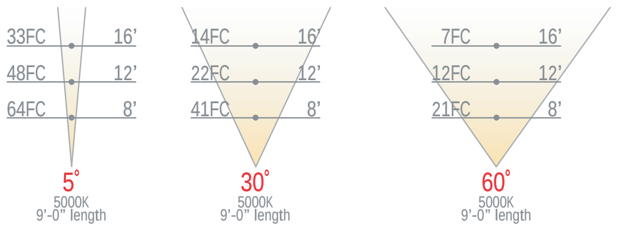
PATENT PENDING

BEST IN SHOW
LIGHTFAIR INTERNATIONAL
2004

Color Options



Light Output



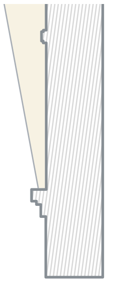
Grazing Option

Edge of optic employs a diffuser to distribute fill light at lower angles. The grazing option may be specified with all three beam spread options.

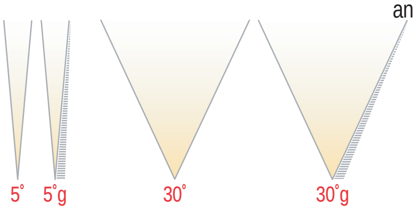
IES format photometrics may be downloaded from www.iolighting.com

Multipliers for Alternate Light Source Colors	.6	.43	.6	.19	.43
	3000k	RED	GREEN	BLUE	AMBER

Distributions


GRAZING OPTION

series 2.0 may be specified with 5˚, 30˚, 60˚ beam spreads. For grazing vertical surfaces, each of the three beam spreads is available with a "grazing option".



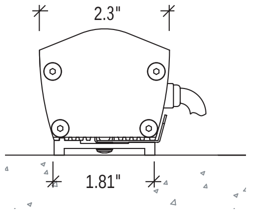
series 2.0's optical assembly is designed to practically eliminate stray light, making it perfect for applications where *light pollution* and/or *light trespass* are important design considerations.


Symmetric

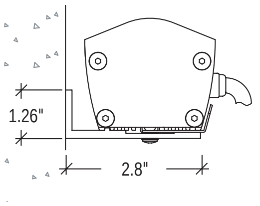
line series 2.0 is UL listed for wet locations. It is not rated for submersible applications. line should not be mounted in conditions where there is any standing water whatsoever.

Mounting Options

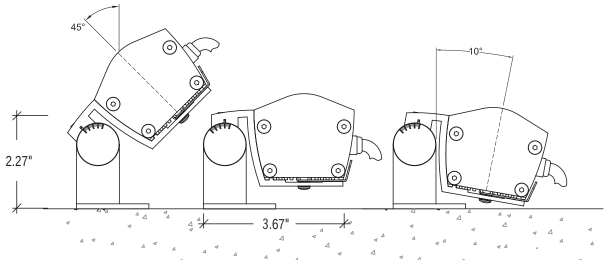
100 surface



101 side surface



102 field adjustable with lockable aiming



Order Code

0	04	I	5K	5G	100	1	36	2	I
io	2.0	Location	Color	Distribution	Mounting	Finish	Length	Voltage Dimming	Driver Enclosure

Location
I Interior
E Exterior

Color
3k White 3000˚K
5k White 5000˚K
*R Red
*G Green
*B Blue
*A Amber

**Note: Driver options and details vary from white light. Consult factory for details.*

Distribution
5 5˚
5g 5˚ w/grazing
30 30˚
30g 30˚ w/grazing
60 60˚
60g 60˚ w/grazing

Mounting
100 Surface
101 Side surface
102 Field adjustable

Finish
1 Anodized Aluminum
2 Custom

Length

UNITS		(actual)
18	18"	(17.71")
36	36"	(34.71")
54	54"	(51.71")
72	72"	(68.71")

CONTINUOS ROW
Specify Length
i.e. 60'-0"

Voltage Dimming
SIDE FEED STANDARD
1 120v
2 277v
3 120v w/dim
4 277v w/dim
5 other

Driver Enclosure
I Interior
E Exterior
N Not Req'd
Supplied by electrical contractors

370 Corporate Woods Pkwy Vernon Hills, IL 60061-3107
T 847.735.7000 F 847.735.7001 E info@iolighting.com W iolighting.com

Lamp Cutsheets

FIXTURE: H1

WORLDWIDE PARTNER

GE Consumer & Industrial Lighting

Commercial Products & Solutions

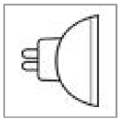
20864 – Q35MR16/C/CG12

GE ConstantColor® Precise™ MR16

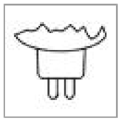
PRINT

- UV protection

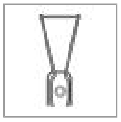
Bulb



Base



Filament



View Larger

GENERAL CHARACTERISTICS

Lamp type	Halogen - MR
Bulb	MR16
Base	2-Pin (GU5.3)
Filament	C-6
Wattage	35
Voltage	12
Voltage (MIN)	35
Rated Life	5000 hrs
Rated Life (Vert)	5000 hrs
Lamp Enclosure Type (LET)	Covered glass

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	7500
Initial Lumens (Hor)	7500
Initial Lumens (Vert)	7500
Center Beam Candlepower (CBCP)	7500
Color Temperature	3000 K
Nominal Initial Lumens per Watt	214

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position

DIMENSIONS

Maximum Overall Length (MOL)	1.8750 in (47.6 mm)
Bulb Diameter (DIA)	2.000 in (50.8 mm)

PRODUCT INFORMATION

Product Code	20864
Description	Q35MR16/C/CG12
ANSI Code	FRB
Standard Package	BUNDLE
Standard Package GTIN	00043168208642
Standard Package Quantity	20
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	20

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures
- Color
- XL Brochure

Application/Segment Brochures
- Contractor Lighting
- Healthcare Lighting
- Office Lighting

Sell Sheets
- GE ConstantColor® Precise™ MR16 Lamps

IES/Photometric Download

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

FIXTURE: H2

WORLDWIDE PARTNER

GE
Lighting

Commercial Products & Solutions

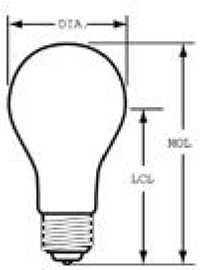
SITE SEARCH | HOME | PRODUCTS | EDUCATION / RESOURCES | LIGHTING APPLICATIONS

Where to Buy | FAQs | Contact Us | EliteNet

91227 – TU*100A1/F-RS/E27 230-240V GE 1/20 MIH

GE A19

PR



GENERAL CHARACTERISTICS

Lamp type	Incandescent - A-line
Bulb	A19
Base	Medium Skirt (E27)
Wattage	100
Rated Life	3000 hrs

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	880
Nominal Initial Lumens per Watt	8

PRODUCT INFORMATION

Product Code	91227
Description	TU*100A1/F-RS/E27 230-240V GE 1/20 MIH
Standard Package Quantity	20
Sales Unit	Unit

Bulb

View Larger

ADDITIONAL RESOURCES

Catalogs

Disposal Policies & Recycling Information

Return To Top

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FIXTURE: F1 & F1A

WORLDWIDE PARTNER

GE Consumer & Industrial Lighting

Commercial Products & Solutions

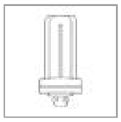
97631 – F32TBX/835/A/ECO

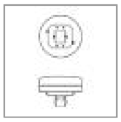
GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings

Bulb Base





View Larger

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-3
Wattage	32
Voltage	120/100
Rated Life	12000 hrs
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	2.700 Ohm
Rated Life (rapid start) @ Time	12000 h @ 3 h 20000 h @ 12 h
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2200
Mean Lumens	1850
Nominal Initial Lumens per Watt	68
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	265 V
Open Circuit Voltage (MIN)	515 V
Lamp Current	0.320 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	20000 Hz

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

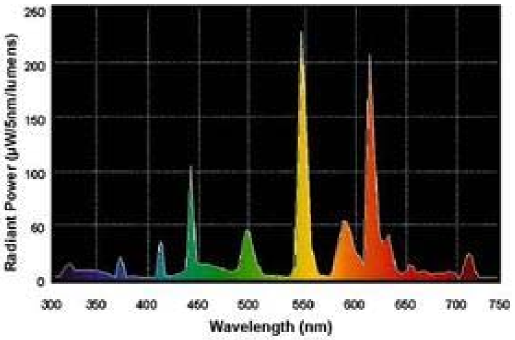
Product Brochures
- Ecolux
- Ecolux (Environmental)

Sell Sheets
- Fast Warming
- Biax® T/E 32W with Amalgam

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



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GE Consumer & Industrial Lighting

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46705 – F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

PRINT

- Passes TCLP, which can lower disposal costs.

High Color Rendering

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	36000 h @ 12 h 30000 h @ 3 h
Bulb Material	Soda lime
Starting Temperature (MIN)	-20 °C (-4 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

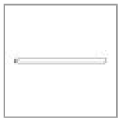
ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in (1163.3 mm)
Nominal Length	45.200 in (1148.0 mm)
Bulb Diameter (DIA)	0.625 in (15.8 mm)
Bulb Diameter (DIA) (MAX)	0.670 in (17.0 mm)
Max Base Face to Base Face (A)	45.240 in (1149.0 mm)
Face to End of Opposing Pin	45.420 in (1153.6 mm)

Bulb



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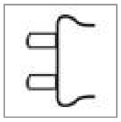

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ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

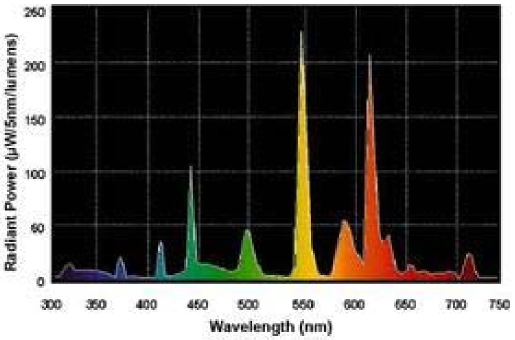
Application/Segment Brochures
- Contractor Lighting
- Healthcare Lighting

Product Brochures
- Ecolux
- Ecolux (Environmental)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Lamp Mortality

FIXTURE: F3 & F3A

WORLDWIDE PARTNER

GE Consumer & Industrial Lighting

Commercial Products & Solutions

46705 – F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

High Color Rendering

PRINT

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	36000 h @ 12 h 30000 h @ 3 h
Bulb Material	Soda lime
Starting Temperature (MIN)	-20 °C (-4 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

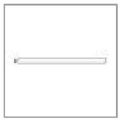
ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in (1163.3 mm)
Nominal Length	45.200 in (1148.0 mm)
Bulb Diameter (DIA)	0.625 in (15.8 mm)
Bulb Diameter (DIA) (MAX)	0.670 in (17.0 mm)
Max Base Face to Base Face (A)	45.240 in (1149.0 mm)
Face to End of Opposing Pin	45.420 in (1153.6 mm)

Bulb



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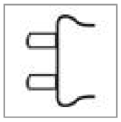

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ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

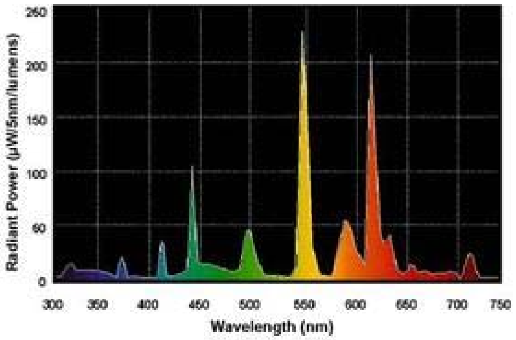
Application/Segment Brochures
- Contractor Lighting
- Healthcare Lighting

Product Brochures
- Ecolux
- Ecolux (Environmental)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Lamp Mortality

FIXTURE: F4

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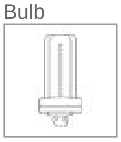
97616 – F26TBX/835/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings



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GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-3
Wattage	26
Voltage	120/105
Rated Life	12000 hrs
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	2.700 Ohm
Rated Life (rapid start) @ Time	12000 h @ 3 h 20000 h @ 12 h
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1710
Mean Lumens	1440
Nominal Initial Lumens per Watt	65
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	265 V
Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.325 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	20000 Hz

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures

- Ecolux
- Ecolux (Environmental)

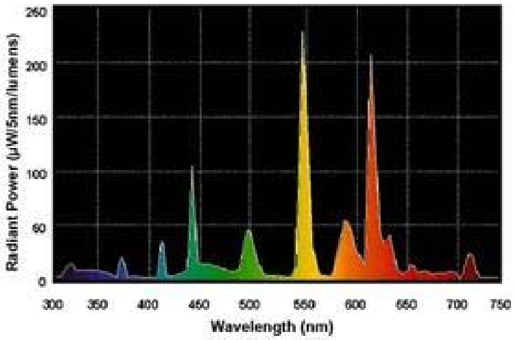
Sell Sheets

- Fast Warming

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F5

F6

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GE Consumer & Industrial Lighting

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97600 – F18DBX/835/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-2
Wattage	18
Voltage	100
Rated Life	12000 hrs/20000
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	6.050 Ohm
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

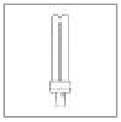
Initial Lumens	1200
Mean Lumens	970
Nominal Initial Lumens per Watt	66
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	220 V
Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.220 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Bulb



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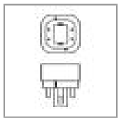

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ADDITIONAL RESOURCES

Catalogs

Testimonials

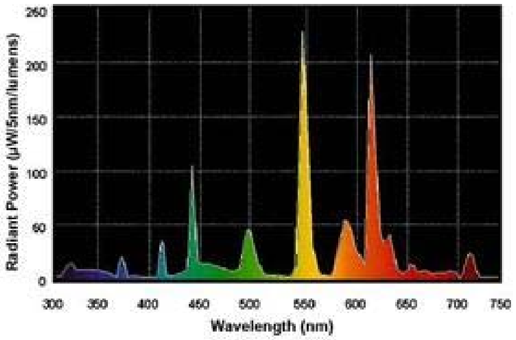
Sell Sheets

- Double Biax® 2-Pin & 4-Pin

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F7A

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46705 – F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

PRINT

- Passes TCLP, which can lower disposal costs.

High Color Rendering

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	36000 h @ 12 h 30000 h @ 3 h
Bulb Material	Soda lime
Starting Temperature (MIN)	-20 °C (-4 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

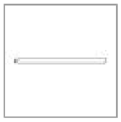
ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in (1163.3 mm)
Nominal Length	45.200 in (1148.0 mm)
Bulb Diameter (DIA)	0.625 in (15.8 mm)
Bulb Diameter (DIA) (MAX)	0.670 in (17.0 mm)
Max Base Face to Base Face (A)	45.240 in (1149.0 mm)
Face to End of Opposing Pin	45.420 in (1153.6 mm)

Bulb



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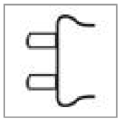

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ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Application/Segment Brochures

- Contractor Lighting
- Healthcare Lighting

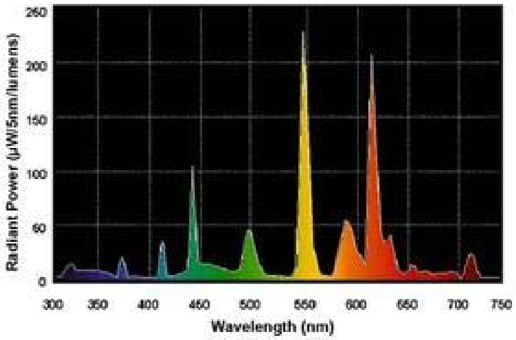
Product Brochures

- Ecolux
- Ecolux (Environmental)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Lamp Mortality

FIXTURE: F8A

GE Consumer & Industrial Lighting

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Commercial Products & Solutions

97600 – F18DBX/835/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-2
Wattage	18
Voltage	100
Rated Life	12000 hrs/20000
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	6.050 Ohm
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

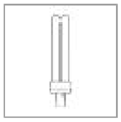
Initial Lumens	1200
Mean Lumens	970
Nominal Initial Lumens per Watt	66
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	220 V
Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.220 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Bulb



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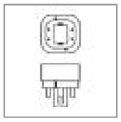

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ADDITIONAL RESOURCES

Catalogs

Testimonials

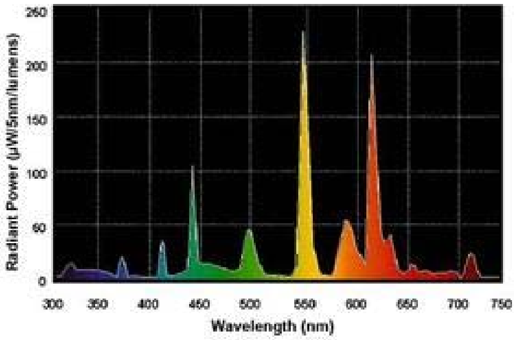
Sell Sheets

- Double Biax® 2-Pin & 4-Pin

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F9

GE Consumer & Industrial Lighting

WORLDWIDE PARTNER

Commercial Products & Solutions

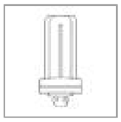
97631 – F32TBX/835/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings

Bulb



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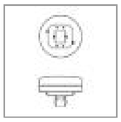

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GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-3
Wattage	32
Voltage	120/100
Rated Life	12000 hrs
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	2.700 Ohm
Rated Life (rapid start) @ Time	12000 h @ 3 h 20000 h @ 12 h
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2200
Mean Lumens	1850
Nominal Initial Lumens per Watt	68
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	265 V
Open Circuit Voltage (MIN)	515 V
Lamp Current	0.320 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	20000 Hz

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures

- Ecolux
- Ecolux (Environmental)

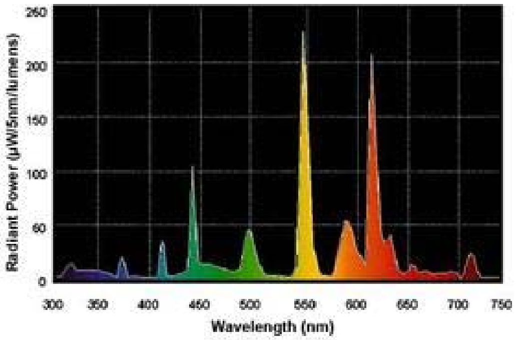
Sell Sheets

- Fast Warming
- Biax® T/E 32W with Amalgam

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F10

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GE Consumer & Industrial Lighting

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97600 – F18DBX/835/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PRINT

High Color Rendering
Energy Savings

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-2
Wattage	18
Voltage	100
Rated Life	12000 hrs/20000
Starting Temperature (MIN)	0 °C (32 °F)
Cathode Resistance	6.050 Ohm
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

PHOTOMETRIC CHARACTERISTICS

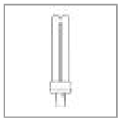
Initial Lumens	1200
Mean Lumens	970
Nominal Initial Lumens per Watt	66
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	220 V
Open Circuit Voltage Across Starter (MIN)	198 V
Lamp Current	0.220 A
Preheat Voltage (MIN)	4 V
Current Crest Factor (MAX)	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Bulb



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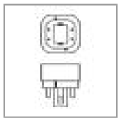

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ADDITIONAL RESOURCES

Catalogs

Testimonials

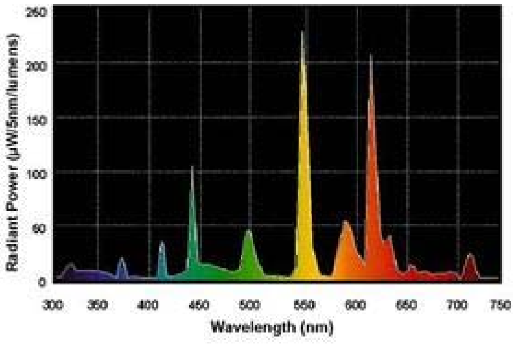
Sell Sheets

- Double Biax® 2-Pin & 4-Pin

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F11

WORLDWIDE PARTNER

GE Lighting

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97635 – F42TBX/835/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings

GENERAL CHARACTERISTICS

Lamp type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24-q4
Wattage	42
Voltage	135
Rated Life	12000 hrs
Starting Temperature (MIN)	-18 °C (-0 °F)
Cathode Resistance	2.700 Ohm
Rated Life (rapid start) @ Time	12000 h @ 3 h 20000 h @ 12 h
Additional Info	Dimmable with appropriate dimming ballast., End of Life Protection (EOL), TCLP compliant
Primary Application	Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

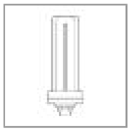
PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3200
Mean Lumens	2690
Nominal Initial Lumens per Watt	76
Color Temperature	3500 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.2500 A
Open Circuit Voltage (after preheating) (MAX)	265 V
Open Circuit Voltage (MIN)	515 V
Lamp Current	0.320 A
Preheat Voltage (MIN)	4 V

Bulb



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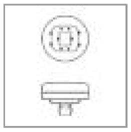

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ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures
- Ecolux
- Ecolux (Environmental)

Sell Sheets
- Fast Warming
- Biax® T/E 42W

Disposal Policies & Recycling Information

FIXTURE: F12

WORLDWIDE PARTNER

GE Lighting

Commercial Products & Solutions

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10326 – F32T8XLSPX35HLEC

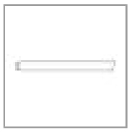
GE Ecolux® Starcoat® T8

PR

- Passes TCLP, which can lower disposal costs.

High Color Rendering
Energy Savings

Bulb



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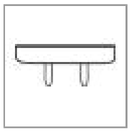

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GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T8
Base	Medium Bi-Pin (G13)
Wattage	32
Voltage	137
Rated Life	24000 hrs
Rated Life (instant start) @ Time	29000 h @ 12 h 24000 h @ 3 h
Rated Life (rapid start) @ Time	29000 h @ 12 h
Bulb Material	Soda lime
Starting Temperature (MIN)	10 °C (50 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3100
Mean Lumens	2915
Nominal Initial Lumens per Watt	96
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

DIMENSIONS

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Application/Segment Brochures
- Contractor Lighting
- Healthcare Lighting
- Office Lighting
- Retail Lighting

Product Brochures
- Ecolux
- Ecolux (Environmental)
- Industrial Lighting
- ULTRA Linear Fluorescent

Sell Sheets
- F32T8 High Lumen Linear Fluorescent System

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution

FIXTURE: F13

WORLDWIDE PARTNER

GE
Lighting

Commercial Products & Solutions

46745 – F39W/T5/835/ECO

GE Ecolux® Starcoat® T5

PR

• Passes TCLP, which can lower disposal costs.

High Color Rendering

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	39
Voltage	112
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	36000 h @ 12 h 30000 h @ 3 h
Bulb Material	Soda lime
Starting Temperature (MIN)	-20 °C (-4 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3500
Mean Lumens	3220
Nominal Initial Lumens per Watt	89
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

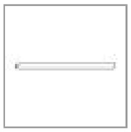
ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	350 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

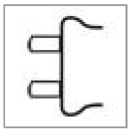
DIMENSIONS

Maximum Overall Length (MOL)	33.9800 in (863.0 mm)
Nominal Length	33.400 in (848.3 mm)

Bulb



Base



View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Application/Segment Brochures

- Contractor Lighting
- Healthcare Lighting

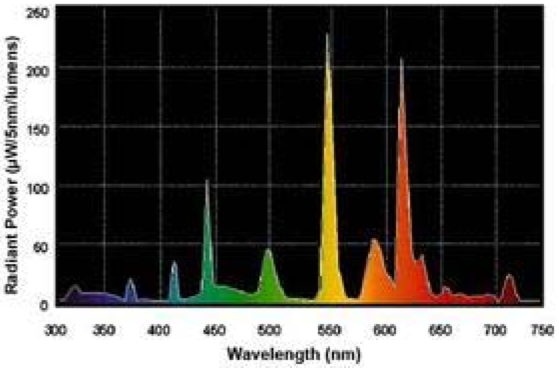
Product Brochures

- Ecolux
- Ecolux (Environmental)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



FIXTURE: F14

WORLDWIDE PARTNER

GE Consumer & Industrial Lighting

Commercial Products & Solutions

46705 – F28W/T5/835/ECO

GE Ecolux® Starcoat® T5

PRINT

• Passes TCLP, which can lower disposal costs.

High Color Rendering

GENERAL CHARACTERISTICS

Lamp type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	28
Voltage	167
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	36000 h @ 12 h 30000 h @ 3 h
Bulb Material	Soda lime
Starting Temperature (MIN)	-20 °C (-4 °F)
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2900
Mean Lumens	2660
Nominal Initial Lumens per Watt	103
Color Temperature	3500 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.5

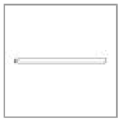
ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	425 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor (MAX)	1.7

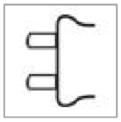
DIMENSIONS

Maximum Overall Length (MOL)	45.8000 in (1163.3 mm)
Nominal Length	45.200 in (1148.0 mm)
Bulb Diameter (DIA)	0.625 in (15.8 mm)
Bulb Diameter (DIA) (MAX)	0.670 in (17.0 mm)
Max Base Face to Base Face (A)	45.240 in (1149.0 mm)
Face to End of Opposing Pin	45.420 in (1153.6 mm)

Bulb



Base



View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

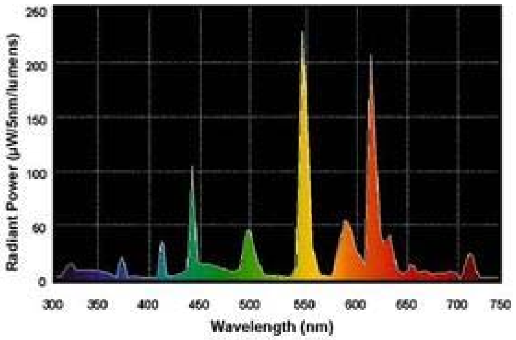
Application/Segment Brochures
- Contractor Lighting
- Healthcare Lighting

Product Brochures
- Ecolux
- Ecolux (Environmental)

Disposal Policies & Recycling Information

GRAPHS & CHARTS

Spectral Power Distribution



Lamp Mortality

FIXTURE: M1

WORLDWIDE PARTNER

GE Consumer & Industrial Lighting

Commercial Products & Solutions

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20153 – CMH39TUVCU830G12

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4.5

PRINT

GENERAL CHARACTERISTICS

Lamp type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4.5
Base	Bi-Pin (G12)
Wattage	39
Rated Life	10000 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	3400
Mean Lumens	2600
Nominal Initial Lumens per Watt	87
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position
Warm Up Time to 90% (MAX)	2 min/3
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

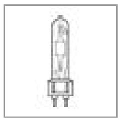
DIMENSIONS

Maximum Overall Length (MOL)	3.5600 in (90.4 mm)
Light Center Length (LCL)	2.180 in (55.3 mm)

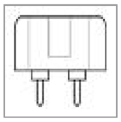
PRODUCT INFORMATION

Product Code	20153
Description	CMH39TUVCU830G12
ANSI Code	M130
Standard Package	Case
Standard Package GTIN	10043168201534
Standard Package Quantity	12

Bulb



Base



View Larger

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures
- Ceramic Metal Halide

Application/Segment Brochures
- Contractor Lighting

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

Ballast Cutsheets

FIXTURE: F1

ADVANCE

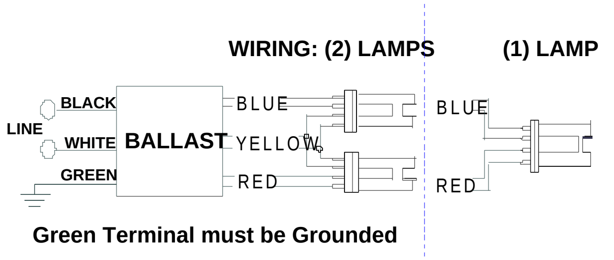
ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
* CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

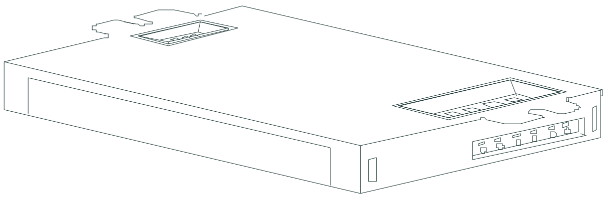
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

Revised 09/02/2004

ADVANCE TRANSFORMER CO.
O'HARE INTERNATIONAL CENTER - 10275 WEST HIGGINS ROAD
ROSEMONT, ILLINOIS 60018
TELEPHONE: (847) 390-5000 FAX: (847) 390-5109

Compact SE Overview

For designs requiring the energy savings and aesthetic appeal of dimmed T4 compact fluorescent or T5 twin-tube lamps, Compact SE dimming ballasts are your solution. The Compact SE product family includes ballasts for nearly every type of dimmable compact fluorescent lamp.

Features

- Continuous, flicker-free dimming from 100% to 5%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models for 4-pin T4 compact lamps and T5 twin-tube lamps
- Programmed rapid start design will preheat lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminate circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life cycle
- Ultra quiet operation
- Protected from miswires of any input power to control lead, or lamp leads to each other or ground
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase
- Ballasts that dim T4 compact fluorescent lamps are intended for factory installation by OEM fixture manufacturer.

Compact SE, case type A
3.00"w (76mm) x 1.00"h (25mm) x 4.90"l (124mm)

Compact SE, case type B
3.00"w (76mm) x 1.00"h (25mm) x 6.75"l (171mm)

Compact SE, case type F
2.38"w (60mm) x 1.50"h (38mm) x 9.50"l (241mm)

LUTRON SPECIFICATION SUBMITTAL

Page

Job Name:	**Model Numbers:**
William H. Gates Hall	FCB-T432-277-1-S
Job Number:	FIXTURE: F1A

Specifications

Performance

- Dimming Range: 100% to 5% measured relative light output (RLO)
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .95 for T4 quad or triple tube lamps, and greater than .85 for T5 twin-tube lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 10%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

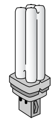
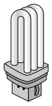
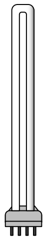
Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer for EMI/RFI emissions requirements
- T4 compact fluorescent ballasts are MIL Std. 461E compliant (meets the requirements of CE101, RE101 and RE102)
- Meets ANSI C62.41 Category A surge protection standards to 6kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001

Job Name:
William H. Gates Hall
Job Number:

Model Numbers:
FCB-T432-277-1-S

Compact SE Ballast Models

				120 VOLTS		277 VOLTS	
Lamp Type	Lamp Watts	Lamps per ballast	Case Type	Ballast Current (amps)	**Compact SE** Model Number[1]	Ballast Current (amps)	**Compact SE** Model Number[1]
T4 4-Pin Quad-Tube  1/2" diameter	18W	1 2	A B	.20 .42	FDB-T418-120-1-S FDB-T418-120-2-S	.08 .17	FDB-T418-277-1-S FDB-T418-277-2-S
	26W	1 2	A B	.26 .50	FDB-T426-120-1-S FDB-T426-120-2-S	.12 .21	FDB-T426-277-1-S FDB-T426-277-2-S
T4 4-Pin Triple-Tube  1/2" diameter	18W	1 2	A B	.20 .42	FDB-T418-120-1-S FDB-T418-120-2-S	.08 .17	FDB-T418-277-1-S FDB-T418-277-2-S
	26W	1 2	A B	.26 .50	FDB-T426-120-1-S FDB-T426-120-2-S	.12 .21	FDB-T426-277-1-S FDB-T426-277-2-S
	32W	1 2	A B	.31 .59	FDB-T432-120-1-S FDB-T432-120-2-S	.13 .24	FDB-T432-277-1-S FDB-T432-277-2-S
	42W	1 2	B B	.36 .67	FDB-T442-120-1-S FDB-T442-120-2-S	.16 .29	FDB-T442-277-1-S FDB-T442-277-2-S
T5 Twin-Tube  5/8" diameter	36/39W (16")	1 2 3	F F F	.33 .58 .85	FDB-1643-120-1 FDB-1643-120-2 FDB-1643-120-3	.14 .25 .35	FDB-1643-277-1 FDB-1643-277-2 FDB-1643-277-3
	40W (22")	1 2 3	F F F	.33 .61 .88	FDB-2227-120-1 FDB-2227-120-2 FDB-2227-120-3	.14 .25 .38	FDB-2227-277-1 FDB-2227-277-2 FDB-2227-277-3
	50W (22")	1 2	F F	.38 .69	FDB-2243-120-1 FDB-2243-120-2	.17 .32	FDB-2243-277-1 FDB-2243-277-2

FCB-T432-277-1-S

[1] Mounting studs standard for T4 ballasts. Delete suffix -S in the model number if mounting studs not needed.

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: FCB-T432-277-1-S

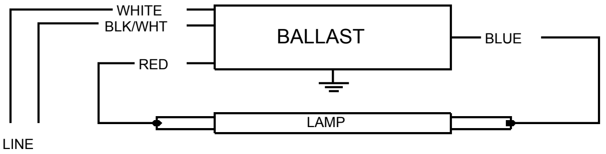
VCN-132-MC

Brand Name	CENTIUM MICRO CAN
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F21T5	1	21	50/10	0.10	27	1.10	10	0.98	1.7	4.07
F25T8	1	25	0/-18	0.09	25	0.98	10	0.98	1.7	3.92
* F28T5	1	28	50/10	0.11	30	0.98	10	0.99	1.7	3.27
F32T8	1	32	0/-18	0.11	30	0.98	10	0.98	1.7	3.27
F32T8/ES (30W)	1	30	60/16	0.10	28	0.98	10	0.98	1.7	3.50

Wiring Diagram



Diag. 63

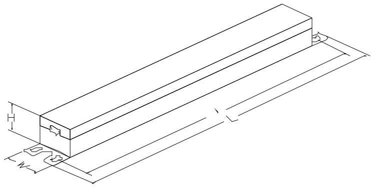
The wiring diagram that appears above is
for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		0
White	25L	63.5
Blue	31R	78.7
Red	37L	94
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White	25L	63.5
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.08 "	1.05 "	8.91 "
9 1/2	1 2/25	1 1/20	8 91/100
24.1 cm	2.7 cm	2.7 cm	22.6 cm

Revised 07/23/2004

VCN-132-MC

Brand Name	CENTIUM MICRO CAN
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Instant Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output, and 1.20 for High Light.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for standard T8 lamps and 16C (60F) for energy-saving T8 lamps.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

NOTE: The use of Optanium 2.0 (IOP) models is recommended to reduce striations in energy-saving T8 lamps (25W, 28W or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium 2.0 (IOP) models.

Consult lamp manufacturer for operation of T5 lamps on instant start ballasts.

Revised 07/23/2004

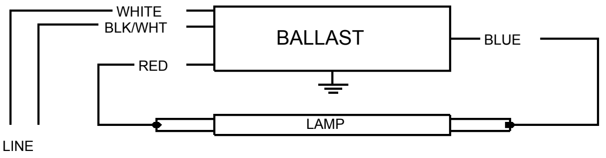
VCN-132-MC

Brand Name	CENTIUM MICRO CAN
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F21T5	1	21	50/10	0.10	27	1.10	10	0.98	1.7	4.07
F25T8	1	25	0/-18	0.09	25	0.98	10	0.98	1.7	3.92
* F28T5	1	28	50/10	0.11	30	0.98	10	0.99	1.7	3.27
F32T8	1	32	0/-18	0.11	30	0.98	10	0.98	1.7	3.27
F32T8/ES (30W)	1	30	60/16	0.10	28	0.98	10	0.98	1.7	3.50

Wiring Diagram



Diag. 63

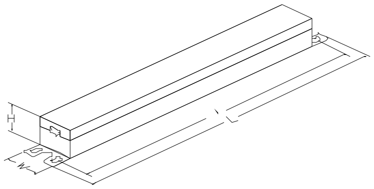
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		0
White	25L	63.5
Blue	31R	78.7
Red	37L	94
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White	25L	63.5
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.08 "	1.05 "	8.91 "
9 1/2	1 2/25	1 1/20	8 91/100
24.1 cm	2.7 cm	2.7 cm	22.6 cm

Revised 07/23/2004

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Corporate Offices: Phone: 800-322-2086

VCN-132-MC

Brand Name	CENTIUM MICRO CAN
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Instant Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output, and 1.20 for High Light.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for standard T8 lamps and 16C (60F) for energy-saving T8 lamps.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

NOTE: The use of Optanium 2.0 (IOP) models is recommended to reduce striations in energy-saving T8 lamps (25W, 28W or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium 2.0 (IOP) models.

Consult lamp manufacturer for operation of T5 lamps on instant start ballasts.

Revised 07/23/2004

Eco-10 Overview

Eco-10 lighting management electronic dimming ballasts are designed to maximize the benefits of a lighting management system. Eco-10 offers 100% to 10% dimming, and is ideal for use in any space where saving energy is the primary goal of the design.

Eco-10, case type C
1.18”w (30mm) x 1.00”h (25mm) x 18.00”l (457mm)

Features

- Continuous, flicker-free dimming from 100% to 10%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T5 and T5-HO linear, T8 linear and U-bent, and T5 twin-tube lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T5 and T5-HO linear models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase

Eco-10, case type D
1.58”w (40mm) x 1.00”h (25mm) x 9.50”l (241mm)

Eco-10, case type F
2.38”w (60mm) x 1.50”h (38mm) x 9.50”l (241mm)

LUTRON® SPECIFICATION SUBMITTAL Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: ECO-T528-277-1

Specifications

Performance

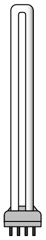
- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Job Name:	**Model Numbers:**	
William H. Gates Hall	ECO-T528-277-1	
Job Number:		

Eco-10 Ballast Models

Lamp Type				120 VOLTS		277 VOLTS	
	Lamp Watts (length)	Lamps per ballast	Case Type	Ballast Current (amps)	**Eco-10** Model Number	Ballast Current (amps)	**Eco-10** Model Number
T5 linear	14W	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
	(22")	2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
 5/8" diameter	21W	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
	(34")	2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
	(45.3")	2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
T5-HO linear high output	24W	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
	(21.5")	2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
 5/8" diameter	39W	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
	(33.4")	2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
	(45.3")	2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
T5 Twin-Tube	36/39W	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
	(16")	2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
 5/8" diameter	40W	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
	(22")	2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
	(22")	2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: ECO-T528-277-1

ADVANCE™

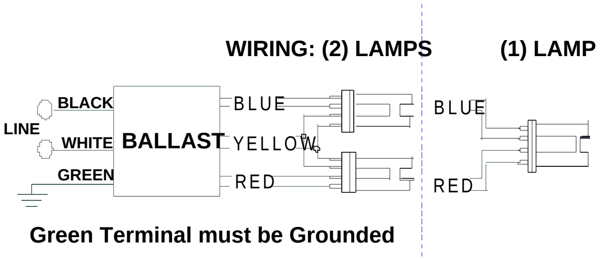
ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
* CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

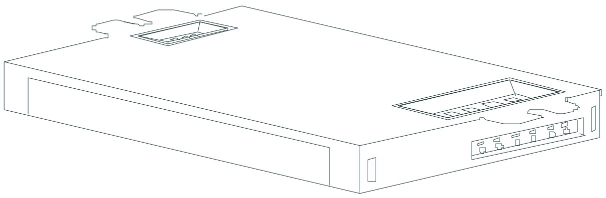
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

Revised 09/02/2004

Eco-10 Overview

Eco-10 lighting management electronic dimming ballasts are designed to maximize the benefits of a lighting management system. Eco-10 offers 100% to 10% dimming, and is ideal for use in any space where saving energy is the primary goal of the design.

Eco-10, case type C
1.18"w (30mm) x 1.00"h (25mm) x 18.00"l (457mm)

Features

- Continuous, flicker-free dimming from 100% to 10%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T5 and T5-HO linear, T8 linear and U-bent, and T5 twin-tube lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T5 and T5-HO linear models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase

Eco-10, case type D
1.58"w (40mm) x 1.00"h (25mm) x 9.50"l (241mm)

Eco-10, case type F
2.38"w (60mm) x 1.50"h (38mm) x 9.50"l (241mm)

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name:
William H. Gates Hall
Job Number:

Model Numbers:
ECO-T528-277-1

Specifications

Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

LUTRON® SPECIFICATION SUBMITTAL

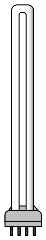
Page

Job Name:
William H. Gates Hall

Job Number:

Model Numbers:
ECO-T528-277-1

Eco-10 Ballast Models

Lamp Type	Lamp Watts (length)	Lamps per ballast	Case Type	120 VOLTS		277 VOLTS	
				Ballast Current (amps)	**Eco-10** Model Number	Ballast Current (amps)	**Eco-10** Model Number
T5 linear  5/8” diameter	14W (22”)	1	C	.17	E 3 T514 C 120 1	.08	E 3 T514 C 277 1
		2	C	.32	E 3 T514 C 120 2	.14	E 3 T514 C 277 2
	21W (34”)	1	C	.25	E 3 T521 C 120 1	.11	E 3 T521 C 277 1
		2	C	.43	E 3 T521 C 120 2	.19	E 3 T521 C 277 2
	28W (45.3”)	1	C	.30	ECO-T528-120-1	.14	ECO-T528-277-1
		2	C	.55	ECO-T528-120-2	.25	ECO-T528-277-2
T5-HO linear high output  5/8” diameter	24W (21.5”)	1	C	.26	ECO-T524-120-1	.13	ECO-T524-277-1
		2	C	.45	ECO-T524-120-2	.20	ECO-T524-277-2
	39W (33.4”)	1	C	.38	ECO-T5H39-120-1	.17	ECO-T5H39-277-1
		2	C	.76	ECO-T5H39-120-2	.31	ECO-T5H39-277-2
	54W (45.3”)	1	C	.58	ECO-T554-120-1	.25	ECO-T554-277-1
		2	C	1.1	ECO-T554-120-2	.45	ECO-T554-277-2
T5 Twin-Tube  5/8” diameter	36/39W (16”)	1	F	.33	ECO-T539-120-1	.14	ECO-T539-277-1
		2	F	.58	ECO-T539-120-2	.25	ECO-T539-277-2
		3	F	.85	ECO-T539-120-3	.35	ECO-T539-277-3
	40W (22”)	1	F	.33	ECO-T540-120-1	.14	ECO-T540-277-1
		2	F	.61	ECO-T540-120-2	.25	ECO-T540-277-2
		3	F	.88	ECO-T540-120-3	.38	ECO-T540-277-3
	50W (22”)	1	F	.38	ECO-T550-120-1	.17	ECO-T550-277-1
		2	F	.69	ECO-T550-120-2	.32	ECO-T550-277-2

LUTRON® SPECIFICATION SUBMITTAL Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: ECO-T528-277-1

Compact SE Overview

For designs requiring the energy savings and aesthetic appeal of dimmed T4 compact fluorescent or T5 twin-tube lamps, Compact SE dimming ballasts are your solution. The Compact SE product family includes ballasts for nearly every type of dimmable compact fluorescent lamp.

Features

- Continuous, flicker-free dimming from 100% to 5%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models for 4-pin T4 compact lamps and T5 twin-tube lamps
- Programmed rapid start design will preheat lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminate circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life cycle
- Ultra quiet operation
- Protected from miswires of any input power to control lead, or lamp leads to each other or ground
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase
- Ballasts that dim T4 compact fluorescent lamps are intended for factory installation by OEM fixture manufacturer.

Compact SE, case type A
3.00"w (76mm) x 1.00"h (25mm) x 4.90"l (124mm)

Compact SE, case type B
3.00"w (76mm) x 1.00"h (25mm) x 6.75"l (171mm)

Compact SE, case type F
2.38"w (60mm) x 1.50"h (38mm) x 9.50"l (241mm)

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: FDB-T418-277-1-S

Specifications

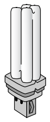
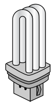
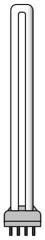
Performance

- Dimming Range: 100% to 5% measured relative light output (RLO)
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .95 for T4 quad or triple tube lamps, and greater than .85 for T5 twin-tube lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 10%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer for EMI/RFI emissions requirements
- T4 compact fluorescent ballasts are MIL Std. 461E compliant (meets the requirements of CE101, RE101 and RE102)
- Meets ANSI C62.41 Category A surge protection standards to 6kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001

Compact SE Ballast Models

Lamp Type	Lamp Watts	Lamps per ballast	Case Type	120 VOLTS		277 VOLTS	
				Ballast Current (amps)	**Compact SE** Model Number[1]	Ballast Current (amps)	**Compact SE** Model Number[1]
T4 4-Pin Quad-Tube	18W	1 2	A B	.20 .42	FDB-T418-120-1-S FDB-T418-120-2-S	.08 .17	FDB-T418-277-1-S FDB-T418-277-2-S
 1/2" diameter	26W	1 2	A B	.26 .50	FDB-T426-120-1-S FDB-T426-120-2-S	.12 .21	FDB-T426-277-1-S FDB-T426-277-2-S
T4 4-Pin Triple-Tube	18W	1 2	A B	.20 .42	FDB-T418-120-1-S FDB-T418-120-2-S	.08 .17	FDB-T418-277-1-S FDB-T418-277-2-S
 1/2" diameter	26W	1 2	A B	.26 .50	FDB-T426-120-1-S FDB-T426-120-2-S	.12 .21	FDB-T426-277-1-S FDB-T426-277-2-S
	32W	1 2	A B	.31 .59	FDB-T432-120-1-S FDB-T432-120-2-S	.13 .24	FDB-T432-277-1-S FDB-T432-277-2-S
	42W	1 2	B B	.36 .67	FDB-T442-120-1-S FDB-T442-120-2-S	.16 .29	FDB-T442-277-1-S FDB-T442-277-2-S
T5 Twin-Tube 	36/39W (16")	1 2 3	F F F	.33 .58 .85	FDB-1643-120-1 FDB-1643-120-2 FDB-1643-120-3	.14 .25 .35	FDB-1643-277-1 FDB-1643-277-2 FDB-1643-277-3
5/8" diameter	40W (22")	1 2 3	F F F	.33 .61 .88	FDB-2227-120-1 FDB-2227-120-2 FDB-2227-120-3	.14 .25 .38	FDB-2227-277-1 FDB-2227-277-2 FDB-2227-277-3
	50W (22")	1 2	F F	.38 .69	FDB-2243-120-1 FDB-2243-120-2	.17 .32	FDB-2243-277-1 FDB-2243-277-2

[1] Mounting studs standard for T4 ballasts. Delete suffix -S in the model number if mounting studs not needed.

LUTRON® SPECIFICATION SUBMITTAL

Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers: FDB-T418-277-1-S

FIXTURE: F9

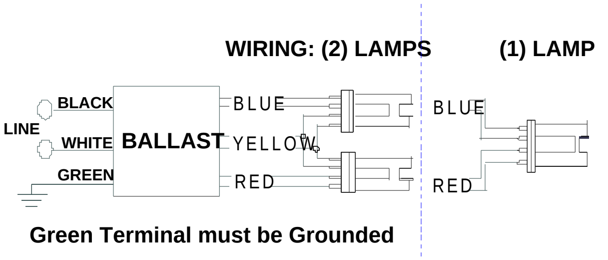
ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
* CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

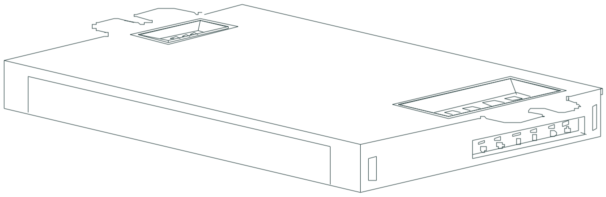
The wiring diagram that appears above is
for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

Revised 09/02/2004

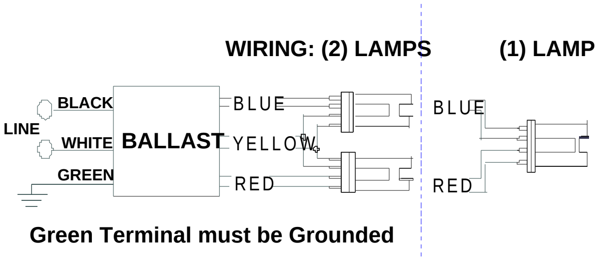
ICF-2S18-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM18W/GX24Q	1	18	0/-18	0.08	20	1.05	10	0.97	1.5	5.25
CFM18W/GX24q	2	18	0/-18	0.14	39	1.05	10	0.99	1.5	2.69
CFQ18W/G24q	1	18	0/-18	0.07	19	1.00	10	0.97	1.5	5.26
* CFQ18W/G24q	2	18	0/-18	0.13	35	0.95	10	0.99	1.5	2.71
CFS16W/GR10q	2	16	0/-18	0.13	37	1.00	09	0.99	1.5	2.70
CFS21W/GR10Q	1	21	0/-18	0.07	20	0.90	15	0.97	1.5	4.50
CFS21W/GR10Q	2	21	0/-18	0.14	40	0.91	10	0.99	1.5	2.28

Wiring Diagram



Green Terminal must be Grounded

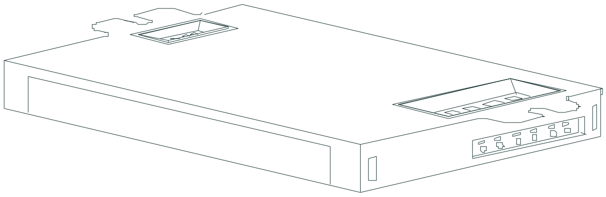
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 08/15/2006

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

ICF-2S18-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

Revised 08/15/2006

ADVANCE TRANSFORMER CO.
O'HARE INTERNATIONAL CENTER - 10275 WEST HIGGINS ROAD
ROSEMONT, ILLINOIS 60018
TELEPHONE: (847) 390-5000 FAX: (847) 390-5109

FIXTURE: F11

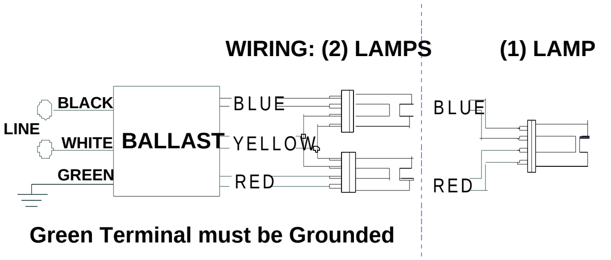
ADVANCE

Electrical Specifications

ICF-2S26-H1-LD@277	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.11	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.20	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.13	36	0.98	10	0.98	1.5	2.72
* CFM42W/GX24q	1	42	0/-18	0.17	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.10	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.19	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.18	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.18	48	0.93	10	0.99	1.5	1.94

Wiring Diagram



Green Terminal must be Grounded

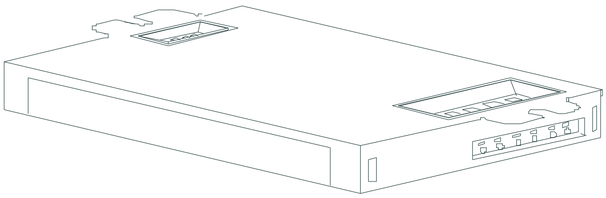
The wiring diagram that appears above is
for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

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O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

ICF-2S26-H1-LD@277

Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start except for ballasts with -QS suffix, which shall be Rapid Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the IntelliVolt ballast. RCF models shall operate from 60 Hz input source of 120V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of -18C (0F) for primary lamp. Ballasts for PL-H lamps shall have a minimum starting temperature of -30C (-20F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall be Underwriters Laboratories (UL) rated for use in air-handling spaces.

3.4 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.5 Ballast shall comply with ANSI C82.11 where applicable.

3.6 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated) except for RCF models which shall be Consumer (Class B).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C and three-years for a maximum case temperature of 85C (90C 3year warranty for ICF1H120-M4-XX, ICF2S42-90C-M2-XX and ICF2S70-M4-XX modesls).

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

Revised 09/02/2004

ADVANCE

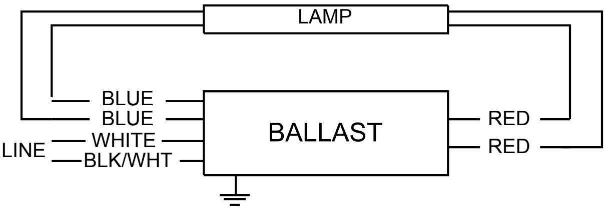
VCN-1S32-SC

Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F17T8	1	17	32/00	0.08	22	1.00	10	0.97	1.7	4.55
F25T8	1	25	32/00	0.10	28	0.95	10	0.98	1.7	3.39
* F32T8	1	32	32/00	0.13	34	0.90	10	0.98	1.7	2.65

Wiring Diagram



Diag. 20

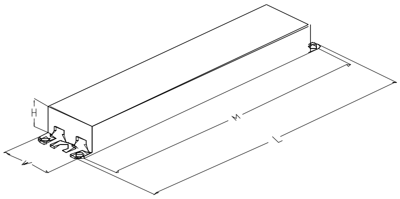
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		0
White	22L	55.9
Blue	36L	91.4
Red	26R	66
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White	22L	55.9
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 11/13/2001

VCN-1S32-SC

Brand Name	CENTIUM
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be __________ (Instant or Rapid) Start.

2.2 Ballast shall provide Independent Lamp Operation (ILO) for Instant Start ballasts allowing remaining lamp(s) to maintain full light output when one or more lamps fail.

2.3 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power (except T8/HO ballast).

2.4 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

2.5 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz ("GCN" models between 20kHz and 30kHz) to avoid interference with infrared devices and eliminate visible flicker.

2.6 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.7 Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output, and 1.20 for High Light.

2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.9 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.10 Ballast shall have a Class A sound rating for all 4-foot lamps and smaller.

2.11 Ballast shall have a minimum starting temperature of _______ [-18C (0F) for standard T8 and Long Twin Tube lamps, 10C (50F) for standard T12 lamps, 0C (32F) for Slimline T8 lamps and "GCN" models, -29C (-20F) for T8/HO lamps,] for primary lamp application. Ballast shall have a minimum starting temperature of 60F (16C) for energy-saving T8 and T12 lamps.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable. Models with -HAZ suffix meet UL 935 Type HL (hazardous location) requirements.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9002 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.

4.3 Manufacturer shall have a fifteen-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be Advance part # _____________ or approved equal.

NOTE: The use of Optanium 2.0 (IOP) models is recommended to reduce striation in energy-saving T8 lamps (25W, 28W or 30W). Remote or tandem wiring of energy-saving T8 lamps (25W, 28W or 30W) is only recommended for Optanium 2.0 (IOP) models.

Revised 11/13/2001

ADVANCE

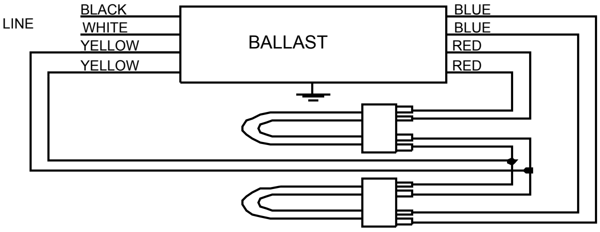
Electrical Specifications

V-2BS39-TP

Brand Name	MAGNETIC STD
Ballast Type	Magnetic
Starting Method	Rapid Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts)	Ballast Factor	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
FT36W/2G11	2	36	50/10	0.32	80	0.91	30	0.90	1.8	1.15
* FT39W/2G11	2	39	50/10	0.33	84	0.91	30	0.91	1.8	1.09

Wiring Diagram



Diag. 41

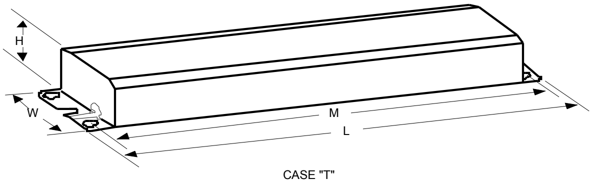
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	12	
White	12	
Blue	24	
Red	24	
Yellow	24	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	2.375 "	1.5 "	8.90625 "
9 1/2	2 3/8	1 1/2	8 29/32
24.1 cm	6 cm	3.8 cm	22.6 cm

Revised 07/01/1999

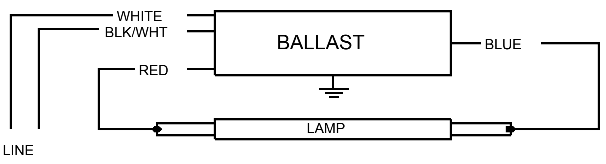
VCN-132-MC

Brand Name	CENTIUM MICRO CAN
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F21T5	1	21	50/10	0.10	27	1.10	10	0.98	1.7	4.07
F25T8	1	25	0/-18	0.09	25	0.98	10	0.98	1.7	3.92
* F28T5	1	28	50/10	0.11	30	0.98	10	0.99	1.7	3.27
F32T8	1	32	0/-18	0.11	30	0.98	10	0.98	1.7	3.27
F32T8/ES (30W)	1	30	60/16	0.10	28	0.98	10	0.98	1.7	3.50

Wiring Diagram



Diag. 63

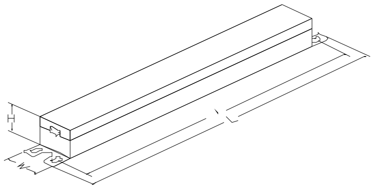
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		0
White	25L	63.5
Blue	31R	78.7
Red	37L	94
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White	25L	63.5
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.08 "	1.05 "	8.91 "
9 1/2	1 2/25	1 1/20	8 91/100
24.1 cm	2.7 cm	2.7 cm	22.6 cm

Revised 07/23/2004

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

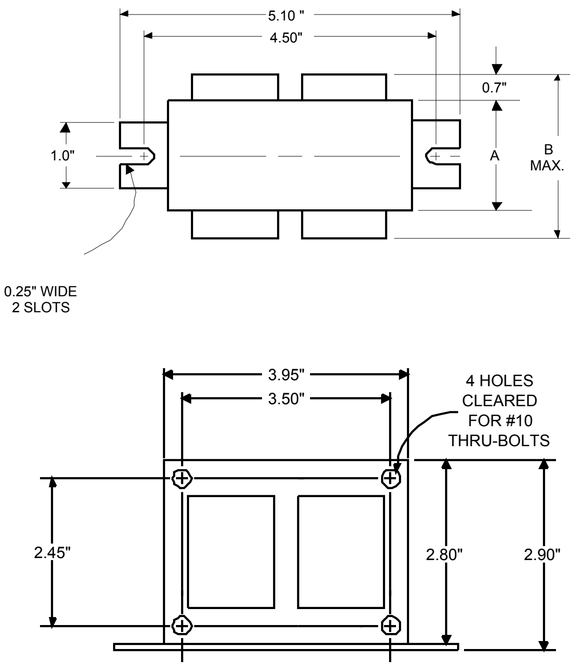
FIXTURE: M1

Metal Halide Lamp Ballast

Catalog Number 71A50Y1
For 39W M130
60 Hz HX-HPF
Status: Active

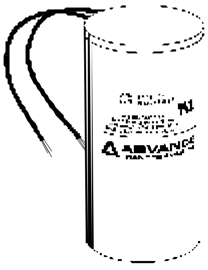
DIMENSIONS AND DATA

3 X 4 CORE - 2 COIL UNIT



INPUT VOLTS		100	200			
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating..		0.56	0.28			
Open Circuit..		1.30	0.70			
Starting..		0.50	0.25			
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A	A			
MIN. AMBIENT STARTING TEMP.	-30°F or -35°C					
NOM. OPEN CIRCUIT VOLTAGE	248					
INPUT VOLTAGE AT LAMP DROPOUT...........................		70	140			
INPUT WATTS	53					
RECOMMENDED FUSE (Amps)....................................		3	2			
CORE and COIL						
Dimension (A)	0.85					
Dimension (B)	1.95					
Weight (lbs.)	3					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	10.0					
Volts (min.)	280					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Advance Test Procedure for HID Ballasts - Form 1270)						
High Potential Test (Volts)						
1 minute	1500					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	223-273					
Short-Circuit Current Test (Amps)						
Secondary Current	0.60-0.74					
Input Current...		0.38	0.19	-	-	-
		0.58	0.29			

Capacitor: 7C100M30-R



Capacitance: 10
Dia/Oval Dim: 1.5
Height: 2.9
Temp Rating: 105°C

Wiring Diagram:

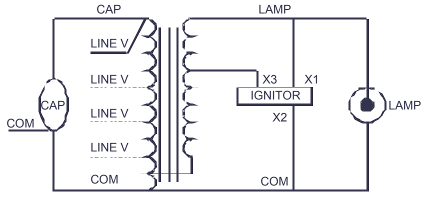


Fig. K3

Ignitor: LI533-H4

Ballast to Lamp Distance
(BTL) = 5 feet
Temp Rating: 105°C

Typical Ordering Information

(please call Advance for suffix availability)

Order Suffix	Description
500D.	Ballast With Ignitor and Dry Film Capacitor

Data is based upon tests performed by Advance Transformer in a controlled environment and representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

ADVANCE
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Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
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04/15/02

Controls

GP Dimming Panels
120-127 / 277 Volt

GP3/4
Mini
Panels

GP8-24
Standard-Size
Panels

GP36
Large-Size Panels

GP48-144
Large-Size Panels

GP Dimming Panels provide power and dimming for up to 144 load circuits and control any light source, including full-conduction non-dim.

Models available with:

- 120-127 V and 277 V input power.
- 3 to 144 circuits.
- Different feed types and breakers.

GP Dimming Panels work with:

- GRAFIK Eye 4000 Control Units.
- GRAFIK 5000TM, GRAFIK 6000®, and GRAFIK 7000® Systems.
- LP Dimming Panels.
- XP SoftswitchTM Panels.
- DMX512 dimming systems via the 2LINKTM option.

Job Name:
William H. Gates Hall
Job Number:

Model Numbers:

Specifications - 120-127 / 277 Volt

Standards

- UL Listed (Reference: UL File 42071).
- Complies with CSA or NOM (where appropriate).

Power

- Input power: 100-127V and 277V, 50/60Hz, phase-to-neutral.
- Branch Circuit Capacity:
  - 120-127V - up to 2000W/VA
  - 277V - 4500W/VA
- Number of Circuits: 3-144
- Branch Circuit Breakers: UL-rated thermal magnetic.
  AIC ratings (other ratings available):
  - 100-127V – 10,000A
  - 277V – 14,000A
- Lightning strike protection: Meets ANSI/IEEE standard 62.41-1980. Can withstand voltage surges of up to 6000V and current surges of up to 3000A.
- 10-year power failure memory: Automatically restores lighting to scene selected prior to power interruption.

Sources/Load Types

Operates these sources with a smooth continuous Square Law dimming curve or on a full conduction non-dim basis:

- Incandescent (Tungsten)/Halogen
- Magnetic Low Voltage Transformer
- Electronic Low Voltage Transformer[1]
- Lutron Electronic Fluorescent Dimming Ballasts
- Magnetic Fluorescent Lamp Ballasts
- Optional modules allow for control of 0-10V, DSI, and PWM load types.
- Operates HID sources on a full conduction non-dim basis.

Wiring

- Internal: Prewired by Lutron.
- System communications: Low-voltage Class 2 (PELV) wiring connects Dimming Panels to other components.
- Line (mains) voltage: Feed, load, and control circuit wiring only. No other wiring or assembly required.

Filter Chokes

- Load current rise time is measured at a 90 degree conduction angle.
- 10-90% of load current waveform:
  - 350µSec rise time at 50% dimmer capacity.
  - 400µSec rise time at 100% dimmer capacity.
- 0-100% of load current waveform:
  - 525µSec rise time at 50% dimmer capacity.
  - 600µSec rise time at 100% dimmer capacity.
- At no point in the waveform can the rate of current change exceed 300mA per µSec.
- Consult Lutron for higher rise time options.

Dimming Cards

- Panel current ratings are listed for continuous operation - UL-listed specifically for each light source.
- RTISS™ filter circuit technology compensates for incoming line voltage variations: No visible flicker with +/-2% change in RMS voltage/cycle and +/-2% Hz change in frequency/second.
- Arcless-relay air gap-off switches (one per load circuit) ensure open load circuits when off function selected. Eliminate arcing at mechanical contacts when loads are switched.

Physical Design

- Enclosure: NEMA-Type 1 (Type 2 available upon request), IP-20 protection; #16 U.S. Gauge Steel. Indoors only.
- Weight: 30-1300 pounds (14-590kg).
- Mounting: Surface mount only. Allow space for ventilating.

Environment/Heat Dissipation

- Patented, ribbed aluminum heat sink base cools Panel by convection. No fans.
- 32-104°F (0-40°C). Relative humidity less than 90% non-condensing.

---

[1] Reverse-phase control transformers require an ELVI Power Interface. Check phase with transformer manufacturer.

LUTRON® SPECIFICATION SUBMITTAL

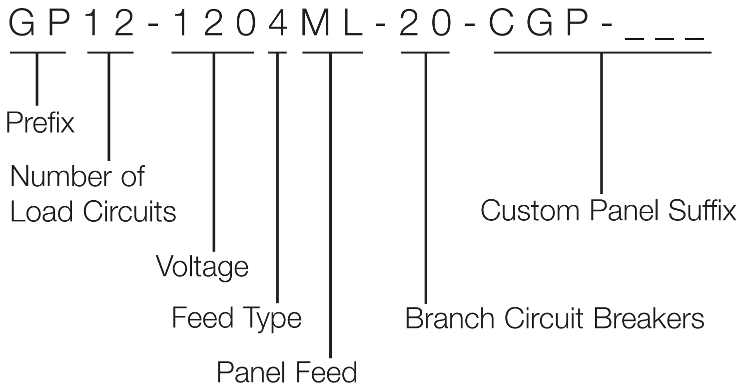
Page

Job Name: William H. Gates Hall

Job Number:

Model Numbers:

How to Build a GP Model Number



Prefix:
GP for GP Dimming Panel

Number of Load Circuits:
Indicates number of load circuits in the panel

Voltage:
120 for 120-127 V
277 for 277 V

Feed Type:
2 for 1 phase 2 wire
3 for 1 phase 3 wire (split phase)
4 for 3 phase 4 wire

Panel Feed:
ML for Main Lugs only
Mxx for Main Breaker with **xx** = breaker size in Amps

Branch Circuit Breakers:
20 for 20A branch circuit breakers
15 for 15A branch circuit breakers

Custom Panel Suffix:
Indicates panel with special options

GP8-24 Standard-Size Models

Only standard panels listed. Consult Lutron for further options.

277V Power

Number Of Circuits	Feed Type	Panel Feed	Maximum Feed	Panel Branch Ratings Circuit Breakers[1]	Maximum Dimmed Hot Load [2]
GP8	1Ø, 2W	Main Lugs Only	175A	20A	4500W/VA
	3Ø, 4W	Main Lugs Only	175A	20A	4500W/VA
		60A Main Breaker	60A	20A	4500W/VA
GP12	3Ø, 4W	Main Lugs Only	175A	20A	4500W/VA
		80A Main Breaker	80A	20A	4500W/VA
GP16	3Ø, 4W	Main Lugs Only	175A	20A	4500W/VA
		125A Main Breaker	125A	20A	4500W/VA

---

[1] 20/16A, 15/12A continuous load rating.

[2] Measured current will not exceed continuous load rating due to voltage drop in the dimmer.

Job Name: William H. Gates Hall

Job Number:

Model Numbers:

Appendix B

Panelboard Worksheets

EXISTING PANELBOARD NW01-N02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	CB-NW01-N	Panel Location:	ELEC. ROOM NW - LEVEL 01	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	MECH FTU	4	WEST	6300	va	1.00	6300	6300		
2	A	LIGHTING	1	SW ROOMS	3000	va	0.95	2850	3000		
3	B	--	4	WEST	6400	va	1.00	6400	6400		
4	B	LIGHTING	1	NW ROOMS	1000	va	0.95	950	1000		
5	C	--	4	WEST	6200	va	1.00	6200	6200		
6	C	LIGHTING	1	LOUNGE	2100	va	0.95	1995	2100		
7	A	LIGHTING	1	RM 118	1300	va	0.95	1235	1300		
8	A	LIGHTING	1	CORRIDOR	3600	w	0.95	3600	3789		
9	B	SPARE			0	w		0	0		
10	B	LIGHTING	1	E EXTERIO	2400	va	0.95	2280	2400		
11	C	SPARE			0	w		0	0		
12	C	LIGHTING	1	E EXTERIO	2100	va	0.95	1995	2100		
13	A	MECH FTU	3	WEST	9500	va	1.00	9500	9500		
14	A	ALC-1A	2		500	va	1.00	500	500		
15	B	--	3	WEST	9500	va	1.00	9500	9500		
16	B	SPARE			0	w		0	0		
17	C	--	3	WEST	9500	va	1.00	9500	9500		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	--			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	--			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								62.8	63.6	Amps=	76.5

PHASE LOADING							kW	kVA	%	Amps
PHASE TOTAL	A						24.0	24.4	38%	88.0
PHASE TOTAL	B						19.1	19.3	30%	69.7
PHASE TOTAL	C						19.7	19.9	31%	71.8

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		14.9	15.7	1.25	18.6	19.6	0.95		
2	equipment		0.5	0.5	1.00	0.5	0.5	1.00		
3	Mechanical - highest		28.5	28.5	1.25	35.6	35.6	1.00		
4	Mechanical		18.9	18.9	1.00	18.9	18.9	1.00		
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						73.7	74.6			
Spare Capacity			25%			18.4	18.7			
Total Design Loads						92.1	93.3	0.99	Amps=	112.3

REVISED PANELBOARD NW01-N02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NW01-N	Panel Location:	ELEC. ROOM NW - LEVEL 01	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	MECH FTU	4	WEST	6300	va	1.00	6300	6300		
2	A	LIGHTING	1	SW ROOMS	3000	va	0.95	2850	3000		
3	B	--	4	WEST	6400	va	1.00	6400	6400		
4	B	LIGHTING	1	NW ROOMS	1000	va	0.95	950	1000		
5	C	--	4	WEST	6200	va	1.00	6200	6200		
6	C	LIGHTING	1	LOUNGE	2100	va	0.95	1995	2100		
7	A	LIGHTING	1	RM 118	1300	va	0.95	1235	1300		
8	A	LIGHTING	1	CORRIDOR	2070	VA	0.95	1967	2070		
9	B	SPARE			0	w		0	0		
10	B	LIGHTING	1	TERRACE	1920	w	0.95	1920	2021		
11	C	SPARE			0	w		0	0		
12	C	LIGHTING	1	TERRACE	1756	w	0.95	1756	1848		
13	A	MECH FTU	3	WEST	9500	va	1.00	9500	9500		
14	A	ALC-1A	2	ELEC. RM	500	va	1.00	500	500		
15	B	--	3	WEST	9500	va	1.00	9500	9500		
16	B	LIGHTING	1	GALLERIA	340	w	0.95	340	358		
17	C	--	3	WEST	9500	va	1.00	9500	9500		
18	C	LIGHTING	1	GALLERIA	936	w	0.95	936	985		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	--			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	--			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								61.8	62.6	Amps=	75.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					22.4	22.7	36%	81.8
PHASE TOTAL	B					19.1	19.3	31%	69.6
PHASE TOTAL	C					20.4	20.6	33%	74.5

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		13.9	14.7	1.25	17.4	18.4	0.95		
2	equipment		0.5	0.5	1.00	0.5	0.5	1.00		
3	Mechanical - highest		28.5	28.5	1.25	35.6	35.6	1.00		
4	Mechanical		18.9	18.9	1.00	18.9	18.9	1.00		
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						72.5	73.4			
Spare Capacity			25%			18.1	18.3			
Total Design Loads						90.6	91.7	0.99	Amps=	110.4

EXISTING PANELBOARD NWB1-E02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	CB-NWB1-E	Panel Location:	ELEC. RM NW - LEVEL B1
Nominal Phase to Neutral Voltage------->	277	Phase:	3
Nominal Phase to Phase Voltage-------->	480	Wires:	4

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
2	A	LIGHTING	1	STAIR 1	400	va	0.95	380	400		
3	B	LIGHTING	1	EGRESS	3300	va	0.95	3135	3300		
4	B	LIGHTING	1	STAIR 4	200	va	0.95	190	200		
5	C	LIGHTING	1	MECH/ELEC	400	va	0.95	380	400		
6	C	LIGHTING	1	L107	1500	va	0.95	1425	1500		
7	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
8	A	SPARE			0	w		0	0		
9	B	LIGHTING	1	EGRESS L-0	1300	va	0.95	1235	1300		
10	B	SPARE			0	w		0	0		
11	C	LIGHTING	1	MECH/ELEC	400	va	0.95	380	400		
12	C	SPARE			0	w		0	0		
13	A	SPARE			0	w		0	0		
14	A	SPARE			0	w		0	0		
15	B	SPARE			0	w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPARE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPARE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	--			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	--			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	--			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	--			0	w		0	0		
PANEL TOTAL								7.3	7.7	Amps=	9.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.6	0.6	8%	2.2
PHASE TOTAL	B					4.6	4.8	62%	17.3
PHASE TOTAL	C					2.2	2.3	30%	8.3

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		7.3	7.7	1.25	9.1	9.6	0.95		
2			0.0	0.0	0.00	0.0	0.0			
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						9.1	9.6			
Spare Capacity			25%			2.3	2.4			
Total Design Loads						11.4	12.0	0.95	Amps=	14.5

REVISED PANELBOARD NWB1-E02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NWB1-E	Panel Location:	ELEC. RM NW - LEVEL B1	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
2	A	LIGHTING	1	STAIR 1	400	va	0.95	380	400		
3	B	LIGHTING	1	EGRESS	3300	va	0.95	3135	3300		
4	B	LIGHTING	1	STAIR 4	200	va	0.95	190	200		
5	C	LIGHTING	1	MECH/ELEC	400	va	0.95	380	400		
6	C	LIGHTING	1	LIBRARY	460	w	0.95	460	484		
7	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
8	A	SPARE			0	w		0	0		
9	B	LIGHTING	1	EGRESS L-0	1175	va	0.95	1116	1175		
10	B	SPARE			0	w		0	0		
11	C	LIGHTING	1	MECH/ELEC	400	va	0.95	380	400		
12	C	SPARE			0	w		0	0		
13	A	SPARE			0	w		0	0		
14	A	SPARE			0	w		0	0		
15	B	SPARE			0	w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPARE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPARE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								6.2	6.6	Amps=	7.9
PHASE LOADING								kW	kVA	%	Amps
PHASE TOTAL			A					0.6	0.6	9%	2.2
PHASE TOTAL			B					4.4	4.7	71%	16.9
PHASE TOTAL			C					1.2	1.3	20%	4.6
LOAD CATAGORIES				Connected			Demand				
				kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting			6.2	6.6	1.25	7.8	8.2	0.95		
2				0.0	0.0	0.00	0.0	0.0			
3				0.0	0.0	0.00	0.0	0.0			
4				0.0	0.0	0.00	0.0	0.0			
5				0.0	0.0	0.00	0.0	0.0			
6				0.0	0.0	0.00	0.0	0.0			
7				0.0	0.0	0.00	0.0	0.0			
8				0.0	0.0	0.00	0.0	0.0			
Total Demand Loads							7.8	8.2			
Spare Capacity				75%			5.8	6.1			
Total Design Loads							13.6	14.3	0.95	Amps=	17.3

EXISTING PANELBOARD NW02-N02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	CB-NW02-N	Panel Location:	ELEC. RM NW LEVEL 02	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	MECH FTU	2	WEST	3900	va	1.00	3900	3900	
2	A	LIGHTING	1	EST OFFICE	2700	va	0.95	2565	2700	
3	B	--	2	WEST	3200	va	1.00	3200	3200	
4	B	LIGHTING	1	W CORRIDO	1900	va	0.95	1805	1900	
5	C	--	2	WEST	2400	va	1.00	2400	2400	
6	C	LIGHTING	1	SW OFFICES	1500	va	0.95	1425	1500	
7	A	SPARE			0	w		0	0	
8	A	LIGHTING	1	NW ROOMS	900	va	0.95	855	900	
9	B	SPARE			0	w		0	0	
10	B	LIGHTING	1	NTRAL COR	2300	va	0.95	2185	2300	
11	C	SPARE			0	w		0	0	
12	C	LIGHTING	1	LEAR STOR	600	va	0.95	570	600	
13	A	SPARE			0	w		0	0	
14	A	SPARE			0	w		0	0	
15	B	--			0	w		0	0	
16	B	SPARE			0	w		0	0	
17	C	--			0	w		0	0	
18	C	SPARE			0	w		0	0	
19	A	SPARE			0	w		0	0	
20	A	SPARE			0	w		0	0	
21	B	SPARE			0	w		0	0	
22	B	SPARE			0	w		0	0	
23	C	SPARE			0	w		0	0	
24	C	SPARE			0	w		0	0	
25	A	SPARE			0	w		0	0	
26	A	SPARE			0	w		0	0	
27	B	SPARE			0	w		0	0	
28	B	SPARE			0	w		0	0	
29	C	SPARE			0	w		0	0	
30	C	SPARE			0	w		0	0	
31	A	SPARE			0	w		0	0	
32	A	SPARE			0	w		0	0	
33	B	SPARE			0	w		0	0	
34	B	SPARE			0	w		0	0	
35	C	SPARE			0	w		0	0	
36	C	SPARE			0	w		0	0	
37	A	SPARE			0	w		0	0	
38	A	SPARE			0	w		0	0	
39	B	SPARE			0	w		0	0	
40	B	SPARE			0	w		0	0	
41	C	SPARE			0	w		0	0	
42	C	SPARE			0	w		0	0	

PANEL TOTAL							18.9	19.4	Amps=	23.3
PHASE LOADING							kW	kVA	%	Amps
PHASE TOTAL		A					7.3	7.5	39%	27.1
PHASE TOTAL		B					7.2	7.4	38%	26.7
PHASE TOTAL		C					4.4	4.5	23%	16.2
LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		9.4	9.9	1.25	11.8	12.4	0.95		
2	mechanical largest		9.5	9.5	1.25	11.9	11.9	1.00		
3	mechanical		0.0	0.0	1.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						23.6	24.3			
Spare Capacity			25%			5.9	6.1			
Total Design Loads						29.5	30.3	0.97	Amps=	36.5

REVISED PANELBOARD NW02-N02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	B-NW02-N	Panel Location:	ELEC. RM NW LEVEL 02	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	MECH FTU	2	WEST	3900	va	1.00	3900	3900		
2	A	LIGHTING	1	EST OFFICE	2700	va	0.95	2565	2700		
3	B	--	2	WEST	3200	va	1.00	3200	3200		
4	B	LIGHTING	1	W CORRIDO	1900	va	0.95	1805	1900		
5	C	--	2	WEST	2400	va	1.00	2400	2400		
6	C	LIGHTING	1	SW OFFICES	935	va	0.95	888	935		
7	A	SPARE			0	w		0	0		
8	A	LIGHTING	1	NW ROOMS	900	va	0.95	855	900		
9	B	SPARE			0	w		0	0		
10	B	LIGHTING	1	NTRAL COR	2300	va	0.95	2185	2300		
11	C	SPARE			0	w		0	0		
12	C	LIGHTING	1	LEAR STOR	600	va	0.95	570	600		
13	A	SPARE			0	w		0	0		
14	A	LIGHTING	1	GALLERIA	340	w	0.95	340	358		
15	B	--			0	w		0	0		
16	B	LIGHTING	1	GALLERIA	1640	w	0.95	1640	1726		
17	C	--			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPARE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								20.3	20.9	Amps=	25.2

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					7.7	7.9	38%	28.4
PHASE TOTAL	B					8.8	9.1	44%	32.9
PHASE TOTAL	C					3.9	3.9	19%	14.2

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		10.8	11.4	1.25	13.6	14.3	0.95		
2	mechanical largest		9.5	9.5	1.25	11.9	11.9	1.00		
3	mechanical		0.0	0.0	1.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						25.4	26.1			
Spare Capacity			50%			12.7	13.1			
Total Design Loads						38.2	39.2	0.97	Amps=	47.2

EXISTING PANELBOARD NE02-N04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NE02-N	Panel Location:	ELEC. RM NE -LEVEL 02	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	MECH FTU	2	EAST	4800	VA	1.00	4800	4800		
2	A	LIGHTING	1	S. FOYER	1400	VA	0.95	1330	1400		
3	B	--	2	EAST	700	VA	1.00	700	700		
4	B	LIGHTING	1	S. FOYER	2400	VA	0.95	2280	2400		
5	C	--	2	EAST	2600	VA	1.00	2600	2600		
6	C	LIGHTING	1	ENTRAL OF	3100	VA	0.95	2945	3100		
7	A	SPARE			0	w		0	0		
8	A	LIGHTING	1	LOCKERS	800	VA	0.95	760	800		
9	B	SPARE			0	w		0	0		
10	B	LIGHTING	1	NE ROOMS	300	VA	0.95	285	300		
11	C	SPARE			0	w		0	0		
12	C	LIGHTING	1	E. FOYER	1300	VA	0.95	1235	1300		
13	A	SPARE			0	w		0	0		
14	A	LIGHTING	1	RM. 217	1900	VA	0.95	1805	1900		
15	B	--			0	w		0	0		
16	B	LIGHTING	1	RM. 213	1300	VA	0.95	1235	1300		
17	C	--			0	w		0	0		
18	C	LIGHTING	1	RM. 212	700	VA	0.95	665	700		
19	A	SPARE			0	w		0	0		
20	A	LIGHTING	1	RM. 222	1700	VA	0.95	1615	1700		
21	B	SPARE			0	w		0	0		
22	B	ALC-2B	3	ELEC. CLOS	500	VA	1.00	500	500		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								22.8	23.5	Amps=	28.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					10.3	10.6	45%	38.3
PHASE TOTAL	B					5.0	5.2	22%	18.8
PHASE TOTAL	C					7.4	7.7	33%	27.8

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		14.2	14.9	1.25	17.7	18.6	0.95		
2	mechanical largest		8.1	8.1	1.25	10.1	10.1	1.00		
3	equipment		0.5	0.5	1.00	0.5	0.5	1.00		
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						28.3	29.3			
Spare Capacity			25%			7.1	7.3			
Total Design Loads						35.4	36.6	0.97	Amps=	44.0

REVISED PANELBOARD NE02-N04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NE02-N	Panel Location:	ELEC. RM NE -LEVEL 02	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	MECH FTU	2	EAST	4800	VA	1.00	4800	4800		
2	A	SPARE				VA	0.95	0	0		
3	B	--	2	EAST	700	VA	1.00	700	700		
4	B	SPARE				VA	0.95	0	0		
5	C	--	2	EAST	2600	VA	1.00	2600	2600		
6	C	LIGHTING	1	ENTRAL OF	3100	VA	0.95	2945	3100		
7	A	SPARE			0	w		0	0		
8	A	LIGHTING	1	LOCKERS	800	VA	0.95	760	800		
9	B	SPARE			0	w		0	0		
10	B	LIGHTING	1	NE ROOMS	300	VA	0.95	285	300		
11	C	SPARE			0	w		0	0		
12	C	LIGHTING	1	E. FOYER	1300	VA	0.95	1235	1300		
13	A	SPARE			0	w		0	0		
14	A	LIGHTING	1	RM. 217	1900	VA	0.95	1805	1900		
15	B	--			0	w		0	0		
16	B	LIGHTING	1	RM. 213	1300	VA	0.95	1235	1300		
17	C	--			0	w		0	0		
18	C	LIGHTING	1	RM. 212	700	VA	0.95	665	700		
19	A	SPARE			0	w		0	0		
20	A	LIGHTING	1	RM. 222	1700	VA	0.95	1615	1700		
21	B	SPARE			0	w		0	0		
22	B	ALC-2B	3	ELEC. CLOS	500	VA	1.00	500	500		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								19.1	19.7	Amps=	23.7

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					9.0	9.2	47%	33.2
PHASE TOTAL	B					2.7	2.8	14%	10.1
PHASE TOTAL	C					7.4	7.7	39%	27.8

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		10.5	11.1	1.25	13.2	13.9	0.95		
2	mechanical largest		8.1	8.1	1.25	10.1	10.1	1.00		
3	equipment		0.5	0.5	1.00	0.5	0.5	1.00		
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						23.8	24.5			
Spare Capacity			25%			6.0	6.1			
Total Design Loads						29.8	30.6	0.97	Amps=	36.9

EXISTING PANELBOARD NW03-E02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NW03-E	Panel Location:	ELEC. RM NW - LEVEL 03	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
2	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
3	B	LIGHTING	1	EGRESS	1300	va	0.95	1235	1300		
4	B	LIGHTING	1	EGRESS	1700	va	0.95	1615	1700		
5	C	LIGHTING	1	MECH. EMER	300	va	0.95	285	300		
6	C	LIGHTING	1	MECH. EMER	300	va	0.95	285	300		
7	A				0	w		0	0		
8	A				0	w		0	0		
9	B				0	w		0	0		
10	B				0	w		0	0		
11	C				0	w		0	0		
12	C				0	w		0	0		
13	A				0	w		0	0		
14	A				0	w		0	0		
15	B				0	w		0	0		
16	B				0	w		0	0		
17	C				0	w		0	0		
18	C				0	w		0	0		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								3.6	3.8	Amps=	4.6

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.2	0.2	5%	0.7
PHASE TOTAL	B					2.9	3.0	79%	10.8
PHASE TOTAL	C					0.6	0.6	16%	2.2

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		3.6	3.8	1.25	4.5	4.8	0.95		
2			0.0	0.0	0.00	0.0	0.0			
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						4.5	4.8			
Spare Capacity			25%			1.1	1.2			
Total Design Loads						5.6	5.9	0.95	Amps=	7.1

REVISED PANELBOARD NW03-E02

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NW03-E	Panel Location:	ELEC. RM NW - LEVEL 03	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100	
2	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100	
3	B	LIGHTING	1	EGRESS	1300	va	0.95	1235	1300	
4	B	LIGHTING	1	EGRESS	1630	va	0.95	1549	1630	
5	C	LIGHTING	1	MECH. EMER	300	va	0.95	285	300	
6	C	LIGHTING	1	MECH. EMER	300	va	0.95	285	300	
7	A				0	w		0	0	
8	A				0	w		0	0	
9	B				0	w		0	0	
10	B				0	w		0	0	
11	C				0	w		0	0	
12	C				0	w		0	0	
13	A				0	w		0	0	
14	A				0	w		0	0	
15	B				0	w		0	0	
16	B				0	w		0	0	
17	C				0	w		0	0	
18	C				0	w		0	0	
19	A				0	w		0	0	
20	A				0	w		0	0	
21	B				0	w		0	0	
22	B				0	w		0	0	
23	C				0	w		0	0	
24	C				0	w		0	0	
25	A				0	w		0	0	
26	A				0	w		0	0	
27	B				0	w		0	0	
28	B				0	w		0	0	
29	C				0	w		0	0	
30	C				0	w		0	0	
31	A				0	w		0	0	
32	A				0	w		0	0	
33	B				0	w		0	0	
34	B				0	w		0	0	
35	C				0	w		0	0	
36	C				0	w		0	0	
37	A				0	w		0	0	
38	A				0	w		0	0	
39	B				0	w		0	0	
40	B				0	w		0	0	
41	C				0	w		0	0	
42	C				0	w		0	0	
PANEL TOTAL								3.5	3.7	Amps= 4.5

PHASE LOADING							kW	kVA	%	Amps
PHASE TOTAL	A						0.2	0.2	5%	0.7
PHASE TOTAL	B						2.8	2.9	79%	10.6
PHASE TOTAL	C						0.6	0.6	16%	2.2

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		3.5	3.7	1.25	4.4	4.7	0.95		
2			0.0	0.0	0.00	0.0	0.0			
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						4.4	4.7			
Spare Capacity			50%			2.2	2.3			
Total Design Loads						6.6	7.0	0.95	Amps=	8.4

EXISTING PANELBOARD NEB1-N04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NEB1-N	Panel Location:	ELEC. RM NE LEVEL B1	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	SE OFFICES	3600	va	0.95	3420	3600		
2	A	LIGHTING	1	S & SE WAL	3100	va	0.95	2945	3100		
3	B	LIGHTING	1	ALCOVE	1000	va	0.95	950	1000		
4	B	LIGHTING	1	STACKS	2900	va	0.95	2755	2900		
5	C	LIGHTING	1	LIBR. RDG	2300	va	0.95	2185	2300		
6	C	LIGHTING	1	STACKS	3000	va	0.95	2850	3000		
7	A	LIGHTING	1	LIBR. RDG	1300	va	0.95	1235	1300		
8	A	LIGHTING	1	STACKS	3400	va	0.95	3230	3400		
9	B	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
10	B	LIGHTING	1	STACKS	2900	va	0.95	2755	2900		
11	C	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
12	C	LIGHTING	1	STACKS	2600	va	0.95	2470	2600		
13	A	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
14	A	LIGHTING	1	STACKS	3000	va	0.95	2850	3000		
15	B	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
16	B	LIGHTING	1	NE ROOMS	2600	va	0.95	2470	2600		
17	C	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
18	C	ALC-L1B	2	ELEC. RM	500	va	1.00	500	500		
19	A	LIGHTING	1	LIBR. RDG	1800	va	0.95	1710	1800		
20	A	SPARE			0	w		0	0		
21	B	LIGHTING	1	LIBR. RDG	2300	va	0.95	2185	2300		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	--			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	--			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	MECH FTU	3	EAST	6500	va	1.00	6500	6500		
38	A	SPARE			0	w		0	0		
39	B	--	3	EAST	4900	va	1.00	4900	4900		
40	B	SPARE			0	w		0	0		
41	C	--	3	EAST	4200	va	1.00	4200	4200		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								58.7	60.9	Amps=	73.3
PHASE LOADING								kW	kVA	%	Amps
PHASE TOTAL			A					23.6	24.5	40%	88.4
PHASE TOTAL			B					19.4	20.2	33%	72.9
PHASE TOTAL			C					15.6	16.2	27%	58.5
LOAD CATAGORIES				Connected			Demand				
				kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting			42.6	44.8	1.25	53.2	56.0	0.95		
2	equipment			0.5	0.5	1.00	0.5	0.5	1.00		
3	Mechanical (Largest)			15.6	15.6	1.25	19.5	19.5	1.00		
4				0.0	0.0	0.00	0.0	0.0			
5				0.0	0.0	0.00	0.0	0.0			
6				0.0	0.0	0.00	0.0	0.0			
7				0.0	0.0	0.00	0.0	0.0			
8				0.0	0.0	0.00	0.0	0.0			
Total Demand Loads							73.2	76.0			
Spare Capacity				25%			18.3	19.0			
Total Design Loads							91.5	95.0	0.96	Amps=	114.3

REVISED PANELBOARD NEB1-N04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	CB-NEB1-N	Panel Location:	ELEC. RM NE LEVEL B1	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	LIGHTING	1	SE OFFICES	3600	va	0.95	3420	3600	
2	A	LIGHTING	1	LIBRARY	1196	w	0.95	1196	1259	
3	B	LIGHTING	1	ALCOVE	1000	va	0.95	950	1000	
4	B	LIGHTING	1	STACKS	2900	va	0.95	2755	2900	
5	C	LIGHTING	1	LIBRARY	1196	w	0.95	1196	1259	
6	C	LIGHTING	1	STACKS	3000	va	0.95	2850	3000	
7	A	LIGHTING	1	LIBR. RDG	1300	va	0.95	1235	1300	
8	A	LIGHTING	1	STACKS	3400	va	0.95	3230	3400	
9	B	LIGHTING	1	LIBR. RDG	1752	w	0.95	1752	1844	
10	B	LIGHTING	1	STACKS	2900	va	0.95	2755	2900	
11	C	LIGHTING	1	LIBR. RDG	1752	w	0.95	1752	1844	
12	C	LIGHTING	1	STACKS	2600	va	0.95	2470	2600	
13	A	SPARE				va	0.95	0	0	
14	A	LIGHTING	1	STACKS	3000	va	0.95	2850	3000	
15	B	SPARE				va	0.95	0	0	
16	B	LIGHTING	1	NE ROOMS	2600	va	0.95	2470	2600	
17	C	SPARE				va	0.95	0	0	
18	C	ALC-L1B	2	ELEC. RM	500	va	1.00	500	500	
19	A	SPARE				va	0.95	0	0	
20	A	SPARE			0	w		0	0	
21	B	SPARE			0	va	0.95	0	0	
22	B	SPARE			0	w		0	0	
23	C	SPARE			0	w		0	0	
24	C	SPARE			0	w		0	0	
25	A	SPARE			0	w		0	0	
26	A	SPARE			0	w		0	0	
27	B	--			0	w		0	0	
28	B	SPARE			0	w		0	0	
29	C	--			0	w		0	0	
30	C	SPARE			0	w		0	0	
31	A	SPARE			0	w		0	0	
32	A	SPARE			0	w		0	0	
33	B	SPARE			0	w		0	0	
34	B	SPARE			0	w		0	0	
35	C	SPARE			0	w		0	0	
36	C	SPARE			0	w		0	0	
37	A	MECH FTU	3	EAST	6500	va	1.00	6500	6500	
38	A	SPARE			0	w		0	0	
39	B	--	3	EAST	4900	va	1.00	4900	4900	
40	B	SPARE			0	w		0	0	
41	C	--	3	EAST	4200	va	1.00	4200	4200	
42	C	SPARE			0	w		0	0	

PANEL TOTAL	47.0	48.6	Amps=	58.5

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					18.4	19.1	39%	68.8
PHASE TOTAL	B					15.6	16.1	33%	58.3
PHASE TOTAL	C					13.0	13.4	28%	48.4

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		30.9	32.5	1.25	38.6	40.6	0.95		
2	equipment		0.5	0.5	1.00	0.5	0.5	1.00		
3	Mechanical (Largest)		15.6	15.6	1.25	19.5	19.5	1.00		
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						58.6	60.6			
Spare Capacity			25%			14.7	15.2			
Total Design Loads						73.3	75.8	0.97	Amps=	91.2

EXISTING PANELBOARD NWB2-N03(2)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	-NWB2-N0	Panel Location:	PUMP ROOM	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
43	A	MECH FC-11	1	B2	800	va	1.00	800	800		
44	A	SPARE			0	w		0	0		
45	B	--	1	B2	800	va	1.00	800	800		
46	B	--			0	w		0	0		
47	C	--	1	B2	800	va	1.00	800	800		
48	C	--			0	w		0	0		
49	A	MECH FC-12	2	B2	800	va	1.00	800	800		
50	A	SPARE			0	w		0	0		
51	B	--	2	B2	800	va	1.00	800	800		
52	B	--			0	w		0	0		
53	C	--	2	B2	800	va	1.00	800	800		
54	C	--			0	w		0	0		
55	A	SPARE			0	w		0	0		
56	A	SPACE			0	w		0	0		
57	B	--			0	w		0	0		
58	B	--			0	w		0	0		
59	C	--			0	w		0	0		
60	C	--			0	w		0	0		
61	A	SPARE			0	w		0	0		
62	A	SPACE			0	w		0	0		
63	B	--			0	w		0	0		
64	B	--			0	w		0	0		
65	C	--			0	w		0	0		
66	C	--			0	w		0	0		
67	A	SPACE			0	w		0	0		
68	A	SPACE			0	w		0	0		
69	B	--			0	w		0	0		
70	B	--			0	w		0	0		
71	C	--			0	w		0	0		
72	C	--			0	w		0	0		
73	A	SPACE			0	w		0	0		
74	A	SPACE			0	w		0	0		
75	B	--			0	w		0	0		
76	B	--			0	w		0	0		
77	C	--			0	w		0	0		
78	C	--			0	w		0	0		
79	A	SPACE			0	w		0	0		
80	A	SPACE			0	w		0	0		
81	B	--			0	w		0	0		
82	B	--			0	w		0	0		
83	C	--			0	w		0	0		
84	C	--			0	w		0	0		
								4.8	4.8	Amps=	5.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					1.6	1.6	33%	5.8
PHASE TOTAL	B					1.6	1.6	33%	5.8
PHASE TOTAL	C					1.6	1.6	33%	5.8

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	mech largest		2.4	2.4	1.25	3.0	3.0	1.00		
2	mechanical		2.4	2.4	1.00	2.4	2.4	1.00		
3	fluorescent lighting		0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						5.4	5.4			
Spare Capacity			25%			1.4	1.4			
Total Design Loads						6.8	6.8	1.00	Amps=	8.1

REVISED PANELBOARD NWB2-N03(2)

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	-NWB2-N0	Panel Location:	PUMP ROOM	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
43	A	MECH FC-11	1	B2	800	va	1.00	800	800		
44	A	DIMMER RACK 1	3	LEVEL 01	1430	w	0.95	1430	1505		
45	B	--	1	B2	800	va	1.00	800	800		
46	B	--	3		1430	w	0.95	1430	1505		
47	C	--	1	B2	800	va	1.00	800	800		
48	C	--	3		1430	w	0.95	1430	1505		
49	A	MECH FC-12	2	B2	800	va	1.00	800	800		
50	A	SPARE			0	w		0	0		
51	B	--	2	B2	800	va	1.00	800	800		
52	B	--			0	w		0	0		
53	C	--	2	B2	800	va	1.00	800	800		
54	C	--			0	w		0	0		
55	A	SPARE			0	w		0	0		
56	A	SPACE			0	w		0	0		
57	B	--			0	w		0	0		
58	B	--			0	w		0	0		
59	C	--			0	w		0	0		
60	C	--			0	w		0	0		
61	A	SPARE			0	w		0	0		
62	A	SPACE			0	w		0	0		
63	B	--			0	w		0	0		
64	B	--			0	w		0	0		
65	C	--			0	w		0	0		
66	C	--			0	w		0	0		
67	A	SPACE			0	w		0	0		
68	A	SPACE			0	w		0	0		
69	B	--			0	w		0	0		
70	B	--			0	w		0	0		
71	C	--			0	w		0	0		
72	C	--			0	w		0	0		
73	A	SPACE			0	w		0	0		
74	A	SPACE			0	w		0	0		
75	B	--			0	w		0	0		
76	B	--			0	w		0	0		
77	C	--			0	w		0	0		
78	C	--			0	w		0	0		
79	A	SPACE			0	w		0	0		
80	A	SPACE			0	w		0	0		
81	B	--			0	w		0	0		
82	B	--			0	w		0	0		
83	C	--			0	w		0	0		
84	C	--			0	w		0	0		
								9.1	9.3	Amps=	11.2

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					3.0	3.1	33%	11.2
PHASE TOTAL	B					3.0	3.1	33%	11.2
PHASE TOTAL	C					3.0	3.1	33%	11.2

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	mech largest		2.4	2.4	1.25	3.0	3.0	1.00		
2	mechanical		2.4	2.4	1.00	2.4	2.4	1.00		
3	fluorescent lighting		4.3	4.5	1.25	5.4	5.6	0.95		
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						10.8	11.0			
Spare Capacity			25%			2.7	2.8			
Total Design Loads						13.5	13.8	0.97	Amps=	16.6

EXISTING PANELBOARD NWB2-N08

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NWB2-N	Panel Location:	ELEC. RM - LEVEL B2	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	SPARE			0	w		0	0	
2	A	LIGHTING	1	W STORAG	1800	va	0.95	1710	1800	
3	B	SPARE			0	w		0	0	
4	B	LIGHTING	1	S. STACKS	3500	va	0.95	3325	3500	
5	C	SPARE			0	w		0	0	
6	C	LIGHTING	1	SE. OFFICES	2000	va	0.95	1900	2000	
7	A	SPARE			0	w		0	0	
8	A	LIGHTING	1	STACKS	3400	va	0.95	3230	3400	
9	B	SPARE			0	w		0	0	
10	B	LIGHTING	1	STACKS	3300	va	0.95	3135	3300	
11	C	SPARE			0	w		0	0	
12	C	LIGHTING	1	STACKS	3300	va	0.95	3135	3300	
13	A	SPARE			0	w		0	0	
14	A	LIGHTING	1	STACKS	2900	va	0.95	2755	2900	
15	B	SPARE			0	w		0	0	
16	B	LIGHTING	1	STACKS	2000	va	0.95	1900	2000	
17	C	SPARE			0	w		0	0	
18	C	LIGHTING	1	STACKS	2700	va	0.95	2565	2700	
19	A	SPARE			0	w		0	0	
20	A	LIGHTING	1	CORRIDOR	3600	va	0.95	3420	3600	
21	B	SPARE			0	w		0	0	
22	B	LIGHTING	1	N. ROOMS	3500	va	0.95	3325	3500	
23	C	SPARE			0	w		0	0	
24	C	LIGHTING	1	L201, L202	2000	va	0.95	1900	2000	
25	A	SPARE			0	w		0	0	
26	A	ALC-L2A	2	ELEC. RM	500	va	1.00	500	500	
27	B	SPARE			0	w		0	0	
28	B	ALC-L2B	2	ELEC. RM	500	va	1.00	500	500	
29	C	SPARE			0	w		0	0	
30	C	SPARE			0	w		0	0	
31	A	SPARE			0	w		0	0	
32	A	SPARE			0	w		0	0	
33	B	SPARE			0	w		0	0	
34	B	SPARE			0	w		0	0	
35	C	SPARE			0	w		0	0	
36	C	SPARE			0	w		0	0	
37	A	SPARE			0	w		0	0	
38	A	SPARE			0	w		0	0	
39	B	SPARE			0	w		0	0	
40	B	SPARE			0	w		0	0	
41	C	SPARE			0	w		0	0	
42	C	SPARE			0	w		0	0	

PANEL TOTAL							33.3	35.0	Amps=	42.1
PHASE LOADING							kW	kVA	%	Amps
PHASE TOTAL		A					11.6	12.2	35%	44.0
PHASE TOTAL		B					12.2	12.8	37%	46.2
PHASE TOTAL		C					9.5	10.0	29%	36.1
LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		32.3	34.0	1.25	40.4	42.5	0.95		
2	equipment		1.0	1.0	1.00	1.0	1.0	1.00		
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						41.4	43.5			
Spare Capacity			25%			10.3	10.9			
Total Design Loads						51.7	54.4	0.95	Amps=	65.4

REVISED PANELBOARD NWB2-E08

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag-------------------------->	CB-NWB2-N	Panel Location:	ELEC. RM - LEVEL B2	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	SPARE			0	w		0	0	
2	A	LIGHTING	1	W STORAG	1800	va	0.95	1710	1800	
3	B	SPARE			0	w		0	0	
4	B	LIGHTING	1	S. STACKS	2160	w	0.95	2160	2274	
5	C	SPARE			0	w		0	0	
6	C	LIGHTING	1	SE. OFFICES	2000	va	0.95	1900	2000	
7	A	SPARE			0	w		0	0	
8	A	LIGHTING	1	STACKS	3400	va	0.95	3230	3400	
9	B	SPARE			0	w		0	0	
10	B	LIGHTING	1	STACKS	3300	va	0.95	3135	3300	
11	C	SPARE			0	w		0	0	
12	C	LIGHTING	1	STACKS	3300	va	0.95	3135	3300	
13	A	SPARE			0	w		0	0	
14	A	LIGHTING	1	STACKS	2900	va	0.95	2755	2900	
15	B	SPARE			0	w		0	0	
16	B	LIGHTING	1	STACKS	2000	va	0.95	1900	2000	
17	C	SPARE			0	w		0	0	
18	C	LIGHTING	1	STACKS	2700	va	0.95	2565	2700	
19	A	SPARE			0	w		0	0	
20	A	LIGHTING	1	CORRIDOR	2000	va	0.95	1900	2000	
21	B	SPARE			0	w		0	0	
22	B	LIGHTING	1	N. ROOMS	3500	va	0.95	3325	3500	
23	C	SPARE			0	w		0	0	
24	C	LIGHTING	1	L201, L202	2000	va	0.95	1900	2000	
25	A	SPARE			0	w		0	0	
26	A	ALC-L2A	2	ELEC. RM	500	va	1.00	500	500	
27	B	SPARE			0	w		0	0	
28	B	ALC-L2B	2	ELEC. RM	500	va	1.00	500	500	
29	C	SPARE			0	w		0	0	
30	C	LIGHTING	1	LIBR. RDG	1380	w	0.95	1380	1453	
31	A	SPARE			0	w		0	0	
32	A	SPARE			0	w		0	0	
33	B	SPARE			0	w		0	0	
34	B	SPARE			0	w		0	0	
35	C	SPARE			0	w		0	0	
36	C	SPARE			0	w		0	0	
37	A	SPARE			0	w		0	0	
38	A	SPARE			0	w		0	0	
39	B	SPARE			0	w		0	0	
40	B	SPARE			0	w		0	0	
41	C	SPARE			0	w		0	0	
42	C	SPARE			0	w		0	0	

PANEL TOTAL						32.0	33.6	Amps=	40.5
PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					10.1	10.6	32%	38.3
PHASE TOTAL	B					11.0	11.6	34%	41.8
PHASE TOTAL	C					10.9	11.5	34%	41.3

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		31.0	32.6	1.25	38.7	40.8	0.95		
2	equipment		1.0	1.0	1.00	1.0	1.0	1.00		
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						39.7	41.8			
Spare Capacity			50%			19.9	20.9			
Total Design Loads						59.6	62.7	0.95	Amps=	75.4

EXISTING PANELBOARD NWB2-E04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NWB2-E	Panel Location:	MAIN ELEC. RM - LEVEL B2	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
2	A	LIGHTING	1	STAIR 2	800	va	0.95	760	800		
3	B	LIGHTING	1	EGRESS	1800	va	0.95	1710	1800		
4	B	LIGHTING	1	STAIR 3	600	va	0.95	570	600		
5	C	LIGHTING	1	MECH/ELEC	1400	va	0.95	1330	1400		
6	C	SPARE			0	w		0	0		
7	A	SPARE			0	w		0	0		
8	A	SPARE			0	w		0	0		
9	B	SPARE			0	w		0	0		
10	B	SPARE			0	w		0	0		
11	C	SPARE			0	w		0	0		
12	C	SPARE			0	w		0	0		
13	A	SPARE			0	w		0	0		
14	A	SPARE			0	w		0	0		
15	B	SPARE			0	w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPARE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPARE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								4.5	4.7	Amps=	5.7

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.9	0.9	19%	3.2
PHASE TOTAL	B					2.3	2.4	51%	8.7
PHASE TOTAL	C					1.3	1.4	30%	5.1

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		4.5	4.7	1.25	5.6	5.9	0.95		
2			0.0	0.0	0.00	0.0	0.0			
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						5.6	5.9			
Spare Capacity			25%			1.4	1.5			
Total Design Loads						7.0	7.3	0.95	Amps=	8.8

REVISED PANELBOARD NWB2-N04

LIGHTING AND APPLIANCE PANELBOARD SIZING WORKSHEET

Panel Tag------------------------->	CB-NWB2-E	Panel Location:	MAIN ELEC. RM - LEVEL B2	
Nominal Phase to Neutral Voltage------->	277	Phase:	3	
Nominal Phase to Phase Voltage-------->	480	Wires:	4	

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	LIGHTING	1	EXIT SIGNS	100	va	0.95	95	100		
2	A	LIGHTING	1	STAIR 2	800	va	0.95	760	800		
3	B	LIGHTING	1	EGRESS	1900	va	0.95	1805	1900		
4	B	LIGHTING	1	STAIR 3	600	va	0.95	570	600		
5	C	LIGHTING	1	MECH/ELEC	1400	va	0.95	1330	1400		
6	C	SPARE			0	w		0	0		
7	A	SPARE			0	w		0	0		
8	A	SPARE			0	w		0	0		
9	B	SPARE			0	w		0	0		
10	B	SPARE			0	w		0	0		
11	C	SPARE			0	w		0	0		
12	C	SPARE			0	w		0	0		
13	A	SPARE			0	w		0	0		
14	A	SPARE			0	w		0	0		
15	B	SPARE			0	w		0	0		
16	B	SPARE			0	w		0	0		
17	C	SPARE			0	w		0	0		
18	C	SPARE			0	w		0	0		
19	A	SPARE			0	w		0	0		
20	A	SPARE			0	w		0	0		
21	B	SPARE			0	w		0	0		
22	B	SPARE			0	w		0	0		
23	C	SPARE			0	w		0	0		
24	C	SPARE			0	w		0	0		
25	A	SPARE			0	w		0	0		
26	A	SPARE			0	w		0	0		
27	B	SPARE			0	w		0	0		
28	B	SPARE			0	w		0	0		
29	C	SPARE			0	w		0	0		
30	C	SPARE			0	w		0	0		
31	A	SPARE			0	w		0	0		
32	A	SPARE			0	w		0	0		
33	B	SPARE			0	w		0	0		
34	B	SPARE			0	w		0	0		
35	C	SPARE			0	w		0	0		
36	C	SPARE			0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								4.6	4.8	Amps=	5.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.9	0.9	19%	3.2
PHASE TOTAL	B					2.4	2.5	52%	9.0
PHASE TOTAL	C					1.3	1.4	29%	5.1

LOAD CATAGORIES			Connected			Demand				
			kW	kVA	DF	kW	kVA	PF		
1	fluorescent lighting		4.6	4.8	1.25	5.7	6.0	0.95		
2			0.0	0.0	0.00	0.0	0.0			
3			0.0	0.0	0.00	0.0	0.0			
4			0.0	0.0	0.00	0.0	0.0			
5			0.0	0.0	0.00	0.0	0.0			
6			0.0	0.0	0.00	0.0	0.0			
7			0.0	0.0	0.00	0.0	0.0			
8			0.0	0.0	0.00	0.0	0.0			
Total Demand Loads						5.7	6.0			
Spare Capacity			50%			2.9	3.0			
Total Design Loads						8.6	9.0	0.95	Amps=	10.8

Conduit Sizing Worksheets

Conduit Sizing Worksheet - 60A Panel

Total Cross Sectional of Wire Area	0.2239	sq. inches
Calculated EMT Conduit Size (minimum size is 3/4")	1	" EMT
Calculated IMC Conduit Size (minimum size is 3/4")	3/4	" IMC
Calculated RMC Conduit Size (minimum size is 3/4")	1	" RMC
Calculated RNC Conduit Size (minimum size is 3/4")	1	" RNC

Ref: 2005 NEC, Tables 4, 5 and 8

									Totals	
Wize Size	TW, THW		THWN, THHN		XHHW		Bare Wire		No.	Area
	No.	Area	No.	Area	No.	Area	No.	Area		
14		0.0139		0.0097		0.0139		0.004	0	0
12		0.0181		0.0133		0.0181		0.006	0	0
10		0.0243	1	0.0211		0.0243		0.011	1	0.0211
8		0.0437		0.0366		0.0437		0.017	0	0
6		0.0726	4	0.0507		0.0590		0.027	4	0.2028
4		0.0973		0.0824		0.0814		0.042	0	0
3		0.1134		0.0973		0.0962		0.053	0	0
2		0.1333		0.1158		0.1146		0.067	0	0
1		0.1901		0.1562		0.1534		0.087	0	0
1/0		0.2223		0.1855		0.1825		0.109	0	0
2/0		0.2624		0.2223		0.2190		0.137	0	0
3/0		0.3117		0.2679		0.2642		0.173	0	0
4/0		0.3718		0.3237		0.3197		0.219	0	0
250		0.4596		0.3970		0.3904		0.260	0	0
300		0.5281		0.4608		0.4536		0.312	0	0
350		0.5958		0.5242		0.5166		0.364	0	0
400		0.6619		0.5863		0.5782		0.416	0	0
500		0.7901		0.7073		0.6984		0.519	0	0
600		0.9729		0.8676		0.8709		0.626	0	0
700		1.1010		0.9887		0.9923		0.730	0	0
750		1.1652		1.0496		1.0532		0.782	0	0
800		1.2272		1.1085		1.1122		0.834	0	0
900		1.3561		1.2311		1.2351		0.940	0	0
1000		1.4784		1.3478		1.3519		1.042	0	0
Totals	0		5		0		0		5	0.2239

Note: "ERROR" indicates conduit size larger than 4" is required.

Conduit Sizing Worksheet - 150A Panel

Total Cross Sectional of Wire Area	0.7927	sq. inches
Calculated EMT Conduit Size (minimum size is 3/4")	1 1/2	" EMT
Calculated IMC Conduit Size (minimum size is 3/4")	1 1/2	" IMC
Calculated RMC Conduit Size (minimum size is 3/4")	1 1/2	" RMC
Calculated RNC Conduit Size (minimum size is 3/4")	1 1/2	" RNC

Ref: 2005 NEC, Tables 4, 5 and 8

									Totals	
Wize Size	TW, THW		THWN, THHN		XHHW		Bare Wire		No.	Area
	No.	Area	No.	Area	No.	Area	No.	Area		
14		0.0139		0.0097		0.0139		0.004	0	0
12		0.0181		0.0133		0.0181		0.006	0	0
10		0.0243		0.0211		0.0243		0.011	0	0
8		0.0437		0.0366		0.0437		0.017	0	0
6		0.0726	1	0.0507		0.0590		0.027	1	0.0507
4		0.0973		0.0824		0.0814		0.042	0	0
3		0.1134		0.0973		0.0962		0.053	0	0
2		0.1333		0.1158		0.1146		0.067	0	0
1		0.1901		0.1562		0.1534		0.087	0	0
1/0		0.2223	4	0.1855		0.1825		0.109	4	0.742
2/0		0.2624		0.2223		0.2190		0.137	0	0
3/0		0.3117		0.2679		0.2642		0.173	0	0
4/0		0.3718		0.3237		0.3197		0.219	0	0
250		0.4596		0.3970		0.3904		0.260	0	0
300		0.5281		0.4608		0.4536		0.312	0	0
350		0.5958		0.5242		0.5166		0.364	0	0
400		0.6619		0.5863		0.5782		0.416	0	0
500		0.7901		0.7073		0.6984		0.519	0	0
600		0.9729		0.8676		0.8709		0.626	0	0
700		1.1010		0.9887		0.9923		0.730	0	0
750		1.1652		1.0496		1.0532		0.782	0	0
800		1.2272		1.1085		1.1122		0.834	0	0
900		1.3561		1.2311		1.2351		0.940	0	0
1000		1.4784		1.3478		1.3519		1.042	0	0
Totals	0		5		0		0		5	0.7927

Note: "ERROR" indicates conduit size larger than 4" is required.

Conduit Sizing Worksheet - 225A Panel

Total Cross Sectional of Wire Area	1.3772	sq. inches
Calculated EMT Conduit Size (minimum size is 3/4")	2 1/2	" EMT
Calculated IMC Conduit Size (minimum size is 3/4")	2	" IMC
Calculated RMC Conduit Size (minimum size is 3/4")	2 1/2	" RMC
Calculated RNC Conduit Size (minimum size is 3/4")	2 1/2	" RNC
Ref: 2005 NEC, Tables 4, 5 and 8		

									Totals	
Wize Size	TW, THW		THWN, THHN		XHHW		Bare Wire		No.	Area
	No.	Area	No.	Area	No.	Area	No.	Area		
14		0.0139		0.0097		0.0139		0.004	0	0
12		0.0181		0.0133		0.0181		0.006	0	0
10		0.0243		0.0211		0.0243		0.011	0	0
8		0.0437		0.0366		0.0437		0.017	0	0
6		0.0726		0.0507		0.0590		0.027	0	0
4		0.0973	1	0.0824		0.0814		0.042	1	0.0824
3		0.1134		0.0973		0.0962		0.053	0	0
2		0.1333		0.1158		0.1146		0.067	0	0
1		0.1901		0.1562		0.1534		0.087	0	0
1/0		0.2223		0.1855		0.1825		0.109	0	0
2/0		0.2624		0.2223		0.2190		0.137	0	0
3/0		0.3117		0.2679		0.2642		0.173	0	0
4/0		0.3718	4	0.3237		0.3197		0.219	4	1.2948
250		0.4596		0.3970		0.3904		0.260	0	0
300		0.5281		0.4608		0.4536		0.312	0	0
350		0.5958		0.5242		0.5166		0.364	0	0
400		0.6619		0.5863		0.5782		0.416	0	0
500		0.7901		0.7073		0.6984		0.519	0	0
600		0.9729		0.8676		0.8709		0.626	0	0
700		1.1010		0.9887		0.9923		0.730	0	0
750		1.1652		1.0496		1.0532		0.782	0	0
800		1.2272		1.1085		1.1122		0.834	0	0
900		1.3561		1.2311		1.2351		0.940	0	0
1000		1.4784		1.3478		1.3519		1.042	0	0
Totals	0		5		0		0		5	1.3772

Note: "ERROR" indicates conduit size larger than 4" is required.

Conduit Sizing Worksheet - 400A Panel

Total Cross Sectional of Wire Area	1.1874	sq. inches
Calculated EMT Conduit Size (minimum size is 3/4")	2	" EMT
Calculated IMC Conduit Size (minimum size is 3/4")	2	" IMC
Calculated RMC Conduit Size (minimum size is 3/4")	2	" RMC
Calculated RNC Conduit Size (minimum size is 3/4")	2	" RNC

Ref: 2005 NEC, Tables 4, 5 and 8

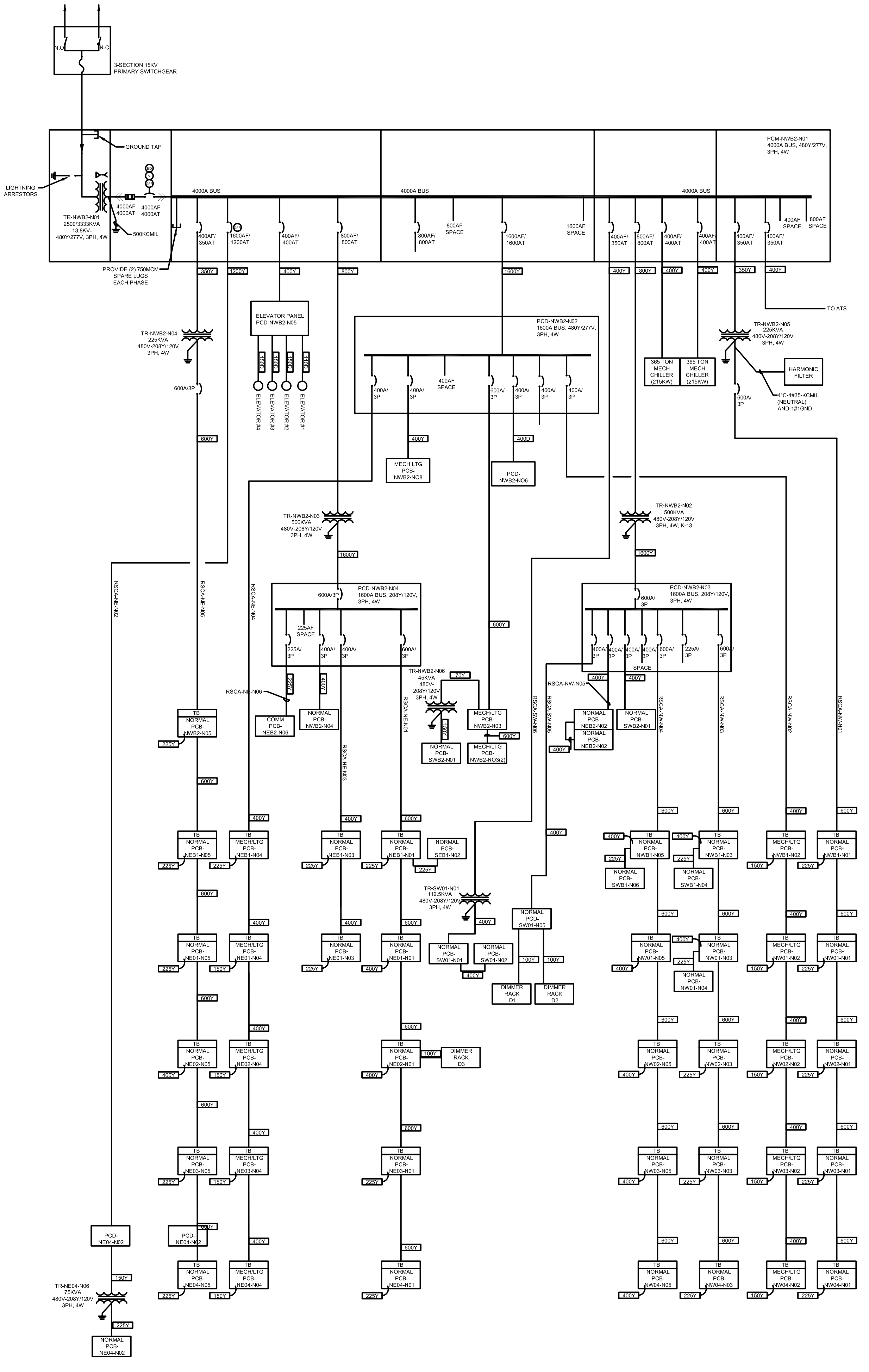
									Totals	
Wize Size	TW, THW		THWN, THHN		XHHW		Bare Wire		No.	Area
	No.	Area	No.	Area	No.	Area	No.	Area		
14		0.0139		0.0097		0.0139		0.004	0	0
12		0.0181		0.0133		0.0181		0.006	0	0
10		0.0243		0.0211		0.0243		0.011	0	0
8		0.0437		0.0366		0.0437		0.017	0	0
6		0.0726		0.0507		0.0590		0.027	0	0
4		0.0973		0.0824		0.0814		0.042	0	0
3		0.1134		0.0973		0.0962		0.053	0	0
2		0.1333	1	0.1158		0.1146		0.067	1	0.1158
1		0.1901		0.1562		0.1534		0.087	0	0
1/0		0.2223		0.1855		0.1825		0.109	0	0
2/0		0.2624		0.2223		0.2190		0.137	0	0
3/0		0.3117	4	0.2679		0.2642		0.173	4	1.0716
4/0		0.3718		0.3237		0.3197		0.219	0	0
250		0.4596		0.3970		0.3904		0.260	0	0
300		0.5281		0.4608		0.4536		0.312	0	0
350		0.5958		0.5242		0.5166		0.364	0	0
400		0.6619		0.5863		0.5782		0.416	0	0
500		0.7901		0.7073		0.6984		0.519	0	0
600		0.9729		0.8676		0.8709		0.626	0	0
700		1.1010		0.9887		0.9923		0.730	0	0
750		1.1652		1.0496		1.0532		0.782	0	0
800		1.2272		1.1085		1.1122		0.834	0	0
900		1.3561		1.2311		1.2351		0.940	0	0
1000		1.4784		1.3478		1.3519		1.042	0	0
Totals	0		5		0		0		5	1.1874

Note: "ERROR" indicates conduit size larger than 4" is required.

Appendix C

Existing One-Line Diagram

FIGURE 3.1 -EXISTIG ONE LINE DIAGRAM



Feeder Schedule

FEEDER SCHEDULE

FEEDER NUMBER	NO. OF RACEWAYS	RACEWAY SIZE	CONDUCTORS (PER RACEWAY)			FEEDER NUMBER	NO. OF RACEWAYS	RACEWAY SIZE	CONDUCTORS (PER RACEWAY)		
			PHASE	NEUTRAL	GROUND				PHASE	NEUTRAL	GROUND
3 PHASE, 3 WIRE, WITH GROUND - SERIES D:						3 PHASE,4 WIRE, WITH GROUND - SERIES Y:					
25D	1	3/4"	3#10	-	1#10	50Y	1	1-1/4"	3#6	1#6	1#10
50D	1	1"	3#6	-	1#10	70Y	1	1-1/4"	3#4	1#4	1#8
75D	1	1-1/4"	3#4	-	1#8	100Y	1	2"	3#3	1#3	1#8
110D	1	1-1/2"	3#1	-	1#6	125Y	1	2"	3#1	1#1	1#6
150D	1	1-1/2"	3# 1/0	-	1#6	150Y	1	2"	3#1/0	1#1/0	1#6
175D	1	2"	3# 2/0	-	1#6	175Y	1	2"	3#2/0	1#2/0	1#6
225D	1	2"	3# 4/0	-	1#4	200Y	1	2	3#3/0	1#3/0	1#6
250D	1	2-1/2"	3#250KCMIL	-	1#4	225Y	1	2-1/2"	3#4/0	1#4/0	1#4
350D	1	4"	3#250KCMIL	-	1#2	350Y	1	3"	3#500KCMIL	1#500KCMIL	1#3
400D	2	2"	3# 3/0	-	1#2	400Y	2	2-1/2"	3#3/0	1#3/0	1#2
600D	2	3"	3#350KCMIL	-	1#1	500Y	2	2-1/2"	3#250KCMIL	1#250KCMIL	1#2
800D	3	2-1/2"	3#300KCMIL	-	1#1/0	600Y	2	3"	3#350KCMIL	1#350KCMIL	1#1
1200D	4	3"	3#350KCMIL	-	1#3/0	800Y	3	3"	3#300KCMIL	1#300KCMIL	1#1/0
400D	2	2"	3# 3/0	-	1#2	1200Y	4	3"	3#350KCMIL	1#350KCMIL	1#3/0
800D	3	2-1/2"	3#300KCMIL	-	1#1/0	1600Y	5	3-1/2"	3#500KCMIL	1#500KCMIL	1#4/0
1200D	4	3"	3#350KCMIL	-	1#3/0	2000Y	6	3-1/2"	3#500KCMIL	1#500KCMIL	1#250KCMIL
1600D	5	4"	3#500KCMIL	-	1#4/0						

FEEDER NUMBER	NO. OF RACEWAYS	RACEWAY SIZE	CONDUCTORS (PER RACEWAY)		
			PHASE	NEUTRAL	GROUND
3 PHASE, 4 WIRE, DOUBLE NEUT, GRD & ISOL GRD - SERIES C:					
100C	1	2"	3#1	2#1	2#8
150C	1	2-1/2"	3#1/0	2#1/0	2#6
225C	1	2-1/2"	3#4/0	2#4/0	2#4
250C	1	3"	3#250KCMIL	2#250KCMIL	2#4
400C	2	3"	3#4/0	2#4/0	2#2
500C	2	3"	3#250KCMIL	2#250KCMIL	2#2
600C	2	3-1/2"	3#350KCMIL	2#350KCMIL	2#1
1600C	5	5"	3#600KCMIL	2#600KCMIL	2#4/0

Transformers

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K Factor Transformers

Three-Phase, Type KT, 60 Hz, for Non-Linear Loads

Type KT

Product Description

- Suitable for indoor or outdoor applications (with weathershield).
- Ventilated enclosures (DT-3).
- 220°C Insulation system, 150°C Rise standard (self extinguishing).
- Type DT-3 is available in ratings of 15 – 1000 kVA and up to 4160 volts.

Application Description

Cutler-Hammer KT Transformers by Eaton Corporation include several major design improvements that address the problems caused by non-linear loads and harmonics. They are designed to withstand the effects of harmonic currents without exceeding the temperature rating of the insulation system. The KT design compensates for the stresses on a transformer's winding insulation which prevents insulation breakdown and premature failure. The net result is longer transformer life.

Design Features

Core

A high grade, nonaging, grain-oriented silicon steel with high magnetic permeability provides reduced core induction levels, preventing saturation as a result of the higher frequency harmonics and resultant peak voltages. In a core approaching saturation, the current in the coil will increase as voltage drops because the core cannot absorb the additional magnetic flux. This core also provides reduced eddy currents or induced currents in the steel caused by the high ratios of peak-to-rms currents and voltages found in harmonic loads.

Coils

Windings are continuous wound aluminum or optional copper construction sized and configured to reduce overheating caused by harmonic currents. These coils reduce skin and proximity effect losses which occur when current carrying conductors next to each other and coiled around steel generate magnetic fields. These magnetic fields push the currents in the conductors away from each other causing increased losses and additional heating.

Neutral Bus

The neutral bus is sized and configured to accommodate at least 200% of the rated current. This compensates for the increased neutral currents found in non-linear loads thus reducing heat.

The K Factor

A common industry term for the amount of harmonics produced by a given load is the K Factor. The larger the K Factor, the more harmonics are present. Linear loads, for example have a K Factor of 1. Transformers may carry a K Factor rating to define the transformer's ability to withstand the additional heating generated by harmonic currents.

Calculating the K Factor

All nonlinear waveforms can be broken down mathematically into a fundamental frequency and its harmonics. IEEE C57.110 establishes a direct relationship between these harmonics and transformer heating. Underwriters Laboratories has established a similar relation-ship, the K Factor, which is derived by summing the square of the percentage current at a given harmonic level multiplied by the square of the harmonic order.

$K = \sum({}^{I}h)^2(h)^2$

Ih = Percent Current at Harmonic h

h = Harmonic Order, i.e., 3rd, 5th, 7th

For example, a load that is 90% of the fundamental, 30% of the third harmonic, and 20% of the fifth harmonic would yield $(.9)^2(1)^2 + (.3)^2(3)^2 + (.2)^2(5)^2$ or a K Factor of 2.62. This load would require an Eaton's Cutler-Hammer KT-4 Transformer with a K Factor rating of 4.

Transformers that carry a K Factor rating define the transformer's ability to withstand a given harmonic load while operating within the transformer's insulation class.

An analysis of harmonic loads and a calculation of the K Factor must be made to properly apply transformers in any building or facility. Note that the calculated K Factor is not constant since non-linear loads change throughout the day as equipment and lighting is turned off and on. These harmonic loads also change over the life of the building or facility as equipment is added or removed.

Harmonic Currents

Harmonic currents are found in nonlinear loads. These currents are generated by various types of equipment including switching mode power supplies that abruptly switch current on and off during each line cycle. Switching mode power supplies or diodecapacitor

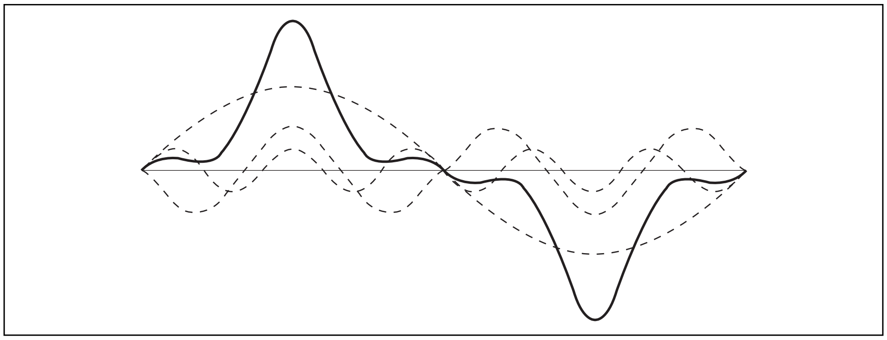

Figure 9-1. Harmonic currents found in non-linear loads cause wave shape distortion and create added stresses on transformers.

Three-Phase

Table 9-41. Type KT-13 — Transformers for Non-Sinusoidal Current Loads with K Factor Up to 13

kVA	Full Cap. Taps		Type	°C Temp. Rise	Dimensions (Inches)			Wt. Lbs.	Dimensions (mm)			Wt. kg	Frame	Wiring Diagram Number	Weathershield		Catalog Number	Price U.S. $
	FCAN	FCBN			H	W	D		H	W	D				Catalog Number	Price U.S. $		
480 △ Volts to 208Y/120 Volts																		
15	2@+2.5%	4@-2.5%	KT	150	30-1/8	20-1/8	14-1/8	230	765	511	359	104	FR910A	283B	**WS31**	350.	**N48M28T15A**	1,970.
30	2@+2.5%	4@-2.5%	KT	150	30-1/8	20-1/8	14-1/8	310	765	511	359	140	FR912A	283B	**WS31**	350.	**N48M28T30A**	2,845.
45	2@+2.5%	4@-2.5%	KT	150	39-3/8	26-1/8	19-1/8	480	1000	663	485	217	FR914B	283B	**WS33**	350.	**N48M28T45A**	3,370.
75	2@+2.5%	4@-2.5%	KT	150	39-3/8	26-1/8	19-1/8	600	1000	663	485	272	FR915B	283B	**WS33**	350.	**N48M28T75A**	4,660.
112.5	2@+2.5%	4@-2.5%	KT	150	46-1/8	28	23	760	1171	712	585	344	FR916A	283B	**WS19**	350.	**N48M28T12A**	6,535.
150	2@+2.5%	4@-2.5%	KT	150	56	31-1/4	24-1/4	1100	1422	793	616	499	FR917	283B	**WS34**	800.	**N48M28T49A**	8,780.
225	2@+2.5%	4@-2.5%	KT	150	62-1/4	31-1/4	30-1/4	1600	1581	794	768	728	FR918A	283B	**WS34**	800.	**N48M28T22A**	12,140.
300	2@+2.5%	4@-2.5%	KT	150	75	44-1/2	36	2400	1905	1130	914	1088	FR919	292A	**WS35**	1,360.	**N48M28T33A**	17,870.
500	2@+2.5%	4@-2.5%	KT	150	90	69	42	4500	2286	1752	1066	2041	FR922	292A	**WS36**	1,360.	**N48M28T55A**	27,570.
15	2@+2.5%	4@-2.5%	KT	115	30-1/8	20-1/8	14-1/8	230	765	511	359	104	FR910A	283B	**WS31**	350.	**N48M28F15A**	2,410.
30	2@+2.5%	4@-2.5%	KT	115	30-1/8	20-1/8	14-1/8	310	765	511	359	140	FR912A	283B	**WS31**	350.	**N48M28F30A**	2,985.
45	2@+2.5%	4@-2.5%	KT	115	39-3/8	26-1/8	19-1/8	480	1000	663	485	217	FR914B	283B	**WS33**	350.	**N48M28F45A**	3,890.
75	2@+2.5%	4@-2.5%	KT	115	39-3/8	26-1/8	19-1/8	600	1000	663	485	272	FR915B	283B	**WS33**	350.	**N48M28F75A**	5,315.
112.5	2@+2.5%	4@-2.5%	KT	115	46-1/8	28	23	760	1171	712	585	344	FR916A	283B	**WS19**	350.	**N48M28F12A**	8,120.
150	2@+2.5%	4@-2.5%	KT	115	56	31-1/4	24-1/4	1100	1422	793	616	499	FR917	283B	**WS34**	800.	**N48M28F49A**	9,560.
225	2@+2.5%	4@-2.5%	KT	115	62-1/4	31-1/4	30-1/4	1600	1581	794	768	728	FR918A	283B	**WS34**	800.	**N48M28F22A**	13,390.
300	2@+2.5%	4@-2.5%	KT	115	75	44-1/2	36	2400	1905	1130	914	1088	FR919	292A	**WS35**	1,360.	**N48M28F33A**	20,100.
500	2@+2.5%	4@-2.5%	KT	115	90	69	42	4500	2286	1752	1066	2041	FR922	292A	**WS36**	1,360.	**N48M28F55A**	30,400.
15	2@+2.5%	4@-2.5%	KT	80	30-1/8	20-1/8	14-1/8	230	765	511	359	104	FR910A	283B	**WS31**	350.	**N48M28B15A**	2,840.
30	2@+2.5%	4@-2.5%	KT	80	30-1/8	20-1/8	14-1/8	310	765	511	359	140	FR912A	283B	**WS31**	350.	**N48M28B30A**	3,730.
45	2@+2.5%	4@-2.5%	KT	80	39-3/8	26-1/8	19-1/8	480	1000	663	485	217	FR914B	283B	**WS33**	350.	**N48M28B45A**	4,755.
75	2@+2.5%	4@-2.5%	KT	80	46-1/8	28	23	760	1171	712	585	344	FR916A	283B	**WS33**	350.	**N48M28B75A**	6,160.
112.5	2@+2.5%	4@-2.5%	KT	80	56	31-1/4	24-1/4	1100	1422	793	616	499	FR917	283B	**WS19**	350.	**N48M28B12A**	8,840.
150	2@+2.5%	4@-2.5%	KT	80	62-1/4	31-1/4	30-1/4	1600	1581	794	768	728	FR918A	283B	**WS34**	800.	**N48M28B49A**	12,565.
225	2@+2.5%	4@-2.5%	KT	80	75	44-1/2	36	2400	1905	1130	914	1088	FR919	292A	**WS35**	1,360.	**N48M28B22A**	17,140.
300	2@+2.5%	4@-2.5%	KT	80	75	44-1/2	36	3600	1905	1130	914	1636	FR919	292A	**WS35**	1,360.	**N48M28B33CU**	26,780.
480 △ Volts to 208Y/120 Volts (Copper Windings)																		
15	2@+2.5%	4@-2.5%	KT	150	30-1/8	20-1/8	14-1/8	300	65	511	359	136	FR910A	283B	**WS31**	350.	**N48M28T15CU**	2,540.
30	2@+2.5%	4@-2.5%	KT	150	30-1/8	20-1/8	14-1/8	370	765	511	359	168	FR912A	283B	**WS31**	350.	**N48M28T30CU**	2,890.
45	2@+2.5%	4@-2.5%	KT	150	39-3/8	26-1/8	19-1/8	575	1000	663	485	261	FR914B	283B	**WS33**	350.	**N48M28T45CU**	4,270.
75	2@+2.5%	4@-2.5%	KT	150	39-3/8	26-1/8	19-1/8	675	1000	663	485	306	FR915B	283B	**WS33**	350.	**N48M28T75CU**	5,690.
112.5	2@+2.5%	4@-2.5%	KT	150	46-1/8	28	23	850	1171	712	585	386	FR916A	283B	**WS19**	350.	**N48M28T12CU**	7,460.
150	2@+2.5%	4@-2.5%	KT	150	56	31-1/4	24-1/4	1200	1422	793	616	545	FR917	283B	**WS34**	800.	**N48M28T49CU**	9,770.
225	2@+2.5%	4@-2.5%	KT	150	62-1/4	31-1/4	30-1/4	2150	1581	794	768	977	FR918A	283B	**WS34**	800.	**N48M28T22CU**	13,440.
300	2@+2.5%	4@-2.5%	KT	150	75	44-1/2	36	3100	1905	1130	914	1409	FR919	292A	**WS35**	1,360.	**N48M28T33CU**	22,330.
500	2@+2.5%	4@-2.5%	KT	150	①	①	①	①	①	①	①	①	①	①	①	—	**N48M28T55CU**	28,930.
15	2@+2.5%	4@-2.5%	KT	115	30-1/8	20-1/8	14-1/8	300	65	511	359	136	FR910A	283B	**WS31**	350.	**N48M28F15CU**	2,785.
30	2@+2.5%	4@-2.5%	KT	115	30-1/8	20-1/8	14-1/8	370	765	511	359	168	FR912A	283B	**WS31**	350.	**N48M28F30CU**	3,295.
45	2@+2.5%	4@-2.5%	KT	115	39-3/8	26-1/8	19-1/8	575	1000	663	485	261	FR914B	283B	**WS33**	350.	**N48M28F45CU**	4,430.
75	2@+2.5%	4@-2.5%	KT	115	39-3/8	26-1/8	19-1/8	675	1000	663	485	360	FR915B	283B	**WS33**	350.	**N48M28F75CU**	6,290.
112.5	2@+2.5%	4@-2.5%	KT	115	46-1/8	28	23	850	1171	712	585	386	FR916A	283B	**WS19**	350.	**N48M28F12CU**	9,025.
150	2@+2.5%	4@-2.5%	KT	115	56	31-1/4	24-1/4	1200	1422	793	616	545	FR917	283B	**WS34**	800.	**N48M28F49CU**	11,950.
225	2@+2.5%	4@-2.5%	KT	115	62-1/4	31-1/4	30-1/4	2150	1581	794	768	977	FR918A	283B	**WS34**	800.	**N48M28F22CU**	16,300.
300	2@+2.5%	4@-2.5%	KT	115	75	44-1/2	36	3100	1905	1130	914	1409	FR919	292A	**WS35**	1,360.	**N48M28F33CU**	24,560.
500	2@+2.5%	4@-2.5%	KT	115	①	①	①	①	①	①	①	①	①	①	①	—	**N48M28F55CU**	31,850.
15	2@+2.5%	4@-2.5%	KT	80	30-1/8	20-1/8	14-1/8	300	65	511	359	136	FR910A	283B	**WS31**	350.	**N48M28B15CU**	3,125.
30	2@+2.5%	4@-2.5%	KT	80	30-1/8	20-1/8	14-1/8	370	765	511	359	168	FR912A	283B	**WS31**	350.	**N48M28B30CU**	4,140.
45	2@+2.5%	4@-2.5%	KT	80	39-3/8	26-1/8	19-1/8	575	1000	663	485	261	FR914B	283B	**WS33**	350.	**N48M28B45CU**	5,570.
75	2@+2.5%	4@-2.5%	KT	80	46-1/8	28	23	950	1171	712	585	431	FR916A	283B	**WS33**	350.	**N48M28B75CU**	7,100.
112.5	2@+2.5%	4@-2.5%	KT	80	56	31-1/4	24-1/4	1200	1422	793	616	545	FR917	283B	**WS19**	350.	**N48M28B12CU**	10,270.
150	2@+2.5%	4@-2.5%	KT	80	62-1/4	31-1/4	30-1/4	2150	1581	794	768	977	FR918A	283B	**WS34**	800.	**N48M28B49CU**	13,480.
225	2@+2.5%	4@-2.5%	KT	80	75	44-1/2	36	3100	1905	1130	914	1409	FR919	292A	**WS35**	1,360.	**N48M28B22CU**	20,520.
300	2@+2.5%	4@-2.5%	KT	80	75	44-1/2	36	3600	1905	1130	914	1636	FR919	292A	**WS35**	1,360.	**N48M28B33CU**	26,780.

① Refer to your Cutler-Hammer sales office.

Note: For single-phase K-factor transformers, contact your local Cutler-Hammer sales office.

Note: Contact your local Cutler-Hammer sales office for CE Mark transformer requirements.

Note: For Energy Star labeled K-factor transformers, contact your local Cutler-Hammer sales office.

For other ratings or styles not shown, or for special enclosure types (including stainless steel) refer to Eaton's Cutler-Hammer.

Discount Symbol **DT-1**

Appendix D

Motor Control Center

IT. Motor Control Centers

IT. MCC

Product Description

Eaton's offerings for motor control centers feature the Cutler-Hammer Intelligent Technologies ***(IT.)*** MCC. This product offers the highest density of motor control in the industry along with the most functionality.
Its innovative design, as well as its enhanced fault performance and protective features, make it the new benchmark in the industry.

Application Description

Cutler-Hammer Motor Control Centers by Eaton Corporation are custom-made assemblies of conveniently grouped control equipment primarily used for control of motors and power distribution. Motor Control Centers are designed for 3-phase, 230-volt applications up to 200 horsepower, or 3-phase, 480-volt applications up to 400 horsepower.

Features, Benefits and Functions

Structure Design

Eaton's Cutler-Hammer Motor Control Centers are 20 inches (508 mm) wide and 90 inches (2286 mm) high with vertical compartments having 72 inches (1829 mm) of unit mounting space in 6-inch (152 mm) increments.

Structure depth is 16 inches (406 mm) or 21 inches (533 mm) deep front mounted only, and 21 inches (533 mm) deep for back-to-back mounted units.

The unique framed design permits the highest flexibility in component and structure configuration.

Accessibility

All parts and wiring are front accessible. Terminal blocks are side mounted in each unit. Vertical wireways separate from control units provide safe and convenient access to wiring and conduits without de-energizing any equipment.

Flexibility

Modular, framed design permits structure arrangements to be tailored to exactly meet any control requirements with a minimum of unusable space. Vertical compartments are incremented for maximum space utilization and unit interchangeability. A 6-inch (152 mm) size 1-2 starter unit provides users with the ability to solve demanding space requirements and still meet all NEMA and UL standards.

Safety

Design tested at Eaton's Cutler-Hammer power laboratory to assure maximum protection for control equipment. Engineered to minimize hazards to operating personnel.

Control Design

IT. Motor Control Centers are available in two basic control configurations:

- Hardwired for connection to traditional local/remote devices, PLC's DCS systems.
- DeviceNet Motor Control Centers which provide the optimal integrated package for control, communication, diagnostics and simplified wiring. Eaton's Cutler-Hammer DeviceNet MCC Solution provides users with significantly reduced installation time and increased uptime through the integration of intelligent devices and advanced software tools.
- Control products include: ODVA Compliant Motor Starters, Variable Speed Drives, Operator Interface and Block I/O.

Standards and Certifications

UL Listing

Standard structures and units are provided with UL label.

Options and Accessories

The ***IT.*** MCC features 24V DC control supplied to each control unit using a structure-mounted DC bus. The DC bus is fed from a power supply unit or by a separate customer-supplied DC source. Units feature fuseless self-protecting DC stabs which distribute control power to each unit. Optional motor lead terminal blocks can be provided through NEMA size 4 starters. The motor lead terminal block remains in the structure when a unit is withdrawn. This makes unit withdraw easy and safe.

IT. communication can be accomplished in two different configurations.

Direct DeviceNet Connection to Each Unit

Each unit will have a DeviceNet connection and will communicate the following information:

- % FLA.
- Status.
- Cause of trip.
- Breaker status.
- Run, stop, reset.

Each unit is one node on the network.

DeviceNet Using QCPort to Each Starter Unit

Each starter unit will have a QCPort interface. Each structure will contain a QCPort backplane, which will be located in the vertical bus area. Connection to the QCPort backplane will be made automatically through a QCPort stab when the unit is inserted into the MCC. The starter units connected on QCPort link to DeviceNet through a QCPort DeviceNet adapter (QCPort DNA). The QCPort DeviceNet Adapter can connect up to 21 starters and only uses one node on the DeviceNet network. One QCPort DNA module is required for every two structures. QCPort units will communicate the following information:

- % FLA.
- Status.
- Cause of trip.
- Breaker status.
- Run, stop, reset.

Product Specifications

Structure

- NEMA 1A, 2, 3R or 12 enclosure.
- Copper horizontal bus 600 – 3200A.
- Fully rated copper vertical bus 300 – 1200A.
- Labyrinth optional.
- Labyrinth barriers for insulated and isolated vertical bus.
- Optional isolating barriers between structures.
- 65 kA and 1000 kA bus bracing.
- Plug-in DC, ground and communication bus.

Units

- *IT.* Motor Starters:
  - ❑ NEMA size 1 through 7.
  - ❑ Heaterless overload relay with Class 10, 20 and 30 overload protection
  - ❑ Built-in phase loss, single-phase
  - ❑ Compact size
  - ❑ Longer contact life
  - ❑ Communications
  - ❑ Extended ride-through
- HMCP with combination starter ratings of 65 kAIC and 100 kAIC at 480 volts.
- Plug-in units up to 400 amperes.
- Handle mechanism with positive trip indication.
- Side-mounted positive latch terminal block.
- 6-inch (152.4 mm) NEMA size 1 and 2 units with HMCP.
- Solid-State Reduced Voltage Starters:
  - ❑ Intelligent Technologies (*IT.*) (20 – 800 hp)
- Adjustable Frequency Drives:
  - ❑ SV9000 (2 – 1100 hp)
- K-Switch visible blade disconnect:
  - ❑ 30 – 800A
  - ❑ 100 kAIC at 600 volts
- Surge protection:
  - ❑ Clipper Visor TVSS (100 – 500 kA)
- Energy monitoring:
  - ❑ IQ 320 (amperes, volts, Hz, watts, PF)
  - ❑ IQ DP-4130 (adds THD, Contact I/O)
  - ❑ IQ Analyzer (adds trending, waveform display)

18

Product Selection

Incoming Line

Table 18-70. Incoming Line — Main Lugs Only

Bus Rating	X-Space	Price U.S. $
600	2	262.
600	3	361.
600	4	572.
800	3	361.
800	4	461.
800	6	662.
1000	4	461.
1000	6	662.
1000	8	914.
1200	5	1000.
1200	6	1000.
1600	12	5,444.
2000	12	5,444.
2500	12	5,444.
3200 ①	12	8,167.

① NEMA 1 gasketed only.

Table 18-71. Incoming Line — Main Circuit Breaker

Frame Size (Amps)	Circuit Breaker Type	Unit Size	Enclosure Width	Price U.S. $
150	HFD	18 (457.2)	20 (508.0)	1,203.
	FDC			1,934.
225	HFD	18 (457.2)		1,518.
	FDC			4,389.
250	HJD	30 (762.0)		1,897.
	JDC			5,486.
400	HKD	30 (762.0)		3,232.
	KDC			6,107.
	CHKD ②			6,228.
	CKDC ②			9,732.
600	HLD	24 (609.6) ⑤⑥		4,149.
	LDC			4,880.
	CHLD ②③			7,346.
	CLDC ②③			8,238.
800	HMDL	30 (762.0) ⑥		6,389.
	CHMDL ②③	48 (1219.2) ⑥		10,080.
	NDC	42 (1066.8) ⑥		9,488.
	CHND ②	72 (1828.8)		10,080.
	CNDC ②	72 (1828.8)		11,580.
1200	HND ④	42 (1066.8) ⑥		7,174.
	NDC ④	42 (1066.8) ⑥		11,387.
	CHND ②③	72 (1828.8)		10,932.
	CNDC ②③	72 (1828.8)		13,993.
2000	RD ④	72 (1828.8) ⑦		14,368.
	RDC ④			16,796.
	CRD ②			17,529.
	CRDC ②			19,918.
2500	RD	72 (1828.8) ⑥	24 (609.6)	21,886.
	RDC			24,868.

② 100% rated when 90° cable applied at 75° ampacity for 100% rating. Digitrip 310 LS is required and included in the price.

③ NEMA 1 gasketed only.

④ Digitrip 310 LS is standard and included in the pricing.

⑤ Add 6-inch (152.4 mm) for top entry of incoming cables.

⑥ Install at top for cable top entry or at bottom for bottom cable entry.

⑦ The main breaker requires the complete vertical section. The rear is unusable.

Structure Modifications

Table 18-72. Structure Modifications

Description	Price U.S. $
Enclosure	
NEMA 1 Gasketed	—
NEMA 12 — Dust Tight	426.
NEMA 3R Front Mounted Only	3,240.
NEMA 3R Front & Rear	3,749.
Space Heater	528.
Thermostat	343.
Bottom Plate	75.
Channel Sills	75.
12-inch (304.8 mm) Pull Box	724.
100K Bracing	594.
DC Bus and Vertical Ground Bus	361.
QCPort Communication Bus	1,950.
Vertical Bus	
300A	—
600A	268.
800A	268.
1200A	538.
Ground Bus 300A	
Horizontal — Copper	105.
Standard Structures	
16-inch (406.4 mm) Front Mounted Only	1,422.
21-inch (533.4 mm) Front Mounted Only	1,578.
21-inch (533.4 mm) Front & Rear	2,182.
Main Horizontal Bus	
600A Copper	294.
800A Copper	751.
1200A Copper	1,158.
1600A Copper	1,757.
2000A Copper	1,882.
2500A Copper	2,321.
3200A Copper	3,318.
Vertical Bus Barrier	
Labyrinth Barrier with Shutters	Std.

Table 18-73. Neutral Bus (bottom)

Ampere Rating	Price U.S. $ Per Structure
300	197.
600 or 800	226.
1000	291.
1200	387.
1600	525.
2000	759.
2500	1,204.
3200 ⑧	1,886.

⑧ Available NEMA 1 gasketed enclosures only.

Note: 1/2 size Main Bus Copper.

Discount Symbol **1CD-2**

Table 18-74. Incoming Line Metering

IQ Meter	X-Space	Price U.S. $
IQ 100	2	2,070.
IQ 320	2	4,050.
IQ DP-4130	2	6,257.
IQ Analyzer	2	9,823.

Note: Does not include Current Transformers pricing.

Table 18-75. Transient Voltage Surge Suppression (Clipper Supervisor) — 18-inch Units with Circuit Breaker Disconnect ①

Includes power quality meter for volts, sag, swell, outage, transient counter, Form C contact, alarm.

Surge Current Per Phase	Unit Size	Price U.S. $
100 kA Model CPS ②	18 (457.2)	6,172.
120 kA Model CPS ②③		6,670.
160 kA Model CPS ②		8,680.
200 kA Model CPS ②		10,891.
250 kA Model CPS ④		14,654.
300 kA Model CPS		17,840.
400 kA Model CPS		23,980.
500 kA Model CPS		29,980.

① Available in 12-inch (304.8 mm) unit (2X) without circuit breaker disconnect.

② Optional integral IQ 200 meter in 18-inch (457.2 mm) unit for 100 kA – 200 kA = $3,900.

③ Recommended branch entrance.

④ Recommended service entrance.

Table 18-76. CPS — Control Power Supplies ⑤

Ampere Rating	Description	X-Space	Price U.S. $
6.5	Single Power Supply	1	1,430.
6.5	Dual Redundant Power Supplies	1	2,950.
12	Single Power Supply	2	3,750.

⑤ Required in all structures that will contain a starter, drive or soft start.

Combination Starters

Table 18-77. Full Voltage Non-Reversing — HMCP (T206)

Size	X-Space	Price U.S. $
1	1	1,111.
2	1	1,342.
3	2	1,956.
4	2	3,742.
5	6	7,454.
6	9	12,330.

Table 18-78. Full Voltage Reversing — HMCP (T216)

Size	X-Space	Price U.S. $
1	2	1,565.
2	2	2,175.
3	3	3,125.
4	4	5,725.
5	10	11,026.
6	12	18,906.

Table 18-79. Non-Reversing 2S, 1W HMCP (T946)

Size	X-Space	Price U.S. $
1	2	2,443.
2	3	3,918.
3	4	4,641.
4	4	9,260.

Table 18-80. Non-Reversing 2S, 2W, HMCP (T956)

Size	X-Space	Price U.S. $
1	2	2,025.
2	2	3,855.
3	3	4,074.
4	4	7,715.

Table 18-81. Fusible Disconnect Starters

Size	X-Space	Price U.S. $
Full Voltage Non-Reversing (T204)		
1	2	989.
2	2	1,332.
3	4	2,089.
4	5	4,074.
5	10	6,662.
Full Voltage Reversing (T214)		
1	3	1,580.
2	3	2,293.
3	5	3,243.
4	6	6,132.
Fusible, Non-Reversing 2S, 1W (T944)		
1	3	2,428.
2	3	3,664.
3	6	4,749.
4	7	8,884.
Fusible, Non-Reversing 2S, 2W (T954)		
1	3	2,103.
2	3	3,662.
3	5	4,052.
4	6	7,494.

Table 18-82. Contactor Only Units

Size	X-Space	Price U.S. $
Circuit Breaker (T208)		
1	1	1,072.
2	1	1,297.
3	2	1,682.
4	2	3,522.
5	5	6,740.
6	9	11,225.
Fusible (T209)		
1	2	1,072.
2	2	1,297.
3	3	1,682.
4	4	3,522.
5	9	6,740.

IT. Motor Control Centers

IT. MCC

Product Description

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Structure Design

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Structure depth is 16 inches (406 mm) or 21 inches (533 mm) deep front mounted only, and 21 inches (533 mm) deep for back-to-back mounted units.

The unique framed design permits the highest flexibility in component and structure configuration.

Accessibility

All parts and wiring are front accessible. Terminal blocks are side mounted in each unit. Vertical wireways separate from control units provide safe and convenient access to wiring and conduits without de-energizing any equipment.

Flexibility

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- DeviceNet Motor Control Centers which provide the optimal integrated package for control, communication, diagnostics and simplified wiring. Eaton's Cutler-Hammer DeviceNet MCC Solution provides users with significantly reduced installation time and increased uptime through the integration of intelligent devices and advanced software tools.
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Standards and Certifications

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IT. communication can be accomplished in two different configurations.

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- Breaker status.
- Run, stop, reset.

Each unit is one node on the network.

DeviceNet Using QCPort to Each Starter Unit

Each starter unit will have a QCPort interface. Each structure will contain a QCPort backplane, which will be located in the vertical bus area. Connection to the QCPort backplane will be made automatically through a QCPort stab when the unit is inserted into the MCC. The starter units connected on QCPort link to DeviceNet through a QCPort DeviceNet adapter (QCPort DNA). The QCPort DeviceNet Adapter can connect up to 21 starters and only uses one node on the DeviceNet network. One QCPort DNA module is required for every two structures. QCPort units will communicate the following information:

- % FLA.
- Status.
- Cause of trip.
- Breaker status.
- Run, stop, reset.

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Product Specifications

Structure

- NEMA 1A, 2, 3R or 12 enclosure.
- Copper horizontal bus 600 – 3200A.
- Fully rated copper vertical bus 300 – 1200A.
- Labyrinth optional.
- Labyrinth barriers for insulated and isolated vertical bus.
- Optional isolating barriers between structures.
- 65 kA and 1000 kA bus bracing.
- Plug-in DC, ground and communication bus.

Units

- *IT.* Motor Starters:
  - ❑ NEMA size 1 through 7.
  - ❑ Heaterless overload relay with Class 10, 20 and 30 overload protection
  - ❑ Built-in phase loss, single-phase
  - ❑ Compact size
  - ❑ Longer contact life
  - ❑ Communications
  - ❑ Extended ride-through
- HMCP with combination starter ratings of 65 kAIC and 100 kAIC at 480 volts.
- Plug-in units up to 400 amperes.
- Handle mechanism with positive trip indication.
- Side-mounted positive latch terminal block.
- 6-inch (152.4 mm) NEMA size 1 and 2 units with HMCP.
- Solid-State Reduced Voltage Starters:
  - ❑ Intelligent Technologies (*IT.*) (20 – 800 hp)
- Adjustable Frequency Drives:
  - ❑ SV9000 (2 – 1100 hp)
- K-Switch visible blade disconnect:
  - ❑ 30 – 800A
  - ❑ 100 kAIC at 600 volts
- Surge protection:
  - ❑ Clipper Visor TVSS (100 – 500 kA)
- Energy monitoring:
  - ❑ IQ 320 (amperes, volts, Hz, watts, PF)
  - ❑ IQ DP-4130 (adds THD, Contact I/O)
  - ❑ IQ Analyzer (adds trending, waveform display)

Product Selection

Incoming Line

Table 18-70. Incoming Line — Main Lugs Only

Bus Rating	X-Space	Price U.S. $
600	2	262.
600	3	361.
600	4	572.
800	3	361.
800	4	461.
800	6	662.
1000	4	461.
1000	6	662.
1000	8	914.
1200	5	1000.
1200	6	1000.
1600	12	5,444.
2000	12	5,444.
2500	12	5,444.
3200 ①	12	8,167.

① NEMA 1 gasketed only.

Table 18-71. Incoming Line — Main Circuit Breaker

Frame Size (Amps)	Circuit Breaker Type	Unit Size	Enclosure Width	Price U.S. $
150	HFD	18 (457.2)	20 (508.0)	1,203.
	FDC			1,934.
225	HFD	18 (457.2)		1,518.
	FDC			4,389.
250	HJD	30 (762.0)		1,897.
	JDC			5,486.
400	HKD	30 (762.0)		3,232.
	KDC			6,107.
	CHKD ②			6,228.
	CKDC ②			9,732.
600	HLD	24 (609.6) ⑤⑥		4,149.
	LDC			4,880.
	CHLD ②③			7,346.
	CLDC ②③			8,238.
800	HMDL	30 (762.0) ⑥		6,389.
	CHMDL ②③	48 (1219.2) ⑥		10,080.
	NDC	42 (1066.8) ⑥		9,488.
	CHND ②	72 (1828.8)		10,080.
	CNDC ②	72 (1828.8)		11,580.
1200	HND ④	42 (1066.8) ⑥		7,174.
	NDC ④	42 (1066.8) ⑥		11,387.
	CHND ②③	72 (1828.8)		10,932.
	CNDC ②③	72 (1828.8)		13,993.
2000	RD ④	72 (1828.8) ⑦		14,368.
	RDC ④			16,796.
	CRD ②			17,529.
	CRDC ②			19,918.
2500	RD	72 (1828.8) ⑥	24 (609.6)	21,886.
	RDC			24,868.

② 100% rated when 90° cable applied at 75° ampacity for 100% rating. Digitrip 310 LS is required and included in the price.

③ NEMA 1 gasketed only.

④ Digitrip 310 LS is standard and included in the pricing.

⑤ Add 6-inch (152.4 mm) for top entry of incoming cables.

⑥ Install at top for cable top entry or at bottom for bottom cable entry.

⑦ The main breaker requires the complete vertical section. The rear is unusable.

Structure Modifications

Table 18-72. Structure Modifications

Description	Price U.S. $
Enclosure	
NEMA 1 Gasketed	—
NEMA 12 — Dust Tight	426.
NEMA 3R Front Mounted Only	3,240.
NEMA 3R Front & Rear	3,749.
Space Heater	528.
Thermostat	343.
Bottom Plate	75.
Channel Sills	75.
12-inch (304.8 mm) Pull Box	724.
100K Bracing	594.
DC Bus and Vertical Ground Bus	361.
QCPort Communication Bus	1,950.
Vertical Bus	
300A	—
600A	268.
800A	268.
1200A	538.
Ground Bus 300A	
Horizontal — Copper	105.
Standard Structures	
16-inch (406.4 mm) Front Mounted Only	1,422.
21-inch (533.4 mm) Front Mounted Only	1,578.
21-inch (533.4 mm) Front & Rear	2,182.
Main Horizontal Bus	
600A Copper	294.
800A Copper	751.
1200A Copper	1,158.
1600A Copper	1,757.
2000A Copper	1,882.
2500A Copper	2,321.
3200A Copper	3,318.
Vertical Bus Barrier	
Labyrinth Barrier with Shutters	Std.

Table 18-73. Neutral Bus (bottom)

Ampere Rating	Price U.S. $ Per Structure
300	197.
600 or 800	226.
1000	291.
1200	387.
1600	525.
2000	759.
2500	1,204.
3200 ⑧	1,886.

⑧ Available NEMA 1 gasketed enclosures only.

Note: 1/2 size Main Bus Copper.

Discount Symbol **1CD-2**

Table 18-74. Incoming Line Metering

IQ Meter	X-Space	Price U.S. $
IQ 100	2	2,070.
IQ 320	2	4,050.
IQ DP-4130	2	6,257.
IQ Analyzer	2	9,823.

Note: Does not include Current Transformers pricing.

Table 18-75. Transient Voltage Surge Suppression (Clipper Supervisor) — 18-inch Units with Circuit Breaker Disconnect ①

Includes power quality meter for volts, sag, swell, outage, transient counter, Form C contact, alarm.

Surge Current Per Phase	Unit Size	Price U.S. $
100 kA Model CPS ②	18 (457.2)	6,172.
120 kA Model CPS ②③		6,670.
160 kA Model CPS ②		8,680.
200 kA Model CPS ②		10,891.
250 kA Model CPS ④		14,654.
300 kA Model CPS		17,840.
400 kA Model CPS		23,980.
500 kA Model CPS		29,980.

① Available in 12-inch (304.8 mm) unit (2X) without circuit breaker disconnect.
② Optional integral IQ 200 meter in 18-inch (457.2 mm) unit for 100 kA – 200 kA = $3,900.
③ Recommended branch entrance.
④ Recommended service entrance.

Table 18-76. CPS — Control Power Supplies ⑤

Ampere Rating	Description	X-Space	Price U.S. $
6.5	Single Power Supply	1	1,430.
6.5	Dual Redundant Power Supplies	1	2,950.
12	Single Power Supply	2	3,750.

⑤ Required in all structures that will contain a starter, drive or soft start.

Combination Starters

Table 18-77. Full Voltage Non-Reversing — HMCP (T206)

Size	X-Space	Price U.S. $
1	1	1,111.
2	1	1,342.
3	2	1,956.
4	2	3,742.
5	6	7,454.
6	9	12,330.

Table 18-78. Full Voltage Reversing — HMCP (T216)

Size	X-Space	Price U.S. $
1	2	1,565.
2	2	2,175.
3	3	3,125.
4	4	5,725.
5	10	11,026.
6	12	18,906.

Table 18-79. Non-Reversing 2S, 1W HMCP (T946)

Size	X-Space	Price U.S. $
1	2	2,443.
2	3	3,918.
3	4	4,641.
4	4	9,260.

Table 18-80. Non-Reversing 2S, 2W, HMCP (T956)

Size	X-Space	Price U.S. $
1	2	2,025.
2	2	3,855.
3	3	4,074.
4	4	7,715.

Table 18-81. Fusible Disconnect Starters

Size	X-Space	Price U.S. $
Full Voltage Non-Reversing (T204)		
1	2	989.
2	2	1,332.
3	4	2,089.
4	5	4,074.
5	10	6,662.
Full Voltage Reversing (T214)		
1	3	1,580.
2	3	2,293.
3	5	3,243.
4	6	6,132.
Fusible, Non-Reversing 2S, 1W (T944)		
1	3	2,428.
2	3	3,664.
3	6	4,749.
4	7	8,884.
Fusible, Non-Reversing 2S, 2W (T954)		
1	3	2,103.
2	3	3,662.
3	5	4,052.
4	6	7,494.

Table 18-82. Contactor Only Units

Size	X-Space	Price U.S. $
Circuit Breaker (T208)		
1	1	1,072.
2	1	1,297.
3	2	1,682.
4	2	3,522.
5	5	6,740.
6	9	11,225.
Fusible (T209)		
1	2	1,072.
2	2	1,297.
3	3	1,682.
4	4	3,522.
5	9	6,740.

Starter Modifications

Table 18-83. Control Options

Description	Price U.S. $
Auxiliary Switch — In Breaker	128.
ETM Mini Meters	288.
Timer — Pneumatic	1,313.
Timer — Solid State	502.
Relay — AR — 600V	245.
Relay — General Purpose 300V	193.
AC Estop Relay	186.

Table 18-84. DeviceNet Options

Description	Price U.S. $
QCPort DeviceNet Adapter ①	6,410.
QCPort for *IT.* Starter ②	400.
DeviceNet for *IT.* Starter ③	1,429.
5 Amp — 24V DC Power Supply	3,495.
20 Amp — 24V DC Power Supply	6,950.
Trunk Cable and Tee	399.
Drop and Auxiliary Cable, Tee	239.
Terminating Resistors	156.

① One adapter required for every 21 starters.
② Communications bus must be added to each structure and QCPort DNA must be added.
③ Includes drop cables.

Table 18-85. Pilot Control Modules

Description	Price U.S. $
Stop	42.
Start/Stop	85.
HOA	85.
Fast Slow-Stop	164.
Fwd/Rev-Stop	164.
Fast/Slow/Off/Auto	110.
Fwd/Rev/Off/Auto	110.
Pilot Lights —	
Run (Red)	135.
Stop (Green)	135.
OL Trip (Red)	135.
CB Trip (Red)	240.
Ground Fault Trip (Red)	135.
Fwd/Rev (Red)	220.
Fast/Slow (Red)	270.

Table 18-86. Intelligent Technologies (*IT.*) SSRV Starters with Integral Bypass

Maximum Hp	X-Space	Price U.S. $
IT06 Solid-State Reduced Voltage Starters — HMCP 65 kAIC — 1.15 Service Factor — Standard Duty		
20	2	7,108.
40	2	8,275.
60	3	10,440.
75	3	11,600.
125	6	14,390.
150	6	14,990.
200	6	18,680.
300	9	29,440.
350	9	30,330.
450	12	32,440.
500	12	42,000.
600	12	53,300.
700	12 ④	68,200.
IT06 Solid-State Reduced Voltage Starters — HMCP 65 kAIC — 1.15 Service Factor — Severe Duty		
10	2	7,108.
25	2	8,275.
40	3	10,440.
50	3	12,800.
75	6	15,120.
100	6	15,550.
125	6	21,320.
150	9	26,120.
200	9	27,380.
250	9	28,450.
300	9	32,440.
350	9	42,000.
450	12 ④	68,200.

④ Requires 24-inch wide, rear is unusable, bottom exit only.

Note: Consult the *Cutler-Hammer Consulting Application Guide, 13th Edition* for more complete information including fusible type disconnects and severe duty-rated design.

Table 18-87. *IT.* SSRV Control Options ⑤

Description	Price U.S. $
Pump Control	2,000.
MOV Protection	380.
DeviceNet — Standard	785.
DeviceNet — Enhanced	3,200.

⑤ Options apply to both HMCP and thermal-magnetic breaker models.

Table 18-88. *IT.* SSRV Power Options ⑥

NEMA Bypass Starter	Price U.S. $
Size 1	686.
Size 2	826.
Size 3	1,197.
Size 4	2,409.
Size 5	4,830.
Size 6	7,859.
Size 7	13,850.

⑥ Options apply to both HMCP and thermal-magnetic breaker models.

Table 18-89. Motor Isolation Contactors

NEMA Isolation Contactor	Price U.S. $
Size 1	554.
Size 2	694.
Size 3	1,065.
Size 4	2,277.
Size 5	4,398.
Size 6	7,427.
Size 7	13,160.

Table 18-90. SV9000 Adjustable Frequency Drives — Plug-in Units NEMA 1 480V Constant / Variable Torque Rated

Hp	X-Space	Price U.S. $	
		VT	CT
3	3	7,306.	7,306.
5	4	8,680.	8,680.
7.5	4	8,878.	9,459.
10	4	9,459.	10,449.
15	4	10,449.	12,193.
20	6	12,193.	15,270.
25	6	15,270.	17,627.
30	6	17,627.	19,760.

Note: SV9000 Plug-in Units with HMCP disconnect, 3% input line reactor, 3% output line reactor, door mounted Keypad, CPT.

Table 18-91. SV9000 Options — Plug-in Units

Description	Price U.S. $
DeviceNet Communications	964.
Profibus Communications	2,620.
2000-foot (609.6 m) dV/dT Filter (3 hp)	1,431.
2000-foot (609.6 m) dV/dT Filter (5 – 15 hp)	1,540.
2000-foot (609.6 m) dV/dT Filter (20 – 30 hp)	
Input Line Fuses (3 – 30 hp)	454.
RFI Filter (3 – 30 hp)	486.

Discount Symbol **1CD-2**

Starter Modifications

Table 18-83. Control Options

Description	Price U.S. $
Auxiliary Switch — In Breaker	128.
ETM Mini Meters	288.
Timer — Pneumatic	1,313.
Timer — Solid State	502.
Relay — AR — 600V	245.
Relay — General Purpose 300V	193.
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Description	Price U.S. $
QCPort DeviceNet Adapter ①	6,410.
QCPort for *IT.* Starter ②	400.
DeviceNet for *IT.* Starter ③	1,429.
5 Amp — 24V DC Power Supply	3,495.
20 Amp — 24V DC Power Supply	6,950.
Trunk Cable and Tee	399.
Drop and Auxiliary Cable, Tee	239.
Terminating Resistors	156.

① One adapter required for every 21 starters.

② Communications bus must be added to each structure and QCPort DNA must be added.

③ Includes drop cables.

Table 18-85. Pilot Control Modules

Description	Price U.S. $
Stop	42.
Start/Stop	85.
HOA	85.
Fast Slow-Stop	164.
Fwd/Rev-Stop	164.
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Fwd/Rev/Off/Auto	110.
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Run (Red)	135.
Stop (Green)	135.
OL Trip (Red)	135.
CB Trip (Red)	240.
Ground Fault Trip (Red)	135.
Fwd/Rev (Red)	220.
Fast/Slow (Red)	270.

Table 18-86. Intelligent Technologies (*IT.*) SSRV Starters with Integral Bypass

IT06 Solid-State Reduced Voltage Starters — HMCP 65 kAIC — 1.15 Service Factor — Standard Duty

Maximum Hp	X-Space	Price U.S. $
20	2	7,108.
40	2	8,275.
60	3	10,440.
75	3	11,600.
125	6	14,390.
150	6	14,990.
200	6	18,680.
300	9	29,440.
350	9	30,330.
450	12	32,440.
500	12	42,000.
600	12	53,300.
700	12 ④	68,200.

IT06 Solid-State Reduced Voltage Starters — HMCP 65 kAIC — 1.15 Service Factor — Severe Duty

Maximum Hp	X-Space	Price U.S. $
10	2	7,108.
25	2	8,275.
40	3	10,440.
50	3	12,800.
75	6	15,120.
100	6	15,550.
125	6	21,320.
150	9	26,120.
200	9	27,380.
250	9	28,450.
300	9	32,440.
350	9	42,000.
450	12 ④	68,200.

④ Requires 24-inch wide, rear is unusable, bottom exit only.

Note: Consult the *Cutler-Hammer Consulting Application Guide, 13th Edition* for more complete information including fusible type disconnects and severe duty-rated design.

Table 18-87. *IT.* SSRV Control Options ⑤

Description	Price U.S. $
Pump Control	2,000.
MOV Protection	380.
DeviceNet — Standard	785.
DeviceNet — Enhanced	3,200.

⑤ Options apply to both HMCP and thermal-magnetic breaker models.

Table 18-88. *IT.* SSRV Power Options ⑥

NEMA Bypass Starter	Price U.S. $
Size 1	686.
Size 2	826.
Size 3	1,197.
Size 4	2,409.
Size 5	4,830.
Size 6	7,859.
Size 7	13,850.

⑥ Options apply to both HMCP and thermal-magnetic breaker models.

Table 18-89. Motor Isolation Contactors

NEMA Isolation Contactor	Price U.S. $
Size 1	554.
Size 2	694.
Size 3	1,065.
Size 4	2,277.
Size 5	4,398.
Size 6	7,427.
Size 7	13,160.

Table 18-90. SV9000 Adjustable Frequency Drives — Plug-in Units NEMA 1 480V Constant / Variable Torque Rated

Hp	X-Space	Price U.S. $	
		VT	CT
3	3	7,306.	7,306.
5	4	8,680.	8,680.
7.5	4	8,878.	9,459.
10	4	9,459.	10,449.
15	4	10,449.	12,193.
20	6	12,193.	15,270.
25	6	15,270.	17,627.
30	6	17,627.	19,760.

Note: SV9000 Plug-in Units with HMCP disconnect, 3% input line reactor, 3% output line reactor, door mounted Keypad, CPT.

Table 18-91. SV9000 Options — Plug-in Units

Description	Price U.S. $
DeviceNet Communications	964.
Profibus Communications	2,620.
2000-foot (609.6 m) dV/dT Filter (3 hp)	1,431.
2000-foot (609.6 m) dV/dT Filter (5 – 15 hp)	1,540.
2000-foot (609.6 m) dV/dT Filter (20 – 30 hp)	
Input Line Fuses (3 – 30 hp)	454.
RFI Filter (3 – 30 hp)	486.

Discount Symbol 1CD-2

SV9000

Table 18-92. SV9000 Adjustable Frequency Drives — Non-Plug-in Units NEMA 1 480V Constant / Variable Torque Rated

Hp	X-Space	Price U.S. $	
		VT	CT
40	9	20,442.	23,292.
50	9	23,473.	25,186.
60	9	29,103.	32,319.
75 ①	9	32,319.	38,269.
100	12	39,748.	44,972.
125	12	48,516.	54,199.
150	12	54,199.	59,103.
200	12	68,647.	74,025.
250	12	76,725.	88,987.
300	12	89,437.	109,237.
400	12	109,237.	174,956.
500	12	174,756.	207,469.
600	12	198,039.	245,700.

① X-Space for 75 hp CT rated drive is 12X.

Note: Consult the *Cutler-Hammer Consulting Application Guide, 13th Edition* for complete details on Drive / Option Assembly Dimensions.

Note: SV9000 Non-Plug-in Units with HMCP disconnect, 3% input line reactor, 3% output line reactor, door mounted Keypad, CPT.

Note: VT — Variable Torque drives are capable of producing 200% starting torque for 10 seconds and are rated for 10 seconds, and are rated 110% overload for one minute.

Note: CT — Variable Torque drives are capable of producing 200% starting torque for 10 seconds and are rated for 10 seconds, and are rated 150% overload for one minute.

Table 18-93. SV9000 Options — Non-Plug-in Units

Description	Price U.S. $
DeviceNet Communications	964.
Profibus Communications	2,620.
2000-foot (609.6 m) dV/dT Filter (40 – 75 VT hp)	4,100.
2000-foot (609.6 m) dV/dT Filter (100 – 150 VT hp)	5,250.
2000-foot (609.6 m) dV/dT Filter (200 – 250 VT hp)	6,810.
2000-foot (609.6 m) dV/dT Filter (300 – 400 VT hp)	8,500.
2000-foot (609.6 m) dV/dT Filter (500 – 600 VT hp)	10,970.
Input Line Fuses (40 – 150 VT hp)	714.
Input Line Fuses (200 – 250 hp)	1,176.
Input Line Fuses (300 – 400 hp)	2,245.

Table 18-94. Active Harmonic Correction for AC Drives

Description	X-Space	Price U.S. $
50A Harmonic Correction	12 ②	48,813.
100A Harmonic Correction	12 ②	76,107.

② Requires 24-inch (609.6 mm) wide structure.

Table 18-95. 18-Pulse Clean Power Drives — NEMA 1, 480 Variable Torque Duty

Hp	X-Space, Inches Wide	Price U.S. $
100	12, 90	36,420.
150	12, 90	53,480.
200	12, 98	69,836.
250	12, 98	78,004.
300	12, 130	102,180.
400	12, 130	104,820.
500	12, 138	115,290.
600	12, 138	119,688.

Note: Includes, 5% Input Line reactor, 18-pulse rectifier, Delta differential transformer. Price standard SV9000 drive separately.

Feeders

Table 18-96. Circuit Breaker

Amperes	X-Space	Price U.S. $
Standard Circuit Breakers		
E125 50	1	667.
E125 125	1	981.
J250 225	1	1,465.
J250 250	1	1,816.
HKD 400	4	2,993.
HLD 600	4	3,842.
HND 800	7	5,916.
HND 1200	7	6,643.

Table 18-97. Fusible Switch

Amperes	X-Space	Price U.S. $
30 or 60	2	427.
100	3	577.
200	6	695.
400	6	1,919.
600	8	3,140.

Table 18-98. Dual Fusible Switches

Amperes	X-Space	Price U.S. $
30	2	956.
60	3	968.

Transformers

Note: Must have primary breaker.
Must be located at bottom of structure.

Table 18-99. Transformers

kVA	X-Space	Price U.S. $
Single-Phase		
5	4	1,865.
10	4	2,445.
15	5	3,142.
20	5	4,452.
30	6	5,846.
45	7	8,851.
Three-Phase		
15	6	4,366.
30	6	6,111.
45	9	8,297.

Panelboards

Table 18-100. Panelboards (240V Maximum)

Circuit	X-Space	Price U.S. $
18	4	1,305.
30	5	1,892.
42	6	2,075.

Note: Space and price for MLO.
Branch breakers included.

Table 18-101. ATS — Automatic Transfer Switches — Open Transition 3-Pole Only

Ampere Rating	Unit Width	Unit Size	Price U.S. $ ③
100 ④ 150 ④	20 (508.0)	36 (914.4)	11,840. 15,174.
100 150	20 (508.0)	48 (1219.2) (8X)	12,313. 15,780.
225 300	20 (508.0)		16,032. 16,032.
400 600 800 1000	24 (609.6) ⑤	72 (1828.8)	20,454. 25,527. 29,601. 41,216.
1000 1200	44 (1117.6) ⑥		73,369. 73,869.
1600 2000	44 (1117.6) ⑦		76,373. 80,002.

③ Price includes option group OG9.
④ Manually operated switch:
NTVS = Electronically operated non-automatic.
MTVX = Single handle manual operation.
⑤ Requires 21-inch (533.4 mm) deep structure.
⑥ Requires 37-inch (939.8 mm) deep structure, flush at the rear. 4-inch (101.6 mm) filler required.
⑦ Requires 42-inch (1066.8 mm) deep structure. 4-inch (101.6 mm) filler required.

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Discount Symbol 1CD-2

Application Guide

Table 18-102. Motor Circuit Protector Selection Guide

NEMA	Maximum Horsepower						
	200V	208V	230V	380V	460V	575V	HMCP
1	—	—	—	3/4	3/4	1	3
	3/4	1	1	2	2	3	7
	2	2	2	3	5	7-1/2	15
	5	5	5	10	10	10	30
	7-1/2	7-1/2	7-1/2	—	—	—	50
2	—	—	—	—	—	15	30
	10	10	10	15	20	25	50
	—	—	15	25	25	—	70
3	—	—	—	—	—	30	50
	15	20	20	30	40	50	100
	25	25	30	50	50	—	150
4	40	40	40	60	100	100	150
	—	—	50	75	—	—	250
5	50	50	60	—	125	150	250
	75	75	75	150	200	200	400
	—	—	100	—	—	—	600
6	150	150	200	300	350	400	600
	—	—	—	—	400	—	1200

Note: Suitable for use with NEMA Design B and D (High Efficiency) Motors.

Table 18-103. Circuit Breaker Application Chart

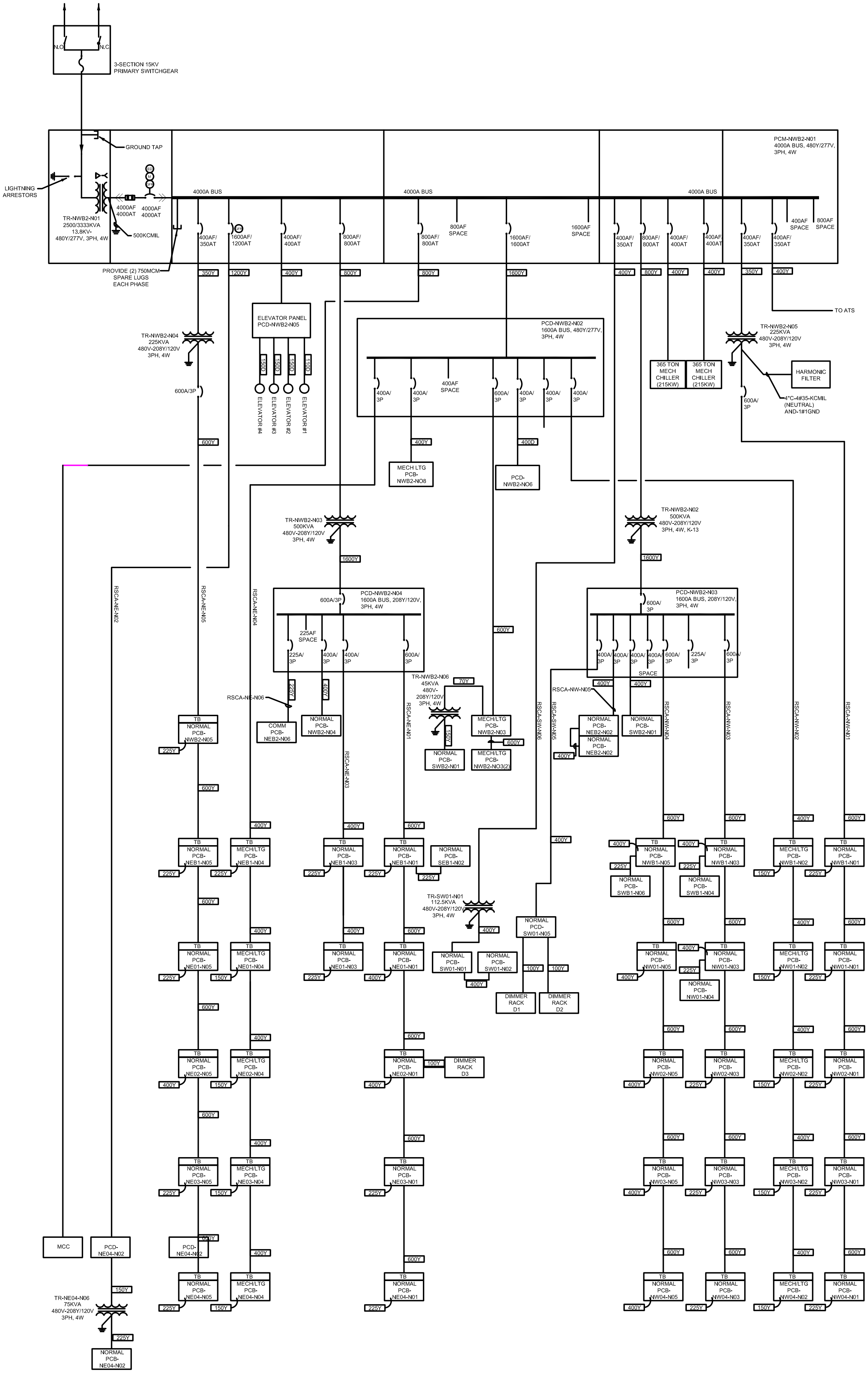
Frame	Frame Rating (Amperes)	Interrupting Rating (kA Symmetrical Amperes)		
		208/240V	480V	600V
Standard Rating Molded Case Circuit Breakers				
E125H	125	65	65	25
HFD	150	100	65	25
HJD	250	100	65	25
J250	250	65	65	25
HKD	400	100	65	35
HLD	600	100	65	35
HND	800	100	65	35
HND	1200	100	65	35
RD	2000	100	65	50
High Interrupting Rating Molded Case Circuit Breakers				
FDC	150	100	100	35
JDC	250	100	100	35
KDC	400	100	100	50
LDC	600	100	100	50
NDC	800	100	100	50
NDC	1200	100	100	50
RDC	2000	100	100	65
RDC	2500	100	100	65
Current Limiting Molded Case Circuit Breakers				
HFD/CL	150	100	100	100
NBTRIPAC	300 – 800	100	100	100
Magnum DS Air Circuit Breakers				
MDS-608	800	65	65	65
MDS-C08	800	100	100	100
MDS-616	1600	65	65	65
MDS-C16	1600	100	100	100
MDS-620	2000	65	65	65
MDS-C20	2000	100	100	100
MDS-632	3200	65	65	65
MDS-C32	3200	100	100	100

Table 18-104. Control Power Requirements (*IT.* Only)

NEMA Size	Continuous Current	Inrush
FVNR, 252W, FVR		
Size 1	.39	3.8
Size 2	.45	5.4
Size 3	.47	5.8
Size 4	.47	5.8
Size 5	.62	7.8
Size 6	.41	3.3
Size 7	.41	3.3
2S1W		
Size 1	.54	7.6
Size 2	.66	10.8
Size 3	.70	11.6
Size 4	.70	11.6
Size 5	1.00	15.6
SSRV		
24A	.45	3.8
33 – 304A	1.24	10
360 – 850A	1.64	10

Motor Control Center One-Line

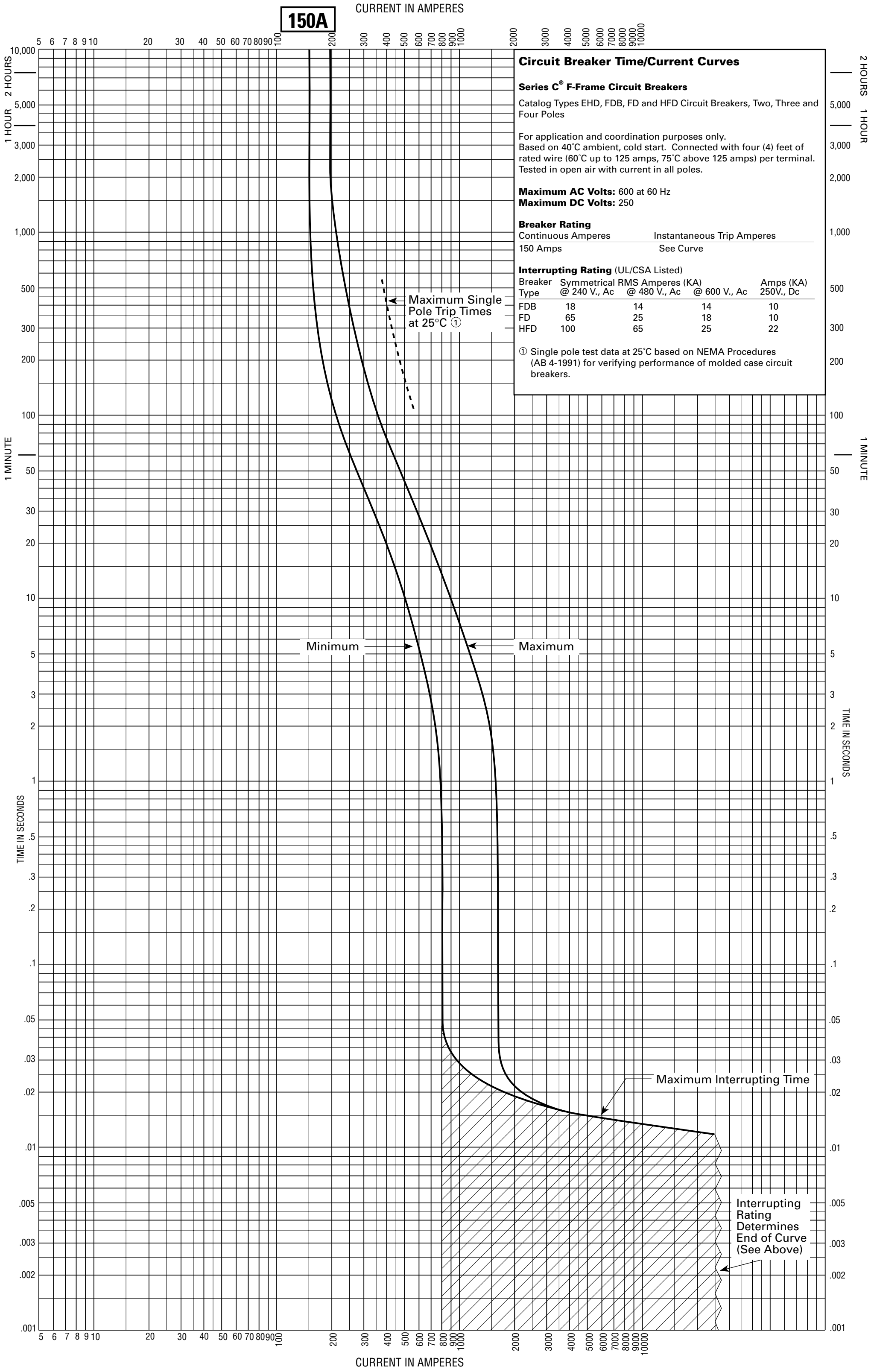
ONE-LINE DIAGRAM INCLUDING ADDITION OF MOTOR CONTORL CENTER



Appendix E

AB DE-ION Circuit Breakers

Types FDB, FD and HFD 150 Amperes



Circuit Breaker Time/Current Curves

Series C® F-Frame Circuit Breakers

Catalog Types EHD, FDB, FD and HFD Circuit Breakers, Two, Three and Four Poles

For application and coordination purposes only.
Based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (60°C up to 125 amps, 75°C above 125 amps) per terminal. Tested in open air with current in all poles.

Maximum AC Volts: 600 at 60 Hz
Maximum DC Volts: 250

Breaker Rating

Continuous Amperes	Instantaneous Trip Amperes
150 Amps	See Curve

Interrupting Rating (UL/CSA Listed)

Breaker Type	Symmetrical RMS Amperes (KA) @ 240 V., Ac	@ 480 V., Ac	@ 600 V., Ac	Amps (KA) 250V., Dc
FDB	18	14	14	10
FD	65	25	18	10
HFD	100	65	25	22

① Single pole test data at 25°C based on NEMA Procedures (AB 4-1991) for verifying performance of molded case circuit breakers.

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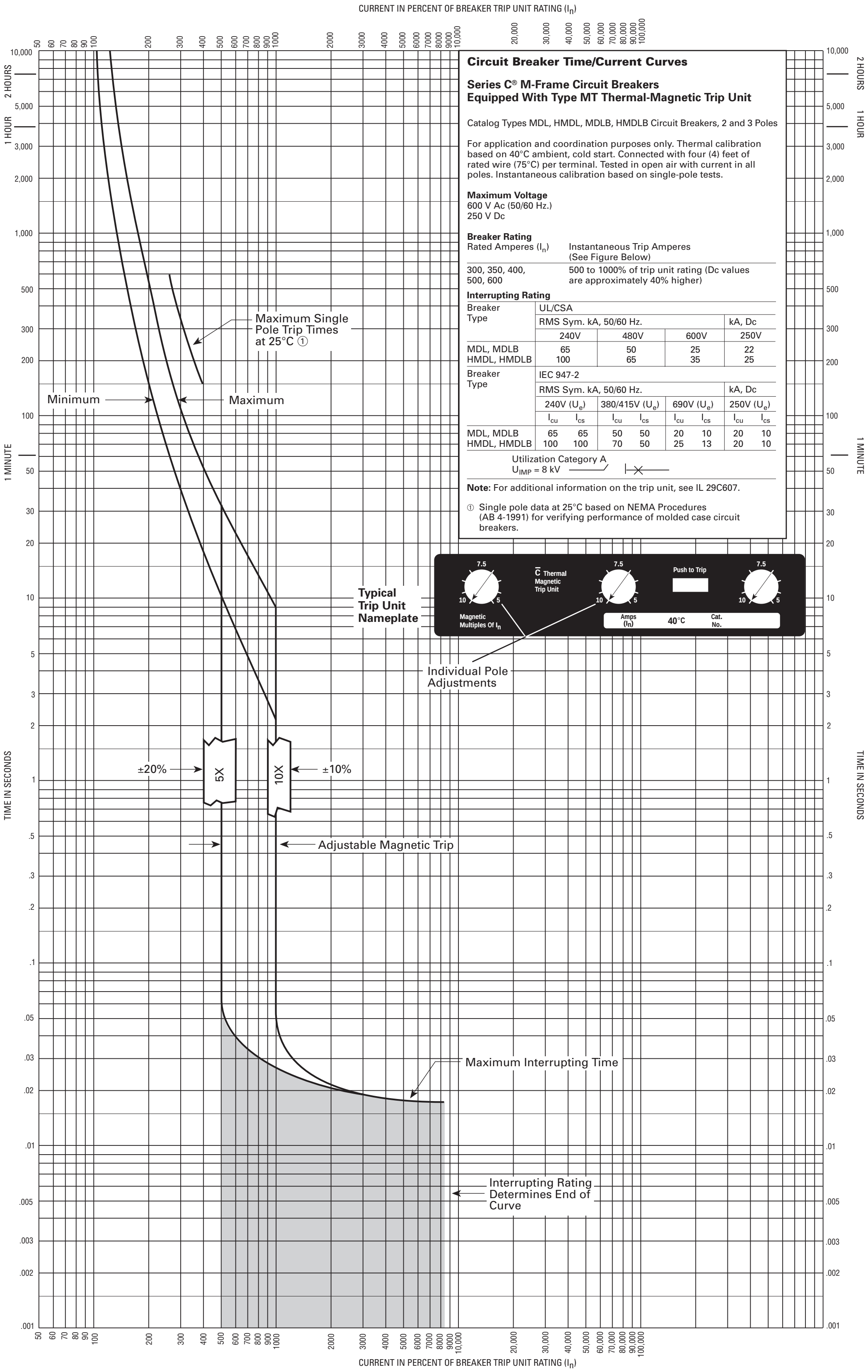
Types MDL, HMDL, MDLB, and HMDLB Equipped with Type MT Thermal-Magnetic Trip Unit, 300 to 600 Amperes



Circuit Breaker Time/Current Curves

Series C® M-Frame Circuit Breakers
Equipped With Type MT Thermal-Magnetic Trip Unit

Catalog Types MDL, HMDL, MDLB, HMDLB Circuit Breakers, 2 and 3 Poles

For application and coordination purposes only. Thermal calibration based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (75°C) per terminal. Tested in open air with current in all poles. Instantaneous calibration based on single-pole tests.

Maximum Voltage
600 V Ac (50/60 Hz.)
250 V Dc

Breaker Rating

Rated Amperes (I_n)	Instantaneous Trip Amperes (See Figure Below)
300, 350, 400, 500, 600	500 to 1000% of trip unit rating (Dc values are approximately 40% higher)

Interrupting Rating

Breaker Type	UL/CSA			
	RMS Sym. kA, 50/60 Hz.			kA, Dc
	240V	480V	600V	250V
MDL, MDLB	65	50	25	22
HMDL, HMDLB	100	65	35	25

Breaker Type	IEC 947-2							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V (U_e)		380/415V (U_e)		690V (U_e)		250V (U_e)	
	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}
MDL, MDLB	65	65	50	50	20	10	20	10
HMDL, HMDLB	100	100	70	50	25	13	20	10

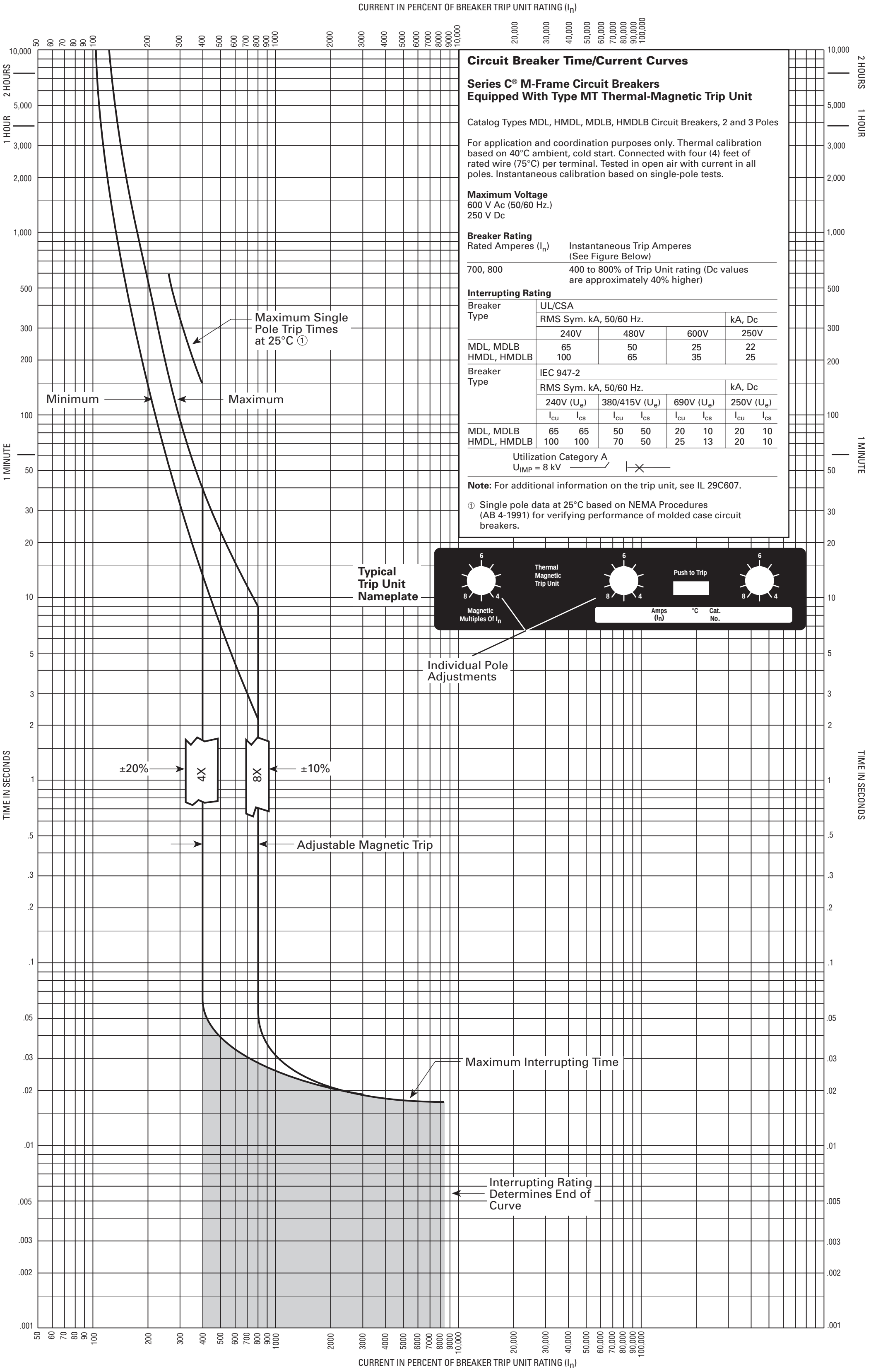
Utilization Category A
U_{IMP} = 8 kV

Note: For additional information on the trip unit, see IL 29C607.

① Single pole data at 25°C based on NEMA Procedures (AB 4-1991) for verifying performance of molded case circuit breakers.

Curve No. SC-6911-98

Types MDL, HMDL, MDLB, and HMDLB Equipped with Type MT Thermal-Magnetic Trip Unit, 700 and 800 Amperes



Circuit Breaker Time/Current Curves

Series C® M-Frame Circuit Breakers
Equipped With Type MT Thermal-Magnetic Trip Unit

Catalog Types MDL, HMDL, MDLB, HMDLB Circuit Breakers, 2 and 3 Poles

For application and coordination purposes only. Thermal calibration based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (75°C) per terminal. Tested in open air with current in all poles. Instantaneous calibration based on single-pole tests.

Maximum Voltage
600 V Ac (50/60 Hz.)
250 V Dc

Breaker Rating

Rated Amperes (I_n)	Instantaneous Trip Amperes (See Figure Below)
700, 800	400 to 800% of Trip Unit rating (Dc values are approximately 40% higher)

Interrupting Rating

Breaker Type	UL/CSA			
	RMS Sym. kA, 50/60 Hz.			kA, Dc
	240V	480V	600V	250V
MDL, MDLB	65	50	25	22
HMDL, HMDLB	100	65	35	25

Breaker Type	IEC 947-2							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V (U_e)		380/415V (U_e)		690V (U_e)		250V (U_e)	
	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}
MDL, MDLB	65	65	50	50	20	10	20	10
HMDL, HMDLB	100	100	70	50	25	13	20	10

Utilization Category A
U_{IMP} = 8 kV

Note: For additional information on the trip unit, see IL 29C607.

① Single pole data at 25°C based on NEMA Procedures (AB 4-1991) for verifying performance of molded case circuit breakers.

Curve No. SC-6912-98