Virginia, USA

Hotel and Conference Center

Senior Thesis Final Report

Spring 2011

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Lighting | Electrical

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Executive Summary

The following report includes specific details concerning the work that was completed during the entire spring 2011 semester for the AE Senior Thesis Capstone Project. It contains a brief background and project description of the Hotel and Conference Center, a recently opened hotel on the outskirts of one of Virginia's finest universities.

For the lighting depth, four spaces were redesigned, including an exterior space, a circulation space, a special purpose space, and a large work space. The new lighting design incorporates concepts regarding the architect's vision of bringing the exterior Virginia landscape indoors into every space. Using data and information from the technical reports completed in the fall of 2010, a complete solution was specified for each of the four types of rooms. Design criteria was set out for each space, lighting plans and mounting details were completed, equipment was selected, calculations were done using lighting software, controls were selected, and the overall performance of each system was evaluated.

The existing electrical design was then modified to meet the change in lighting design for each room. Branch circuiting panels, feeders, and voltage drop was resized for each design. The short circuit was also calculated for one electrical path. Two other depth topics were considered here as well, including an analysis of aluminum versus copper feeders and whether or not a photovoltaic array should be implemented for the building.

Two other separate breadths were completed per requirement of the program. As a part of the Ballroom's lighting design concept, daylight was brought into the Ballroom by the use of clerestories. With their placement, two structural columns had to be moved. The column heights and framing was checked after this move, too.

The proposed lighting design changes are not only aesthetically pleasing, but integrate the initial design concepts and goals from start to finish. Energy efficiency, flexibility, and overall pleasing lighting design generally drove the design from start to finish.

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Project Background

Construction on the $50 million dollar Hotel and Conference Center began in the fall of 2008 and finished in the summer of 2010. The building recently opened and is an 8-story, 174,000 square foot facility located on the outskirts of one of the country's most respected universities in Virginia. Although the exterior façade of the building does not boast any discrepancies from the architecture of the university, the handsome interior spaces display the epitome of bringing the campus landscape indoors. Rich colors and woodwork dominate each of the spaces alike, reminding one of the outdoors and the campus setting which provided inspiration to the interior décor. The Hotel and Conference Center provides a luxurious and warm atmosphere to all patrons, whether residing in the hotel or merely attending a business or private event in the conference center. The elegant inn houses 148 guest rooms, a lounge and bar area, a restaurant, ballroom, 24-hour fitness facility, and various meeting rooms in the conference center. Hotel guests not only become immersed in the sophisticated atmosphere, but are reminded of the spirit and vivacity of the university when visiting the facility.

Building Statistics

Building name:	Hotel and Conference Center
Location:	Virginia, USA
Occupancy type:	Mixed use – Hotel (R-1) and Conference (A-3)
Size:	174,000 sq. ft.
Number of stories:	7 stories above grade 1 parking level below grade

Primary project team:

Owner:	Information withheld
Contractor:	Balfour Beatty http://www.balfourbeatty.com/
Architect:	Gensler http://www.gensler.com/
MEP Engineers:	GHT Limited http://www.ghtltd.com/
Interior Designer:	Gensler http://www.gensler.com/
Structural Engineers:	Thornton Tomasetti http://www.thorntontomasetti.com/ Abel Consulting Engineers http://www.acepa.net/
Civil Engineer:	Christopher Consultants http://www.ccl-eng.com/mainpeo.htm
Lighting Designer:	Horton Lees Brogden Lighting Design http://www.hlblighting.com/
Landscape Architect:	ParkerRodriguez http://parkerrodriguez.com/index.cfm
Fire/Life-Safety Consultant:	Schirmer Engineering http://www.aonfpe.com/home.aspx
Vertical Transportation:	Lerch Bates & Associates http://www.lerchbates.com/
AV/Acoustics/IT/Telecom/Security:	Cerami & Associates http://www.ceramiassociates.com/

Dates of construction:	Fall 2008 – Summer 2010
Cost information:	$50 million
Project delivery method:	GMP

Architecture:

Design/functional components:

The recently opened Hotel and Conference Center, on the outskirts of one of the country's most respected universities, embodies the notions of comfort and relaxation with professionalism and academic success. The Hotel and Conference Center provides a luxurious and warm atmosphere to all patrons, whether residing in the hotel or merely attending a business or private event in the conference center. Although the exterior façade of the facility does not boast any discrepancies from the architecture of the university, the handsome interior spaces display the epitome of bringing the campus landscape indoors. Rich colors and woodwork dominate each of the spaces alike, reminding one of the outdoors and the campus setting which provided inspiration to the interior décor. The elegant inn houses 148 guest rooms, a lounge and bar area, a restaurant, ballroom, 24-hour fitness facility, and various meeting rooms in the conference center. Hotel guests not only become immersed in the sophisticated atmosphere, but are reminded of the spirit and vivacity of the university when visiting.

Codes:

2006 | Virginia Uniform Statewide Building Code (VUSBC)
2004 | Commonwealth of Virginia Construction and Professional Services Manual (CPSM)
2005 | National Electrical Code (NFPA 70)

Zoning:

Historical requirements: There are no historical requirements for this area.

Building envelope:

The building façade is constructed of two different types of brick, mainly to differentiate between the public first floor of the hotel and the private hotel room floors of the rest of the building. Glazed aluminum windows and entrance ways line both the convention center and hotel halves of the building. There are also metal canopies over the hotel and conference center entryways.

The roofing consists of multiple-ply built-up roof membrane with thermal insulation.

Construction:

The development team of the Hotel and Conference Center was University Hotel Partners, LLC, a joint venture between Balfour Beatty Construction and Concord Eastridge, Inc. Construction began in the fall of 2008 and was completed in the summer of 2010. The total cost of the building was $50 million, $42 million of that being a part of the construction budget (all hard costs). In order to raise excitement and awareness of the university's new hotel, hard hat tours were frequently coordinated for the university's administrators, donors, and local business leaders.

Electrical:

A pad-mounted transformer owned by the utility company provides power for the Hotel and Conference Center. The main switchboard delivers 3000A at 480Y/277V, 3PH, 4W, which feeds to an 800A panel. This panel steps down the voltage and feeds panels and loads on each of the six floors of the hotel tower. The main switchboard also distributes power to numerous pieces of kitchen, laundry, and lighting equipment. A diesel generator producing 150kW of continuous standby power at 480Y/277V provides back-up power for emergency lighting, the fire alarm system, one of the building elevators at a time, the fire pump, and non-emergency power.

Lighting:

The Hotel and Conference Center in Virginia has a distinct, urbane atmosphere. It is seen through the architecture and the finishes, but more importantly, the lighting. Through the use of coves, branding walls, decorative luminaires, and accent lights, guests feel welcome and relaxed. Halogen lamps are the main lamp-type used, enhancing the rich hues and finishes in the building using warmer tones of light. Dimming systems are implemented into the public facilities of the building. ASHRAE 90.1 lighting power density requirements and IESNA illuminance recommendations were closely examined in each space. With the use of warm colored light on the furniture, innovative ways to highlight signage and accentuate millwork, and decorative fixtures, the Hotel and Conference Center promotes relaxation and elegance through its lighting design.

Mechanical:

The mechanical system consists of fourteen roof top units on the conference center roof, ranging from about 1200-5600 CFM, and two outdoor air units on the roof of the hotel tower, sized at 6500 and 8600 CFM. Both the roof top units and outdoor air units provide gas heat. Two make-up air units are designated for the kitchen and laundry rooms, providing fresh, supply air. There are eleven water source heat pump units but only nine are being used. Additionally, a cooling tower found directly outside of the building is sized at 292 tons.

Structural:

The overall structure of the building is made up of load bearing and non-load bearing metal panel walls, ideal for modular or repetitious construction. Lateral loads are handled utilizing concrete shear walls. The hotel tower consists of concrete columns varying in size, whereas the conference center half of the building has steel columns encased in concrete. The floor system is 5" LW concrete with 2" steel deck.

Fire Protection:

Manual fire alarm stations are located at every entrance of the hotel tower and conference center. There are also two per floor in the hotel tower. Speaker and strobe combination units are common in most rooms of the conference center and first floor of the hotel, and there are typically three per guest floor of the hotel as well. In case of emergencies in the hotel tower on the guest floors, magnetic door hold open devices are installed in every elevator lobby. Fire alarm speakers and system smoke detectors are typical in each guestroom. Photo-electric smoke detectors and heat detectors are placed in the service elevator.

Transportation:

The hotel tower of the Hotel and Conference Center has three elevators and two emergency stairwells. Two of the elevators are for general public use and extend from the lower parking level all the way to the seventh floor. The third elevator is used extensively as a service elevator for employees.

Telecommunications:

A main telecommunications room is located in the conference center portion of the building. There is also one telecommunications room per floor of the hotel tower. Voice and data outlets are located on the walls of rooms, although in the more public areas (meeting rooms, ballrooms, etc), they are mounted into the floor. Wall-mounted television outlets are in the Lounge and in all guest rooms. Wireless internet is available in most rooms in the building, including all of the conference center rooms, the lounge, and all of the guest rooms.

Security:

Security systems are very important in hotels. The Hotel and Conference Center implements both an intercom entry and card reader entry into the lower level parking garage. Card readers are also used for the guest elevators, hallways of the conference center, and guest rooms. Exterior cameras are extensively used around the perimeter of the building, especially around the back-of-house area.

Audiovisual Systems:

The use of audiovisual systems is only on the public first floor of the Hotel and Conference Center. Recessed ceiling speakers are located throughout much of this floor, including the main lobby, the Lounge, restaurant, and ballrooms and meeting rooms in the conference center. Both button based and touch panel based control systems are utilized. The Ballroom uses recessed ceiling projection screens, whereas the other typical meeting rooms generally use flat panel displays or projectors. Microphone usage is also prevalent in the conference center portion of the building.

Lighting Depth

Introduction:

"Our concept is to blur the line between interior and exterior and to pull the outdoors indoors."
-Gensler Architecture Group

The Hotel and Conference Center is located outside of one of Virginia's most prestigious universities. Situated in rural Virginia, the site includes dozens of beautiful cedar trees and landscaping, common to the university as well. Through the use of colors and finishes, the natural landscape has already physically been brought into the building. Deep olive greens, bright oranges and reds, and rich gold hues all evoke the ideas of nature inside the building. Floor finishes and architectural shelving units and millwork made from wood and quarry stone all exhibit the natural wooded landscape. Effective lighting design in each space can help to enhance the unique materials and finishes implemented, and further accentuate the interaction between surfaces and light.

Integrating the idea of nature and the beautiful wooded landscape of the university into the lighting design will complement the interior décor of the facility and tailor to the architect's vision for the building.

Four spaces will be analyzed and redesigned. These four spaces include:

1. Exterior facades of both the hotel and conference center, as well as the central courtyard
2. Main Lobby
3. Lounge
4. Ballroom

New lighting designs in each space will focus on the architect's concept of bringing Virginia's outdoor landscape indoors.

Lighting designs for each space will be designed to establish all important qualitative and quantitative design criteria. IESNA recommendations and power density allowances from ASHRAE Standard 90.1 will be acknowledged and met in each space.

Exterior Space | Façade and Courtyard

Space Description:

As guests arrive at the Hotel and Conference Center, they will drive through an exterior courtyard with a triangular shaped plaza. The façade of the Hotel and Conference Center is made up of two types of brick. The public spaces of the building on the first floor all have a more decorative brick with accent bands, while the rest of the hotel tower is clad in brick without accent bands. Precast cornices break up the tower of the hotel into horizontal lines, accentuating the length of the building. Concrete panels beneath the 6'-0" x 6'-8" windows enhance the height of the hotel tower. Glazed aluminum window walls wrap around the first floor of the Hotel and Conference Center, allowing natural light into the public areas of the building.

Activities | Tasks:

- Hotel and Conference Center entrance and drop-off
- Walking
- Sitting outside

Dimensions:

- Building Height:
  - 71'-7" to roof of Hotel Tower
  - 21'-0" to roof of Conference Center
- Length of Façade:
  - 208'-0" total length of front of Hotel
  - 181'-6" total length of front of Conference Center
- Area = approximately 19,000 sq. ft.
- Perimeter = approximately 970 ft.

Surface Materials:

- Brick
- Precast decorative frames with metal
- Spandrel panels and screen walls
- Glazed aluminum window walls (double pane, clear, Low-E insulating glazing with a transmission value of 0.46)
- Metal entry canopies

Exterior Plans:

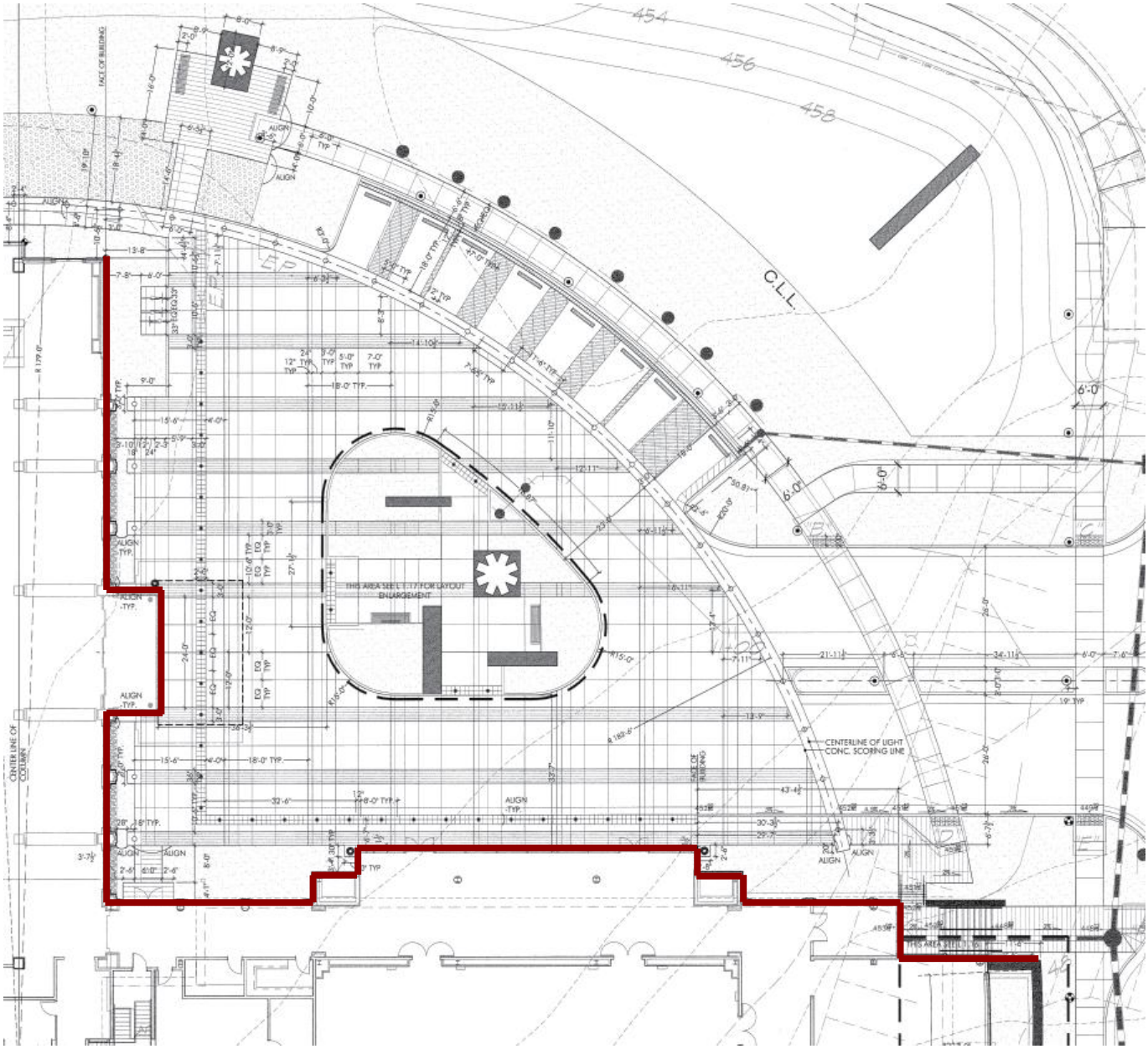


Figure 1: Outline of Building Facade

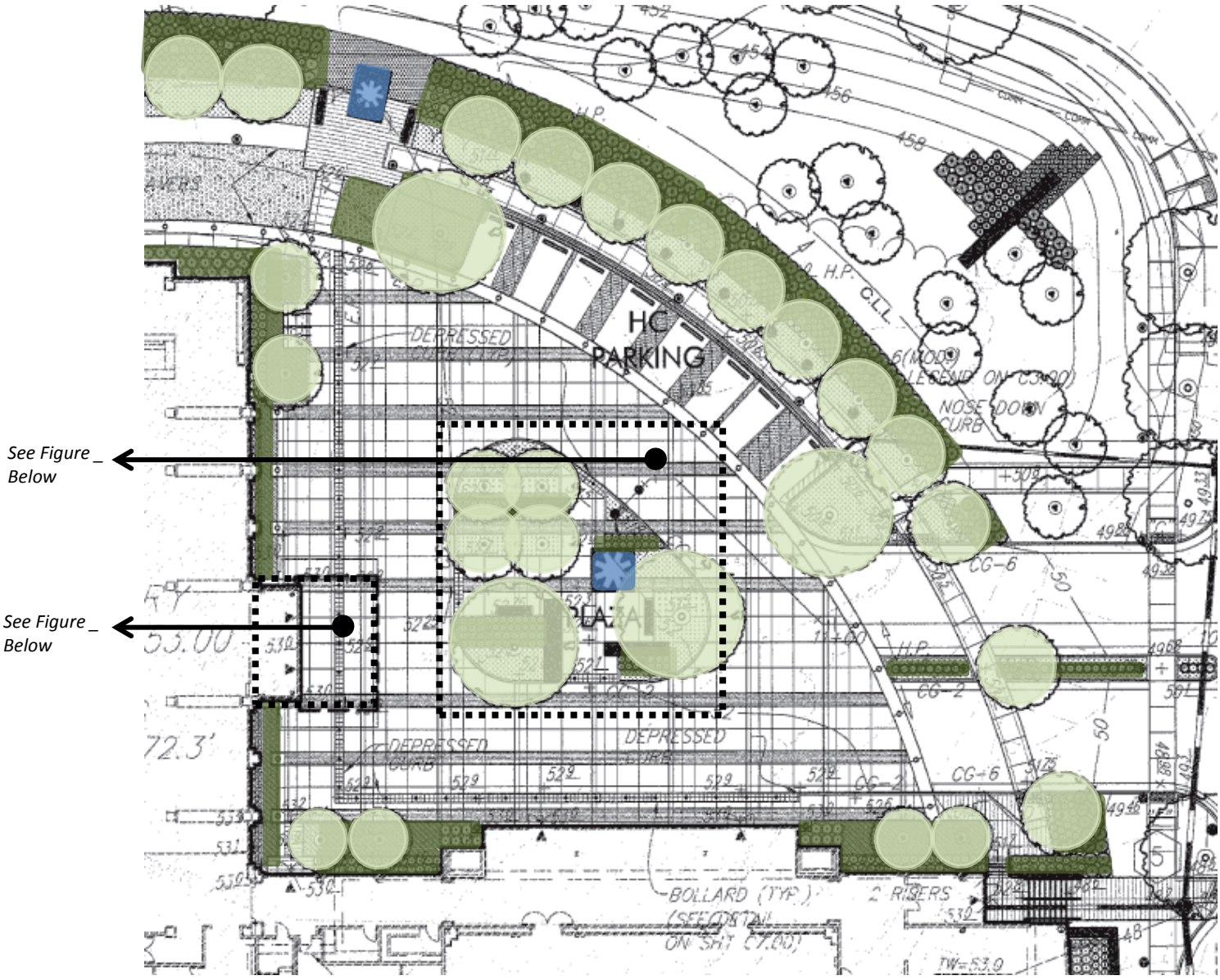


Figure 2: Landscaping Plan in Courtyard | Important landscaping noted, including unknown sculptures

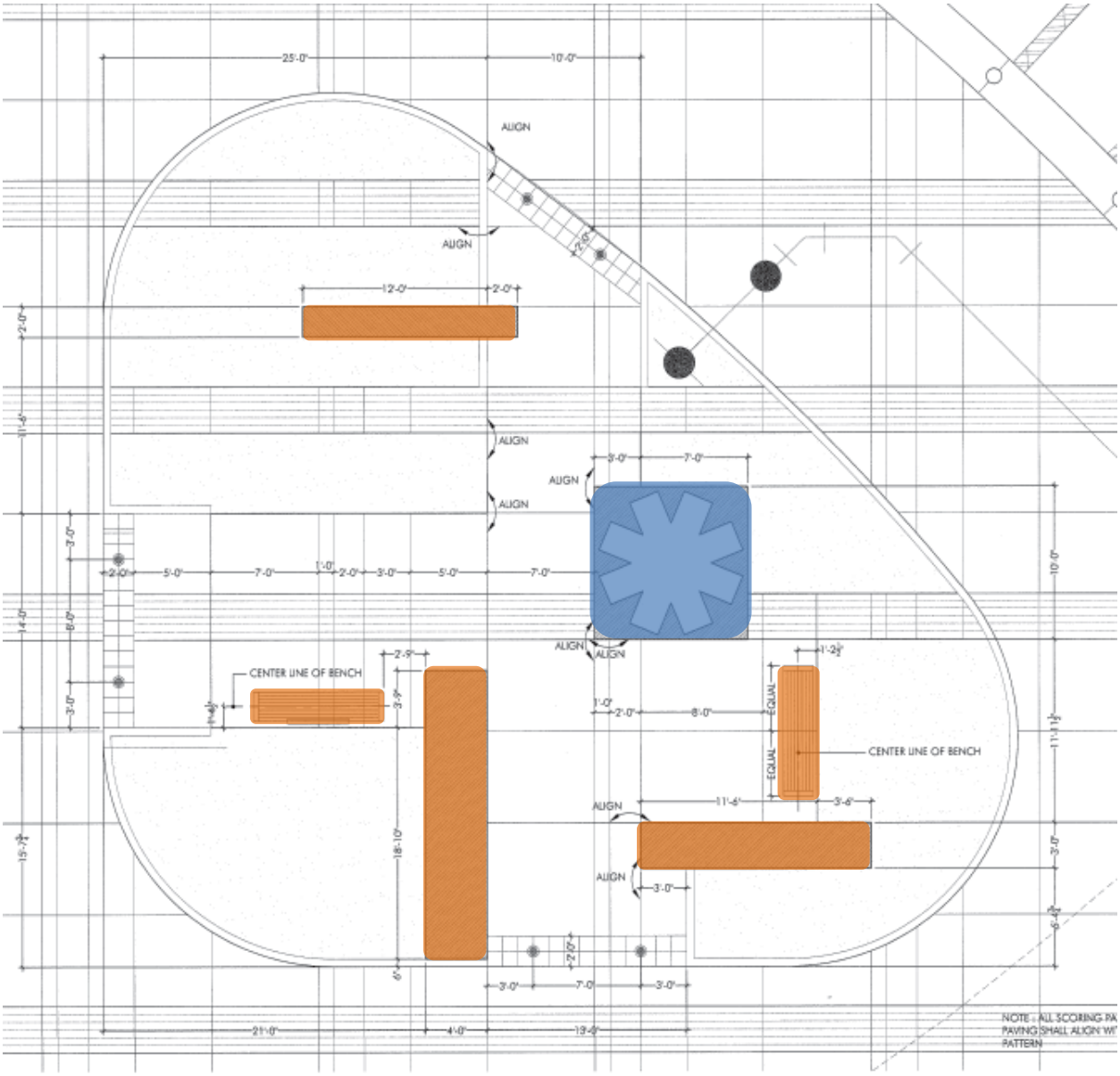


Figure 3: Central Plaza | Benches and unknown sculpture identified

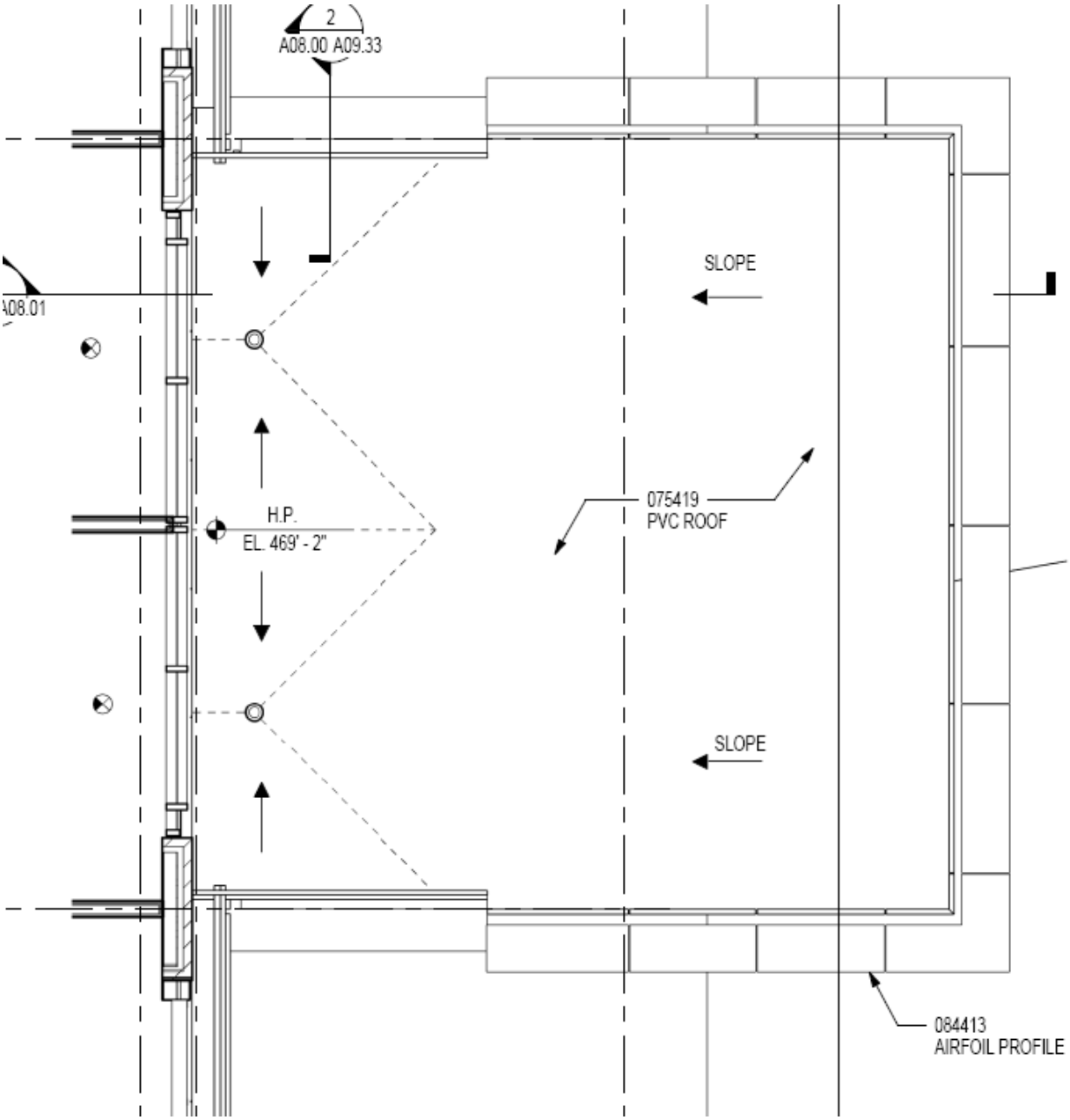


Figure 4: Plan of Hotel Canopy

Exterior Elevations:

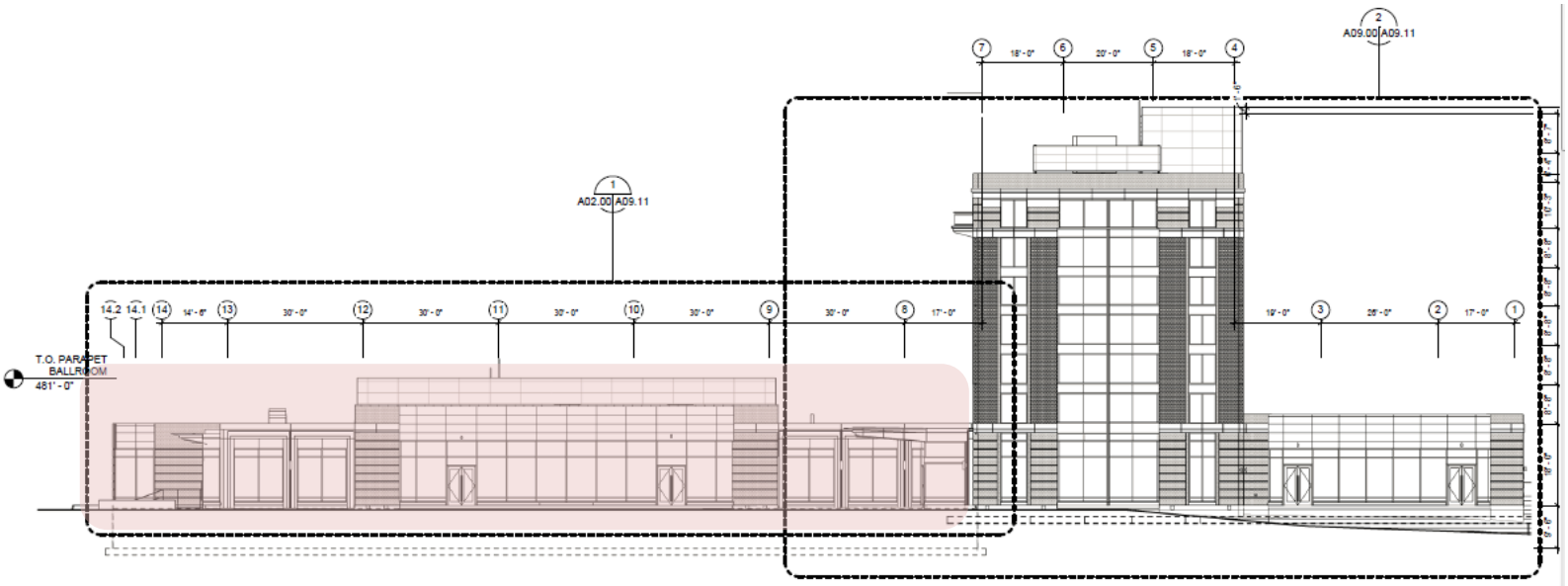


Figure 5: North Elevation | Front Facade of Conference Center

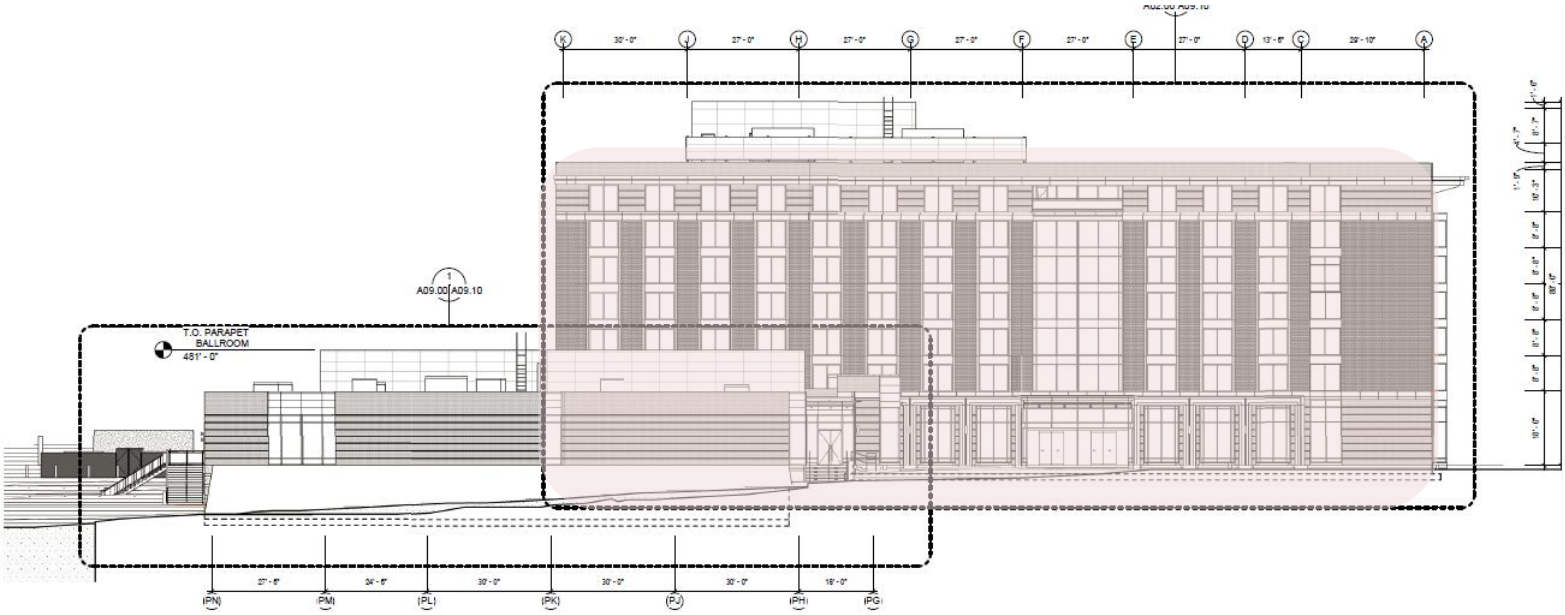


Figure 6: East Elevation | Front Facade of Hotel Tower

Design Criteria and Considerations:

General Lighting Concept:

Nature | Light as a Path

Guests of the Hotel and Conference Hotel arrive at the building and drive around a central courtyard located in front of the facility. The central plaza is made up of planters, benches, and even incorporates walkways to encourage guest interaction with the exterior space. The exterior facades of both buildings include a variety of materials, such as brick, glass, and metal canopies and spandrel panels. Although the architectural design does not differentiate itself much from the rest of the university's buildings, through the use of light, the Hotel and Conference Center can stand alone as an icon reflecting the natural beauty of Virginia.

Figure 7: Inspirational Image

Inspiration of natural light for the exterior façade includes an image of a sunburst, shining through the clouds. This image mirrors the concept of uplight and accentuating forms and textures of the clouds, much like grazing brick on the exterior of the building. However, the proposed lighting design of the exterior façade considers both light trespass and light pollution, as to preserve the natural wooded landscape around the site. Minimal uplight is applied on the middle tier of the hotel tower. Sconces along the first floor levels of the building graze light upwards and downwards while still providing adequate light levels at the pedestrian level and architecturally enhancing the textures of the facades. Most of the light on the exterior is at a pedestrian level, promoting safety and a sense of welcoming onto the site. The metal canopy of the hotel provides higher levels of light for guests to drive up to and gather their bags. Orientation onto the site is also important to help guide guests to the main entrance of the building. Canopy lighting illuminates the entrance area of the building as a focal point and therefore signal to guests the main doors of the building.

Psychological Aspect:
When arriving at the Hotel and Conference Center, guests should feel welcomed as they approach the building. The façade and exterior courtyard should feel inviting and relaxing to guests.

Safety:
Guests need and want to feel safe and secure when staying at a hotel and lighting plays a critical role in this. Having the walkways and parking lots well lit at night will make guests feel safer about walking around outside. Lamps with good CRIs will enable good color appearance and modeling of others.

Connection with Architecture:
The lighting design on the façade should enhance the architecture of the building. The lighting should lead guests up to the front of the building. Having the Hotel and Conference Center glow from within on the first floor also gives the building another dimension as people drive by.

Direct Glare:
Direct glare should be avoided at all costs. As guests approach the building in their vehicles, any glare from luminaires could be dangerous to drivers and pedestrians. Light levels should stay at a relatively uniform illuminance on the site as guests make their way up the driveway, around the central plaza, and to the porte cochere. Direct glare is also relevant in that fixtures should be properly placed so as to not shine any light through the windows.

Horizontal Illuminance:
- Building Exteriors
  -Entrances > Active: 5fc
  -Prominent structures: 5fc

- Gardens
  -General Lighting: 5:1 ratio
  -Paths, Away From Building: 10:1 ratio
  -Trees or Shrubbery, Emphasized: 3fc

Vertical Illuminance:
- Building Exteriors
  -Entrances > Active: 3fc
  -Prominent structures: 3fc

- Gardens
  -General Lighting: 2:1 ratio
  -Paths, Away From Building: 3:1 ratio
  -Trees or Shrubbery, Emphasized: 3fc

Modeling of Faces or Objects:
When guests are outside walking to and from their cars late at night, they should be able to make out other people's facial features and the objects around them. This is so guests feel safe and comfortable while walking outside at night. The use of lamps with high CRIs will help achieve this.

Light Pollution and Light Trespass:
Because the Hotel and Conference Center is located near a major interstate and university, light pollution and light trespass post potential threats. If lighting the actual façade, minimizing the amount of uplight helps with light pollution. Luminaires used should also be direct around the perimeter of the site so as to reduce the effects of light trespass.

Power Density Allowance: ASHRAE 90.1.2007
- Tradable Surfaces > Building Grounds > Plaza Areas = **0.2W/SF**
- Tradable Surfaces > Building Entrances and Exits > Main Entrances = **30W/LF** of door width; Other Entrances = **20W/LF**
- Tradable Surfaces > Walkways = **1.0W/LF**
- Tradable Surfaces > Roadways = **0.15W/LF**
- Tradable Surfaces > Building Entrances > Canopies and Overhangs = **1.25W/SF**
- Nontradable Surfaces > Building Facades > = **0.2W/SF** for each illuminated wall or surface or **5.0W/LF** for each illuminated wall or surface length

Lighting Plan – Refer to Appendix C

Mounting Details – Refer to Appendix C

Luminaire Equipment Schedule:

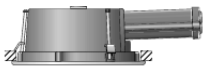
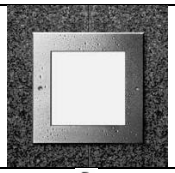
Tag	Luminaire	Description
K1-3		Low voltage Plexineon White 2X Series in 2800°K for warmer light. Lengths vary for use in cove, under the toe kick in bar, and bar shelves. Outside corner pieces also specified.
Q		Recessed wide beam luminaire made of aluminium alloy, aluminium, and stainless steel. Reflector made of anodized pure aluminum. Dust tight and protection against water jets. (1) 42W CFL lamp lamped horizontally.
R		Walk-over and drive-over luminaire recessed in compacted surfaces, paths, and open areas for pressure load up to 5000 kg. Made of aluminium alloy, aluminum, and stainless steel, and contains white safety glass. Dust tight and protection against temporary immersion.
S		Clessidra urban column with 32W in (4) Xicato LEDs. Powder coated polyester and highly resistant to UV and oxidation. Surface mounted and suitable for wet location. Finish color in anthracite gray.
T		Reese exterior sconce from Winona, with (1) F17T8 medium bi-pin lamp. UL listed and CUL approved for wet location. Opal acrylic lens and custom painted finish (gray).
U		Slim profile linear floodlight with a 120° flood distribution for short throw applications, with 6 LEDs per foot and consuming 8W per foot. ½" low profile body sealed for IP68 rating (dry, damp, wet location) and mounted on an 8" cantilever. Extruded and die cast aluminum housing.

Table 1: Condensed Lounge Luminaire Schedule

**The full Lighting Equipment Schedule can be found in Appendix A.*

Light Loss Factors:

Light Loss Factors						
Tag	**Initial Lumens**	**Mean Lumens**	**LLD**	**LDD**	**BF**	**Total**
K1-3	-	-	0.70	0.90	1.0	0.63
Q	3200	2690	0.84	0.74	0.85	0.53
R	265	220	0.83	0.74	0.95	0.58
S	-	-	0.70	0.80	1.0	0.56
T	1325	1260	0.95	0.80	0.95	0.72
U	-	-	0.70	0.74	1.0	0.52

Table 2: Lobby Light Loss Factors

**Use of the new procedure to find LDD was used. As the new handbook does not address RSDD, it was not calculated. According to the new handbook, a LEDs LLD is assumed to be 0.7. A 12 month cleaning interval and "clean" environment was assumed. Any other LLFs not displayed are assumed to be 1.0.*

Controls:

Luminaires located in the exterior plaza and on the façade will be controlled via a time clock within the main Lutron GRAFIK Eye System. The luminaires will be switched off during the day and the time clock will turn them on at night. Please refer to Appendix C for more information.

Control Schedule						
Tag	**Product**	**Manufacturer**	**Product/Catalog No.**	**No. Units**	**Description**	**Location**
EQ-A	Viseo Wallstation	Lutron GRAFIK	OMX-VDC-LF	1	Main wallstation that provides local access to the lighting control system. Operates every scene and zone in the system, as well as the ability to change fade and delay times in any area. Includes a time clock.	AV Closet (Room #1324)

Table 3: Control Schedule | Exterior

Performance Data and Preliminary Renderings:

Note: The calculations were done with all of the lights on and no daylight.

Exterior Entrance | Calculation Summary		
	Ground	**Vertical**
Avg Illuminance	***9.19 fc***	***2.4***
Max Illuminance	13.4 fc	3.73
Min Illuminance	4.5 fc	0.83
Avg/Min	2.04	2.88
Max/Min	2.98	4.48
Criteria	5 fc	3 fc
Compliance?	**Yes**	**Yes**

Table 4: Calculation Summary of Exterior

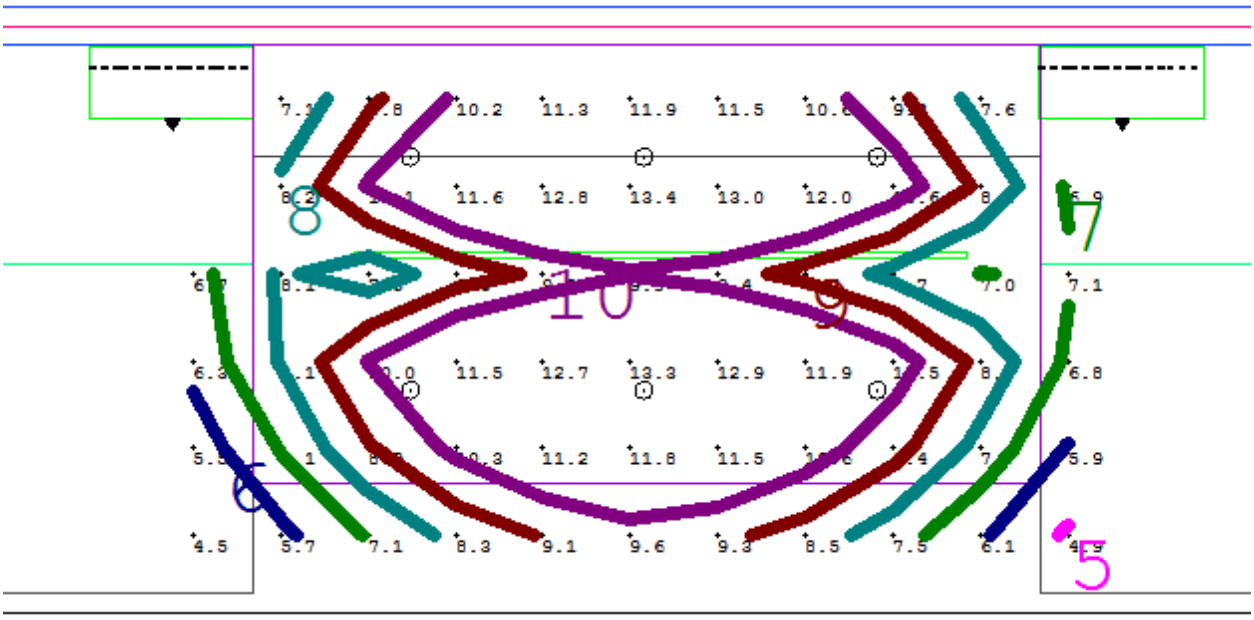


Figure 8: Illuminance Contours | Canopy

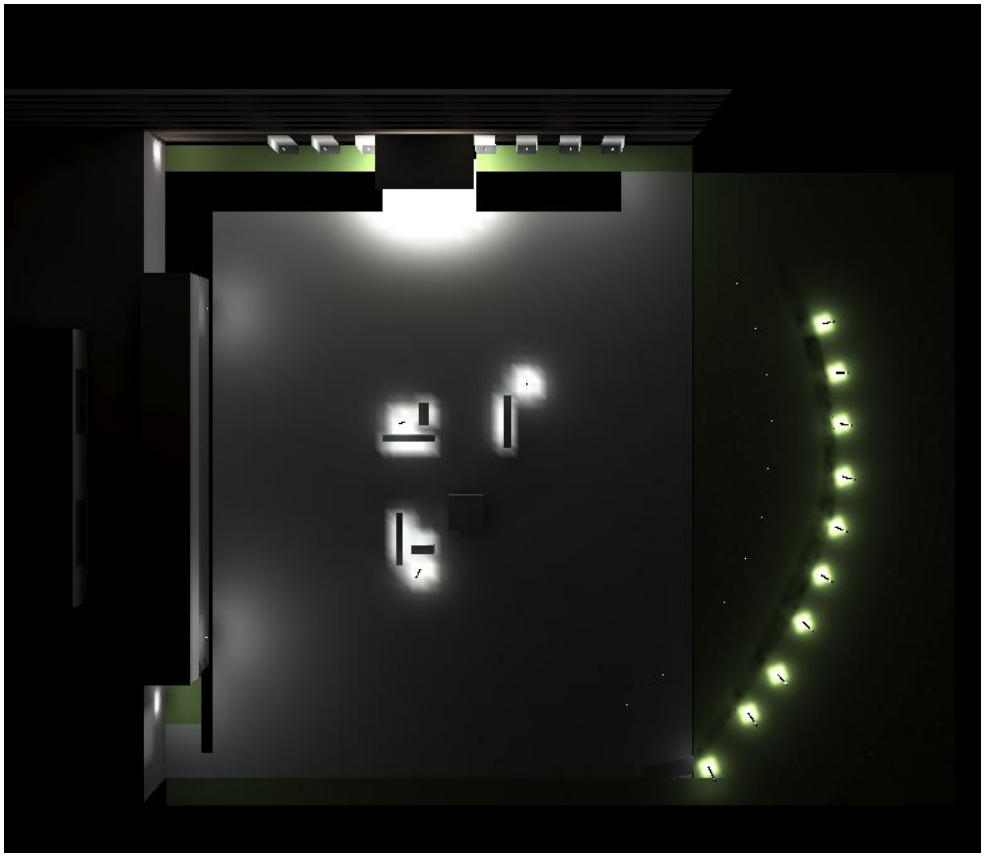


Figure 9: AGI32 Rendering of Exterior Space

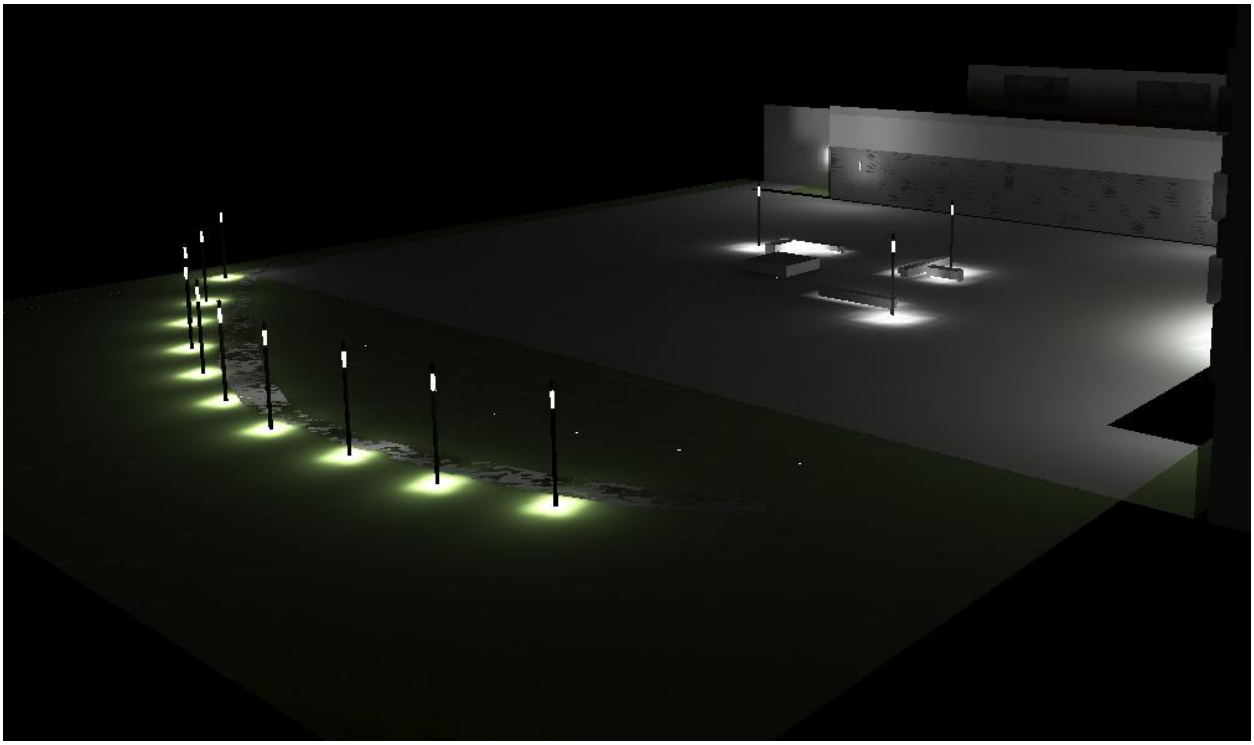


Figure 10: AGI32 Rendering of Exterior

Figure 11: AGI32 Rendering of Exterior

Lighting Power Density:

ASHRAE Standard 90.1 | LPD Summary				
Area	**Size**	**Power Density Allowable**	**Allowable Wattage**	**Designed Wattage**
Façade (nontradable)	15043.83 sf	5.0 W/SF	75219	160
Other entrance (tradable)	6 ft	20 W/LF	120	38
Plaza (tradable)	175.5 ft	0.2 W/LF	35.1	0.15
Canopies and overhangs (tradable)	347.5 sf	1.25 W/SF	434.375	282
Walkways (tradable)	704 ft	1.0 W/LF	704	370
Roadway (tradable)	620 ft	0.15 W/LF	93	0.03
		Total Tradable Watts	**1386.5**	**690.2**

Table 5: LPD Summary Tables | Exterior

Performance Summary:

The lighting design for the Exterior façade and entry courtyard addresses issues that are presented during the nighttime hours. Minimal uplight from LED strips applied along tiers of brick emphasize the verticality of the hotel tower, grazing the texture of the brick. Sconces mounted on linear post elements along the first floor of the hotel glow with light, highlighting the architectural forms and providing additional lighting for the walkways at a more human scale. Recessed compact fluorescent downlights in the entry canopy help make the porte cochere stand out amongst patrons when arriving at the Hotel and Conference Center, bringing attention the hotel's entrance. LED light columns glow around the perimeter of the outer walkway along the exterior portion of the site. Recessed in-ground LED uplights mark parking spaces for patrons and hotel staff. LED strips mounted under the concrete benches in the central courtyard lure patrons to the garden area at nighttime. At night, the Hotel and Conference Center glows with light from within on the first floor, making the building appear more friendly and approachable.

As designed, the lighting design for this space complies with both the IESNA recommendations and ASHRAE Standard 90.1 requirements. It is also successful in creating a nighttime presence and sense of welcoming for the building that is aesthetically pleasing, safe, and effective.

Circulation Space | Main Lobby

Space Description:

Upon arrival at the Hotel and Conference Center, the Main Lobby serves as a particularly important space for guests and staff. Guests enter the main lobby through the vestibule and make their way to the front desk and check-in area. There are also seating areas throughout the main lobby, providing relaxation for guests and serving as waiting areas. These seating nooks are ideal for those waiting to enter either the Restaurant or Lounge. Floor to ceiling windows provide daylight into the space during the day. The lobby is filled with rich colors and finishes, complimenting the relaxing atmosphere.

Activities | Tasks:

- Check in at the front desk
- VDTs at the front desk for employees
- Lounging areas for guests
  - Reading
  - Socializing
  - Waiting for entrance to the Restaurant or Lounge
- Elevator lobby
- Passing through to Conference Center

Dimensions:

Area: 4430 SF

Dimensions: Approximately 121'-6" x 36'-6"

Surface Materials:

Main Surface	Description	Tag	Manufacturer	Color	Reflectance
Ceiling	Overall Ceiling	P-12	Benjamin Moore	Vanilla Ice-Cream	0.87
Floor	Lobby rugs inset into wood flooring	C-3	--	--	0.14
	Porcelain tile with matte finish	PT-1	Daltile	Gold and Almond	0.37
	Solid hardwood				0.56
Walls	Wall covering	WC-1	--	--	0.95
	Medite-FR wood paneling (48"x96") planks, with a membrane film finish	WD-3	Interlam Inc		0.31
Base	Solid hardwood finish with semi-open pore lacquer and 30% sheen finish	WD-4	Danzer Specialty Veneer		0.03
Reception Desk	Solid hardwood finish with semi-open pore lacquer and 30% sheen finish	WD-6	GC to provide		0.03
	Desk top is 12"x12" Interior Stone (Granite) with polished finish, 3/4" thick and 1/16" max grout	ST-2	Daltile	G759-Golden Crystal	0.27
Column Surrounds and Floor Accents	12"x12" Interior Stone (Natural Stone Collection), 1/2" to 1" thick and 1/4" grout	ST-1	Daltile	S783-Golden Sun	0.37
Front entry signage	Plastic laminate	PL-8	Chemetal	Brushed medium bronze aluminum	0.14
Woodwork	Wood veneer, sliced andes cedar with semi-open pore lacquer 30% sheen	WD-1	Danzer Specialty Veneer		0.24
Hostess Stand	Wood veneer, sliced sapele with semi-open pre lacquer 30% sheen	WD-2	Dooge Veneers Inc		0.03

Table 6: Reflectance Values | Lobby

Lobby Plans:

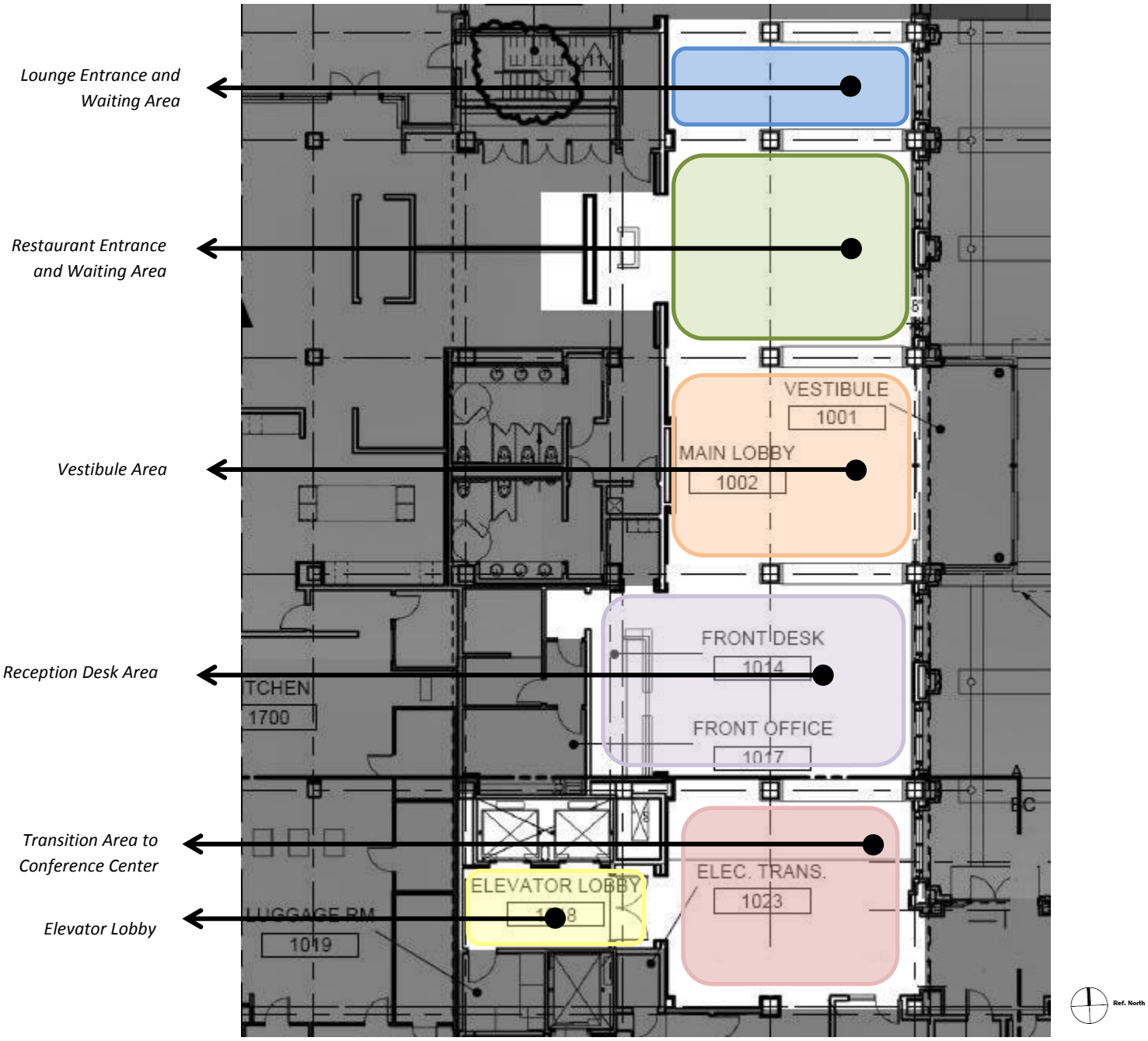


Figure 12: Lobby Plan

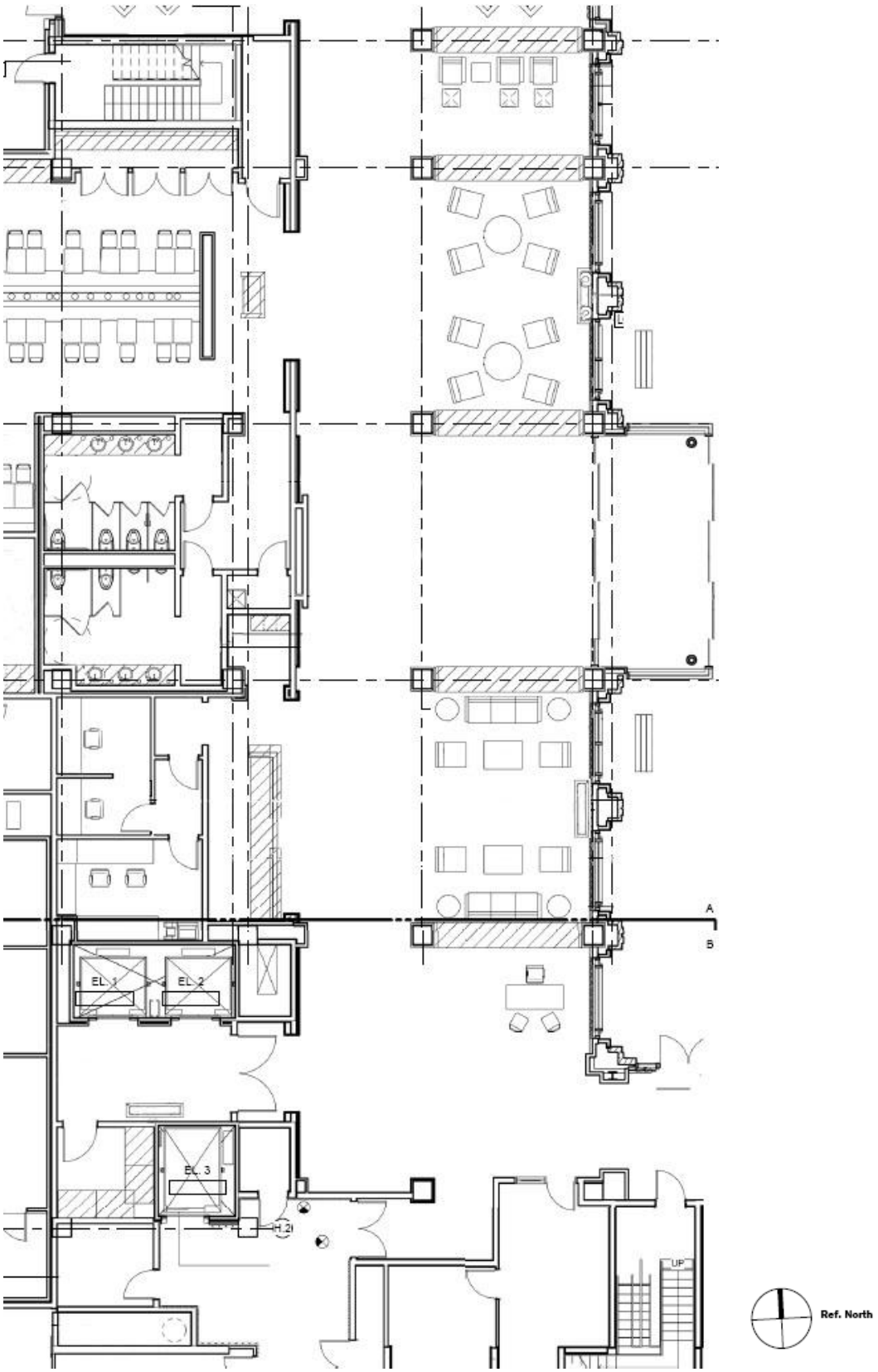


Figure 5: Lobby Furniture Plan

Design Criteria and Considerations:

General Lighting Concept:

Nature | Light as a Pathway

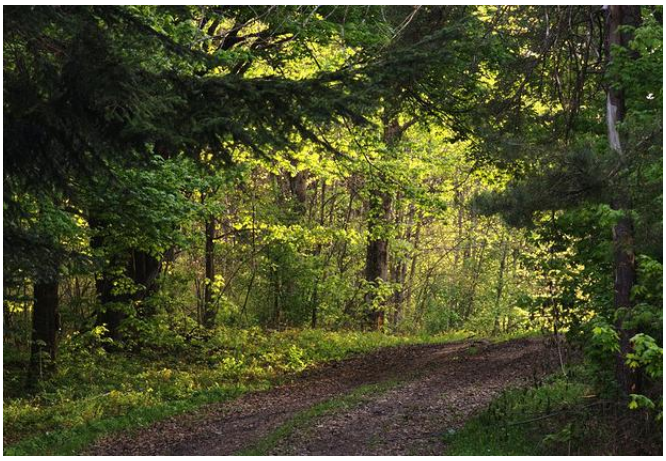


Figure 14: Pathway of Light | Photo from Flicker

The source for inspiration for the Lobby is of a natural wooded landscape, illuminated with light from above. Light cascades onto the pathway of this trail, guiding people as they make their way through the woods. The Lobby of the Hotel and Conference Center should also orient and direct people to particular points and pathways in the building like this pathway does, and lighting can help accomplish this.

Signage displays are seen in the lobby, signaling to guests where different areas of the hotel are located. The main hotel sign and sign behind the reception desk are backlit, while the sign for the restaurant is grazed with light. A cove over each seating area makes the areas more relaxed as light will not directly be on the occupants. Small decorative elements on tables provide task lighting to those wanting to relax and do work in the seating areas. Keeping light on the walls and away from the occupants is generally wanted to create a relaxing and much more intimate atmosphere. Artwork located on walls is accented using fully adjustable track fixtures.

At the front desk, the light levels should be higher than the rest of the lobby. Modeling of faces and objects is important at a front desk, especially when dealing with guests' money. In any way, illuminating people's faces is important and is complete using downlights over the desk, so as not to distract from the backlit sign behind the counter. Light grazes the surface of the desk to enhance the wooden finish. Illuminating the desk with striplights for general task lighting is also utilized for the staff's day-to-day activities.

Psychological Aspect:
The Lobby is the space where guests develop their initial impression of the hotel. Therefore, the lobby should create a warm and welcoming atmosphere. The Lobby should also be relaxing for all of the guests, as they may be waiting to go into the Restaurant or Lounge.

Appearance of Space and Luminaires:
Because the Lobby sets the tone for the rest of the Hotel and Conference Center, an inviting ambiance is wanted. The lighting design should complement the wood millwork and rich finishes and colors in the Lobby. Luminaire selections in the Lobby contribute to maintaining a welcoming and relaxing atmosphere.

Color Appearance and Color Contrast:
The gold, taupe, chocolate brown, and off-white hues in the Lobby should be enhanced by warm light. Lamps with warmer CCTs are specified to stimulate a relaxing atmosphere by keeping light levels low and enhancing the richer colors. Since the Lobby has distinct seating areas for guests, color appearance is important for reading.

Reflected Glare:
Because of the glossy surfaces of the reception desk and some of the table tops in the reading areas, reflected glare could be a potential risk for guests. Transactions between the receptionists and guests at the main desk involve money and paperwork and reflected disability glare would be a distraction. Guests reading in the waiting areas would also experience glare on the tables.

Modeling of Faces or Objects:
At the front desk, visual appearance of the receptionist and guests is imperative for transactions to take place. In general, the light levels at the main desk will be higher than the rest of the Lobby. Lamps with high CRIs (greater than 80) will generate warm skin tones much more naturally and are utilized. Having the receptionist at the front desk appear welcoming and friendly will in turn create happier guests staying at the Hotel and Conference Center.

Daylighting Integration and Control:
Floor to ceiling glazing on the east façade of the Lobby provides the space with plenty of daylight during the day in the summer months. However, in the winter, the sun will not shine directly into the windows and the building may even lose heat during this time. Integrating a dimming system in the Lobby would be ideal as to provide energy savings during daylight hours. Having lower light levels during the evening will help promote the relaxing and comforting atmosphere and mood of the space. When the hotel is open but not as active, a dimming system can be utilized to further decrease the light levels.

Direct Glare:
In a space with a relaxing atmosphere, decorative luminaires should not be the only sources of light as they may appear "glary" to guests reading and relaxing in the seating areas of the Lobby. Direct glare should be avoided at all costs as it will make guests feel tense and will distract them from the rest of the space. Direct glare in the entrance canopy should also be avoided as guests are entering from outside and their eyes need to adjust to the light levels inside.

Light Distribution on Surfaces:
The Lobby can be split up into six distinct zones (see Figure 12) horizontally. Each of these areas has its own purpose, and some overlap. The waiting areas for the Lounge, Restaurant, and Reception Desk all have strong relationships with the furniture present, so light levels can be more or less around furniture surface height. In the Vestibule Area, Elevator Lobby, and Transition Corridor to the Conference Center, getting to and from one spot to another is the most important task. Therefore, the lighting on the floor and walls should help orient guests to their designation. The Reception Desk's main focal point is the actual desk itself and should therefore act as such. In general, the Lobby should have non-uniform lighting vertically as this promotes a more relaxing atmosphere.

Points of Interest:
The branding walls throughout the Lobby not only orient guests, but provide visual interest because they are so large in size and dimension. By implementing back lit glass, cove lighting, and grazing textures, the architectural details stand out to guests and reveal and transform the space. Artwork on some of the walls is also accented. The seating areas are also an important feature, dividing the Lobby into more intimate spaces for conversation and reading.

Luminances of Room Surfaces:
Finishes in the Lobby consist of expensive porcelain tile and custom millwork. Consideration of the luxurious surfaces of the furniture and warm, neutral colors must be included when designing the lighting system.

Horizontal Illuminance:
- General lighting is suggested to be in Category "C", **10fc**. The recommendation seems practical as people will mainly be passing through the lobby and sitting in the waiting areas.
- At the front desk, the IESNA Handbook suggests Category "E" at 50fc. I plan on deviating from this recommendation and producing a solution at **30fc** instead, because I think if the rest of the space is lit at 10fc, the front desk will still remain a focal point at three times the illuminance.

Vertical Illuminance:
(No recommendations noted)

Power Density Allowance: ASHRAE 90.1.2007
- Lobby | For Hotel: 1.1 W/SF
- Additional Interior Lighting Power – In addition to the installation of general lighting, decorative lighting is permitted (chandeliers, sconces, or for highlighting features) as long as it does not exceed 1.0 W/SF.
- Total allowable = **2.1 W/SF**

Lighting Plan – Refer to Appendix C

Mounting Details – Refer to Appendix C

Luminaire Equipment Schedule:

Tag	Luminaire	Description
D		Alfa Gemini fully adjustable, directional track head with G26 bronze, mesh metal shade and vintage bronze hardware. (1) 50W max MR16 halogen utilized per track head.
E		15' MonoTrack starter kit with 300W surface mounted transformer and 5 MonoTrack sections. Includes supports, (6) fixture adapters, and mounting hardware. Hardware finish in vintage bronze.
F		3.5" aperture downlight with Xicato Artsits Series LED module containing 8 LEDs and having an R-9 value of 96. Dark chrome reflector finish and 3000 K color temperature.
G		Covelite with 1-T8 lamp and die-formed 20 gauge cold-rolled steel painted white housing. Highly specular Miro IV aluminum white 20 gauge steel optical system.
H		Perimeter trough recessed 1-light T8 luminaire with die-formed 20 gauge pre-painted steel housing and precision parabolic roll-formed semi-specular aluminum reflector.
I		Staggered strip surface mounted fluorescent lamp with 3" overlap and 1-5/8" deep housing. Made of heavy duty code gauge cold rolled steel and finished with white polyester enamel. Utilizes (1) T8 fluorescent lamp.
K1-3		Low voltage Plexineon White 2X Series in 2800°K for warmer light. Lengths vary for use in cove, under the toe kick in bar, and bar shelves. Outside corner pieces also specified.

Table 7: Condensed Lounge Luminaire Schedule

**The full Lighting Equipment Schedule can be found in Appendix A.*

Light Loss Factors:

Light Loss Factors						
Tag	**Initial Lumens**	**Mean Lumens**	**LLD**	**LDD**	**BF**	**Total**
D	-	470	0.95	0.94	-	0.89
E	-	-	-	-	-	-
F	-	-	0.70	0.94	1.0	0.66
G	2950	2800	0.95	0.90	1.0	0.86
H	2950	2800	0.95	0.94	1.0	0.89
I	2950	2800	0.95	0.90	1.0	0.86
K1-3	-	-	0.70	0.90	1.0	0.63

Table 8: Lobby Light Loss Factors

**Use of the new procedure to find LDD was used. As the new handbook does not address RSDD, it was not calculated. According to the new handbook, a LEDs LLD is assumed to be 0.7. A 12 month cleaning interval and "clean" environment was assumed. Any other LLFs not displayed are assumed to be 1.0.*

Controls:

The Lobby is equipped with a Lutron Grafik Eye System. Hotel personnel in the Lobby will be able to control the lighting scene in the space easily and conveniently by means of a 5-button preset wallstation. A main wallstation controlling the dimming and switching capabilities as well as all scenes and zones of lights is located in the AV Closet (Room #1324) behind the Ballroom.

The Lutron GRAFIK Eye system will provide energy savings during daylight hours, as well as atmosphere and mood during the evening, and lower level lighting during "off" hours when the hotel is still open but less active.

Control Schedule					
Tag	**Product**	**Manufacturer**	**Product/Catalog #**	**Description**	**Location**
EQ-A	Viseo Wallstation	Lutron GRAFIK	OMX-VDC-LF	Main wallstation that provides local access to the lighting control system. Operates every scene and zone in the system, as well as the ability to change fade and delay times in any area. Includes a time clock.	AV Closet (Room #1324)
EQ-B	seeTouch Wallstation	Lutron GRAFIK	SO-5WRLN	5-button preset Sivoia QED wallstation with raise/lower capability	Lobby

Table 9: Control Schedule | Lobby

Performance Data and Preliminary Renderings:

Note: The calculations were done with all of the lights on and no daylight.

Lobby - Floor | Calculation Summary	
	Horizontal (2.5')
Avg Illuminance	***12.14 fc***
Max Illuminance	36.9 fc
Min Illuminance	0.5 fc
Avg/Min	24.28
Max/Min	73.80
Criteria	10 fc
Compliance?	**Yes**

Table 10: Calculation Summary of Lobby

The maximum to minimum ratio is obviously really high for the Lobby. This is due to the fact that light spilling from the Lounge was not taken into account in the calculations. Figure x below shows the minimum values which affected the ratio, seen at the Lounge entrance.

Figure 15: Lounge Entrance | Illuminance values highlighted below 2.0 fc

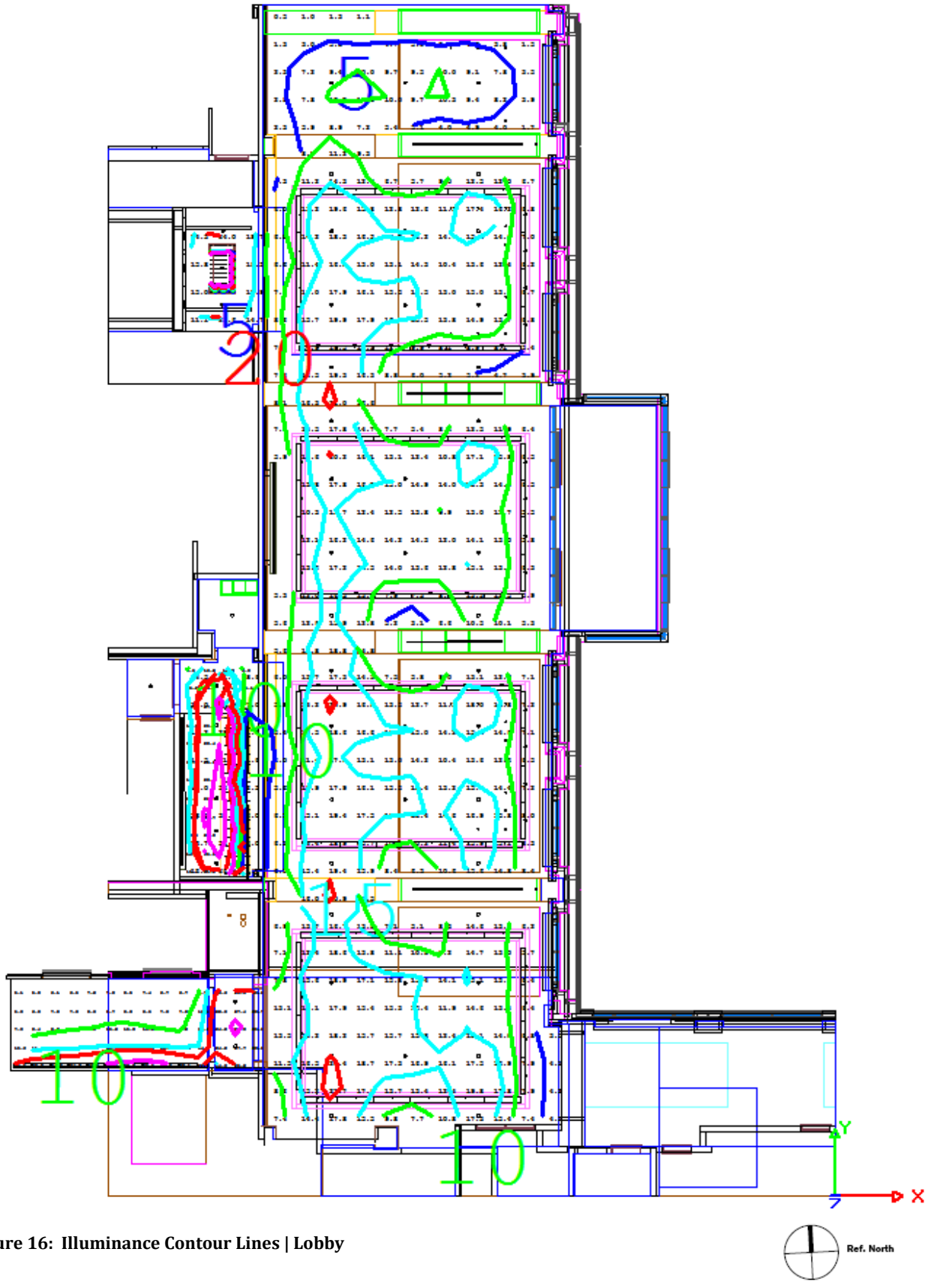


Figure 16: Illuminance Contour Lines | Lobby

Figure 17: Preliminary Rendering | Elevator Lobby Entrance

Figure 18: Preliminary Rendering | Reception Desk

Figure 19: Preliminary Rendering | Restaurant Entrance

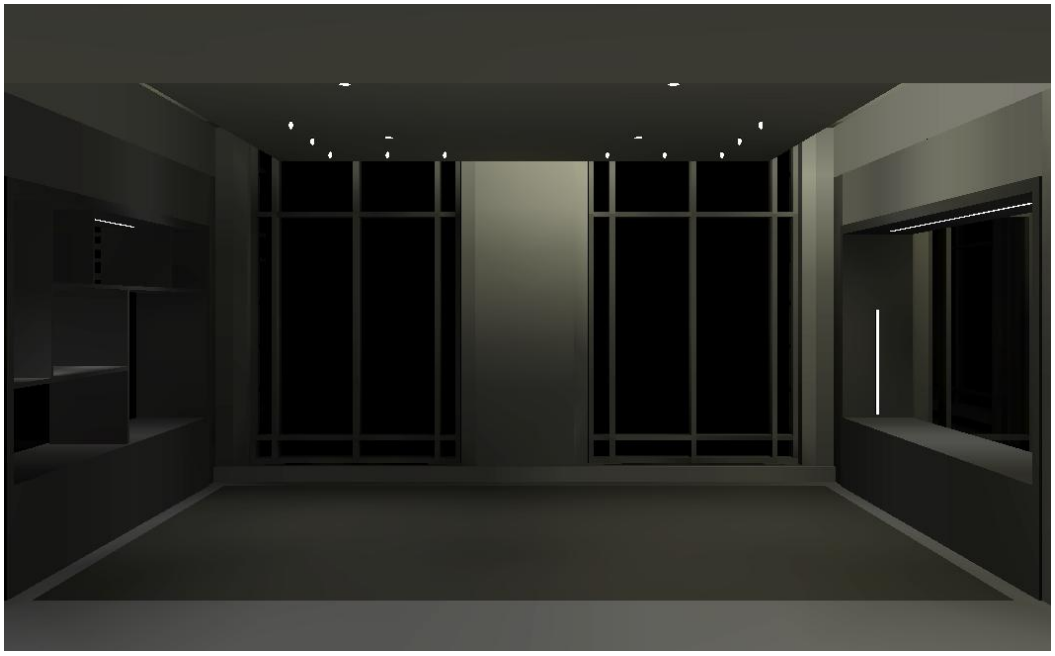


Figure 20: Preliminary Rendering | Looking out to windows from reception desk

Figure 21: Preliminary Rendering | Looking down corridor

Figure 21: Preliminary Rendering | Lines of light in bookshelves

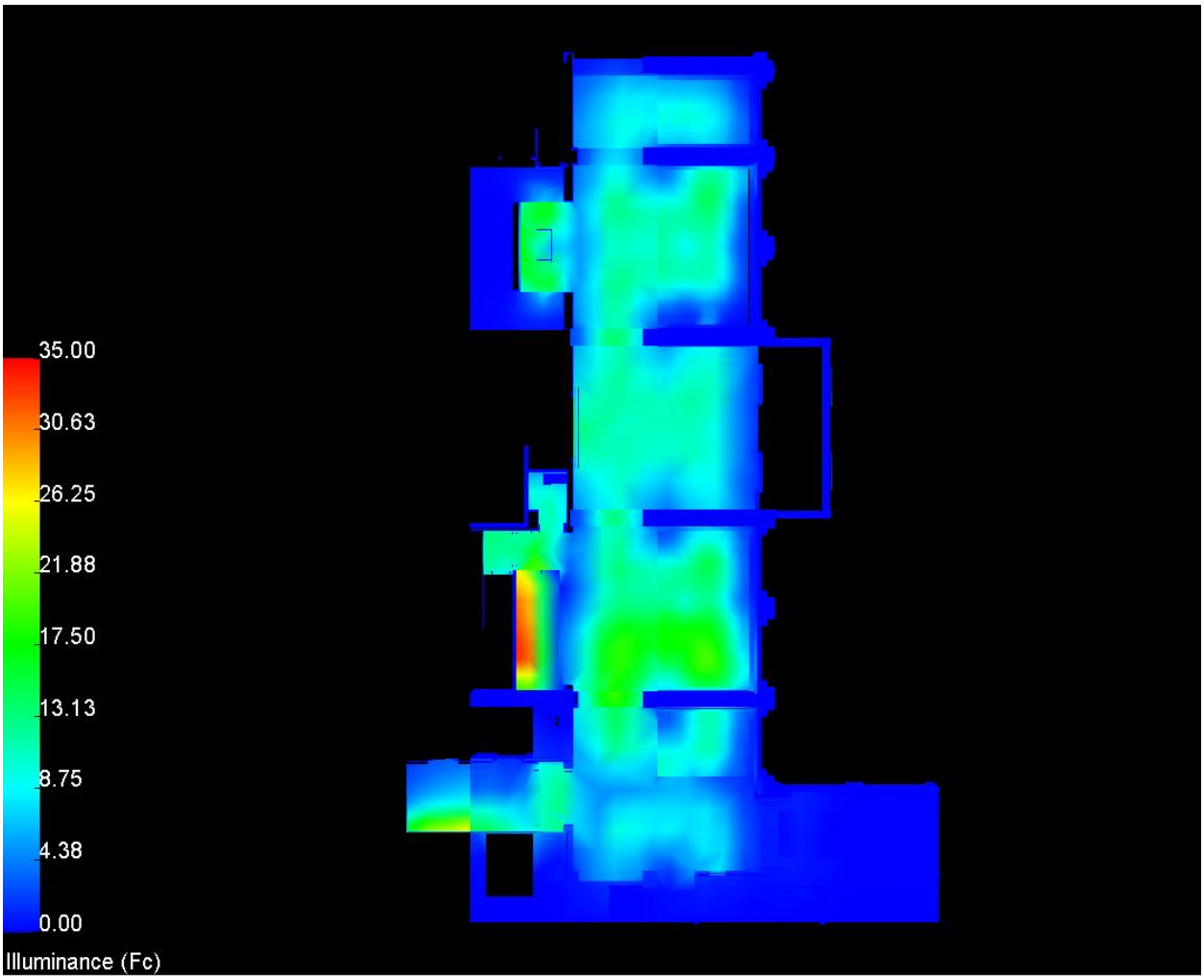


Figure 22: Pseudo color rendering | Lobby

Lighting Power Density:

ASHRAE Standard 90.1 | LPD Summary				
Tag	**Quantity**	**Watts/Luminaire**	**Watts/LF**	**Total Watts**
D[1]	26	50	--	1300
E	5	300	--	1500[2]
F	56	23	--	1288
G	80	35	--	2800
H	5	33		165
I	10	33	--	330
K1-3	106 ft	--	4.32	457.92
			Total Watts	**6540.92**

Table 11: LPD Summary | Lobby

[1]The maximum wattage allowable for the track head is 50W, although the 35W lamp is specified for the project
2The maximum wattage per track is 300W, therefore this value was considered in the LPD calculations because it is greater than the number of track heads specified

ASHRAE Standard 90.1 | LPD Summary						
Room	**Area**	**Power Density Allowable**	**Allowable Wattage**	**Designed Wattage**	**LPD**	**Met?**
Lobby	4430	1.1 W/SF	4873	4400	0.99	Yes
Decorative Allowance	4430	1.0 W/SF	4430	2141	0.48	Yes

Table 12: LPD Summary | Lobby

**Note: The decorative allowance accounted for above includes all of the track fixtures (D/E), the surface mounted fluorescents (I), and 72'-0" of the LED strips (K1-3).*

Performance Summary:

Similarly to the Exterior space, architectural elements, including the rhythmic wood shelving units, are emphasized in the lighting redesign. Fluorescent coves hover overhead with warm light, drawing the eye down the corridor and around each nook of the Lobby. Halogen track lights accent small seating areas and artwork located on the walls, giving the space a more private and relaxing feel. Recessed LED downlights provide enough ambient light on the ground for patrons to be able to get from one place to another, guiding people along a line of light. In the elevator lobby, fluorescent wall washers along the back wall offer an interesting impression to the space, keeping light away from guests and on the walls. While getting from one place to another is extremely important in the lobby of the hotel, the front desk is also important. A backlit glass panel of the Virginia countryside is backlit with fluorescent strips. An LED downlight provides for the majority of the light on the horizontal plane here. LED strip lights mounted underneath the front desk both graze the wood surface and illuminate the desk plane for receptionist usage. The main hotel front desk sign is backlit with fluorescent strips (like the one behind the front desk). At the Restaurant entrance, fluorescent strips graze a textured wall and give the entrance more punch for added attention and interest.

The lighting reinforces the "light as a pathway" notion as the coves simply draw people to open areas when walking along the corridor. Backlit glass signage panels signal to guests important areas of the hotel. The lighting design successfully meets both lighting power density requirements and IESNA recommendations as well.

Special Purpose Space | Lounge

Space Description:

The Lounge in the Hotel and Conference Center is a more private space in the hotel for customers. It is a space separated from the rest of the hotel where guests can enjoy fine food and spirits at the bar during the late afternoon and evening hours. Situated on the northernmost part of the building, floor to ceiling glazing spans almost the entirety of the façade, allowing daylight into the space.

Guests of the Hotel and Conference Center can enter the Lounge through the main lobby and corridor on the first floor. A set of double doors on the western wall provides access to the outdoor terrace.

The ceiling in the Lounge has an overall height of 14'-0", with a 1'-8" cove above the bar. Pine wood flooring with custom area rugs set into the wood flooring give the Lounge a more luxurious feel. The central bar is constructed of walnut, wood veneer and a polished granite bar top, adding to the lavish décor as well. Plush sofas and chairs and leather bar stools encourage conversation and make the space more comfortable.

Activities | Tasks:

- Dining
- Drinking
- Socializing
- Bartenders/Servers
- Guests watching television or reading

Dimensions:

Area: 1730 SF

Dimensions: Approximately 29'-10" x 54'-0"

Surface Materials:

Main Surface	Description	Color	Reflectance
Ceiling	Overall Ceilings	Desolate	0.95
	Dropped Ceiling Canopy	Classic Brown	0.01
Floor	Radiata Pine wood flooring with a clear Finish; planks are 4.25" wide	Cohiban	0.43
	Area rug insert into the wood floor		0.25
	Beige 6"x6" quarry tile with matte finish		0.03
Walls	General wall covering		0.85
Bar	Wood veneer, walnut/semi open Pre-lacquer with 30% sheen paneled barface		0.06
	Polished granite bar top		0.09
	Plastic laminate back bar	Antiqued brushed brass	0.05
Bookcases	High-gloss lacquer	Weather Vane	0.05

Table 13: Reflectance Values | Lounge

Lounge Plans:

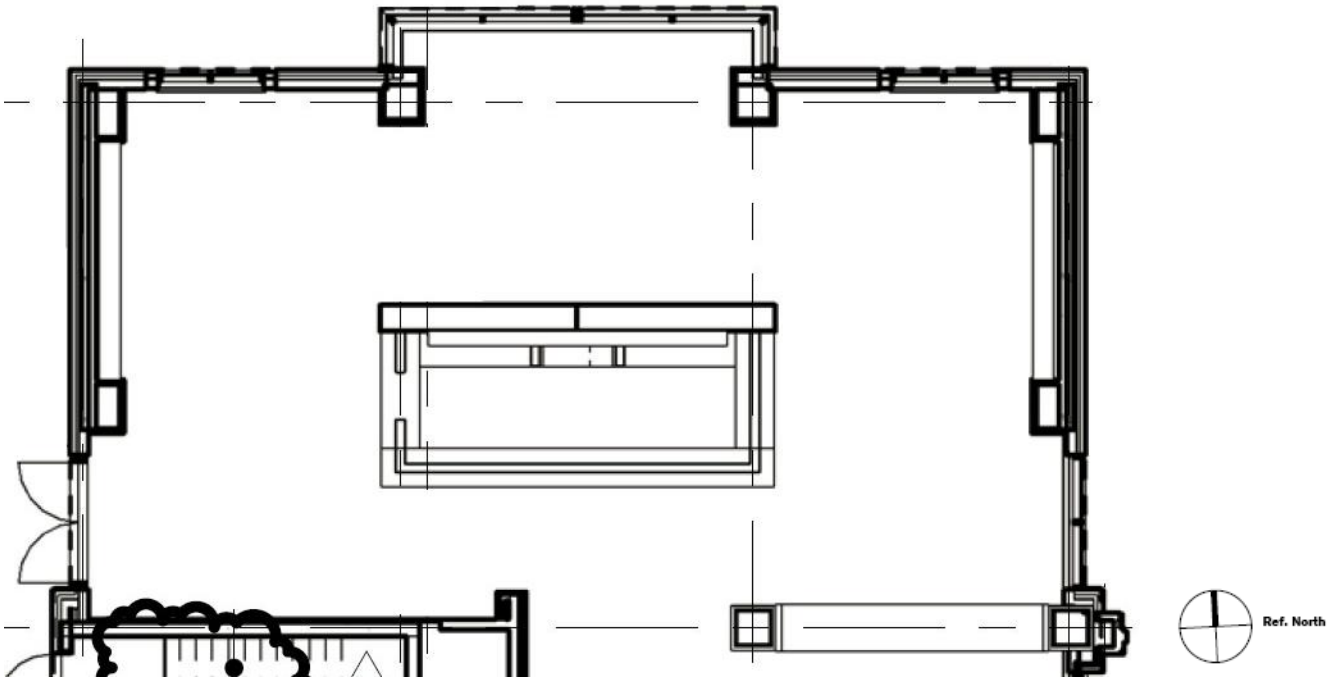


Figure 23: Lounge Plan

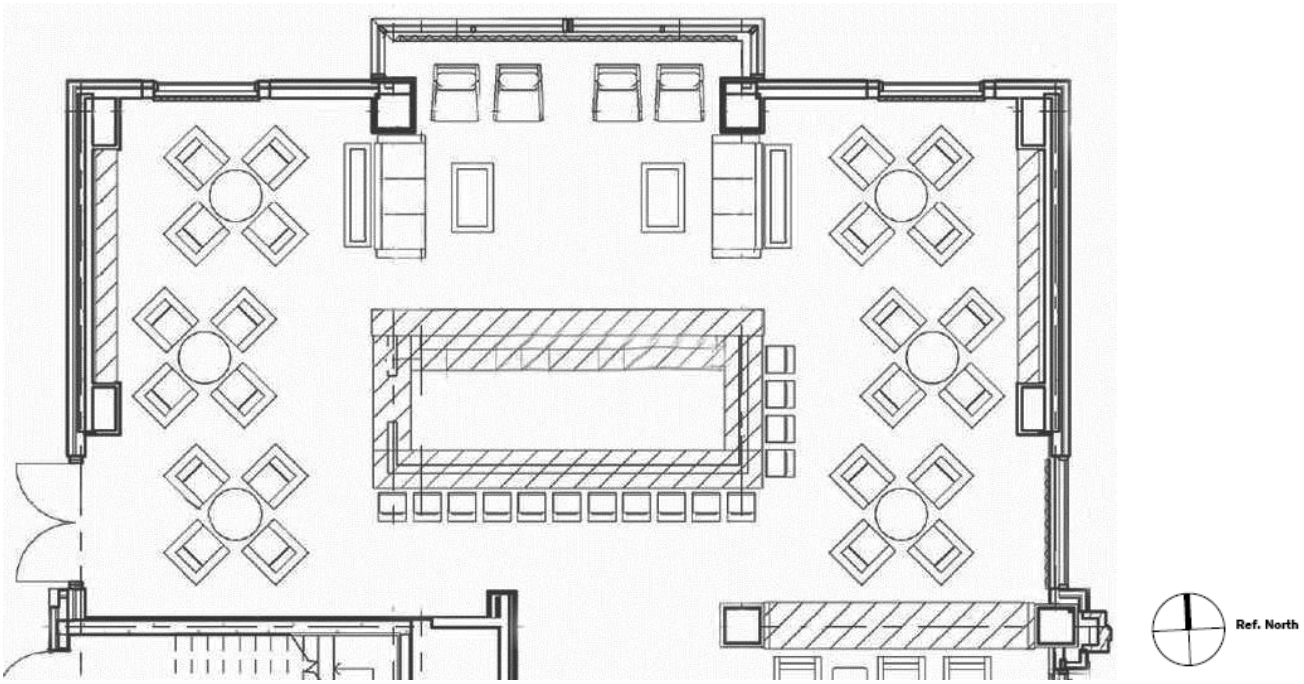


Figure 24: Lounge Furniture Plan

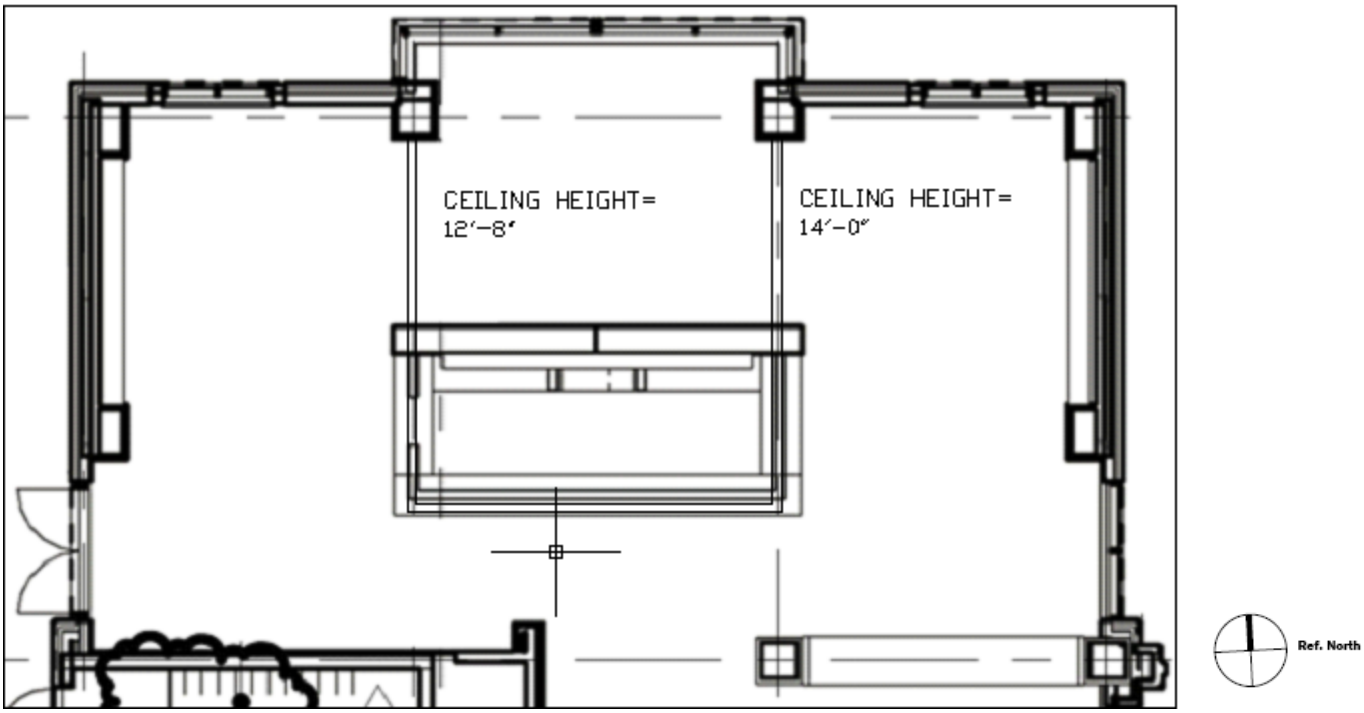


Figure 25: Ceiling Plan

Lounge Elevations:

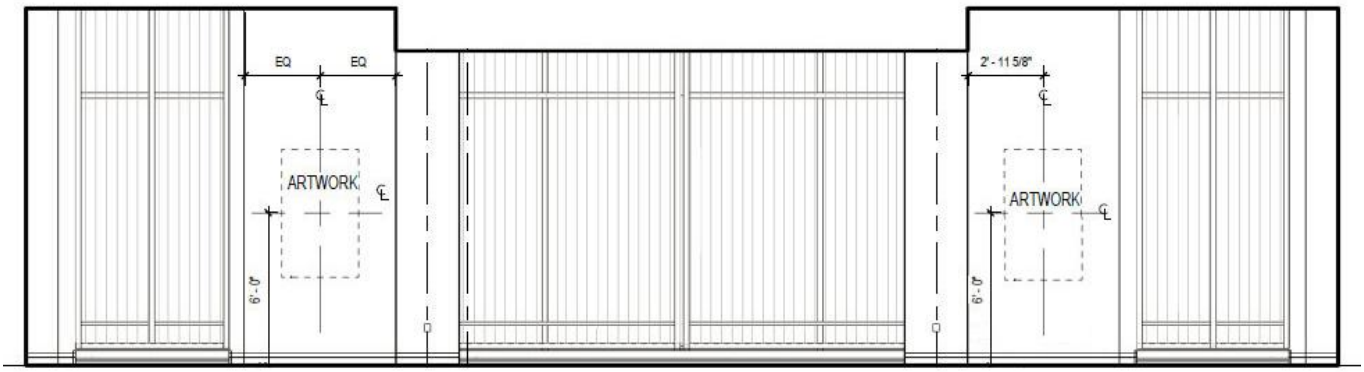


Figure 26: North Elevation

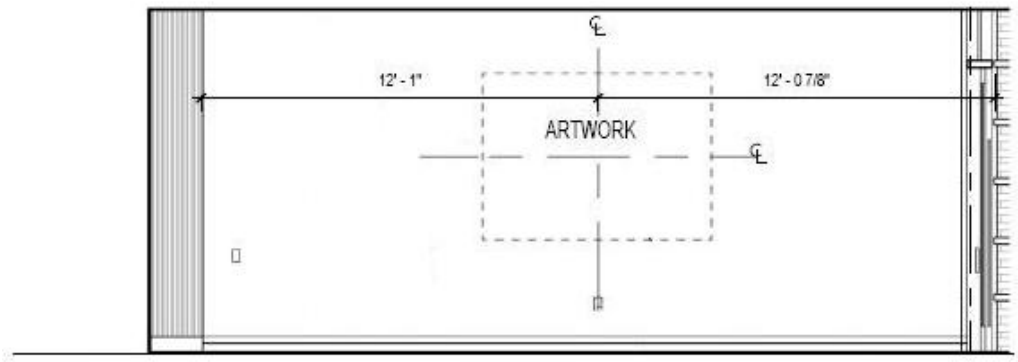


Figure 27: South Elevation

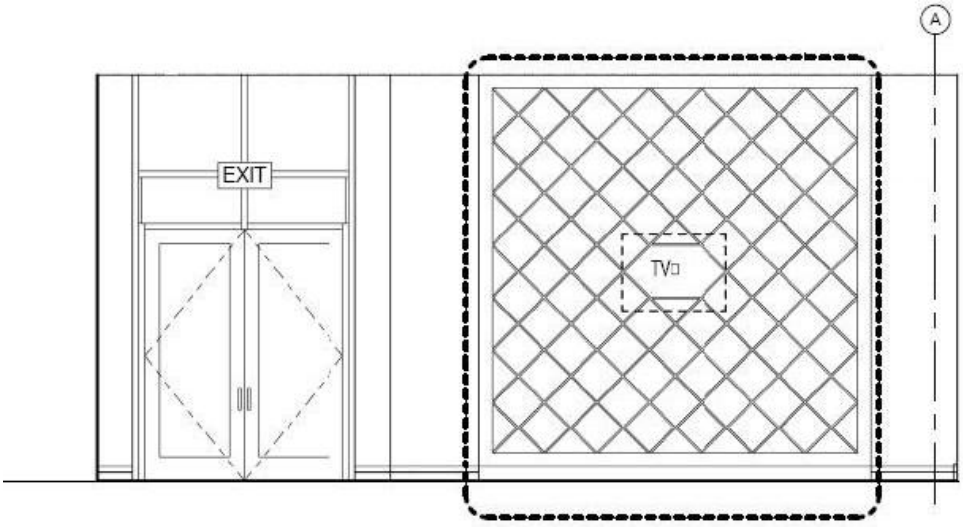


Figure 28: West Elevation

Design Criteria and Considerations:

General Lighting Concept:

Nature | Reflection and Transparency

The sources of inspiration for this space are two images from the original design concepts explored last semester. These two images include the notions of light as a reflection and light as a transparent element. Together, the two concepts combine common techniques of light as seen in nature on a daily basis. They also fully integrate the overall impression of the Lounge as a sophisticated and relaxing space in the Hotel and Conference Center, making great use of light properties and how they interact with the material selections in the room.

Figure 29: Reflection | Photo from Flicker

Reflections are used in the Lounge as a means to emphasize and direct light away from guests. A cove light above the central bar "reflects" or mirrors the glowing element below the bar at the feet of the patrons. Surface properties of both the bar and the tables located throughout the room are specular and reflective to further accentuate this idea of reflection.

Figure 30: Transparency | Photo from Flicker

The impression of transparency is also noted in the Lounge. Instead of having the bar shelving completely hide the seating area directly behind it, integrating a semi-transparent bar engages guests to see what is "on the other side". This also makes the space feel more mysterious at nighttime and gives guests a focal point throughout the day. Small, semi-transparent glass tiles are set in the bar in front of each seat at the bar, glowing from the bottom with a soft light. The light reflects into wine glasses set on top of them and creates an element of sparkle for guests. Decorative candle-light in semi-transparent jars is provided on every table in the direct locale of guests. Recessed square downlights with both reflective and transparent properties tie the lighting concepts together and provide enough light on the workplane for patrons while dining.

Psychological Aspect:
The Lounge is meant for hotel guests to unwind and enjoy good food and wine while relaxing and chatting amongst friends. During the daytime hours, the Lounge is a more public and open atmosphere. Evening and night-time hours will be accompanied with dim, non-uniform light, providing a more intimate and private atmosphere to guests.

Appearance of Space and Luminaires:
The Lounge is an area of the Hotel and Conference Center where guests come to quietly enjoy small specialty platters and organic local and domestic wine. The space is meant for chatting with friends, family, or business partners, or even to perform small tasks in a quiet nook of the hotel. Because of the rich architectural finishes, lavish furniture, fine food and wine being served, and the artwork on

display along the walls, the overall image and experience of the patrons is extremely important. Therefore, having decorative lighting fixtures in the Lounge to compliment the décor is critical to the overall ambience of the room. Although the light utilizes nonconventional applications in the space, it complements the architectural finishes and adds interesting elements and points of interest to guests.

Color Appearance and Color Contrast:
Lighting is not only critical when preparing food, but it is also important when serving food. Color rendering of the food is important because the food served will be fresh. Lamps with high CRIs (above 80) are therefore specified. The CCT of the lamps are also warm in the space, in order to enhance the relaxing, private atmosphere and wood finishes in the room.

Direct and Reflected Glare:
In order to avoid direct glare, general lighting should is utilized with the decorative lighting. Because one of the main design concepts for the Lounge is light and its reflective quality, semi-specular finishes on both the bar and tables were implemented, yet also increase the glare possibility to patrons and/or staff.

Point(s) of Interest:
The main feature in the Lounge is the bar, centrally located in the room. The bar was redesigned as a semi-transparent display case in order to complement the transparency design concept. Shelves containing the bottles and wine are an important feature in the Lounge and highlighting them will not only create visual interest but perhaps even promote more business.

System Control and Flexibility:
Since the Lounge is open during both afternoon and evening hours, utilizing a dimming system provides variation in the quantity and quality of light. Preset scene controls are available for the Lounge (more information given in the Controls section below).

Horizontal Illuminance:
Because simple visual tasks are being performed in the Lounge, **10fc** (Category C) is recommended on the workplane.

Vertical Illuminance:
Vertical illuminance values should be **3fc** (Category A).

Power Density Allowance: ASHRAE 90.1.2007

- Dining Area > Bar Lounge/Leisure Dining: **1.4 W/SF**
- Additional Interior Lighting Power – In addition to the installation of general lighting, decorative lighting is permitted (chandeliers, sconces, or for highlighting features) as long as it does not exceed **1.0 W/SF**.
- Total allowable = **2.4 W/SF**

Lighting Plan – Refer to Appendix C

Mounting Details – Refer to Appendix C

Luminaire Equipment Schedule:

Tag	Luminaire	Description
J		Mira 2 Semi-recessed square downlight with acid-etched, poured Satin White glass diffuser. Utilizes (1) 50W low-voltage, halogen MR-16 lamp.
K1-3		Low voltage Plexineon White 2X Series in 2800°K for warmer light. Lengths vary for use in cove, under the toe kick in bar, and bar shelves. Outside corner pieces also specified.

Table 14: Condensed Lounge Luminaire Schedule

**The full Lighting Equipment Schedule can be found in Appendix A.*

Light Loss Factors:

Light Loss Factors						
Tag	**Initial Lumens**	**Mean Lumens**	**LLD**	**LDD**	**BF**	**Total**
J	-	1000	0.95	0.94	-	0.89
K1-3	-	-	0.70	0.90	1.0	0.63

Table 15: Lounge Light Loss Factors

**Use of the new procedure to find LDD was used. As the new handbook does not address RSDD, it was not calculated. According to the new handbook, a LEDs LLD is assumed to be 0.7. A 12 month cleaning interval and "clean" environment was assumed. Any other LLFs not displayed are assumed to be 1.0.*

Controls:

The Lounge is equipped with a Lutron Grafik Eye System. Bartenders in the Lounge will be able to control the lighting scene specific to the mood and environment in the space easily and conveniently by means of a 5-button preset wallstation. A main wallstation controlling the dimming and switching capabilities as well as all scenes and zones of lights is located in the AV Closet (Room #1324) behind the Ballroom.

Control Schedule					
Tag	**Product**	**Manufacturer**	**Product/Catalog #**	**Description**	**Location**
EQ-A	Viseo Wallstation	Lutron GRAFIK	OMX-VDC-LF	Main wallstation that provides local access to the lighting control system. Operates every scene and zone in the system, as well as the ability to change fade and delay times in any area. Includes a time clock.	AV Closet (Room #1324)
EQ-B	seeTouch Wallstation	Lutron GRAFIK	SO-5WRLN	5-button preset Sivoia QED wallstation with raise/lower capability	Lounge

Table 16: Control Schedule | Lounge

Performance Data and Preliminary Renderings:

Note: The calculations were done with all of the lights on and no daylight.

Lounge | Calculation Summary	
	Horizontal (2.5')
Avg Illuminance	***12.03 fc***
Max Illuminance	23.1 fc
Min Illuminance	2.1 fc
Avg/Min	5.73
Max/Min	11.0
Criteria Compliance?	10 fc **Yes**

Table 17: Calculation Summary of Lounge

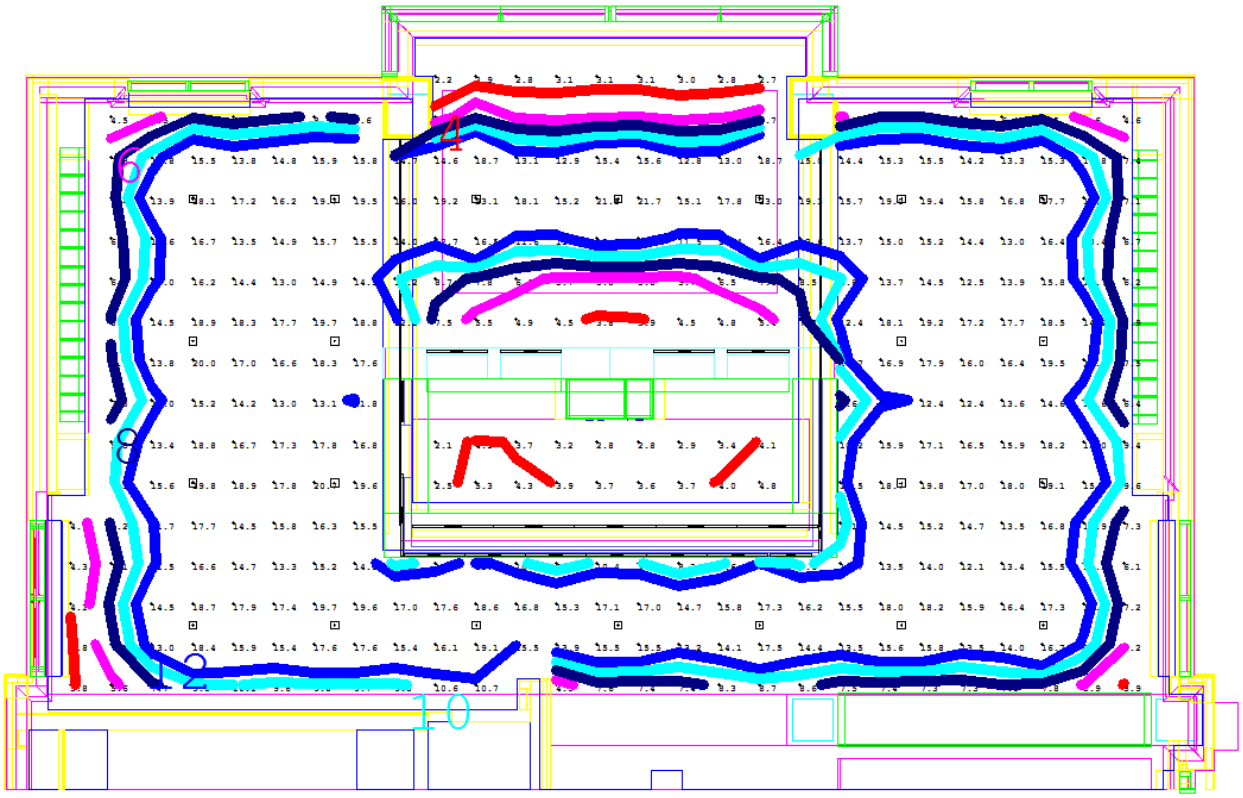


Figure 31: Illuminance Contours of Lounge

Figure 32: Preliminary Draft Rendering | 3D Studio

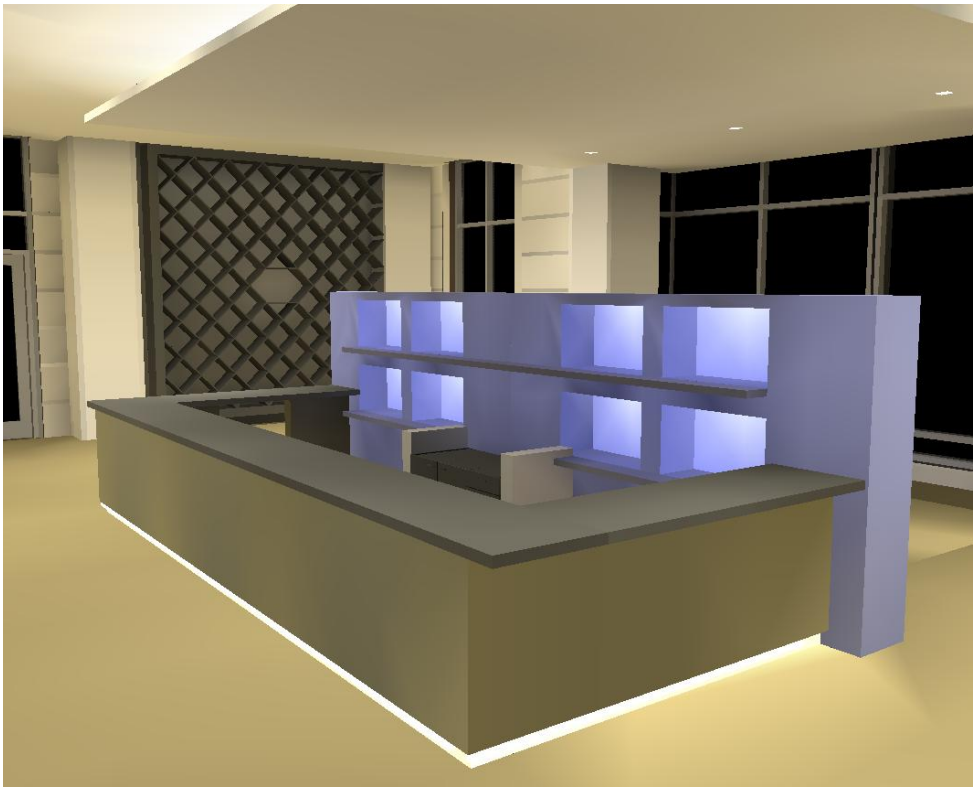


Figure 33: Preliminary Rendering of Lounge | AGI32

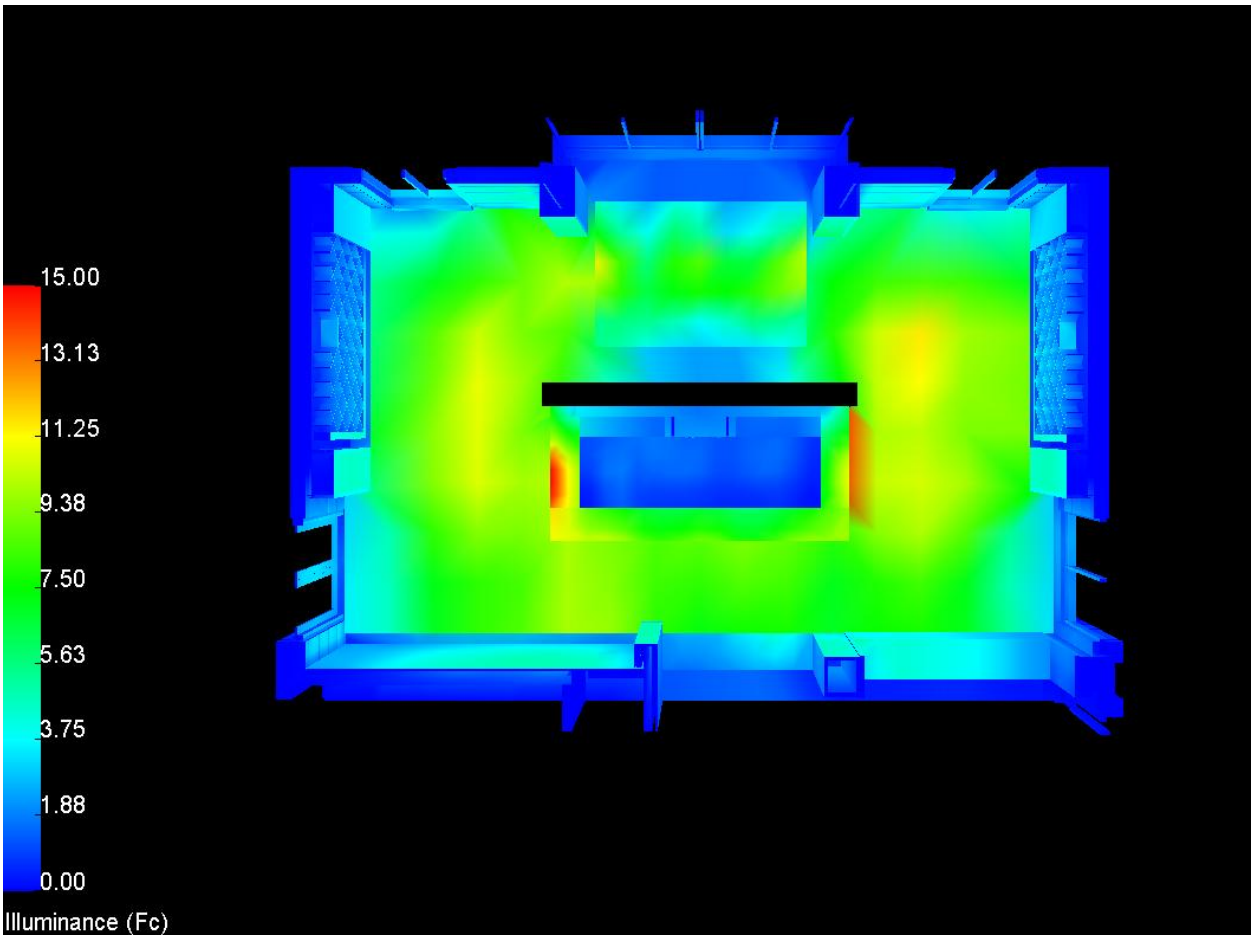


Figure 34: Pseudo Color Rendering of Lounge

Lighting Power Density:

ASHRAE Standard 90.1 | LPD Summary				
Tag	**Quantity**	**Watts/Luminaire**	**Watts/LF**	**Total Watts**
J	22	50	--	1100
K	94 ft	--	4.32	406.08
			Total Watts	**1506.08**

ASHRAE Standard 90.1 | LPD Summary				
Room	**Area**	**Power Density Allowable**	**Allowable Wattage**	**Designed Wattage**
Lounge	1730	1.4 W/SF	2422	1506.08
			W/SF	**0.87**

Table 18: LPD Summary Tables

The Lounge met ASHRAE Standard 90.1 Lighting Power Density requirements without the use of the decorative allowance.

Performance Summary:

Whether during the daytime or at nighttime, the lighting design in the Lounge provides appropriate light for its uses and offers an interesting lighting design concept. During the day, a suitable amount of horizontal footcandles reaches the floor for guests for general illumination. At nighttime, the bar transforms into a bit of a more modern bar, but one that still retains the architectural charm of the space.

The central bar is definitely the focus of the Lounge, so lighting design is crucial here as well. Mirroring the ideas of transparency and reflectance was taken into account on several occasions. First, an LED cove above the bar mirrors a toe-kick light glowing beneath bar, emulating the idea of reflectance. Small, semi-transparent acrylic glass tiles fastened into the bar glow with warm light from below, making wine glasses sparkle. This is not only reflectance but transparency as well, as the glass tiles are semi-transparent. A Leucos square downlight with an acid-etched glass diffuser was specified because of both its transparent and reflective characteristics.

Reflective surfaces in the Lounge were also used for the sole purpose of enhancing the lighting as well. All of the table tops and the bar counter are more reflective in nature than the rest of the space in order to enhance the reflection and transparency that is also found in nature.

Overall, the lighting design exceeded ASHRAE 90.1 for lighting power density requirements. IESNA recommendations and criteria were also met in the space.

Large Workspace | Ballroom

Space Description:

The Hotel and Conference Center highlights various social events in its Ballroom, including themed events, cocktail receptions, company outings, anniversary parties, reunions, and wedding receptions. Capacities may vary in the room, so making use of the two operable partitions is available. These partitions can separate the Ballroom into one, two, or three salons. The Ballroom accommodates up to 579 guests in a reception setting, 611 as a theater, and as many as 456 in a banquet setting.

The ceiling height was increased to include four clerestories (two on both the northern and eastern sides of the space), for a general ceiling height of 22'-0". Four 2'-0" coffers spaced in the center of the room have 2'-0" pop-ups inside of them as well.

Activities | Tasks:

- Dining
- Socializing
- Receptions
- Parties/dancing

Dimensions:

Area: 5400 SF

Dimensions: Approximately 90'-0" x 60'-0"

Surface Materials:

Main Surface	Description	Color	Reflectance
Ceiling	Overall Ceilings	Antique Lace	0.95
	Ceiling popups	Golden Ecru	0.95
Floor	Carpet, ballroom inlays	Multi-colored	0.17
Walls	General wall covering	--	0.94
	Ballroom space inlays wall covering	--	0.98
Woodwork	Wood veneer, sliced andes cedar with semi-open pore lacquer 30% sheen	--	0.24

Table 19: Ballroom Material Schedule

Ballroom Plans:

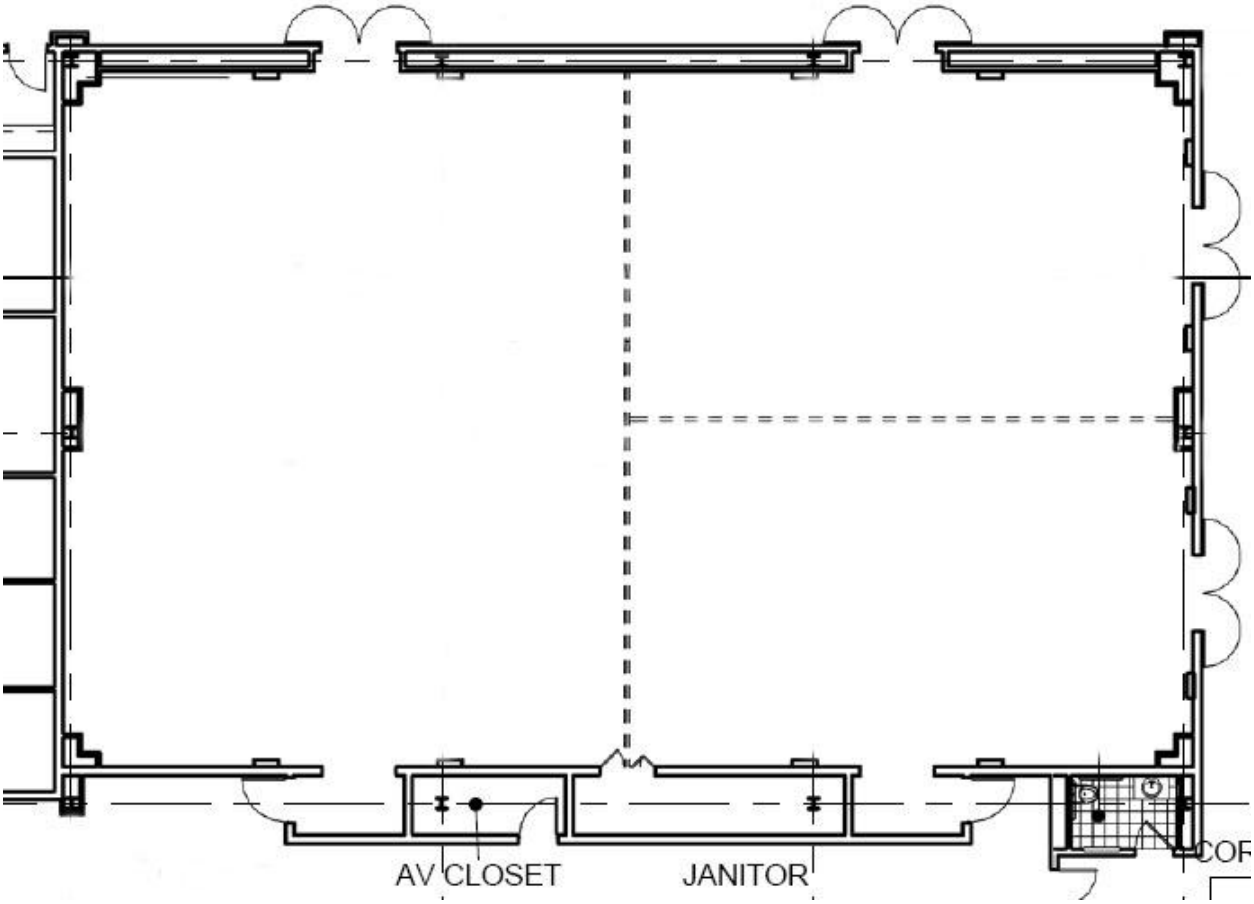


Figure 35: Ballroom Plan with partitions shown (dashed)

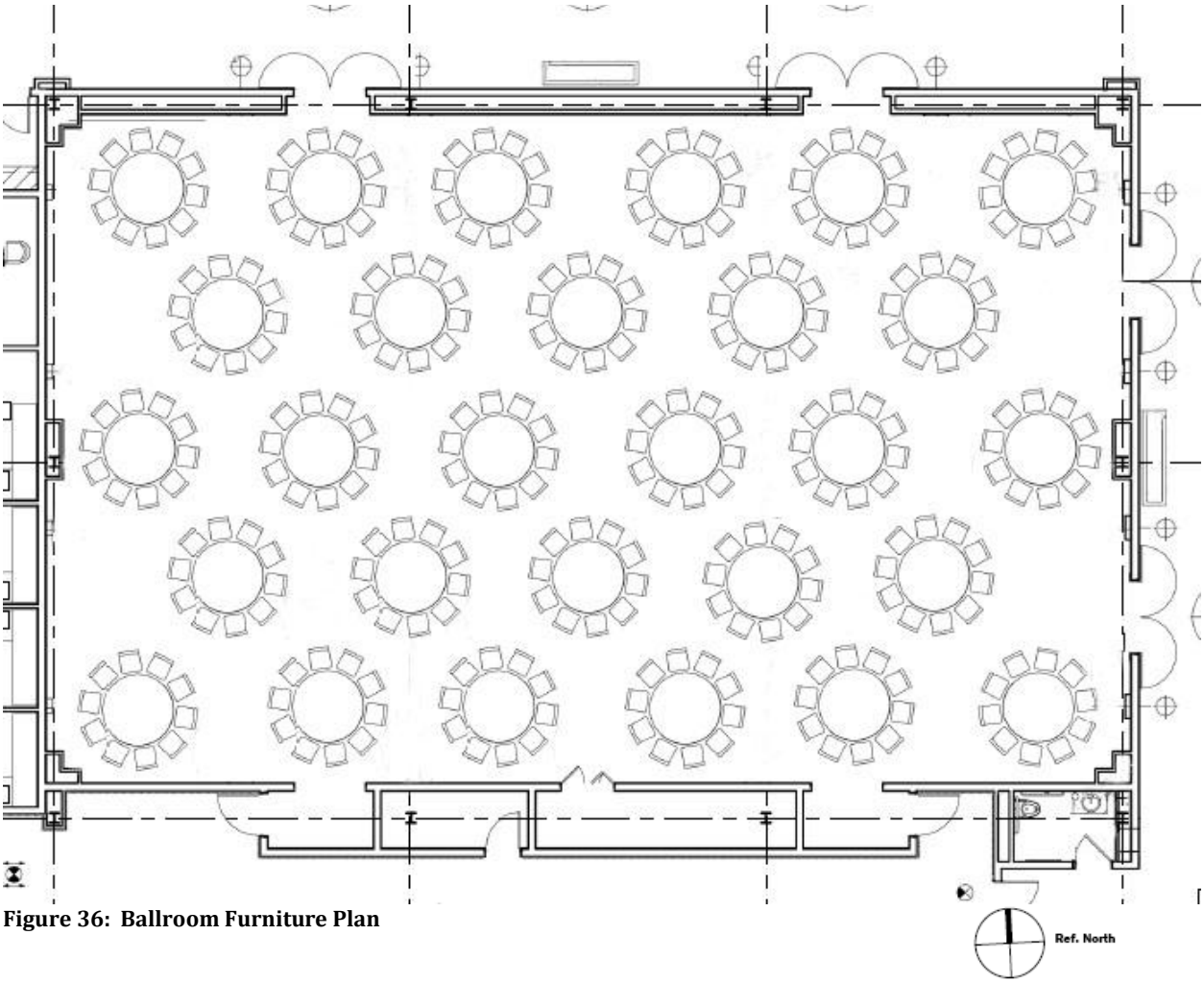


Figure 36: Ballroom Furniture Plan

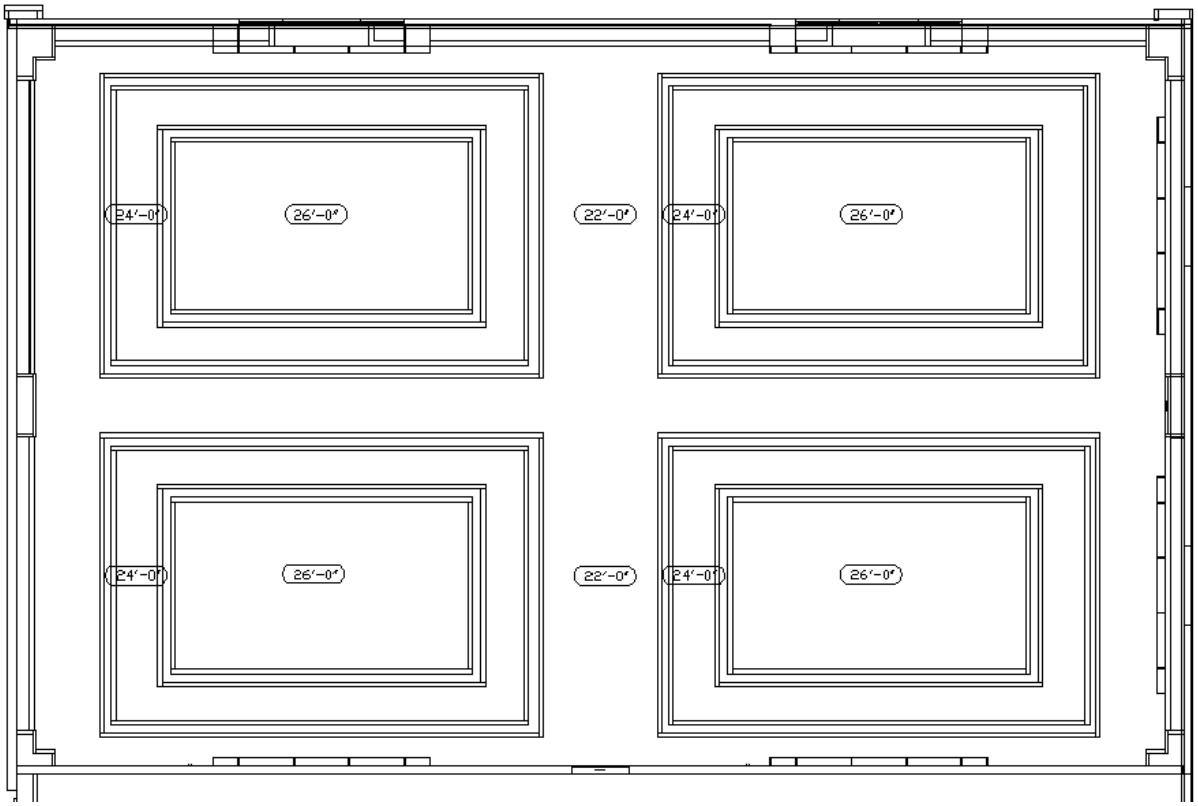


Figure 37: Ballroom Ceiling Plan

Ballroom Elevations:

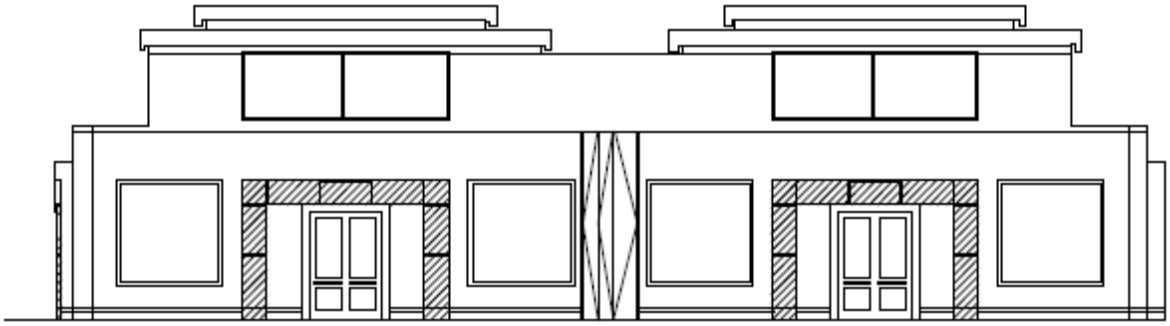


Figure 38: North Elevation

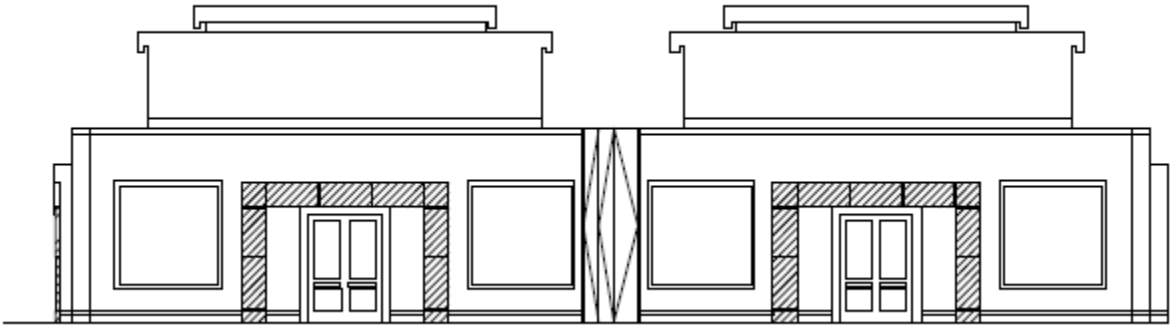


Figure 39: South Elevation

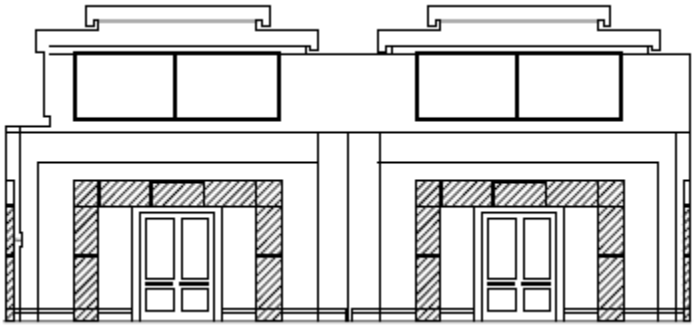


Figure 40: East Elevation

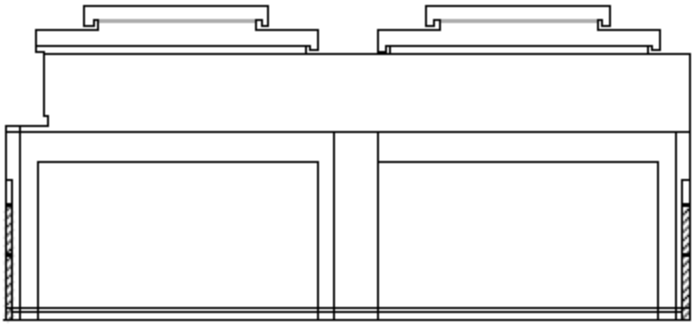


Figure 41: West Elevation

Design Criteria and Considerations:

General Lighting Concept:

Nature | Daylight

The source of inspiration for this space is a dark cave illuminated by a sliver of daylight. Just like a cave in nature, a ballroom in a conference center shuns the daylight. However, adding in daylight into the space really enhances the overall atmosphere during certain types of events, specifically long conferences. With the use of four clerestories, daylight is integrated into the Ballroom. For events not wanting daylight or for those using projection screens, shading devices will be utilized.

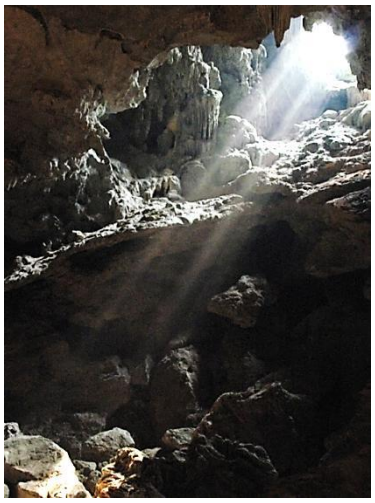


Figure 42: Inspirational Image

Three preset scenes were considered for the lighting design of the Ballroom, as function is a driving factor for the lighting design. Flexibility and controls are of extreme significance for the lighting design solution as well.

First, a more public lighting design was created in the Ballroom. The clerestories are assumed to be open, allowing daylight to come into the room. Uniform perimeter lighting is included to make the space feel more open and spacious during public events or company outings. A double tiered cove lighting system with a uniform glow inside the coves is also included in the design. To add an element of sparkle, decorative chandeliers are added in each of the cove systems.

During a private event, such as a reception or reunion, the lighting design will alter slightly. Shades on the clerestories can be programmed to be down if daylight is not wanted. To make the room more intimate and add visual interest, sconces along the perimeter glow with warm light. Low levels of perimeter lighting and low levels of light from the coved system also add to a more intimate scale during reception events. The decorative chandeliers in the coves remain on to add sparkle and as a focal point to the space.

Themed parties and bar mitzvahs, as well as other very festive and social events, also have the option of utilizing a separate preset scene. Color drives the lighting design in this space--colored light around the perimeter and in the coves not only make the events more memorable, but adds to a more fun and exciting space. Adding sparkle and more intimacy into the room is created with the use of the decorative chandeliers and sconces along the perimeter.

Psychological Aspect:
The Ballroom has the ability to create many different impressions, depending upon the wanted function of the space. For instance, a more public feel with general ambient light would be utilized during a company or university event, such as a conference, meeting, or networking reception. Themed parties, dances, or anniversary parties tend to have a festive atmosphere, and includes the use of color, sparkle, and reflected highlights around the room.

Appearance of Space and Luminaires:
The Ballroom in the Hotel and Conference Center is the largest space available in the building for guests. As such, it is used to showcase the sophistication and uniqueness of the venue. By incorporating chandeliers, wall sconces, and other such decorative luminaires, the space will transform venues and create a chic design. The wood millwork around each of the doorways and crown molding in the coffered ceiling can also be accented, as the details aid in the overall appearance of the Ballroom.

Color Appearance and Color Contrast:
The colors and finishes of the Ballroom match with the rest of the Hotel and Conference Center: warm and relaxing. Lamps with warmer CCTs are specified to uphold the character of the space and enhance the finishes and colors present. Warmer CRIs were also considered because of fresh food being catered or served and the effects of lighting on people's skin.

Luminances of Room Surfaces:
Color and finish selections in the Hotel and Conference Center were thoroughly thought out and executed, as similar ones were selected for the Ballroom. Because of this, the lighting in the Ballroom should enhance the textures and colors.

System Control and Flexibility:
Lighting has a prominent effect and role during large events. Lights dimming or changing color, for example, signal to guests that an important event is starting or happening. The Ballroom should definitely employ a flexible control system for different scene presets. Different presets are used to accommodate for each of the venue options. Control of the shades on the clerestories is also important during events where daylight is not wanted or when the projection screen is in use.

Light Distribution on Surfaces:
Uniform lighting on tables is critical during the more public events, for reading and writing purposes especially. A public atmosphere is achieved with higher levels of illumination and more uniform light distributed on both the horizontal and vertical planes. Having higher luminances on the workplane with peripheral emphasis will make the Ballroom appear more clear and open. Another lighting system is employed during the more private events, with a non-uniform distribution and lower light levels. Emphasis on architectural features will draw guests' eyes towards these surfaces.

Modeling of Faces or Objects:
With the application of lamps with high CRIs, guests' facial features and skin tones will appear much more natural. The Ballroom is a public, social room that is meant for interaction, so vertical illumination is critical.

Sparkle/Desirable Reflected Highlights:
During the more festive activities in the Ballroom, such as themed parties or dances, sparkle is necessary to add to the excitement of the event. Decorative chandeliers and sconces along the wall add sparkle to the space.

Horizontal Illuminance:
A horizontal illuminance is recommended in Category "B", **5fc** for simple visual tasks. It was decided that depending on the type of event occurring in the Ballroom, the following criteria would be met:

- Public (conferences, pre-function type events, etc): **30fc**
- Presentations (screen projector usage): **15fc**
- Private (dinners, receptions, etc): **10fc**
- Festive (wedding receptions, parties, etc): **5fc**

Vertical Illuminance:
A vertical illuminance is recommended in Category "A", **3fc**.

Power Density Allowance: ASHRAE 90.1.2007
- Convention Center > Exhibit Space = **1.3W/SF**
- Additional Interior Lighting Power – In addition to the installation of general lighting, decorative lighting is permitted (chandeliers, sconces, or for highlighting features) as long as it does not exceed **1.0 W/SF**.
- Total allowable = **2.3 W/SF**

Daylighting
As stated in the design concept of the ballroom, daylight integration is wanted within the space. The current design of the ballroom does not include any glazing at all, so glazing had to be added. Because of this addition, an architectural breadth was conducted (refer to the Architectural Breadth study for more information). Four clerestories were added, two on the northern side and two on the eastern side of the ballroom. Each was strategically placed above the four double doors leading out into the prefunction area. Their properties are listed below:

- (4) clerestories; (2) on North façade and (2) on East façade
- 5'-6 1/2" wide x 17'-0" long
- Viracon Low-E (VE) Laminated Glass ½" (VE 1-40)
  - VT = 39%
  - U-value (winter) = 97%
  - U-value (summer) = 88%
  - SHGC = 38%

Shading devices were also specified to have the option of having the shades either open or closed for all of the clerestories. Not all of the functions in the ballroom will want to utilize the clerestories, specifically if the projection screen (on western wall) is being used. Shading devices from Lutron were selected to integrate with the control system.

The shades that are being used in the Ballroom are the Sivoia QED roller20 shades. A pocket lineal (see Figure 43) was selected for having the option of two different shades depending on the event taking place. A sheer, Basketweave NT shade was selected as one of the shades, maintaining the view to the outside while reducing glare, solar heat gain, and ultraviolet penetration. Blackout shade Value Premiere was chosen as the second shade option, so all daylight can be eliminated from the space at any time. These shades have a smooth, quiet operation controlled by an Electronic Drive Unit. The EDU is housed inside of the roller shade assembly and adjusts the shade to the desired preset positions. Because the clerestories are located in all three salons (Ballrooms A, B, and C), two power panels are needed for each room.

Sivoia QED roller20 Shades – Classico Collection								
Shade	**Name**	**Model**	**Color**	**Ts**	**Tv**	**As**	**Rs**	**Openness Factor**
Sheer	*Basketweave NT*	SN-010-10	Sable/Sable	12%	**12%**	52%	36%	10%
Blackout	*Value Premiere*	BP-Q57-0	Wheat	0%	**0%**	36%	64%	0%

Table 20: Shade specifications | Lutron

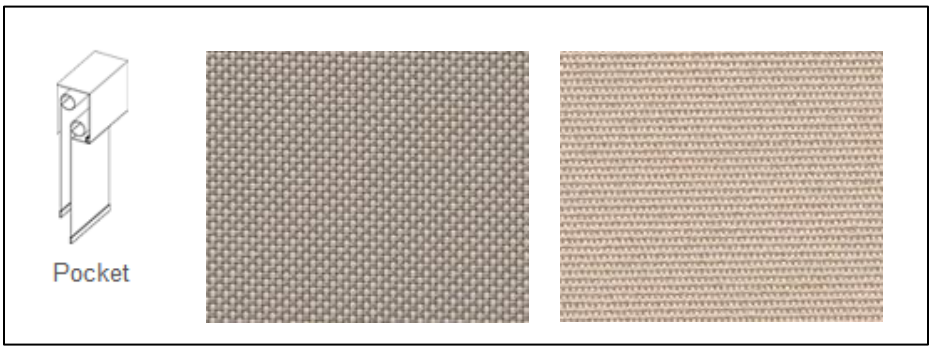


Figure 43: Lineal section, Basketweave NT shade, and Value Premiere shade

Lighting Plan – Refer to Appendix C

Mounting Details – Refer to Appendix C

Luminaire Equipment Schedule:

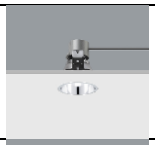
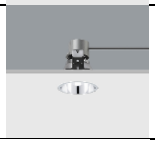
Tag	Luminaire	Description
L		Open recessed 4" aperture downlight with vertical lamp orientation for (1) 100W low voltage halogen lamp. Bright anodized, aluminum darklight reflector with cut-off angle of 30° and a glass, frosted diffuser.
M		Open recessed 4" aperture downlight with vertical lamp orientation for (1) 75W low voltage halogen lamp. Bright anodized, aluminum darklight reflector with cut-off angle of 45° and a glass, frosted diffuser.
N		Colourline. 12" compact linear RGB LED cove light with beam distribution of 120° x 120°. Clear diffuse lens with ratcheting mounting bracket for secure aiming. 20 LEDs per foot. Dimming available.
O		Decorative custom chandelier based on design from Yellow Goat Design with 3 tiers and 21 lamps. Assemblage of clear acrylic swirls and curves to form classic chandelier shape. Crystal accents added for sparkle. Black finish. 48"h x 72"w.
P		Decorative custom sconce with assemblage of clear acrylic swirls and curves. 15.5"h x 9.5"w x 7" projection. Candelabra base. Mounted 7'-0" AFF.

Table 21: Condensed Ballroom Luminaire Schedule

**The full Lighting Equipment Schedule can be found in Appendix A.*

Light Loss Factors:

Light Loss Factors						
Tag	**Initial Lumens**	**Mean Lumens**	**LLD**	**LDD**	**BF**	**Total**
L	-	2350	0.95	0.94	-	0.89
M	-	1600	0.95	0.94	-	0.89
N	--	--	0.70	0.90	1.00	0.63
O	--	60	0.95	0.94	-	0.89
P	--	60	0.95	0.94	-	0.89

Table 22: Ballroom Light Loss Factors

**Use of the new procedure to find LDD was used. As the new handbook does not address RSDD, it was not calculated. According to the new handbook, a LEDs LLD is assumed to be 0.7. A 12 month cleaning interval and "clean" environment was assumed. Any other LLFs not displayed are assumed to be 1.0.*

Controls:

Because the Ballroom is a multi-functional space, specific controls were needed to accommodate the scene changes and different lighting zones assigned in the space. A Viseo Wallstation provides local access to the lighting control system and operates every zone and scene. Shades for the clerestories are controlled with the Sivoia QED Controller interface. The LEDs in the Ballroom are controlled via the DMX512 Control Interface. Because the Ballroom can be divided into three separate, smaller ballrooms (A, B, and C), individual 5-button preset stations are provided in each room, with the main wallstation in the AV Closet directly beside the Ballroom.

Control Schedule						
Tag	**Product**	**Manufacturer**	**Product/Catalog No.**	**No. Units**	**Description**	**Location**
EQ-A	Viseo Wallstation	Lutron GRAFIK	OMX-VDC-LF	1	Main wallstation that provides local access to the lighting control system. Operates every scene and zone in the system, as well as the ability to change fade and delay times in any area. Includes a time clock.	AV Closet (Room #1324)
EQ-B	seeTouch Wallstation	Lutron GRAFIK	SO-5WRLN	3	5-button preset Sivoia QED wallstation with raise/lower capability for Sivoia QED roller20 shades	Ballrooms A, B, and C
EQ-C	DMX512 Control Interface	Lutron GRAFIK	LUT-DMX	1	Allows GRAFIK Eye lighting controls to operate lighting and other equipment including LED-based lamps	Ballroom
EQ-D	roller 20 shades	Lutron | Sivoia QED	Sivoia QED | roller 20	3	Smooth, ultra-quiet operable shades controlled by an Electronic Drive Unit (EDU), housed in the roller shade assembly. The EDU controls the movement positions of the shades	Ballroom

Table 23: Controls Schedule | Ballroom

Performance Data and Preliminary Renderings:

Public Atmosphere—Sconces off, and all other lights on at full output; daylight not considered in calculation

Ballroom | Calculation Summary	
	Horizontal (2.5')
Avg Illuminance	***34.14 fc***
Max Illuminance	50.2 fc
Min Illuminance	13.7 fc
Avg/Min	2.49
Max/Min	3.66
Criteria	30 fc
Compliance?	**Yes**

Table 24: Calculation Summary of Ballroom | Public

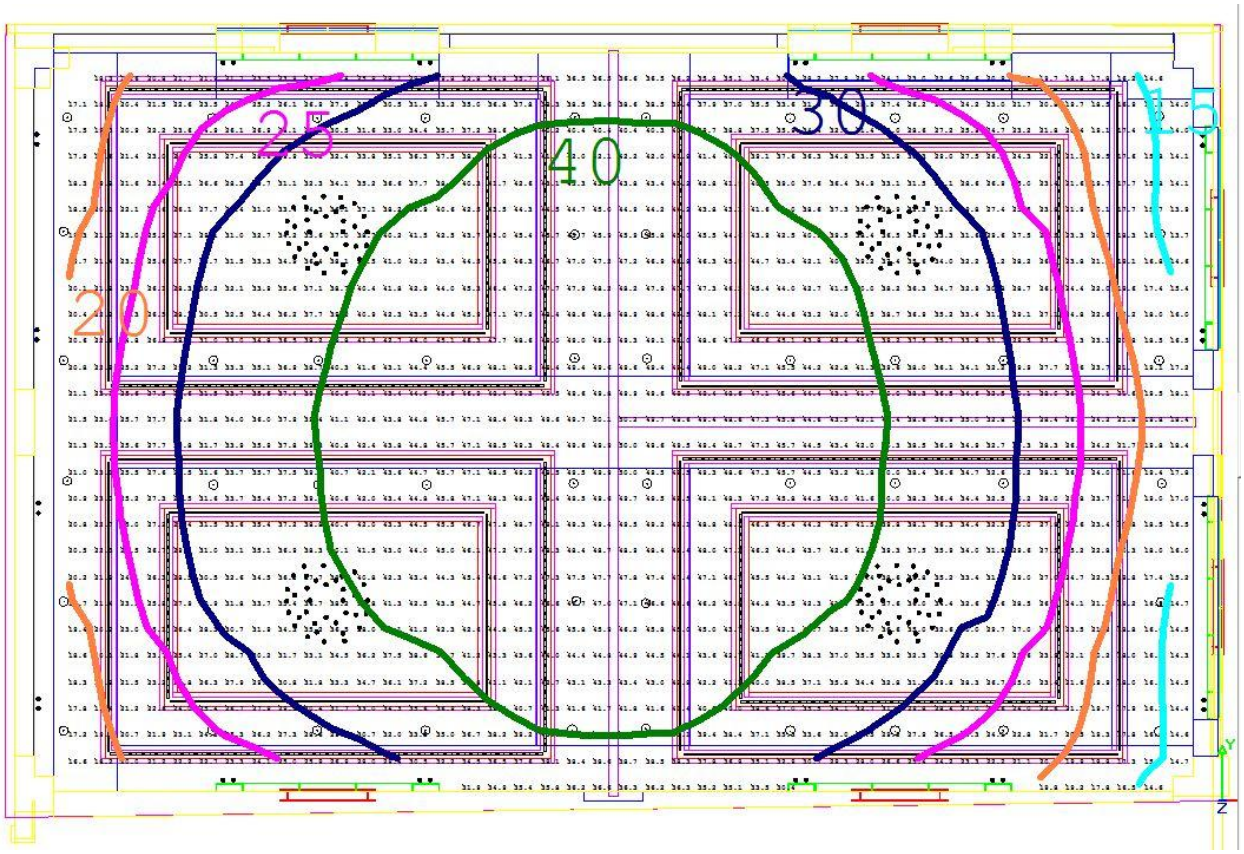


Figure 44: Illuminance Contours of Ballroom | Public

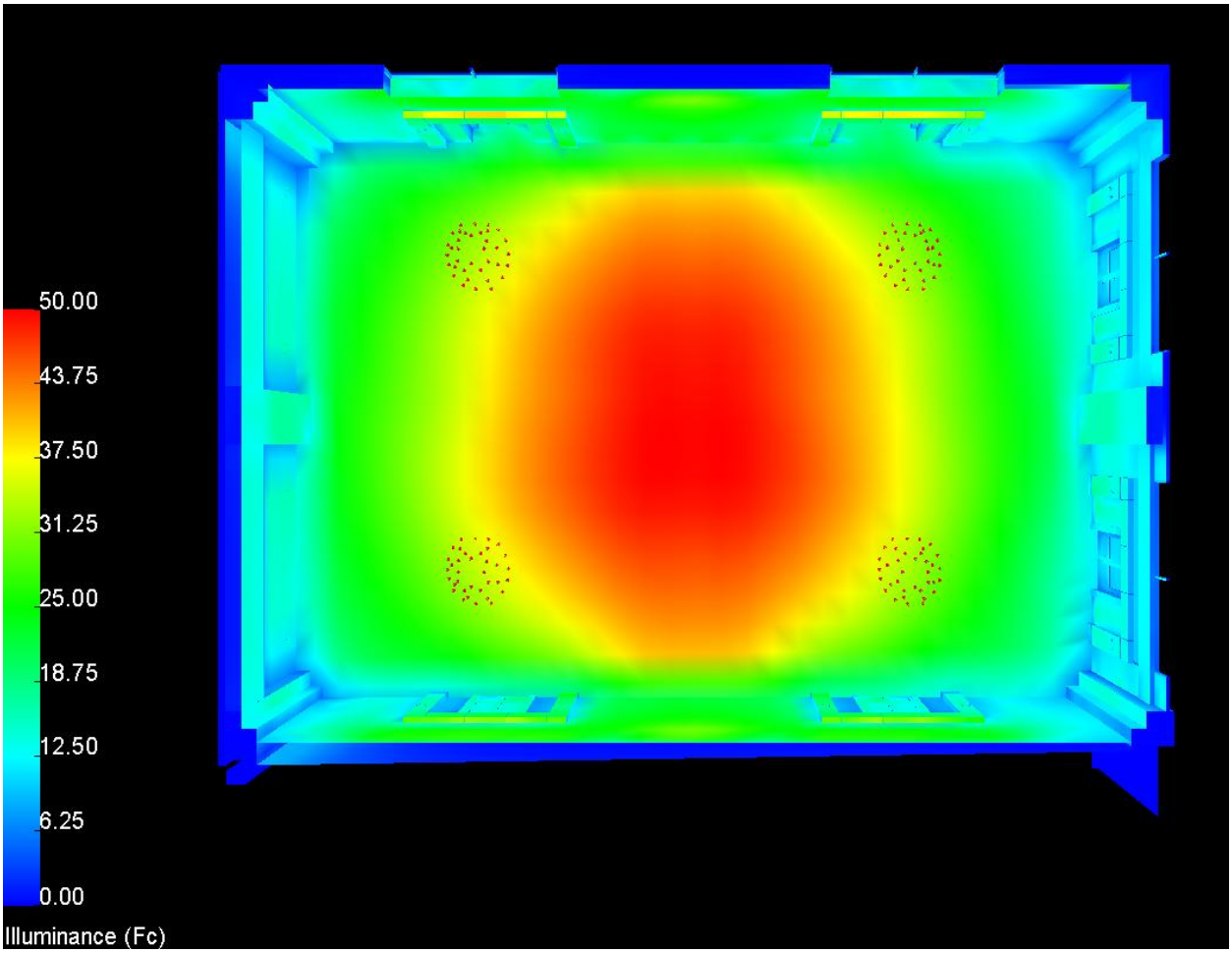


Figure 45: Pseudo Color Rendering of Ballroom | Public

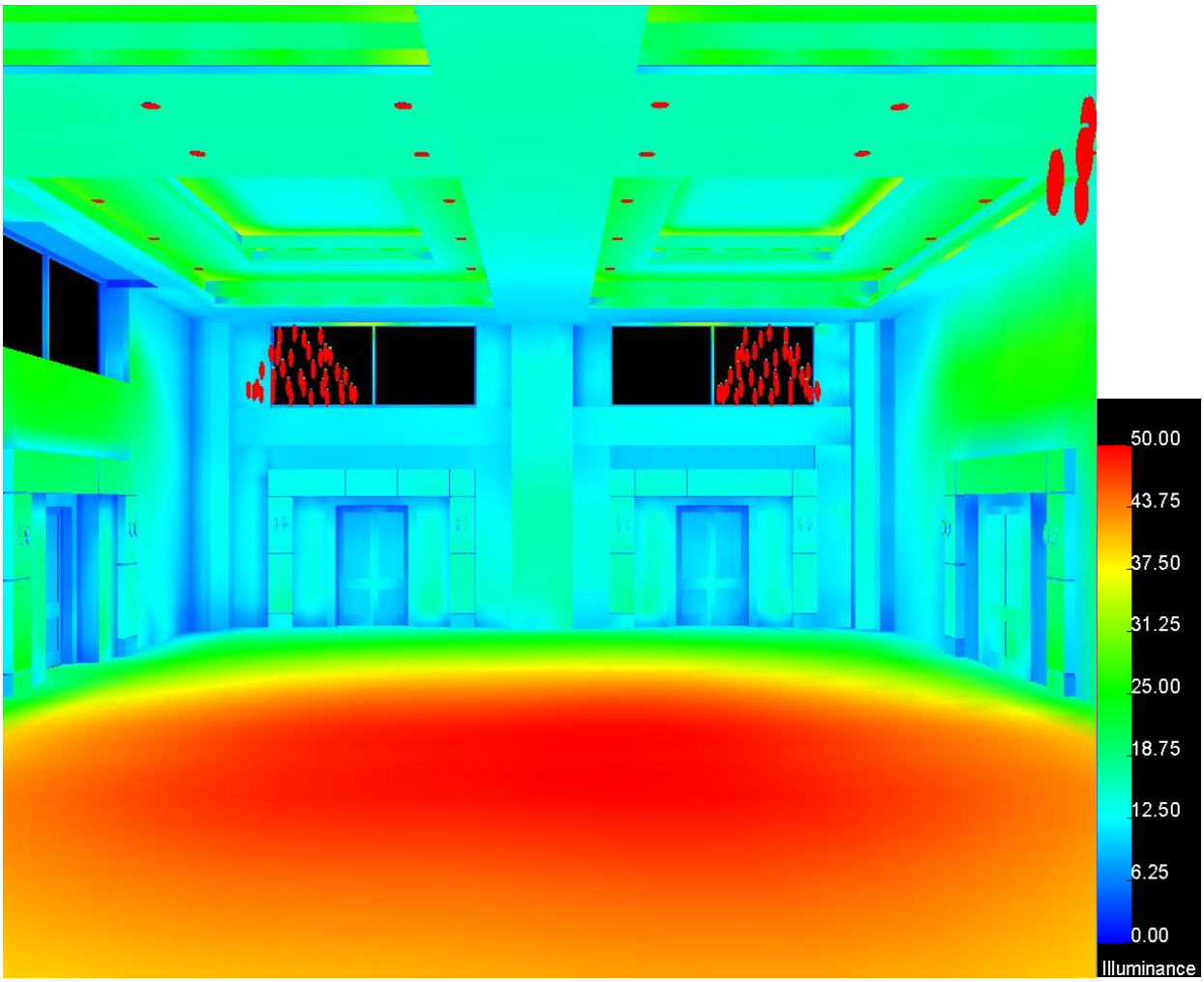


Figure 46: Pseudo Color Rendering of Ballroom | Public

Private Atmosphere—Downlights dimmed to 20%, sconces switched on; no daylight

Ballroom | Calculation Summary	
	Horizontal (2.5')
Avg Illuminance	***10.88 fc***
Max Illuminance	13.9 fc
Min Illuminance	5.2 fc
Avg/Min	2.09
Max/Min	2.67
Criteria Compliance?	10 fc **Yes**

Table 25: Calculation Summary of Ballroom | Private

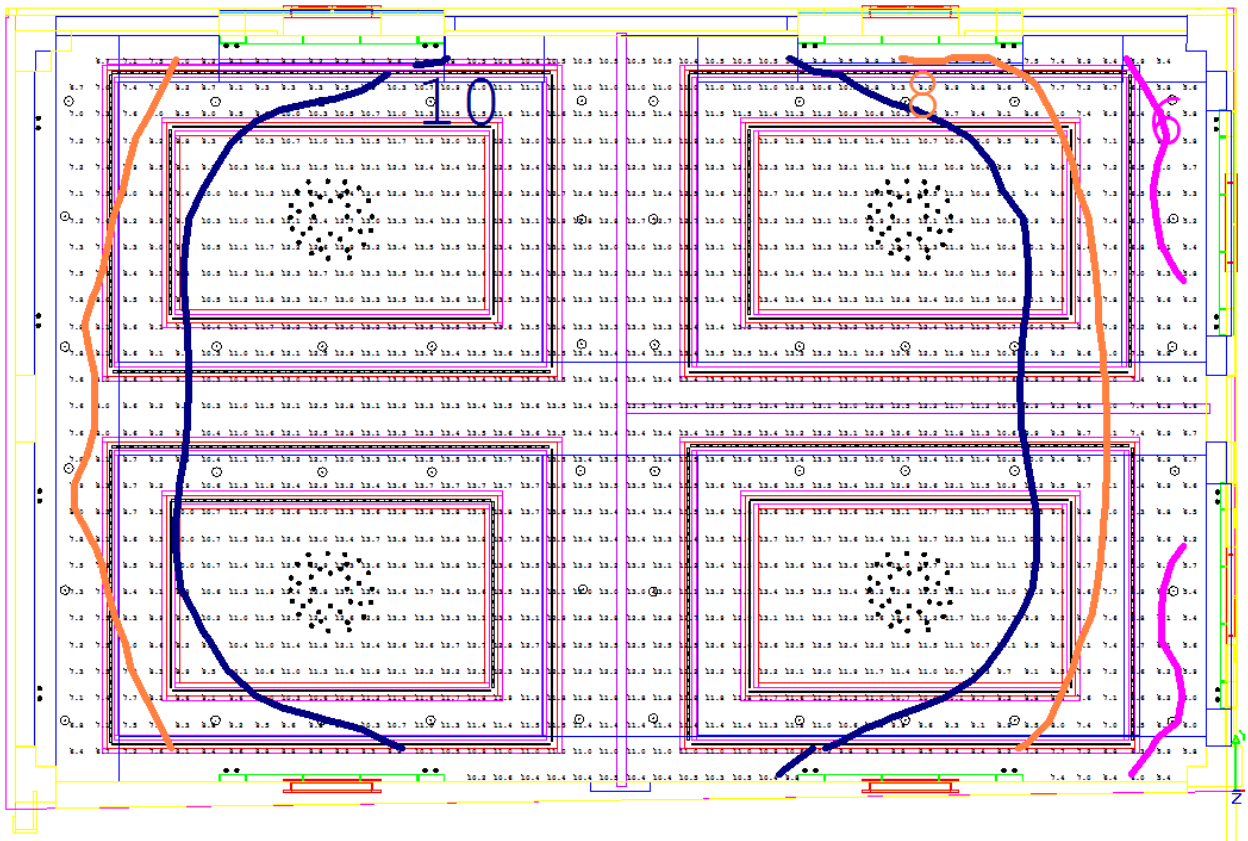


Figure 47: Illuminance Contours of Ballroom | Private

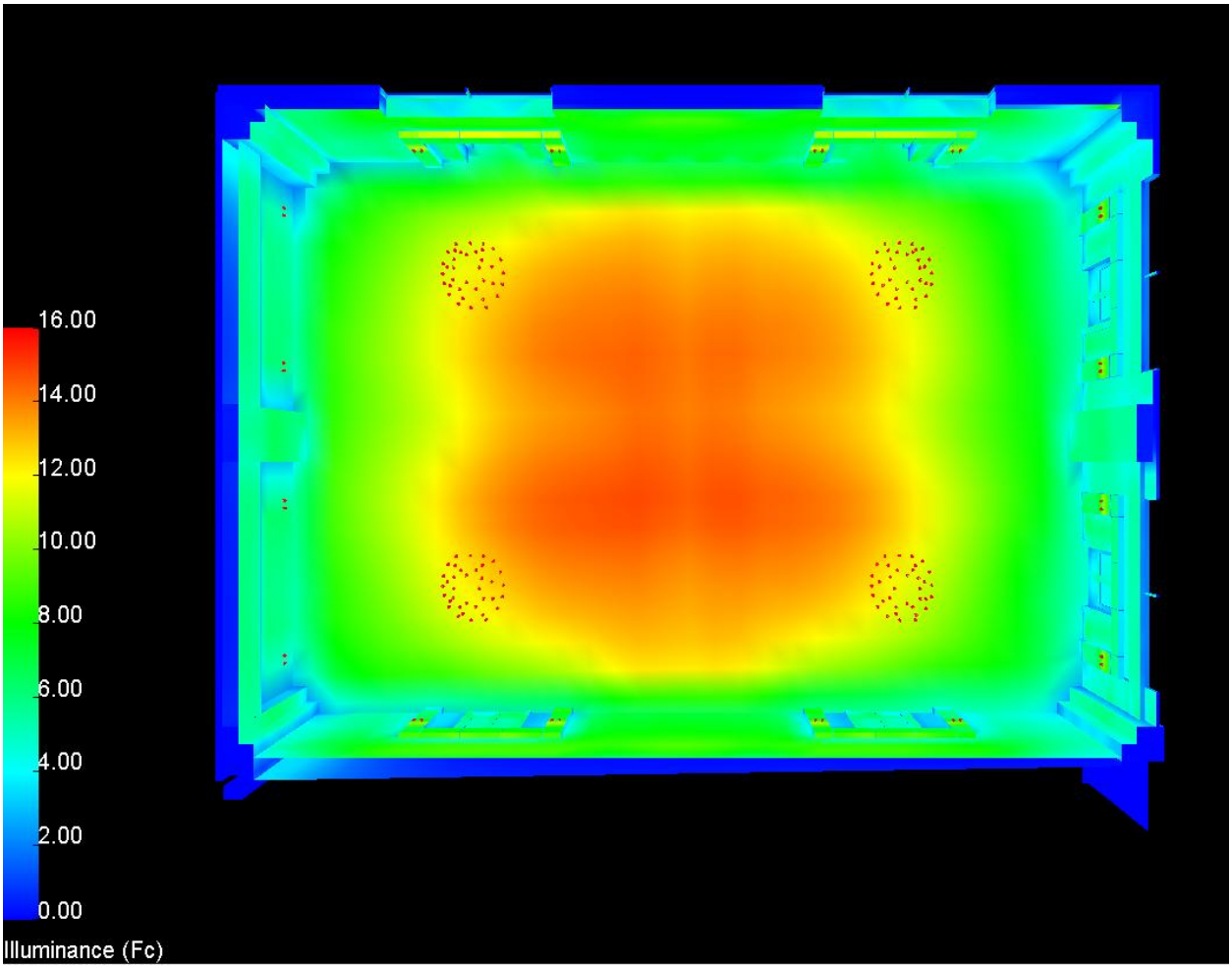


Figure 48: Pseudo Color Rendering of Ballroom | Private

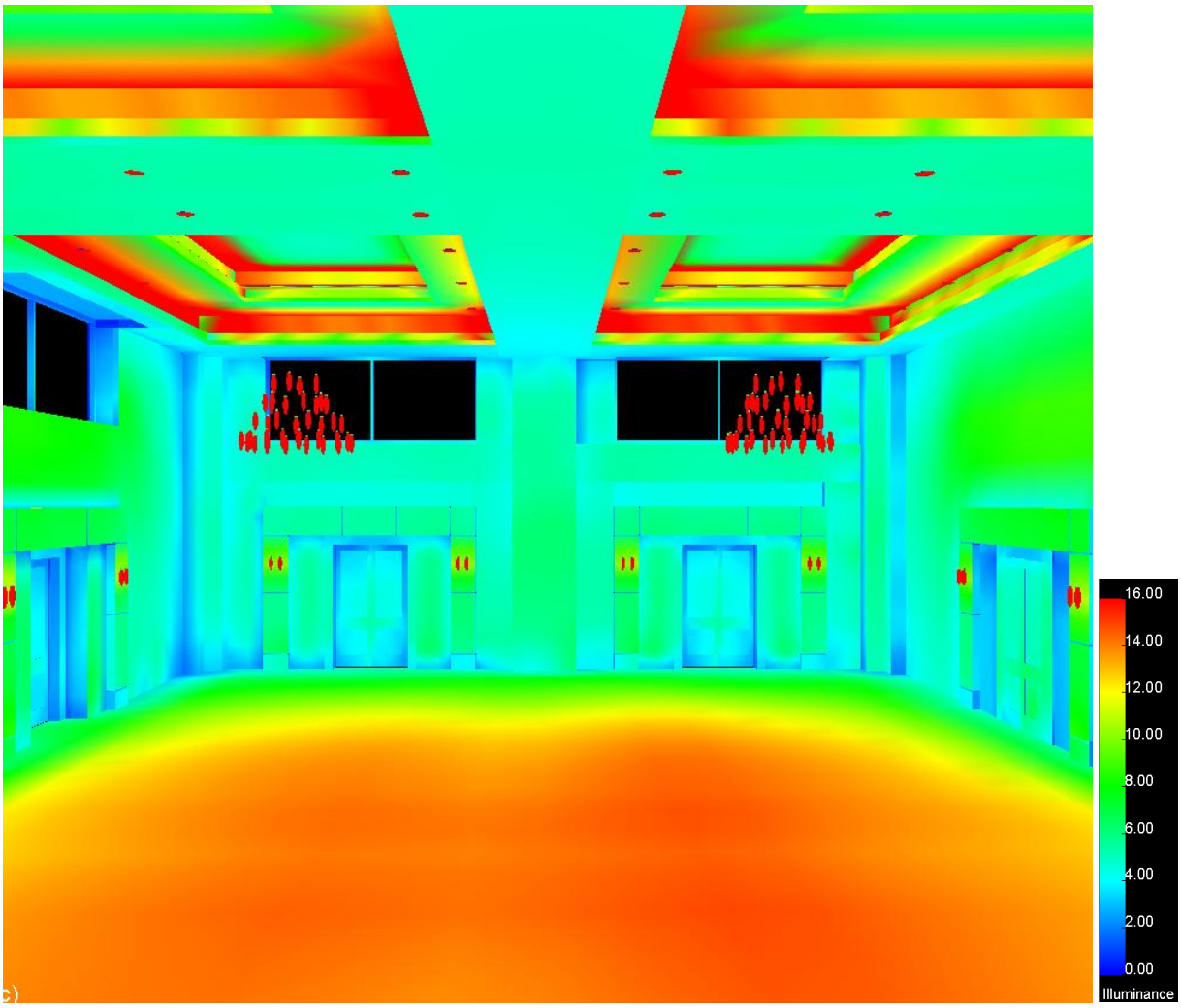


Figure 49: Pseudo Color Rendering of Ballroom | Private

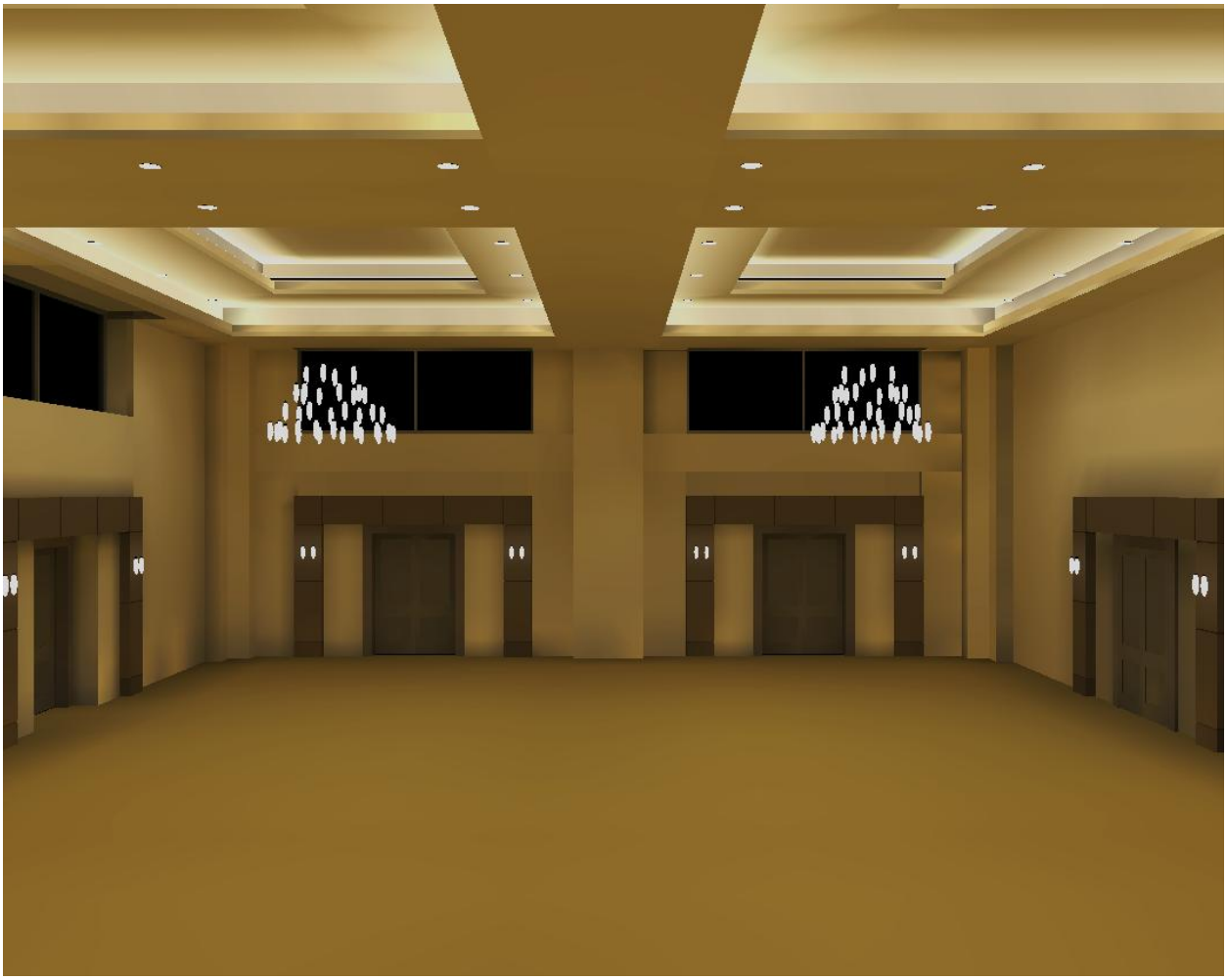


Figure 50: Preliminary Rendering of Ballroom | Private

Presentation Setting—Some downlights on (in cove system only) dimmed to 20%; no daylight

Ballroom | Calculation Summary	
	Horizontal (2.5')
Avg Illuminance	***14.45fc***
Max Illuminance	17.6 fc
Min Illuminance	9.6 fc
Avg/Min	1.51
Max/Min	1.83
Criteria	15 fc
Compliance?	**Yes**

Table 26: Calculation Summary of Ballroom | Presentation Mode

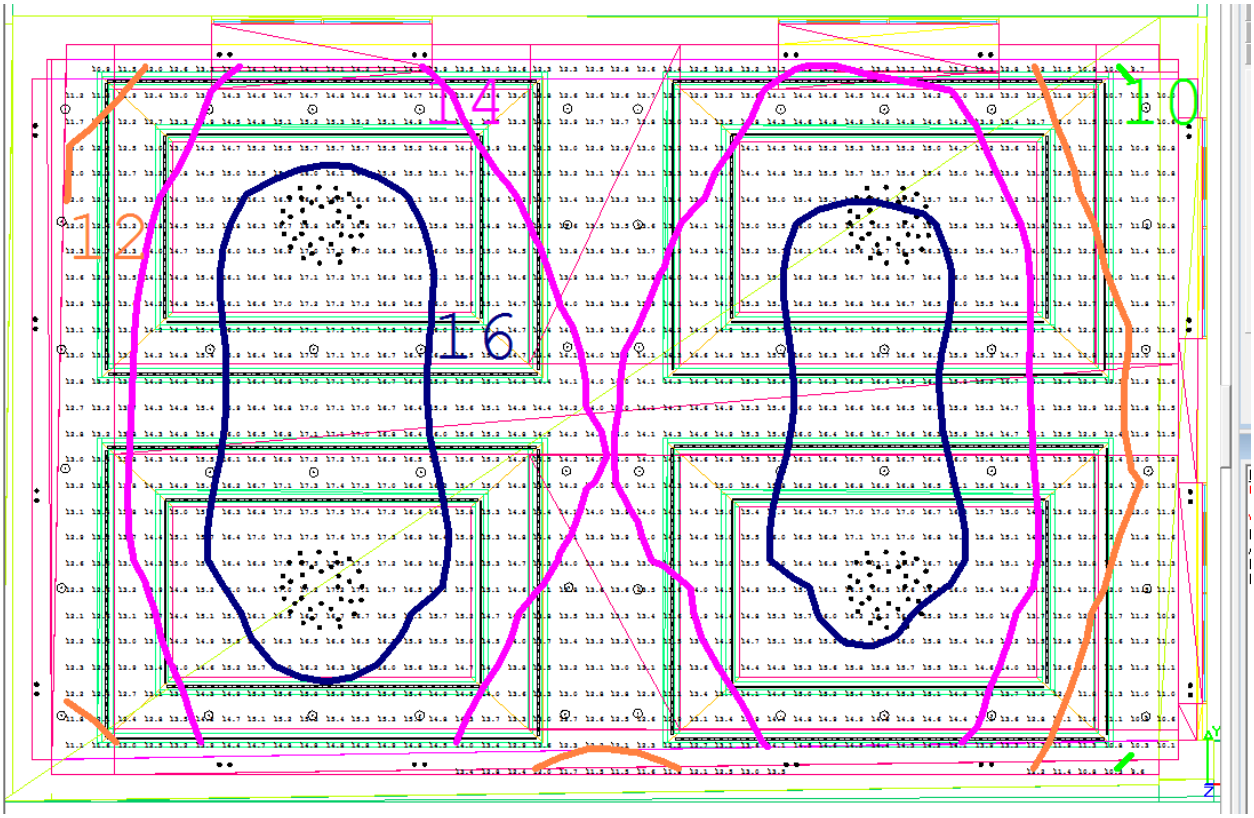


Figure 51: Illuminance Contours | Ballroom - Presentation Mode

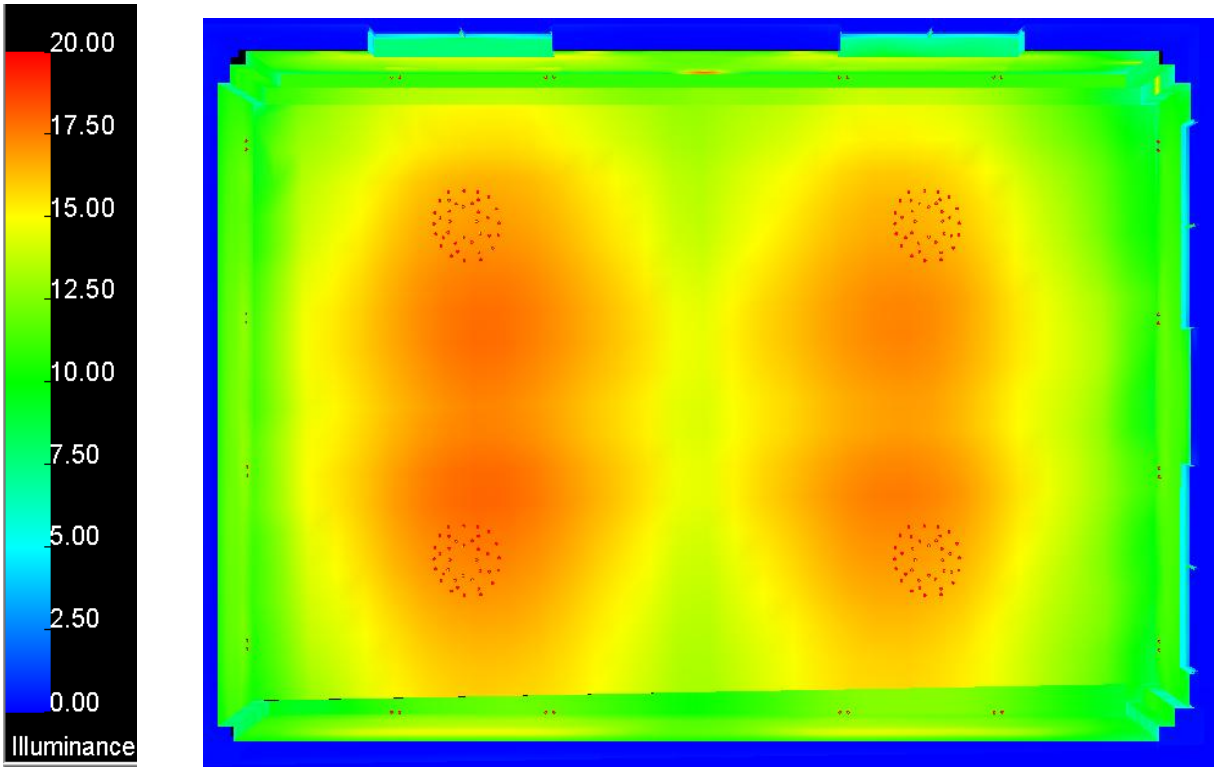


Figure 52: Pseudo color | Presentation Scene

Lighting Power Density:

ASHRAE Standard 90.1 | LPD Summary				
Tag	**Quantity**	**Watts/Luminaire**	**Watts/LF**	**Total Watts**
L	36	100	--	3600
M	12	75	--	900
N	744	3	--	2232
O	4	105	--	420
P	16	10	--	160
			Total Watts	**7312**

ASHRAE Standard 90.1 | LPD Summary						
Room	**Area**	**Power Density Allowable**	**Allowable Wattage**	**Designed Wattage**	**Actual LPD**	**Met?**
Ballroom	5400	1.3 W/SF	7020	6732	1.25	Yes
Decorative Allowance	5400	1.0 W/SF	5400	580	0.11	Yes
			W/SF	**1.24**		

Table 27: LPD Summary Tables

The lighting power density requirements from ASHRAE Standard 90.1 allow only 7020 Watts total in the Ballroom without the decorative allowance. Because there are 7312 Watts total, the decorative allowance was utilized to meet ASHRAE standards. The decorative chandeliers and sconces were accounted for in the decorative allowance.

Performance Summary:

The Ballroom in the Hotel and Conference Center is a very flexible and functional space, able to accommodate all kinds of different events. Therefore, the lighting design should also be flexible and functional. A GRAFIK Eye System controls the scenes and zones of the room in order to change the overall look and feel of the space. Custom decorative chandeliers and sconces sparkle and shine as light reflect off of their surfaces. A double tiered cove system bounces light on the ceiling as well, making the room feel more public and open. The GRAFIK Eye System also controls the shading devices that are to be specified for the clerestories. This is extremely important and useful in knowing, too, specifically because the Ballroom can be split up into three separate "rooms" (with the use of partitions).

With the use of low color temperature halogen lamps and LED luminaires, the lighting design does in fact meet criteria set forth in ASHRAE 90.1 with the use of the decorative allowance. The new lighting design also met design recommendations found in ASHRAE 90.1

Electrical Depth

Redesigned Spaces

Lighting redesign was done for four spaces in the Hotel and Conference Center. These four spaces are the exterior space (façade and courtyard), Main Lobby, Lounge, and Ballroom.

On the exterior of the building, LED and compact fluorescent make up the majority of the new lighting. The original design included a mixture of both LED and compact fluorescent, as well as ceramic metal halide lamps.

The Main Lobby originally had a combination of compact fluorescent, linear fluorescent, LED, and halogen lamps. The projected lighting design actually utilizes the majority of these fixtures as well. For the most part, LED and fluorescent are used in the Lobby, with the exception of halogen accent lights for highlighting artwork around the perimeter of the space.

Originally, the lighting in the Lounge was a mixture of halogen, LED, and fluorescent sources. The modified lighting design incorporates all halogen and LED lamps. During the evening, lower levels of light can be utilized, so dimming presets are optional.

Where the lighting in the Ballroom was a combination of both fluorescent and halogen lamps, the proposed solution employs a mixture of dimmable LED and quartz halogen sources. These sources are also dimmable, allowing for a variety of preset scenes depending on the event taking place.

Branch circuit distribution has been redesigned in response to the new lighting designs. Both the panelboards and feeder sizes changed and their modifications are shown below. Additional lighting controls specified for the rooms are also documented.

The table shown below details the panelboards affected by the lighting modifications:

Panelboards						
Panel Tag	**Voltage**	**System**	**Exterior**	**Main Lobby**	**Lounge**	**Ballroom**
DML	208Y/120V 3ϕ 4W	N				x
DMB	208Y/120V 3ϕ 4W	N		x	x	
HH	480Y/277v 3ϕ 4W	N	x			
EML	208Y/120V 3ϕ 4W	N/E		x		x
EMH	480Y/277v 3ϕ 4W	N/E	x		x	

Table 28: Panelboard Schedule

Exterior (façade and courtyard)

The new lighting design on the exterior portion of the Hotel and Conference Center is made up of LED and compact fluorescent sources. LED light columns and inground compact fluorescent road markers wrap around the walkway along the exterior of the site. The central plaza has a couple more of the light columns, as well as LED strips recessed underneath the concrete seating benches. Compact fluorescent downlights are utilized in the canopy of the hotel entrance and compact fluorescent sconces glow around the perimeter of the building. LED grazers are mounted on the exterior of the façade, accentuating the texture of the brick.

Lighting Plan

The lighting plans with controls and circuiting can be found in Appendix C.

Existing Panelboard Schedule - HH

Circuits that will be modified for the Exterior façade and courtyard on panel HH are highlighted below:

PANELBOARD SCHEDULE — HH

VOLTAGE	PHASE	WIRE	MCB (A)	MLO (A)	AIC	MOUNTING	MANUFAC.	MDL #	DWG REF
277 / 480	3	4	225	–	–	SURFACE	–	–	E6.01

TYPE LEGEND				REMARKS
L	LIGHTING	K	KITCHEN EQ	PROVIDE EQUIPMENT GROUND BUS
R	RECEPTACLES	E	EXISTING	PROVIDE FEED THRU LUGS FOR MULTI-SECTION PANELS
M	MECH EQUIP	O	OTHER	–

CKT. #	ITEM SERVED	TYPE	WIRE	CONDUIT	CKT. BRK TRIP	CKT. BRK P	LOAD (VA)	PHASE	LOAD (VA)	CKT. BRK P	CKT. BRK TRIP	CONDUIT	WIRE	TYPE	ITEM SERVED	CKT. #
1	LTG – LG. MTG. RMS.	L	#12	3/4"	20A	1	2592	A	0	1	20A	–	–	–	SPARE	2
3	LTG – SM. MTG. RMS.	L	#12	3/4"	20A	1	2062	B	200	1	20A	1"	#10	L	SITE LTG	4
5	LTG – BLDG EXT.	L	#12	3/4"	20A	1	1228	C	0	1	20A	1"	#10	L	SITE LTG (SCULPTURE)	6
7	LTG – GUEST FLOORS	L	#12	3/4"	20A	1	768	A	26	1	20A	1"	#10	L	SITE LTG (STEPS)	8
9	SPARE	–	–	–	20A	1	0	B	150	1	20A	1"	#10	L	SITE LTG (BENCHES)	10
11	SPARE	–	–	–	20A	1	0	C	385	1	20A	1"	#10	L	SITE LTG (TERRACE)	12
13	SPARE	–	–	–	20A	1	0	A	0	1	20A	–	–	–	SPARE	14
15	SPARE	–	–	–	20A	1	0	B	0	1	20A	–	–	–	SPARE	16
17	SPARE	–	–	–	20A	1	0	C	0	1	20A	–	–	–	SPARE	18
19	BUSSED SPACE	–	–	–	20A	1	0	A	0	1	20A	–	–	–	BUSSED SPACE	20
21	BUSSED SPACE	–	–	–	20A	1	0	B	0	1	20A	–	–	–	BUSSED SPACE	22
23	BUSSED SPACE	–	–	–	20A	1	0	C	0	1	20A	–	–	–	BUSSED SPACE	24
25	BUSSED SPACE	–	–	–	20A	1	0	A	2176	1	20A	1/2"	#12	L	KIT., LAUN., ETC LTG	26
27	BUSSED SPACE	–	–	–	20A	1	0	B	2500	1	20A	1/2"	#12	L	UTILITY SPACES LTG	28
29	BUSSED SPACE	–	–	–	20A	1	0	C	2500	1	20A	1/2"	#12	L	1ST FLR CORR. LTG	30
31	BUSSED SPACE						0	A	1996	1	20A	1"	#10	L	ADMIN AREA LTG	32
33	BUSSED SPACE						0	B	4400	1	20A	1"	#10	L	EXT. PARK. LTG	34
35	BUSSED SPACE						0	C	341	1	20A	1"	#10	L	SITE LTG	36
37	TRANSFORMER FOR		SEE	SEE	SEE	3	SEE	A	490	1	20A	1"	#10	L	SITE LTG	38
39	PANEL "HL"		RISER	RISER	RISER		SUB	B	490	1	20A	1"	#10	L	SITE LTG	40
41			DIAG.	DIAG.	DIAG.		LOAD	C	97	1	20A	1"	#10	L	SITE LTG	42

	A	B	C	TOTAL
CONNECTED LOAD (VA)	8048	9802	4551	22401

Figure 54: Existing Panelboard Schedule | Exterior

Emergency Panel Affected

PANELBOARD SCHEDULE																EMH	
VOLTAGE		PHASE	WIRE	MCB (A)		MLO (A)		AIC		MOUNTING		MANUFAC.		MDL #		DWG REF	
277 / 480		3	4	250		–		–		SURFACE		–		–		E6.03	
TYPE LEGEND														REMARKS			
L	LIGHTING			K	KITCHEN EQ									PROVIDE EQUIPMENT GROUND BUS			
R	RECEPTACLES			E	EXISTING									PROVIDE FEED THRU LUGS FOR MULTI-SECTION PANELS			
M	MECH EQUIP			O	OTHER									–			

CKT. #	ITEM SERVED	TYPE	WIRE	CONDUIT	CKT. BRK TRIP	CKT. BRK P	LOAD (VA)	PHASE	LOAD (VA)	CKT. BRK P	CKT. BRK TRIP	CONDUIT	WIRE	TYPE	ITEM SERVED	CKT. #
1	PARKING LOT EMERG. LTG	L	#12	3/4"	20A	1	2500	A	180	1	20A	1"	#10	L	COOLING TOWER LTG	2
3	PENTHOUSE EMERG. LTG	L	#10	3/4"	20A	1	350	B	1000	1	20A	3/4"	#10	L	FIRST FLOOR EM. LTG	4
5	LTG-STAIR #1	L	#12	3/4"	20A	1	448	C	0	1	20A	–	–	–	SPARE	6
7	LTG- 1ST FL	L	#10	3/4"	20A	1	2741	A	0	1	20A	–	–	–	SPARE	8
9	LTG- STAIR #2	L	#12	3/4"	20A	1	480	B	0	1	20A	–	–	–	SPARE	10
11	LTG – EXTERIOR	L	#10	3/4"	20A	1	531	C	0	1	20A	–	–	–	SPARE	12
13	LTG – GUEST FLRS	L	#12	3/4"	20A	1	2490	A	0	1	20A	–	–	–	SPARE	14
15	LTG – 1ST FLOOR	L	#12	3/4"	20A	1	615	B	0	1	20A	–	–	–	SPARE	16
17	N.E. EXIT LTG	L	#12	3/4"	20A	1	0	C	0	1	20A	–	–	–	SPARE	18
19	SPARE	–	–	–	20A	1	0	A	0	1	20A	–	–	–	SPARE	20
21	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	22
23	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	24
25	BUSSED SPACE					1	0	A	0	1					BUSSED SPACE	26
27	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	28
29	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	30
31	BUSSED SPACE					1	0	A	0	1					BUSSED SPACE	32
33	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	34
35	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	36
37	PANEL "EML"		SEE	SEE	SEE	3	SEE	A	0	1					BUSSED SPACE	38
39	TRANSFORMER		RISER	RISER	RISER		SUB	B	0	1					BUSSED SPACE	40
41	(SEE RISER FOR MORE INFO)		DIAG.	DIAG.	DIAG.		LOAD	C	0	1					BUSSED SPACE	42

	A	B	C	TOTAL
CONNECTED LOAD (VA)	7911	2445	979	11335

Figure 55: Existing Emergency Panelboard | Exterior

Branch Circuit Calculations

Panelboard HH

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
K1-3	44 lf	4.32/lf	190.08	0.99	480Y/277V	0.23
Q	6	47	282	0.80	480Y/277V	0.42
R	13	11	143	0.82	480Y/277V	0.21
S	13	42	546	0.90	480Y/277V	0.73
T	10	19	190	0.93	480Y/277V	0.21
U	20	50	1000	0.90	480Y/277V	1.34
		Total Watts	**2351**		Total Amps	**3.14**

Table 29: Branch Circuit Calcs | PB HH

The exterior has four different zones of lights: one for the walkway and roadway lights wrapping around the perimeter of the site, one for the plaza, one for the exterior sconces and grazers, and one for the entry canopy downlights. The branch circuit calculations are seen in the tables below:

Panelboard HH

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
4	S	10	42	420	0.90	480Y/277V	0.56
	R	13	11	143	0.82	480Y/277V	0.21
6	K1-3	44 lf	4.32/lf	190.08	0.99	480Y/277V	0.23
	S	3	42	126	0.90	480Y/277V	0.17
8	T	10	19	190	0.93	480Y/277V	0.25
	U	20	50	1000	0.90	480Y/277V	1.34
10	Q	6	47	282	0.80	480Y/277V	0.42
						Total Amps	**3.14**

Table 30: Branch Circuiting Table for Panelboard HH

Panelboard EMH

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
11	R	5	11	55	0.82	480Y/277V	0.08
	S	7	42	294	0.90	480Y/277V	0.39
	T	4	19	76	0.93	480Y/277V	0.10
						Total Amps	**0.57**

Table 31: Branch Circuiting Table for Panelboard HH

Panelboard Sizing

Circuits 4, 6, 8, and 10 were modified in Panel HH for the Exterior façade and courtyard of the Hotel and Conference Center. Emergency Panelboard EMH was modified for the new emergency lighting on the exterior as well. The new panelboards are seen on the next page.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					HH	Panel Location:			Electrical 1	
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	Ltg - Lg Mtg Rms	2	Lg Mtg Rm	2592	w	0.95	2592	2728	
2	A	Spare	3	-	0	w	0.99	0	0	
3	B	Ltg - Sm Mtg Rms	2	Sm Mtg Rm	2062	w	0.95	2062	2171	
4	B	Site Ltg	1	Site	563	w	0.86	563	655	
5	C	Ltg - Bldg Ext	1	Site	1228	w	1.00	1228	1228	
6	C	Site ltg (sculpture)	1	Site	316.08	w	0.95	316	334	
7	A	Ltg - guest floors	2	Guest Flrs	768	w	1.00	768	768	
8	A	Site ltg (steps)	1	Site	1190	w	0.92	1190	1301	
9	B	Spare	3	-	0	w	1.00	0	0	
10	B	Site ltg (benches)	1	Site	282	w	0.80	282	353	
11	C	Spare	3	-	0	w	1.00	0	0	
12	C	Site ltg (terrace)	1	Site	385	w	0.80	385	481	
13	A	Spare	3	-	0	w	1.00	0	0	
14	A	Spare	3	-	0	w	1.00	0	0	
15	B	Spare	3	-	0	w	1.00	0	0	
16	B	Spare	3	-	0	w	1.00	0	0	
17	C	Spare	3	-	0	w	1.00	0	0	
18	C	Spare	3	-	0	w	1.00	0	0	
19	A	Bussed Space	4	-	0	w	1.00	0	0	
20	A	Bussed Space	4	-	0	w	1.00	0	0	
21	B	Bussed Space	4	-	0	w	1.00	0	0	
22	B	Bussed Space	4	-	0	w	1.00	0	0	
23	C	Bussed Space	4	-	0	w	1.00	0	0	
24	C	Bussed Space	4	-	0	w	1.00	0	0	
25	A	Bussed Space	4	-	0	w	1.00	0	0	
26	A	Kit Lau 1st Flr Corr	2	1st Flr	2176	w	0.95	2176	2291	
27	B	Bussed Space	4	-	0	w	1.00	0	0	
28	B	Kit Lau 1st Flr Corr	2	1st Flr	2500	w	0.95	2500	2632	
29	C	Bussed Space	4	-	0	w	1.00	0	0	
30	C	Kit Lau 1st Flr Corr	2	1st Flr	2500	w	0.95	2500	2632	
31	A	Bussed Space	4	-	0	w	1.00	0	0	
32	A	Admin Area Ltg	2	1st Flr	1996	w	0.95	1996	2101	
33	B	Bussed Space	4	-	0	w	1.00	0	0	
34	B	Ext Park Ltg	1	Site	4400	w	0.90	4400	4889	
35	C	Bussed Space	4	-	0	w	1.00	0	0	
36	C	Site Ltg	1	Site	341	w	0.90	341	379	
37	A	XFR for HL	5	-	0	w	0.95	0	0	
38	A	Site Ltg	1	Site	490	w	0.90	490	544	
39	B	XFR for HL	5	-	0	w	0.95	0	0	
40	B	Site Ltg	1	Site	490	w	0.90	490	544	
41	C	XFR for HL	5	-	0	w	0.95	0	0	
42	C	Site Ltg	1	Site	97	w	0.90	97	108	
PANEL TOTAL								24.4	26.1	Amps= 94.4

Figure 56: Panelboard Sizing Worksheet | Exterior

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					9.2	9.7	37%	35.1
PHASE TOTAL	B					10.3	11.2	43%	40.6
PHASE TOTAL	C					4.9	5.2	20%	18.6

LOAD CATAGORIES			Connected			Demand				Ver: 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Site Ltg		9.8	10.8		9.8	10.8	0.99		
2	Interior Ltg		14.6	15.3		14.6	15.3	0.95		
3	Spare		0.0	0.0		0.0	0.0			
4	Bussed Space		0.0	0.0		0.0	0.0			
5	Other		0.0	0.0		0.0	0.0			
6			0.0	0.0		0.0	0.0			
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						24.4	26.1			
Spare Capacity			25%			6.1	6.5			
Total Design Loads						30.5	32.7	0.99	Amps=	39.3

Figure 57: Panelboard Sizing Worksheet | Exterior

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 60A
SIZE/TYPE MAIN: 60A/3P MLO

PANEL TAG: HH
PANEL LOCATION: Electrical 1
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
Ltg - Lg Mtg Rms	Lg Mtg Rm	2592	20A/1P	1	*			2	20A/1P	0	-	Spare
Ltg - Sm Mtg Rms	Sm Mtg Rm	2062	20A/1P	3		*		4	20A/1P	563	Site	Site Ltg
Ltg - Bldg Ext	Site	1228	20A/1P	5			*	6	20A/1P	316	Site	Site ltg (sculpture)
Ltg - guest floors	Guest Flrs	768	20A/1P	7	*			8	20A/1P	1190	Site	Site ltg (steps)
Spare	-	0	20A/1P	9		*		10	20A/1P	282	Site	Site ltg (benches)
Spare	-	0	20A/1P	11			*	12	20A/1P	385	Site	Site ltg (terrace)
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
Bussed Space	-	0	20A/1P	19	*			20	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	21		*		22	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	23			*	24	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	25	*			26	20A/1P	2176	1st Flr	Kit Lau 1st Flr Corr
Bussed Space	-	0	20A/1P	27		*		28	20A/1P	2500	1st Flr	Kit Lau 1st Flr Corr
Bussed Space	-	0	20A/1P	29			*	30	20A/1P	2500	1st Flr	Kit Lau 1st Flr Corr
Bussed Space	-	0	20A/1P	31	*			32	20A/1P	1996	1st Flr	Admin Area Ltg
Bussed Space	-	0	20A/1P	33		*		34	20A/1P	4400	Site	Ext Park Ltg
Bussed Space	-	0	20A/1P	35			*	36	20A/1P	341	Site	Site Ltg
XFR for HL	-	0	20A/1P	37	*			38	20A/1P	490	Site	Site Ltg
XFR for HL	-	0	20A/1P	39		*		40	20A/1P	490	Site	Site Ltg
XFR for HL	-	0	20A/1P	41			*	42	20A/1P	97	Site	Site Ltg

CONNECTED LOAD (KW) - A Ph.	9.21	TOTAL DESIGN LOAD (KW)	30.47
CONNECTED LOAD (KW) - B Ph.	10.30	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C Ph.	4.87	TOTAL DESIGN LOAD (AMPS)	39

Figure 58: New Panelboard | Exterior

PANELBOARD SIZING WORKSHEET										
Panel Tag---------->					EMH	Panel Location:			Electrical 2	
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	Pkg Lot EM LTG	2	Pkg Lot	2500	w	0.95	2500	2632	
2	A	Cooling Twr LTG	1	Exterior	180	w	0.95	180	189	
3	B	PentHse EM LTG	2	PentHse	350	w	0.95	350	368	
4	B	1ST FLR EM LTG	2	1ST FLR	300	w	0.95	300	316	
5	C	LTG-Stair #1	1	STAIR 1	448	w	0.95	448	472	
6	C	Spare	3	-	0	w	1.00	0	0	
7	A	LTG-1ST FLR	1	1ST FLR	2741	w	0.95	2741	2885	
8	A	Spare	3	-	0	w	1.00	0	0	
9	B	LTG-Stair #2	1	STAIR 2	480	w	0.95	480	505	
10	B	Spare	3	-	0	w	1.00	0	0	
11	C	LTG-Exterior	1	Exterior	425	w	0.95	425	447	
12	C	Spare	3	-	0	w	1.00	0	0	
13	A	LTG-Guest FLRS	1	Guest Flrs	2490	w	0.95	2490	2621	
14	A	Spare	3	-	0	w	1.00	0	0	
15	B	LTG-1ST FLR	1	1ST FLR	615	w	0.95	615	647	
16	B	Spare	3	-	0	w	1.00	0	0	
17	C	N.E. Exit LTG	1	1ST FLR	0	w	0.95	0	0	
18	C	Spare	3	-	0	w	1.00	0	0	
19	A	Spare	3	-	0	w	1.00	0	0	
20	A	Spare	3	-	0	w	1.00	0	0	
21	B	Bussed Space	4	-	0	w	1.00	0	0	
22	B	Bussed Space	4	-	0	w	1.00	0	0	
23	C	Bussed Space	4	-	0	w	1.00	0	0	
24	C	Bussed Space	4	-	0	w	1.00	0	0	
25	A	Bussed Space	4	-	0	w	1.00	0	0	
26	A	Bussed Space	4	-	0	w	1.00	0	0	
27	B	Bussed Space	4	-	0	w	1.00	0	0	
28	B	Bussed Space	4	-	0	w	1.00	0	0	
29	C	Bussed Space	4	-	0	w	1.00	0	0	
30	C	Bussed Space	4	-	0	w	1.00	0	0	
31	A	Bussed Space	4	-	0	w	1.00	0	0	
32	A	Bussed Space	4	-	0	w	1.00	0	0	
33	B	Bussed Space	4	-	0	w	1.00	0	0	
34	B	Bussed Space	4	-	0	w	1.00	0	0	
35	C	Bussed Space	4	-	0	w	1.00	0	0	
36	C	Bussed Space	4	-	0	w	1.00	0	0	
37	A	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
38	A	Bussed Space	4	-	0	w	1.00	0	0	
39	B	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
40	B	Bussed Space	4	-	0	w	1.00	0	0	
41	C	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
42	C	Bussed Space	4	-	0	w	1.00	0	0	
PANEL TOTAL								10.5	11.1	Amps= 40.0

Figure 59: Emergency Panelboard Sizing Worksheet | Exterior

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					7.9	8.3	75%	30.1
PHASE TOTAL	B					1.7	1.8	17%	6.6
PHASE TOTAL	C					0.9	0.9	8%	3.3

LOAD CATAGORIES			Connected			Demand				Ver: 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Lighting		7.4	7.8		7.4	7.8	0.95		
2	Emergency Lighting		3.2	3.3		3.2	3.3	0.95		
3	Spare		0.0	0.0		0.0	0.0			
4	Bussed Space		0.0	0.0		0.0	0.0			
5	Panel		0.0	0.0		0.0	0.0			
6			0.0	0.0		0.0	0.0			
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						10.5	11.1			
Spare Capacity			25%			2.6	2.8			
Total Design Loads						13.2	13.9	0.95	Amps=	16.7

Figure 60: Emergency Panelboard Sizing Worksheet | Exterior

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 60A
SIZE/TYPE MAIN: 60A/3P MLO

PANEL TAG: EMH
PANEL LOCATION: Electrical 2
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
Pkg Lot EM LTG	Pkg Lot	2500	20A/1P	1	*			2	20A/1P	180	Exterior	Cooling Twr LTG
PentHse EM LTG	PentHse	350	20A/1P	3		*		4	20A/1P	300	1ST FLR	1ST FLR EM LTG
LTG-Stair #1	STAIR 1	448	20A/1P	5			*	6	20A/1P	0	-	Spare
LTG-1ST FLR	1ST FLR	2741	20A/1P	7	*			8	20A/1P	0	-	Spare
LTG-Stair #2	STAIR 2	488	20A/1P	9		*		10	20A/1P	0	-	Spare
LTG-Exterior	Exterior	425	20A/1P	11			*	12	20A/1P	0	-	Spare
LTG-Guest FLRS	Guest Flrs	2490	20A/1P	13	*			14	20A/1P	0	-	Spare
LTG-1ST FLR	1ST FLR	615	20A/1P	15		*		16	20A/1P	0	-	Spare
N.E. Exit LTG	1ST FLR	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Bussed Space	-	0	20A/1P	21		*		22	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	23			*	24	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	25	*			26	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	27		*		28	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	29			*	30	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	31	*			32	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	33		*		34	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	35			*	36	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	37	*			38	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	39		*		40	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	41			*	42	20A/1P	0	-	Bussed Space

CONNECTED LOAD (KW) - A Ph.	7.91	TOTAL DESIGN LOAD (KW)	13.16
CONNECTED LOAD (KW) - B Ph.	1.75	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C Ph.	0.87	TOTAL DESIGN LOAD (AMPS)	17

Figure 61: New Emergency Panelboard | Exterior

Feeder Sizing

The data for the table below is a summary of redesigned wires for panelboards DMB and EMH. The 2008 NEC Handbook was referenced for sizes of wires.

Feeder Sizing	
Panelboard Tag	HH
Panelboard Voltage	480Y/277
Calculated Design Load (kW)	30.47
Calculated Power Factor	0.99
Calculated Design Load (A)	39
Calculated Load (A) with spare	48.75
Feeder Protection Size	60A
Sets	1
Wire Size	
Phase	(3) #6 AWG
Neutral	(1) #6 AWG
Ground	(1) #10 AWG
Conduit	1.00" EMT
Power Factor	0.95
Length of Run	48.15 ft
Voltage Drop	2.43
% Drop	0.51

Table 32: Feeder Sizing | PB HH

*Copper wire, 75°C, THWN, EMT conduit

Feeder Sizing	
Panelboard Tag	EMH
Panelboard Voltage	480Y/277
Calculated Design Load (kW)	13.16
Calculated Power Factor	0.95
Calculated Design Load (A)	17
Calculated Load (A) with spare	21.25
Feeder Protection Size	60A
Sets	1
Wire Size	
Phase	(3) #8 AWG
Neutral	(1) #8 AWG
Ground	(1) #10 AWG
Conduit	0.75" EMT
Power Factor	0.95
Length of Run	5.54 ft
Voltage Drop	0.39
% Drop	0.19

Table 33: Feeder Sizing | PB EMH

*Copper wire, 75°C, THWN, EMT conduit

Main Lobby

New lighting design in the Lobby is made up of a mixture of halogen, fluorescent and LED lighting. Halogen track lights accent points of interest in the Lobby such as artwork on the walls. Fluorescent coves separate the Lobby into distinct areas and points of interest for patrons. Surface mounted fluorescent lights graze a textured wall leading into the Restaurant. Fluorescent lamps are also utilized for backlighting display signs in the Lobby and for wallwashing purposes in the Elevator corridor. LED downlights are utilized throughout the Lobby, as well as LED strips for accenting woodwork.

Lighting Plan

The lighting plans with controls and circuiting can be found in Appendix C.

Existing Panelboard Schedule - DMB

Circuits that will be modified for the Main Lobby on panel DMB are highlighted below:

"DMB" GP Dimming Panel Load Schedule

Panel Name: Panel Unit 1
Lutron Model No.: CGP48-1204T8-ML-20-CGP344
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Lobby	6	Z5		A4-5	LED Ceiling Cove	FL - 0-10V	1375	2000	20A-1P	A
Lobby	7	Z5		A4-5	LED Ceiling Cove	FL - 0-10V	1250	2000	20A-1P	B
Restaurant	8	ZR7		A1-7	COVE LED	FL - DSI	1875	2000	20A-1P	C
Lobby	9	Z7		A4-7	LED Shelves	FL - 0-10V	310	2000	20A-1P	A
Lounge	7	ZL5		A3-5	Lobby Ceiling LED Cove	FL - 0-10V	375	2000	20A-1P	B
Restaurant	15	ZR14		A2-6	Private Dining Cove LED	FL - 0-10V	125	2000	20A-1P	C
Lobby	4	Z3		A4-3	LED Entry Wall	FL - 0-10V	125	2000	20A-1P	A
Lounge	10	ZL6-B		A3-8	Bar Counter Edge	FL - 0-10V	125	2000	20A-1P	B
Restaurant	7	ZR6	9	A1-6	AA Table DL	Electronic LV	1087	2000	20A-1P	C
Lobby	5	Z4	10	A4-4	MR16 DL Spline Wall	Electronic LV	684	2000	20A-1P	A
Lobby	17	Z15	11	A5-7	Lobby Curtain Wash	Electronic LV	845	2000	20A-1P	B
Restaurant	10	ZR9	12	A2-1	Buffett WW	Electronic LV	483	2000	20A-1P	C
Lounge	9	ZL7	13	A3-7	Bookshelves WW	Electronic LV	483	2000	20A-1P	A
Lobby	1	Z1	14	A4-1	Entry Foyer MR16 DL	Electronic LV	483	2000	20A-1P	B
Lounge	8	ZL6	15	A3-6	Lounge Bar Niche Shelves	Electronic LV	414	2000	20A-1P	C
Lobby	8	Z6	16	A4-6	MR16 DL Lobby Columns	Electronic LV	403	2000	20A-1P	A
Restaurant	5	ZR4	17	A1-4	Table DL	Electronic LV	322	2000	20A-1P	B
Restaurant	16	ZR15	18	A2-7	Rest. Curtain Wash	Electronic LV	322	2000	20A-1P	C
Restaurant	12	ZR11	19	A2-3	Main Buffett Decorative Pend	Incandescent	300	2000	20A-1P	A
Restaurant	4	ZR3	20	A1-3	WW	Electronic LV	282	2000	20A-1P	B
Lobby	2	Z1	21	A4-1	Entry Foyer MR16 DL	Electronic LV	282	2000	20A-1P	C
Restaurant	6	ZR5	22	A1-5	Small Decorative Pendants	Electronic LV	276	2000	20A-1P	A

Panel Name: Panel Unit 1
Lutron Model No.: CGP48-1204T8-ML-20-CGP344
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Lounge	1	ZL1	23	A3-1	Lounge Pendants	Electronic LV	265	2000	20A-1P	B
Restaurant	3	ZR2	24	A1-2	Wood Wall and RR DL	Electronic LV	242	2000	20A-1P	C
Lobby	18	Z16	25	A5-8	Lobby Sundries Accents	Electronic LV	242	2000	20A-1P	A
Lobby	14	Z12	26	A5-4	Reg. Desk Wall Wash	Electronic LV	242	2000	20A-1P	B
Lobby	20	Z18	27	A6-2	MR16 Firm Group DL	Electronic LV	242	2000	20A-1P	C

Figure 62: Existing Panelboard Schedule | Lobby

Restaurant	9	ZR8	28	A1-8	Wait Station WW	Electronic LV	201	2000	20A-1P	A
Restaurant	2	ZR2	29	A1-2	Wood Wall and RR DL	Electronic LV	201	2000	20A-1P	B
Restaurant	1	ZR1	30	A1-1	Maitre'D WW	Electronic LV	161	2000	20A-1P	C
Lobby	3	Z2	31	A4-2	MR16 Accent Brand Wall	Electronic LV	161	2000	20A-1P	A
Restaurant	11	ZR10	32	A2-2	Main Buffett DL	Electronic LV	161	2000	20A-1P	B
Lobby	12	Z10	33	A5-2	Reg. Desk Pendant	Electronic LV	161	2000	20A-1P	C
Restaurant	14	ZR13	34	A2-5	Private Dining Lg Pendant	Incandescent	150	2000	20A-1P	A
Lobby	13	Z11	35	A5-3	Reg. Desk MR16 DL	Electronic LV	161	2000	20A-1P	B
Lobby	15	Z13	36	A5-5	Elevator Lobby Pendant	FL - Hi-Lume	150	2000	20A-1P	C
Restaurant	13	ZR12	37	A2-4	Private Dining WW	Electronic LV	121	2000	20A-1P	A
Lounge	2	ZL2	38	A3-2	Lounge Curtain WW	Electronic LV	121	2000	20A-1P	B
Lounge	4	ZL2	39	A3-2	Lounge Curtain WW	Electronic LV	121	2000	20A-1P	C
Lounge	6	ZL4	40	A3-4	Bar Wall Accents	Electronic LV	121	2000	20A-1P	A
Lobby	11	z9	41	A5-1	MR16 WW Elevator Foyer	Electronic LV	121	2000	20A-1P	B
Lobby	16	Z14	42	A5-6	Business Center Foyer	Electronic LV	121	2000	20A-1P	C
Lobby	19	Z17	43	A6-1	Lobby Niche AA	Electronic LV	121	2000	20A-1P	A
Restaurant	17	ZR16	44	A2-8	Private Dining Curtain Wash	Electronic LV	81	2000	20A-1P	B
Lounge	3	ZL2	45	A3-2	Lounge Curtain WW	Electronic LV	81	2000	20A-1P	C
Lobby	10	Z8	46	A4-8	MR16 DL Elevator Foyer	Electronic LV	81	2000	20A-1P	A
Lounge	5	ZL3	47	A3-3	Seating DownLights	Electronic LV	81	2000	20A-1P	B
			48		Spare		0	2000	20A-1P	

120/208V, 3Ø-4 Wire Main Lugs GP Dimming Panel containing 1 20A-1Pole branch breaker rated at 10,000AIC for each of the 48 dimming circuits. Panel is subdivided into three sections. Max input feed = 350A
Project Name: GMU Hotel Restaurant, Lounge & Lobby

Feed Type: Normal

Phase A: 5154 W/VA
Phase B: 5116 W/VA
Phase C: 5867 W/VA

Figure 63: Existing Panelboard Schedule | Lobby

Emergency Panel Affected

Circuit 22 on emergency panelboard EML was also modified for new emergency lighting in the Lobby. The existing panelboard schedule is seen below.

PANELBOARD SCHEDULE — **EML**

VOLTAGE	PHASE	WIRE	MCB (A)	MLO (A)	AIC	MOUNTING	MANUFAC.	MDL #	DWG REF
120 / 208	3	4		0	–	SURFACE	–	–	E6.03

TYPE LEGEND				REMARKS
L	LIGHTING	K	KITCHEN EQ	PROVIDE EQUIPMENT GROUND BUS
R	RECEPTACLES	E	EXISTING	PROVIDE FEED THRU LUGS FOR MULTI-SECTION PANELS
M	MECH EQUIP	O	OTHER	

CKT. #	ITEM SERVED	TYPE	WIRE	CONDUIT	CKT. BRK TRIP	CKT. BRK P	LOAD (VA)	PHASE	LOAD (VA)	CKT. BRK P	CKT. BRK TRIP	CONDUIT	WIRE	TYPE	ITEM SERVED	CKT. #
1	DR HOLD OPEN, 1ST FL	O	#10	3/4"	20A	1	200	A	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	2
3	DR HOLD OPEN, 2ND FL	O	#10	3/4"	20A	1	200	B	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	4
5	DR HOLD OPEN, 3RD FL	O	#10	3/4"	20A	1	200	C	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	6
7	DR HOLD OPEN, 4TH FL	O	#10	3/4"	20A	1	200	A	1200	2	20A	1"	#10	O	GENERATOR ENGINE HEATER	8
9	DR HOLD OPEN, 5TH FL	O	#10	3/4"	20A	1	200	B	1200					O		10
11	DR HOLD OPEN, 6TH FL	O	#10	3/4"	20A	1	200	C	1200	3	20A	1"	#10	O	GENERATOR BATTERY CHGR	12
13	DR HOLD OPEN, 7TH FL	O	#10	3/4"	20A	1	200	A	1200					O		14
15	FIRE EXTING. SYSTEM	O	#10	3/4"	25A	1	2400	B	1200					O		16
17	JOCKEY PUMP	–	–	–	20A	1	0	C	720	1	20A	3/4"	#12	R	FIRE PUMP ROOM RECS	18
19	SPARE	–	–	–	20A	1	0	A	612	1	20A	3/4"	#12	R	EMERG. ELEC RM REC & E.FL.	20
21	SPARE	–	–	–	20A	1	0	B	352	1	20A	3/4"	#12	L	LTG- 1ST FL LOBBY	22
23	SPARE	–	–	–	20A	1	0	C	520	1	20A	3/4"	#12	L	LTG- 1ST FL REST	24
25	P-TRAP HEAT TRACE	M	#10	1"	20A	1	624	A	1200	1	20A	3/4"	#12	L	LTG- 1ST FL BALLRM	26
27	CTFS-1 HEATER RECEPT.	R	#10	1"	20A	1	1200	B	720	1	20A	3/4"	#12	L	LTG- 1ST FL BALLRM	28
29	COOLING TOWER YARD REC	R	#10	1"	20A	1	500	C	778	1	20A	3/4"	#12	L	LTG-1ST FL PREFUNC	30
31	CLING TWR HEAT TRACE	M	#10	1"	30A	2	1200	A	0	1		–	–	–	BUSSED SPACE	32
33							1200	B	0	1		–	–	–	BUSSED SPACE	34
35	BUSSED SPACE	–	–	–		1	0	C	0	1		–	–	–	BUSSED SPACE	36
37	BUSSED SPACE	–	–	–		1	0	A	0	1		–	–	–	BUSSED SPACE	38
39	BUSSED SPACE	–	–	–		1	0	B	0	1		–	–	–	BUSSED SPACE	40
41	BUSSED SPACE	–	–	–		1	0	C	0	1		–	–	–	BUSSED SPACE	42

	A	B	C	TOTAL
CONNECTED LOAD (VA)	7136	9172	4618	20926

Figure 64: Existing Emergency Panelboard | Lobby

Branch Circuit Calculations

Panelboard DMB

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
D[1]	26	50	1300	1.00	208Y/120V	3.61
E[2]	5	300	1500	1.00	208Y/120V	4.16
F	56	23	1288	0.90	208Y/120V	3.22
G	80	35	2800	0.99	208Y/120V	7.69
H	5	33	165	0.50	208Y/120V	0.23
I	10	33	330	0.50	208Y/120V	0.46
K1-3	106 lf	4.32W/lf	457.92	0.99	208Y/120V	1.40
		Total Watts	**6540.92**		Total Amps	**17.16**

Table 34: Panelboard DMB

[1]The maximum wattage allowable for the track head is 50W, although the 35W lamp is specified for the project
2The maximum wattage per track is 300W, therefore this value was considered in the LPD calculations because it is greater than the number of track heads specified. It will therefore be considered instead of D.

Panelboard EML

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
F	18	23	414	0.90	208Y/120V	1.28
H	3	33	99	0.50	208Y/120V	0.55
		Total Watts			Total Amps	**1.83**

Table 35: Panelboard EML

The Lobby has seven different zones of lights: one for the decorative track fixtures, one for the LED downlights, one for the fluorescent coves, one for the recessed fluorescent linear fixtures in the elevator lobby corridor, and three different zones for the LED strips. The LED strips are separated into three zones: one for the main reception desk, one for the strips in the book shelves, and one for the fixtures at the hostess stand. Seven circuits were utilized to accommodate the seven zones. The calculations are summarized below for each circuit in the panelboards affected by the modified lighting design:

Panelboard DMB

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
5	E	5	300/track	1500	1.00	208Y/120V	4.17
6	G	80	35	2800	0.99	208Y/120V	7.86
7	H	5	33	165	0.50	208Y/120V	0.92
8	I	10	33	330	0.99	208Y/120V	0.93
9	K1	60 lf	4.32/lf	259.2	0.99	208Y/120V	0.71
10	K2	34 lf	4.32/lf	146.88	0.99	208Y/120V	0.40
11	K3	24 lf	4.32/lf	103.68	0.99	208Y/120V	0.28
						Total Amps	**15.27**

Table 36: Panelboard DMB Circuit Calcs

Panelboard EML

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
22	F	18	23	414	0.90	208Y/120V	1.28
22	H	3	33	99	0.50	208Y/120V	0.55
						Total Amps	**1.83**

Table 36: Panelboard EML Circuit Calcs

Panelboard Sizing

Circuits 5-11 were modified in Panelboard DMB for the Lobby. Only a portion of each of these circuits had luminaires in the Lounge, so in order to modify the circuits, the old loads from only the Lounge were subtracted and the new ones (calculated above) were added. The new panelboard is seen in the figure below.

PANELBOARD SIZING WORKSHEET										
Panel Tag---------->					DMB	Panel Location:			Electrical 1	
Nominal Phase to Neutral Voltage------->					120	Phase:			3	
Nominal Phase to Phase Voltage-------->					208	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Lounge/Rest	1	L/R	1744	w	1.00	1744	1744	
2	A	Lounge/Rest	1	L/R	581.2	w	0.99	581	587	
3	B	Lounge/Rest	1	L/R	549.88	w	0.99	550	555	
4	B	Lounge/Rest	1	L/R	510.68	w	0.99	511	516	
5	C	Lobby/Rest	1	L/R	245.17	w	1.00	245	245	
6	C	Lobby/Rest	1	L/R	2955	w	0.99	2955	2985	
7	A	Lobby/Rest	1	L/R	877	w	0.50	877	1754	
8	A	Lobby/Rest	1	L/R	1791	w	0.99	1791	1809	
9	B	Lobby/Rest	1	L/R	460.2	w	0.99	460	465	
10	B	Lobby/Rest	1	L/R	504.88	w	0.99	505	510	
11	C	Lobby/Rest	1	L/R	264.68	w	0.99	265	267	
12	C	Lobby/Rest	1	L/R	461	w	1.00	461	461	
13	A	Lobby/Rest	1	L/R	282	w	1.00	282	282	
14	A	Lobby/Rest	1	L/R	392	w	1.00	392	392	
15	B	Lobby/Rest	1	L/R	275	w	1.00	275	275	
16	B	Lobby/Rest	1	L/R	443	w	1.00	443	443	
17	C	Lobby/Rest	1	L/R	926	w	1.00	926	926	
18	C	Lobby Sundries	1	Lobby	242	w	1.00	242	242	
19	A	Lobby Niche AA	1	Lobby	121	w	1.00	121	121	
20	A	Lobby MR16 DL	1	Lobby	242	w	1.00	242	242	
21	B		2		0	w		0	0	
22	B		2		0	w		0	0	
23	C		2		0	w		0	0	
24	C		2		0	w		0	0	
25	A		2		0	w		0	0	
26	A		2		0	w		0	0	
27	B		2		0	w		0	0	
28	B		2		0	w		0	0	
29	C		2		0	w		0	0	
30	C		2		0	w		0	0	
31	A		2		0	w		0	0	
32	A		2		0	w		0	0	
33	B		2		0	w		0	0	
34	B		2		0	w		0	0	
35	C		2		0	w		0	0	
36	C		2		0	w		0	0	
37	A		2		0	w		0	0	
38	A		2		0	w		0	0	
39	B		2		0	w		0	0	
40	B		2		0	w		0	0	
41	C		2		0	w		0	0	
42	C		2		0	w		0	0	
PANEL TOTAL								13.9	14.8	Amps= 123.5

Figure 65: Panelboard Sizing Worksheet | Lobby

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					6.0	6.9	47%	57.8
PHASE TOTAL	B					2.7	2.8	19%	23.0
PHASE TOTAL	C					5.1	5.1	35%	42.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Lighting		13.9	14.8		13.9	14.8	0.99		
2	Spare		0.0	0.0		0.0	0.0			
3			0.0	0.0		0.0	0.0			
4			0.0	0.0		0.0	0.0			
5			0.0	0.0		0.0	0.0			
6			0.0	0.0		0.0	0.0			
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						13.9	14.8			
Spare Capacity			25%			3.5	3.7			
Total Design Loads						17.3	18.5	0.99	Amps=	51.5

Figure 66: Panelboard Sizing Worksheet | Lobby

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 60A
SIZE/TYPE MAIN: 60A/3P MLO

PANEL TAG: DMB
PANEL LOCATION: Electrical 1
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
Lounge/Rest	L/R	1744	20A/1P	1	*			2	20A/1P	581	L/R	Lounge/Rest
Lounge/Rest	L/R	550	20A/1P	3		*		4	20A/1P	511	L/R	Lounge/Rest
Lobby/Rest	L/R	245	20A/1P	5			*	6	20A/1P	2955	L/R	Lobby/Rest
Lobby/Rest	L/R	877	20A/1P	7	*			8	20A/1P	1791	L/R	Lobby/Rest
Lobby/Rest	L/R	460	20A/1P	9		*		10	20A/1P	505	L/R	Lobby/Rest
Lobby/Rest	L/R	265	20A/1P	11			*	12	20A/1P	461	L/R	Lobby/Rest
Lobby/Rest	L/R	282	20A/1P	13	*			14	20A/1P	392	L/R	Lobby/Rest
Lobby/Rest	L/R	275	20A/1P	15		*		16	20A/1P	443	L/R	Lobby/Rest
Lobby/Rest	L/R	926	20A/1P	17			*	18	20A/1P	242	Lobby	Lobby Sundries
Lobby Niche AA	Lobby	121	20A/1P	19	*			20	20A/1P	242	Lobby	Lobby MR16 DL
		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 Ph.	6.03	TOTAL DESIGN LOAD (KW)	17.33
CONNECTED LOAD (KW) - B Ph.	2.74	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C Ph.	5.09	TOTAL DESIGN LOAD (AMPS)	51

Figure 67: New Panelboard Schedule | Lobby

Circuit number 22 on emergency panelboard EML also was modified for the new emergency lighting in the Lobby. The sizing worksheet and the new panelboard schedule are shown below.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					EML	Panel Location:			Electrical 2	
Nominal Phase to Neutral Voltage------->					120	Phase:			3	
Nominal Phase to Phase Voltage-------->					208	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	DR Hold Open 1F	3	FL 1	200	w	1.00	200	200	
2	A	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
3	B	DR Hold Open 2F	3	FL 2	200	w	1.00	200	200	
4	B	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
5	C	DR Hold Open 3F	3	FL 3	200	w	1.00	200	200	
6	C	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
7	A	DR Hold Open 4F	3	FL 4	200	w	1.00	200	200	
8	A	Gener Engine Htr	3	Exterior	1200	w	1.00	1200	1200	
9	B	DR Hold Open 5F	3	FL 5	200	w	1.00	200	200	
10	B		6		1200	w	1.00	1200	1200	
11	C	DR Hold Open 6F	3	FL 6	200	w	1.00	200	200	
12	C	Gener Battery Chgr	3	Exterior	1200	w	1.00	1200	1200	
13	A	DR Hold Open 7F	3	FL 7	200	w	1.00	200	200	
14	A		6		1200	w	1.00	1200	1200	
15	B	Fire Exiting Sys	3	Fire P Rm	2400	w	1.00	2400	2400	
16	B		6		1200	w	1.00	1200	1200	
17	C	Jockey Pump	3	Fire P Rm	0	w	1.00	0	0	
18	C	Fire Pump Rm Rec	3	Fire P Rm	720	w	1.00	720	720	
19	A	Spare	4		0	w	1.00	0	0	
20	A	EM Elec Rm Rec	3	Em-Elec R	612	w	1.00	612	612	
21	B	Spare	4		0	w	1.00	0	0	
22	B	LTG - 1st FL Lobby	1	Lobby	513	w	0.70	513	733	
23	C	Spare	4		0	w	1.00	0	0	
24	C	LTG - 1st FL Rest	1	Restaurant	520	w	1.00	520	520	
25	A	P-Trap Heat Trace	3		624	w	1.00	624	624	
26	A	LTG - 1st FL BLRM	1	Ballroom	1000	w	1.00	1000	1000	
27	B	CTFS-1 HTR Recs	3		1200	w	1.00	1200	1200	
28	B	LTG - 1st FL BLRM	1	Ballroom	600	w	1.00	600	600	
29	C	Cooling Twr Rec	3	Exterior	500	w	1.00	500	500	
30	C	LTG - 1st FL Prefu	1	Prefunct.	778	w	1.00	778	778	
31	A	Clg Twr Heat Trace	3	Exterior	1200	w	1.00	1200	1200	
32	A	Bussed Space	5		0	w	1.00	0	0	
33	B		6		1200	w	1.00	1200	1200	
34	B	Bussed Space	5		0	w	1.00	0	0	
35	C	Bussed Space	5		0	w	1.00	0	0	
36	C	Bussed Space	5		0	w	1.00	0	0	
37	A	Bussed Space	5		0	w	1.00	0	0	
38	A	Bussed Space	5		0	w	1.00	0	0	
39	B	Bussed Space	5		0	w	1.00	0	0	
40	B	Bussed Space	5		0	w	1.00	0	0	
41	C	Bussed Space	5		0	w	1.00	0	0	
42	C	Bussed Space	5		0	w	1.00	0	0	
PANEL TOTAL								20.8	21.1	Amps= 175.5

Figure 68: Emergency Panelboard Sizing Worksheet | Lobby

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					6.9	7.0	33%	58.0
PHASE TOTAL	B					9.2	9.5	45%	78.8
PHASE TOTAL	C					4.6	4.6	22%	38.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Lighting		3.4	3.6		3.4	3.6	0.94		
2	Lighting and Rec Combo		1.5	1.6		1.5	1.6	0.95		
3	Other		11.1	11.1		11.1	11.1	1.00		
4	Spare		0.0	0.0		0.0	0.0			
5	Bussed Space		0.0	0.0		0.0	0.0			
6	unassigned		4.8	4.8		4.8	4.8	1.00		
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						20.8	21.1			
Spare Capacity			25%			5.2	5.3			
Total Design Loads						26.0	26.3	0.99	Amps=	73.1

Figure 69: Emergency Panelboard Sizing Worksheet | Lobby

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 80A
SIZE/TYPE MAIN: 80A/3P MLO

PANEL TAG: EML
PANEL LOCATION: Electrical 2
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
DR Hold Open 1F	FL 1	200	20A/1P	1	*			2	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 2F	FL 2	200	20A/1P	3		*		4	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 3F	FL 3	200	20A/1P	5			*	6	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 4F	FL 4	200	20A/1P	7	*			8	20A/1P	1200	Exterior	Gener Engine Htr
DR Hold Open 5F	FL 5	200	20A/1P	9		*		10	20A/1P	1200	0	0
DR Hold Open 6F	FL 6	200	20A/1P	11			*	12	20A/1P	1200	Exterior	Gener Battery Chgr
DR Hold Open 7F	FL 7	200	20A/1P	13	*			14	20A/1P	1200	0	0
Fire Exiting Sys	Fire P Rm	2400	20A/1P	15		*		16	20A/1P	1200	0	0
Jockey Pump	Fire P Rm	0	20A/1P	17			*	18	20A/1P	720	Fire P Rm	Fire Pump Rm Rec
Spare	0	0	20A/1P	19	*			20	20A/1P	612	Em-Elec R	EM Elec Rm Rec
Spare		0	20A/1P	21		*		22	20A/1P	513	Lobby	LTG - 1st FL Lobby
Spare		0	20A/1P	23			*	24	20A/1P	520	Restaurant	LTG - 1st FL Rest
P-Trap Heat Trace		624	20A/1P	25	*			26	20A/1P	1000	Ballroom	LTG - 1st FL BLRM
CTFS-1 HTR Recs		1200	20A/1P	27		*		28	20A/1P	600	Ballroom	LTG - 1st FL BLRM
Cooling Twr Rec	Exterior	500	20A/1P	29			*	30	20A/1P	778	Prefunct.	LTG - 1st FL Prefu
Clg Twr Heat Trace	Exterior	1200	20A/1P	31	*			32	20A/1P	0		Bussed Space
		1200	20A/1P	33		*		34	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	35			*	36	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	37	*			38	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	39		*		40	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	41			*	42	20A/1P	0		Bussed Space

CONNECTED LOAD (KW) - A Ph.	6.94	TOTAL DESIGN LOAD (KW)	25.96
CONNECTED LOAD (KW) - B Ph.	9.21	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C Ph.	4.62	TOTAL DESIGN LOAD (AMPS)	73

Figure 70: New Panelboard Schedule | Lobby

Feeder Sizing and Voltage Drop

The data for the table below is a summary of redesigned wires for panelboards DMB and EML. Voltage drop calculations for both panels were calculated as well. The 2008 NEC Handbook was referenced for sizes of wires.

Feeder Sizing and Voltage Drop	
Panelboard Tag	DMB
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	17.33
Calculated Power Factor	0.99
Calculated Design Load (A)	17.51
Calculated Load (A) with spare	48.63
Feeder Protection Size	60A
Sets	1
Wire Size	
Phase	(3) #6 AWG
Neutral	(1) #6 AWG
Ground	(1) #8 AWG
Conduit	1.25" EMT
Power Factor	0.95
Length of Run	7.8 ft
Voltage Drop	0.39
% Drop	0.19

Table 37: Feeder Sizing for DMB

*Copper wire, 75°C, THWN, EMT conduit

Feeder Sizing and Voltage Drop	
Panelboard Tag	EML
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	25.96
Calculated Power Factor	0.99
Calculated Design Load (A)	26.22
Calculated Load (A) with spare	72.84
Feeder Protection Size	80A
Sets	1
Wire Size	
Phase	(3) #4 AWG
Neutral	(1) #4 AWG
Ground	(1) #8 AWG
Conduit	1.25" EMT
Power Factor	0.95
Length of Run	8.45 ft
Voltage Drop	0.37
% Drop	0.18

Table 38: Feeder Sizing for EML

*Copper wire, 75°C, THWN, EMT conduit

Lounge

The lighting design in the Lounge is comprised of LED strip lights mounted in a cove, the toe kick of the bar, and the bar shelving, and of square recessed halogen downlights. A dimming panel allows for lower levels of light during the evening. A summary of the electrical changes within the Lounge are documented below.

Lighting Plan

The lighting plans with controls and circuiting can be found in Appendix C.

Existing Panelboard Schedule - DMB

Circuits that were modified for the Lounge on panel DMB are highlighted in purple below:

"DMB" GP Dimming Panel Load Schedule

Panel Name: Panel Unit 1
Lutron Model No.: CGP48-1204T8-ML-20-CGP344
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Lobby	6	Z5		A4-5	LED Ceiling Cove	FL - 0-10V	1375	2000	20A-1P	A
Lobby	7	Z5		A4-5	LED Ceiling Cove	FL - 0-10V	1250	2000	20A-1P	B
Restaurant	8	ZR7		A1-7	COVE LED	FL - DSI	1875	2000	20A-1P	C
Lobby	9	Z7		A4-7	LED Shelves	FL - 0-10V	310	2000	20A-1P	A
Lounge	7	ZL5		A3-5	Lobby Ceiling LED Cove	FL - 0-10V	375	2000	20A-1P	B
Restaurant	15	ZR14		A2-6	Private Dining Cove LED	FL - 0-10V	125	2000	20A-1P	C
Lobby	4	Z3		A4-3	LED Entry Wall	FL - 0-10V	125	2000	20A-1P	A
Lounge	10	ZL6-B		A3-8	Bar Counter Edge	FL - 0-10V	125	2000	20A-1P	B
Restaurant	7	ZR6	9	A1-6	AA Table DL	Electronic LV	1087	2000	20A-1P	C
Lobby	5	Z4	10	A4-4	MR16 DL Spline Wall	Electronic LV	684	2000	20A-1P	A
Lobby	17	Z15	11	A5-7	Lobby Curtain Wash	Electronic LV	845	2000	20A-1P	B
Restaurant	10	ZR9	12	A2-1	Buffett WW	Electronic LV	483	2000	20A-1P	C
Lounge	9	ZL7	13	A3-7	Bookshelves WW	Electronic LV	483	2000	20A-1P	A
Lobby	1	Z1	14	A4-1	Entry Foyer MR16 DL	Electronic LV	483	2000	20A-1P	B
Lounge	8	ZL6	15	A3-6	Lounge Bar Niche Shelves	Electronic LV	414	2000	20A-1P	C
Lobby	8	Z6	16	A4-6	MR16 DL Lobby Columns	Electronic LV	403	2000	20A-1P	A
Restaurant	5	ZR4	17	A1-4	Table DL	Electronic LV	322	2000	20A-1P	B
Restaurant	16	ZR15	18	A2-7	Rest. Curtain Wash	Electronic LV	322	2000	20A-1P	C
Restaurant	12	ZR11	19	A2-3	Main Buffett Decorative Pend	Incandescent	300	2000	20A-1P	A
Restaurant	4	ZR3	20	A1-3	WW	Electronic LV	282	2000	20A-1P	B
Lobby	2	Z1	21	A4-1	Entry Foyer MR16 DL	Electronic LV	282	2000	20A-1P	C
Restaurant	6	ZR5	22	A1-5	Small Decorative Pendants	Electronic LV	276	2000	20A-1P	A

Panel Name: Panel Unit 1
Lutron Model No.: CGP48-1204T8-ML-20-CGP344
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Lounge	1	ZL1	23	A3-1	Lounge Pendants	Electronic LV	265	2000	20A-1P	B
Restaurant	3	ZR2	24	A1-2	Wood Wall and RR DL	Electronic LV	242	2000	20A-1P	C
Lobby	18	Z16	25	A5-8	Lobby Sundries Accents	Electronic LV	242	2000	20A-1P	A
Lobby	14	Z12	26	A5-4	Reg. Desk Wall Wash	Electronic LV	242	2000	20A-1P	B
Lobby	20	Z18	27	A6-2	MR16 Firm Group DL	Electronic LV	242	2000	20A-1P	C

Figure 71: Existing Panelboard DMB

Restaurant	9	ZR8	28	A1-8	Wait Station WW	Electronic LV	201	2000	20A-1P	A
Restaurant	2	ZR2	29	A1-2	Wood Wall and RR DL	Electronic LV	201	2000	20A-1P	B
Restaurant	1	ZR1	30	A1-1	Maitre'D WW	Electronic LV	161	2000	20A-1P	C
Lobby	3	Z2	31	A4-2	MR16 Accent Brand Wall	Electronic LV	161	2000	20A-1P	A
Restaurant	11	ZR10	32	A2-2	Main Buffett DL	Electronic LV	161	2000	20A-1P	B
Lobby	12	Z10	33	A5-2	Reg. Desk Pendant	Electronic LV	161	2000	20A-1P	C
Restaurant	14	ZR13	34	A2-5	Private Dining Lg Pendant	Incandescent	150	2000	20A-1P	A
Lobby	13	Z11	35	A5-3	Reg. Desk MR16 DL	Electronic LV	161	2000	20A-1P	B
Lobby	15	Z13	36	A5-5	Elevator Lobby Pendant	FL - Hi-Lume	150	2000	20A-1P	C
Restaurant	13	ZR12	37	A2-4	Private Dining WW	Electronic LV	121	2000	20A-1P	A
Lounge	2	ZL2	38	A3-2	Lounge Curtain WW	Electronic LV	121	2000	20A-1P	B
Lounge	4	ZL2	39	A3-2	Lounge Curtain WW	Electronic LV	121	2000	20A-1P	C
Lounge	6	ZL4	40	A3-4	Bar Wall Accents	Electronic LV	121	2000	20A-1P	A
Lobby	11	z9	41	A5-1	MR16 WW Elevator Foyer	Electronic LV	121	2000	20A-1P	B
Lobby	16	Z14	42	A5-6	Business Center Foyer	Electronic LV	121	2000	20A-1P	C
Lobby	19	Z17	43	A6-1	Lobby Niche AA	Electronic LV	121	2000	20A-1P	A
Restaurant	17	ZR16	44	A2-8	Private Dining Curtain Wash	Electronic LV	81	2000	20A-1P	B
Lounge	3	ZL2	45	A3-2	Lounge Curtain WW	Electronic LV	81	2000	20A-1P	C
Lobby	10	Z8	46	A4-8	MR16 DL Elevator Foyer	Electronic LV	81	2000	20A-1P	A
Lounge	5	ZL3	47	A3-3	Seating DownLights	Electronic LV	81	2000	20A-1P	B
			48		Spare		0	2000	20A-1P	

120/208V, 3Ø-4 Wire Main Lugs GP Dimming Panel containing 1 20A-1Pole branch breaker rated at 10,000AIC for each of the 48 dimming circuits. Panel is subdivided into three sections. Max input feed = 350A

Project Name: GMU Hotel Restaurant, Lounge & Lobby

Feed Type: Normal

Phase A: 5154 W/VA
Phase B: 5116 W/VA
Phase C: 5867 W/VA

Figure 72: Existing Loads on Panelboard | Lounge

Emergency Panel Affected

Circuit 4 on panelboard EMH was modified in order to accommodate the new emergency lighting in the Lounge.

PANELBOARD SCHEDULE — EMH

VOLTAGE	PHASE	WIRE	MCB (A)	MLO (A)	AIC	MOUNTING	MANUFAC.	MDL #	DWG REF
277 / 480	3	4	250	–	–	SURFACE	–	–	E6.03

TYPE LEGEND				REMARKS
L	LIGHTING	K	KITCHEN EQ	PROVIDE EQUIPMENT GROUND BUS
R	RECEPTACLES	E	EXISTING	PROVIDE FEED THRU LUGS FOR MULTI-SECTION PANELS
M	MECH EQUIP	O	OTHER	–

CKT. #	ITEM SERVED	TYPE	WIRE	CONDUIT	CKT. BRK TRIP	CKT. BRK P	LOAD (VA)	PHASE	LOAD (VA)	CKT. BRK P	CKT. BRK TRIP	CONDUIT	WIRE	TYPE	ITEM SERVED	CKT. #
1	PARKING LOT EMERG. LTG	L	#12	3/4"	20A	1	2500	A	180	1	20A	1"	#10	L	COOLING TOWER LTG	2
3	PENTHOUSE EMERG. LTG	L	#10	3/4"	20A	1	350	B	1000	1	20A	3/4"	#10	L	FIRST FLOOR EM. LTG	4
5	LTG-STAIR #1	L	#12	3/4"	20A	1	448	C	0	1	20A	–	–	–	SPARE	6
7	LTG- 1ST FL	L	#10	3/4"	20A	1	2741	A	0	1	20A	–	–	–	SPARE	8
9	LTG- STAIR #2	L	#12	3/4"	20A	1	480	B	0	1	20A	–	–	–	SPARE	10
11	LTG - EXTERIOR	L	#10	3/4"	20A	1	531	C	0	1	20A	–	–	–	SPARE	12
13	LTG - GUEST FLRS	L	#12	3/4"	20A	1	2490	A	0	1	20A	–	–	–	SPARE	14
15	LTG - 1ST FLOOR	L	#12	3/4"	20A	1	615	B	0	1	20A	–	–	–	SPARE	16
17	N.E. EXIT LTG	L	#12	3/4"	20A	1	0	C	0	1	20A	–	–	–	SPARE	18
19	SPARE	–	–	–	20A	1	0	A	0	1	20A	–	–	–	SPARE	20
21	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	22
23	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	24
25	BUSSED SPACE					1	0	A	0	1					BUSSED SPACE	26
27	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	28
29	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	30
31	BUSSED SPACE					1	0	A	0	1					BUSSED SPACE	32
33	BUSSED SPACE					1	0	B	0	1					BUSSED SPACE	34
35	BUSSED SPACE					1	0	C	0	1					BUSSED SPACE	36
37	PANEL "EML"		SEE	SEE	SEE	3	SEE	A	0	1					BUSSED SPACE	38
39	TRANSFORMER		RISER	RISER	RISER		SUB	B	0	1					BUSSED SPACE	40
41	(SEE RISER FOR MORE INFO)		DIAG.	DIAG.	DIAG.		LOAD	C	0	1					BUSSED SPACE	42

	A	B	C	TOTAL
CONNECTED LOAD (VA)	7911	2445	979	11335

Figure 73: Existing Emergency Panelboard Schedule

Branch Circuit Calculations

Panelboard DMB

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
J	22	50	1100	1.00	208Y/120V	3.05
K1-3	118 lf	4.32/lf	509.76	0.99	208Y/120V	1.40
		Total Watts	**1436.96**		Total Amps	**4.44**

Table 39: Panelboard DMB Branch Circuit Calcs

Panelboard EMH

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
J	6	50	300	1.00	208Y/120V	0.83
		Total Watts	**300**		Total Amps	**0.83**

Table 39: Panelboard DMB Branch Circuit Calcs

The Lounge has four different zones of lights: one for the downlights, one for the LED cove above the central bar, one for the toe-kick below the bar, and one for the LEDs within the bar shelves. Four circuits were utilized to accommodate the four zones. The calculations are summarized below for each circuit in the panelboards affected by the modified lighting design:

Panelboard DMB

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
1	J	22	50	1100	1.00	208Y/120V	3.05
2	K1	60 lf	4.32/lf	259.2	0.99	208Y/120V	0.71
3	K2	34 lf	4.32/lf	146.88	0.99	208Y/120V	0.40
4	K3	24 lf	4.32/lf	103.68	0.99	208Y/120V	0.28
						Total Amps	**4.44**

Table 40: New Panelboard Circuiting

Panelboard EMH

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
4	J	6	50	300	1.00	208Y/120V	0.83
						Total Amps	**0.83**

Table 40: PB EMH | Panelboard Sizing WS

Panelboard Sizing

Circuits 1-4 were modified in Panel DMB for the Lounge. Only a portion of each of these circuits had luminaires in the Lounge, so in order to modify the circuits, the old loads from only the Lounge were subtracted and the new ones (calculated above) were added. The new panelboard is seen on the next page.

PANELBOARD SIZING WORKSHEET										
Panel Tag---------->					DMB	Panel Location:			Electrical 1	
Nominal Phase to Neutral Voltage------->					120	Phase:			3	
Nominal Phase to Phase Voltage-------->					208	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Lobby/Lounge/Rest	1	L/L/R	1744	w	1.00	1744	1744	
2	A	Lobby/Lounge/Rest	1	L/L/R	581.2	w	0.99	581	587	
3	B	Lobby/Lounge/Rest	1	L/L/R	549.88	w	0.99	550	555	
4	B	Lobby/Lounge/Rest	1	L/L/R	510.68	w	0.99	511	516	
5	C	Lobby/Lounge/Rest	1	L/L/R	1087	w	1.00	1087	1087	
6	C	Lobby/Lounge/Rest	1	L/L/R	1772	w	1.00	1772	1772	
7	A	Lobby/Lounge/Rest	1	L/L/R	2712	w	1.00	2712	2712	
8	A	Lobby/Lounge/Rest	1	L/L/R	2692	w	1.00	2692	2692	
9	B	Lobby/Lounge/Rest	1	L/L/R	994	w	1.00	994	994	
10	B	Lobby/Lounge/Rest	1	L/L/R	689	w	1.00	689	689	
11	C	Lobby/Rest	1	L/R	282	w	1.00	282	282	
12	C	Lobby/Rest	1	L/R	461	w	1.00	461	461	
13	A	Lobby/Rest	1	L/R	282	w	1.00	282	282	
14	A	Lobby/Rest	1	L/R	392	w	1.00	392	392	
15	B	Lobby/Rest	1	L/R	275	w	1.00	275	275	
16	B	Lobby/Rest	1	L/R	443	w	1.00	443	443	
17	C	Lobby/Rest	1	L/R	926	w	1.00	926	926	
18	C	Lobby Sundries	1	Lobby	242	w	1.00	242	242	
19	A	Lobby Niche AA	1	Lobby	121	w	1.00	121	121	
20	A	Lobby MR16 DL	1	Lobby	242	w	1.00	242	242	
21	B		2		0	w		0	0	
22	B		2		0	w		0	0	
23	C		2		0	w		0	0	
24	C		2		0	w		0	0	
25	A		2		0	w		0	0	
26	A		2		0	w		0	0	
27	B		2		0	w		0	0	
28	B		2		0	w		0	0	
29	C		2		0	w		0	0	
30	C		2		0	w		0	0	
31	A		2		0	w		0	0	
32	A		2		0	w		0	0	
33	B		2		0	w		0	0	
34	B		2		0	w		0	0	
35	C		2		0	w		0	0	
36	C		2		0	w		0	0	
37	A		2		0	w		0	0	
38	A		2		0	w		0	0	
39	B		2		0	w		0	0	
40	B		2		0	w		0	0	
41	C		2		0	w		0	0	
42	C		2		0	w		0	0	
PANEL TOTAL								17.0	17.0	Amps= 141.8

Table 75: PB Sizing Worksheet

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					8.8	8.8	52%	73.1
PHASE TOTAL	B					3.5	3.5	20%	28.9
PHASE TOTAL	C					4.8	4.8	28%	39.8

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Lighting		17.0	17.0		17.0	17.0	0.99		
2	Spare		0.0	0.0		0.0	0.0			
3			0.0	0.0		0.0	0.0			
4			0.0	0.0		0.0	0.0			
5			0.0	0.0		0.0	0.0			
6			0.0	0.0		0.0	0.0			
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						17.0	17.0			
Spare Capacity			25%			4.2	4.3			
Total Design Loads						21.2	21.3	0.99	Amps=	59.1

Figure 76: Panelboard Sizing Worksheet | Lounge

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: DMB
PANEL LOCATION: Electrical 1
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
Lobby/Lounge/Rest	L/L/R	1744	20A/1P	1	*			2	20A/1P	581	L/L/R	Lobby/Lounge/Rest
Lobby/Lounge/Rest	L/L/R	550	20A/1P	3		*		4	20A/1P	511	L/L/R	Lobby/Lounge/Rest
Lobby/Lounge/Rest	L/L/R	1087	20A/1P	5			*	6	20A/1P	1772	L/L/R	Lobby/Lounge/Rest
Lobby/Lounge/Rest	L/L/R	2712	20A/1P	7	*			8	20A/1P	2692	L/L/R	Lobby/Lounge/Rest
Lobby/Lounge/Rest	L/L/R	994	20A/1P	9		*		10	20A/1P	689	L/L/R	Lobby/Lounge/Rest
Lobby/Rest	L/R	282	20A/1P	11			*	12	20A/1P	461	L/R	Lobby/Rest
Lobby/Rest	L/R	282	20A/1P	13	*			14	20A/1P	392	L/R	Lobby/Rest
Lobby/Rest	L/R	275	20A/1P	15		*		16	20A/1P	443	L/R	Lobby/Rest
Lobby/Rest	L/R	926	20A/1P	17			*	18	20A/1P	242	Lobby	Lobby Sundries
Lobby Niche AA	Lobby	121	20A/1P	19	*			20	20A/1P	242	Lobby	Lobby MR16 DL
		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 Ph.	8.77	TOTAL DESIGN LOAD (KW)	21.25
CONNECTED LOAD (KW) - B Ph.	3.46	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C Ph.	4.77	TOTAL DESIGN LOAD (AMPS)	59

Figure 77: New Panelboard Schedule | Lounge

Circuit 4 was modified in Panel EMH for the emergency lighting in the Lounge. The new panelboard is seen below.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					EMH	Panel Location:			Electrical 2	
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	Pkg Lot EM LTG	2	Pkg Lot	2500	w	0.95	2500	2632	
2	A	Cooling Twr LTG	1	Exterior	180	w	0.95	180	189	
3	B	PentHse EM LTG	2	PentHse	350	w	0.95	350	368	
4	B	1ST FLR EM LTG	2	1ST FLR	300	w	0.95	300	316	
5	C	LTG-Stair #1	1	STAIR 1	448	w	0.95	448	472	
6	C	Spare	3	-	0	w	1.00	0	0	
7	A	LTG-1ST FLR	1	1ST FLR	2741	w	0.95	2741	2885	
8	A	Spare	3	-	0	w	1.00	0	0	
9	B	LTG-Stair #2	1	STAIR 2	480	w	0.95	480	505	
10	B	Spare	3	-	0	w	1.00	0	0	
11	C	LTG-Exterior	1	Exterior	531	w	0.95	531	559	
12	C	Spare	3	-	0	w	1.00	0	0	
13	A	LTG-Guest FLRS	1	Guest Flrs	2490	w	0.95	2490	2621	
14	A	Spare	3	-	0	w	1.00	0	0	
15	B	LTG-1ST FLR	1	1ST FLR	615	w	0.95	615	647	
16	B	Spare	3	-	0	w	1.00	0	0	
17	C	N.E. Exit LTG	1	1ST FLR	0	w	0.95	0	0	
18	C	Spare	3	-	0	w	1.00	0	0	
19	A	Spare	3	-	0	w	1.00	0	0	
20	A	Spare	3	-	0	w	1.00	0	0	
21	B	Bussed Space	4	-	0	w	1.00	0	0	
22	B	Bussed Space	4	-	0	w	1.00	0	0	
23	C	Bussed Space	4	-	0	w	1.00	0	0	
24	C	Bussed Space	4	-	0	w	1.00	0	0	
25	A	Bussed Space	4	-	0	w	1.00	0	0	
26	A	Bussed Space	4	-	0	w	1.00	0	0	
27	B	Bussed Space	4	-	0	w	1.00	0	0	
28	B	Bussed Space	4	-	0	w	1.00	0	0	
29	C	Bussed Space	4	-	0	w	1.00	0	0	
30	C	Bussed Space	4	-	0	w	1.00	0	0	
31	A	Bussed Space	4	-	0	w	1.00	0	0	
32	A	Bussed Space	4	-	0	w	1.00	0	0	
33	B	Bussed Space	4	-	0	w	1.00	0	0	
34	B	Bussed Space	4	-	0	w	1.00	0	0	
35	C	Bussed Space	4	-	0	w	1.00	0	0	
36	C	Bussed Space	4	-	0	w	1.00	0	0	
37	A	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
38	A	Bussed Space	4	-	0	w	1.00	0	0	
39	B	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
40	B	Bussed Space	4	-	0	w	1.00	0	0	
41	C	Panel "EML" XMR	5	Elec Rm 2	0	w	1.00	0	0	
42	C	Bussed Space	4	-	0	w	1.00	0	0	
PANEL TOTAL								10.6	11.2	Amps= 40.4

Figure 78: Emergency Panelboard Sizing Worksheet | Lounge

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					7.9	8.3	74%	30.1
PHASE TOTAL	B					1.7	1.8	16%	6.6
PHASE TOTAL	C					1.0	1.0	9%	3.7

LOAD CATAGORIES		Connected			Demand				Ver. 1.04
		kW	kVA	DF	kW	kVA	PF		
1	Lighting	7.5	7.9		7.5	7.9	0.95		
2	Emergency Lighting	3.2	3.3		3.2	3.3	0.95		
3	Spare	0.0	0.0		0.0	0.0			
4	Bussed Space	0.0	0.0		0.0	0.0			
5	Panel	0.0	0.0		0.0	0.0			
6		0.0	0.0		0.0	0.0			
7		0.0	0.0		0.0	0.0			
8		0.0	0.0		0.0	0.0			
9	unassigned	0.0	0.0		0.0	0.0			
Total Demand Loads					10.6	11.2			
Spare Capacity		25%			2.7	2.8			
Total Design Loads					13.3	14.0	0.95	Amps=	16.8

Figure 79: Emergency Panelboard Sizing Worksheet | Lounge

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 60A
SIZE/TYPE MAIN: 60A/3P MLO

PANEL TAG: EMH
PANEL LOCATION: Electrical 2
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
Pkg Lot EM LTG	Pkg Lot	2500	20A/1P	1	*			2	20A/1P	180	Exterior	Cooling Twr LTG
PentHse EM LTG	PentHse	350	20A/1P	3		*		4	20A/1P	300	1ST FLR	1ST FLR EM LTG
LTG-Stair #1	STAIR 1	448	20A/1P	5			*	6	20A/1P	0	-	Spare
LTG-1ST FLR	1ST FLR	2741	20A/1P	7	*			8	20A/1P	0	-	Spare
LTG-Stair #2	STAIR 2	480	20A/1P	9		*		10	20A/1P	0	-	Spare
LTG-Exterior	Exterior	531	20A/1P	11			*	12	20A/1P	0	-	Spare
LTG-Guest FLRS	Guest Flrs	2490	20A/1P	13	*			14	20A/1P	0	-	Spare
LTG-1ST FLR	1ST FLR	615	20A/1P	15		*		16	20A/1P	0	-	Spare
N.E. Exit LTG	1ST FLR	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Bussed Space	-	0	20A/1P	21		*		22	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	23			*	24	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	25	*			26	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	27		*		28	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	29			*	30	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	31	*			32	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	33		*		34	20A/1P	0	-	Bussed Space
Bussed Space	-	0	20A/1P	35			*	36	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	37	*			38	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	39		*		40	20A/1P	0	-	Bussed Space
Panel "EML" XMR	Elec Rm 2	0	3P	41			*	42	20A/1P	0	-	Bussed Space

CONNECTED LOAD (KW) - A Ph.	7.91	TOTAL DESIGN LOAD (KW)	13.29
CONNECTED LOAD (KW) - B Ph.	1.75	POWER FACTOR	0.95
CONNECTED LOAD (KW) - C Ph.	0.98	TOTAL DESIGN LOAD (AMPS)	17

Figure 80: New Emergency Panelboard Schedule | Lounge

Feeder Sizing and Voltage Drop

The data for the table below is a summary of redesigned wires for panelboards DMB and EMH. Voltage drop calculations for both panels were calculated as well. The 2008 NEC Handbook was referenced for sizes of wires.

Feeder Sizing	
Panelboard Tag	DMB
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	21.25
Calculated Power Factor	0.99
Calculated Design Load (A)	21.46
Calculated Load (A) with spare	59.62
Feeder Protection Size	60A
Sets	1
Wire Size	
Phase	(3) #6 AWG
Neutral	(1) #6 AWG
Ground	(1) #10 AWG
Conduit	1.00" EMT
Power Factor	0.95
Length of Run	7.8 ft
Voltage Drop	0.39
% Drop	0.19

Table 41: Feeder Sizing

*Copper wire, 75°C, THWN, EMT conduit

Feeder Sizing	
Panelboard Tag	EMH
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	13.29
Calculated Power Factor	0.95
Calculated Design Load (A)	13.99
Calculated Load (A) with spare	38.86
Feeder Protection Size	60A
Sets	1
Wire Size	
Phase	(3) #6 AWG
Neutral	(1) #6 AWG
Ground	(1) #10 AWG
Conduit	1.00" EMT
Power Factor	0.95
Length of Run	5.54 ft
Voltage Drop	0.28
% Drop	0.13

Table 42: Feeder Sizing

*Copper wire, 75°C, THWN, EMT conduit

Ballroom

The luminaires in the Ballroom are controlled via a Lutron GRAFIK Eye System. A Viseo Wallstation provides local access to the lighting control system and operates every zone and scene. Shades for the clerestories are controlled by a control interface for the GRAFIK System called the Sivoia QED Controller. LUT-DMX is another control interface specified to control the LED luminaires in the space. Because the Ballroom can be divided into three separate spaces with the use of partitions, each smaller ballroom (A, B, and C) is controlled by its own individual 5-button preset scene wallstation with raise and lower capabilities.

Lighting Plan

The lighting plan with controls and circuiting can be found in Appendix C.

Existing Panelboard Schedule - DML

All of the circuits on panel DML were modified, and the original panel is shown below.

"DML" GP Dimming Panel Load Schedule

Panel Name: Panel Unit 1
Lutron Model No.: GP60-1204ML-20
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Prefunction	12	ZP12	1	A7-4	T8 CEILING COVE	FL - HI-Lume	1792	2000	20A-1P	A
Large Ballroom A	5	ZLB5	2	A3-5	T8 CEILING COVE	FL - HI-Lume	1504	2000	20A-1P	B
Large Ballroom A	5	ZLB5	3	A3-5	T8 CEILING COVE	FL -HI-Lume	1504	2000	20A-1P	C
Prefunction	11	ZP11	4	A7-3	DECORATIVE PENDANT	Incandescent	1120	2000	20A-1P	A
Small Ballroom B	5	ZSB11	5	A2-5	T8 CEILING COVE	FL - HI-Lume	1200	2000	20A-1P	B
Small Ballroom A	5	ZSB5	6	A1-5	T8 CEILING COVE	FL - HI-Lume	1200	2000	20A-1P	C
Large Ballroom A	2	ZLB2	7	A3-2	WALL ACCENT LIGHT	Incandescent	960	2000	20A-1P	A
Prefunction	1	ZP1	8	A6-1	DECORATIVE PENDANT	Incandescent	1000	2000	20A-1P	B
Prefunction	4	ZP4	9	A6-4	T8 CEILING COVE	FL - HI-Lume	1120	2000	20A-1P	C
Prefunction	8	ZP8	10	A6-8	MR16 DOWNLIGHT	Electronic LV	665	2000	20A-1P	A
Prefunction	9	ZP9	11	A7-1	MR16 WALL WASH	Electronic LV	735	2000	20A-1P	B
Large Ballroom A	1	ZLB1	12	A3-1	DECORATIVE SCONCE	Incandescent	800	2000	20A-1P	C
Large Ballroom B	3	ZLB9	13	A4-3	DOWNLIGHTS	Incandescent	720	2000	20A-1P	A
Large Ballroom C	5	ZLB17	14	A5-5	T8 CEILING COVE	FL - HI-Lume	1504	2000	20A-1P	B
Large Ballroom B	5	ZLB11	15	A4-5	T8 CEILING COVE	FL - HI-Lume	1504	2000	20A-1P	C
Prefunction	2	ZP2	16	A6-2	MR16 WALL WASH	Electronic LV	665	2000	20A-1P	A
Prefunction	5	ZP5	17	A6-5	CURTAIN DL	Electronic LV	630	2000	20A-1P	B
Large Ballroom C	3	ZLB15	18	A5-3	DOWNLIGHTS	Incandescent	720	2000	20A-1P	C
Prefunction	6	ZP6	19	A6-6	MR16 DOWNLIGHT	Electronic LV	483	2000	20A-1P	A
Small Ballroom A	2	ZSB2	20	A1-2	WALL ACCENT LIGHT	Incandescent	600	2000	20A-1P	B
Small Ballroom B	2	ZSB8	21	A2-2	WALL ACCENT	Incandescent	600	2000	20A-1P	C
Large Ballroom B	2	ZLB8	22	A4-2	WALL ACCENT	Incandescent	480	2000	20A-1P	A
Small Ballroom A	4	ZSB4	23	A1-4	DOWNLIGHTS	Incandescent	480	2000	20A-1P	B
Small Ballroom B	4	ZSB10	24	A2-4	DOWNLIGHTS	Incandescent	480	2000	20A-1P	C
Large Ballroom A	6	ZLB6	25	A3-6	DECORATIVE PENDANT	Incandescent	960	2000	20A-1P	A
Large Ballroom C	2	ZLB14	26	A5-2	WALL ACCENT LIGHT	Incandescent	480	2000	20A-1P	B

George Mason University GP Dimming Panel Load Schedule

Panel Name: Panel Unit 1
Lutron Model No.: GP60-1204ML-20
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Large Ballroom B	8	ZLB26	27	A5-8	Retractable Ltg Device Ctk 2	Incandescent	575	2000	20A-1P	C
Large Ballroom C	8	ZLB28	28	A6-8	Retractable Ltg	Incandescent	575	2000	20A-1P	A
Small Ballroom A	4	ZSB4	29	A1-4	DOWNLIGHTS	Incandescent	480	2000	20A-1P	B
Prefunction	6	ZP6	30	A7-6	MR16 DOWNLIGHT	Electronic LV	483	2000	20A-1P	C

Figure 80: Existing Panelboard Schedule | Ballroom

Equation 1

Large Ballroom B	2	ZLB8	31	A5-2	WALL ACCENT	Incandescent	480	2000	20A-1P	A
Large Ballroom B	6	ZLB12	32	A5-6	DECORATIVE PENDANT	Incandescent	480	2000	20A-1P	B
Small Ballroom B	4	ZSB10	33	A2-4	DOWNLIGHTS	Incandescent	480	2000	20A-1P	C
Large Ballroom C	6	ZLB18	34	A6-6	DECORATIVE PENDANT	Incandescent	480	2000	20A-1P	A
Prefunction	3	ZP3	35	A7-3	DECORATIVE SCONCE	Incandescent	450	2000	20A-1P	B
Large Ballroom C	2	ZLB14	36	A6-2	WALL ACCENT LIGHT	Incandescent	480	2000	20A-1P	C
Small Ballroom B	6	ZSB12	37	A2-6	DECORATIVE PENDANT	Incandescent	480	2000	20A-1P	A
Small Ballroom A	6	ZSB6	38	A1-6	DECORATIVE PENDANT	Incandescent	280	2000	20A-1P	B
Large Ballroom A	1	ZLB1	39	A3-1	DECORATIVE SCONCE	Incandescent	400	2000	20A-1P	C
Prefunction	10	ZP10	40	A8-2	DECORATIVE SCONCE	FL - Hi-Lume	240	2000	20A-1P	A
Prefunction	13	ZP13	41	A8-5	MR16 WALL WASH	Electronic LV	242	2000	20A-1P	B
Large Ballroom A	2	ZLB2	42	A3-2	WALL ACCENT LIGHT	Incandescent	240	2000	20A-1P	C
Small Ballroom A	1	ZSB1	43	A1-1	DECORATIVE SCONCE	Incandescent	200	2000	20A-1P	A
Large Ballroom A	9	ZLP20	44	A3-8	Wall Accent Light	Incandescent	240	2000	20A-1P	B
Small Ballroom B	1	ZSB7	45	A2-1	DECORATIVE SCONCE	Incandescent	200	2000	20A-1P	C
Prefunction	7	ZP7	46	A7-7	MR16 WALL WASH	Electronic LV	121	2000	20A-1P	A
Small Ballroom A	3	ZSB3	47	A1-3	AA DOWNLIGHTS	Incandescent	120	2000	20A-1P	B
Small Ballroom B	3	ZSB9	48	A2-3	AA DOWNLIGHT	Incandescent	120	2000	20A-1P	C
Large Ballroom A	4	ZLB4	49	A3-4	AA DOWNLIGHT Podium	Incandescent	120	2000	20A-1P	A
Large Ballroom A	8	ZLB19	50	A3-7	AA DOWNLIGHT-PODIUM	Incandescent	120	2000	20A-1P	B
Large Ballroom B	4	ZLB10	51	A5-4	AA DOWNLIGHTS	Incandescent	120	2000	20A-1P	C
Large Ballroom C	4	ZLB16	52	A6-4	AA DOWNLIGHT	Incandescent	120	2000	20A-1P	A

George Mason University GP Dimming Panel Load Schedule

Panel Name: Panel Unit 1
Lutron Model No.: GP60-1204ML-20
Panel Address / Location: 1,2,3 /

Area/Room	Customer Circuit #	Customer Zone	Lutron Circuit #	Lutron Zone	Zone/Circuit Description	Load Type	Actual Load (W/VA)	Max. Load (W/VA)	BRKR Size	Phase
Large Ballroom B	1	ZLB7	53	A5-1	DECORATIVE SCONCE	Incandescent	100	2000	20A-1P	B
Large Ballroom C	1	ZLB13	54	A6-1	DECORATIVE SCONCE	Incandescent	100	2000	20A-1P	C
Large Ballroom A	3	ZLB3	55	A8-6	DOWNLIGHTS	Incandescent	1440	2000	20A-1P	A
			56		Spare		0	2000	20A-1P	
			57		Spare		0	2000	20A-1P	
			58		Spare		0	2000	20A-1P	
			59		Spare		0	2000	20A-1P	
			60		Spare		0	2000	20A-1P	

120/208V, 3Ø-4 Wire Main Lugs GP Dimming Panel containing 1 20A-1Pole branch breaker rated at 10,000AIC for each of the 60 dimming circuits. Panel is subdivided into three sections. Max input feed = 400A

Feed Type: Normal

Phase A: 11088 W/VA
Phase B: 11081 W/VA
Phase C: 11146 W/VA

Figure 81: Existing Panelboard Schedule

Emergency Panel Affected:
The circuiting for emergency panel EML was altered after changing the lighting. The original panelboard schedule is shown with the two circuits modified highlighted below:

PANELBOARD SCHEDULE — EML

VOLTAGE	PHASE	WIRE	MCB (A)	MLO (A)	AIC	MOUNTING	MANUFAC.	MDL #	DWG REF
120 / 208	3	4		0	–	SURFACE	–	–	E6.03

TYPE LEGEND				REMARKS
L	LIGHTING	K	KITCHEN EQ	PROVIDE EQUIPMENT GROUND BUS
R	RECEPTACLES	E	EXISTING	PROVIDE FEED THRU LUGS FOR MULTI-SECTION PANELS
M	MECH EQUIP	O	OTHER	

CKT. #	ITEM SERVED	TYPE	WIRE	CONDUIT	CKT. BRK TRIP	CKT. BRK P	LOAD (VA)	PHASE	LOAD (VA)	CKT. BRK P	CKT. BRK TRIP	CONDUIT	WIRE	TYPE	ITEM SERVED	CKT. #
1	DR HOLD OPEN, 1ST FL	O	#10	3/4"	20A	1	200	A	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	2
3	DR HOLD OPEN, 2ND FL	O	#10	3/4"	20A	1	200	B	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	4
5	DR HOLD OPEN, 3RD FL	O	#10	3/4"	20A	1	200	C	500	1	20A	3/4"	#12	R	ELEVATOR PIT LTG AND REC	6
7	DR HOLD OPEN, 4TH FL	O	#10	3/4"	20A	1	200	A	1200	2	20A	1"	#10	O	GENERATOR ENGINE HEATER	8
9	DR HOLD OPEN, 5TH FL	O	#10	3/4"	20A	1	200	B	1200					O		10
11	DR HOLD OPEN, 6TH FL	O	#10	3/4"	20A	1	200	C	1200	3	20A	1"	#10	O	GENERATOR BATTERY CHGR	12
13	DR HOLD OPEN, 7TH FL	O	#10	3/4"	20A	1	200	A	1200					O		14
15	FIRE EXTING. SYSTEM	O	#10	3/4"	25A	1	2400	B	1200					O		16
17	JOCKEY PUMP	–	–	–	20A	1	0	C	720	1	20A	3/4"	#12	R	FIRE PUMP ROOM RECS	18
19	SPARE	–	–	–	20A	1	0	A	612	1	20A	3/4"	#12	R	EMERG. ELEC RM REC & F-EL-1	20
21	SPARE	–	–	–	20A	1	0	B	352	1	20A	3/4"	#12	L	LTG- 1ST FL LOBBY	22
23	SPARE	–	–	–	20A	1	0	C	520	1	20A	3/4"	#12	L	LTG- 1ST FL REST	24
25	P-TRAP HEAT TRACE	M	#10	1"	20A	1	624	A	1200	1	20A	3/4"	#12	L	LTG- 1ST FL BALLRM	26
27	CTFS-1 HEATER RECEPT.	R	#10	1"	20A	1	1200	B	720	1	20A	3/4"	#12	L	LTG- 1ST FL BALLRM	28
29	COOLING TOWER YARD REC	R	#10	1"	20A	1	500	C	778	1	20A	3/4	#12	L	LTG-1ST FL PREFUNC	30
31	CLING TWR HEAT TRACE	M	#10	1"	30A	2	1200	A	0	1		–	–	–	BUSSED SPACE	32
33							1200	B	0	1		–	–	–	BUSSED SPACE	34
35	BUSSED SPACE	–	–	–		1	0	C	0	1		–	–	–	BUSSED SPACE	36
37	BUSSED SPACE	–	–	–		1	0	A	0	1		–	–	–	BUSSED SPACE	38
39	BUSSED SPACE	–	–	–		1	0	B	0	1		–	–	–	BUSSED SPACE	40
41	BUSSED SPACE	–	–	–		1	0	C	0	1		–	–	–	BUSSED SPACE	42

	A	B	C	TOTAL
CONNECTED LOAD (VA)	7136	9172	4618	20926

Figure 82: Existing Emergency Panelboard | Ballroom

Branch Circuit Calculations

Panelboard DML

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
L	36	100	3600	1.00	208Y/120V	10.00
M	12	75	900	1.00	208Y/120V	2.5
N	744	3	2232	0.99	208Y/120V	6.26
O	4	105	420	1.00	208Y/120V	1.17
P	16	10	160	1.00	208Y/120V	0.44
		Total Watts	**4764**		Total Amps	**20.37**

Table 43: Branch Circuit Calcs | PB DML

Panelboard EML

Luminaire Tag	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
L	10	100	1000	1.00	208Y/120V	2.78
M	8	75	600	1.00	208Y/120V	1.67
		Total Watts	**1356**		Total Amps	**4.45**

Table 44: Branch Circuit Calcs | PB EML

Because the Ballroom has so many different zones of lights and will accommodate four preset scenes, more than one circuit will be used. In fact, because there are 15 zones assigned to the lighting layout, 15 circuits will be used because of dimming purposes in the different scenes. The calculations are summarized below for each circuit:

Panelboard DML

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
1	P	8	10	80	1.00	208Y/120V	0.22
2	M	6	75	450	1.00	208Y/120V	1.25
3	L	18	100	1800	1.00	208Y/120V	5.00
4	N	372	3	1116	0.99	208Y/120V	3.13
5	O	2	105	210	1.00	208Y/120V	0.58
6	P	4	10	40	1.00	208Y/120V	0.11
7	M	3	75	225	1.00	208Y/120V	0.63
8	L	9	100	900	1.00	208Y/120V	2.50
9	N	186	3	558	0.99	208Y/120V	1.57
10	O	1	105	105	1.00	208Y/120V	0.29
11	P	4	10	40	1.00	208Y/120V	0.11
12	M	3	75	225	1.00	208Y/120V	0.63
13	L	9	100	900	1.00	208Y/120V	2.50
14	N	186	3	558	0.99	208Y/120V	1.57
15	O	1	105	105	1.00	208Y/120V	0.29
						Total Amps	**20.38**

Table 45: Branch Circuit Calcs | PB DML

Panelboard EML

Circuit	Luminaires (Tag)	Quantity	Watts/Luminaire	Total Watts	PF	Voltage	Amps
26	L	10	100	1000	1.00	208Y/120V	2.78
28	M	8	75	600	1.00	208Y/120V	1.67
						Total Amps	**4.45**

Table 46: Branch Circuit Calcs | PB EML

Panelboard Sizing

Circuits 1-15 were modified in Panel DML for the Ballroom. Only a portion of each of these circuits had luminaires in the Ballroom, so in order to modify the circuits, the old loads from only the Ballroom were subtracted and the new ones (calculated above) were added. The new panelboard is seen below.

PANELBOARD SIZING WORKSHEET										
Panel Tag---------->					DML	Panel Location:			Storage	
Nominal Phase to Neutral Voltage------->					120	Phase:			3	
Nominal Phase to Phase Voltage-------->					208	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Prefunction/Blrms	1	P/B	1480	w	1.00	1480	1480	
2	A	Prefunction/Blrms	1	P/B	1650	w	1.00	1650	1650	
3	B	Prefunction/Blrms	1	P/B	2490	w	1.00	2490	2490	
4	B	Prefunction/Blrms	1	P/B	4156	w	0.99	4156	4198	
5	C	Prefunction/Blrms	1	P/B	3240	w	1.00	3240	3240	
6	C	Prefunction/Blrms	1	P/B	1766	w	1.00	1766	1766	
7	A	Prefunction/Blrms	1	P/B	346	w	1.00	346	346	
8	A	Prefunction/Blrms	1	P/B	1565	w	1.00	1565	1565	
9	B	Prefunction/Blrms	1	P/B	1293	w	0.99	1293	1306	
10	B	Prefunction/Blrms	1	P/B	345	w	1.00	345	345	
11	C	Prefunction/Blrms	1	P/B	1160	w	1.00	1160	1160	
12	C	Prefunction/Blrms	1	P/B	2017	w	1.00	2017	2017	
13	A	Prefunction/Blrms	1	P/B	1142	w	1.00	1142	1142	
14	A	Prefunction/Blrms	1	P/B	558	w	0.99	558	564	
15	B	Prefunction/Blrms	1	P/B	105	w	1.00	105	105	
16	B		2		0	w	1.00	0	0	
17	C		2		0	w	1.00	0	0	
18	C		2		0	w	1.00	0	0	
19	A		2		0	w	1.00	0	0	
20	A		2		0	w	1.00	0	0	
21	B		2		0	w		0	0	
22	B		2		0	w		0	0	
23	C		2		0	w		0	0	
24	C		2		0	w		0	0	
25	A		2		0	w		0	0	
26	A		2		0	w		0	0	
27	B		2		0	w		0	0	
28	B		2		0	w		0	0	
29	C		2		0	w		0	0	
30	C		2		0	w		0	0	
31	A		2		0	w		0	0	
32	A		2		0	w		0	0	
33	B		2		0	w		0	0	
34	B		2		0	w		0	0	
35	C		2		0	w		0	0	
36	C		2		0	w		0	0	
37	A		2		0	w		0	0	
38	A		2		0	w		0	0	
39	B		2		0	w		0	0	
40	B		2		0	w		0	0	
41	C		2		0	w		0	0	
42	C		2		0	w		0	0	
PANEL TOTAL								23.3	23.4	Amps= 194.8

Figure 83: Panelboard Sizing Worksheet | Ballroom

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					6.7	6.7	29%	56.2
PHASE TOTAL	B					8.4	8.4	36%	70.4
PHASE TOTAL	C					8.2	8.2	35%	68.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	Lighting		23.3	23.4		23.3	23.4	1.00		
2	Spare		0.0	0.0		0.0	0.0			
3			0.0	0.0		0.0	0.0			
4			0.0	0.0		0.0	0.0			
5			0.0	0.0		0.0	0.0			
6			0.0	0.0		0.0	0.0			
7			0.0	0.0		0.0	0.0			
8			0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						23.3	23.4			
Spare Capacity			25%			5.8	5.8			
Total Design Loads						29.1	29.2	1.00	Amps=	81.2

Figure 84: Panelboard Sizing Worksheet | Ballroom

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 110A
SIZE/TYPE MAIN: 110A/3P MLO

PANEL TAG: DML
PANEL LOCATION: Storage
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
Prefunction/Blrms	P/B	1480	20A/1P	1	*			2	20A/1P	1650	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	2490	20A/1P	3		*		4	20A/1P	4156	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	3240	20A/1P	5			*	6	20A/1P	1766	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	346	20A/1P	7	*			8	20A/1P	1565	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	1293	20A/1P	9		*		10	20A/1P	345	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	1160	20A/1P	11			*	12	20A/1P	2017	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	1142	20A/1P	13	*			14	20A/1P	558	P/B	Prefunction/Blrms
Prefunction/Blrms	P/B	105	20A/1P	15		*		16	20A/1P	0	0	0
0	0	0	20A/1P	17			*	18	20A/1P	0	0	0
0	0	0	20A/1P	19	*			20	20A/1P	0	0	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 Ph.	6.74	TOTAL DESIGN LOAD (KW)	29.14
CONNECTED LOAD (KW) - B Ph.	8.39	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	8.18	TOTAL DESIGN LOAD (AMPS)	81

Figure 85: New Panelboard Schedule | Ballroom

Circuits 26 and 28 on Panelboard EML were modified for the new emergency lighting in the Ballroom. The new panelboard schedule is shown below.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				EML	Panel Location:			Electrical 2		
Nominal Phase to Neutral Voltage------->				120	Phase:			3		
Nominal Phase to Phase Voltage-------->				208	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	DR Hold Open 1F	3	FL 1	200	w	1.00	200	200	
2	A	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
3	B	DR Hold Open 2F	3	FL 2	200	w	1.00	200	200	
4	B	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
5	C	DR Hold Open 3F	3	FL 3	200	w	1.00	200	200	
6	C	Elev Pit Ltg & Rec	2	Elev Pit	500	w	0.95	500	526	
7	A	DR Hold Open 4F	3	FL 4	200	w	1.00	200	200	
8	A	Gener Engine Htr	3	Exterior	1200	w	1.00	1200	1200	
9	B	DR Hold Open 5F	3	FL 5	200	w	1.00	200	200	
10	B		6		1200	w	1.00	1200	1200	
11	C	DR Hold Open 6F	3	FL 6	200	w	1.00	200	200	
12	C	Gener Battery Chgr	3	Exterior	1200	w	1.00	1200	1200	
13	A	DR Hold Open 7F	3	FL 7	200	w	1.00	200	200	
14	A		6		1200	w	1.00	1200	1200	
15	B	Fire Exiting Sys	3	Fire P Rm	2400	w	1.00	2400	2400	
16	B		6		1200	w	1.00	1200	1200	
17	C	Jockey Pump	3	Fire P Rm	0	w	1.00	0	0	
18	C	Fire Pump Rm Rec	3	Fire P Rm	720	w	1.00	720	720	
19	A	Spare	4		0	w	1.00	0	0	
20	A	EM Elec Rm Rec	3	Em-Elec R	612	w	1.00	612	612	
21	B	Spare	4		0	w	1.00	0	0	
22	B	LTG - 1st FL Lobby	1	Lobby	352	w	0.98	352	359	
23	C	Spare	4		0	w	1.00	0	0	
24	C	LTG - 1st FL Rest	1	Restaurant	520	w	1.00	520	520	
25	A	P-Trap Heat Trace	3		624	w	1.00	624	624	
26	A	LTG - 1st FL BLRM	1	Ballroom	1000	w	1.00	1000	1000	
27	B	CTFS-1 HTR Recs	3		1200	w	1.00	1200	1200	
28	B	LTG - 1st FL BLRM	1	Ballroom	600	w	1.00	600	600	
29	C	Cooling Twr Rec	3	Exterior	500	w	1.00	500	500	
30	C	LTG - 1st FL Prefu	1	Prefunct.	778	w	1.00	778	778	
31	A	Clg Twr Heat Trace	3	Exterior	1200	w	1.00	1200	1200	
32	A	Bussed Space	5		0	w	1.00	0	0	
33	B		6		1200	w	1.00	1200	1200	
34	B	Bussed Space	5		0	w	1.00	0	0	
35	C	Bussed Space	5		0	w	1.00	0	0	
36	C	Bussed Space	5		0	w	1.00	0	0	
37	A	Bussed Space	5		0	w	1.00	0	0	
38	A	Bussed Space	5		0	w	1.00	0	0	
39	B	Bussed Space	5		0	w	1.00	0	0	
40	B	Bussed Space	5		0	w	1.00	0	0	
41	C	Bussed Space	5		0	w	1.00	0	0	
42	C	Bussed Space	5		0	w	1.00	0	0	
PANEL TOTAL								20.6	20.7	Amps= 172.4

Figure 86: Emergency Panelboard Sizing Worksheet | Ballroom

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					6.9	7.0	34%	58.0
PHASE TOTAL	B					9.1	9.1	44%	75.7
PHASE TOTAL	C					4.6	4.6	22%	38.7

LOAD CATAGORIES		Connected			Demand				Ver. 1.04
		kW	kVA	DF	kW	kVA	PF		
1	Lighting	3.3	3.3		3.3	3.3	1.00		
2	Lighting and Rec Combo	1.5	1.6		1.5	1.6	0.95		
3	Other	11.1	11.1		11.1	11.1	1.00		
4	Spare	0.0	0.0		0.0	0.0			
5	Bussed Space	0.0	0.0		0.0	0.0			
6	unassigned	4.8	4.8		4.8	4.8	1.00		
7		0.0	0.0		0.0	0.0			
8		0.0	0.0		0.0	0.0			
9	unassigned	0.0	0.0		0.0	0.0			
Total Demand Loads					20.6	20.7			
Spare Capacity		25%			5.2	5.2			
Total Design Loads					25.8	25.9	1.00	Amps=	71.8

Figure 87: Emergency Panelboard Sizing Worksheet | Ballroom

PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 100A
SIZE/TYPE MAIN: 100A/3P MLO

PANEL TAG: EML
PANEL LOCATION: Electrical 2
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
DR Hold Open 1F	FL 1	200	20A/1P	1	*			2	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 2F	FL 2	200	20A/1P	3		*		4	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 3F	FL 3	200	20A/1P	5			*	6	20A/1P	500	Elev Pit	Elev Pit Ltg & Rec
DR Hold Open 4F	FL 4	200	20A/1P	7	*			8	20A/1P	1200	Exterior	Gener Engine Htr
DR Hold Open 5F	FL 5	200	20A/1P	9		*		10	20A/1P	1200	0	0
DR Hold Open 6F	FL 6	200	20A/1P	11			*	12	20A/1P	1200	Exterior	Gener Battery Chgr
DR Hold Open 7F	FL 7	200	20A/1P	13	*			14	20A/1P	1200	0	0
Fire Exiting Sys	Fire P Rm	2400	20A/1P	15		*		16	20A/1P	1200	0	0
Jockey Pump	Fire P Rm	0	20A/1P	17			*	18	20A/1P	720	Fire P Rm	Fire Pump Rm Rec
Spare	0	0	20A/1P	19	*			20	20A/1P	612	Em-Elec R	EM Elec Rm Rec
Spare		0	20A/1P	21		*		22	20A/1P	352	Lobby	LTG - 1st FL Lobby
Spare		0	20A/1P	23			*	24	20A/1P	520	Restaurant	LTG - 1st FL Rest
P-Trap Heat Trace		624	20A/1P	25	*			26	20A/1P	1000	Ballroom	LTG - 1st FL BLRM
CTFS-1 HTR Recs		1200	20A/1P	27		*		28	20A/1P	600	Ballroom	LTG - 1st FL BLRM
Cooling Twr Rec	Exterior	500	20A/1P	29			*	30	20A/1P	776	Prefunct.	LTG - 1st FL Prefu
Clg Twr Heat Trace	Exterior	1200	20A/1P	31	*			32	20A/1P	0		Bussed Space
		1200	20A/1P	33		*		34	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	35			*	36	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	37	*			38	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	39		*		40	20A/1P	0		Bussed Space
Bussed Space		0	20A/1P	41			*	42	20A/1P	0		Bussed Space

CONNECTED LOAD (KW) - A Ph.	6.94	TOTAL DESIGN LOAD (KW)	25.76
CONNECTED LOAD (KW) - B Ph.	9.05	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	4.62	TOTAL DESIGN LOAD (AMPS)	72

Figure 88: New Emergency Panelboard | Ballroom

Feeder Sizing and Voltage Drop

The data for the table below is a summary of redesigned panelboards DML and EML. Voltage drop calculations for both panels were calculated as well. The 2008 NEC Handbook was referenced for sizes of wires.

Feeder Sizing	
Panelboard Tag	DML
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	29.14
Calculated Power Factor	1.00
Calculated Design Load (A)	72
Calculated Load (A) with spare	90
Feeder Protection Size	100A
Sets	1
Wire Size	
Phase	(3) 2/0
Neutral	(1) 2/0
Ground	(1) #8 AWG
Conduit	2.00" EMT
Power Factor	0.95
Length of Run	307.62
Voltage Drop	5.36
% Drop	2.58

Table 47: Feeder Sizing for DML

*Copper wire, 75°C, THWN, EMT conduit

Feeder Sizing	
Panelboard Tag	EML
Panelboard Voltage	208Y/120
Calculated Design Load (kW)	25.76
Calculated Power Factor	1.00
Calculated Design Load (A)	71.56
Calculated Load (A) with spare	89.44
Feeder Protection Size	100A
Sets	1
Wire Size	
Phase	(3) #3 AWG
Neutral	(1) #3 AWG
Ground	(1) #8 AWG
Conduit	1.25" EMT
Power Factor	0.95
Length of Run	8.45
Voltage Drop	0.37
% Drop	0.18

Table 48: Feeder Sizing for EML

*Copper wire, 75°C, THWN, EMT conduit

Dimming Control Diagram

The Ballroom lighting is all on dimming panel DML. Lutron's GRAFIK Eye system controls all of the zones and scenes in the Ballroom. Below is an example of a Lutron GRAFIK Eye Wiring diagram.

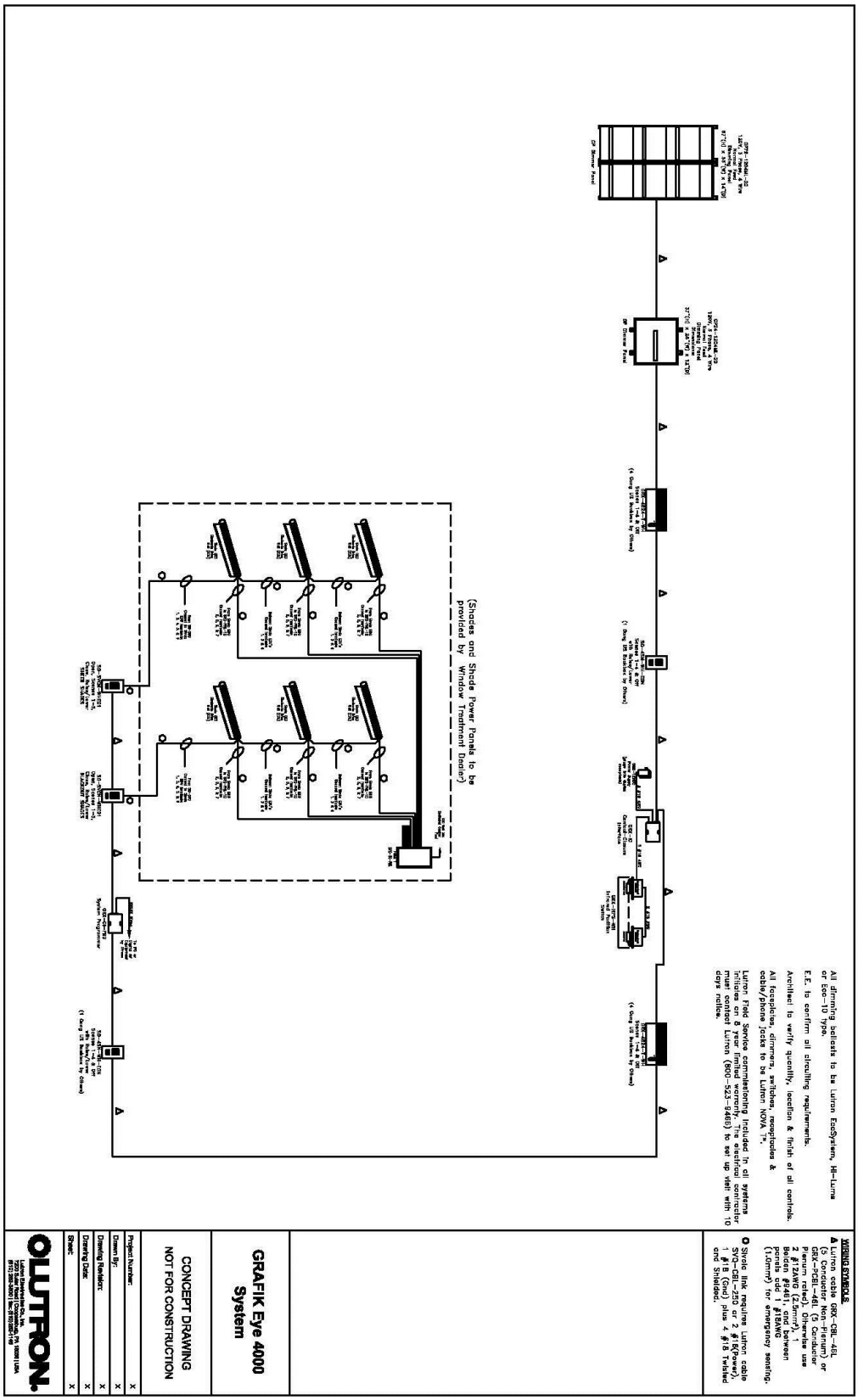


Figure 6: Dimming Control Diagram

Protective Device Coordination Study

A protective device coordination study was conducted addressing a single-path through the distribution system using the Per Unit Short Circuit Method. The path chosen for this study was from the utility transformer to Switchboard C/T to Distribution Panel HM to local panel HM Sec 2. This path is shown below.

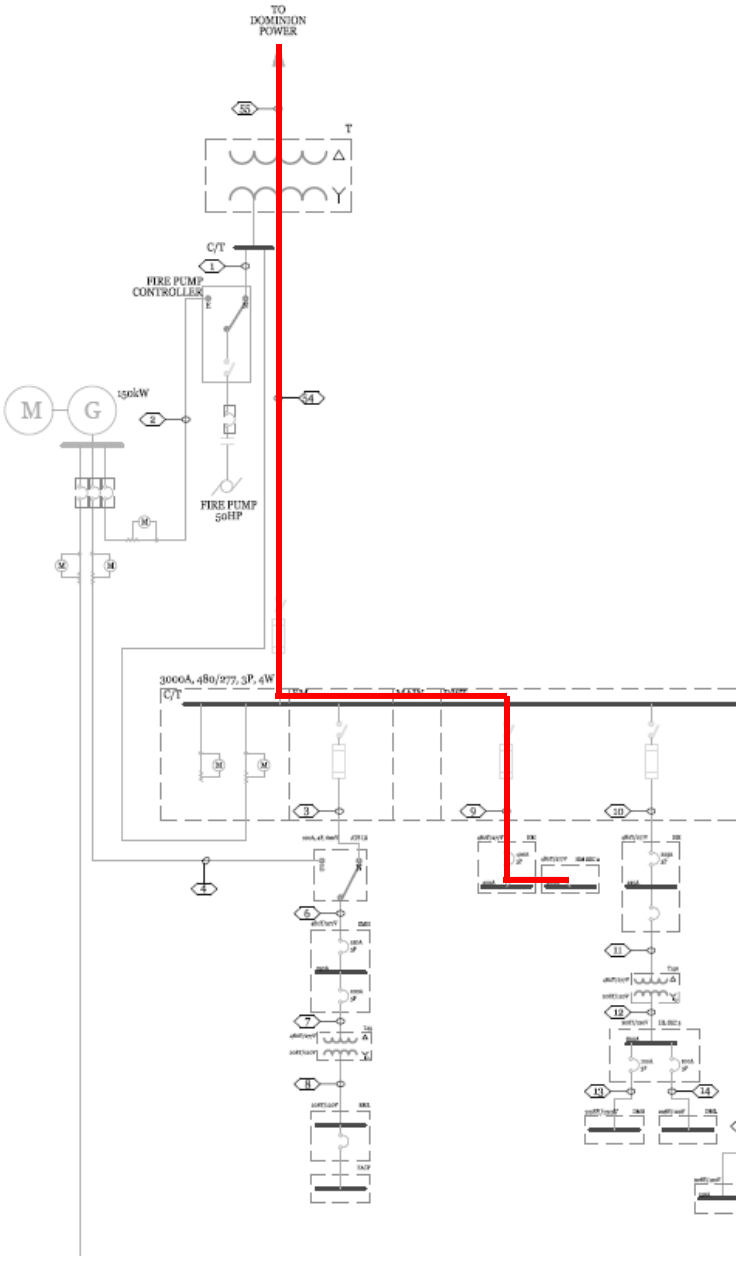


Figure 89: Coordination Study | Path

Fault Current Analysis - Per Unit Method							
	Base kVA	1000	ΣX	ΣR	ΣZ	Isc(A)	
	Available Utility Fault (kVA)	10000					
	System Voltage	0.1					
Utility Transformer Primary							
	X(p.u.) = kVA base / Utility S.C. kVA =	0.0001	0	0	0	**4373**	
	R(p.u.) =	0					
Utility Transformer Secondary							
Avg. %Z =	5.8	X(p.u.) = %X * kVA base / 100 * kVA transformer =	0.0535				
Avg. X/R =	2.38	R(p.u.) = %R * kVA base / 100 * kVA transformer =	0.0225	0.1535	0.0225	0.158	**76109**
%X =	5.35						
%R =	2.25						
kVA =	1000						
Switchboard P							
Wire =	#4	X = (L/1000) * XL * (1/Sets), X(p.u.) =	0.0892				
Length =	32.52	R = (L/1000) * R * (1/Sets), R (p.u.) =	0.4531	0.2427	0.4756	0.6198	**15463**
Sets =	1						
X =	0.0632						
R =	0.321						
Panelboard HM and HM Sec 2							
Wire =	4/0AWG	X = (L/1000) * XL * (1/Sets), X(p.u.) =	0.0476				
Length =	44.11	R = (L/1000) * R * (1/Sets), R (p.u.) =	0.0613	0.3319	0.9287	1.0816	**8153**
Sets =	2						
X =	0.0497						
R =	0.064						

Table 46: Short Circuit Analysis | Results

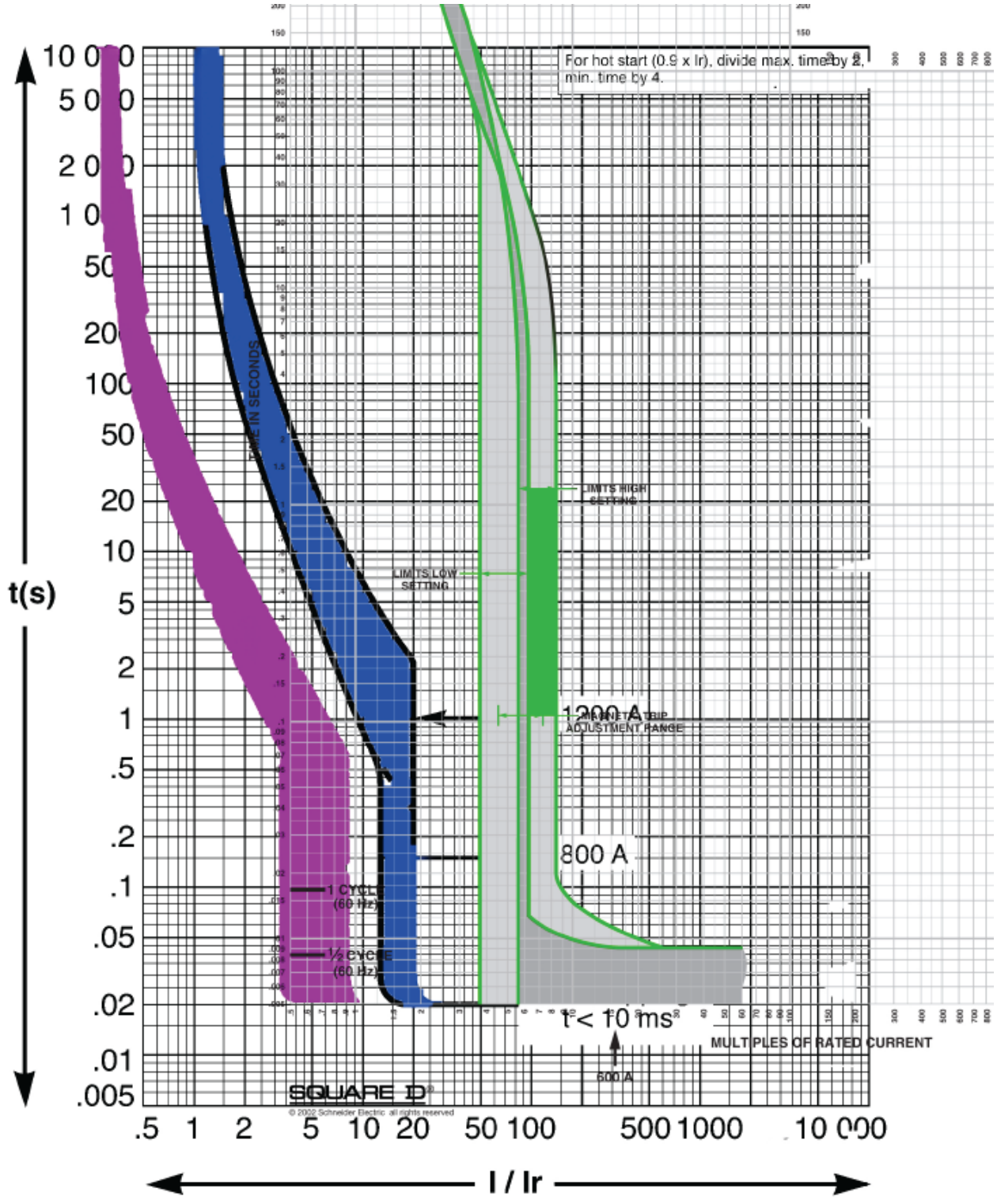
Base kVA	1000														
Utility Contribution (MVA)	10														
Equipment Characteristics											Per-Unit Value Table				
Mark	%X	%R	%Z	kVA	X/1000ft	R/1000ft	Z/1000ft	Length	# sets	3Ph Voltage (V)	Mark	Xu	Ru	Zu	Isc
Utility	0.1			10000						13200	Utility	0.1		0.1	
															4373.866
T-1	5.350	2.250	5.804	1000.000							T-1	0.0535	0.0225	0.058039	
												0.1535	0.0225	0.158039	**76108.73**
FEEDER 1					0.063	0.321	0.327	32.52	1.000	480.000	FEEDER 1	0.089204	0.453078	0.461776	
												0.242704	0.475578	0.619815	**15463.23**
SWBD P												SWBD P			
															15463.23
FEEDER 9					0.050	0.064	0.081	44.11	2.000	480.000	FEEDER 9	0.047575	0.061264	0.077567	
												0.331908	0.928656	1.081591	**8153.362**
HM												HM			
															8153.362

Table 7: Short Circuit Analysis | Calculations

Because information was not found regarding one of the circuit breakers in this run, another run with three circuit breakers was chosen for the protective coordination device study. The three breakers were rated at 60A, 150A, and 600A. The calculations are shown below:

60 x 13 = 780 / 150 = 5.2

60 x 13 = 780 / 600 = 1.3


For hot start (0.9 x Ir), divide max. time by 2, min. time by 4.
TIME IN SECONDS
t(s)
LIMITS HIGH SETTING
LIMITS LOW SETTING
1200 A
ADJUSTMENT RANGE
800 A
1 CYCLE (60 Hz)
½ CYCLE (60 Hz)
t< 10 ms
600 A
MULTIPLES OF RATED CURRENT
SQUARE D
© 2002 Schneider Electric all rights reserved
I / Ir

The 60A breaker is shown in blue, 150A in pink, and 600A in green. The trip curves for the three breakers were placed on the same graph for ease in analyzing the system. According to the study (see figure and calculations above), the circuit breakers were properly sized on the system.

Copper versus Aluminum Feeder Analysis

Introduction:

The purpose of this study is to determine whether a change from copper to aluminum feeders in the distribution system of the Hotel and Conference Center is advantageous or not. There are advantages and disadvantages to both materials that must be considered. Because aluminum is the most abundant metal, it is less expensive than copper, so there is a potential for saving money by changing the feeders. Data from the RS Means Building Construction Cost Data 2011 was referenced for pricing of both aluminum and copper feeders. Spreadsheets comparing the cost data are shown on the next page.

FEEDER SCHEDULE - COPPER

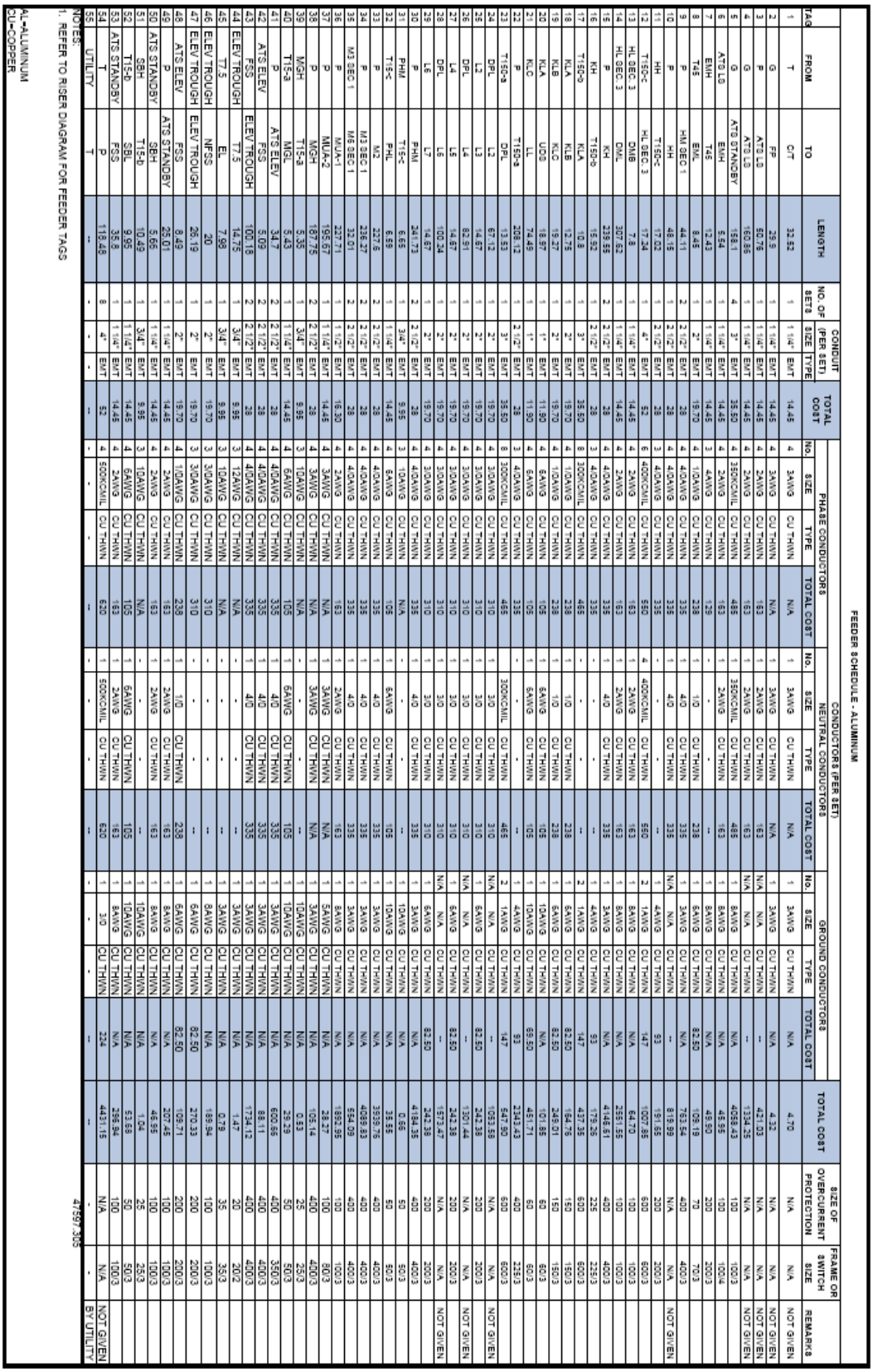
TAG	FROM	TO	LENGTH	NO. OF SETS	CONDUIT (PER SET) SIZE	CONDUIT (PER SET) TYPE	TOTAL COST	CONDUCTORS (PER SET): PHASE CONDUCTORS No.	SIZE	TYPE	TOTAL COST	NEUTRAL CONDUCTORS No.	SIZE	TYPE	TOTAL COST	GROUND CONDUCTORS No.	SIZE	TYPE	TOTAL COST	TOTAL COST	SIZE OF OVERCURRENT PROTECTION	FRAME OR SWITCH SIZE	REMARKS
1	T	C/T	32.52	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	239	1	3AWG	CU THWN	239	1	3AWG	CU THWN	N/A	393.31	N/A	N/A	NOT GIVEN
2	G	FP	29.9	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	239	1	3AWG	CU THWN	239	1	3AWG	CU THWN	N/A	361.63	N/A	N/A	NOT GIVEN
3	P	ATS LS	50.76	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	N/A	N/A	CU THWN	--	723.05	N/A	N/A	NOT GIVEN
4	G	ATS LS	160.86	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	N/A	N/A	CU THWN	--	2291.37	N/A	N/A	NOT GIVEN
5	G	ATS STANDBY	158.1	4	3"	EMT	35.50	4	350KCMIL	CU THWN	1100	1	350KCMIL	CU THWN	1100	1	8AWG	CU THWN	86	9055.97	100	100/3	
6	ATS LS	EMH	5.54	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	83.68	100	100/4	
7	EMH	T45	12.43	1	1 1/4"	EMT	14.45	3	4AWG	CU THWN	207	-	-	-	--	1	8AWG	CU THWN	86	89.68	200	200/3	
8	T45	EML	8.45	1	2"	EMT	19.70	4	1/0AWG	CU THWN	420	1	1/0	CU THWN	420	1	6AWG	CU THWN	116	188.92	70	70/3	
9	P	HM SEC 1	44.11	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	1656.77	400	400/3	
10	P	HH	48.15	1	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	N/A	N/A	CU THWN	--	1795.03	N/A	N/A	NOT GIVEN
11	HH	T150-c	17.02	1	2 1/2"	EMT	28	3	4/0AWG	CU THWN	740	-	-	-	--	1	4AWG	CU THWN	173	412.05	200	200/3	
12	T150-c	HL SEC. 3	17.24	1	4"	EMT	52	6	400KCMIL	CU THWN	1225	4	400KCMIL	CU THWN	1225	2	1AWG	CU THWN	320	2231.20	600	600/3	
13	HL SEC. 3	DMB	7.8	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	117.82	100	100/3	
14	HL SEC. 3	DML	307.62	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	4646.45	100	100/3	
15	P	KH	239.55	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	8997.50	400	400/3	
16	KH	T150-b	15.92	1	2 1/2"	EMT	28	3	4/0AWG	CU THWN	740	-	-	-	--	1	4AWG	CU THWN	173	385.42	225	225/3	
17	T150-b	KLA	10.8	1	3"	EMT	35.50	8	300KCMIL	CU THWN	980	-	-	-	--	2	1AWG	CU THWN	320	919.67	600	600/3	
18	KLA	KLB	12.75	1	2"	EMT	19.70	4	1/0AWG	CU THWN	420	1	1/0	CU THWN	420	1	6AWG	CU THWN	116	285.05	150	150/3	
19	KLB	KLC	19.27	1	2"	EMT	19.70	4	1/0AWG	CU THWN	420	1	1/0	CU THWN	420	1	6AWG	CU THWN	116	430.82	150	150/3	
20	KLA	UDS	18.97	1	1"	EMT	11.90	4	6AWG	CU THWN	152	1	6AWG	CU THWN	152	1	10AWG	CU THWN	69.50	159.61	60	60/3	
21	KLC	LL	74.49	1	1"	EMT	11.90	4	6AWG	CU THWN	152	1	6AWG	CU THWN	152	1	10AWG	CU THWN	69.50	626.76	60	60/3	
22	P	T150-a	208.12	1	2 1/2"	EMT	28	3	4/0AWG	CU THWN	740	-	-	-	--	1	4AWG	CU THWN	173	5038.59	400	225/3	
23	T150-a	DPL	13.53	1	3"	EMT	35.50	8	300KCMIL	CU THWN	980		300KCMIL	CU THWN	980	2	1AWG	CU THWN	320	1152.15	600	600/3	
24	DPL	L2	67.12	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	N/A	N/A	CU THWN	--	2077.16	N/A	N/A	NOT GIVEN
25	L2	L3	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	1	6AWG	CU THWN	116	471.01	200	200/3	
26	DPL	L4	82.91	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	N/A	N/A	CU THWN	--	2565.82	N/A	N/A	NOT GIVEN
27	L4	L5	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	1	6AWG	CU THWN	116	471.01	200	200/3	
28	DPL	L6	100.24	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	N/A	N/A	CU THWN	--	3102.13	N/A	N/A	NOT GIVEN
29	L6	L7	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	615	1	3/0	CU THWN	615	1	6AWG	CU THWN	116	471.01	200	200/3	
30	P	PHM	241.73	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	9079.38	400	400/3	
31	PHM	T15-c	6.65	1	3/4"	EMT	9.95	3	10AWG	CU THWN	81.50	-	-	-	--	1	10AWG	CU THWN	69.50	21.54	50	50/3	
32	T15-c	PHL	6.59	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	152	1	6AWG	CU THWN	152	1	10AWG	CU THWN	69.50	55.62	50	50/3	
33	P	M2	227.6	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	8548.66	400	400/3	
34	P	M3 SEC 1	236.27	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	8874.30	400	400/3	
35	M3 SEC 1	M6 SEC 1	32.01	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	1202.30	400	400/3	
36	P	MUA-1	227.71	1	1 1/2"	EMT	16.30	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	3443.66	100	100/3	
37	P	MUA-2	195.67	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	239	1	3AWG	CU THWN	239	1	5AWG	CU THWN	N/A	2366.53	100	80/3	
38	P	MGH	187.75	2	2 1/2"	EMT	28	4	3AWG	CU THWN	239	1	3AWG	CU THWN	239	1	3AWG	CU THWN	N/A	2348.75	400	400/3	
39	MGH	T15-a	5.35	1	3/4"	EMT	9.95	3	10AWG	CU THWN	81.50	-	-	-	--	1	10AWG	CU THWN	69.50	17.33	25	25/3	
40	T15-a	MGL	5.43	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	152	1	6AWG	CU THWN	152	1	10AWG	CU THWN	69.50	45.83	50	50/3	
41	P	ATS ELEV	34.7	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	1303.33	400	350/3	
42	ATS ELEV	FSS	5.09	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	191.18	400	400/3	
43	FSS	ELEV TROUGH	100.18	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	740	1	4/0	CU THWN	740	1	3AWG	CU THWN	N/A	3762.76	400	400/3	
44	ELEV TROUGH	T7.5	14.75	1	3/4"	EMT	9.95	3	12AWG	CU THWN	68	-	-	-	--	1	3AWG	CU THWN	N/A	31.56	20	20/2	
45	T7.5	EL	7.98	1	3/4"	EMT	9.95	3	10AWG	CU THWN	81.50	-	-	-	--	1	3AWG	CU THWN	N/A	20.31	35	35/3	
46	ELEV TROUGH	NFSS	20	1	2"	EMT	19.70	3	3/0AWG	CU THWN	615	-	-	-	--	1	8AWG	CU THWN	86	390.14	100	100/3	
47	ELEV TROUGH	ELEV TROUGH	26.19	1	2"	EMT	19.70	3	3/0AWG	CU THWN	615	-	-	-	--	1	6AWG	CU THWN	116	518.75	200	200/3	
48	ATS ELEV	FSS	8.49	1	2"	EMT	19.70	4	1/0AWG	CU THWN	420	1	1/0	CU THWN	420	1	6AWG	CU THWN	116	189.81	200	200/3	
49	P	ATS STANDBY	25.01	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	377.76	100	100/3	
50	ATS STANDBY	SBH	5.66	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	85.49	100	100/3	
51	SBH	T15-b	10.49	1	3/4"	EMT	9.95	3	10AWG	CU THWN	81.50	-	-	-	--	1	10AWG	CU THWN	69.50	33.98	25	25/3	
52	T15-b	SBL	9.95	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	152	1	6AWG	CU THWN	152	1	10AWG	CU THWN	69.50	83.97	50	50/3	
53	ATS STANDBY	FSS	35.8	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	282	1	2AWG	CU THWN	282	1	8AWG	CU THWN	86	540.74	100	100/3	
54	T	P	118.48	8	4"	EMT	52	4	500KCMIL	CU THWN	1475	1	500KCMIL	CU THWN	1475	1	3/0	CU THWN	530	9858.72	N/A	N/A	NOT GIVEN
55	UTILITY	T	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	--	-	-	BY UTILITY

104593.020

NOTES:
1. REFER TO RISER DIAGRAM FOR FEEDER TAGS

AL=ALUMINUM
CU=COPPER

Figure 90: Copper Feeder



FEEDER SCHEDULE - ALUMINUM

TAG	FROM	TO	LENGTH	NO. OF SETS	CONDUIT (PER SET) SIZE	CONDUIT (PER SET) TYPE	TOTAL COST	PHASE CONDUCTORS (PER SET) No.	PHASE CONDUCTORS (PER SET) SIZE	PHASE CONDUCTORS (PER SET) TYPE	PHASE CONDUCTORS (PER SET) TOTAL COST	CONDUCTORS (PER SET) NEUTRAL CONDUCTORS No.	CONDUCTORS (PER SET) NEUTRAL CONDUCTORS SIZE	CONDUCTORS (PER SET) NEUTRAL CONDUCTORS TYPE	CONDUCTORS (PER SET) NEUTRAL CONDUCTORS TOTAL COST	GROUND CONDUCTORS No.	GROUND CONDUCTORS SIZE	GROUND CONDUCTORS TYPE	GROUND CONDUCTORS TOTAL COST	TOTAL COST	SIZE OF OVERCURRENT PROTECTION	FRAME OR SWITCH SIZE	REMARKS
1	T	C/T	32.52	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	N/A	1	3AWG	CU THWN	N/A	1	3AWG	CU THWN	N/A	4.70	N/A	N/A	NOT GIVEN
2	G	FP	29.9	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	N/A	1	3AWG	CU THWN	N/A	1	6AWG	CU THWN	N/A	4.32	N/A	N/A	NOT GIVEN
3	P	ATS LB	50.76	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	N/A	N/A	CU THWN	--	421.03	N/A	N/A	NOT GIVEN
4	G	ATS LB	160.86	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	N/A	N/A	CU THWN	--	1334.25	N/A	N/A	NOT GIVEN
5	G	ATS STANDBY	158.1	4	3"	EMT	35.50	4	350KCMIL	CU THWN	485	1	350KCMIL	CU THWN	485	1	8AWG	CU THWN	N/A	4058.43	100	1200/3	NOT GIVEN
6	G	ATS LB	5.54	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	46.55	100	1200/4	
7	P	EMH	12.43	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	49.90	100	2000/3	
8	P	T4S	8.46	1	2"	EMT	19.70	4	1/0AWG	CU THWN	238	1	1/0	CU THWN	238	1	6AWG	CU THWN	N/A	109.19	70	700/3	
9	P	EML	44.11	1	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	763.54	400	400/3	
10	P	HM SEC 1	48.15	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	6AWG	CU THWN	N/A	819.99	N/A	N/A	NOT GIVEN
11	HH	T15D-c	17.02	1	2 1/2"	EMT	28	3	4/0AWG	CU THWN	335	-	-	-	--	1	4AWG	CU THWN	93	191.85	200	200/3	
12	T15D-c	HL SEC. 3	17.24	1	4"	EMT	52	6	400KCMIL	CU THWN	550	4	400KCMIL	CU THWN	550	2	1AWG	CU THWN	147	1007.85	600	600/3	
13	HL SEC. 3	DMB	7.8	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	64.70	100	100/3	
14	HL SEC. 3	DML	307.62	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	2551.55	100	100/3	
15	P	KH	239.55	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	-	-	-	--	1	3AWG	CU THWN	N/A	4146.51	400	400/3	
16	P	T15D-b	15.52	2	2 1/2"	EMT	28	3	4/0AWG	CU THWN	335	-	-	-	--	1	4AWG	CU THWN	93	179.35	225	225/3	
17	T15D-b	KLA	10.8	1	3"	EMT	35.50	8	300KCMIL	CU THWN	465	-	-	-	--	2	1AWG	CU THWN	147	437.35	600	600/3	
18	KLA	KLB	12.75	1	2"	EMT	19.70	4	1/0AWG	CU THWN	238	-	-	-	--	1	6AWG	CU THWN	82.50	164.76	150	150/3	
19	KLB	KLC	19.27	1	2"	EMT	19.70	4	1/0AWG	CU THWN	238	1	1/0	CU THWN	238	1	6AWG	CU THWN	82.50	249.01	150	150/3	
20	KLA	UDB	18.97	1	1"	EMT	11.90	4	6AWG	CU THWN	105	1	6AWG	CU THWN	105	1	10AWG	CU THWN	N/A	101.86	60	60/3	
21	KLC	LL	74.49	1	1"	EMT	11.90	4	6AWG	CU THWN	105	1	6AWG	CU THWN	105	1	10AWG	CU THWN	69.50	451.71	60	60/3	
22	P	T15D-a	208.12	1	2 1/2"	EMT	28	3	4/0AWG	CU THWN	335	-	-	-	--	1	4AWG	CU THWN	93	2343.43	400	225/3	
23	T15D-a	DPL	67.12	1	3"	EMT	35.50	8	300KCMIL	CU THWN	465	-	300KCMIL	CU THWN	465	2	1AWG	CU THWN	147	547.90	600	600/3	
24	DPL	L2	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	310	1	3/0	CU THWN	310	N/A	N/A	CU THWN	--	1053.58	200	200/3	NOT GIVEN
25	L2	L3	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	310	1	3/0	CU THWN	310	1	6AWG	CU THWN	82.50	242.38	200	200/3	
26	DPL	L4	82.91	1	2"	EMT	19.70	4	3/0AWG	CU THWN	310	1	3/0	CU THWN	310	N/A	N/A	CU THWN	--	1351.44	N/A	N/A	NOT GIVEN
27	L4	L5	14.67	1	2"	EMT	19.70	4	3/0AWG	CU THWN	310	1	3/0	CU THWN	310	1	6AWG	CU THWN	82.50	242.38	200	200/3	
28	DPL	L6	100.24	1	2"	EMT	19.70	4	3/0AWG	CU THWN	310	1	3/0	CU THWN	310	N/A	N/A	CU THWN	--	1573.47	N/A	N/A	NOT GIVEN
29	P	L7	14.67	1	2"	EMT	19.70	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	6AWG	CU THWN	82.50	242.38	200	200/3	
30	P	PHM	241.73	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	-	-	-	--	1	3AWG	CU THWN	N/A	4184.35	400	400/3	
31	PHM	T15-c	6.65	1	3/4"	EMT	9.95	3	1/0AWG	CU THWN	N/A	-	-	-	--	1	6AWG	CU THWN	N/A	66	50	50/3	
32	T15-c	PHL	6.59	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	105	1	6AWG	CU THWN	105	1	10AWG	CU THWN	N/A	35.55	50	50/3	
33	P	M2	227.6	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	3939.76	N/A	N/A	NOT GIVEN
34	P	M3 SEC 1	216.27	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	4099.83	400	400/3	
35	M3 SEC 1	M2 SEC 1	32.01	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	554.09	400	400/3	
36	P	MUA-1	227.71	1	1 1/2"	EMT	16.32	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	1551.98	100	100/3	
37	P	MUA-2	195.57	1	1 1/4"	EMT	14.45	4	3AWG	CU THWN	N/A	1	3AWG	CU THWN	N/A	1	5AWG	CU THWN	N/A	28.27	100	100/3	
38	P	MGH	187.75	2	2 1/2"	EMT	28	4	3AWG	CU THWN	N/A	1	3AWG	CU THWN	N/A	1	10AWG	CU THWN	N/A	105.14	400	400/3	
39	MGH	T15-a	5.35	1	3/4"	EMT	9.95	3	1/0AWG	CU THWN	N/A	-	-	-	--	1	6AWG	CU THWN	N/A	0.53	25	25/3	
40	T15-a	MGL	5.43	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	105	1	6AWG	CU THWN	105	1	10AWG	CU THWN	N/A	29.29	50	50/3	
41	P	ATS ELEV	34.7	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	600.86	400	350/3	
42	ATS ELEV	FSS	5.09	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	88.11	400	400/3	
43	FSS	ELEV TROUGH	100.18	2	2 1/2"	EMT	28	4	4/0AWG	CU THWN	335	1	4/0	CU THWN	335	1	3AWG	CU THWN	N/A	1734.12	400	400/3	
44	ELEV TROUGH	T7.5	14.75	1	3/4"	EMT	9.95	3	12AWG	CU THWN	N/A	-	-	-	--	1	3AWG	CU THWN	N/A	1.47	20	20/2	
45	T7.5	EL	7.98	1	3/4"	EMT	9.95	3	10AWG	CU THWN	N/A	-	-	-	--	1	3AWG	CU THWN	N/A	0.78	35	35/3	
46	ELEV TROUGH	NFSS	20	1	2"	EMT	19.70	3	3/0AWG	CU THWN	310	-	-	-	--	1	8AWG	CU THWN	N/A	189.94	100	100/3	
47	ELEV TROUGH	ELEV TROUGH	26.19	1	2"	EMT	19.70	3	3/0AWG	CU THWN	310	-	-	-	--	1	8AWG	CU THWN	82.50	270.33	200	200/3	
48	ATS ELEV	FSS	8.49	1	2"	EMT	19.70	4	1/0AWG	CU THWN	238	1	1/0	CU THWN	238	1	6AWG	CU THWN	82.50	109.71	200	200/3	
49	P	ATS STANDBY	25.01	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	6AWG	CU THWN	N/A	207.45	100	100/3	
50	ATS STANDBY	SBH	5.66	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	46.55	100	100/3	
51	SBH	T15-b	10.49	1	3/4"	EMT	9.95	3	1/0AWG	CU THWN	N/A	-	-	-	--	1	10AWG	CU THWN	N/A	1.04	25	25/3	
52	T15-b	SBL	9.95	1	1 1/4"	EMT	14.45	4	6AWG	CU THWN	105	1	6AWG	CU THWN	105	1	10AWG	CU THWN	N/A	53.98	50	50/3	
53	ATS STANDBY	FSS	35.8	1	1 1/4"	EMT	14.45	4	2AWG	CU THWN	163	1	2AWG	CU THWN	163	1	8AWG	CU THWN	N/A	296.94	100	100/3	
54	T	P	118.48	8	4"	EMT	52	4	500KCMIL	CU THWN	620	1	500KCMIL	CU THWN	620	1	3/0	CU THWN	224	4431.15	N/A	NOT GIVEN	NOT GIVEN BY UTILITY
55	UTILITY	T	--	-	-	-	--	-	-	-	--	-	-	-	--	-	-	-	--	--	-	-	
																					4759.305		

NOTES:
1. REFER TO RISER DIAGRAM FOR FEEDER TAGS

AL=ALUMINUM
CU=COPPER

Figure 91: Aluminum Feeders

Analysis and Conclusions:

After comparing the costs of both aluminum and copper feeders for the distribution system, cost savings were determined. A summary is provided below:

Copper Wire	$104,593.02
Aluminum Wire	$47,597.31
Cost Savings	$56,995.71
Percent Savings	54%

Table 51: Table #51

Part of the reason for such a large difference is due to the fact that some of the cost data for certain feeder sizes were not available in the RS Means Building Construction Cost Data book.

Misconceptions about the inferiority of aluminum conductors are often made throughout the country. The electrical industry has, in fact, utilized aluminum feeders for well over 100 years. Aluminum happens to be a very reliable source for conductors, too, withstanding more surge and overload currents than copper conductors. On a per pound basis, aluminum is over twice as good as conducting electricity than copper. Aluminum conductors also have a longer life than copper. Aluminum conductors do oxidize like copper, however, if surface oxidation occurs again under the right conditions, the exposed surfaces can be protected again; whereas copper completely oxidizes over time.

Copper conductors have a higher tensile strength and conduct electricity better than aluminum. Copper wires also have a less expensive life cycle. Therefore, if space is a critical component of the electrical distribution system in a building, copper tends to be a better option.

If the copper wires were to be replaced with aluminum wires, the wire sizes would have to increase to achieve the same ampacity. This would also increase the conduit size in response. The study does show that there is a huge amount of cost savings by employing aluminum wires. Because the cost benefit is so great in replacing the conductors to aluminum, and because space is not an issue in design, I recommend the aluminum conductors. Additional space to accommodate a greater volume of aluminum enables the alternating current to be greater on its surface than the core. This will mean the conductors will be more efficient, too.

Photovoltaic Array Feasibility Study

Introduction:

Since the Hotel and Conference Center has received a LEED Gold certification by the U.S. Green Building Council, it is evident that sustainability was a driving factor in design. Therefore, an analysis of adding a photovoltaic (PV) array onto the roof was completed in order to evaluate the benefits and feasibility of the system.

Background:

Located in a more rural area, the Hotel and Conference Center will not receive any shadows from buildings as no buildings are located anywhere on its site. However, Virginia is not necessarily the sunniest of locations in the United States and may not be the most ideal location for installing solar panels.

The percentage of sunshine per month in Virginia throughout the year is less than the national average.

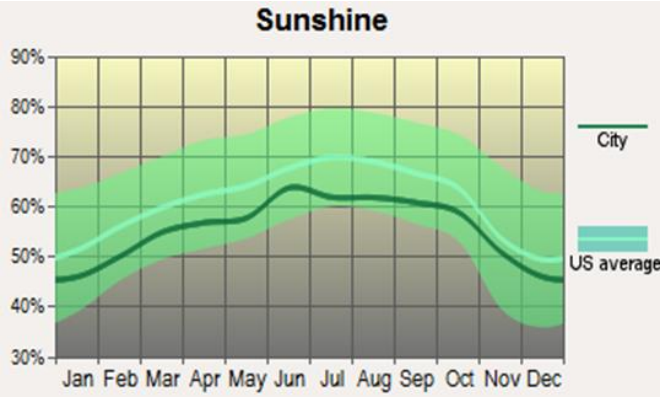


Figure 92: Sunny Days in Unknown City, Virginia

Percentage of cloud cover per month indicates that for the course of an entire year, over 50% of the days will have some sort of cloud coverage.

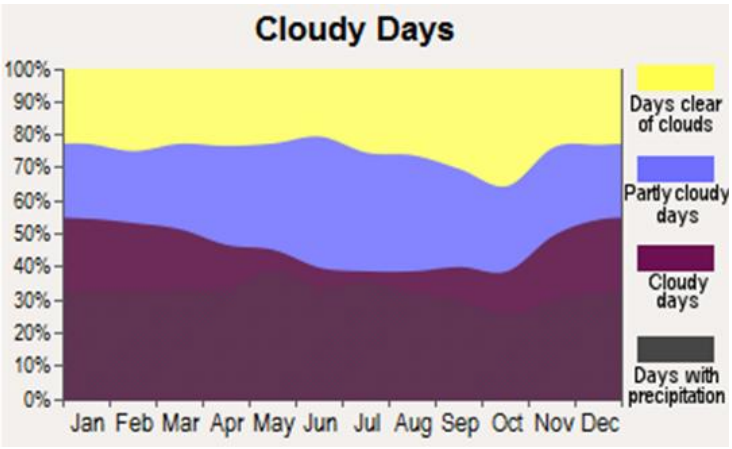


Figure 92: Cloudy Days in Unknown City, Virginia

System:

The proposed photovoltaic array will be mounted on the roof of the hotel tower on the building. Because the roof is flat, the panels will not need to be mounted on racks and angled at all.

The E19/320 Solar Panel from Sunpower is the most efficient photovoltaic panel on the market. It has an efficiency of 19.6%, higher than conventional panels specified.

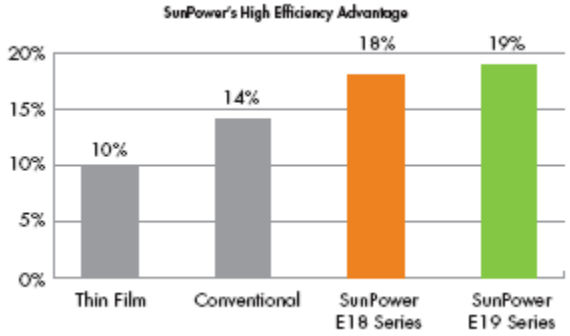


Figure 93: Efficiency Comparison Graph

The proposed photovoltaic system was to try and produce about 500kW (or about 1/3 the power of the main distribution panel) on the hotel tower roof. The square footage of usable roof space is about 10600SF, allowing about (530) 5'-0" x 4'-0" panels at 320kW each. However, the system only receives about half of the power, reaching a maximum of 169.6 kW.

Electrical Data		
Measured at Standard Test Conditions (STC): Irradiance of 1000W/m², AM 1.5, and cell temperature 25° C		
Peak Power (+5/-3%)	P_{max}	320 W
Efficiency	η	19.6 %
Rated Voltage	V_{mpp}	54.7 V
Rated Current	I_{mpp}	5.86 A
Open Circuit Voltage	V_{oc}	64.8 V
Short Circuit Current	I_{sc}	6.24 A
Maximum System Voltage	UL	600 V
Temperature Coefficients	Power (P)	-0.38% / K
	Voltage (V_{oc})	-176.6mV / K
	Current (I_{sc})	3.5mA / K
NOCT		45° C +/-2° C
Series Fuse Rating		15 A

Figure 94: Electrical Data of PV Panel

Calculations:

The maximum voltage of the photovoltaic array occurs at the lowest temperature of the array. Therefore, ASHRAE 90.1-2007 was referenced to find the minimum temperature in Virginia (the exact city cannot be revealed) of 14°F (-10°C). The change in temperature from the Standard Test Condition (STC) and the change in open circuit voltage was accounted for as well.

Noted above, the STD temperature is 25° and the open-circuit voltage changes with a slope of -0.177 V/°C. The open circuit voltage of the PV Array specified is 64.8V. The change in temperature from the STC is then:

-10°C - 25°C = -35°C

The change in open-circuit voltage is:

-0.177 V/°C x -35°C = 6.195V

Therefore, the new open-circuit voltage is 64.8V plus the change of 6.195V, for a total of 70.995V at 10°C.

Next, the maximum voltage of the array was calculated and checked to see how many panels could fit on the inverter specified (Sunny Tower with 6 Sunny Mini with 68.4 kW each).

The maximum DC voltage is 700V. Dividing this total voltage by the voltage of the system allows you to determine how many modules are allowed on the inverter. Therefore, 9 modules are allowed on this system (700V / 70.995V = 9.86 modules = 9). The voltage has to be checked as well (9 * 70.995V = 638.995V) to make sure the system can handle the number of modules. This also means no more than nine panels can be in series with the inverter.

Nine panels at 320W each gives a total of about 2.88kW. The goal of the PV Array study was to determine if the maximum power of the array could indeed be reached (recall maximum of 169.6 kW). This means that 59 rows of panels must be installed in order to reach the maximum (169.6 / 2.88 kW = 59 rows of panels).

Using the dimensions of the roof plan, 54 rows of 9 panels each could be obtained on the roof, or 155.5 kW.

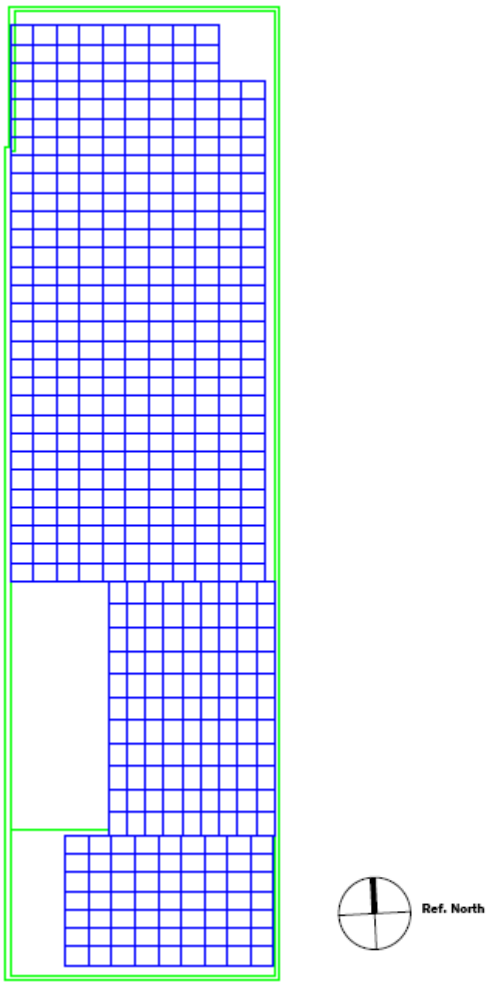


Figure 95: Roof Plan of Hotel Tower | NTS

Analysis and Conclusions

Knowing that the optimal number of panels cannot fit on the roof nor can the targeted amount of kW be generated by the photovoltaic system, it is recommended that the Hotel and Conference do not implement a photovoltaic system.

Architectural Breadth

Introduction:

The Hotel and Conference Center highlights various social events in its Ballroom, including themed events, cocktail receptions, company outings, anniversary parties, reunions, and wedding receptions. Capacities may vary in the room, so making use of the two operable partitions is available. These partitions can separate the Ballroom into one, two, or three salons. The Ballroom accommodates up to 579 guests in a reception setting, 611 as a theater, and as many as 456 in a banquet setting.

The inspirational image for this space is a dark cave illuminated by a sliver of daylight. Just like a cave in nature, a ballroom in a conference center shuns the daylight. However, adding in daylight into the space really enhances the overall atmosphere during certain types of events, specifically long conferences or even early morning breakfasts. With the use of four clerestories, daylight is integrated into the Ballroom. For events not wanting daylight or for those using projection screens, shading devices can be utilized.

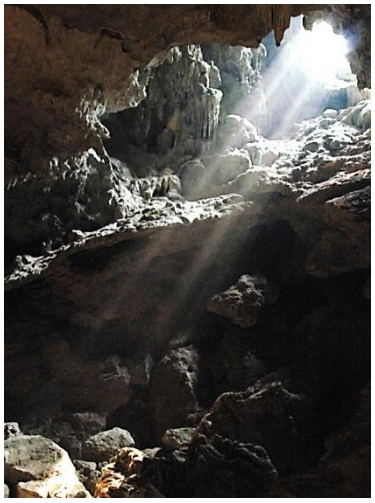


Figure 96: Inspirational Image

The main objectives of the architecture breadth are as follows:

1. Integrate a unique daylighting system within the space to enhance the architect's overall image for the hotel
2. Enhance room aesthetics and architectural integrity

Problem:

Ballrooms typically do not integrate daylight into their design, but with the architect's vision for the building, daylight seemed an integral part that could enhance the aesthetics of the Ballroom.

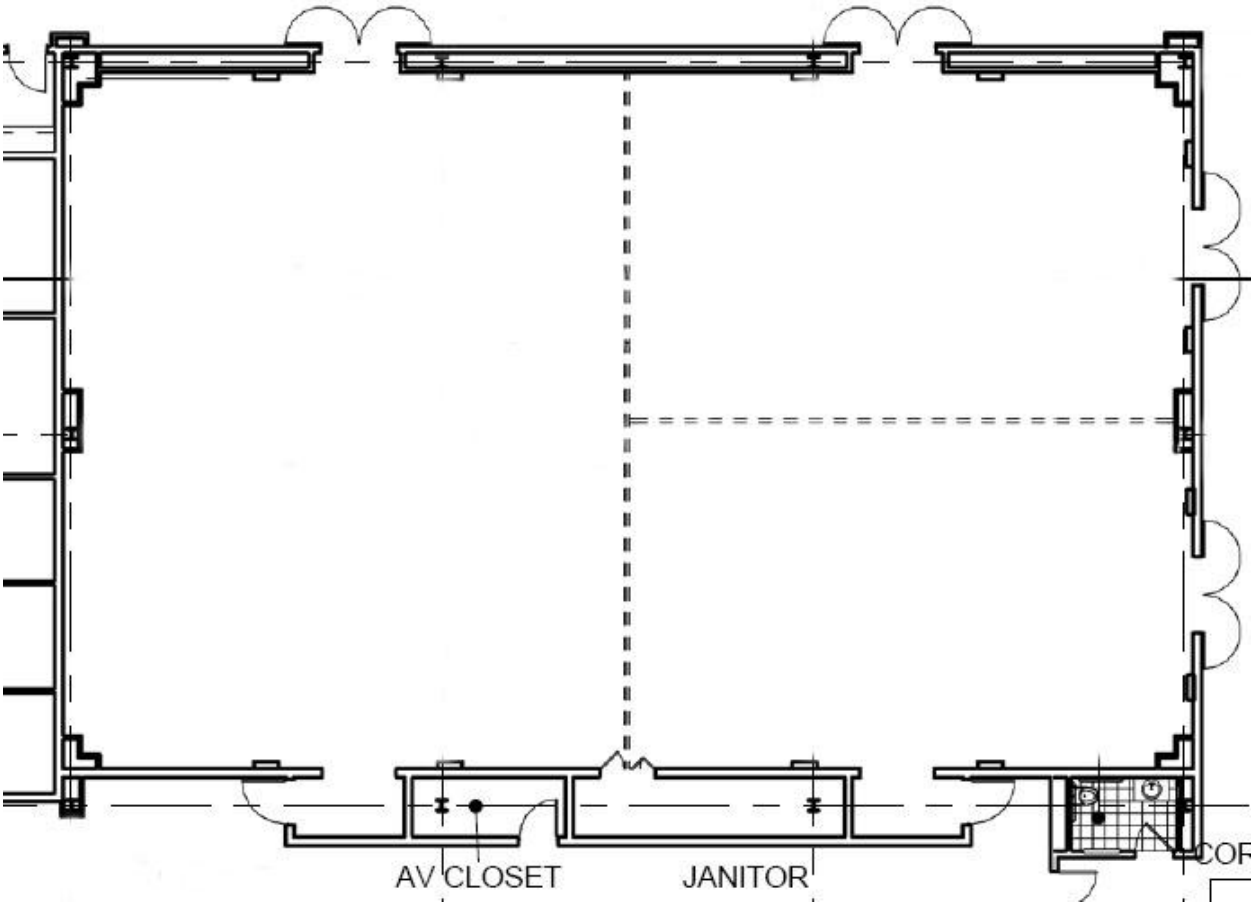


Figure 96: Ballroom Plan | NTS

As seen above, the Ballroom is on the interior of the conference center portion of the building, allowing no natural light into the space. A double tiered cove lighting system actually makes the Ballroom space much taller than the overall height of the rest of the conference center. With another height addition, clerestories could be added that would not distract from the view from the exterior of the building. Clerestories are a simple means of bringing in natural light into a space and can be controlled using appropriate shading devices depending on orientation.

The four clerestories are centered along the entranceways of the Ballroom on the north and east elevations. Even if the Ballroom is split into two or three separate spaces, each room will have some sort of daylight integration with it.

The original elevations of the north and east elevations are shown below.

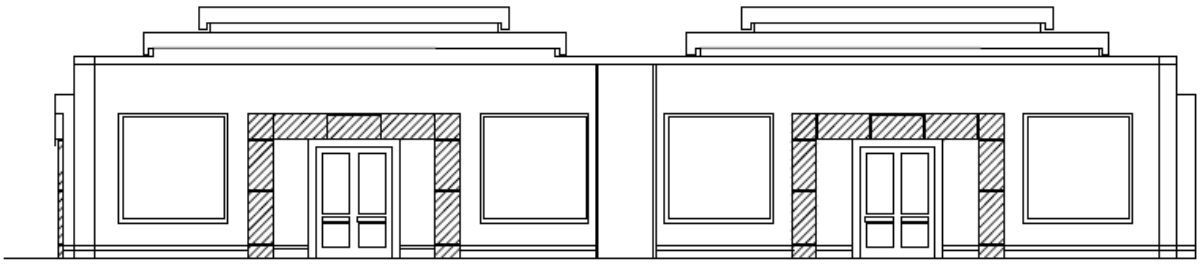


Figure 98: Ballroom North Elevation | Original

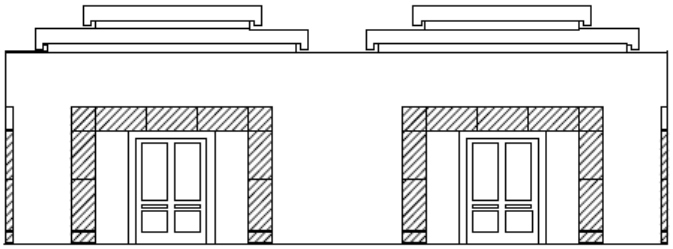


Figure 99: Ballroom East Elevation | Original

Solution:

Adding in daylight into a Ballroom could be troublesome for a variety of reasons. Controls are typically one such reason, and would definitely pose a threat in the Ballroom design as the design implements shades, as well. The proposed Ballroom design includes high-tech dimming, scene, and zone controls via a Lutron Grafik Eye System, which also integrates shading controls. This will allow the users in the space to adjust the shades as necessary.

Originally, the ceiling height of the Ballroom was 16'-0", with a double tiered coffered ceiling extending up to 20'-0" total (each ceiling pop-up was 2'-0" tall). The ceiling height was increased by 6'-0" to include four clerestories (two on both the northern and eastern sides of the space), for a general ceiling height of 22'-0". In order to keep the architectural integrity of the room, the double coffered ceiling was kept and extended as well. This led to an increase in overall height of 26'-0" in the topmost cove.

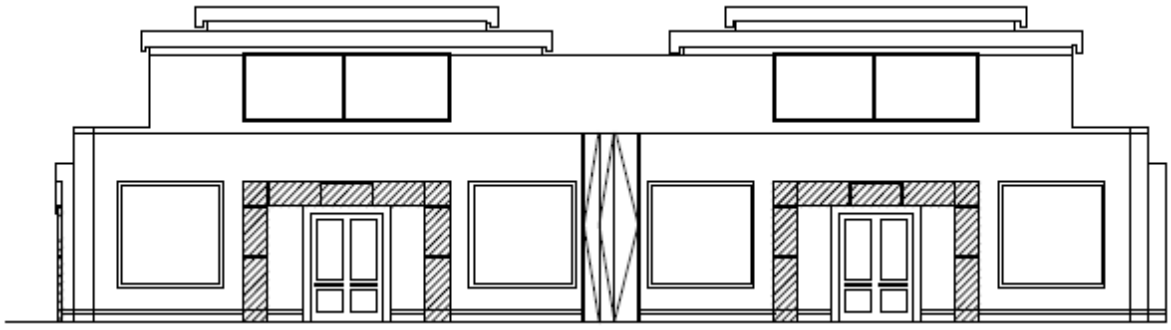


Figure 100: Ballroom North Elevation | New

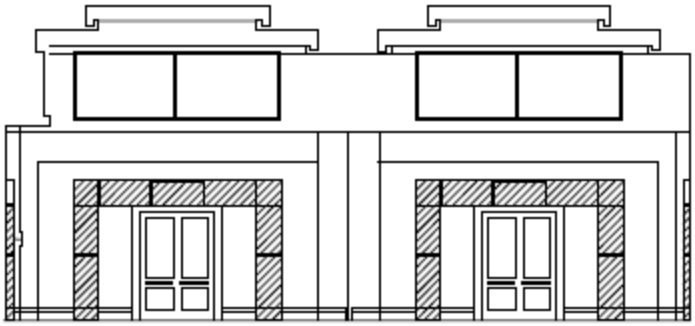


Figure 7: Ballroom East Elevation | New

The clerestories could not be simply added in, however. Two columns on the northern wall of the Ballroom had to be moved in order to accommodate for the size and position of the clerestories (for more information pertaining to this, please refer to the Structural Breadth).

Conclusions:

With the addition of four clerestories in the Ballroom, the Ballroom transforms into an open and airy space, allowing exterior views to the outside. These clerestories bring natural light in, consistent with the architect's vision for bringing the outdoors indoors.

Structural Breadth

Introduction:

As a result of adding clerestories on both the northern and eastern walls of the Ballroom, the structure of the original design had to be analyzed and slightly modified. Adding in the clerestories increased the ceiling height by 6'-0", so checking columns for the height addition was accounted for in the analysis. Redesigning the framing also had to be completed because two of the columns moved as a result of adding the clerestories in their respective places.

The drawing below highlights the columns in the Ballroom that were affected by adding in clerestories. Columns in red indicate that a structural redesign was carried out.

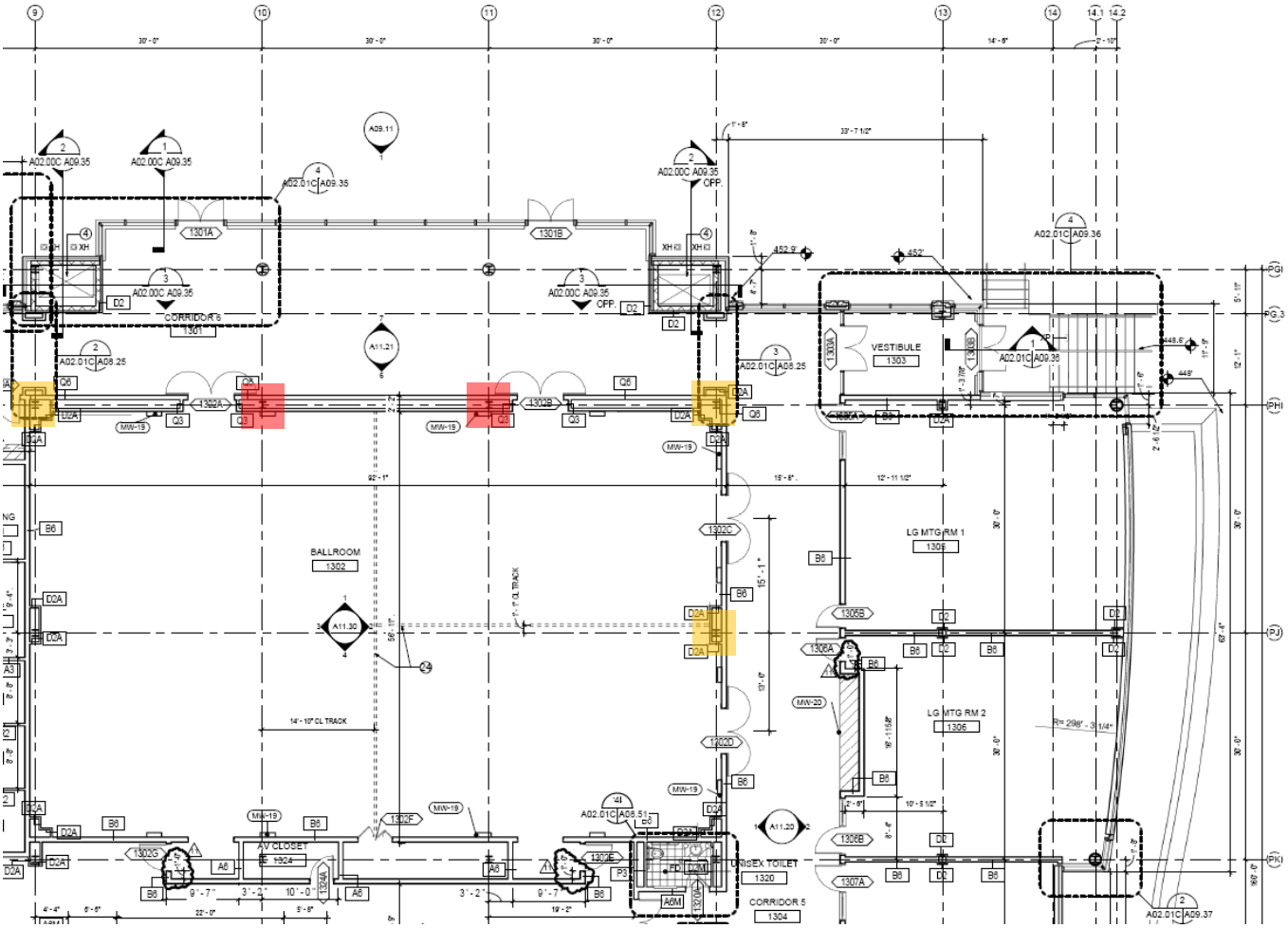


Figure 102: Level 1 Construction Plan

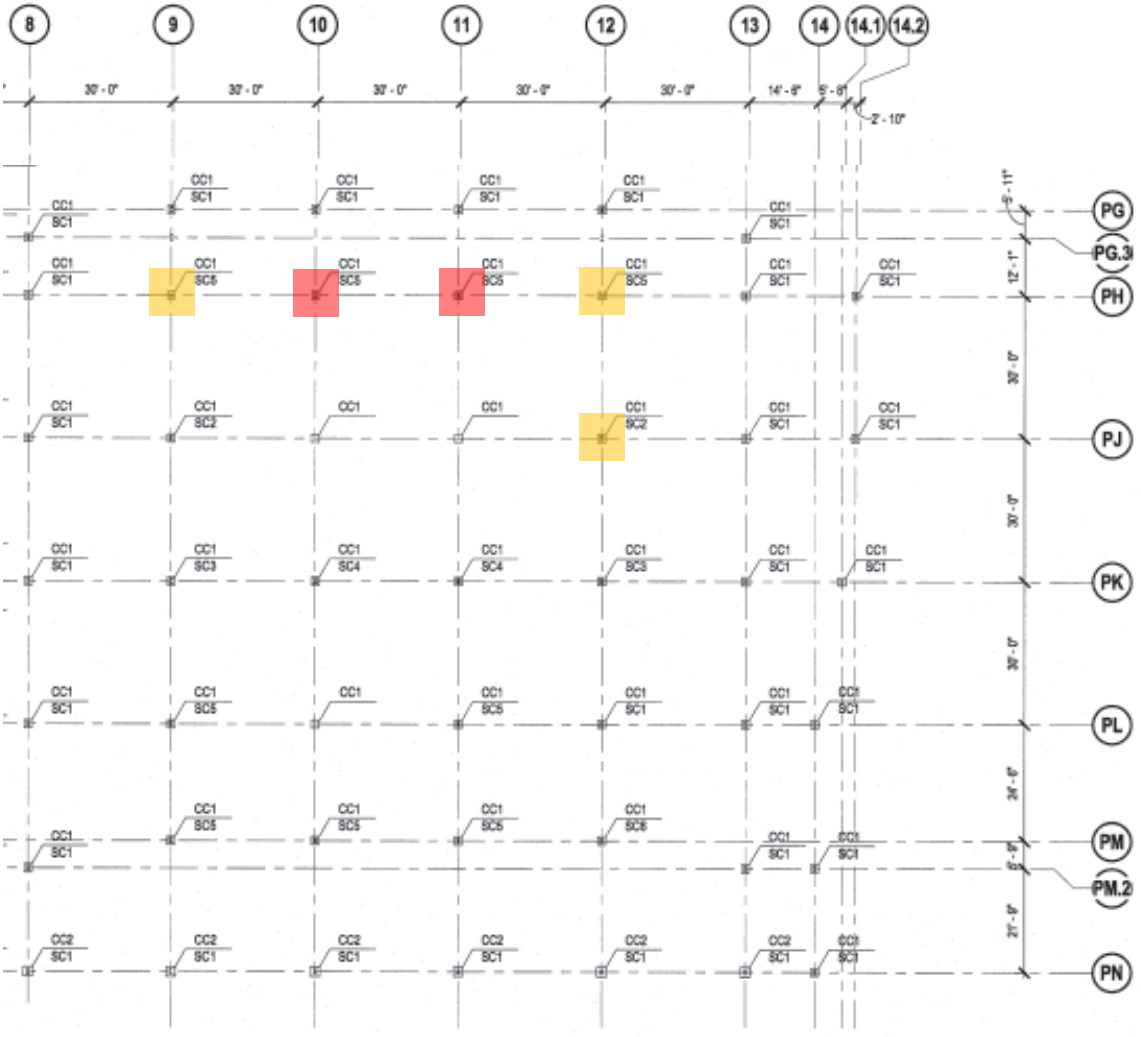


Figure 103: Structural Column Keyplan

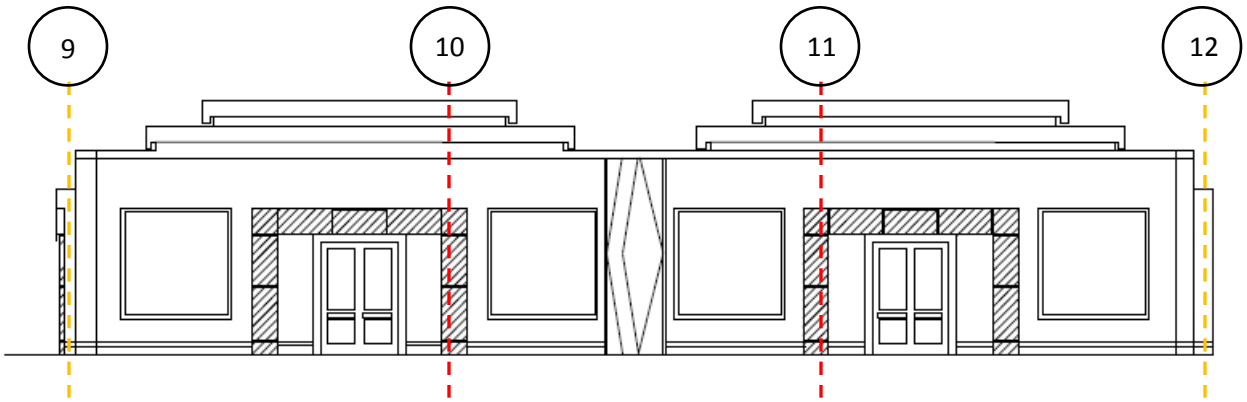


Figure 104: North Elevation of Ballroom | Original

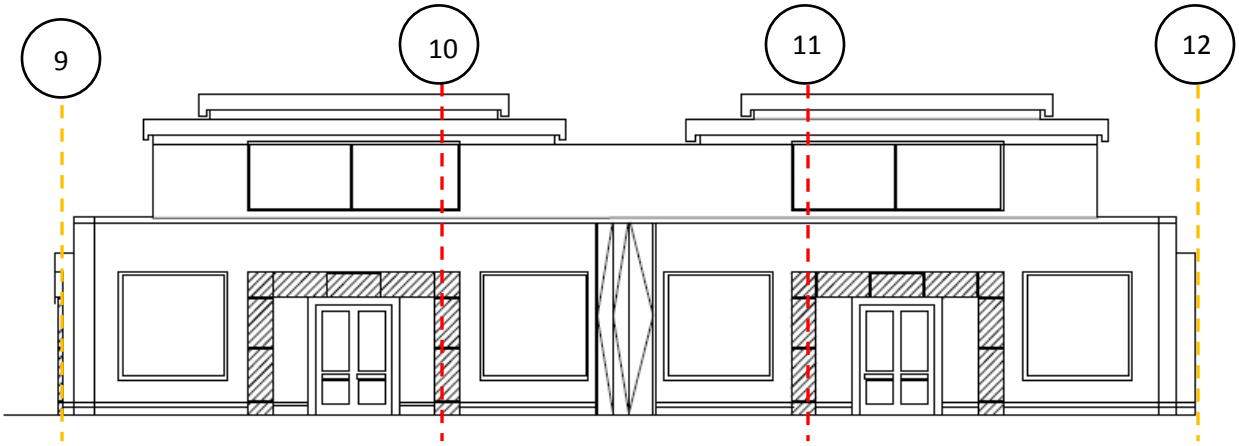


Figure 105: North Elevation of Ballroom | Proposed Location of Clerestories

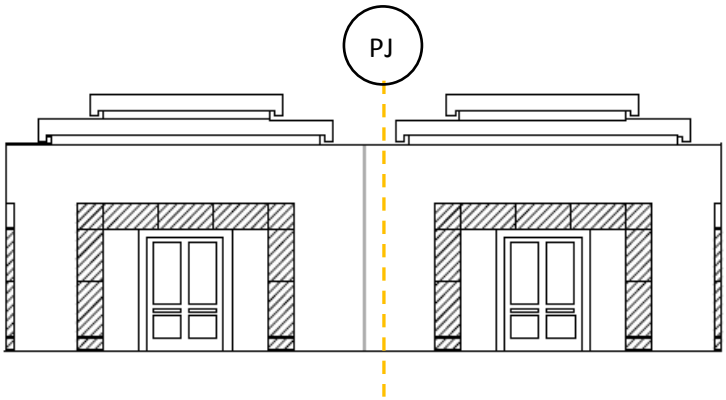


Figure 106: East Elevation of Ballroom | Original

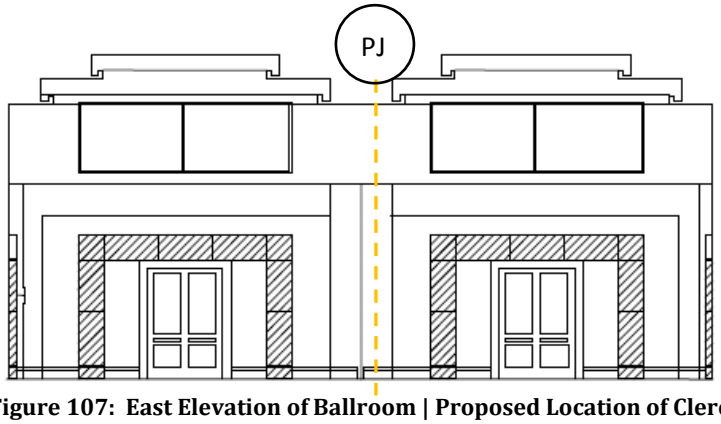


Figure 107: East Elevation of Ballroom | Proposed Location of Clerestories

Beam Calculations:

The columns highlighted in red were each moved in (ie towards each other) by 3'-0" to accommodate for the clerestories on the northern wall of the Ballroom. Because these columns were moved, the framing had to be checked and modified. The braced frames became longer. See the framing plan and braced frame elevations below for more details.

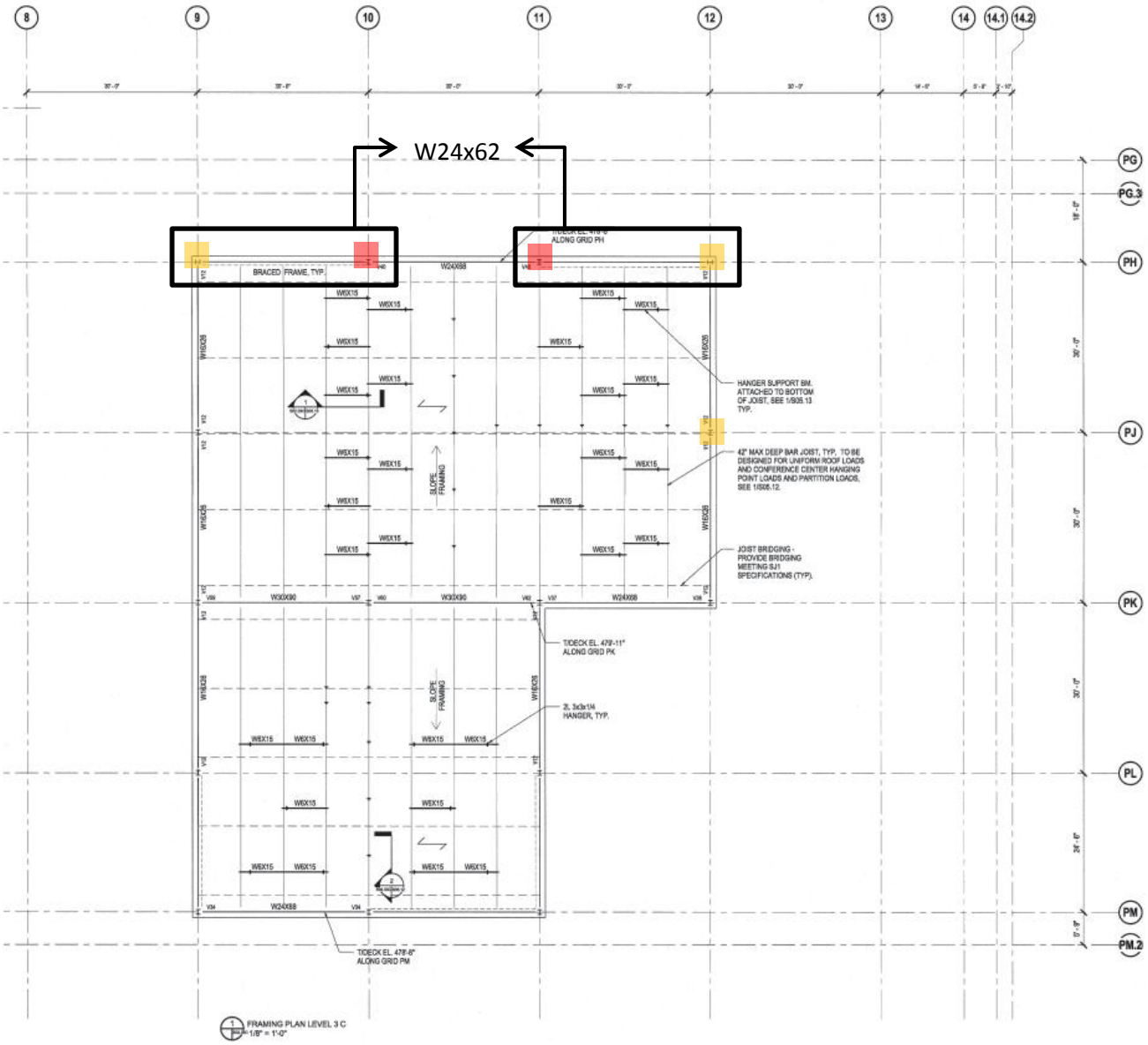


Figure 108: Framing Plan

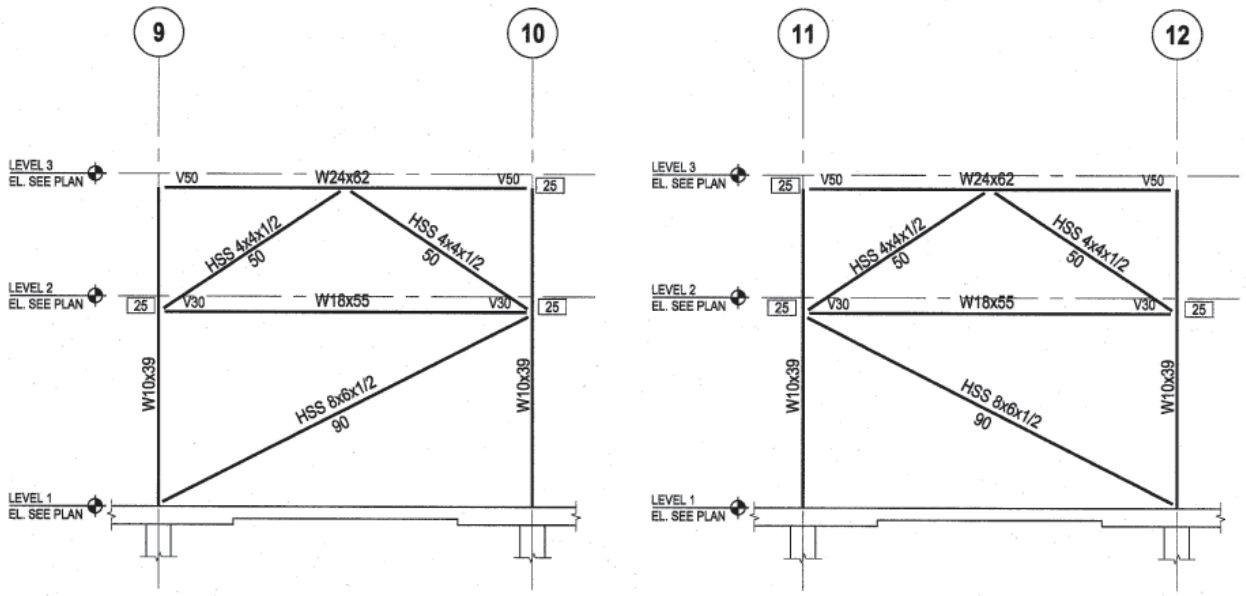


Figure 109: Braced Frame Elevations

Loading from the engineers was then documented and assumed. These values are given below.

Structural Loads	
Snow Load	22 psf
Superimposed Dead Load	10 psf
Roof Load	40 psf
Framing	10 psf

Loading for the beams was calculated to determine resizing would be necessary. The hand calculations for the loads was determined and both these calculations and the sizing checks are provided below.

Tributary area of the joist:
7.5 ft x 30 ft

Dead load:
P_D = (Superimposed Dead Load + Roof Load) x Tributary Area + Joist Load
= (10 psf + 40 psf) x (7.5 ft x 30 ft) + (12 plf x 30 ft)
= 11250 lbs + 360 lbs
= 11610 lbs

Live load:
P_S = Snow Load x Tributary Area
= 22 psf x (7.5 ft x 30 ft)
= 4950 lbs

Total P_U:
P_U = 1.2D + 1.6L = 1.2(11610) + 1.6(4950) = 21.9 kip

The distribution of the 33'-0" W24x62 beam is shown below. The calculations for both the shear and moment follow the diagram.

Sum of the moments at point "A":

$0 = 21.9 \text{ kip } (3 \text{ ft}) + 21.9 \text{ kip } (10.5 \text{ ft}) + 21.9 \text{ kip } (18 \text{ ft}) + 21.9 \text{ kip } (25.5 \text{ ft}) - R_B (33 \text{ ft})$

$R_B = 37.8 \text{ kip}$

Sum of the reactions in the Y direction:

$R_A = 4(21.9 \text{ kip}) - 37.8$

$R_A = 49.8 \text{ kip}$

The maximum shear was determined to be at point "A" and is 49.8 kip. The maximum moment is the point of minimum shear (at 0), and was determined by calculating the area underneath the shear diagram from this point. Therefore, the maximum moment was calculated as 403.65 ft kip.

Using Tables 3-2 (Z tables) and Table 3-10 (Unbraced length table) from the AISC Steel Manual, the following values were recorded for a W24x62 beam.

W24x62 Steel Beam	
φM_P	574 ft kip
φM_R	344 ft kip
φV_N	306 kip
φM_N	510 ft kip

The maximum shear for the W24x62 beam is 306 kip, and the calculated maximum shear is 49.8, therefore, this checks. The maximum moment for the beam is 510 ft kip, which is greater than the 404 ft kip calculated above.

Next, deflection had to be accounted for. Because there are four point loads on the beam, it can be assumed as a distributed load. The maximum deflection calculations are shown below.

Distributed load = $(P_D + P_S)(4) / 33 \text{ ft} = (11610 + 4950)(4) / 33 = 2007 \text{ plf} = 2.01 \text{ klf}$

Using Table 1-1:
$I = 1550 \text{ in}^4$
$E = 29000 \text{ psi}$

$\Delta_{max} = 5wl^4 / 384EI = [(5 \times 2.01 \times 33^4) / (384 \times 29000 \times 1550)] \times 1728^* = 1.193 \text{ in}$
*1728 is the multiplier used to easily convert the units

The check for the deflection is shown below.

$l/240 = (33 \times 12) / 240 = 1.65$ in

$\Delta_{max} < l/240$
1.193 in < 1.65 in, so the member size does not need to be increased for deflection.

Column Calculations:

The ceiling height was increased by 6'-0" with the addition of the clerestories so the column heights therefore also had to increase (the columns were originally 20'-0" and increased to 26'-0"). Steel column length is typically controlled by buckling, so the column strength was calculated below.

As shown in Figure x, columns 10 and 11 are both W10x39.

Details on these columns can be found in the Steel Column Schedule below.

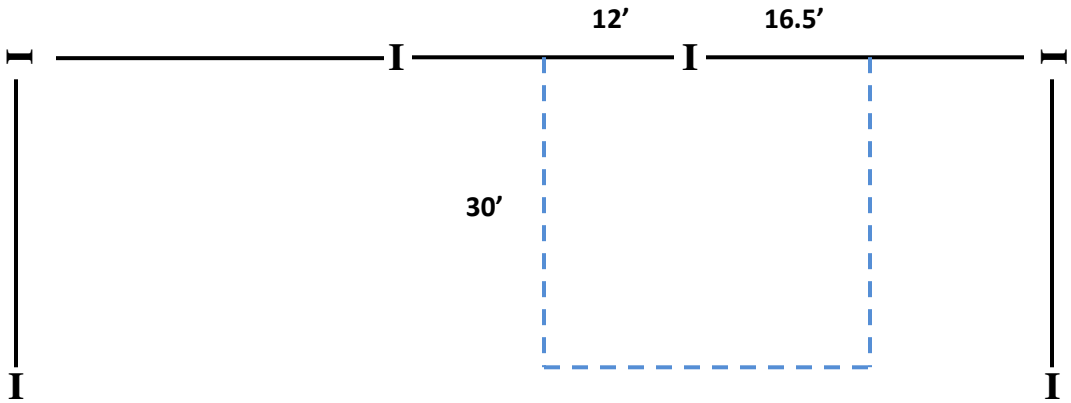
STEEL COLUMN SCHEDULE

FLOOR ELEVATION	COLUMN TYPE						FLOOR ELEVATION
	SC1	SC2	SC3	SC4	SC5*	SC6*	
LEVEL 3							LEVEL 3
EL. SEE PLAN							EL. SEE PLAN
LEVEL 2							LEVEL 2
EL. SEE PLAN	W10x33	W10x39	W10x49	W10x49	W10x39	W10x39	EL. SEE PLAN
LEVEL 1							LEVEL 1
BASE PLATE SIZE "N"x"B"x"T"	12 x 10 x 3/4	12 x 10 x 3/4	12 x 10 x 3/4	12 x 12 x 3/4	20 x 20 x 1-1/2	20 x 20 x 1-1/2	BASE PLATE SIZE "N"x"B"x"T"
REMARKS							REMARKS

NOTES:
1. SEE DETAIL 2/S05.05 FOR TYPICAL GRAVITY BASE PLATE AND COLUMN DETAIL.
2. SEE DETAIL 3/S05.05 FOR TYPICAL LATERAL BASE PLATE AND COLUMN DETAIL.
3. * - DENOTES LATERAL COLUMN.
4. BASE PLATE DIMENSIONS ARE IN INCHES.
5. SEE COLUMN KEYPLAN ON S04.02 FOR COLUMN TYPE ASSIGNMENTS AND COLUMN LOCATIONS.

Figure 110: Steel Column Schedule

The new tributary area for the column is seen below.



The calculation and check of column 11 is seen below.

Table 4-1: φP_N with an effective length of 26'-0" = 104 kip.
*Assume k = 1

Dead Load:
= Superimposed Dead Load + Roof Load + Framing
= 10 psf + 40 psf + 10 psf
= 60 psf

Dead Load x Tributary Area = 60 psf x (30 ft x 28.5 ft) = 51300 = 51.3 kip

Live Load x Tributary Area = 22 psf x (30 ft x 28.5 ft) = 18810 = 18.8 kip

Total P:
$P = 1.2D + 1.6L = 1.2(51.3) + 1.6(18.8) = 91.6$ kip

$P < \varphi P_N$, therefore the column checks.

Conclusions:

With the addition of clerestories, the structural integrity of the Ballroom had to be reevaluated to make sure column heights and framing were in accordance with code. The clerestories added on the north elevation forced two structural columns to be moved, changing the sizing of a couple of beams. In addition, column heights were checked to make sure nothing more needed to be modified.

Summary and Conclusions

In conclusion, great efforts have been made with the architectural and interior design to create a one-of-a-kind experience for guests at the Hotel and Conference Center. Luxurious finishes, wood millwork, and paints and plush furniture fill the rooms and the opportunities for relaxation and enjoyment are abundant.

Lighting design plays an integral right to enhance the architecture of the building and help make the space come to life. The exterior courtyard and façade had two completely different canvases, as one was geared more towards building form and architecture while the other is more about the general idea of light at nighttime and the effects on people.

The central plaza has surface mounted LED strips on the underside of concrete benches. These create linear elements, stressing the horizontal plane on the ground. In-grade fixtures serve as beacons to patrons in vehicles driving through to the porte cochere. Light columns illuminate the walkway found on the exterior of the site. Wall sconces glow on the column accents on the exterior façade while LED wall grazers mounted on a cantilever accentuate the texture of the brick. The exterior lighting guides guests onto the site and serves as the initial impression of the hotel. Once inside, the Main Lobby serves as a welcoming and sets the tone of warm color temperatures and the feeling of relaxation throughout the hotel. The Lounge is a specialty bar with a more modern feel than the rest of the spaces. Various lights in concealed locations illuminate and make the room feel seamless. In the conference center portion of the hotel, the Ballroom brings a multitude of people and events to the Hotel and Conference Center. The lighting design is aesthetically pleasing, with custom decorative chandeliers and sconces for added sparkle, and an intricate double tiered cove system with RGB LED cove lights. Daylight was implemented into the space by raising the ceiling height of the Ballroom. Clerestories were added to further enhance the space in order to have the option of allowing daylight during daylong conferences. Flexible controls were therefore specified in the room, in order to accommodate for over a dozen zones, several different scenes of lights (dependent on function of event), and daylight integration into each separate smaller ballrooms.

The Hotel and Conference Center is all about bringing the outdoors indoors – nature, or the environment, is of utmost importance. Therefore, being energy conscious is also an important concern to the hotel. All four spaces involved in this senior thesis were below lighting power density allowances set forth by ASHRAE 90.1-2007. Utilizing compact fluorescent, fluorescent, and LED sources allowed more energy efficient lamps without the compromise of a cooler temperature, as all warm sources were specified. Illuminance criteria in each of the spaces was met as well.

Electrical design was also considered in the senior thesis. New branch circuit calculations were performed to resize the existing panelboards that were affected by the old lighting designs. A study concerning aluminum versus copper feeders was conducted for the entire building as well, and with the considerable amount of money saved, it is suggested to switch to aluminum feeders. Also, the implementation of a photovoltaic array was, too, considered, but it seems as if the payback would be way too significant for this new design to be used on the building.

Two separate breadth studies were also conducted for the thesis requirements that were outside of the lighting and electrical disciplines. An architecture breadth was chosen as the first one, raising the ceiling height of the Ballroom to implement a daylighting design. With this, a structural analysis had to be completed to make sure the integrity of the structure was still sufficient with the added clerestories.

References

The following software was used for calculations, renderings, and analysis:

Adobe Photoshop CS5
AGI-32
Autodesk AutoCAD 2011
Autodesk 3D Studio Max Design 2011
Autodesk Revit Architecture 2011
RETScreen4

The following references were used in completing the research and design:

AISC-Steel Construction Manual, 13th Edition. American Institute of Steel Construction.

ASHRAE Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. Atlanta, GA. 2007.

The IESNA Lighting Handbook: Reference & Application, 9th Edition. Illuminating Engineering Society of North America. New York, NY. 2000.

The IESNA Lighting Handbook: Reference & Application, 10th Edition. Illuminating Engineering Society of North America. New York, NY. 2011.

National Electric Code: 2008. National Fire Protection Association. Quincy, MA. 2004.

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Thank you to my roommate, for putting up with my odd sleeping schedule and for never giving me a hard time when thesis was always my exuse for everything.

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