Army National Guard Readiness Center

Final Report

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Arlington, VA

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Project Team:

Owner: Army National Guard
General Contractor: Tompkins Builder, Inc.
Architect: CH2M Hill
Engineer: AECOM

Project Overview

Function: Administrative office building.
Size: 251, 500 ft^2.
Stories: 5 stories above grade +3 below.
Cost: 100,000,000.
Delivery Method: Design-Bid-Build.

Electrical System

- 35.4 kV total utility load.
- (2) 15 kV medium voltage feeders at building.
- 480/277, 3 phase, 4 wire system in building.
- 208/120, 3 phase, 4 wire lighting system.
- (2) 1500 kW diesel-powered back-up generators.
- Majority of illumination done with fluorescent lighting.

Structural System

- Cast-In-Place Concrete and Structural Steel.
- Two-Way Concrete on Metal Deck.
- Shear Wall Lateral System.
- Spread Footing Foundation.
- Typical Bay Size: 20'x25' - 20'x30'
- Typical Column Size: 1'-10"x 1'x10"

Mechanical System

- AHU's and VAV units on each floor.
- Hydronic four-pipe heating and chilled water system.
- Emergency generators and energy recovery units located in mechanical penthouse.

Architectural Features

- Aluminum curtain wall system.
- Architectural precast panels.
- Single-ply roofing system for tower.
- Outdoor Plaza also functions as a green roof for lower floors.
- Building expected to achieve LEED Silver Rating.
- Steel Tricorn on top of building designed to give the appearance of an eyebrow.

http://www.engr.psu.edu/ae/thesis/portfolios/2011/ijh5004 | Images and data courtesy of The Army National Guard and Tompkins Builders, Inc.

Contents

Executive Summary

The Army National Guard Readiness Center is an eight story joint headquarters building located in Arlington, Virginia. Its purpose is to provide extra office space for the increase in employment as well as provide additional special purpose spaces. The following report analyzes various existing design conditions and proposes research on possible redesigns.

Four spaces were studied and redesigned as part of a lighting depth analysis. The spaces include an open office area, the auditorium, prefunction area, and the outdoor plaza/ green roof.

For each of the previously mentioned spaces, a redesign of the panelboards that serve the normal and emergency power was also conducted. Two electrical depth analyses were conducted which include an SKM Power Tools analysis on the entire electrical system and a transformer consolidation take-off. A hand calculation of the short circuit currents through a single path in the electrical distribution system was also conducted.

In addition to the lighting and electrical depth topics, two breadth topics outside of the lighting/electrical option were researched. The first is an acoustical analysis of the auditorium where T_{60} degradation time was analyzed and suggestions were made for improvements. The second topic is an analysis of the heat load difference between the existing incandescent luminaires with the compact fluorescents proposed in the new design.

The contents of this report are the results the studies conducted on each of the previously mentioned design topics. All conclusions are suggestions on an already functioning design.

Building Statistics

Building Name: Army National Guard Readiness Center Addition
Location and Site: 111 S. Mason Drive, Arlington Hall Station, Arlington VA
Building Occupant Name: The Army National Guard
Building Function: Joint Headquarters Administrative Building
Size: Approximately 251,444 ft^2
Number of Stories: There are 5 stories above grade and three below totaling to 8 stories.
Project Team:

Owner Army: National Guard
General Contractor: Tompkins Builders Inc.
Architect: CH2M
Engineer: AECOM

Dates of Construction:

Start Date: 12/2008
Anticipated Completion Date: 01/2011

Cost Information: Contract Value– $100,000,000.00
Project Delivery Method: Design-Build with Lump Sum
Architecture:

- **Design and Functional Components:**

This eight story addition will serve as a Joint Headquarters Administrative building for an existing building site. Although it functions as a standalone building, there is a one story bridge connecting this building to the already existing one. The new addition will have 3 levels below grade consisting of open office space, an auditorium, fitness facilities, locker rooms, and a telecommunication center. Above grade, there is a 5 story triangular tower of smaller footprint then the three levels below that it stands on. General office space makes up the majority of the tower, along with conference rooms and an auditorium. Where the below grade levels transition to the tower, there is an outdoor plaza consisting of seating and walkways and doubles as a green roof. A unique architectural feature of the building is the steel tricorn that sits atop the southern point of the tower. It is an aesthetic feature meant to give the appearance of an eyebrow.

- **Major National Codes:**

· International Building Code 2006 (IBC)
· Unified Facilities Criteria
· National Fire Protection Agency Codes (NFPA)
· PAM 200-1, 415-15, 420-7
· Leed-NC v2.2

- **Zoning:** S3 –A
- **Historical Requirements:** Not Applicable
- **Building Enclosure:**

The façade of the Army National guard Readiness Center Addition is made of an aluminum curtain wall system, metal panels, and architectural precast panels. The aluminum curtain wall system will consist of a mixture of vision and spandrel glass panels, however, glass types have not been finalized as of this moment.

There are two separate roofing systems, one for the tower and one for the below grade levels. The roofing system for the tower consists of a vapor barrier on top of a structural concrete slab, sloped rigid insulation, singe-ply roofing membrane, and topped by roof pavers. For the roofing system at the plaza level, there is a structural concrete slab with a softer concrete topping sloped for drainage, roofing membrane with fabric reinforcement, root barrier, insulation, a drainage water retention element, filter fabric, and a planting element. Note that this roofing system is to function as a green roof.

- **Sustainability Features:**

The outdoor plaza level also functions as a green roof, which serves as the main sustainable aspect of the building. Many of the materials have yet to be finalized a this moment, however, many shall be LEED rated and the building expects to achieve a LEED silver rating.

Primary Systems

- **Construction:**

Construction on the Army National Guard Readiness Center Addition began on December 1, 2008 and is expected to be completed by March of 2011. The project delivery method is Design-Bid-Build with the general contractor holding lump sum contracts with subcontractors. Tompkins Builders Inc. is the general contractor for the project, which is a subsidiary of Turner Construction Company. In addition to the office building, Tompkins Builders Inc. will be in the process of simultaneously constructing a new parking garage on site. Because of extensive amount of construction activity happening on site, it is imperative that efficient coordination between Tomkins Builders and its subcontractors is achieved. Logistics planning and Building Information Modeling (BIM) will both be utilized in order to ensure completion of the project on time and within budget.

- **Electrical:**

Dominion Power supplies to the Army National Guard Readiness Center through an onsite utility yard. The power is delivered at 35.4kV and then stepped down by switchgear which delivers power to the building through two medium voltage feeders at 15kV each. Two substations within the second basement level of the building step the power further down to a 480/277, 3 Ph, 4 wire system. Lighting systems are fed by 208/120, 3 phase, 4 wire panel boards.

Emergency power is supplied to the building through two 1500 kW diesel powered generators located on the penthouse level. A large conduit riser goes down seven stories through the building and cuts east-west across the second story to connect to the unit substations. Emergency power is routed to the building through three automatic transfer switches. Uninterrupted Power Supply (UPS) systems are also located in the basement levels for critical systems.

The lighting in the building will consist o f fluorescent luminaires at 277V and Incandescent luminaires at 120V with HID lighting for the exterior plaza. Programmable lighting relay systems will be used to control the lighting in the open office areas while dimming systems will be utilized in some of the private offices and special purpose areas where flexible lighting schemes are desired.

- **Mechanical Systems:**

Each floor house's air-handling units (AHUs) with individual variable air volume (VAV) terminal units and fan coil units (FCU) in a mechanical room. These AHUs range from 1500 cfm to 2450 cfm and are supplied by 100% outside air. A hydronic HVAC system consisting of a four-pipe heating and chilled water system distributes water to the AHUs and VAVs on each floor and also to the energy recovery units in the mechanical penthouse. A Building Automation System (BAS) is used to control the individual units, monitor the temperatures in each space, and controlling the FCUs throughout the building. There are also backup generators and energy recovery units located in the mechanical penthouse.

- **Structural:**

The structure of the Army National Guard Readiness Center is a combination of cast-in-place concrete and structural steel. The majority of the structure is cast-in-place concrete with only the main stairwell tower number 2 on the southern side made of structural steel. Typical bay sizes range from 20' by 25' to 20' by 30'. The typical column size is 1'-10" by 1'-10" with (8) #8 longitudinal reinforcing bars and #3 ties at 12' on center. The floor system is a 2 way flat plate system. Structural steel at the stair tower is HSS type beams and composite HSS columns. The beams range from HSS12x8x0.625 to HSS 14x4x0.625. The columns are either HSS 8.625x0.322 or HSS 11.25x0.500

The foundation system consists of a 6" crushed stone base, 2" concrete mud mat, 3'-7" mat foundation, 2'-9" aggregate, and a 12" slab-on –grade. Structural s

- **Fire Protection:**

There are two existing hydrants that provide 1520 gallon per minute flow rate to the sprinkler system. The building is designed for both light hazard areas, requiring 0.10 GPM over 3,000 ft^2, and ordinary hazard areas which require 0.20 over 3,000 ft^2.

Within the main server room is a FM-200 system. FM-200 is a colorless, non-toxic gas that when released into the room extinguishes a fire within ten seconds of detection. A major

advantage to this system as opposed to sprinkler systems is the minimal damage that the gas will do to the electrical equipment.

- **Transportation**

There is an elevator core in each of the two major sections of the building, each one containing three elevators. Elevators 1-3, located in core one, will be passenger elevators rated at 3500 pounds. Elevators 4-6, located in core 2, are gearless service elevators rated at 4500 pounds. All elevators run though each story of the building.
Three stairwells exist throughout the building, two of which extend from the lowest level 3P to level 5T. These two stairwells are located in the northwest corner and center of the building. The third stairwell is located in the southwest corner and only goes through the below grade levels (3P-1P). The centrally located stairwell is considered the main stairwell. It is completely enclosed by glass which allows for a view over the outdoor plaza.

- **Telecommunications:**

All of the major communication systems equipment are located on the 3rd basement level in various telecommunication and server rooms. The main servers for the building are located in room P346. However, there are at least IT/telecommunication rooms located on each floor. Each one of these rooms has 100% access flooring as well as in the conference rooms, and offices. Telecommunication systems are distributed through the building 12" cable trays and 24" width by 4" depth under-floor cable basket tray. Most of the workstations access the telecommunication systems through either ceiling or floor mounted box telecommunication outlets. Each box outlet either contains 2 or 4 voice and data outlets.

Lighting Depth

Open Office- Work Space

Existing Conditions:

On almost every floor of the building there is a large open office, each very similar to the others. The one that will be evaluated is the open office area located on the fourth level of the tower portion of the building (level 4T) within the northeast section of the building. This one was chosen because it appeared to be the most similar to the others. An exterior glass and aluminum curtain wall system makes up the entire north and east walls, allowing a large amount of natural light to enter the space. There is a double height ceiling, with 9'-6" above the work area and 9'-0" over the perimeter. To the south and west of the office space are partition walls that separate the space from smaller, individual offices. The space is comprised mostly of cubicles in sections of 6 to 8, each with its own desk and computer. Therefore, intensive VDT

use is a design consideration within the space. Also, reading of various text sizes and styles will be a major task taking place within the space.

Materials

Floor- The floor is modular carpet tile that matches architect's sample (CPT-2)

Ceiling- The ceiling above the worker area is acoustical ceiling tile (ACT1). Above the perimeter is gypsum wall board ceiling (CLG1)

Base- The base is flush wood base specified to match adjacent finishes (WB-1)

Walls- The north and east walls are comprised of vision glass (G6). The south and west walls are gypsum wall board (GWB1)

Material		Manufacturer	Style/Color	Reflectance
Modular Carpet	CP-2	Constantine	Narrow/ R252200	0.2
Gypsum Wall Board	CLG1	-	Bright White	0.76
Acoustical Ceiling Tile	ACT1	-	2'x2'/White Finish	0.8
Wood Base	WB1	Sherwin Williams	2.5" high/ Alabaster	0.3
Vision Glass	G6	-	Tempered Monolithic	0.25
Gypsum Wall Board	GWB1		Eggshell Sheen	0.5

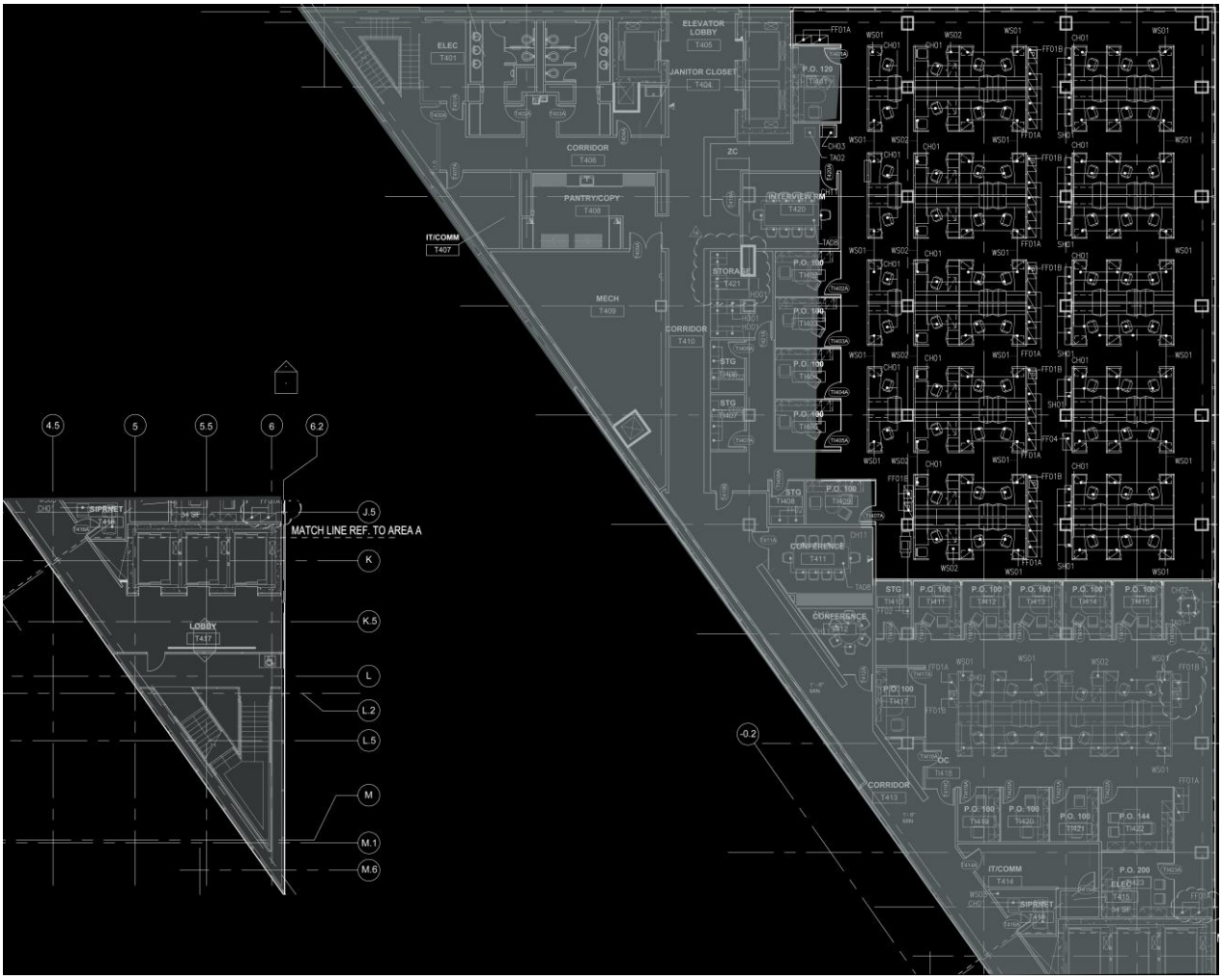


Figure: Open Office Floor Plan

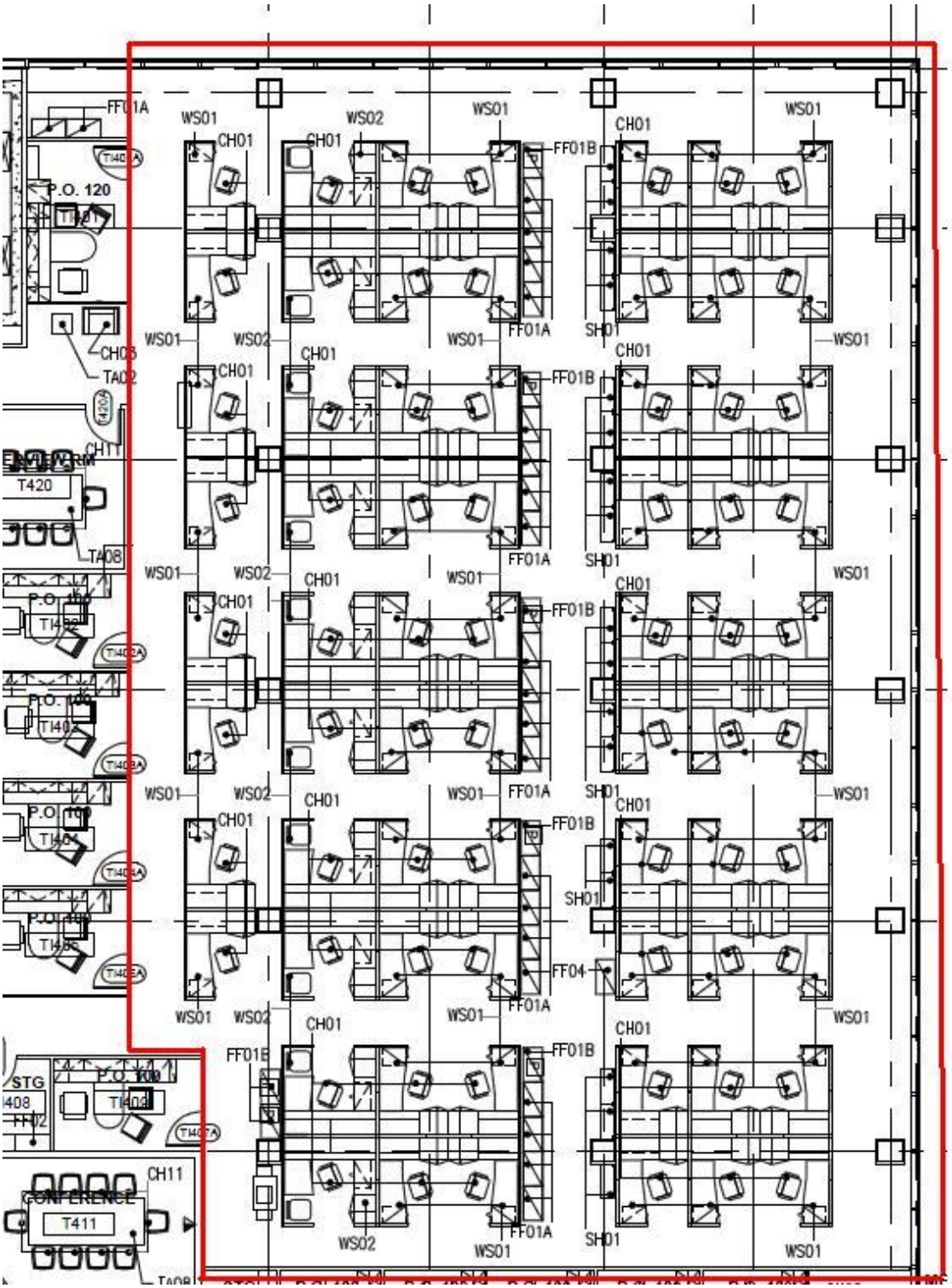


Figure: Open Office Reflected Enlarged Plan

Design Criteria: Open plan office- Intensive VDT use; Reading- VDT screens, Handwritten tasks, Printed tasks

Illuminance Values

- Horizontal- 30 fc
- Vertical- 5 fc

Direct Glare- Very Important

- Direct glare can cause visual discomfort and interfere with visibility of the occupants. Its main causes are from luminaire placement and natural light coming in through windows. Because reading and writing will be two tasks being performed by the occupants, it is crucial to control this problem in order for work to be properly done. Considerations to prevent this lie in use of indirect instead of direct light sources, luminaire placement, and placement of seating around fenestrations.

Reflected Glare- Very Important

- Reflected glare can be caused by light refracting off of shiny or glossy surfaces such as magazines. Veiling reflections from such surfaces can cause visual discomfort and reduce contrast on the surface. It is very likely that the occupants will be reading text glossy paper so reflected glare should not be ignored. This problem can be solved in much the same way direct glare can.

Luminances of Surfaces- Very Important

- Luminance values should be uniform on all surfaces; including floor, wall, ceiling, and work plane in order to reduce visual clutter and distractions. However, a slightly higher luminance value may be desired on work surfaces in order to direct focus to the work of the occupants.

Light Distribution on Task Plane (Uniformity) - Very Important

- Uniformity on the task plane is important for visual clarity while performing tasks such as reading and writing. Any type of patterns is undesirable for they will be distracting to the occupants.

Source/ Task/ Eye Geometry- Very Important

- Luminaires should be kept away from the offending zone to reduce reflections. Indirect lighting and luminaires placed to the sides of the desks will help avoid these problems.

Appearance of Space and Luminaires- Important

- It is important that the space be bright and uniformly illuminated to avoid visual distractions and clutter. Areas of circulation should stand out in order to guide foot traffic.

Color Appearance (and Color Contrast) - Important

- Proper color rendering is crucial for producing a pleasant looking space and complementing the appearance of the occupants. Contrast is required for distinguishing text in reading applications.

Daylighting Integration and Controls- Important

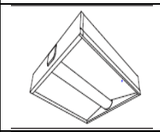
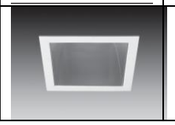
- Daylighting integration is important for reduction of lighting load and to provide high quality light or light with exceptional color rendering. The space receives an ample amount of natural light due to the fact that about 50 percent of its walls are exterior glazing. However, measures need to be taken to control the amount of daylighting such as shading in order to reduce glare or excessive solar heat gain.

Modeling of Faces and or Objects- Important

- Within the work environment, it is often important for people to converse with one another and share ideas. Therefore, it is necessary that the occupants' faces are rendered in a pleasant manner in order to optimize social interaction.

Lighting

Indirect/direct lighting will be the main technique for illuminating the space. Indirect lighting will uniformly illuminate the space while preventing any discomfort glare. The direct lighting component will help render objects in more detail. My proposed lighting solution will take advantage of the rigidity of the space by utilizing task/ambient fixtures integrated with the furniture. Tambient's luminaires will be used to accomplish this design. The advantage that these luminaires have over pendants is that the direct component of the light will be focused on where it is truly needed, the desk surfaces. This will ensure that the direct lumens will not be wasted on areas of circulation where the indirect light will illuminate. Recessed, direct luminaires will be used to illuminate the walkway at the left.

	Open Office Luminaire Schedule											
Type	**Image**	**Description**	**Manufacturer**	**Catalog NO.**	**No. of Lamps**	**Lamp type**	**Watts Per Lamp**	**Ballast Type**	**Input Wattage**	**BF**	**Voltage**	**Height**
OA		Integrated task/ambient luminaire	Tambient	L221-83S7-M-TASL-1-1-R-00-35	2	Sylvania 1 FP28/835/ECO-2900 Lumens CRI-85 T5 3500k and 1 FP21/835/ECO 2100 Lumens CRI-85 T5 3500K	49W Total	Sylvania QTP 2x28T5/UNV PSN NL	65/63W	1	120	4'-6"
OB		Integrated task/ambient luminaire	Tambient	L221-48S4-M-TASL-1-1-R-00-35	1	Sylvania FP28/835/ECO-2900 Lumens CRI-85 T5 3500k	28W	Sylvania QTP 2x28T5/UNV PSN NL	32W	1	120	4'-6"
OC		2' X 2' Direct recessed downlight	Ledalite	9422-D2-ST-2TT5-S-1-277V	1	Sylvania FT40W/2G11/RS/835	40W	Sylvania QTP 1x40TT5/277 PSN-F	37W	0.88	277	9
OD		Recessed emergency luminaire	Kurt Versen	H-8443-DM	1	Sylvania CFTR32W/GX24Q/830	32W	Sylvania QTP 1/2XCF/UNV TM	36W	1	277	9’-5”

Light Loss Factors				
Luminaire Type	**LLD**	**LDD**	**BF**	
OA	0.9	0.9	1.00	
OB	0.9	0.9	1.00	
OC	0.9	0.9	0.88	
OD	0.9	0.9	1.00	

*LDD value is based on the IESNA 2011 handbook calculation

Performance Graphics:

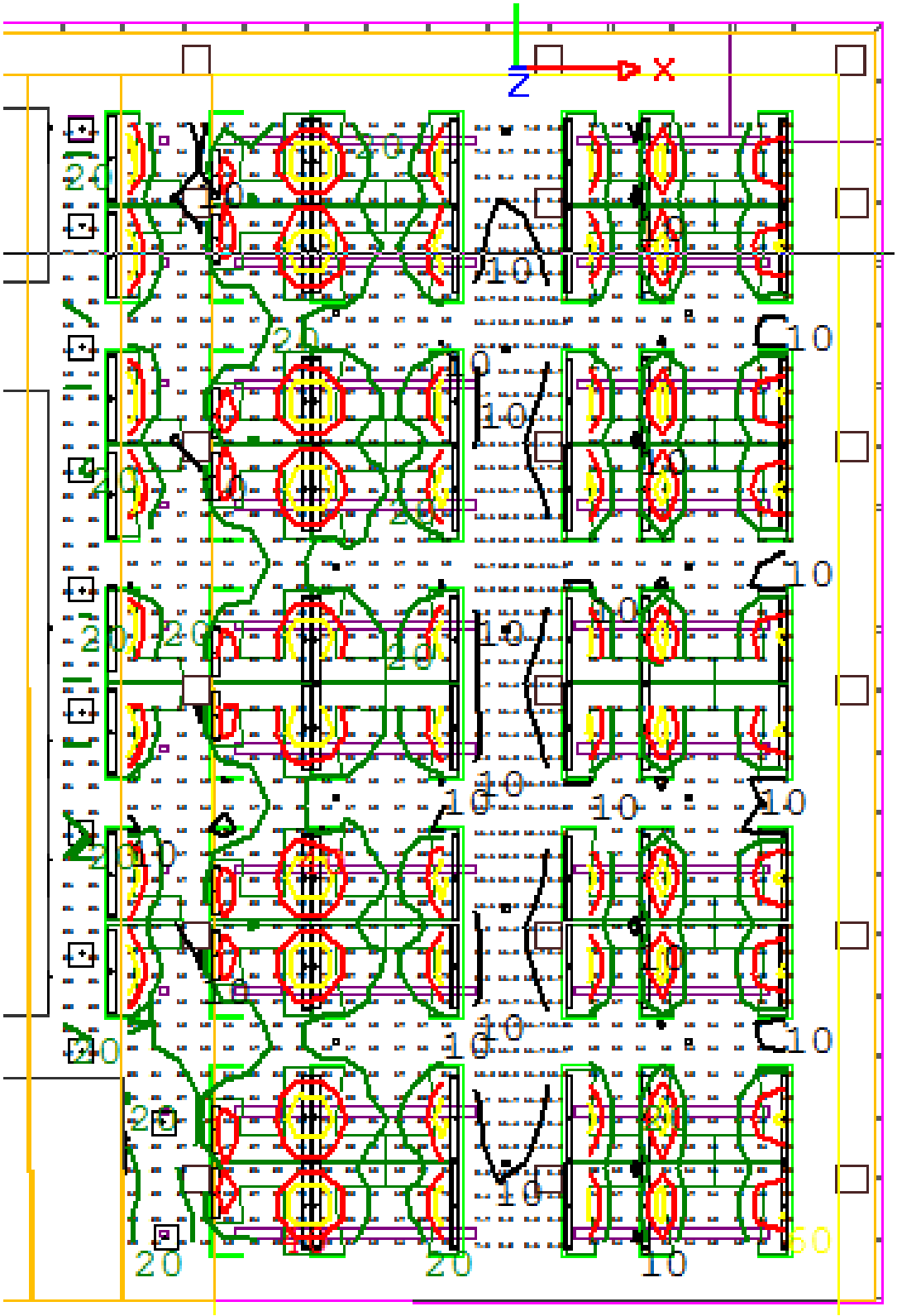


Figure: Open Office Isoline

Isoline Color	Illuminance Value (fc)
Black	10
Green	20
Red	40
Yellow	60

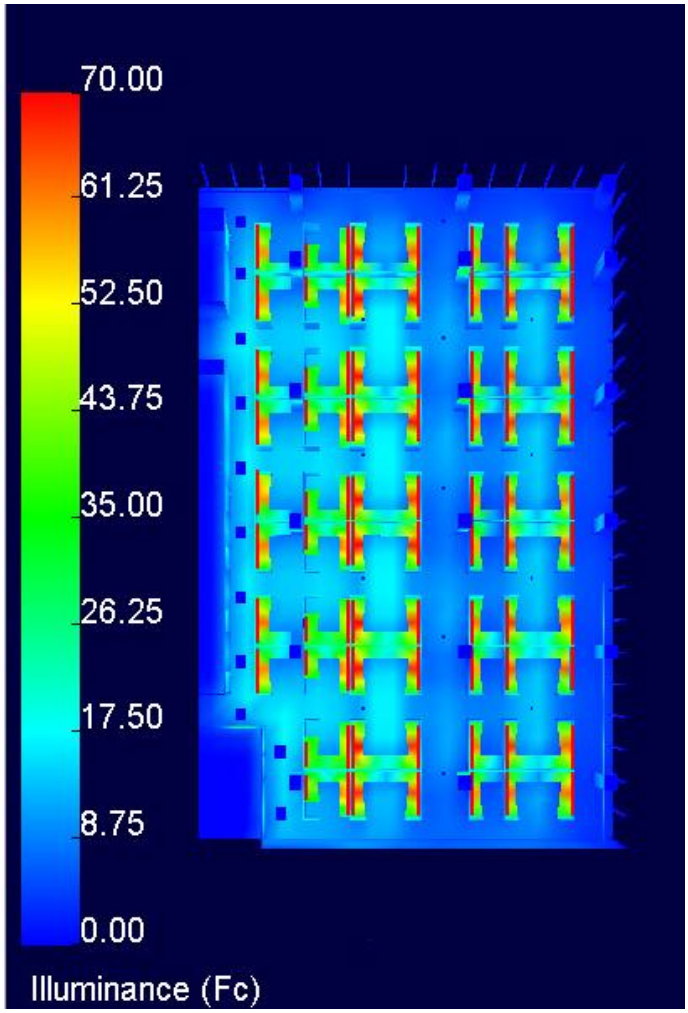


Figure 6: Open Office Psudo Color Plan

Figure 7: Open Office Grey Scale Perspective

Illuminance Values		
	Workplane	Circulation
Average Illuminance	37	19.6
Maximum	64	23
Minimum	20	17

Power Density Calculation

- Square Footage = 7052 ft^2
- Power= 68(OA)*65+10(OB)*32W+10(OC)*40W=5140W
- Power Density= 5140W/7052ft^2= 0.73W/ft^2

Power Density		
ASHRAE 90.1	**Actual**	**Difference**
1.1W/ft^2	0.73W/ft^2	-0.37W/ft^2

Performance Evaluation

As was proposed, the majority of the lumens are focused on the desk areas where it is most needed. Because of this, there is higher illuminance on the desk than is recommended by IESNA. IESNA recommends 30 fc, however; an average of 35 to 40 fc was achieved with some 70 fc values located directly under the luminaire. Positioning of the luminaires provides a higher amount of illuminance over the work stations, which also results in less wasted lumens.

Although the area of the western cubicles is brighter than the eastern, the daylighting provided by the exterior glazing should help make up the difference. Although there is no direct illumination on the center pathway, the indirect lighting component of the luminaires provides adequate illumination on the area with an average of 10fc. This is the recommended light level for hallways and egress. Along the western side of the office, the pathway is illuminated at a higher illuminance to the center in order to draw attention to the perimeter offices and means of egress.

The design worked as was intended with the exception of a slightly higher than desired illuminance level on the desk surfaces. One concern is the effect of scalloping on the western wall. However, according to the AGI model, any scalloping that might occur will occur in between the office doors.

Auditorium- Special Purpose Space

Existing Conditions:

The auditorium is located on the third floor or the first floor below grade (level 1P) in the southern portion of the building. It is 1594ft^2 and the height varies from 12 to 16 feet. It is surrounded by corridors on the east, west, and south side and a prefunction area to the north, therefore, no natural sunlight enters the space. It contains 142 seats and at the southern end of the auditorium lies a stage and motorized projector screen for presentations.

Materials:

Floor- The floor under the seating area is broad loom modular carpet tile. The stage is wood floor (WF-1)

Ceiling- The ceiling is Gypsum wall board (CLG1).

North Wall- The north wall consists of wood veneer (WD1) and upholstered wall panel (UWP2)

East Wall- The east wall consists of wood veneer (WD1), upholstered wall panel (UWP2), plastic laminate on plywood surface (PL1), and gypsum wall board painted alabaster (P1).

West Wall- The west wall consists of wood veneer (WD1), upholstered wall panel (UWP2), plastic laminate on plywood surface (PL1), and gypsum wall board painted alabaster (P1).

South Wall- The west wall consists of wood veneer (WD1), upholstered wall panel (UWP2), plastic laminate on plywood surface (PL1), and gypsum wall board painted alabaster (P1).

Material		Manufacturer	Style/Color	Reflectance
Modular Carpet	CPT-5	Constantine	Broad loom/ R204850	0.08
Wood Floor	WF-1	Robins	Northern Hard Maple	0.08
Gypsum Wallboard	CLG1	-	Bright White/ Flat Sheen	0.76
Wood Veneer	WD-1	-	Quartered Red gum	0.16
Upholstered Wall Panel	UPW2	-	029 Tonic	0.2
Paint	P1		Alabaster	0.5
Plastic Laminate	PL1		New White	0.6

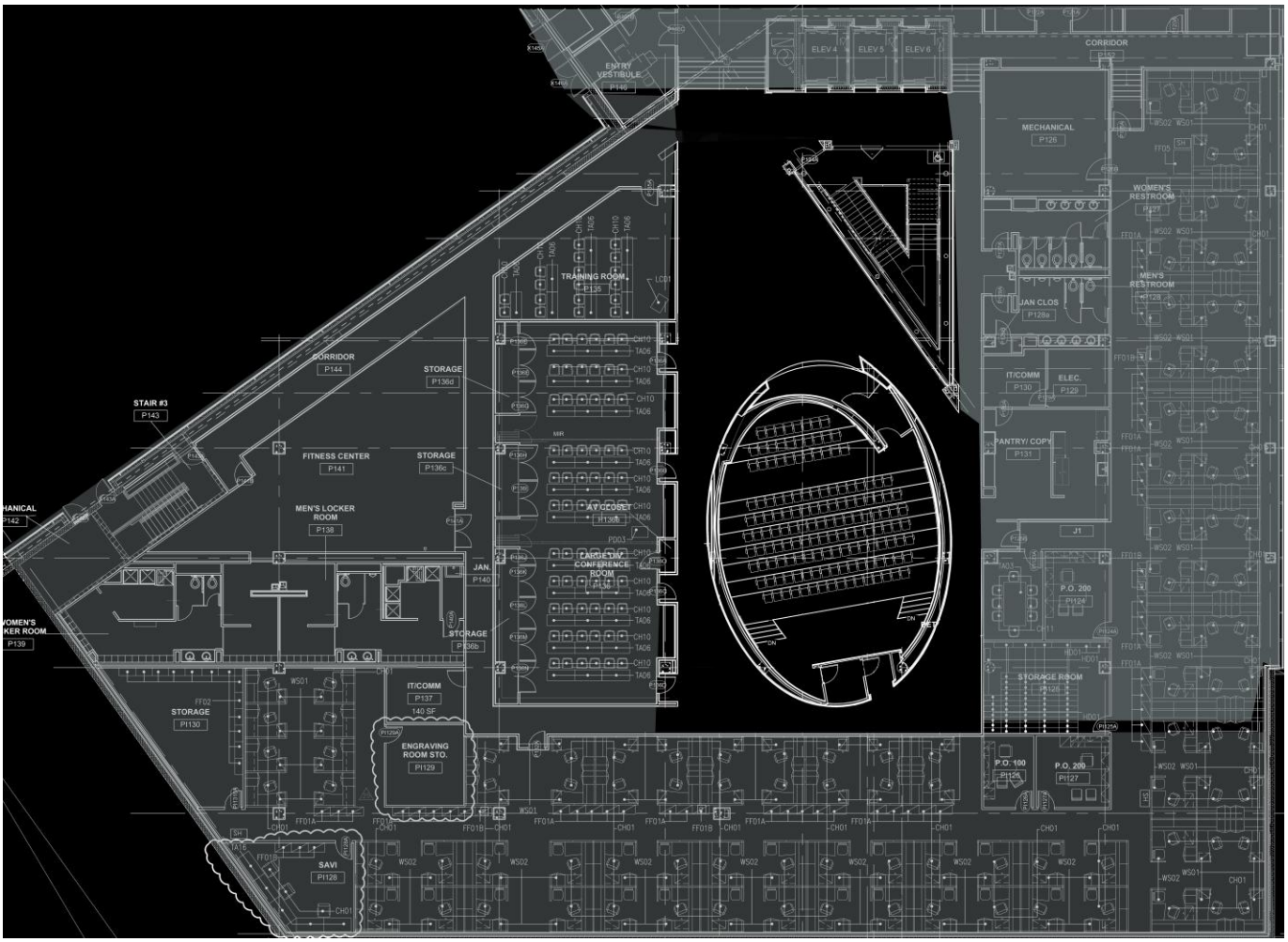


Figure: Auditorium Floor Plan

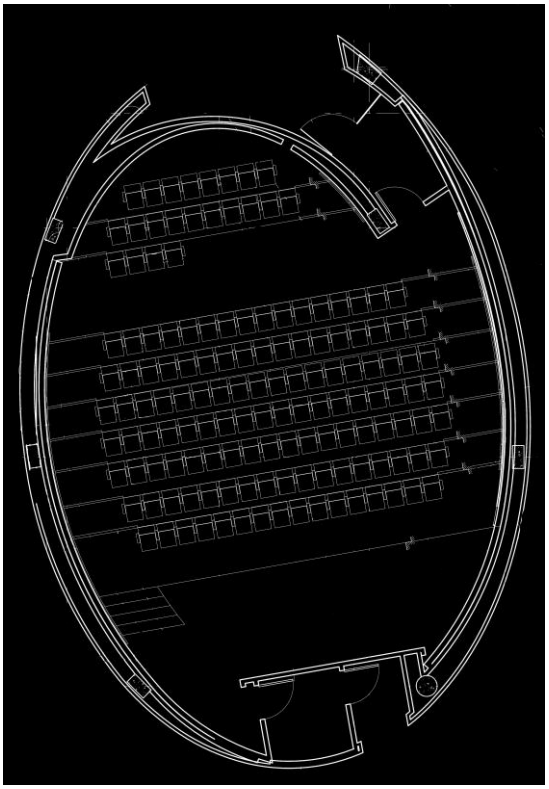
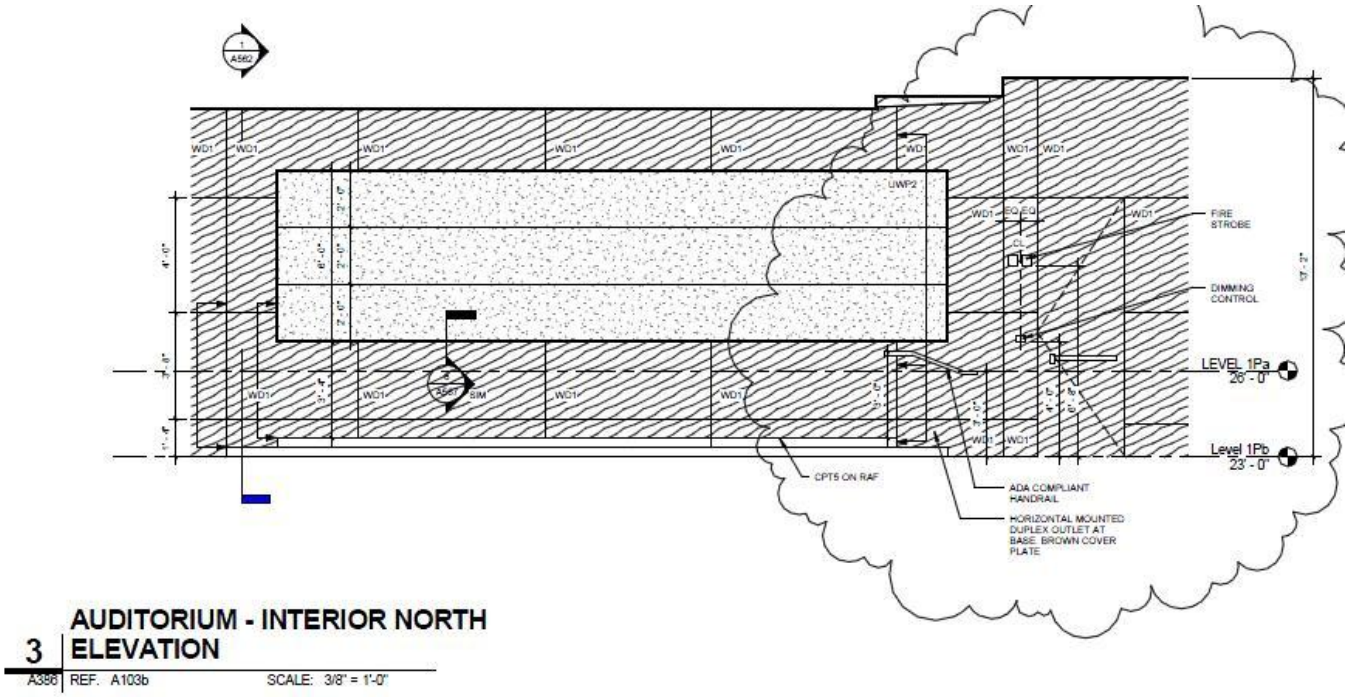


Figure: Auditorium Enlarged Floor Plan



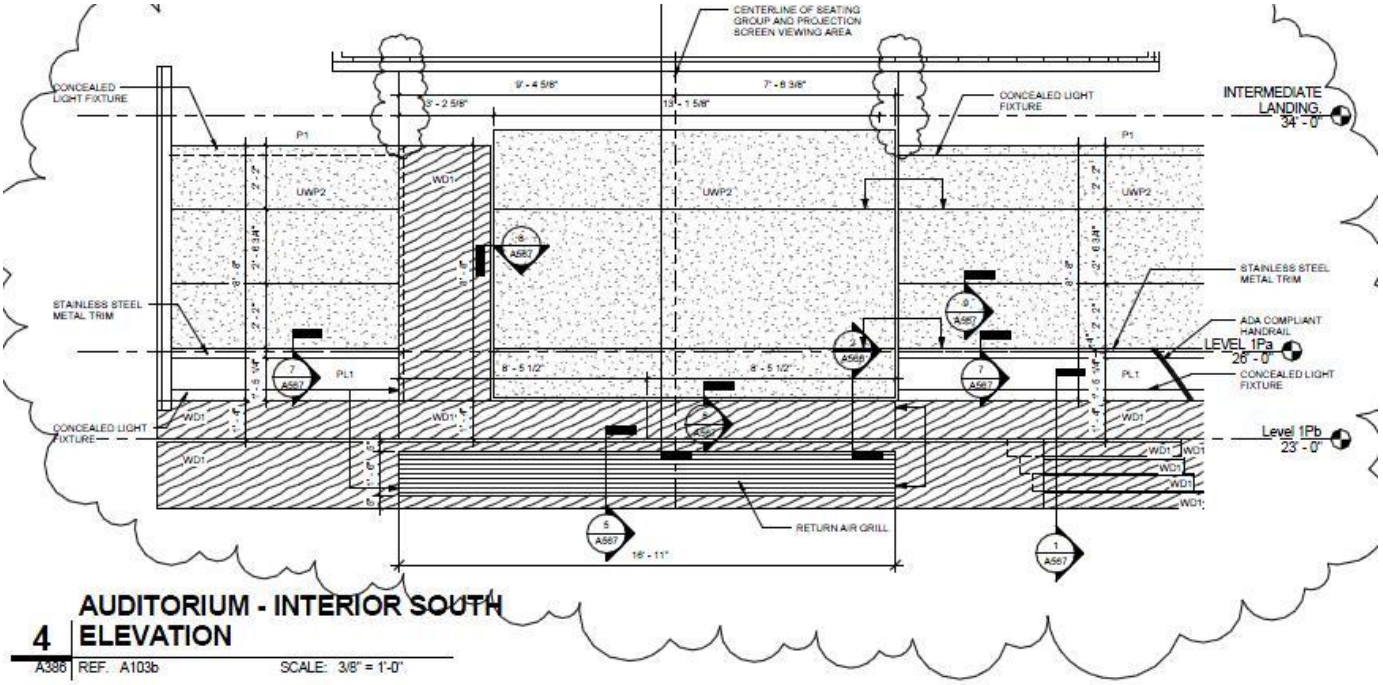


Figure 10: Auditorium elevations

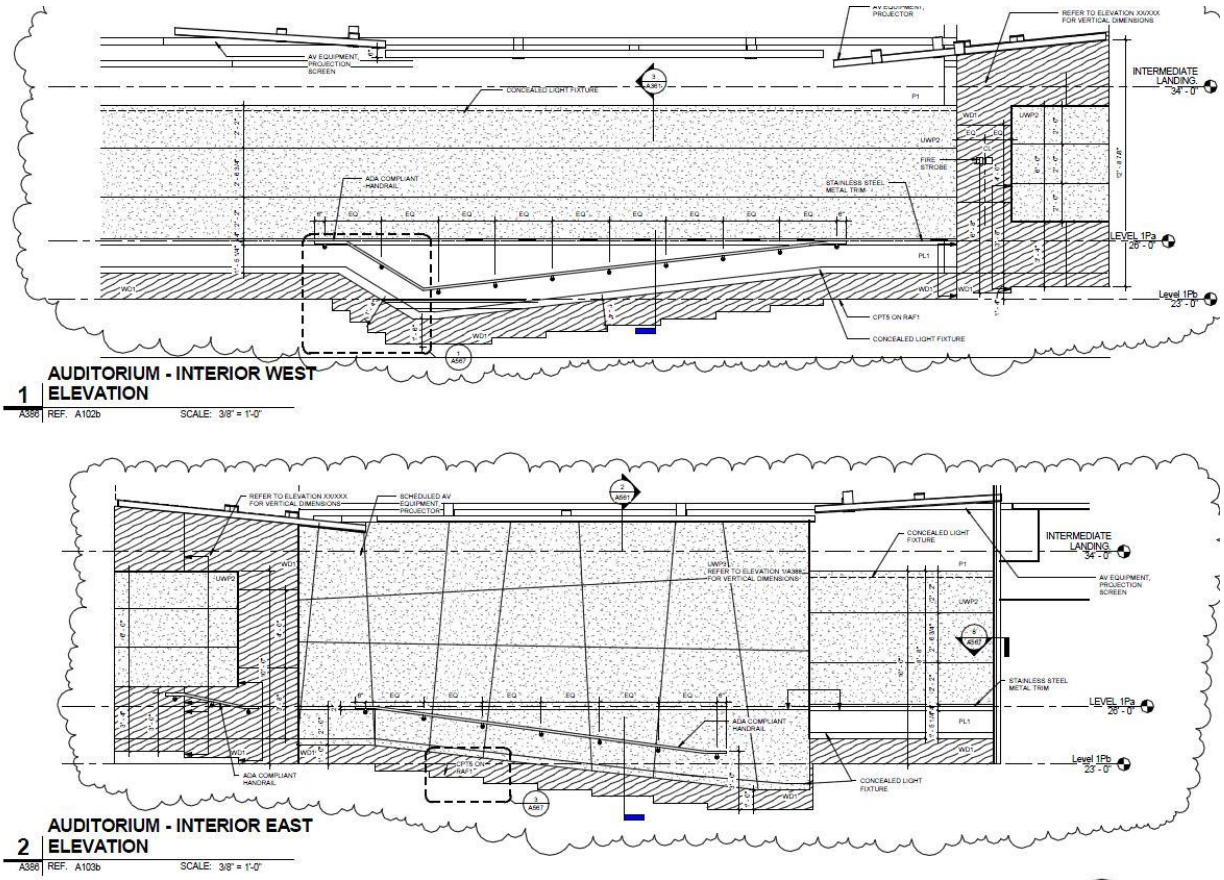


Figure 11: Auditorium Elevations

Design Criteria

Illuminance Values:

- Horizontal-30 fc
- Vertical- NA

System Control and Flexibility- Very Important

- Because this space can be used for different events and purposes, the lighting must be able to adjust for the specific tasks. For example, higher luminance values are necessary for reading or filing occupants to their seats but lower luminance values would be required for presentations on a projector. Also, the lighting must be able to highlight specific areas to draw attention such as the stage or a speaker at the podium.

Color Appearance (and Color Contrast) - Important

- Color appearance is important for rendering the furnishings in the space and making them appear more vibrant. Such finishes that would benefit from good color rendering characteristics would be the wood finishes of the stage and walls.

Modeling of Faces or Objects- Important

- Modeling of faces will be important in the space for on certain occasions there may be a speaker giving a presentation. It is therefore necessary to ensure that the speaker's facial expressions and characteristics are visible in order to enhance nonverbal communication. Excessive facial contrast should be avoided.

Points of Interest- Somewhat Important

- IESNA considers this design criterion to not be important for an auditorium, however, one may argue otherwise. The reason for this is because there are a couple areas that should draw the attention of the occupants and should therefore be brighter than the surrounding spaces. One of them being the stage area since it is where the most important activity will take place. The other is the side walkways because in times when the task in the space requires lower light levels (such as a presentation on the projection screen) occupants may have a hard time finding the exit unless the pathways are illuminated at a higher value.

Daylighting Integration and Control- Somewhat Important to Not Important

- Daylighting integration would be beneficial for such a large space in that it would help reduce the lighting load and help the space conform to ASHRAE 90.1 while

providing continuous spectrum light. Contrary to what IESNA recommends, one could argue that that daylighting for this particular auditorium is not important at all. One reason is because it will be impossible to incorporate daylighting since the space is isolated from any natural light. Also, because most of the tasks in the space will require use of the projection screen, daylighting will not be necessary since it would not be beneficial.

Lighting:

The existing lighting design uses incandescent downlights and track lighting. In order to reduce power consumption, many of the recessed down lights will be replaced with similar compact fluorescent fixtures. Above the seating area will be 4.5" x 4.5" recessed downlights, each housing a 32W triple tube CFL. Above the stage are sloped ceiling directional 7 ¼" conoid apertures, each housing one 42W triple tube CFL. In front of the stage will be par 38 track luminaires to highlight speakers. Around the perimeter of the auditorium will be flexible cold cathode luminaires that can conform to the curved walls. They will be installed in a way that will be comparable to a wall wash luminaire. Its purpose will be to illuminate not only the wall but also the side aisles.

There will be three different zones within the space. The first is the perimeter aisles whose lighting is composed of flexible cold cathode luminaires. The second is the central seating area which will be illuminated by recessed 32W CFL luminaires. The third zone is the stage which will be illuminated by a combination of directional recessed 42W CFL luminaires and PAR38 floodlights. Each zone will be independently controlled by dimmable switches.

Separate control of each zone will allow for scenes within the space. One scene will be for general assembly where all luminaires will be on and the entire space brightly illuminated. A second scene will be for attention on a speaker on stage in which all but the central seating luminaires will be on so as to provide focus towards the speaker on stage. The last scene would be for presentations given on the overhead projector, in which case only the perimeter cold cathode luminaires will be on to provide for just enough illumination for egress.

Auditorium Luminaire Schedule												
Type	**Image**	**Description**	**Manufacturer**	**Catalog NO.**	**No. of Lamps**	**Lamp type**	**Watts Per Lamp**	**Ballast Type**	**BF**	**Input Wattage**	**Voltage**	**Height**
AA		Sloped ceiling directional	Kurt Versen	P-904-DM	1	Sylvania CFTR32W/GX24Q/830	32W	Sylvania QTP 1/2XCF/UNV TM	0.97	36W	120	Varies between 12’-5” and 12’ 8” based on slope
AB		Recessed downlight square parabolic trim	Kurt Versen	H-8443-DM	1	Sylvania CFTR32W/GX24Q/830	32W	Sylvania QTP 1/2XCF/UNV TM	0.97	36W	120	12’-5”
AC		Sloped ceiling directional	Kurt Versen	P-904-DM	1	Sylvania CFTR32W/GX24Q/830	42W	Sylvania QTP 1/2XCF/UNV TM	1	46W	120	Varies between 12’-5” and 12’ 8” based on slope
AD		Spotlight/Floodlight	Altman Lighting, Inc.	PAR38	1	Sylvania 150PAR/FL	150W	NA	NA	NA	120	12’-5”
AE		Dimmable cold cathode cove curved on the inside of auditorium	Cathode LTG Systems	Flexible Cathode Light Strips-FCLS-C-277- 7.2 Lumens/Watt 30TC-3500K Dimmable	1	Flexible Cathode Light Strips FCLS-C-277	13.7W/ft		0.9	13.7W/ft	277	Varies with ceiling slope

Light Loss Factors			
Luminaire Type	LLD	LDD	BF
AA	0.9	0.9	0.97
AB	0.9	0.9	0.97
AC	0.9	0.9	1
AD	0.7	0.9	NA
AE	0.9	0.9	0.9

*LDD Values are based on the IESNA 2011 handbook calculation

Performance Graphics

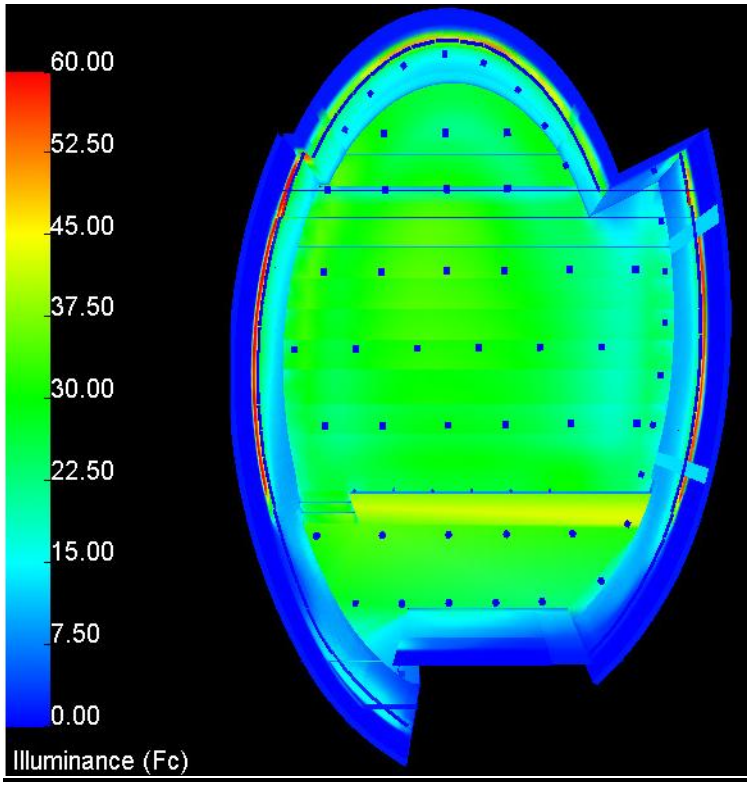


Figure: Auditorium Pseudo Scene 1

Figure 15: Auditorium Perspective Scene 1

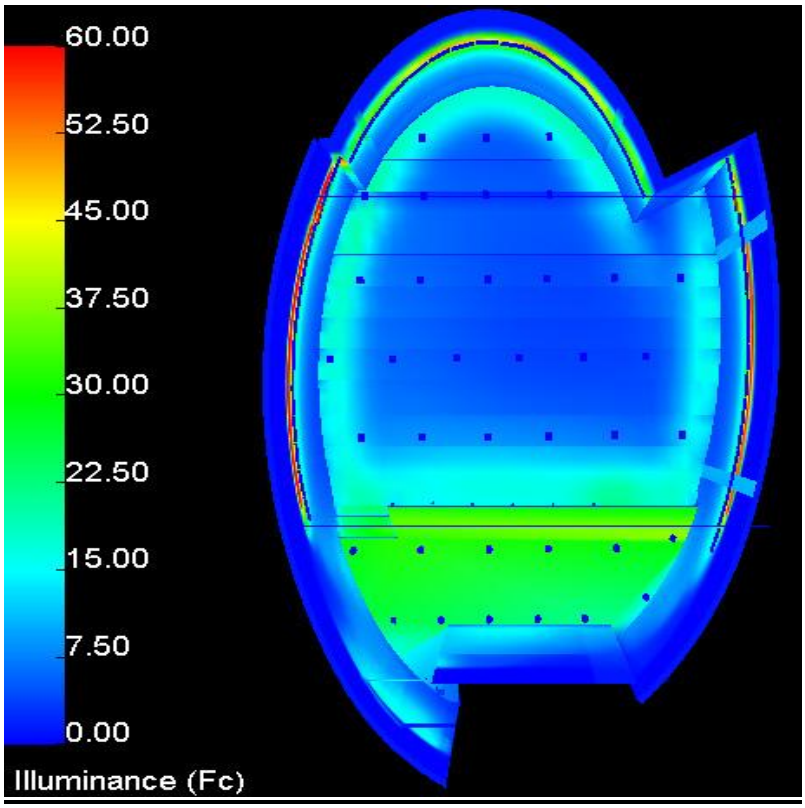


Figure: Auditorium Pseudo Scene 2

Figure: Auditorium Perspective Scene 2

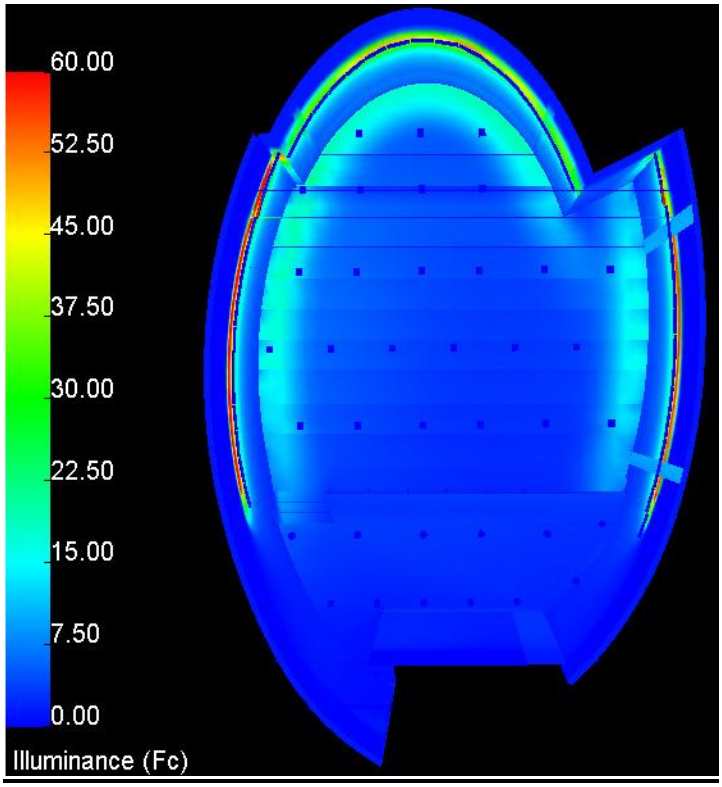


Figure: Auditorium Pseudo Scene 3

Figure: Auditorium Perspective Scene 3

Illuminance Values		
	Seating	Stage
Average Illuminance	29	48
Maximum	40	75
Minimum	12	20

Power Density Calculation

Square Footage= 1594ft^2

Power= 8(AA)*36W+18(AB)*36W+12(AC)*46W+6(AD)*150+92ft(AE)*13.4W/ft=3620.8W

Power Density = 3620.8/1594= 2.27W/ft^2

Ashrae 90.1 Allowed Power Density = 2.6W/ft^2

Power Density		
ASHRAE 90.1	**Actual**	**Difference**
2.6 W/ft^2	2.27 W/ft^2	-0.33 W/ft^2

Performance Evaluation

In the first scene, the illuminance over the three zones is quite uniform at 30 fc. This was the desired result for the purpose of this scene is to allow occupants to navigate throughout the entire space with visual clarity. The uniformity on the stage may vary do to the positioning of the track lights based on whether or not attention is being focused on a guest speaker.

The results of the second scene were also satisfactory. In this scene, the lights above the seating area were turned off so that hardly any foot candles measured. The purpose of this was to direct the focus of the audience to the stage. The perimeter wall grazing luminaires still remain on to provide the recommended illuminance for egress, which is 10 fc.

For the final scene, all lights but the perimeter cold cathode luminaires were turned off. This is meant for projector screen presentations while providing illuminance for the perimeter aisles. An average of 10 fc is cast along the perimeter to provide adequate illuminance for egress. Almost no foot candles were cast on the other zones.

Prefunction Area- Circulation Space

Existing Conditions:

The Prefunction area is located just outside the entrance to the auditorium and will serve as a gathering space for employees or guests who are about to participate in events taking place within the auditorium or large conference room. Surrounding the space are conference rooms, an auditorium, elevator lobby, and glass staircase. The space is 12'-0.5" high and approximately 3402ft ^{2}. Because the staircase is transparent and has a skylight that leads to the roof of the building, there is a possibility that the space may receive some amount of daylighting. However, since this light must travel through 5 stories, its impact on the space should be minimal.

Materials:

Floor-The floor is stone plank (ST-1) ST-1: Stone Floor (Plank)

Ceiling- The ceiling is gypsum wall board (CLG1).

Base- The base is flush wood base (WB3).

North Wall- Not enclosed, Material NA

East Wall- The east wall is composed of Italian plaster (SP1) and gypsum wall board (GWB1).

South Wall- The east wall is composed of Italian plaster (SP1).

West Wall- The east wall is composed of Italian plaster (SP1) and gypsum wall board (GWB1).

Material		Manufacturer	Style/Color	Reflectance
Stone Floor	ST-1	Alabama Stone Company	Honed/ Limestone	0.2
Flush Wood Base	WB3	-	6"high/Alabaster	0.2
Gypsum Wallboard	CLG1	-	Bright White/ Flat Sheen	0.76
Italian Plaster	SP1	Valley Craftsmen	Hand Applied	0.5
Upholstered Wall Panel	UPW2	-	029 Tonic	
Gypsum wall board	GWB1	-	Alabaster sheen	0.5

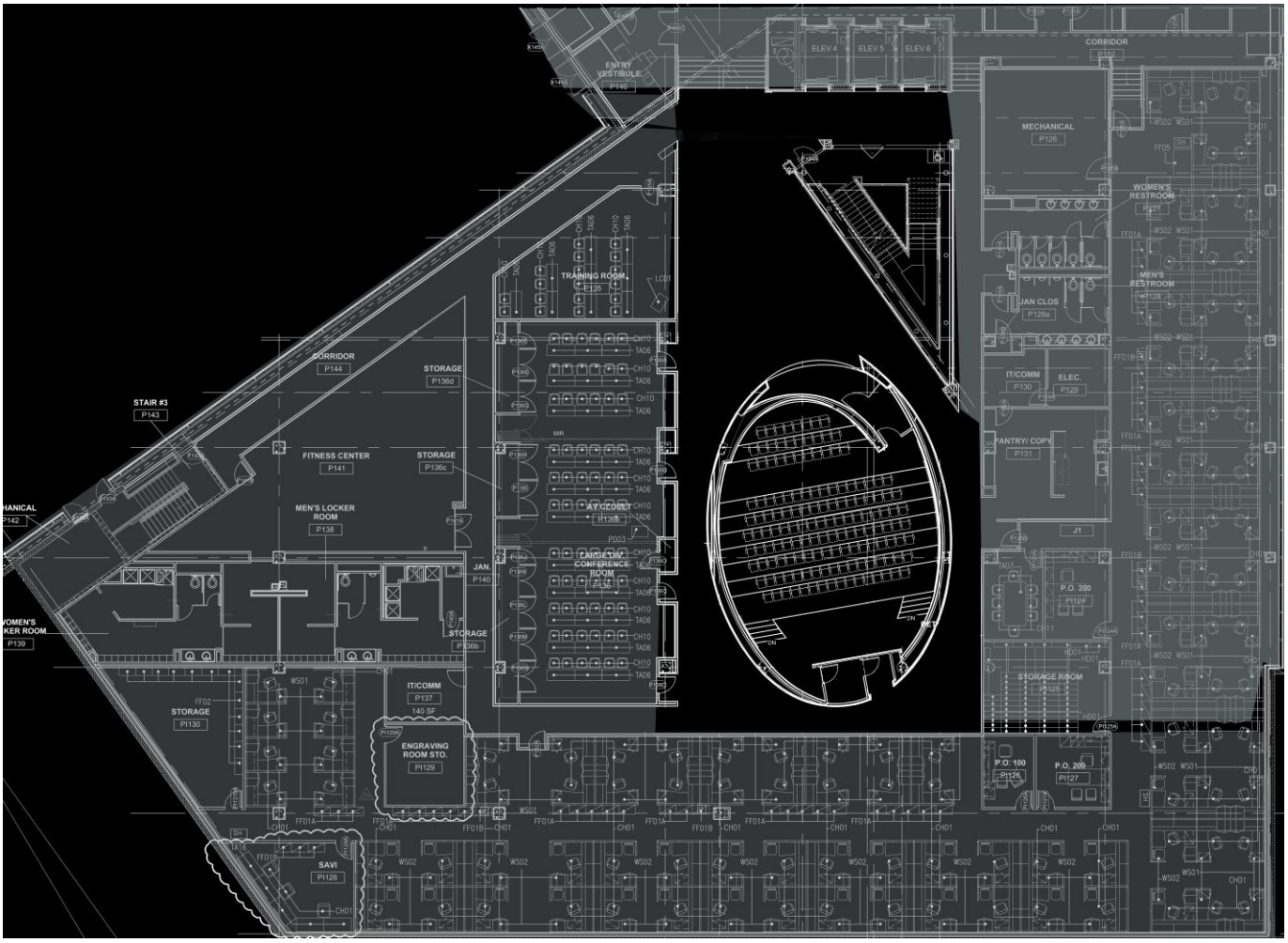


Figure: Prefunction Floor Plan

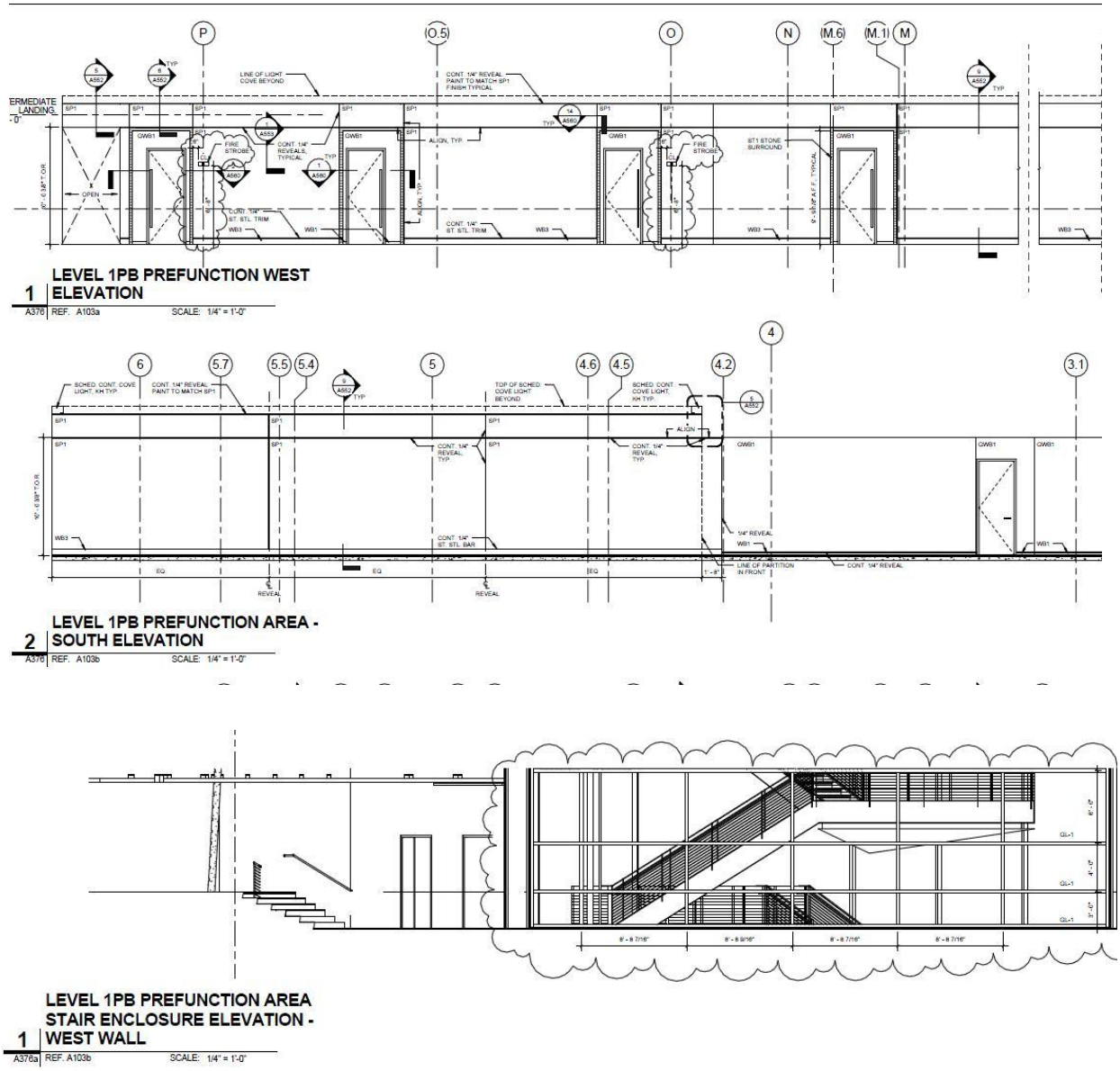


Figure: Prefunction Elevations

Design Criteria: Offices- Lobbies, lounges, and reception areas

Illuminance Values

- Horizontal Illuminance: 10 fc
- Vertical Illuminance: 3 fc

Psychological Reinforcement

- Two psychological impressions would be appropriate to incorporate through two different lighting schemes in the space. These impressions are that of spaciousness and enclosure. An impression of spacious ness is achieved by brightly illuminating the ceiling and walls. Enclosure is experienced through the

use of over-head direct downlighting without any emphasis on lighting the ceiling or walls.

Appearance of Space and Luminaires- Very Important

- The prefunction area will often be used as a socializing area, possible including guests who do not work within the building. Therefore, appearance of the space is important in order to make a good impression and to set a proper mood for the event that is about to take place. The luminaires should also be located in a manner which helps guide occupants through the space to other areas it connects to.

Color Appearance- Important

- Food is often served in prefunction areas before an event and color appearance is crucial for determining how appetizing the food will appear. Color appearance is also important for the general rendering of people and to make socialization more pleasant.

Direct Glare- Important

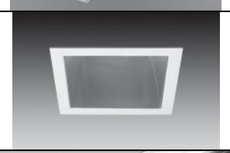
- Direct glare can cause discomfort to the occupants and inhibit social interaction. Luminaires should not be placed in the direct line of sight of the occupants.

Modeling of Faces or Objects- Important

- Because this will be a space for social interaction, facial modeling is important for occupants to read other people's facial expressions. Luminaires should be aimed in a way that excessive facial contrast is avoided.

Lighting:

The goal of the design for this space is to produce a psychological impression of spaciousness. Some of the features that will be taken advantage of are the wide open area, relatively high ceiling, and the glass stair case that will provide vision across the entire space. Lighting techniques such as cove lighting and wall washing will be implemented to draw the occupants' attention towards the perimeter and ceiling, which will in turn produce a sense of spaciousness.

Prefunction Luminaire Schedule												
Type	**Image**	**Description**	**Manufacturer**	**Catalog NO.**	**No. of Lamps**	**Lamp type**	**Watts Per Lamp**	**Ballast Type**	**BF**	**Input Wattage**	**Voltage**	**Height**
PA		Continuous wall wash cove	Mark Architectural Lighting	PPL-WH-277-1T5HO-EB	1	Sylvania F54/835/HO	54W	Sylvania QTP1X54T5HOUNVPSN	1	60W	277	12’-0 ½”
PB		Recessed downlight square parabolic trim	Kurt Versen	H-8443-DM	1	Sylvania CFTR32W/GX24Q/830	32W	Sylvania QTP 1/2XCF/UNV TM	0.97	36W	277	12’-0 ½”
PC		Ceiling Cove	Elliptipar	F305-T128-S-00-2-00-0	1	Sylvania FP28/835	28W	Sylvania QTP1x28T5UNVPSN NL	1	33W	277	12’-0 ½”

Light Loss Factors			
Luminaire Type	LLD	LDD	BF
PA	0.89	0.95	1
PB	0.9	0.95	0.97
PC	0.9	0.95	1

*LDD values are based on the IESN 2011 handbook calculation

Performance Graphics:

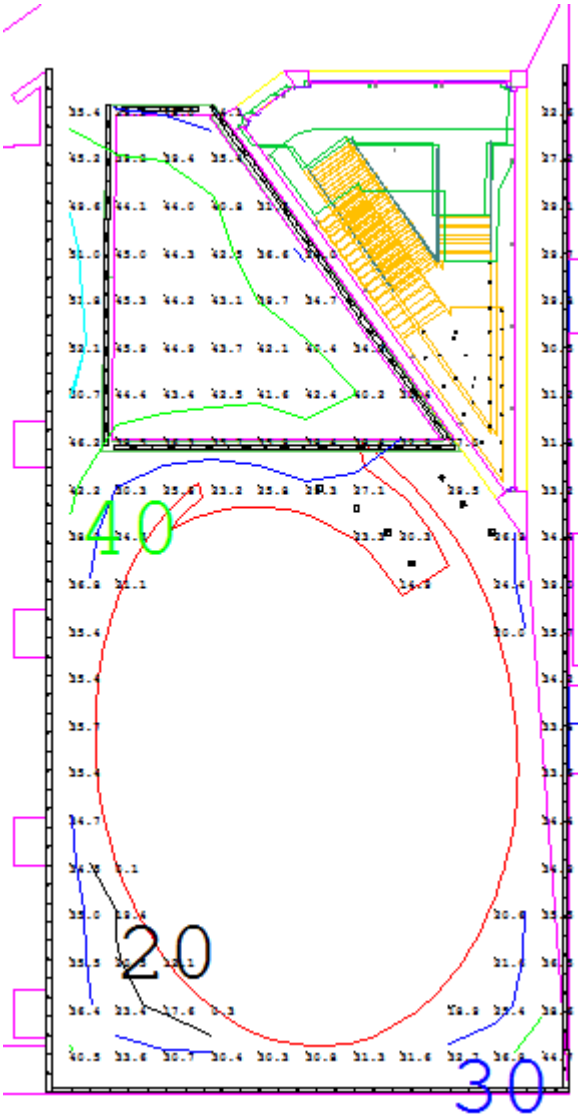


Figure: Prefunction Isoline

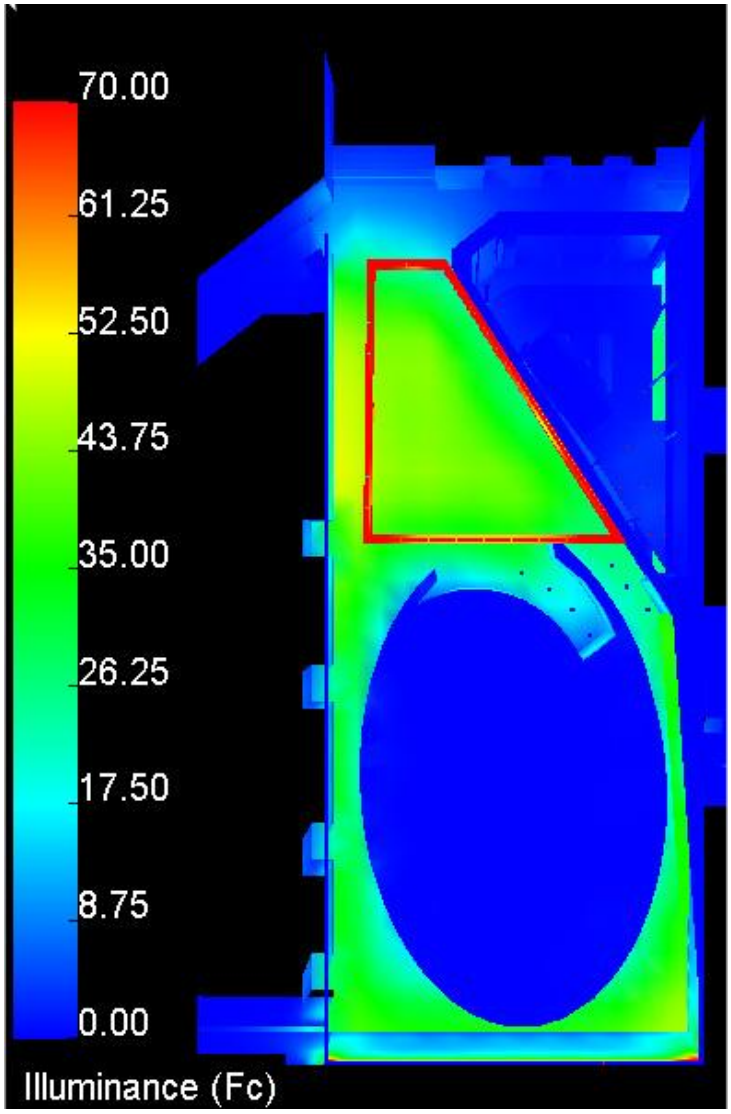


Figure: Prefunction Pseudo Color

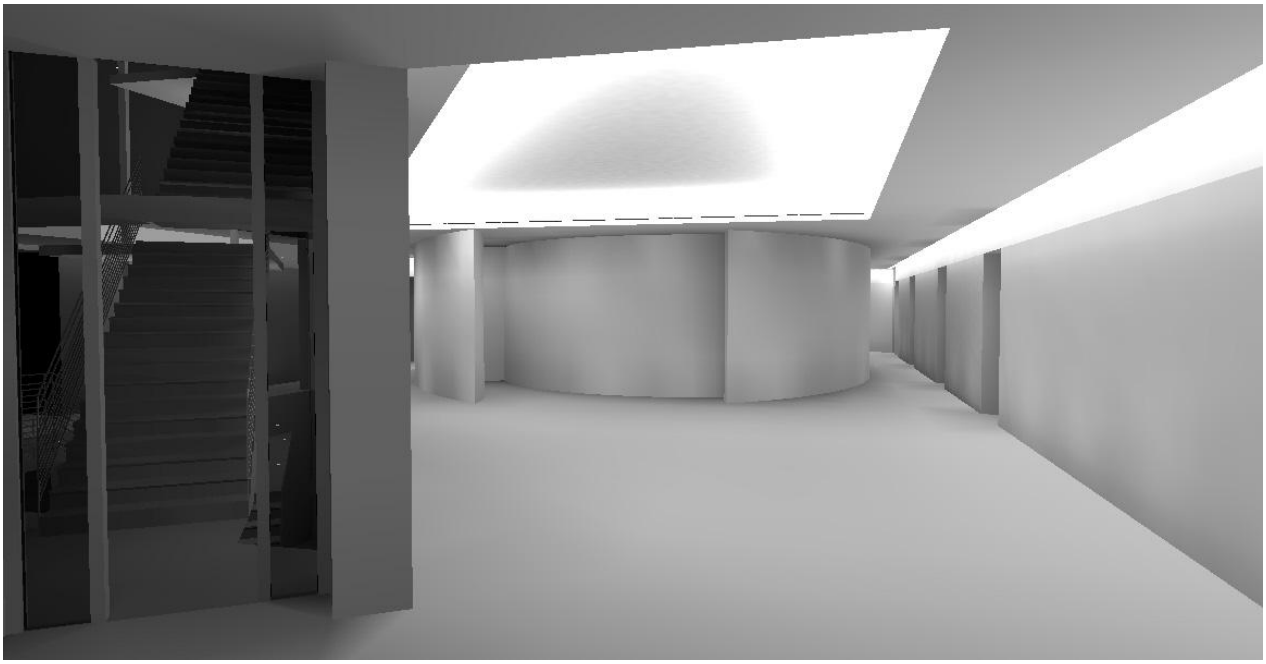


Figure: Prefunction Grayscale Perspective

Evaluation:

The addition of a cove makes the biggest impact within the space, giving an impression of the space being bigger than it really is. The perimeter wall slots do a good job at uniformly illuminating the perimeter at the recommended 30 fc. The center area is a little more illuminated than the IESNA recommended 30 fc, with an average illuminance of about 40 fc. This however will help to reinforce the impression of spaciousness.

Power Density Calculation

66(PA) * 54W + 31(PC) * 28W = 4432W
4432W/ 3410ft^2 =1.29W/ft^2

Power Density		
ASHRAE 90.1	**Actual**	**Net Difference**
1.3W/ft^2	1.29W/ft^2	0.01 W/ft^2

Outdoor Plaza- Exterior Space

Existing Conditions:

The outdoor plaza is located where the three below grade levels transition into a five story triangular tower. It is approximately 37779 ^{ft2} and will have features such as pedestrian walkways, seating areas, planters, and a roof monument pad. The purpose of this space will be for relaxation and circulation. An interesting fact about the plaza is that it also serves as a green roof for the lower floors, giving the building LEED credibility.

Materials:

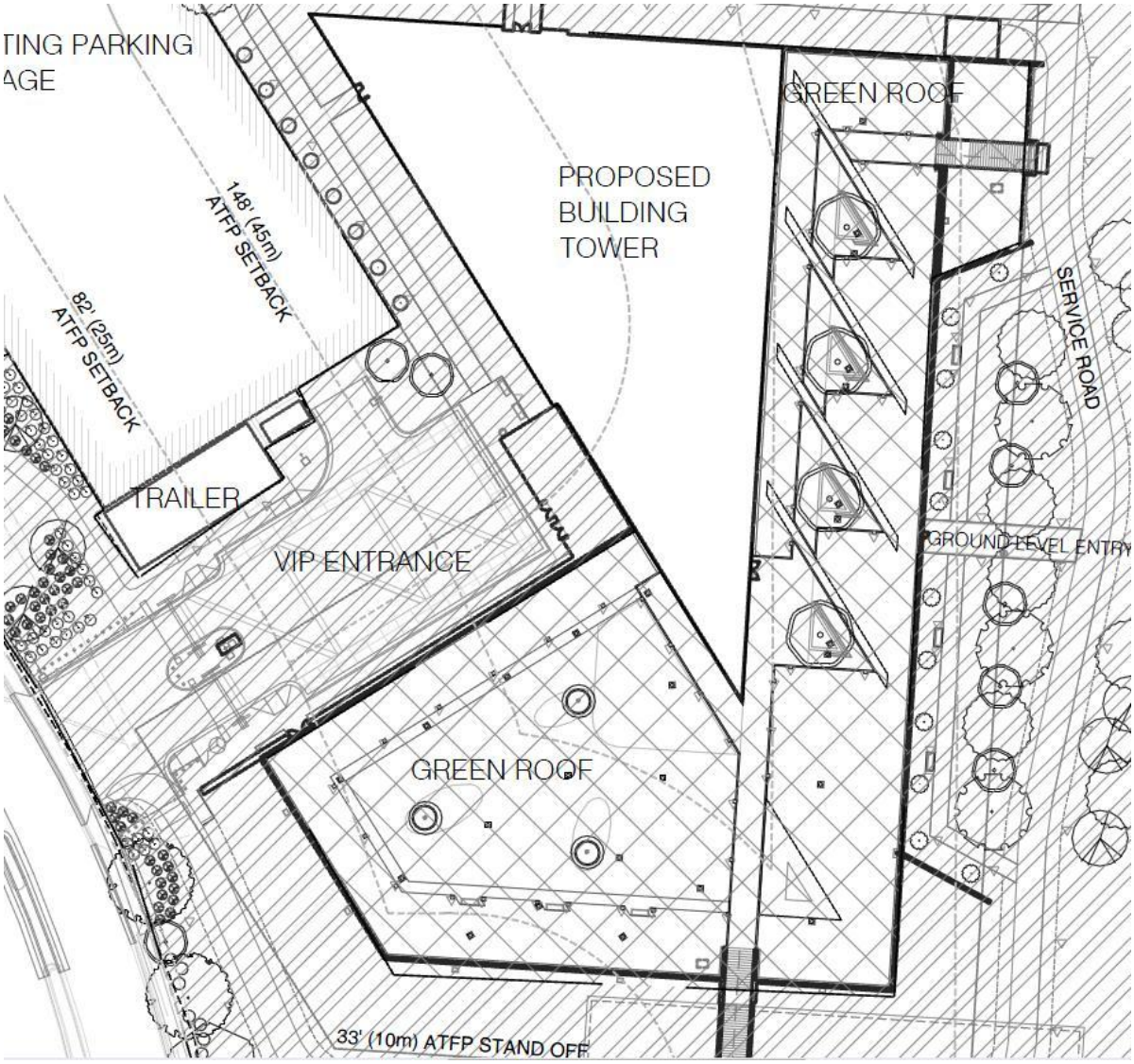
Grass- Reflectance: 0.24

Walkways- Paver D: Pedestal Pavers

- Reflectance: 0.15

Paver B: Flagstone Paving

- Reflectance: 0.28


TING PARKING
AGE
GREEN ROOF
PROPOSED
BUILDING
TOWER
148' (45m)
ATFP SETBACK
82' (25m)
ATFP SETBACK
SERVICE ROAD
TRAILER
VIP ENTRANCE
GROUND LEVEL ENTRY
GREEN ROOF
33' (10m) ATFP STAND OFF

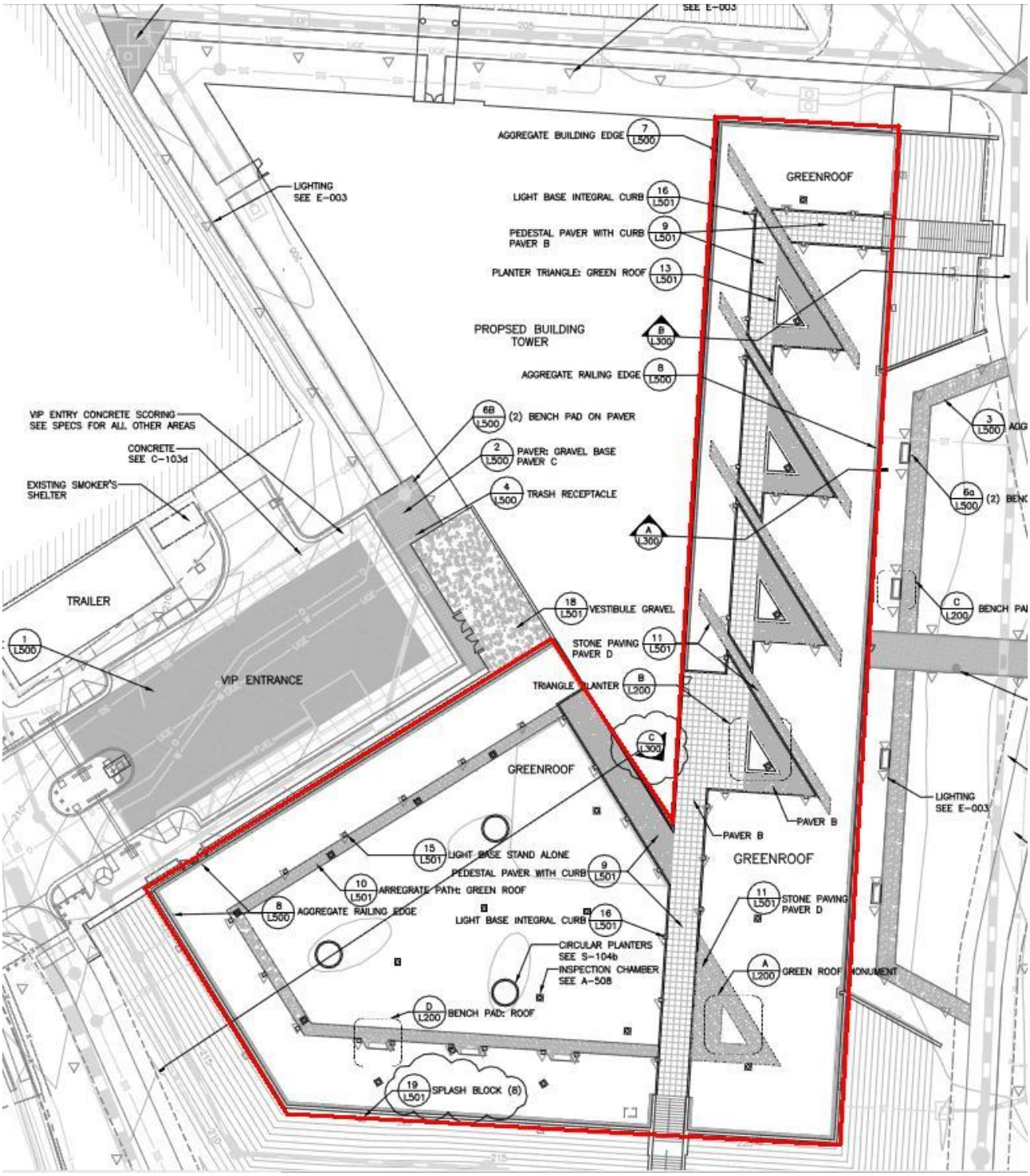


Figure 21: Plaza Floor Plans

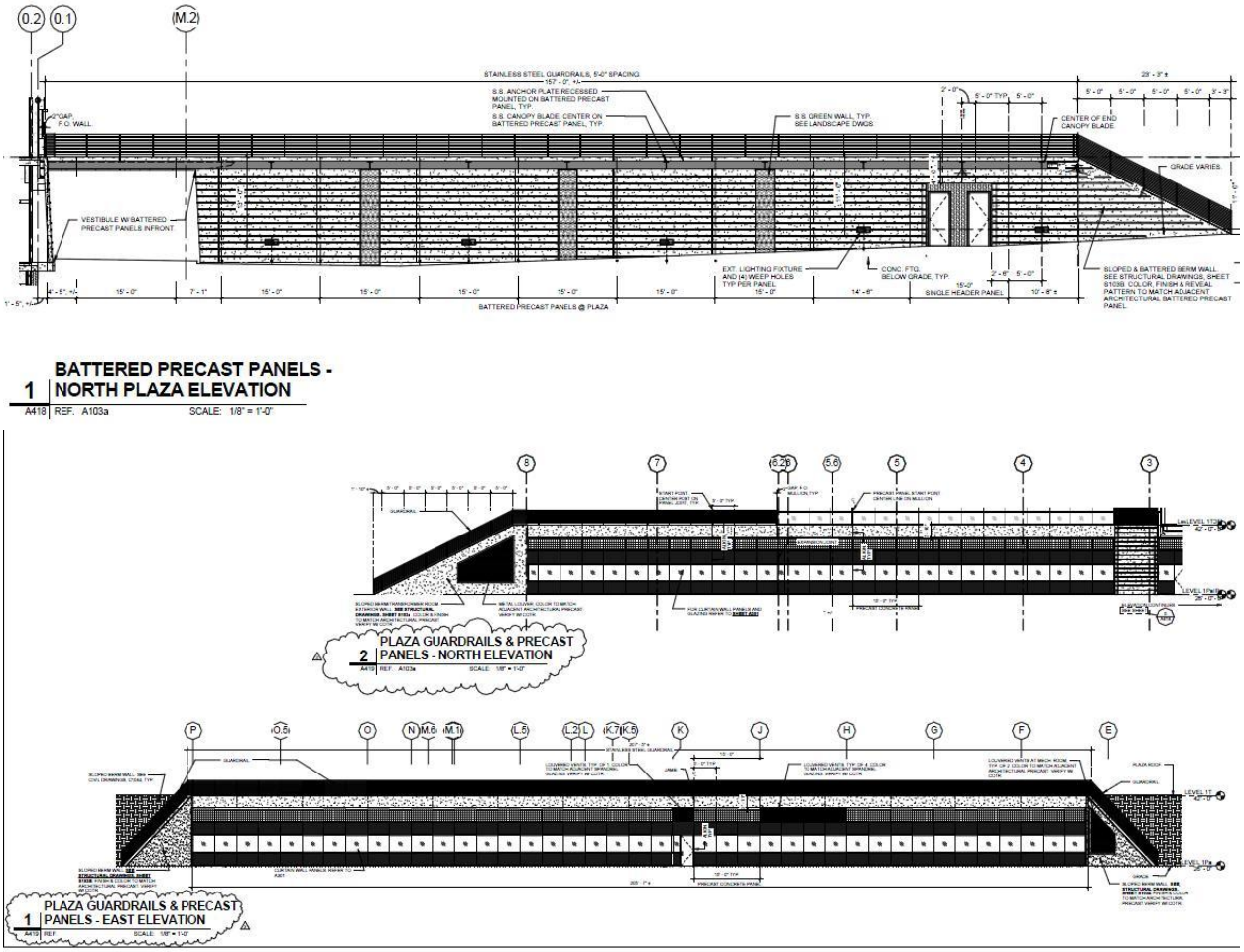


Figure 22: Plaza Elevations

Design Criteria: Parks, Plazas, and Pedestrian Malls

Illuminance Values

- Horizontal-5 fc
- Vertical- 3 fc

Color Appearance (and Color Contrast) - Very Important

- The plaza will contain vegetation in the form of trees and shrubbery and it is desirable to showcase these items to make the space seem lush and inviting at night. Lamps with CRI's of 80 or higher should be sufficient for rendering the vegetation.

Direct Glare- Very Important

- Direct glare can cause discomfort to pedestrians and inhibit their ability to navigate through the space. Considerations must be taken to avoid placing luminaires directly in the line of sight of occupants. Also, shielding can be incorporated on the luminaires.

Light Pollution/Trespass- Very Important

- Light pollution and trespass can cause discomfort to and affect the appearance of surrounding properties. Fixtures should have shielding or cutoffs and be placed as close to the pathways as possible. This is to ensure wasted light is kept to a minimum.

Modeling of Faces or Objects- Very Important

- Human interaction and socialization will be a very common experience within the space. Many co-workers within the office building will meet on a regular basis within the space, so modeling of faces is important for facial recognition. Luminaires should be aimed in a way that excessive facial contrast is avoided.

Shadows- Very Important

- Shadows can be distracting for occupants circulating through the space. They can also impair visual clarity on the pathways and make the space unpleasant. Lighting from multiple directions can help soften up shadows and make the pathways more uniformly light.

Source/Task/Eye Geometry- Very Important

- The space will be used for either circulation around the site or relaxation. It is important that the occupants circulating through the space are not affected by direct glare. All light sources should not be immediately visible which might cause glare.

Appearance of Space and Luminaires- Important

- The outdoor plaza is one of the first things visitors will notice about the building so it is crucial that the space be well displayed well. Lighting fixtures and layout should reflect the building and surround landscape style as best as possible.

Points of Interest- Important

- The plaza will contain both circular and triangular planters as well as a monument platform. These will be key features for the space and should be highlighted. Direct lighting on the trees and the proposed monument should provide contrast with the surrounding site and draw the attention of visitors.

Lighting:

The main focus is to light the pathways with luminaires shorter than eye level. The reason for this is to avoid making the area look public at night. Because this is a government building, security is a top priority. Therefore, only employees will be utilizing the space and using lower mounted fixtures should provide adequate illuminance over the paths for them. One of the features that will be most accentuated is the planters and the trees. Luminaires will be incorporated into the planters and the trees will be uplight. The purpose of incorporating the luminaires into the planters is to give the sense that these features are actual luminaires.

Plaza Luminaire Schedule												
Type	**Image**	**Description**	**Manufacturer**	**Catalog NO.**	**No. of Lamps**	**Lamp type**	**Watts Per Lamp**	**Ballast Type**	**BF**	**Input Wattage**	**Voltage**	**Height**
GA		Outdoor pole mounted	Elliptipar	M452-035G-S-02-277-V0	1	Sylvania MC39T6/U/G12/830	39W	Sylvania QTP 1X39MH/UNV F	1	45W	120	3’
GB		Outdoor surface mounted luminaire	Allscape	B-MD-LED-e28-S-MIT-1-B	1	3k LED	2W	NA	NA	NA	120	On grade
GC		Linear recessed wall luminaire	Ligman	A-41051-RAL 9006	1	Sylvania CFTR32W/GX24Q/830	32W	Sylvania QTP 1/2XCF/UNV TM	1	36W	120	1’-6”
GD		Landscape luminaire	Cooper Ltg	740-MH70 Par38-120-EL- MB-BK	1	Sylvania MCP70PAR38/U/SP/830/ECO	70W	Sylvania M70/MULTI-KIT	1	95	120	3’
GE		Railing integrated LED luminaire	Luxrail	0-06-SSS-1-PM-NR-65-3K-2	As Required	White LED 32K	2.1 W/ft	NA	NA	2.1W/ft	277	Underneath Handrail

Light Loss Factors			
Luminaire Type	LLD	LDD	BF
GA	0.8	0.8	0.97
GB	0.7	0.8	NA
GC	0.93	0.8	1
GD	0.7	0.8	1
GE	0.7	0.8	NA

*LDD values are based on the 2011 IESNA handbook calculation

Performance Graphics:

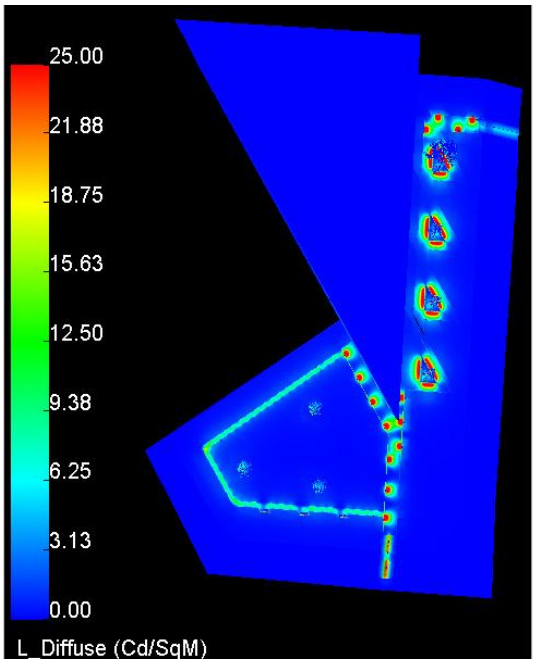


Figure: Plaza Pseudo Plan

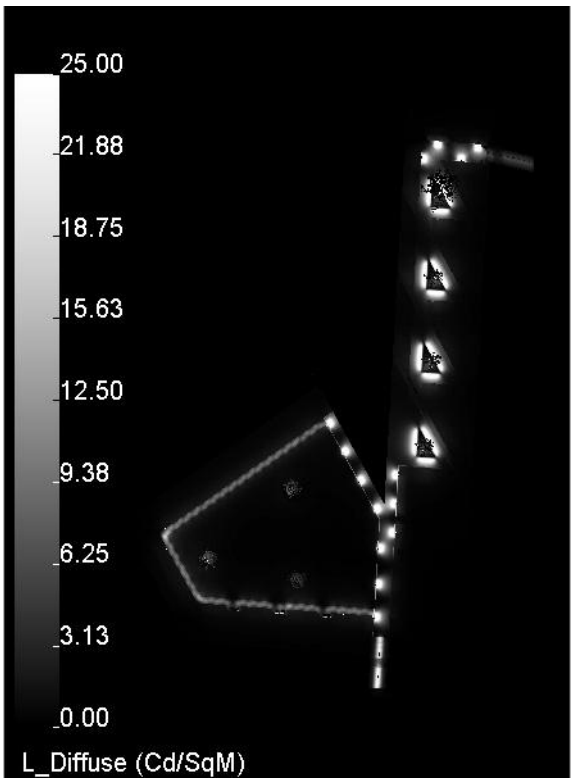
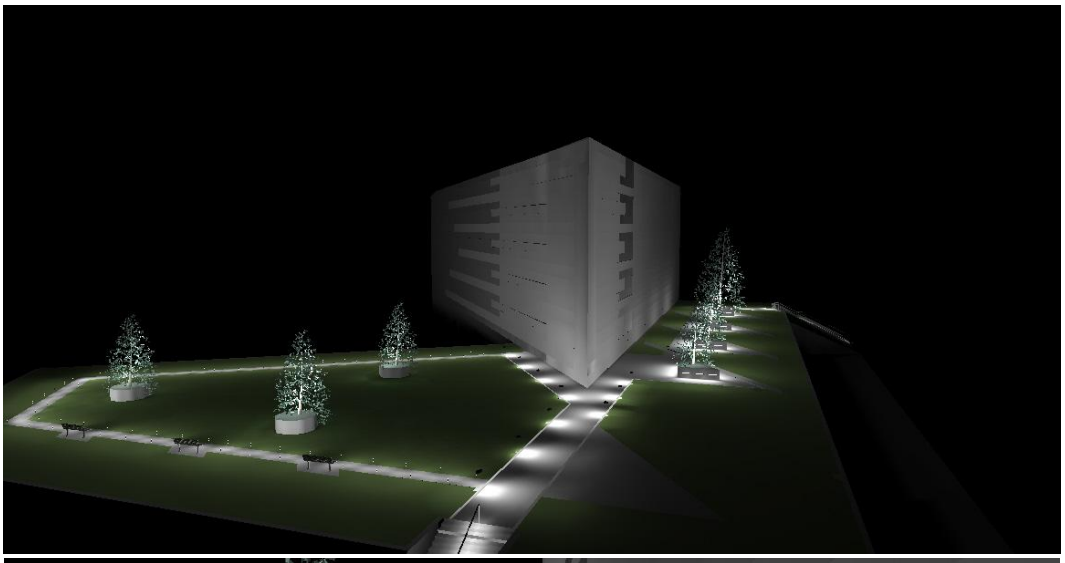
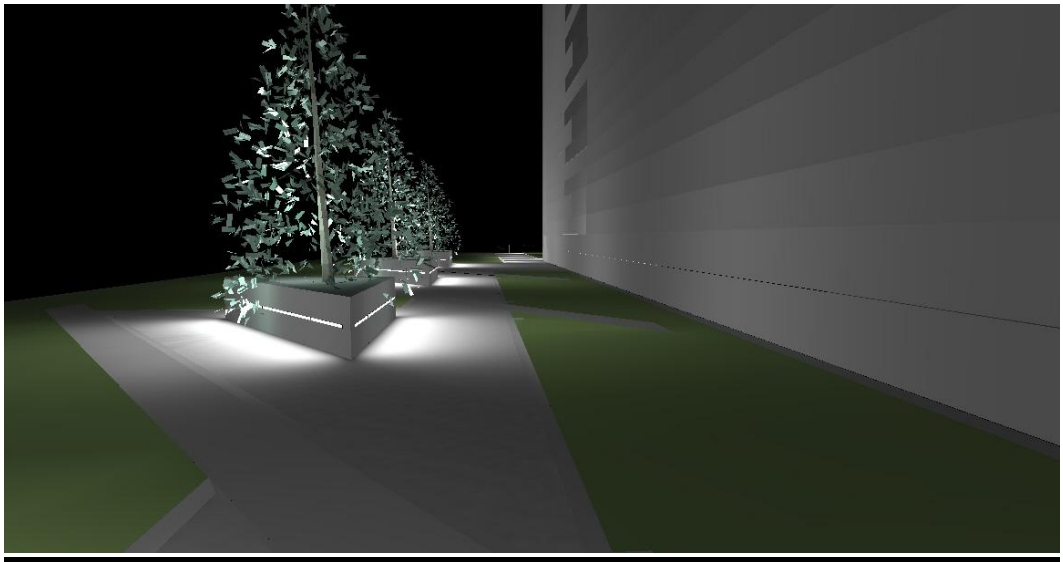
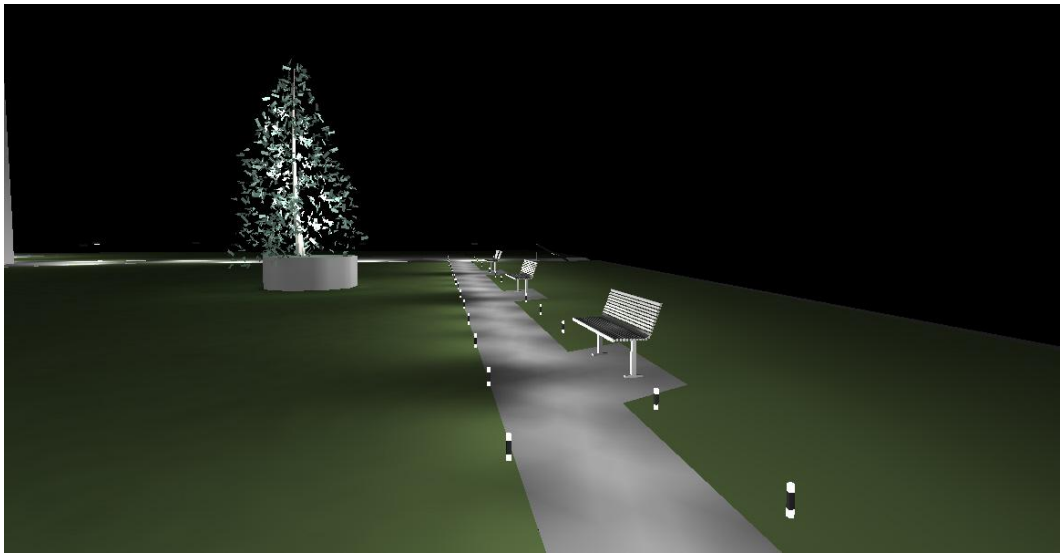


Figure: Plaza Grayscale Plan







Evaluation:

The low height luminaires concentrate the light solely on the pathways quite well, which makes sure lumens aren't wasted where it is not needed. While focusing the lumens onto the areas where it is intended, a side effect was multiple hot spots along the pathways. This is not much of a design flaw for it tends to produce a rhythmic pattern. The planter integrated luminaires illuminate the surrounding area well and give the impression that planter is a luminaire itself.

Because all the luminaires are below eye level, one might argue that facial features will not be rendered and a sense of insecurity may result. One factor that must be taken into consideration that is not able to be proven in AGI model is light bouncing off the ground and illuminating faces. Another light source that cannot be displayed in the model is the spill light from the building itself. The majority of the façade that faces the plaza is glazing. Since this glazing rises five stories high, adequate vertical illuminance for facial rendering is to be assumed.

Power Density Calculation

Walkways < 10ft
78(GB)*2W= 156W
156W/291ft = 0.5W/ft

Walkways < 10ft wide
14(GA)*45 + 28(GC)*36 = 1350W
1350W/6770ft^2=0.19

Stairways
South Stairs: 32ft (GE)*2.1W/ft= 67.2W
67.2W/413ft^2= 0.16 W/ ft^2
East Stairs: 36ft (GE)*2.1W/ft= 75.6
75.6W/412.5 ft^2

Power Density			
	ASHRAE 90.1	Actual	Difference
Walkways < 10 ft	1.0 W/linear foot	0.5W/linear foot	-0.5W/linear foot
Walkways ≥ 10ft	0.2 W/ft^2	0.19W/ft^2	- 0.01 W/ft^2
South Stairway	1.0W/ft^2	0.16W/ft^2	-0.84 W/ft^2
East Stairway	1.0W/ft^2	0.18 W/ft^2	-0.82 W/ft^2

Electrical Depth

Panelboard Redesign

For each of the spaces affected by the new lighting designs, adjustments to the branch circuits, feeder sizes, and panelboard layout were made. The changes are illustrated below:

Panelboard Change summary

Panelboards						
Panel Tag	Voltage	System	Office	Prefunction	Auditorium	Plaza
LS4T	208Y/120, 3P, 4W	N	X			
LN4T	208Y/120, 3P, 4W	N	X			
HN4T	480Y/277, 3P, 4W	N	X			
LDIM1	208Y/120, 3P, 4W	N			X	
HDIM2	480Y/277, 3P, 4W	N			X	
ELDIM1	208Y/120, 3P, 4W	E			X	
EHS3P	480Y/277, 3P, 4W	E		X		
H1PB	480Y/277, 3P, 4W	N		X		
L1PBB	208Y/120, 3P, 4W	N				X

Open Office Electrical Redesign

All luminaires within the space are controlled by a computerized relay panel and are set on a time schedule. There is a low voltage override switch which overrides the schedules incase occupants are within the space outside the programmed time range.

The affected lighting loads for the open office space can be found on panel HN4T:

PANEL HN4T

PANEL: HN4T — MAIN BUS RATING 225A
MAIN BREAKER: NO. OF POLES 3 — FRAME 225A — TRIP 150A — TYPE MCB
VOLTAGE: 480 Y277, 3P, 4 WIRE — MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 14,000

CIRCUIT DESCRIPTION	CTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
LTG OPEN AREA T419	2.81	------	------		20	1	1	2	1	20		0.45	------	------	LTG CONFERENCE T412
LTG OPEN AREA T419	------	1.71	------		20	1	3	4	1	20		------	0.45	------	LTG PANTRY/COPY T408
LTG CORRIDOR T406, T410, T413	------	------	2.05		20	1	5	6	1	20		------	------	0.52	LTG CONFERENCE T411
LTG MECH/JC T404, T409	0.47	------	------		20	1	7	8	1	20		0.40	------	------	LTG RESTROOMS T402, T403
LTG OPEN AREA T419	------	1.80	------		20	1	9	10	1	20		------		------	SPARE
SPARE	------	------			20	1	11	12	1	20		------	------		SPARE
SPARE		------	------		20	1	13	14	1	20			------	------	SPARE
SPARE	------		------		20	1	15	16	1	20		------		------	SPARE
SPARE	------	------			20	1	17	18	1	20		------	------		SPARE
SPARE		------	------		20	1	19	20	1	20			------	------	SPARE
SPARE	------		------		20	1	21	22	1	20		------		------	SPARE
SPARE	------	------			20	1	23	24	1	20		------	------		SPARE
SPARE		------	------		20	1	25	26	1	20			------	------	SPARE
SPARE	------		------		20	1	27	28	1	20		------		------	SPARE
SPARE	------	------			20	1	29	30	1	20		------	------		SPARE
SPACE		------	------				31	32	1	20			------	------	SPARE
SPACE	------		------				33	34	1	20		------		------	SPARE
SPACE	------	------					35	36	1	20		------	------		SPARE
	21.79	------	------				37	38					------	------	SPACE
XFMR T-13 (PANEL LN4T)	------	21.51	------		125	3	39	40				------		------	SPACE
	------	------	20.71				41	42				------	------		SPACE
LEFT SUB-TOTAL	25.07	25.02	22.76												TOTAL PANEL LOAD
RIGHT SUB-TOTAL	0.85	0.45	0.52												CONNECTED / DEMAND
PER PHASE TOTAL	25.92	25.47	23.28												KVA 74.7 / 52
PANEL TOTAL			74.67												AMPS 89.8 / 63

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)
1.

Panelboard Resizing

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	HN4T	Panel Location:	T401 N. Electrical
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	Fluorescent Ltg	3	T419	1440	w	0.90	1440	1600	
2	A	Fluorescent Ltg	3	T412	405	w	0.90	405	450	
3	B	Fluorescent Ltg	3	T406	1845	w	0.90	1845	2050	
4	B	Fluorescent Ltg	3	T408	405	w	0.90	405	450	
5	C	Fluorescent Ltg	3	T404	423	w	0.90	423	470	
6	C	Fluorescent Ltg	3	T419	1620	w	0.90	1620	1800	
7	A	Fluorescent Ltg	3	T411	468	w	0.90	468	520	
8	A	Fluorescent Ltg	3	T402	360	w	0.90	360	400	
9	B	Spare	9		0	w		0	0	
10	B	Spare	9		0	w		0	0	

11	C	Spare	9		0	w		0	0		
12	C	Spare	9		0	w		0	0		
13	A	Spare	9		0	w		0	0		
14	A	Spare	9		0	w		0	0		
15	B	Spare	9		0	w		0	0		
16	B	Spare	9		0	w		0	0		
17	C	Spare	9		0	w		0	0		
18	C	Spare	9		0	w		0	0		
19	A	Spare	9		0	w		0	0		
20	A	Spare	9		0	w		0	0		
21	B	Spare	9		0	w		0	0		
22	B	Spare	9		0	w		0	0		
23	C	Spare	9		0	w		0	0		
24	C	Spare	9		0	w		0	0		
25	A	Spare	9		0	w		0	0		
26	A	Spare	9		0	w		0	0		
27	B	Spare	9		0	w		0	0		
28	B	Spare	9		0	w		0	0		
29	C	Spare	9		0	w		0	0		
30	C	Spare	9		0	w		0	0		
31	A	Space	9		0	w		0	0		
32	A	Spare	9		0	w		0	0		
33	B	Space	9		0	w		0	0		
34	B	Spare	9		0	w		0	0		
35	C	Space	9		0	w		0	0		
36	C	Spare	9		0	w		0	0		
37	A	XFMR T-13	9	T401	17432	w		17432	21790		
38	A	Space	9		0	w		0	0		
39	B	XFMR T-13	9	T401	17208	w		17208	21510		
40	B	Space	9		0	w		0	0		
41	C	XFMR T-13	9	T401	16568	w		16568	20710		
42	C	Space	9		0	w		0	0		
PANEL TOTAL								58.2	71.8	Amps=	86.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					20.1	24.8	37%	89.4
PHASE TOTAL	B					19.5	24.0	36%	86.7
PHASE TOTAL	C					18.6	18.8	28%	68.0

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			

3	fluorescent lighting		7.0	7.7	1.00	7.0	7.7	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		51.2	64.0		51.2	64.0	0.80		
Total Demand Loads						58.2	71.8			
Spare Capacity			20%			11.6	14.4			
Total Design Loads						69.8	86.1	0.81	Amps=	103.6

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Bus	225A
Main	125A
Feeder	(4) 2 AWG + 4 AWG Ground
Conduit	1.25” EMT

Voltage Drop:

VD= 0.196V * 103.6A * 239 ft/ 1000A-ft = 4.85 < (480*0.03)

Voltage drop is acceptable.

The Elliptipar luminaires draw power from the receptacles found underneath the work stations. Therefore, there is no change to the panelboards they connect to. However, it should be shown that the reserved panel slots for the receptacles can handle the loads.

The panelboards that will be affected by these luminaires are LS4T and LN4T.

PANEL LS4T

PANEL: LS4T — MAIN BUS RATING 225A
MAIN BREAKER: NO. OF POLES 3 — FRAME 225A — TRIP 225A — TYPE MCB
VOLTAGE: 208 Y120, 3P, 4 WIRE — MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 10,000

CIRCUIT DESCRIPTION	CONNECTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
REC - ELECTRICAL RM S	0.18	------	------		20	1	1	2	2	20		1.92	------	------	SYSTEM FURNITURE RM T419
REC - CORRIDOR	------	0.54	------		20	1	3	4				------	1.92	------	SYSTEM FURNITURE RM T419
A/V RACK - CONFERENCE RM	------	------	1.80		20	1	5	6	2	20		------	------	1.92	SYSTEM FURNITURE RM T419
REC - SIPRNET RM	1.00	------	------		20	1	7	8				1.92	------	------	SYSTEM FURNITURE RM T419
REC - SIPRNET RM	------	1.00	------		20	1	9	10	1	20		------	1.38	------	REC OFFICE RM T415
LCD - CONFERENCE RM	------	------	0.50		20	1	11	12	1	20		------	------	0.54	REC OFFICE RM T415
REC - OPEN OFFICE	1.08	------	------		20	1	13	14	1	20		0.54	------	------	REC OFFICE RM T412
SYSTEM FURNITURE RM T419	------	1.92	------		20	2	15	16	1	20		------	1.38	------	REC OFFICE RM T412
SYSTEM FURNITURE RM T419	------	------	1.92				17	18	1	20		------	------	1.92	REC CONFERENCE RM T411
SYSTEM FURNITURE RM T419	1.92	------	------		20	2	19	20	1	20		1.92	------	------	REC CONFERENCE RM T411
SYSTEM FURNITURE RM T419	------	1.92	------				21	22	1	20		------	1.92	------	REC CONFERENCE RM T412
REC OFFICE TI419	------	------	0.64		20	1	23	24	1	20		------	------	1.92	REC CONFERENCE RM T412
REC OFFICE TI419	0.64	------	------		20	1	25	26	1	20		0.64	------	------	REC OFFICE RM T417
REC OFFICE TI422	------	0.54	------		20	1	27	28	1	20		------		------	SPARE
REC OFFICE TI422	------	------	1.38		20	1	29	30	1	20		------	------	1.20	PRINTERS RM T419
PRINTERS/ FAX RM OC	1.50	------	------		20	1	31	32	1	20		0.90	------	------	PRINTER/ FAX RM T419
SPARE	------		------		20	1	33	34	1	20		------	1.00	------	PRINTER RM T419
SPARE	------	------			20	1	35	36	1	20		------	------		SPARE
SPACE		------	------			1	37	38	1	20			------	------	SPARE
SPACE	------		------			1	39	40	1	20		------		------	SPARE
SPACE	------	------				1	41	42	1	20		------	------		SPARE
LEFT SUB-TOTAL	6.32	5.92	6.24												
RIGHT SUB-TOTAL	7.84	7.60	7.50												
PER PHASE TOTAL	14.16	13.52	13.74												
PANEL TOTAL			41.42												

TOTAL PANEL LOAD	CONNECTED	DEMAND
KVA	41.4	**26**
AMPS	115.0	**71**

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)
1. PROVIDE WITH 200% NEUTRAL BUS
2. FOR SYSTEM FURNITURE, PROVIDE 20A, 2 POLE BREAKER TO SERVE THE 120V CIRCUITS

PANEL LN4T

PANEL: LN4T — MAIN BUS RATING 225A

MAIN BREAKER: NO. OF POLES 3 — FRAME 225A — TRIP 225A — TYPE MCB

VOLTAGE: 208 Y120, 3P, 4 WIRE — MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 10,000

CIRCUIT DESCRIPTION	CONNECTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	NO	P	CKT BRKR TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
GFI REC - MENS'/WOMEN'S RR N	1.08	------	------		20	1	1	2	1	20		1.44	------	------	REFRIGERATOR
REC - CORRIDOR	------	1.08	------		20	1	3	4	1	20		------	1.92	------	ICE MAKER
EWC	------	------	0.62		20	1	5	6	2	30		------	------	1.44	COPIER
PANTRY PLUG MONLD	0.45	------	------	G	20	1	7	8				1.44	------	------	
PANTRY PLUG MONLD	------	0.45	------	G	20	1	9	10	1	20		------	0.50	------	PRINTER
PANTRY PLUG MONLD	------	------	0.45	G	20	1	11	12	1	20		------	------	0.50	PRINTER
PANTRY PLUG MONLD	0.45	------	------	G	20	1	13	14	2	30		1.44	------	------	COPIER
LCD - ELEVATOR LOBBY	------	0.50	------		20	1	15	16				------	1.44	------	
REC - MECHANICAL RM	------	------	0.36		20	1	17	18	1	20		------	------	1.56	MICROWAVE
REC - OPEN OFFICE	1.08	------	------		20	1	19	20	1	20		0.80	------	------	MICROWAVE
REC - ELECTRICAL RM N	------	0.18	------		20	1	21	22	1	20		------	0.72	------	REC STORAGE RM TI406
REC INTERVIEW RM T420	------	------	0.72		20	1	23	24	1	20		------	------	1.80	COFFE MAKER
LTG - PANTRY COVE	0.11	------	------		20	1	25	26	2	20		1.92	------	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	1.92	------		20	2	27	28				------	1.92	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	------	1.92				29	30	2	20		------	------	1.92	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	1.92	------	------		20	2	31	32				1.92	------	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	1.92	------				33	34	2	20		------	1.92	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	------	1.92		20	2	35	36				------	------	1.92	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	1.92	------	------				37	38	2	20		1.92	------	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	1.92	------		20	2	39	40				------	1.92	------	SYSTEM FURNITURE RM T419
SYSTEM FURNITURE RM T419	------	------	1.92				41	42	2	20		------	------	1.28	SYSTEM FURNITURE RM T419
PRINTER RM T419	0.60	------	------		20	1	43	44				1.28	------	------	SYSTEM FURNITURE RM T419
PRINTERS RM T419	------	1.20	------		20	1	45	46	2	20		------	1.46	------	SYSTEM FURNITURE RM T419
SPARE	------	------			20	1	47	48				------	------	1.74	SYSTEM FURNITURE RM T419
SPARE		------	------		20	1	49	50	1	20		1.38	------	------	REC OFFICE RM PI404
SPARE	------		------		20	1	51	52	1	20		------	0.54	------	REC OFFICE RM PI404
SPARE	------	------			20	1	53	54	1	20		------	------	0.64	REC OFFICE RM PI403
SPARE		------	------		20	1	55	56	1	20		0.64	------	------	REC OFFICE RM PI403
SPARE	------		------		20	1	57	58	1	20		------		------	SPARE
SPARE	------	------			20	1	59	60	1	20		------	------		SPARE
SPARE		------	------		20	1	61	62	1	20			------	------	SPARE
SPARE	------		------		20	1	63	64	1	20		------		------	SPARE
SPARE	------	------			20	1	65	66	1	20		------	------		SPARE
SPARE		------	------		20	1	67	68	1	20			------	------	SPARE
SPARE	------		------		20	1	69	70	1	20		------		------	SPARE
SPARE	------	------			20	1	71	72	1	20		------	------		SPARE
SPARE		------	------		20	1	73	74					------	------	SPACE
SPARE	------		------		20	1	75	76				------		------	SPACE
SPARE	------	------			20	1	77	78				------	------		SPACE
SPACE		------	------				79	80					------	------	SPACE
SPACE	------		------				81	82				------		------	SPACE
SPACE	------	------					83	84				------	------		SPACE
LEFT SUB-TOTAL	7.61	9.17	7.91												
RIGHT SUB-TOTAL	14.18	12.34	12.80												
PER PHASE TOTAL	21.79	21.51	20.71												
PANEL TOTAL			64.01												

TOTAL PANEL LOAD	CONNECTED	DEMAND
KVA	64.0	**39**
AMPS	177.7	**108**

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)

1. PROVIDE WITH 200% NEURTAL BUS
2. FOR SYSTEM FURNITURE, PROVIDE 20A, 2 POLE BREAKER TO SERVE THE 120V CIRCUITS

The highlighted slots are the ones that are possible of being affected by the lighting loads. As one can see, they are all rated for 1.92 kVA. Therefore, if all the Elliptipar luminaires of one section of cubicles is under this value, then there is no need for any resizing of the panelboard.

6(OA) * 49W + 2(OB) * 29W= 352W

352W/0.9 P.F. = 0.391 kVA < 1.92 kVA

Auditorium Electrical Redesign

All the luminaires within the space are controlled by a preset dimmer control station that will have different lighting scenes programmed within it. There is a low voltage override switch to turn off all luminaires at once.

The affected lighting loads for the auditorium can be found on panel LDIM1, HDIM1, and ELDIM1:

PANEL LDIM1 (DIMMING PANEL)

PANEL: LDIM1 | MAIN BUS RATING 40A
MAIN BREAKER: NO. OF POLES 3 | FRAME 100A | TRIP 40A | TYPE MCB
VOLTAGE: 208 Y120, 3P, 4 WIRE | MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 10,000

CIRCUIT DESCRIPTION	CONNECTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
P150 WALL WASH REAR	1.20	------	------		20	1	1	2	1	20		0.45	------	------	P150 STAGE WALL WASH
P150 DOWN LTG REAR	------	1.65	------		20	1	3	4	1	20		------	0.27	------	P150 STAGE TRACKS
P150 DOWN LTG FRONT	------	------	1.50		20	1	5	6	1	20		------	------	0.27	P150 STAGE TRACKS
P150 STAGE DOWN LTG	0.60	------	------		20	1	7	8	1	20		1.20	------	------	P150 WALL WASH EAST
SPACE	------		------				9	10				------		------	SPACE
SPACE	------	------					11	12				------	------		SPACE
SPACE		------	------				13	14					------	------	SPACE
SPACE	------		------				15	16				------		------	SPACE
SPACE	------	------					17	18				------	------		SPACE
SPACE		------	------				19	20					------	------	SPACE
SPACE	------		------				21	22				------		------	SPACE
SPACE	------	------					23	24				------	------		SPACE
SPACE		------	------				25	26					------	------	SPACE
SPACE	------		------				27	28				------		------	SPACE
SPACE	------	------					29	30				------	------		SPACE
SPACE		------	------				31	32					------	------	SPACE
SPACE	------		------				33	34				------		------	SPACE
SPACE	------	------					35	36				------	------		SPACE
SPACE		------	------				37	38					------	------	SPACE
SPACE	------		------				39	40				------		------	SPACE
SPACE	------	------					41	42				------	------		SPACE

	A	B	C
LEFT SUB-TOTAL	1.80	1.65	1.50
RIGHT SUB-TOTAL	1.65	0.27	0.27
PER PHASE TOTAL	3.45	1.92	1.77
PANEL TOTAL			7.14

TOTAL PANEL LOAD

	CONNECTED	DEMAND
KVA	7.1	9
AMPS	19.8	25

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)
1.

PANELBOARD SIZING WORKSHEET				
Panel Tag---------->	LDIM1	Panel Location:	P129	
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	Fluorescent Ltg	3	P150	756	w	0.90	756	840	
2	A	Space	9		0	w		0	0	
3	B	Incandescent Ltg	5	P150	900	w	1.00	900	900	
4	B	Space	9		0	w		0	0	
5	C	Fluorescent Ltg	3	P150	506	w	0.90	506	562	
6	C	Space	9		0	w		0	0	
7	A	Space	10		0	w		0	0	
8	A	Space	11		0	w		0	0	
9	B	Space	12		0	w		0	0	
10	B	Space	13		0	w		0	0	
11	C	Space	14		0	w		0	0	
12	C	Space	15		0	w		0	0	
13	A	Space	16		0	w		0	0	
14	A	Space	17		0	w		0	0	
15	B	Space	18		0	w		0	0	
16	B	Space	19		0	w		0	0	
17	C	Space	20		0	w		0	0	
18	C	Space	21		0	w		0	0	
19	A	Space	22		0	w		0	0	
20	A	Space	23		0	w		0	0	
21	B	Space	24		0	w		0	0	
22	B	Space	25		0	w		0	0	
23	C	Space	26		0	w		0	0	
24	C	Space	27		0	w		0	0	
25	A	Space	28		0	w		0	0	
26	A	Space	29		0	w		0	0	
27	B	Space	30		0	w		0	0	
28	B	Space	31		0	w		0	0	
29	C	Space	32		0	w		0	0	
30	C	Space	33		0	w		0	0	
31	A	Space	34		0	w		0	0	
32	A	Space	35		0	w		0	0	
33	B	Space	36		0	w		0	0	
34	B	Space	37		0	w		0	0	
35	C	Space	38		0	w		0	0	
36	C	Space	39		0	w		0	0	
37	A	Space	40		0	w		0	0	
38	A	Space	41		0	w		0	0	
39	B	Space	42		0	w		0	0	
40	B	Space	43		0	w		0	0	
41	C	Space	44		0	w		0	0	
42	C	Space	45		0	w		0	0	

PANEL TOTAL						2.2	2.3	Amps=	6.4
PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.8	0.8	36%	7.0
PHASE TOTAL	B					0.9	0.9	39%	7.5
PHASE TOTAL	C					0.5	0.6	24%	4.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		1.3	1.4		1.3	1.4	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.9	0.9		0.9	0.9	1.00		
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						2.2	2.3			
Spare Capacity			20%			0.4	0.5			
Total Design Loads						2.6	2.8	0.94	Amps=	7.7

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Feeder: 7.7A + (20A*39 spaces*0.2) = 163.7A

Bus	225A
Main	175A
Feeder	(4) 2/0 AWG + 4 AWG Ground
Conduit	2” EMT

Voltage Drop:]

VD= 0.098V * 163.7A * 30 ft/ 1000A-ft = 0.48V < (208V*0.03)

Voltage drop is acceptable

PANEL HDIM2 (DIMMING PANEL)

PANEL: HDIM2 MAIN BUS RATING 20A
MAIN BREAKER: NO. OF POLES 3 FRAME 20A TRIP 20A TYPE MCB
VOLTAGE: 480 Y277, 3P, 4 WIRE MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 14,000

CIRCUIT	:CTED LOAD (KVA)				CKT BRKR			CKT BRKR				CONNECTED LOAD (KVA)			CIRCUIT
DESCRIPTION	A	B	C	*	TRIP	P	NO	NO	P	TRIP	*	A	B	C	DESCRIPTION
P136 NORTH LINEAR	0.47	------	------		20	1	1	2					------	------	SPACE
P150 AUD COLD CATHODE	------	2.35	------		20	1	3	4				------		------	SPACE
P150 AUD COLD CATHODE	------	------	2.35		20	1	5	6				------	------		SPACE
SPACE		------	------				7	8					------	------	SPACE
SPACE	------		------				9	10				------		------	SPACE
SPACE	------	------					11	12				------	------		SPACE
SPACE		------	------				13	14					------	------	SPACE
SPACE	------		------				15	16				------		------	SPACE
SPACE	------	------					17	18				------	------		SPACE
SPACE		------	------				19	20					------	------	SPACE
SPACE	------		------				21	22				------		------	SPACE
SPACE	------	------					23	24				------	------		SPACE
SPACE		------	------				25	26					------	------	SPACE
SPACE	------		------				27	28				------		------	SPACE
SPACE	------	------					29	30				------	------		SPACE
SPACE		------	------				31	32					------	------	SPACE
SPACE	------		------				33	34				------		------	SPACE
SPACE	------	------					35	36				------	------		SPACE
SPACE		------	------				37	38					------	------	SPACE
SPACE	------		------				39	40				------		------	SPACE
SPACE	------	------					41	42				------	------		SPACE
LEFT SUB-TOTAL	0.47	2.35	2.35												
RIGHT SUB-TOTAL															
PER PHASE TOTAL	0.47	2.35	2.35												
PANEL TOTAL			5.17												

TOTAL PANEL LOAD		
	CONNECTED	DEMAND
KVA	5.2	6
AMPS	6.2	8

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)
1.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	HDIM2	Panel Location:	P129
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	Fluorescent Ltg.	3	P136	423	w	0.90	423	470	
2	A	Space	9		0	w		0	0	
3	B	Fluorescent Ltg.	3	P150	657.5	w	0.90	658	731	
4	B	Space	9		0	w		0	0	
5	C	Fluorescent Ltg.	3	P150	657.5	w	0.90	658	731	
6	C	Space	9		0	w		0	0	
7	A	Space	10		0	w		0	0	
8	A	Space	11		0	w		0	0	
9	B	Space	12		0	w		0	0	
10	B	Space	13		0	w		0	0	

11	C	Space	14		0	w		0	0		
12	C	Space	15		0	w		0	0		
13	A	Space	16		0	w		0	0		
14	A	Space	17		0	w		0	0		
15	B	Space	18		0	w		0	0		
16	B	Space	19		0	w		0	0		
17	C	Space	20		0	w		0	0		
18	C	Space	21		0	w		0	0		
19	A	Space	22		0	w		0	0		
20	A	Space	23		0	w		0	0		
21	B	Space	24		0	w		0	0		
22	B	Space	25		0	w		0	0		
23	C	Space	26		0	w		0	0		
24	C	Space	27		0	w		0	0		
25	A	Space	28		0	w		0	0		
26	A	Space	29		0	w		0	0		
27	B	Space	30		0	w		0	0		
28	B	Space	31		0	w		0	0		
29	C	Space	32		0	w		0	0		
30	C	Space	33		0	w		0	0		
31	A	Space	34		0	w		0	0		
32	A	Space	35		0	w		0	0		
33	B	Space	36		0	w		0	0		
34	B	Space	37		0	w		0	0		
35	C	Space	38		0	w		0	0		
36	C	Space	39		0	w		0	0		
37	A	Space	40		0	w		0	0		
38	A	Space	41		0	w		0	0		
39	B	Space	42		0	w		0	0		
40	B	Space	43		0	w		0	0		
41	C	Space	44		0	w		0	0		
42	C	Space	45		0	w		0	0		
PANEL TOTAL								1.7	1.9	Amps=	2.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.4	0.5	24%	1.7
PHASE TOTAL	B					0.7	0.7	38%	2.6
PHASE TOTAL	C					0.7	0.7	38%	2.6

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			

3	fluorescent lighting		1.7	1.9		1.7	1.9	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						1.7	1.9			
Spare Capacity			20%			0.3	0.4			
Total Design Loads						2.1	2.3	0.90	Amps=	2.8

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Feeder: 2.8A + (0.2*39 spaces* 20A)= 159A

Bus	225A
Main	225A
Feeder	(4) 2/0 AWG + 4 AWG Ground
Conduit	2” EMT

Voltage Drop

VD= 0.098V * 159A * 50 ft/ 1000A-ft = 0.78V < (480V*0.03)

Voltage Drop is Acceptable

PANEL ELDIM1 (DIMMING PANEL)

PANEL: ELDIM1 MAIN BUS RATING 20A
MAIN BREAKER: NO. OF POLES 3 FRAME 20A TRIP 20A TYPE MCB
VOLTAGE: 208 Y120, 3P, 4 WIRE MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 10,000

CIRCUIT DESCRIPTION	CONNECTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
P150 EAST WW	0.15	------	------		20	1	1	2					------	------	SPACE
P150 DOWN LTG	------	0.30	------		20	1	3	4				------		------	SPACE
P150 DOWN LTG STAGE	------	------	0.30		20	1	5	6				------	------		SPACE
SPACE		------	------				7	8					------	------	SPACE
SPACE	------		------				9	10				------		------	SPACE
SPACE	------	------					11	12				------	------		SPACE
SPACE		------	------				13	14					------	------	SPACE
SPACE	------		------				15	16				------		------	SPACE
SPACE	------	------					17	18				------	------		SPACE
SPACE		------	------				19	20					------	------	SPACE
SPACE	------		------				21	22				------		------	SPACE
SPACE	------	------					23	24				------	------		SPACE
SPACE		------	------				25	26					------	------	SPACE
SPACE	------		------				27	28				------		------	SPACE
SPACE	------	------					29	30				------	------		SPACE
SPACE		------	------				31	32					------	------	SPACE
SPACE	------		------				33	34				------		------	SPACE
SPACE	------	------					35	36				------	------		SPACE
SPACE		------	------				37	38					------	------	SPACE
SPACE	------		------				39	40				------		------	SPACE
SPACE	------	------					41	42				------	------		SPACE
LEFT SUB-TOTAL	0.15	0.30	0.30												TOTAL PANEL LOAD
RIGHT SUB-TOTAL															CONNECTED / DEMAND
PER PHASE TOTAL	0.15	0.30	0.30												KVA 0.8 / 1
PANEL TOTAL			0.75												AMPS 2.1 / 3

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)
1.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	ELDIM1	Panel Location:	P129		
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	Fluorescent Ltg.	3	P150	72	w	0.90	72	80	West Downlight
2	A	Space	9		0	w		0	0	
3	B	Fluorescent Ltg.	3	P150	82	w	0.90	82	91	Stage Light
4	B	Space	9		0	w		0	0	
5	C	Fluorescent Ltg.	3	P150	72	w	0.90	72	80	East Downlight
6	C	Space	9		0	w		0	0	
7	A	Space	10		0	w		0	0	
8	A	Space	11		0	w		0	0	
9	B	Space	12		0	w		0	0	
10	B	Space	13		0	w		0	0	

11	C	Space	14		0	w		0	0	
12	C	Space	15		0	w		0	0	
13	A	Space	16		0	w		0	0	
14	A	Space	17		0	w		0	0	
15	B	Space	18		0	w		0	0	
16	B	Space	19		0	w		0	0	
17	C	Space	20		0	w		0	0	
18	C	Space	21		0	w		0	0	
19	A	Space	22		0	w		0	0	
20	A	Space	23		0	w		0	0	
21	B	Space	24		0	w		0	0	
22	B	Space	25		0	w		0	0	
23	C	Space	26		0	w		0	0	
24	C	Space	27		0	w		0	0	
25	A	Space	28		0	w		0	0	
26	A	Space	29		0	w		0	0	
27	B	Space	30		0	w		0	0	
28	B	Space	31		0	w		0	0	
29	C	Space	32		0	w		0	0	
30	C	Space	33		0	w		0	0	
31	A	Space	34		0	w		0	0	
32	A	Space	35		0	w		0	0	
33	B	Space	36		0	w		0	0	
34	B	Space	37		0	w		0	0	
35	C	Space	38		0	w		0	0	
36	C	Space	39		0	w		0	0	
37	A	Space	40		0	w		0	0	
38	A	Space	41		0	w		0	0	
39	B	Space	42		0	w		0	0	
40	B	Space	43		0	w		0	0	
41	C	Space	44		0	w		0	0	
42	C	Space	45		0	w		0	0	
PANEL TOTAL								0.2	0.3	Amps= 0.7

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					0.1	0.1	32%	0.7
PHASE TOTAL	B					0.1	0.1	36%	0.8
PHASE TOTAL	C					0.1	0.1	32%	0.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			

3	fluorescent lighting		0.2	0.3		0.2	0.3	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						0.2	0.3			
Spare Capacity			20%			0.0	0.1			
Total Design Loads						0.3	0.3	0.90	Amps=	0.8

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Feeder: 0.8A + (0.2*20A*37 spaces) = 149A

Bus	225A
Main	150A
Feeder	(4) 2/0 AWG + 4 AWG Ground
Conduit	2” EMT

Voltage Drop:

VD= 0.098V * 149A * 50 ft/ 1000A-ft = 0.73V > (208V*0.03)

Voltage Drop is acceptable.

Prefunction Electrical Redesign

All luminaires within the space are controlled by a computerized relay panel and are set on a time schedule. There is a low voltage override switch which overrides the schedules incase occupants are within the space outside the programmed time range.

The affected lighting loads for the open office space can be found on panel H1PB and EHS3P:

PANEL H1PB

PANEL: H1PB MAIN BUS RATING 225A

MAIN BREAKER: NO. OF POLES 3 FRAME 225A TRIP 225A TYPE MCB

VOLTAGE: 480 Y277, 3P, 4 WIRE MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 25,000

CIRCUIT	CTED LOAD (KVA)				CKT BRKR			CKT BRKR				CONNECTED LOAD (KVA)			CIRCUIT
DESCRIPTION	A	B	C	*	TRIP	P	NO	NO	P	TRIP	*	A	B	C	DESCRIPTION
SPARE		------	------		20	1	1	2	1	20		3.18	------	------	LTG OPEN AREA P125
LTG RESTROOMS P127, P128	------	1.71	------		20	1	3	4	1	20		------	3.69	------	LTG OPEN AREA P125
LTG PREFUNCTION P133	------	------	2.94		20	1	5	6	1	20		------	------	0.53	LTG CORRIDOR P144
LTG FITNESS CENTER P141	1.43	------	------		20	1	7	8	1	20		0.74	------	------	LTG TRAINING ROOM P135
LTG LOCKER ROOMS P138, P139	------	0.31	------		20	1	9	10	1	20		------	0.90	------	LTG LOCKER ROOMS P138, P139
LTG PREFUNCTION P133	------	------	3.97		20	1	11	12	1	20		------	------	3.28	LTG PREFUNCTION P133
ETWH-2 PANTRY 1PB	9.00	------	------		45	1	13	14	1	20			------	------	SPARE
SPARE	------		------		20	1	15	16	1	20		------		------	SPARE
SPARE	------	------			20	1	17	18	1	20		------	------		SPARE
SPARE		------	------		20	1	19	20	1	20			------	------	SPARE
SPARE	------		------		20	1	21	22	1	20		------		------	SPARE
SPARE	------	------			20	1	23	24	1	20		------	------		SPARE
SPARE		------	------		20	1	25	26	1	20			------	------	SPARE
SPARE	------		------		20	1	27	28	1	20		------		------	SPARE
SPARE	------	------			20	1	29	30	1	20		------	------		SPARE
XFMR T-13 (PANEL LIPBB)	26.83	------	------		125	3	31	32	3	20		0.47	------	------	DIMMING PANEL HDIM2
	------	25.09	------				33	34				------	2.35	------	
	------	------	25.30				35	36				------	------	2.35	
XFMR T-13 (PANEL L1PBA)	25.77	------	------		125	3	37	38	3	20		1.84	------	------	DIMMING PANEL HDIM1
	------	25.35	------				39	40				------	3.58	------	
	------	------	26.47				41	42				------	------	2.48	
LEFT SUB-TOTAL	63.03	52.45	58.68												
RIGHT SUB-TOTAL	6.24	10.52	8.64												
PER PHASE TOTAL	69.26	62.97	67.32												
PANEL TOTAL			199.55												

TOTAL PANEL LOAD

	CONNECTED	DEMAND
KVA	199.5	148
AMPS	240.0	179

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)

1.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	H1PB	Panel Location:	P129 SE. Elcectric
Nominal Phase to Neutral Voltage------->	277	Phase:	3
Nominal Phase to Phase Voltage-------->	480	Wires:	4

Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Spare	3		0	w	0.90	0	0	
2	A	Fluorescent Ltg	3	P125	2862	w	0.90	2862	3180	
3	B	Fluorescent Ltg	3	P127	1539	w	0.90	1539	1710	
4	B	Fluorescent Ltg	3	P125	3321	w	0.90	3321	3690	
5	C	Fluorescent Ltg	3	P133	3540	w	0.90	3540	3933	
6	C	Fluorescent Ltg	3	P144	477	w	0.90	477	530	
7	A	Fluorescent Ltg	3	P141	1278	w	0.90	1278	1420	
8	A	Fluorescent Ltg	3	P135	666	w	0.90	666	740	
9	B	Fluorescent Ltg	3	P138	279	w	0.90	279	310	

10	B	Fluorescent Ltg	3	P138	810	w	0.90	810	900	
11	C	Fluorescent Ltg	3	P133	1068	w	0.90	1068	1187	
12	C	Fluorescent Ltg	3	Pantry 1PB	8100	w	0.90	8100	9000	
13	A					w	0.90	0	0	
14	A				0	w		0	0	
15	B				0	w		0	0	
16	B				0	w		0	0	
17	C				0	w		0	0	
18	C				0	w		0	0	
19	A				0	w		0	0	
20	A				0	w		0	0	
21	B				0	w		0	0	
22	B				0	w		0	0	
23	C				0	w		0	0	
24	C				0	w		0	0	
25	A				0	w		0	0	
26	A				0	w		0	0	
27	B				0	w		0	0	
28	B				0	w		0	0	
29	C				0	w		0	0	
30	C				0	w		0	0	
31	A	Panel L1PBB	9	P129	34900	w	1.00	34900	34900	
32	A	Panel HDIM 2	9	P129	24736	w		24736	30920	
33	B	Panel L1PBB	9	P129	39700	w	1.00	39700	39700	
34	B	Panel HDIM 2	9	P129	25036	w		25036	31295	
35	C	Panel L1PBB	9	P129	38500	w	1.00	38500	38500	
36	C	Panel HDIM 2	9	P129	25036	w		25036	31295	
37	A	Panel L1PBA	9	P129	20616	w		20616	25770	
38	A	Panel HDIM1	9	P129	1472	w		1472	1840	
39	B	Panel L1PBA	9	P129	20280	w		20280	25350	
40	B	Panel HDIM1	9	P129	2864	w		2864	3580	
41	C	Panel L1PBA	9	P129	21176	w		21176	26470	
42	C	Panel HDIM1	9	P129	1984	w		1984	2480	
PANEL TOTAL								280.2	318.7	Amps = 383.5

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					86.5	98.8	32%	356.6
PHASE TOTAL	B					93.8	106.5	34%	384.6
PHASE TOTAL	C					99.9	107.6	34%	388.5

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		23.9	26.6		23.9	26.6	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		256.3	292.1		256.3	292.1	0.88		
Total Demand Loads						280.2	318.7			
Spare Capacity			20%			56.0	63.7			
Total Design Loads						336.3	382.4	0.88	Amps =	460.2

	0.8	
Default Power Factor =	0	
Default Demand Factor =	100	%

Bus	600A
Main	500A
Feeder	2 sets of (4) 250 kCMIL +2 sets of 1/0 AWG Ground
Conduit	3.5” EMT

Voltage Drop:

VD= 0.054V * 460.2A * 190ft/ 1000A-ft = 4.72V < (480V*0.03)

Voltage Drop is acceptable.

PANEL EHS3P

PANEL: EHS3P — MAIN BUS RATING 225A

MAIN BREAKER: NO. OF POLES 3 — FRAME N/A — TRIP N/A — TYPE MLO

VOLTAGE: 480 Y277, 3P, 4 WIRE — MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 25,000

CIRCUIT DESCRIPTION	CTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
EMERG LTG LEVEL 3PB	2.05	------	------		20	1	1	2				0.72	------	------	
EMERG LTG LEVEL 3PB	------	2.23	------		20	1	3	4	3	20		------	0.72	------	FUEL OIL PUMP PACKAGE P142
EMERG LTG AV ROOM 3PB	------	------	0.70		20	1	5	6				------	------	0.72	
EMERG LTG MECH/ELEC P323	0.20	------	------		20	1	7	8	1	20			------	------	SPARE
EMERG LTG MECH 3PM	------	0.60	------		20	1	9	10	1	20		------		------	SPARE
EMERG LTG MECH 3PM	------	------	0.60		20	1	11	12	1	20		------	------		SPARE
EMERG LTG LEVEL 1PB	1.80	------	------		20	1	13	14	1	20			------	------	SPARE
EMERG LTG SOUTH STAIRS	------	0.14	------		20	1	15	16	1	20		------		------	SPARE
EMERG LTG LEVEL 1PB	------	------	2.24		20	1	17	18	1	20		------	------		SPARE
EMERG LTG SOUTH STAIRS	0.21	------	------		20	1	19	20	1	20			------	------	SPARE
SPARE	------		------		20	1	21	22	1	20		------		------	SPARE
SPARE	------	------			20	1	23	24	1	20		------	------		SPARE
SPARE		------	------		20	1	25	26	1	20			------	------	SPARE
SPARE	------		------		20	1	27	28	1	20		------		------	SPARE
SPARE	------	------			20	1	29	30	1	20		------	------		SPARE
SPACE		------	------				31	32					------	------	SSPACE
SPACE	------		------				33	34				------		------	SPACE
SPACE	------	------					35	36				------	------		SPACE
	5.03	------	------				37	38				0.04	------	------	
XFMR T1 (PANEL ELS3P)	------	4.17	------		25	3	39	40	3	20		------	0.04	------	DIMMING PANEL EHDIM3
	------	------	4.87				41	42				------	------		
LEFT SUB-TOTAL	9.29	7.14	8.41												
RIGHT SUB-TOTAL	0.76	0.76	0.72												
PER PHASE TOTAL	10.05	7.90	9.13												
PANEL TOTAL			27.08												

TOTAL PANEL LOAD

	CONNECTED	DEMAND
KVA	27.1	31
AMPS	32.6	37

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)

1.

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	EHS3P	Panel Location:	P323
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	Fluorescent Ltg	3	Level 3PB	1845	w	0.90	1845	2050	
2	A	Fuel Pump	9	P142	576	w		576	720	
3	B	Fluorescent Ltg	9	Level 3PB	2007	w	0.90	2007	2230	
4	B	Fuel Pump	9	P142	576	w		576	720	
5	C	Fluorescent Ltg	3	AV Room	630	w	0.90	630	700	
6	C	Fuel Pump	9	P142	576	w		576	720	
7	A	Fluorescent Ltg	3	P323	180	w	0.90	180	200	
8	A	Spare			0	w		0	0	
9	B	Fluorescent Ltg	3	Mech 3PM	540	w	0.90	540	600	

10	B	Spare			0	w		0	0	
11	C	Fluorescent Ltg	3	Mech 3PM	540	w		540	675	
12	C	Spare			0	w		0	0	
13	A	Fluorescent Ltg	3	P133	780	w	0.90	780	867	
14	A	Spare			0	w		0	0	
15	B	Fluorescent Ltg	3	South Stairs	126	w	0.90	126	140	
16	B	Spare			0	w		0	0	
17	C	Fluorescent Ltg	3	Level 1Pb	2016	w	0.90	2016	2240	
18	C	Spare			0	w		0	0	
19	A	Fluorescent Ltg	3	South Stairs	189	w	0.90	189	210	
20	A	Spare			0	w		0	0	
21	B	Spare			0	w		0	0	
22	B	Spare			0	w		0	0	
23	C	Spare			0	w		0	0	
24	C	Spare			0	w		0	0	
25	A	Spare			0	w		0	0	
26	A	Spare			0	w		0	0	
27	B	Spare			0	w		0	0	
28	B	Spare			0	w		0	0	
29	C	Spare			0	w		0	0	
30	C	Spare			0	w		0	0	
31	A	Space			0	w		0	0	
32	A	Space			0	w		0	0	
33	B	Space			0	w		0	0	
34	B	Space			0	w		0	0	
35	C	Space			0	w		0	0	
36	C	Space			0	w		0	0	
37	A	Panel ELS3P	9	P323	4024	w		4024	5030	
38	A	Panel EHDIM3	9	P129	36	w		36	45	
39	B	Panel ELS3P	9	P323	3753	w		3753	4691	
40	B	Panel EHDIM3	9	P129	36	w		36	45	
41	C	Panel ELS3P	9	P323	4383	w		4383	5479	
42	C	Panel EHDIM3	9	P129	36	w		36	45	
PANEL TOTAL								22.8	27.4	Amps= 33.0

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	7.6	9.1	35%	32.9
PHASE TOTAL	B	7.0	8.4	32%	30.4
PHASE TOTAL	C	8.2	8.8	33%	31.6

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			

2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		6.8	7.7		6.8	7.7	0.89		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		16.0	19.7		16.0	19.7	0.81		
Total Demand Loads						22.8	27.4			
Spare Capacity			20%			4.6	5.5			
Total Design Loads						27.4	32.9	0.83	Amps=	39.6

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Bus	40A
Main	40A
Feeder	(4) 8 AWG + 8 AWG Ground
Conduit	0.75" EMT

Voltage Drop:

VD= 0.75V * 39.6A * 284 ft/ 1000A-ft = 8.4V < (480V*0.03)

Voltage Drop is acceptable.

Plaza Electrical Redesign

All luminaires within the space are controlled by a computerized relay panel and are set on a time schedule as well as a photo relay.

The affected lighting loads for the open office space can be found on panel L1PBB:

PANEL L1PBB

PANEL: L1PBB — MAIN BUS RATING 225A

MAIN BREAKER: NO. OF POLES 3 — FRAME 225A — TRIP 225A — TYPE MCB

VOLTAGE: 208 Y120, 3P, 4 WIRE — MINIMUM INTERRUPTING CAPACITY (RMS SYM AMPS) 10,000

CIRCUIT DESCRIPTION	CONNECTED LOAD (KVA) A	B	C	*	CKT BRKR TRIP	P	NO	CKT BRKR NO	P	TRIP	*	CONNECTED LOAD (KVA) A	B	C	CIRCUIT DESCRIPTION
AV RACK CONF RM P136	1.92	------	------		20	1	1	2	1	20		0.95	------	------	PROJECTOR/LIFT CONF RM P136
AV RACK CONF RM P136	------	1.92	------		20	1	3	4	1	20		------	0.95	------	PROJECTOR/LIFT CONF RM P136
AV RACK CONF RM P136	------	------	1.92		20	1	5	6	1	20		------	------	0.95	PROJECTOR/LIFT CONF RM P136
PROJECTOR SCRN CONF RM P136	0.13	------	------		20	1	7	8	1	20		0.13	------	------	PROJECTOR SCRN CONF RM P136
PROJECTOR SCRN CONF RM P136	------	0.13	------		20	1	9	10	1	20		------	0.13	------	PROJECTOR SCRN CONF RM P136
PROJECTOR/LIFT CONF RM P136	------	------	0.95		20	1	11	12	1	20		------	------	0.13	PROJECTOR SCRN TRAINING RM P135
PROJECTOR/LIFT TRAINING RM P135	0.95	------	------		20	1	13	14	1	20		1.92	------	------	PODIUM TRAINING ROOM P135
REC - COORIDOR P133	------	0.54	------		20	1	15	16	1	20		------	1.92	------	AV RACK AV CLOSET RM 136e
REC - CONF RM P136	------	------	0.54		20	1	17	18	1	20		------	------	0.62	EWC - FITNESS CENTER RM P141
REC - CORRIDOR P144	1.08	------	------		20	1	19	20	1	20		1.92	------	------	TREADMILL FITNESS CENTER RM P141
LCD TVS FITNESS CENTER RM P141	------	0.90	------		20	1	21	22	1	20		------	1.92	------	TREADMILL FITNESS CENTER RM P141
FITNESS CENTER RM P141	------	------	0.72		20	1	23	24	1	20		------	------	1.92	TREADMILL FITNESS CENTER RM P141
REC - FITNESS CENTER RM P141	1.92	------	------		20	1	25	26	1	20		1.92	------	------	TREADMILL FITNESS CENTER RM P141
FITNESS CENTER EQPM RM P141	------	1.92	------		20	1	27	28	1	20		------	1.92	------	TREADMILL FITNESS CENTER RM P141
PLAZA SITE LIGHTING	------	------	0.74		20	1	29	30	1	20		------	------	1.00	REC CONFERENCE RM P136
PLAZA EXTERIOR RECEPTACLES	0.72	------	------		20	1	31	32	1	20		0.72	------	------	REC CONFERENCE RM P136
SYSTEM FURNITURE	------	1.92	------		20	2	33	34	1	20		------	0.72	------	REC CONFERENCE RM P136
SYSTEM FURNITURE	------	------	1.92				35	36	1	20		------	------	1.00	REC CONFERENCE RM P136
REC OFFICE	0.64	------	------		20	2	37	38	1	20		1.00	------	------	REC CONFERENCE RM P136
REC OFFICE	------	0.64	------				39	40	1	20		------	0.72	------	REC CONFERENCE RM P136
SYSTEM FURNITURE	------	------	1.28		20	2	41	42	1	20		------	------	1.92	REC PODIUM RM P136
SYSTEM FURNITURE	1.28	------	------				43	44	1	20		1.08	------	------	REC TRAINING RM P135
SYSTEM FURNITURE	------	1.92	------		20	2	45	46	1	20		------	1.08	------	REC TRAINING RM P135
SYSTEM FURNITURE	------	------	1.92				47	48	1	20		------	------	0.72	REC TRAINING RM P135
SYSTEM FURNITURE	1.92	------	------		20	2	49	50	1	20		0.72	------	------	REC TRAINING RM P135
SYSTEM FURNITURE	------	1.92	------				51	52	1	20		------	1.92	------	REC PODIUM AUDITORIUM
PLAZA SITE LIGHTING	------	------	0.77		20	1	53	54	1	20		------	------	1.92	REC AUDITORIUM
REC TRAINING P135	0.72	------	------		20	1	55	56				3.45	------	------	
SITE LIGHTING	------	0.07	------		20	1	57	58	3	40		------	1.92	------	DIMMING PANEL LDIM1
REC TRAINING P135	------	------	0.54		20	1	59	60				------	------	1.77	
PROJECTOR SCRN AUDITORIUM P150	0.13	------	------		20	1	61	62	1	20		0.60	------	------	LTG - FITNESS CENTER
SPARE	------		------		20	1	63	64	1	20		------		------	SPARE
PROJECTOR/LIFT RM P150	------	------	1.00		20	2	65	66	1	20		------	------	1.05	LTG - AUDITORIUM P150
	1.00	------	------				67	68	1	20			------	------	SPARE
FUTURE BARBER SHOP RM PI130	------	1.92	------		20	1	69	70	1	20		------		------	SPARE
FUTURE BARBER SHOP RM PI131	------	------	1.92		20	1	71	72	1	20		------	------		SPARE
SPARE		------	------		20	1	73	74	1	20			------	------	SPARE
SPARE	------		------		20	1	75	76	1	20		------		------	SPARE
SPARE	------	------			20	1	77	78	1	20		------	------		SPARE
SPACE		------	------				79	80					------	------	
SPACE	------		------				81	82	3	60		------		------	TVSS
SPACE	------	------					83	84				------	------		
LEFT SUB-TOTAL	12.41	13.80	14.22												
RIGHT SUB-TOTAL	14.41	13.20	13.00												
PER PHASE TOTAL	26.83	27.01	27.22												
PANEL TOTAL			81.05												

TOTAL PANEL LOAD

	CONNECTED	DEMAND
KVA	81.1	**54**
AMPS	225.0	**149**

* NOTES: (E = EXST TO REMAIN UNO, G = GF, L = LOCKABLE, S = SHUNT TRIP)

1. PROVIDE WITH 200% NEUTRAL BUS
2. FOR SYSTEM FURNITURE, PROVIDE 20A, 2 POLE BREAKER TO SERVE THE 120V CIRCUITS

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	L1PBB-1	Panel Location:	P129	
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	Receptacle	1	P136	1536	w		1536	1920	
2	A	Projector	9	P136	760	w		760	950	
3	B	Receptacle	1	P136	1536	w		1536	1920	
4	B	Projector	9	P136	760	w		760	950	
5	C	Receptacle	1	P136	1536	w		1536	1920	
6	C	Projector	9	P136	760	w		760	950	
7	A	Projector	9	P136	104	w		104	130	
8	A	Projector	9	P136	104	w		104	130	
9	B	Projector	9	P136	104	w		104	130	
10	B	Projector	9	P136	104	w		104	130	
11	C	Projector	9	P136	1536	w		1536	1920	
12	C	Projector	9	P136	104	w		104	130	
13	A	Projector	9	P135	760	w		760	950	
14	A	Receptacle	1	P135	1536	w		1536	1920	
15	B	Receptacle	1	P133	432	w		432	540	
16	B	Receptacle	1	P135	1536	w		1536	1920	
17	C	Receptacle	1	P136	432	w		432	540	
18	C	EWC	7	P141	469	w		469	586	
19	A	Receptacle	1	P144	864	w		864	1080	
20	A	Treadmill	9	P141	1563	w		1563	1954	
21	B	LCD TV	9	P141	720	w		720	900	
22	B	Treadmill	9	P141	1563	w		1563	1954	
23	C	Receptacle	1	P141	576	w		576	720	
24	C	Treadmill	9	P141	1563	w		1563	1954	
25	A	Receptacle	1	P141	1563	w		1563	1954	
26	A	Treadmill	9	P141	1563	w		1563	1954	
27	B	Fitness Equip	9	P141	1563	w		1563	1954	
28	B	Treadmill	9	P141	1563	w		1563	1954	
29	C	Lighting	3	Exterior	636	w		636	795	

30	C	Receptacle	1	P136	800	w		800	1000	
31	A	Receptacle	1	Level 1PB	576	w		576	720	
32	A	Treadmill	9	P136	576	w		576	720	
33	B	Receptacle	1	Level 1PB	1563	w		1563	1954	
34	B	Receptacle	1	P136	576	w		576	720	
35	C	Receptacle	1	Level 1PB	1563	w		1563	1954	
36	C	Receptacle	1	P136	800	w		800	1000	
37	A	Receptacle	1	Level 1PB	512	w		512	640	
38	A	Receptacle	1	P136	800	w		800	1000	
39	B	Receptacle	1	Level 1PB	512	w		512	640	
40	B	Receptacle	1	P136	576	w		576	720	
41	C	Receptacle	1	Level 1PB	1024	w		1024	1280	
42	C	Receptacle	1	P136	1563	w		1563	1954	
PANEL TOTAL								39.3	49.1	Amps = 136.4

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					12.8	16.0	33%	133.5
PHASE TOTAL	B					13.1	16.4	34%	136.5
PHASE TOTAL	C					13.4	16.1	33%	133.8

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		22.4	28.0		22.4	28.0	0.80		
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		0.6	0.8		0.6	0.8	0.80		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.5	0.6		0.5	0.6	0.80		
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		15.8	19.7		15.	19.7	0.80		

						8				
Total Demand Loads						39.3	49.1			
Spare Capacity			20%			7.9	9.8			
Total Design Loads						47.1	58.9	0.80	Amps =	163.7

	0.8	
Default Power Factor =	0	
Default Demand Factor =	100	%

PANELBOARD SIZING WORKSHEET

Panel Tag---------->	L1PBB-2	Panel Location:	P129		
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	Receptacle	1	Level 1PB	1024	w		1024	1280	
2	A	Receptacle	1	P135	864	w		864	1080	
3	B	Receptacle	1	Level 1PB	1563	w		1563	1954	
4	B	Receptacle	1	P135	864	w		864	1080	
5	C	Receptacle	1	Level 1PB	1563	w		1563	1954	
6	C	Receptacle	1	P135	576	w		576	720	
7	A	Receptacle	1	Level 1PB	1563	w		1563	1954	
8	A	Receptacle	1	P135	576	w		576	720	
9	B	Receptacle	1	Level 1PB	1563	w		1563	1954	
10	B	Receptacle	1	P133	1563	w		1563	1954	
11	C	Lighting	3	Exterior	1323	w		1323	1654	
12	C	Receptacle	1	P150	1563	w		1563	1954	
13	A	Receptacle	1	P135	576	w		576	720	
14	A	LDIM1	9	P129	11383	w	1.00	11383	11383	
15	B	Lighting	3	Exterior	63	w	0.90	63	70	
16	B	LDIM1	9	P129	11483	w		11483	14354	

17	C	Receptacle	1	P135	432	w		432	540		
18	C	LDIM1	9	P129	11183	w		11183	13979		
19	A	Projector Screen	9	P150	104	w		104	130		
20	A	Lighting	3	Fitness	540	w	0.90	540	600		
21	B	Spare	9		0	w		0	0		
22	B	Spare	9		0	w		0	0		
23	C	Projector	9	P150	800	w		800	1000		
24	C	Lighting	3	P150	945	w	0.90	945	1050		
25	A	Projector	9	P150	800	w		800	1000		
26	A	Spare	9		0	w		0	0		
27	B	Barber Shop	9	Pl130	1563	w		1563	1954		
28	B	Spare	9		0	w		0	0		
29	C	Barber Shop	9	Pl131	1563	w		1563	1954		
30	C	Spare	9		0	w		0	0		
31	A	Spare	9		0	w		0	0		
32	A	Spare	9		0	w		0	0		
33	B	Spare	9		0	w		0	0		
34	B	Spare	9		0	w		0	0		
35	C	Spare	9		0	w		0	0		
36	C	Spare	9		0	w		0	0		
37	A	Space	9		0	w		0	0		
38	A	TVSS	9		0	w		0	0		
39	B	Space	9		0	w		0	0		
40	B	TVSS	9		0	w		0	0		
41	C	Space	9		0	w		0	0		
42	C	TVSS	9		0	w		0	0		
PANEL TOTAL								56.0	67.0	Amps =	186.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					17.4	18.9	28%	157.2
PHASE TOTAL	B					18.7	23.3	35%	194.3
PHASE TOTAL	C					19.9	24.8	37%	206.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		14.3	17.9		14.	17.9	0.80		

						3				
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		2.9	3.4		2.9	3.4	0.85		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		38.9	45.8		38.9	45.8	0.85		
Total Demand Loads						56.0	67.0			
Spare Capacity			20%			11.2	13.4			
Total Design Loads						67.2	80.4	0.84	Amps =	223.3

	0.8	
Default Power Factor =	0	
Default Demand Factor =	100	%

Panel Total (Both Sections)

PANEL TOTAL						93.4	113.6	Amps=	0.0
PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					30.2	34.9	31%	290
PHASE TOTAL	B					31.8	39.7	35%	0.0
PHASE TOTAL	C					31.3	38.5	34%	0.0

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		0.0	0.0		0.0	0.0			
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						98.8	98.8			
Spare Capacity			20%			19.8	19.8			

Total Design Loads					118.6	118.6		Amps= 142.7

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Bus	225A
Main	150A
Feeder	(4) 1/0 AWG + 4 AWG Ground
Conduit	2" EMT

Voltage Drop

VD= 0.121V * 142.7A * 15 ft/ 1000A-ft = 0.26V < (208V*0.03)

Voltage Drop is acceptable.

Protective Device Coordination Study

A protective device coordination study that addresses a single-path through The Army National Guard Readiness Center's distribution system was performed to ensure the system is able to clear the fault current in the least amount of time possible. The path consists of MVS1 to Unit Substation B to panel LS4T. The path can be mapped in the riser diagram below.

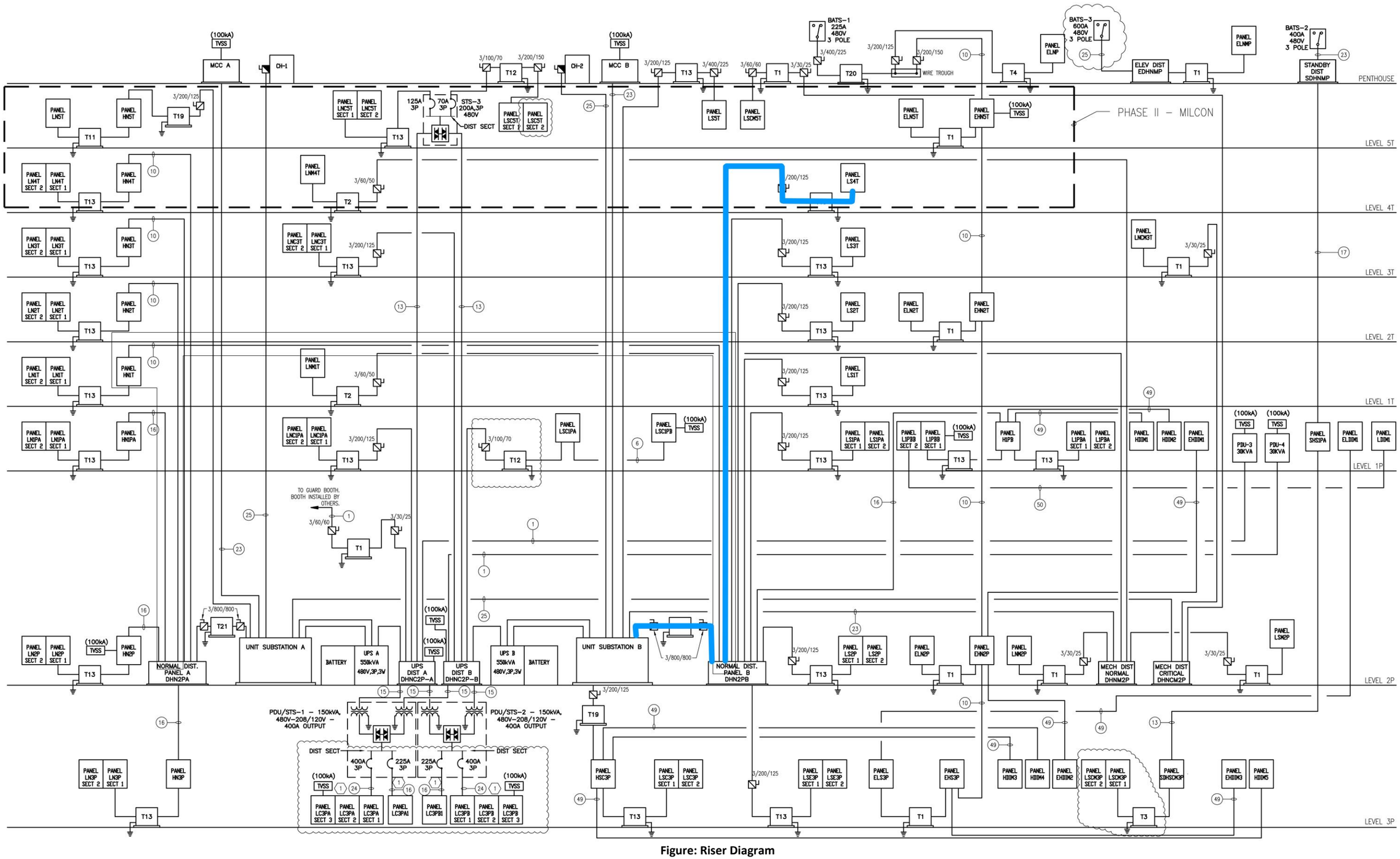
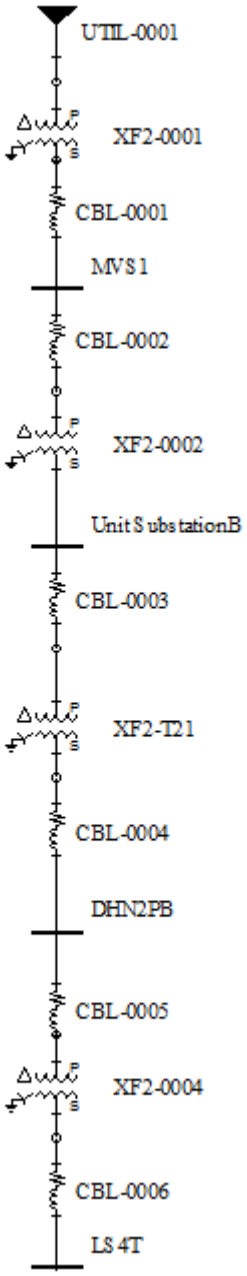
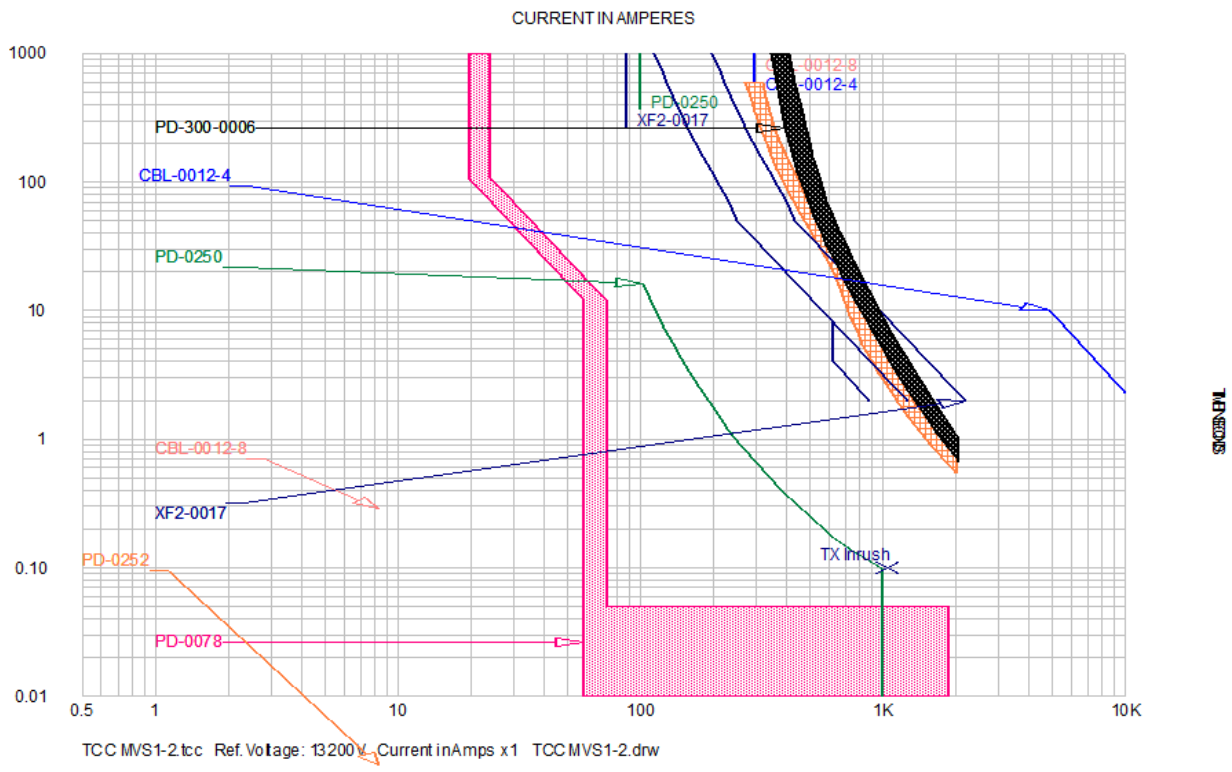


Figure: Riser Diagram


UTIL-0001
XF2-0001
CBL-0001
MVS1
CBL-0002
XF2-0002
Unit Substation B
CBL-0003
XF2-T21
CBL-0004
DHN2PB
CBL-0005
XF2-0004
CBL-0006
LS4T



Short Circuit Calculations

A short circuit analysis determines the maximum interrupting capacities of a distribution system. The following short circuit analysis provides a calculation at each component along the one-path via the per unit method. The utility short circuit is assumed to be 100,000kVA

Short Circuit Analysis (Per Unit Method)	
System Voltage	480
Base kVA	10,000
Utility Available Fault (kVA)	100,000

					ΣX	ΣR	ΣZ	I_{sc}(A)
Utility								
		$X_{(p.u)}$= (KVA_{base})/(Utility S.C. kVA)	=	0.100	0.10	0.00	0.10	16735
Switchboard MVS1								
					ΣX	ΣR	ΣZ	I_{sc}(A)
Transformer Secondary								
%Z	5.75	$X_{(p.u)}$= (%X*kVA_{base})/(100*kVA_{xfmr})	=	0.210				
X/R	7.5	$R_{(p.u)}$= (%R*kVA_{base})/(100*kVA_{xfmr})	=	0.028	0.31	0.03	0.41	1064
%X	0.69							
%R	5.18							
kVA	2500							

Wire								
Gauge	1/0 AWG	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.001				
Length (ft)	100	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.001	0.31	0.03	0.31	1411
Sets	1							
X	0.1231							
R	0.035							
Unit Substation B								
Wire								
Gauge	4/0 AWG	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.004				
Length (ft)	2283	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.008	0.32	0.04	0.32	1379
Sets	1							
X	0.0326							
R	0.0614							
Transformer Secondary								
%Z	5.75	$X_{(p.u)}= (\%X*kVA_{base})/(100*kVA_{xfmr})$	=	0.260				
X/R	7.2	$R_{(p.u)}= (\%R*kVA_{base})/(100*kVA_{xfmr})$	=	0.036	0.58	0.07	0.58	20755
%X	5.2							
%R	0.72							
kVA	2000							
Wire								
Gauge	4/0 AWG	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.042				
Length (ft)	30	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.080	0.62	0.15	0.64	18926
Sets	1							
X	0.0326							
R	0.0614							
Distribution Panel DHN2PA								
Wire								
Gauge	250kcmil	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.007				
Length (ft)	15	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.012	0.62	0.16	0.65	18640
Sets	3					.		
X	0.0328							
R	0.0534							
Transformer Secondary								
%Z	6.1	$X_{(p.u)}= (\%X*kVA_{base})/(100*kVA_{xfmr})$	=	1.180				
X/R	3.69	$R_{(p.u)}= (\%R*kVA_{base})/(100*kVA_{xfmr})$	=	0.320	1.80	0.48	1.87	6439
%X	5.9							
%R	1.6							
kVA	500							
Wire								

Gauge	250kcmil	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.007				
Length (ft)	15	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.012	1.81	0.50	1.88	6405
Sets	3					.		
X	0.0328							
R	0.0534							
Panel LS4T								
Wire								
Gauge	1/0 AWG	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.380				
Length (ft)	250	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	1.340	2.19	1.84	2.86	4208
Sets	1							
X	0.035							
R	0.1231							
Transformer Secondary								
%Z	3	$X_{(p.u)}= (\%X*kVA_{base})/(100*kVA_{xfmr})$	=	5.890				
X/R	0.83	$R_{(p.u)}= (\%R*kVA_{base})/(100*kVA_{xfmr})$	=	7.110	8.08	8.95	12.06	2303
%X	4.42							
%R	5.33							
kVA	75							
Wire								
Gauge	4 AWG	$X_{(p.u)}= (L*X_L*kVA_{base})/(1000^2*Sets*kV^2)$	=	0.131				
Length (ft)	15	$R_{(p.u)}= (L*R*kVA_{base})/(1000^2*Sets*kV^2)$	=	1.080	8.21	10.03	12.96	2142
Sets	1							
X	0.0377							
R	0.3114							

Depth 1- SKM Short Circuit Analysis

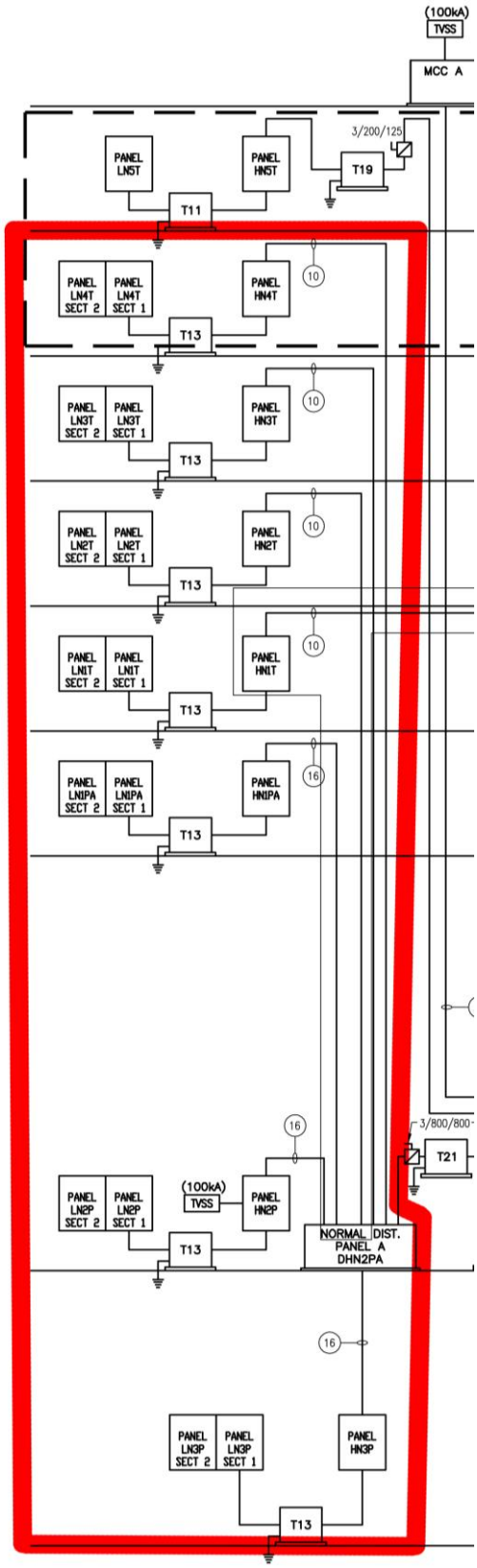
The first electrical depth is an analysis of the entire distribution system using SKM Power Tools. Upon modeling the electrical distribution system, a balance system analysis was performed which provided information for the short circuit, arc flash, and over-current device coordination study. All reports for the evaluations can be found in Appendix C.

Depth 2- Transformer Consolidation

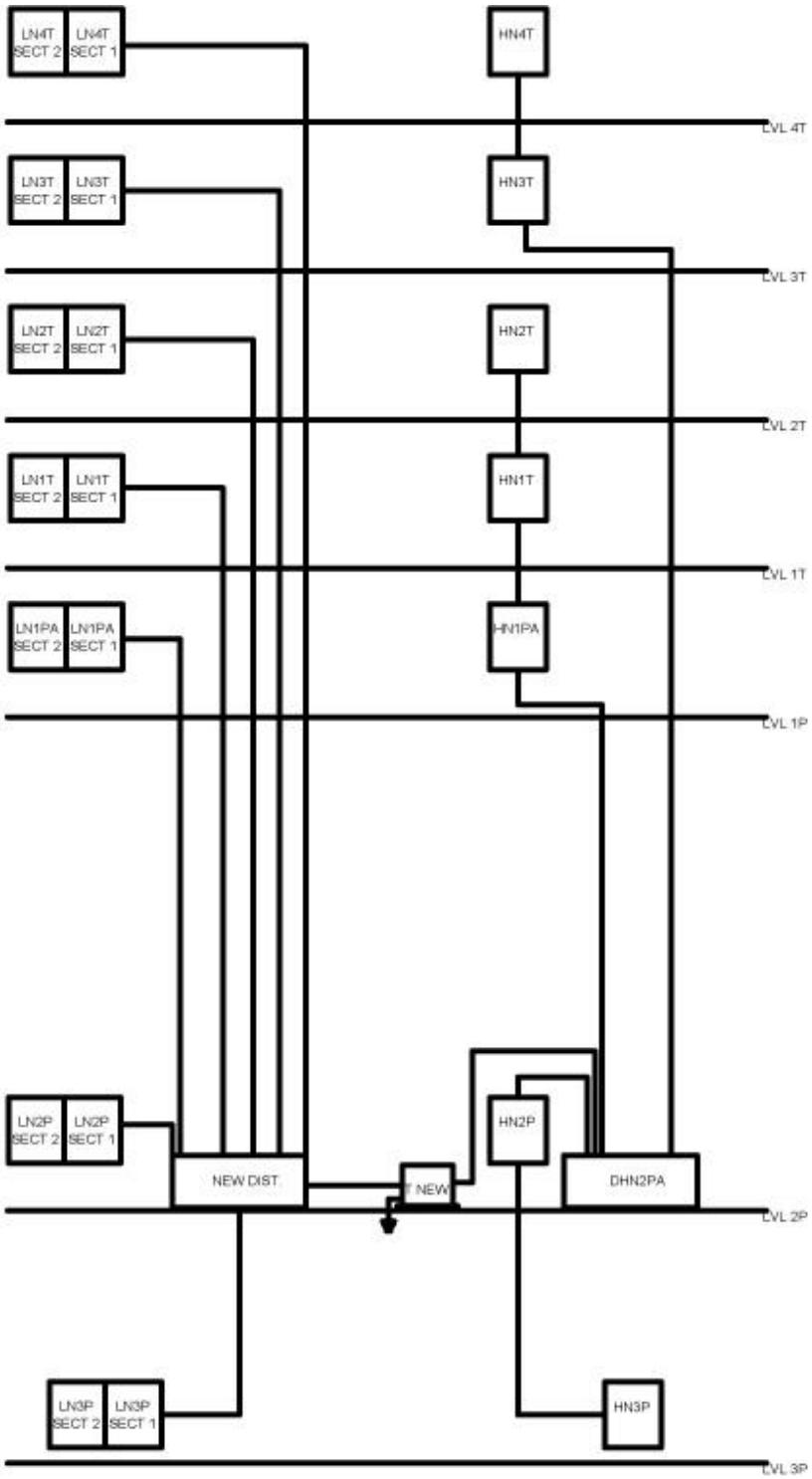
A defining characteristic of the electrical distribution system of the Army National Guard Readiness Center is its use of multiple transformers throughout the building. In several parts of the distribution system, distribution panels feed into identical transformers that repeat on each floor. The purpose of these transformers is to lower the voltage to 208Y/120V for use with panelboards of that same voltage. One may consider this to be redundant and the use of so many transformers may be a waste of space and money. The purpose of this depth research is

to redesign a portion of the distribution system by consolidating several of the smaller transformers into one larger one.

The first step of the research was to first determine which portion of the distribution system to redesign. It was determined that the feeders coming off of distribution panel DHN2PA and feeding into the connected panels would provide a good example of the stated problem. An image of the redesigned portion of the riser diagram is displayed below.


(100kA)
TVSS
MCC A
3/200/125
PANEL LN5T
PANEL HN5T
T19
T11
PANEL LN4T SECT 2
PANEL LN4T SECT 1
PANEL HN4T
10
T13
PANEL LN3T SECT 2
PANEL LN3T SECT 1
PANEL HN3T
PANEL LN2T SECT 2
PANEL LN2T SECT 1
PANEL HN2T
PANEL LN1T SECT 2
PANEL LN1T SECT 1
PANEL HN1T
PANEL LN1PA SECT 2
PANEL LN1PA SECT 1
PANEL HN1PA
16
3/800/800
T21
PANEL LN2P SECT 2
PANEL LN2P SECT 1
(100kA)
TVSS
PANEL HN2P
NORMAL DIST. PANEL A DHN2PA
PANEL LN3P SECT 2
PANEL LN3P SECT 1
PANEL HN3P

Upon reviewing the existing conditions, a new design was drawn up to consolidate the T13 transformers. The schematic for the new design is displayed below.



The new design consolidates seven 75kVA transformers into a single 300kVA transformer. One change that resulted from this is a separation of the 480Y/277V panelboards from the 208Y/120V. By eliminating the transformer loads from the 480Y/277V panelboards, the bus and

MCB rating of them were significantly reduced. This allowed for several of the panels to be fed by one feeder. A table of the original demand loads vs. the new for these panels is listed below.

Panel Tag	Demand Loads (kVA)	
	Existing	New
HN4T	52	7.42
HN3T	47	8.1
HN2T	50	9.4
HN1T	45	7.2
HN1PA	140	49.4
HN2P	79	30.9
HN3P	144	66

A reduction in the size of distribution panel DHN2PA was also a consequence of the new design. The size went down from the original 800A to 600A

A new distribution panel was also required to supply power to the separated 208Y/120V panelboards. The required size turned out to be 800A. Below is a table of the demand loads to the existing panelboards.

Panel Tag	Demand Loads	
	kVA	Amps
LN4T	39	108
LN3T	32	90
LN2T	36	99
LN1T	33	92
LN1PA	50	140
LN2P	33	92
LN3P	46	127

The final part of the analysis included a cost estimate of the existing design verses the new one. All information was taken from the 2011 R.S. Means and all prices are not including overhead and projection.

Existing Design					
Panelboards					
Label	**Voltage**	**Size (A)**	**Cost**		
HN4T	480/277V	225	5350		
HN3T	480/277V	225	5350		
HN2T	480/277V	225	5350		
HN1T	480/277V	225	5350		
HN1PA	480/277V	225	5350		

HN2P	480/277V	225	5350		
HN3P	480/277V	225	5350		
			37450		
Transformers					
Label	**Voltage**	**Size (kVA)**	**Cost**	**Number**	**Total**
T13	480-208/120V	75	5025	7	**35175**
Feeders					
Lable	**Size**	**Length (ft)**	**Number**	**Cost $/ (CLF)**	**Total $**
HN4T	1/0 AWG	239	4	338	3231.28
HN4T gnd	6 AWG	239	1	117	279.63
HN3T	1/0 AWG	226	4	338	3055.52
HN3T gnd	6 AWG	226	1	117	264.42
HN2T	1/0 AWG	213	4	338	2879.76
HN2T gnd	6 AWG	213	1	117	249.21
HN1T	1/0 AWG	200	4	338	2704
HN1T gnd	6 AWG	200	1	117	234
HN1PA	4/0 AWG	184	4	608	4474.88
HN1PA gnd	4 AWG	184	1	162.5	299
HN2P	4/0 AWG	174	4	608	4231.68
HN2P gnd	4 AWG	174	1	162.5	282.75
HN3P	4/0 AWG	187	4	608	4547.84
HN3P gnd	4 AWG	187	1	162.5	303.875
T 13 Prim.	1 AWG	10	21	274	575.4
T13 Prim gnd	6 AWG	10	7	117	81.9
T13 Sec.	250 kCMIl	10	21	706	1482.6
T13 Sec Neu	250 kCMIl	10	14	706	988.4
T13 Sec gnd	4 AWG	10	7	162.5	113.75
					30279.895
Conduits					
Label	**Diameter (in.)**	**Length**	**Cost (L.F.)**	**Total**	
HN4T	2	239	9.79	2339.81	
HN3T	2	226	9.79	2212.54	
HN2T	2	213	9.79	2085.27	
HN1T	2	200	9.79	1958	
HN1PA	2.5	184	18.05	3321.2	
HN2P	2.5	174	18.05	3140.7	
HN3P	2.5	187	18.05	3375.35	
T 13 Prim.	1.25	10	6.83	478.1	
T13 Sec.	2	10	9.79	685.3	
				19596.27	

Grand Total				$122501.17	

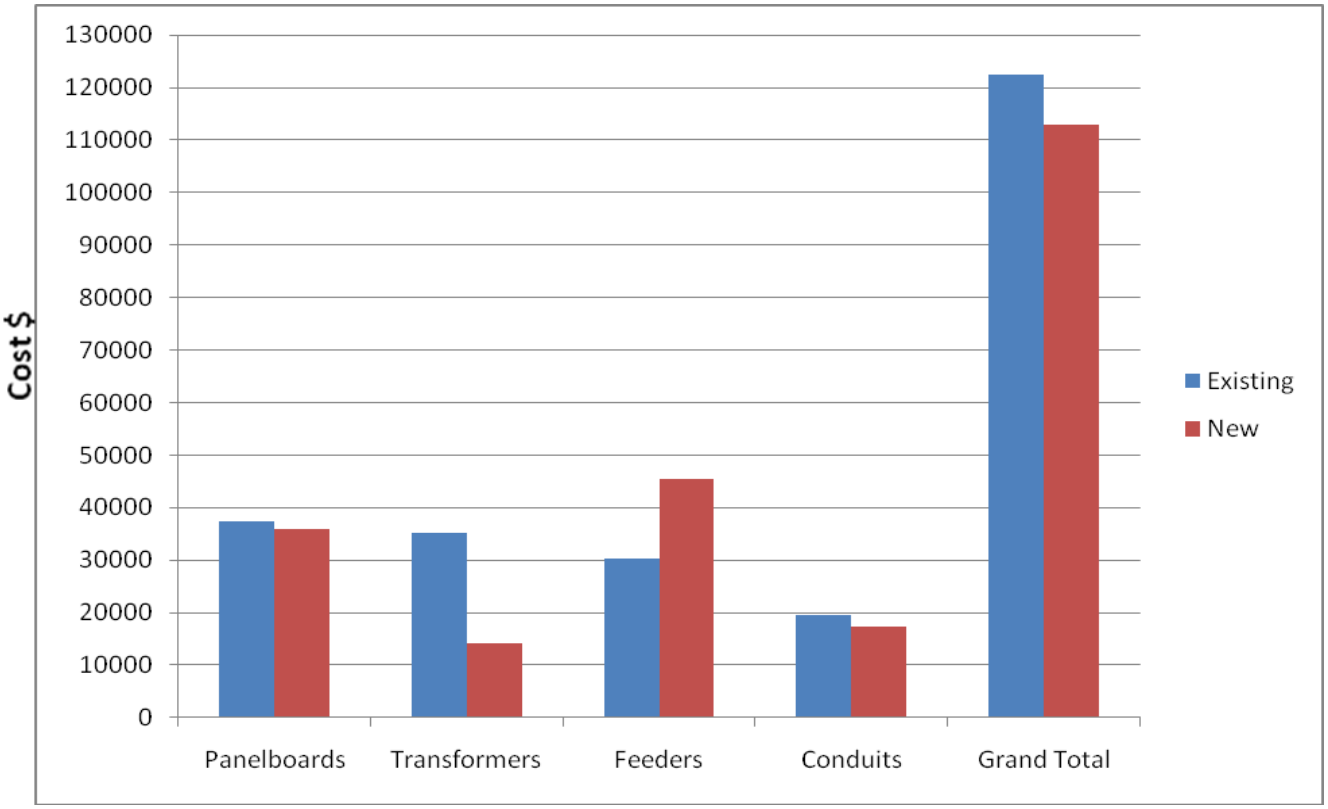
New Design					
Transformers					
Label	**Size (kVA)**	**Voltage**	**Cost**		
New Transformer	300	480-208/120V	**14035**		
Panelboards					
Label	**Voltage**	**Size (A)**	**Cost $**		
HN4T	480/277V	100	3575		
HN3T	480/277V	100	3575		
HN2T	480/277V	100	3575		
HN1T	480/277V	100	3575		
HN1PA	480/277V	100	3575		
HN2P	480/277V	100	3575		
HN3P	480/277V	100	3575		
New Dist	208/120	1200	4825		
			29850		
Circuit Breakers for New Dist. Panel					
Label	**Size (A)**	**Cost $**			
LN4T	125	880			
LN3T	125	880			
LN2T	125	880			
LN1T	125	880			
LN1PA	125	880			
LN2P	125	880			
LN3P	125	880			
		6160			
Feeders					
Label	**Size**	**Length (ft)**	**Number**	**Cost (CLF)**	**Total $**
HN4T	3 AWG	239	4	189.5	1811.62
HN3T					
HN4T gnd	8 AWG	239	1	83	198.37
HN3T gnd					
HN2T	3 AWG	213	4	189.5	1614.54
HN1T					
HN1PA					

HN2T gnd	8 AWG	213	1	83	176.79
HN1T gnd					
HN1PA gnd					
HN2P	3 AWG	187	4	189.5	1417.46
HN3P					
HN2P gnd	8 AWG	187	1	83	155.21
HN3P gnd					
New Trans Prim	(3 sets) 4/0 AWG	10	9	608	547.2
Trans Prim gnd.	(3 sets) 1/0 AWG	10	3	338	101.4
New Trans Sec.	(6 sets) 250 kCMIL	10	30	706	2118
Trans Sec. gnd.	(6 sets) 4/0 AWG	10	6	608	364.8
LN4T	4/0 AWG	239	4	608	5812.48
LN4T gnd	4 AWG	239	1	162.5	388.375
LN3T	4/0 AWG	226	4	608	5496.32
LN3T gnd	4 AWG	226	1	162.5	367.25
LN2T	4/0 AWG	213	4	608	5180.16
LN2T gnd	4 AWG	213	1	162.5	346.125
LN1T	4/0 AWG	200	4	608	4864
LN1T gnd	4 AWG	200	1	162.5	325
LN1PA	4/0 AWG	184	4	608	4474.88
LN1PA gnd	4 AWG	184	1	162.5	299
LN2P	4/0 AWG	174	4	608	4231.68
LN2P gnd	4 AWG	174	1	162.5	282.75
LN3P	4/0 AWG	187	4	608	4547.84
LN3P gnd	4 AWG	187	1	162.5	303.875
					205264.585
Conduits					
Label	**Diameter (in.)**	**Length (ft)**	**Cost (L.F.)**	**Total $**	
HN4T	0.75	239	4.1	979.9	
HN3T					
HN2T	0.75	213	4.1	873.3	
HN1T					
HN1PA					
HN2P	0.75	187	4.1	766.7	
HN3P					
New Trans Prim	1.25	30	6.83	204.9	
New Trans Sec.	2	60	9.79	587.4	
LN4T	2	239	9.79	2339.81	
LN3T	2	226	9.79	2212.54	
LN2T	2	213	9.79	2085.27	

LN1T	2	200	9.79	1958	
LN1PA	2	184	9.79	1801.36	
LN2P	2	174	9.79	1703.46	
LN3P	2	187	9.79	1830.73	
				17343.37	
Grand Total				**$272652.96**	

New Design	$272652.96
Existing Design	$122501.17
Price Difference	$150151.79

As one can see, consolidating all the transformers results in a system that is slightly less expensive than the original. The only category that ended up being more expensive was the feeders. The bar chart below gives a visual representation of the differences in component prices.



Acoustical Analysis

The same auditorium where the lighting was redesigned also had its acoustical characteristics analyzed. The main feature that was analyzed was the T_{60} reverberation time. T_{60} reverberation time is the most practical method of representing a room's absorptivity and is also one the most important characteristics in describing the acoustical quality of a room. It is defined as the time it takes for the pressure level of a sound wave to drop by 60dB when the source is turned off. To calculate the T_{60} reverberation time the room volume, surface areas, and surface absorption values are needed.

Surface	Label	Description	Area (ft^2)	Absorption Value	
				500Hz	1000Hz
Wall	P1	Paint on Gypsum	390	0.05	1.14
Wall	UPW2	Upholstered Wall Panel	1210	1.07	1.05
Wall	PL1	Plastic Laminate	154	0.1	0.09
Floor	WF-1	Wood Floor	345	0.2	0.17
Floor	CPT-5	Modular Carpet	735	0.14	0.35
Ceiling	CLG1	Gypsum Board	1706	0.05	0.04
Wall	WD1	Wood Veneer	370	0.2	0.17
Occupants	Audience	Audience	626	0.88	0.91

The volume of the room is approximately 21545 ft^3. The T_{60} reverberation time was calculated using the Sabine Equation:

T60 = 0.161V/ (A + 4mV)s,

$A = \alpha_{tot} S_{tot}\ ft^2$

$\alpha_{tot} = (\alpha_t S_T + \alpha_R S_R + \sum \alpha_i S_i)/S_{tot}$

$S_{tot} = S_T + S_R + \sum S_i\ ft^2$

$\alpha_t = (\alpha_{tot} S_{tot} - \alpha_R S_R - \sum \alpha_i S_i)/S_T$

<u>T_{60} Reverberation Time at 500Hz:</u>

Volume= 21545.4 ft^3

S_{tot}= 5563.2301

α_{tot}= [(0.05*389.6647) + (1.07*1210.1123) + (0.1*154.1354) + (0.2*344.7611) + (0.14*735.201) + (0.2*369.56) + (0.05*1706.3788) + (0.88*626.4167)]/5563.2301

=0.4

A = 0.4*5563.2301= 2225.3

T_{60}= 0.161*21545.4/2225.3 = 1.5 seconds

T_{60} Calculation @1000Hz:

Volume= 21545.4 ft^3

S_{tot}= 5563.2301

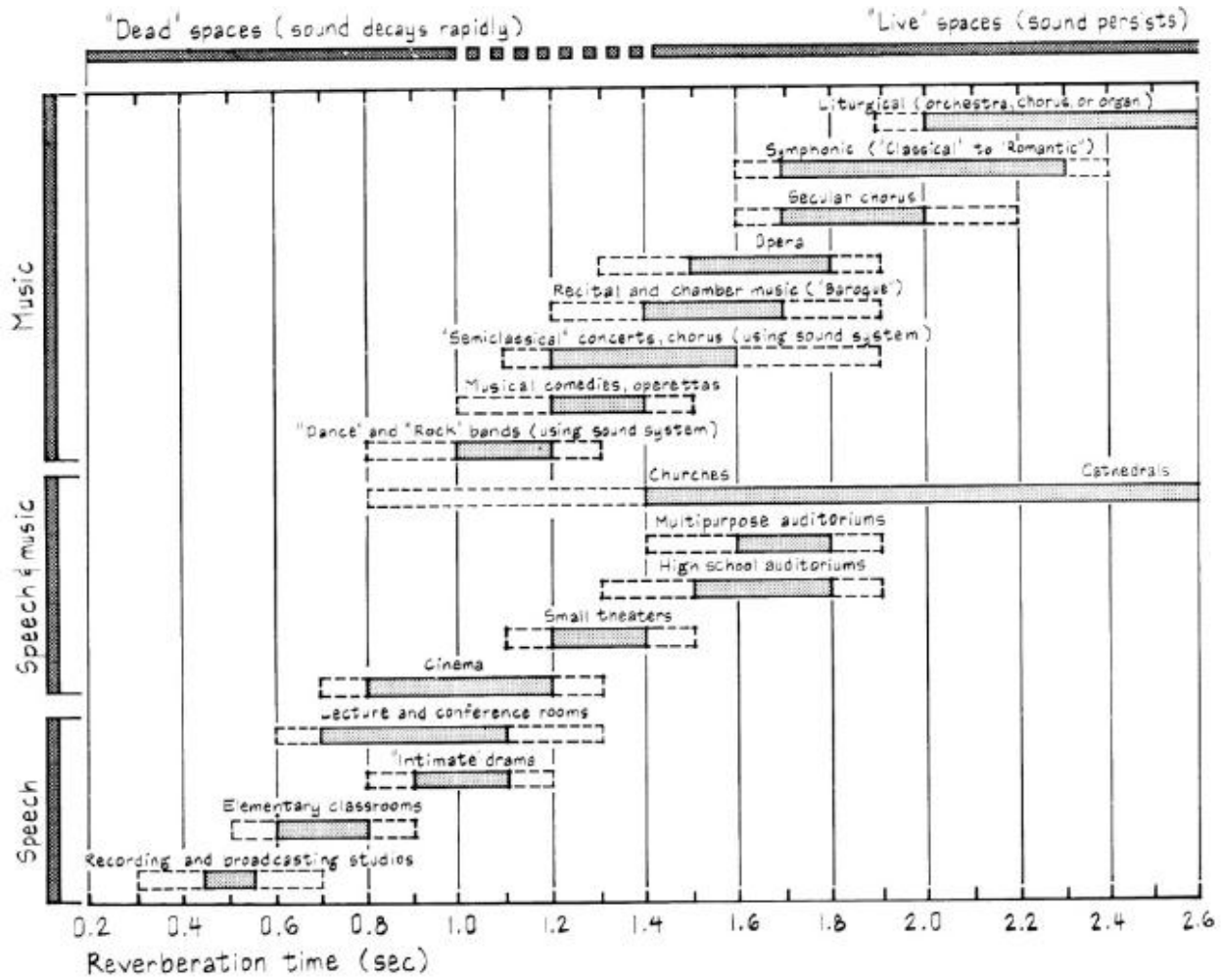
α_{tot}= [(0.04*390) + (1.05*1210) + (0.09*154.) + (0.17*344) + (0.35*735) + (0.17*370) + (0.04*1706) + (0.91*626)]/5563.2301

= 0.42

A = 0.42*5563.2301= 2336.6

T_{60}= 0.161*21545.4/2336.6 = 1.4 seconds

The following chart illustrates acceptable T_{60} reverberation times based on the type of space.



Based on the above chart, the T_{60} reverberation times of the auditorium are best suited for small theaters and high school auditoriums and falls within the lower limits of multipurpose auditoriums. However, these categories are meant for both music and speech while the space is only required to project speech well. Therefore, it would be best to increase the absorptive of the space. The most appropriate category to fall within the range is lecture and conference rooms. The most obvious way to solve this problem is to replace the most reflective surface with a more absorptive one. By replacing the ceiling material with an acoustic plaster, a significant reduction in T_{60} reverberation time should occur. Calculations of the material change are illustrated below.

New T_{60} Reverberation Time at 500Hz:

Volume= 21545.4 ft^3
S_{tot}= 5563.2301
α_{tot}= [(0.05*390) + (1.07*1210) + (0.1*154) + (0.2*344) + (0.14*735) + (0.2*370) + (0.4*1706) + (0.88*626)]/5563.2301
=0.5
A = 0.5*5563.2301= 2782
T_{60}= 0.161*21545.4/2782 = 1.2 seconds

T_{60} Calculation @1000Hz:

Volume= 21545.4 ft^3
S_{tot}= 5563.2301
α_{tot}= [(0.04*390) + (1.05*1210) + (0.09*154.) + (0.17*344) + (0.35*735) + (0.17*370) + (0.55*1706) + (0.91*626)]/5563.2301
= 0.57
A = 0.57*5563.2301= 3171
T_{60}= 0.161*21545.4/3171 = 1.1 seconds

The calculations show that if the roof is covered in acoustic plaster then the T_{60} reverberation time falls right in the range for lecture and conference rooms.

Mechanical Analysis

The second breath analysis also takes place within the auditorium. The original lighting design for the space utilizes all incandescent luminaires. However, the new design discussed in the

previous Lighting Depth section uses almost all fluorescent sources. Because 90% of the energy put into incandescent is converted into heat, it is assumed that a sizeable reduction in heat load to the space would occur if they were all replaced with fluorescent sources. Through the use of a Trane Trace model, an analysis of the change in heat load was performed.

For the Trace model, several data and assumptions were entered into the program in terms of occupancy and times of use. For the internal loads, there are 148 seats for people, 7740 watts of incandescent lighting, 1226 watts fluorescent. The lighting type loads were non-vented recessed fluorescents, 80% load to space and incandescent hung below ceiling, 75% load to space. The activity schedule is based on the auditorium preset. Only cooling design was accounted for in the schedule. The room checksum reports displayed the sensible and latent loads from both types of luminaires.

Room Checksums

By ACADEMIC

sp-1-Room

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 16
Outside Air: OADB/WB/HR: 87 / 74 / 110

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	22,990	5,458	28,448	36
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	22,990	5,458	28,448	36
Internal Loads				
Lights	8,084	2,021	10,105	13
People	39,600	0	39,600	50
Misc	865	0	865	1
Sub Total ==>	48,549	2,021	50,569	64
Ceiling Load	1,011	-1,011	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	72,549	6,468	79,018	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 16
OADB: 87

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	22,990	38
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	22,990	38
Internal Loads		
Lights	8,084	13
People	27,000	45
Misc	865	1
Sub Total ==>	35,949	60
Ceiling Load	1,011	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing		
Exhaust Heat		
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
System Plenum Heat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	59,949	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: -9

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	-45,402	-55,738	74.04
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-45,402	-55,738	74.04
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-3,540	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		-6,372	8.46
Additional Reheat		-13,168	17.49
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-48,942	-75,278	100.00

TEMPERATURES

	Cooling	Heating
SADB	56.3	70.0
Ra Plenum	77.0	62.9
Return	77.0	62.9
Ret/OA	77.0	62.9
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	2,953	886
Terminal	2,953	886
Main Fan	2,953	886
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	886	886
Return	2,953	886
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.86	0.56
cfm/ton	448.43	
ft²/ton	240.48	
Btu/hr·ft²	49.90	-39.22
No. People	150	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter gr/lb	Leave DB °F	Leave WB °F	Leave gr/lb
Main Clg	6.6	79.0	66.4	2,953	77.0	63.1	66.4	56.3	54.0	60.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	6.6	79.0								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	1,584		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	1,642	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-62.1	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-62.1			

Figure: Incandescent Lighting Load

Room Checksums

By ACADEMIC

sp-1-Room

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 16
Outside Air: OADB/WB/HR: 87 / 74 / 110

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	22,990	5,482	28,473	39
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	22,990	5,482	28,473	39
Internal Loads				
Lights	2,709	677	3,386	5
People	39,600	0	39,600	55
Misc	865	0	865	1
Sub Total ==>	43,173	677	43,850	61
Ceiling Load	926	-926	0	0
Ventilation Load	0	0	0	0
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		0	0	0
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	67,090	5,233	72,323	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 16
OADB: 87

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	22,990	42
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	22,990	42
Internal Loads		
Lights	2,709	5
People	27,000	50
Misc	865	2
Sub Total ==>	30,573	56
Ceiling Load	926	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Exhaust Heat	0	0
Grand Total ==>	54,490	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: -9

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	-45,402	-55,662	75.84
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	0	0	0.00
Sub Total ==>	-45,402	-55,662	75.84
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-3,807	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		0	0.00
RA Preheat Diff.		-5,640	7.68
Additional Reheat		-12,093	16.48
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-49,208	-73,395	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.8	70.0
Ra Plenum	76.9	62.4
Return	76.9	62.4
Ret/OA	76.9	62.4
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	2,608	782
Terminal	2,608	782
Main Fan	2,608	782
Sec Fan	0	0
Nom Vent	0	0
AHU Vent	0	0
Infil	0	0
MinStop/Rh	782	782
Return	2,608	782
Exhaust	0	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	1.65	0.49
cfm/ton	432.66	
ft²/ton	262.74	
Btu/hr·ft²	45.67	-38.71
No. People	150	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter gr/lb	Leave DB °F	Leave WB °F	Leave gr/lb
Main Clg	6.0	72.3	59.7	2,608	76.9	63.1	66.5	55.8	53.6	59.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	6.0	72.3								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	1,584		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	1,642	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-61.3	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-61.3			

Figure: Fluorescent Lighting Loads

Based on the Trace data, the heat load caused by the fluorescent lamps is about a third less than that of the incandescent lamps. A sizing down of the cooling system for the auditorium may be possible, which would lower the cost of the system.

Conclusions

The senior thesis project provided an opportunity to perform independent analyses on real life projects. The objective of the project was to demonstrate competent knowledge in the field of Architectural Engineering and apply it to existing designs. As a result, acoustical and mechanical analyses were performed for the auditorium. The reverberation times worked well for speech and music but was too high for just speech. Adding acoustical plaster to the ceiling remedied this situation. The existing incandescent luminaires perform well for color rendering and dimming purposes but consume a lot of energy and produce a lot of heat at the same time. Replacing them with the compact fluorescents in the proposed design dramatically reduces the wattage and heat load.

Although just about all of the existing designs perform well, there was still some room for improvement. The auditorium power density level was well above the ASHRAE 90.1 standard for the by space method due to the use of incandescent luminaires. Switching to fluorescent remedied the problem. The electrical distribution system was well designed and cost efficient. The price of multiple transformers is far less than the cost of the extra feeders.

Acknowledgements

I would like to thank the following people for all of their support and assistance throughout the duration of this senior thesis project:

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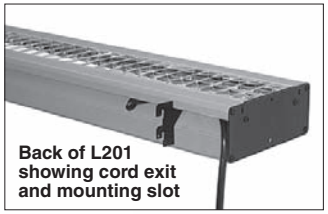
Tompkins Builders Construction Managers
- Arne Kvinnesland
- George VanSanford

Army National Guard Readiness Center, especially:
- LTC Rodney Graham- Owner Representative

All of my classmates, friends, and family

APPENDIX A



Back of L201 showing cord exit and mounting slot

Mounting brackets: Hang-on option available for most modular furniture systems. Order separately for mounting slot at rear of L201.

Louvers: High performance for maximum uplight coverage. Low brightness from below standing eye height. Lift out for re-lamping and cleaning.

Fillers: extruded aluminum. 3/8" to 6" long depending on luminaire length. Standard modular length units do not require fillers.

Housing: extruded aluminum, radiused edges

On/off switch (optional) is centered on the bottom of the luminaire.

Task lens: clear, linear prismatic acrylic, 18" long. Slides to any position along length to reduce veiling reflections.

End plates: stamped steel, finished black, mate with bridge stanchions and end mount brackets

Low profile: 6" (152mm) wide, 2-1/2" (64mm) high

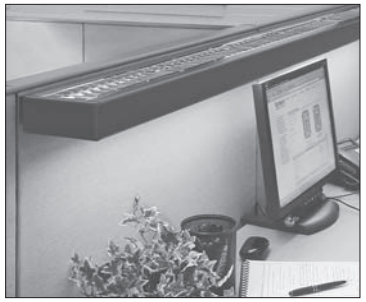
Downlight reflectors: specular extruded aluminum

T5 lamp(s) included

Personal switch for dimming control (for L201, optional)

Cord: 9' 18-3 SJT, molded NEMA 5-15 grounded plug, factory installed. Chicago Code cord with integral circuit breaker available.

Removable decorative end plates provided. Use where luminaire ends are not concealed by furniture. Pair. Each adds 3/8" to luminaire length.



Features

- *Task and ambient lighting from a single T5 lamp*
- *Typical energy consumption is 0.6 W/sf or less*
- *Integrates with embedded wireless controls (consult factory)*
- *Low profile; integrates with open plan office furniture systems*
- *Portable; may be reconfigured along with the furniture*
- *Reduces glare, eyestrain and visual distraction*

TA 1.0

Specifications

Finish:

Painted housing, fillers, decorative end plates, and mounting accessories (panel hooks, end mount rails, stanchions).

Painted surfaces – environmentally friendly 6-stage pretreatment and electrostatically applied thermoset powder coat provides a long lasting, scratch resistant finish. Choice of standard colors. RAL and computer matched colors available on request.

Reflector – extruded aluminum, chemically brightened and clear anodized.

Louver tiles – specular vacuum metalized polycarbonate with clear polymer topcoat for easy cleaning.

Mounting:

L201 has a continuous mounting slot along the rear of the unit, and can be mounted to a wall, furniture panel, or desk clamp stanchion. L201 cords are routed along the mounting slot and can be specified for right- or left-hand exit.

L202 has a smooth back surface for mounting with end mount rails (for 24" wide end panels) or with desk clamp stanchions. L202 cord exits are specified left or right, rear or bottom of unit, depending on mounting method. Stanchions feature a cord management slot.

Electrical:

Integral electronic ballast is HPF thermally protected class P, 120 volt. BF > 0.98. Programmed start maximizes lamp life and minimizes energy use.

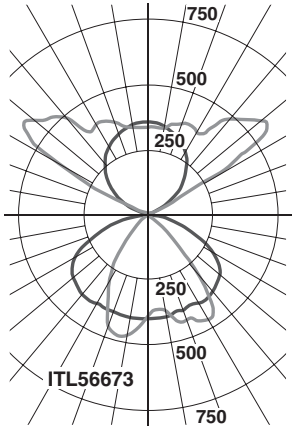
Cord – 9' 18-3 SJT, molded NEMA 5-15 grounded plug, factory installed. Chicago Code cord with integral circuit breaker available. Low profile grounded plug with 45° rotation is standard. Black is standard; gray and beige cords are available at additional cost.

Standard output T5 lamps are included. Choose from 3000K, 3500K and 4100K lamps.

Standard:

UL listed or CSA certified.

Performance



Lighter curve at left shows 180° to 0°. Darker curve shows 90° to 270°.

High lamp height position, see website for alternate positions. Illuminance based on a minimum of ten workstations. Light levels will be 5-10% greater in large rooms with more workstations. Ballast factor 0.98, input watts 52, maximum candlepower at 140° is 629 cd.

*For complete photometrics, see **thelightingquotient.com**.*

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Green in any color™

Project: _____ Type: _____

Sample number: L201-71S6-M-EL15-1-1R-0S-35

L	2	0		–		–		–		–		–		–		–	
Style				Length/Lamp(s) Code		Optic		Finish		Electrical		Cord	Cord Exit		Options		Lamp Color

Style

L201 Task ambient luminaire with integral hang-on mounting channel

L202 Task ambient luminaire with smooth back panel

Length/Lamps

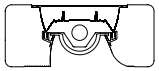
Code	*Length (mm)*	*Lamp(s)*	*Input*
24S2	24" (610)	1xF14T5	14W
36S3	35-3/4" (910)	1xF21T5	27W
48S4	47-1/2" (1205)	1xF28T5	33W
60S5	59" (1500)	1xF35T5	41W
71S6	70-3/4" (1800)	2xF21T5	49W
83S7	82-1/2" (2095)	1xF21T5 + 1xF28T5	60W
95S8	94-1/4" (2395)	2xF28T5	66W

Other lengths and lamping are available; consult factory.

TA 1.1

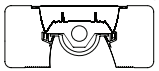
Optic

L Low-mount (L202 shown)



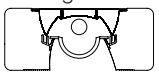
For low-mount IES information, consult factory.

M Mid-mount (L202 shown)



Download IES file.

H High-mount (L202 shown)



Download IES file.

Mounting Height	*Worksurface Depth*	
	24"	*30"*
48" – 50"	Low	Low
51" – 52"	Mid	Low
53" – 57"	Mid	Mid
58" – 61"	High	Mid
62" – 63"	High/(1)	High
64" – 66"	(1)	High

(1) Consult factory. Notation for height 62" – 63" is for L202.

To avoid glare, do not install below 48" or above 66".

Finish

EL02 Eggshell white
EL06 Dark bronze
EL07 Silver
EL08 Semi-gloss black
EL12 British racing green
EL15 Warm metallic
TASL Semi-gloss slate
XXXX Custom color (specify or submit sample)
or 4-digit RAL color code (color chart available)

Electrical

120 V only

1 Electronic ballast

T Dimming ballast for personal dimming control option (L201 only, specify with option **0D**). For other dimming applications, consult factory.

Cord

90° SW rotation plug, 9 feet:

1 Black
3 Gray
5 Beige
7 Chicago cord, integral circuit breaker, black

Straight plug, 9 feet (L202 only):

2 Black
4 Gray
6 Beige
8 Chicago cord, integral circuit breaker, black

Cord Exit

R Right rear (L201, L202)
L Left rear (L201, L202)
E Right bottom (L202 only)
W Left bottom (L202 only)

For L202, **R** and **L** are on dual stanchion only. **E** and **W** exits (L202) are 1-1/2" from end of luminaire.

Options

00 None
0S On/off switch
0D Dimming switch (L201, for use with dimming ballast only)
X0 Dual stanchion pre-drill (L202)
XS Dual stanchion pre-drill and integral on/off switch (L202)
XX Custom modification (specify)

Lamp Color

30 3000K, 85 CRI
35 3500K, 85 CRI
41 4100K, 85 CRI

Mounting Accessories

*For compatible furniture systems, see website.

TPH Panel Hooks, pair (L201)
TPR End Mount Rail Kit (L202)

T	P			–	
			System*		Finish (at left)

TPH Panel Hooks mount to slotted panel frame. Stamped and formed CRS, pair. **TPR End Mount Rails** (for 24" wide end panels) mount to slotted panel frames. Several models are available to interface with a variety of panel systems. Pair of rails, includes pair of black interface plates.

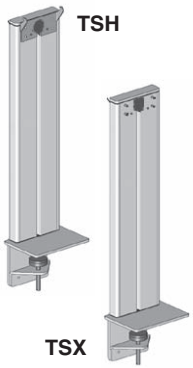
TPE End Mount Brackets, pair (P202)

Support the ends of the luminaire, black, pair.

TMHDW Wall Brackets, pair (L201)

T	M	H	D	W	–	E	L	0	0

TMHDW Wall Brackets mount to stud framed walls, millwork, and other solid surfaces. Stamped and formed CRS, black, pair.



TSH Desk Clamp Stanchion (L201)
TSX Desk Clamp Stanchion (L202)

T	S			–	
			Height		Finish (at left)

Desk Clamp Stanchions mount to edge of worksurface – 1/2" to 3-1/4" thick. Extruded aluminum post. Resilient pads resist slippage, protect surfaces. Integral cord management. **TSH19-/TSX19-** places top of luminaire 19-1/2" above worksurface. Sold individually; some luminaires require two stanchions.

L202 with TSX stanchion, back view

tambient *from* **The Lighting Quotient**
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **thelightingquotient.com**

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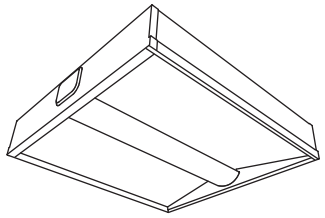
1 TT5 (40W)

mesoOptics® airwave™ RESPONSE®



Project Name

Spec Type

Notes

Order Guide

Some combinations of product options may not be available. Consult factory for assistance with your specification.

9422			B140	–		–		–		–	

Product Series & Size

PureFX 2’x2’

Version

D1 Standard T-Grid
D2 Slot T-Grid
A1 Air Return on Standard T-Grid
A2 Air Return on Slot T-Grid

See details on next page

Configuration

ST Standalone
CR Continuous Row
SMS Standalone Master/Satellite
CMS Continuous Row Master/Satellite

Lamping

1 TT5 (40W)

Housing

S Standard (22ga.)
N New York (20ga.)
C Chicago Plenum
T Standard w/ Frame Restraint

Wiring

1 1 cct
5 1 cct w/ Battery Pack
7 1 cct Dimming

Consult website for complete list of standard wiring options

Voltage

1 120V
2 277V
3 347V

Ballast

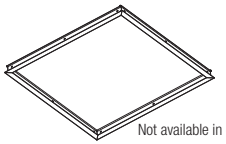
E Standard Ballast

Consult website for ballast manufacturer information

Upgrades & Accessories

Please indicate with check mark.

- ☐ Lamps Included
- ☐ Lamps Included & Installed
- ☐ Job Pack
- ☐ Flex Whip
- ☐ Drywall Kit



Not available in continuous row

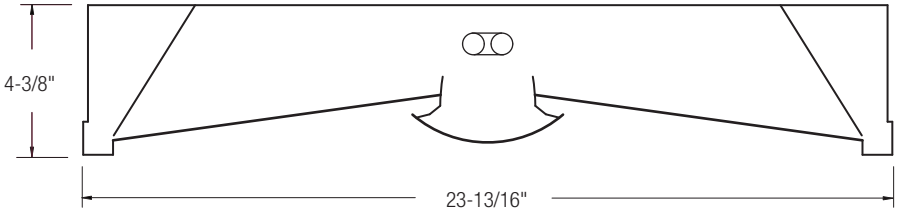
Can be mounted to wood frame or with hanger wire

Wood Frame

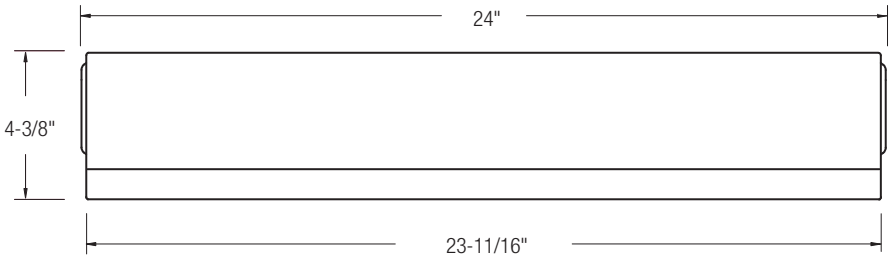
Hanger Wire

- ☐ Response Daylight
  For details visit www.ledalite.com/response

Cross Section



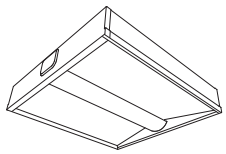
Side View



Phone: 604.888.6811 Fax: 800.665.5332 Web: www.ledalite.com

PureFX®

Recessed
2'x2'
1 TT5 (40W)



Photometry

Report Summary

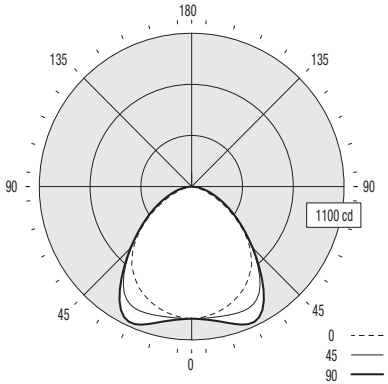
Report # 9900426
Filename 9422D1B140.ies
Efficiency 79%

Spacing Criteria 1.3 @ 0˚ along
1.4 @ 90˚ across

Meets RP-1-04 recommendations for VDT-Normal spaces

Candela Distribution

Vertical Angle	Horizontal Angle 0	22.5	45	67.5	90	Zonal Lumens
0	948	948	948	948	948	
5	940	945	949	955	956	92
15	904	920	958	996	1013	272
25	840	879	965	1044	1071	441
35	739	791	860	902	905	524
45	584	600	614	626	626	472
55	376	377	390	402	398	349
65	187	199	223	234	229	216
75	64	77	105	113	111	102
85	8	12	20	22	21	23
90	0	0	0	0	0	



Coefficients of Utilization (%)

Ceiling:	80				70			50			0
Wall:	70	50	30	10	70	50	30	50	30	10	0
0 RCR	94	94	94	94	92	92	92	87	87	87	79
1	87	83	80	78	85	82	79	78	76	74	68
2	80	74	69	65	78	72	68	70	66	63	58
3	73	65	60	55	71	64	59	62	57	53	50
4	67	58	52	47	66	57	51	55	50	46	43
5	62	53	46	41	60	52	45	50	45	40	38
6	57	47	41	36	56	47	40	45	40	36	33
7	53	43	37	32	52	43	36	41	36	32	30
8	50	39	33	29	48	39	33	38	32	28	27
9	46	36	30	26	45	36	30	35	29	26	24
10	44	33	27	23	43	33	27	32	27	23	22

Based on a floor reflectance of 0.2

Avg. Luminance (cd/m²)

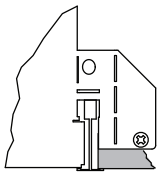
Vertical Angle	Horizontal Angle 0	45	90
55	1913	1985	2025
65	1292	1540	1582
75	722	1184	1252
85	268	670	703

IES files for this and other photometric options can be downloaded online at www.ledalite.com

Additional Information

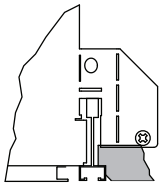
Mounting

Integrates with most common T-bar ceiling types.



D1 Standard T-Grid

Option D1 works with 9/16" and 15/16" flat T-grid ceilings. It can also be used with slot T-grid ceilings, but it will not sit flush with the bottom of the T-bar.

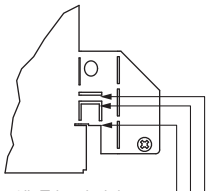


D2 Slot T-Grid

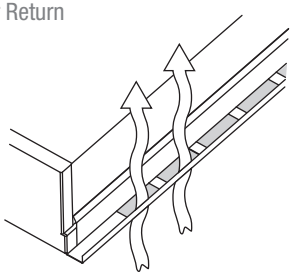
Option D2 is designed to sit flush with slot T-grid ceilings and some tegular tile ceiling types.

Ceiling Types

Integrated mounting tabs can be field-adjusted to various T-bar ceiling heights for fastening directly to the T-bar grid and/or tied-off to the building structure.



Air Return



The air return version features slotted vents along the sides of the fixture. As a result, the installation method of the air return version is different to the standard version, and the fixture cannot be installed in continuous rows.

Specifications

Due to continuing product improvements, Ledalite reserves the right to change specifications without notice.

Housing
Die-formed, post-painted, 22 gauge cold-rolled steel (New York City version is 20 gauge). Wire entrances are positioned on the side of the housing to allow easy wiring access for the installer. Multiple wire entrances are available on top or side to allow continuous row mounting of fixtures. Optional frame restraint is available to provide additional support to the optical frame.

Weight
Maximum 23 lbs.

Optical System
Optical assembly consists of flat acrylic panels and extruded curved acrylic lens. A protected MesoOptics® film layer creates optimal light distribution and high efficiency. The optical frame ends are constructed from die-formed cold-rolled steel assembled together with extruded aluminum profiles in a sturdy frame. The frame is hinged to allow easy access to the inside of the fixture. Maintenance can be performed from below the ceiling without tools. No hardware is visible.

Mounting
Fixture is compatible with most ceiling types. Integrated bend-out tabs are provided for different T-grid heights. Optional drywall kit is available for non-accessible ceilings. Use screws or hanger wire (supplied by others) to secure fixture.

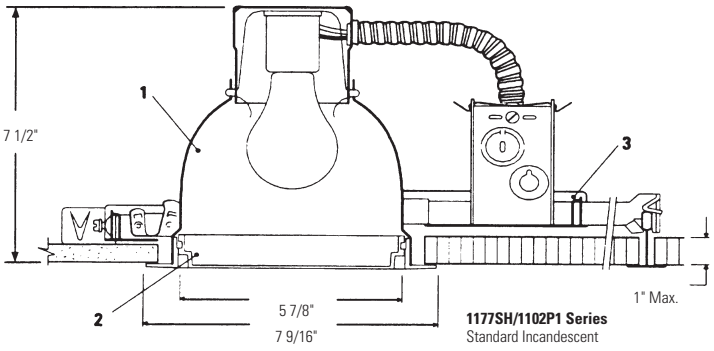
Ballast
Electronic. Supplied with pre-installed ballast disconnects as per national electric codes.

Wiring
Optional flex whips are supplied in 6' lengths for 1x4, 2x2 and 2x4 fixtures. Flex connectors are supplied in 9' lengths for standard master/satellite configurations.

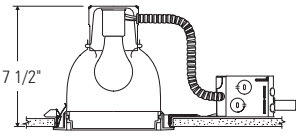
Air Return
Air return option available in 2'x2' and 2'x4' sizes only. Side rails are finished in black.

Approvals
Certified to UL & CSA Standards.
City of Chicago Approved CCEA (housing option C).
Designed to comply with NYC code requirements (Housing Option N).

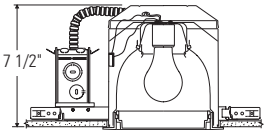
Finish
Housing and Frame: Post-painted, high quality powder coat. Available in white only.



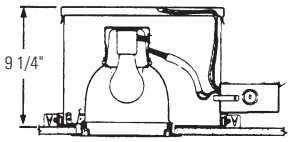
1177SH/1102P1 Series
Standard Incandescent



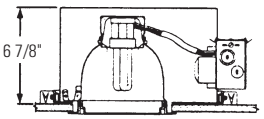
1177SH/1103R
Lytening™ Non-IC
Remodeler Ring



1177SH/1104IC
Lytening™
Convertible Non-IC Only



1177SH/1100 DEEP IC Series
Incandescent Insulated Ceiling



1177SH/1100AICMFT
Fluorescent Insulated Ceiling

Complete Fixture consists of Reflector Trim & Frame-In Kit. Select each separately.

Reflector Trim	Frame-In Kit — See Individual Frame-In Kit Specification Sheets							
	Incandescent				Fluorescent			
	Frame-In Kit	Installation Type	Lamping	Height	Frame-In Kit	Installation Type	Lamping	Height
1177SH Lexan®	**1102P1** **1103R**	Non-IC Non-IC Remodeler	60W A19	7 1/2" 7 1/2"	**1101F18U Series**	UniFrame™ Non-IC	(1) Quad/Triple 18W (GX24q-2)	6 5/8"
	1100IC **1100AICM** **1100DICM** **1100DAICM**	IC AirSeal® IC Deep IC Deep AirSeal® IC	40W A19	7 5/16" 7 5/16" 9 1/4" 9 1/4"	**1101F2642U Series**	UniFrame™ Non-IC	(1) Triple 26/32W (GX24q-3)	6 5/8"
					1104F13 Series	IC	(1) Quad/Triple 13W (GX24q-1)	7 1/2"
					1104F18 Series	IC	(1) Quad/Triple 18W (GX24q-2)	7 1/2"
	1104IC/N **1104ICR**	Non-IC Non-IC Remodeler	40W A19	7 1/2" 7 1/2"	**1104F26 Series**	IC	(1) Quad/Triple 26W (GX24q-3)	7 1/2"
					1100FTU Series	Non-IC	(1) Triple 26/32W (GX24q-3)	7 5/8"
					1100AICMFT	AirSeal®-IC	(1) Triple 26/32W (GX24q-3)	6 7/8"
					1910XFH1	Conversion Kit	(1) Quad 13W (GX23-2)	7 5/8"
					1101F18ICU/N	Performance IC	(1) Quad/Triple 18W (GX24q-2)	7 1/4"
					1101F2642ICU **1101F26421UN**	Performance IC	(1) Triple 26/32W (GX24q-3)	7 1/4"
					1101FDICMX1/N	Performance IC Advance Mark10 Dimming 120v	(1) Triple 26/32W (GX24q-3)	7 1/4"
					1101FDICMX2/N	Performance IC Advance Mark10 Dimming 277v	(1) Triple 26/32W (GX24q-3)	7 1/4"
					1910XDH1	Conversion Kit	(2) Quad 13W (GX23-2)	7 5/8"

Features

1. **Reflector:** Hydroformed aluminum, .040" minimum thickness (18 ga.); Anobrite® (anodic-processed) semi-specular finish for permanent reflectivity; plastic white trim flange.
2. **Flush Diffuser:** Translucent white, break resistant polycarbonate Lexan® Installs and removes with twist-lock actions; no tools required.
3. **Frame-In Kit:** (1102P1 standard frame shown). Other frames listed above and shown on the right. See Frame-In Kit specification sheets for more details.

Labels

UL (Suitable for Wet Locations - Covered Ceiling), I.B.E.W.
Meets NEC® requirements for Spas and Hot Tubs.

NEC® is a registered trademark of the National Fire Protection Agency.
US Patent Numbers: 5,045,985
Other US & Foreign Patents Pending.

Job Information **Type:**

Job Name:

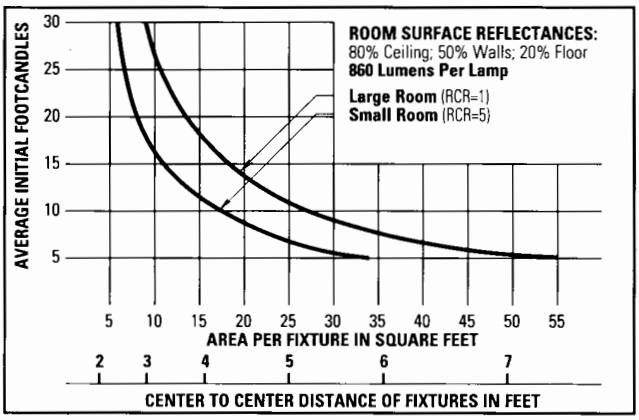
Cat. No.:

Lamp(s):

Notes:

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

LIGHTOLIER®

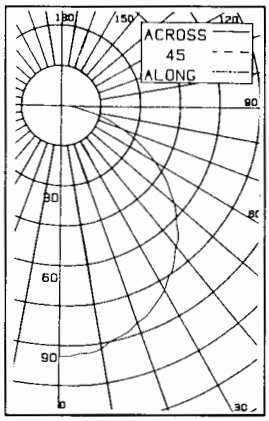


Use quick calculator chart to determine the spacing of 2 Lt. Watt Quad Tube units for a desired level of illumination. Conversion Factors: 1 Lt. 13W Quad Tube, F.C. x 0.5. 60W A19, F.C. x 1.0.

SPACING RATIO = 1.2

CERTIFIED TEST REPORT NO. 2145
COMPUTED BY LSI PROGRAM **TEST-LITE**

RECESSED LYTECASTER DOWNLIGHT
5 7/8" DIA., FLUSH OPLAX TRANSLUCENT LEXAN
TWO 13W DTT QUAD TUBE FLUORESCENT LAMPS. LUMEN RATING = 860 LMS.



DATE: JULY 18, 1990
PREPARED FOR:
LIGHTOLIER, SECAUCUS N.J.

CANDLEPOWER SUMMARY

ANGLE	MEAN CP	LUMENS
0	94	
5	93	9
10	92	
15	89	25
20	86	
25	83	38
30	79	
35	74	46
40	68	
45	62	48
50	56	
55	49	44
60	41	
65	33	33
70	25	
75	18	19
80	10	
85	4	5
90	1	

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP	% LUMINAIRE
0—30	72	4.21	27.01
0—40	118	6.91	44.30
0—60	210	12.25	78.59
0—90	268	15.59	100.00
40—90	149	8.68	55.70
60—90	57	3.34	21.41
90—180	0	.00	.00
0—180	268	15.59	100.00

** EFFICIENCY = 15.6% **

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

COEFFICIENTS OF UTILIZATION

% EFFECTIVE CEILING CAVITY REFLECTANCE

	80			70			50			30			10			0
	% WALL REFLECTANCE															
ROOM CAVITY RATIO	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.16	.16	.15	.16	.16	.15	.15	.15	.15	.15	.15	.14	.14	.14	.14	.13
2	.15	.14	.13	.14	.13	.13	.14	.3	.12.	13	.13	.12	.13	.12	.12	.11
3	.13	.12	.11	.13	.12	.11	.12	.11	.10	.12	.11	.10	.11	.11	.10	.10
4	.12	.10	.09	.11	.10	.09	.11	.10	.09	.11	.10	.09	.10	.09	.09	.09
5	.10	.09	.08	.10	.09	.08	.10	.09	.08	.09	.09	.08	.09	.08	.08	.07
6	.09	.08	.07	.09	.08	.07	.09	.08	.07	.09	.08	.07	.08	.07	.07	.06
7	.08	.07	.06	.08	.07	.06	.08	.07	.06	.08	.07	.06	.07	.07	.06	.06
8	.07	.06	.05	.07	.06	.05	.07	.06	.05	.07	.06	.05	.07	.06	.05	.05
9	.07	.06	.05	.07	.05	.05	.07	.05	.05	.06	.05	.05	.06	.05	.05	.04
10	.06	.05	.04	.06	.05	.04	.06	.05	.04	.06	.05	.04	.06	.05	.04	.04

20% FLOOR CAVITY REFLECTANCE

Conversion Factors: 1 Lt. 13W Quad Tube, C.U. x 1.0. 60W A19, C.U. x 2.0.

To convert lighting data for a lower wattage incandescent lamp of the **same type**, multiply the footcandle (or candlepower) values by the ratio of the lumens of the two lamps.
The coefficients of utilization remain the same.

Job Information **Type:**

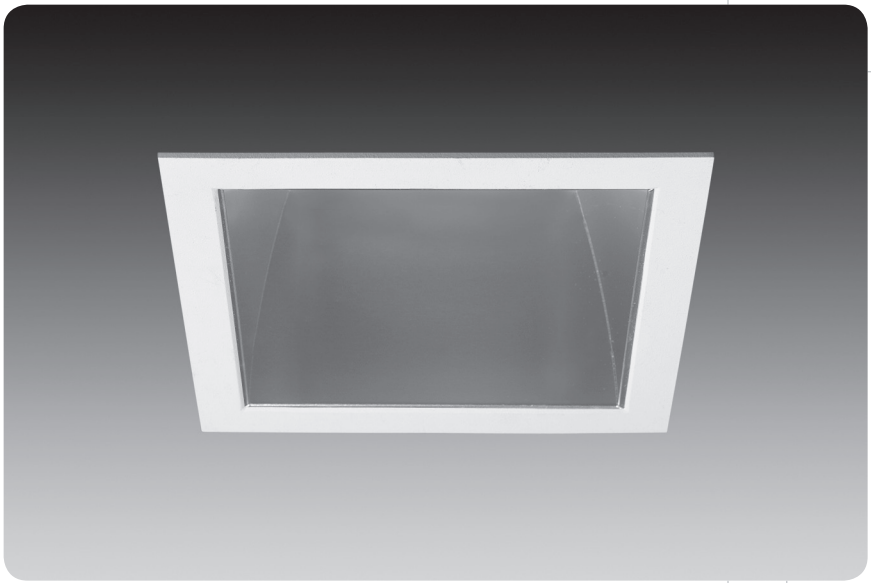
Lightolier a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

LIGHTOLIER®

4.5" x 4.5" – downlight

id®

CFL



Patent Pending

features

Overlap trim features:

- One piece die-cast construction creates seamless integration with reflector eliminating mitered corners.
- Die-cast flange maintains tight fit of reflector corners.
- **SmartLock™** clip allows for quick removal and re–assembly of trim components for field painting.

Flush trim features:

- Minimal .225" thick self flanged trim integrates seamlessly into drywall ceilings.
- Flush flange requires no field painting.

Centered optics achieved with **CenterLock™** die-cast socket cup which locates and locks 18, 26 or 32 watt lamp in center of aperture.

LampAlign™ allows installation of upper reflector in any direction regardless of housing direction. Lamps are aligned for consistent appearance and light distribution.

Reflector design eliminates tabs in corners for a seamless, no light leaks look.

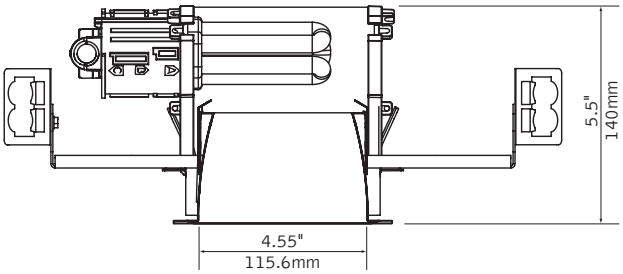
1" tall housing collar rotates up to 90˚.

55-degree cut-off to lamp and its image.

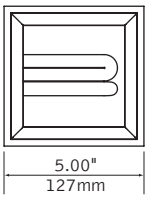
lens option

MicroGlow

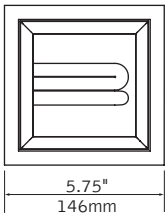
dimensional data

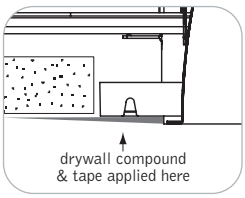


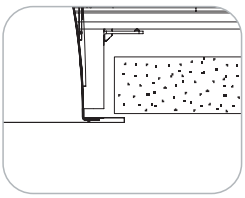
flush trim



overlap trim

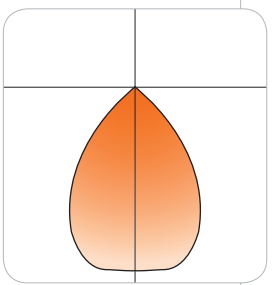






performance

1–Lamp 32W Triple Tube
Downlight Optic, Clear Diffuse
45% Efficiency
761 cd @ 10°



Visit focalpointlights.com for complete photometric data.

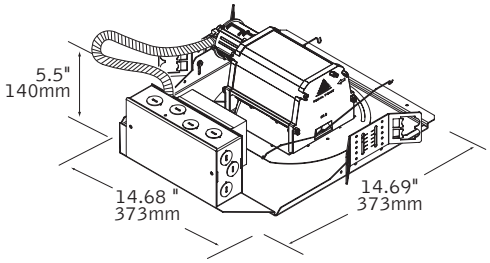
octeber 2010 C

fixture:

project:

details

t–rated housing non–ic



specifications

housing

Frame features up to 90-degree locking adjustment of aperture after installation for parallel alignment to walls or adjacent fixtures.
Frame may be installed into ceiling thicknesses up to 1". For thicker ceiling consult factory.
Flex conduit with screw tight fittings mechanically fasten to CenterLock™ socket cup. CenterLock™ provides proper venting for lamps.
Butterfly brackets allow mounting to ½ emt. Order bar hangers as an accessory.
Galvanized steel frame includes large Junction box 7" x 3.5" with (10) ½" pry outs.
UL listed for through branch wiring, four #12 90°C conductors.

upper reflector

Multi-faceted steel upper reflector mounts to die cast end caps and is finished in High Reflectance White powder coat. Adjustable socket cup allows 18, 26 and 32W lamps to be centered in the optic to maintain optimal performance.

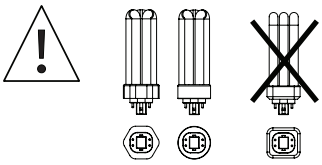
trim

Lower reflector provides 55-degree cut off to lamp and lamp image.
Parabolic aluminum fastens to die-cast flange on overlap trim. Flush trim option for drywall installations features a minimal reflector flange.
Trim attaches to upper reflector via torsion springs.
Consult factory for custom reflector finishes.
Upper reflector and lower reflector ship separately from housing frame to avoid construction abuse.
Optional .125" thick MicroGlow™ micro prism lens provides lamp obscuration.

electrical

Luminaires are pre-wired for single circuit with thermally protected Class "P" program start <10% THD electronic ballast.
Consult factory for dimming specifications and availability.
UL Listed.
Integral emergency battery test switch and indicator light in optic.
Rotary lock socket allows for easy lamp removal and reduces lamp breakage.
One lamp triple tube compact fluorescent, 4-pin, 18W-(GX24q-2), 26W/32W-(Gx24q-3/4). OSI and GE lamps only.

finish



Trim flange, end caps and upper reflector finished in polyester powder coat over a 5-stage pre-treatment.

housing ordering

		FC44
housing series		
ID CFL Square Housing	FC44	
lamp (OSI & GE lamps only)		_____
18W Triple Tube, GX24q-2	18TT	
26W Triple Tube, GX24q-3 (Includes wattage restriction label)	26TT	
32W Triple Tube, GX24q-3	32TT	
ballast		_____
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
voltage		_____
120V	120	
277V	277	
347V	347	
faceplate type		_____
Square Flush	SF	
Square Overlap	SO	
housing type		T
Thermally Protected, Non-IC	T	
factory options		
Chicago Plenum	CP	_____
Emergency Battery Pack*	EM	_____
HLR/GLR Fuse	FU	_____
Include 3000K Lamp	L830	_____
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	

trim ordering

		D44
trim aperture		
4.5" Square Aperture	D44	
faceplate type		_____
Square Flush	SF	
Square Overlap	SO	
optic		_____
Downlight	DN	
Regress MicroGlow Lens	RLMG	
color		_____
Clear Specular	CS	
Clear Diffuse	CD	
Warm Diffuse	WD	
Silver Talc Diffuse	TD	
flange finish (for SO option only)		_____
White	WH	
Black	BK	
Titanium Silver	TS	
Aluminum Raw	AL	

a complete unit consists of
two line items, housing and trim
example: FC44-32TT-S-120-SO-T
D44-SO-DN-CD-WH

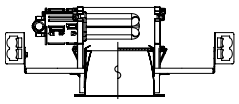
* for more information see Reference section.

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

4.5"x4.5" – downlight

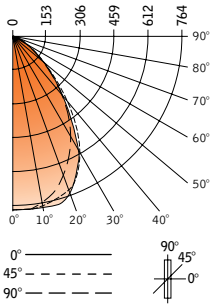
id®

CFL



Filename: D44DNCS32TT.IES
Catalog #: FC44-32TT-U-SO-T, D44-SO-DN-CS-WH
Efficiency: 45%
Photometric Report #: 13971.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	760	760	760	760	760	
5°	761	760	763	764	763	73
15°	699	711	735	759	761	208
25°	569	604	660	647	646	291
35°	403	456	463	422	410	274
45°	224	233	217	236	231	177
55°	52	69	62	58	49	54
65°	9	8	9	9	9	9
75°	3	2	3	2	3	3
85°	0	0	0	0	0	0
90°	0	0	0	0	0	

Spacing Criteria
End: 1.0
Cross: 1.1

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	572	23.8	52.6
	0°40°	847	35.3	77.8
	0°-60°	1077	44.9	99
	0°-90°	1089	45.4	100
Total Luminaire	0°-180°	1089	45.4	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	24062	23310	24814
55°	6886	8210	6489
65°	1618	1618	1618
75°	880	880	880
85°	0	0	0

CO–EFFICIENTS OF UTILIZATION

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

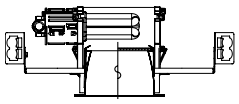
Numbers indicate percentage values of reflectivity.

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

4.5"x4.5" – downlight

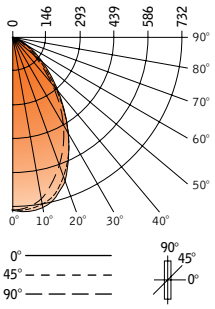
id®

CFL



Filename: D44DNCD32TT.IES
Catalog #: FC44-32TT-S-SO-T, D44-SO-DN-CD-WH
Efficiency: 42%
Photometric Report #: 14182.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	727	727	727	727	727	
5°	717	722	726	729	732	69
15°	633	656	679	390	693	191
25°	497	523	549	552	544	248
35°	344	363	353	357	365	224
45°	203	192	181	207	221	153
55°	97	78	75	90	107	77
65°	44	33	28	38	48	36
75°	15	12	10	14	20	14
85°	4	3	2	3	5	3
90°	0	0	0	0	0	

Spacing Criteria
End: 0.9
Cross: 1.0

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	508	21.2	50
	0°40°	732	30.5	72
	0°-60°	936	40.1	94.7
	0°-90°	1016	42.3	100
Total Luminaire	0°-180°	1016	42.3	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	21806	19443	23740
55°	12845	9932	14170
65°	7908	5032	8627
75°	4402	2935	5869
85°	3486	1743	4357

CO–EFFICIENTS OF UTILIZATION

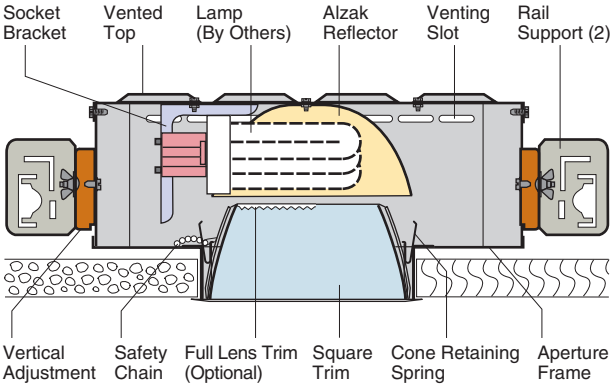
Floor		80				70			50		30		10		00
Ceiling										20					
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	50	10	00
RCR 0	50	50	50	50	49	49	49	47	47	45	45	43	43	42	
1	48	46	45	44	47	45	46	44	42	42	41	41	39	39	
2	45	42	40	39	44	42	38	40	37	39	37	38	36	35	
3	43	39	36	35	47	38	34	37	34	36	33	35	33	32	
4	39	36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

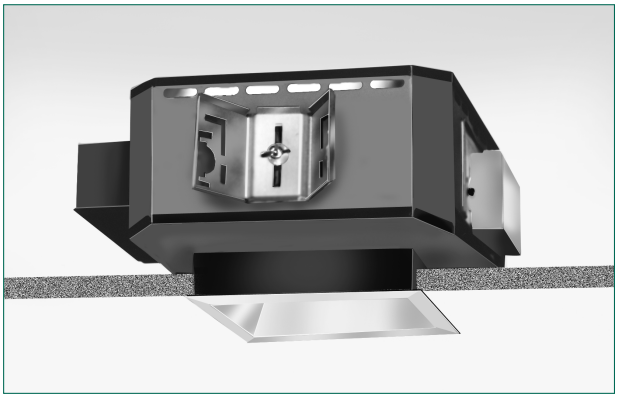
Numbers indicate percentage values of reflectivity.

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

H8443 H22a

Shallow Depth Downlight
One 26 or 32W Triple Tube Compact Fluorescent Lamp
4 1/2" Square Parabolic Trim





Optics and Applications
The socket is mounted horizontally in an ellipsoidal primary reflector. Recess depth is reduced for shallow plenums. Use in low to medium height ceilings for corridors, entries and for general and area lighting.

Design Features
A steel housing protects and aligns reflectors and lamps. The socket and ballast will accept 26 or 32W triple tube wattages interchangeably. The square trim is stabilized by a proprietary steel web to prevent racking and is held to the ceiling by constant pressure springs. Maximum ceiling thickness 7/8". Ballast and lamp service from below.

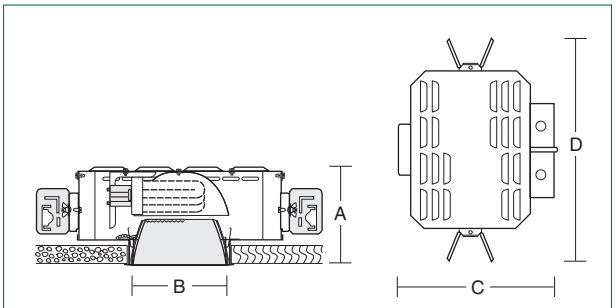
Finish
Housings and structural parts are painted matte black to suppress stray light leaks. Standard trims are anodized Softglow® clear. Special finishes, textures and colors are available, see below under Accessories.

Trim Textures
Textured trims create a subtle new aperture appearance. Select among different embossed patterns to match the ambiance of the space being illuminated. Refer to Squares brochure for descriptive photos.

Ballasts
Fully electronic, microprocessor controlled with programmed start to assure rated lamp life. Input voltage ranges from 120V through 277V. Operates 26 or 32W lamps interchangeably. Power factor .98, starting temperature 0°F (-18°C), THD<10%. Pre-heat start < 1.0 second. End of lamp life protection. Rated for > 50,000 starts.

General
Fixtures are pre-wired, UL and C-UL listed for eight wire 75°C branch circuit wiring. Union made IBEW. Suitable for damp locations.

Dimensions and Lamps



Number	A Depth	B Aperture	C Width	D Length	Lamps
H8443	5 1/2" 140mm	4 1/2" sq. 114mm	13 1/2" 343mm	19" 483mm	26-32W TripleTube compact fluorescent

Accessories

R2	26" support rails.	WT	White trim flange.
R5	52" support rails.	WHT	White complete trim.
SB	Softglow black.	BP	Ball Peen texture.
SG	Softglow gold.	CG	Corrugated texture.
SH	Softglow mocha.	DS	Distressed texture.
SP	Softglow graphite.	WV	Woven texture.
ST	Softglow titanium.	LL	Linear spread lens.
SW	Softglow wheat.	LP	Large prism lens.
SY	Softglow pewter.	MP	Microprism lens.
SZ	Softglow bronze.	V347	347 volt ballast.
BR	Bright trim finish.	FC	Four cell cross baffle.
FR	Frosting on lens.	DM	Dimming ballast. Specify watts and volts.
F	Fuse.		

FLT4 Full lens trim, specify lens type, e.g. H8443-FLT4LL.
WRL Wattage restriction label, specify wattage.
EM Emergency power includes integral charger light and test switch visible through aperture. Battery operation for 90 minutes.

kurt versen
Kurt Versen Company Point Source Lighting
Westwood, New Jersey 07675

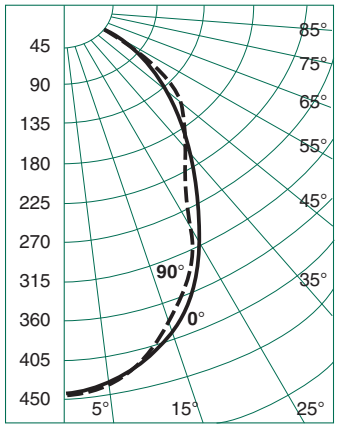
H22a H8443

Performance Datachart

Single Unit Initial Footcandles, 30" Work Plane							Ceiling to Floor	Multiple Units Initial Footcandles, 30" Work Plane			
H8443 26W Philips Triple Tube Read Top Data H8443 32W Philips Triple Tube Read Bottom Data								Ceiling 80% Walls 50% Floor 20%			
Nadir	10°		20°		30°			Spacing is Maximum Over Work Plane			
FC	FC	Diam	FC	Diam	FC	Diam		Spacing	RCR 1	RCR 3	RCR 8
15 18	13 16	2' 2'	10 12	4' 4'	5 7	6' 6'	8'	5' 6'	26 29	22 25	14 16
11 13	9 11	2' 2'	7 9	5' 5'	4 5	8' 8'	9'	6' 7'	19 21	16 18	10 11
8 9	7 9	3' 3'	5 7	5' 5'	3 4	9' 9'	10'	7' 8'	14 16	12 13	8 9
6 7	6 7	3' 3'	4 5	6' 6'	2 3	10' 10'	11'	8' 9'	11 12	9 10	6 7
5 6	4 5	3' 3'	3 4	7' 7'	2 2	11' 11'	12'	9' 10'	9 10	7 8	5 5

See notes 2, 3 and 4.

Candlepower Distribution

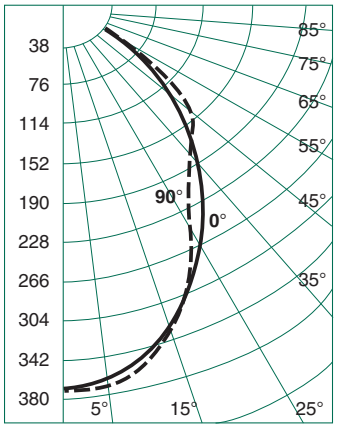


H8443 One 26W Triple Tube Philips
Eff. 35% S/M 0° .94 S/M 90° .91

Candelas

°	0° 1800*	90° 1800*
0	445	445
5	440	441
10	422	417
15	393	386
20	355	346
25	307	293
30	254	231
35	211	208
40	173	190
45	143	156
50	104	120
55	57	80
60	20	35
65	9	10
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

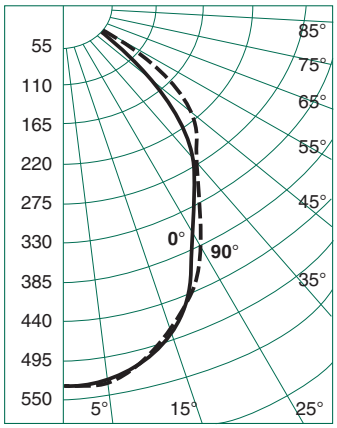
° Vertical Angles
* Initial Lamp Lumens



H8443 One 26W Triple Tube Osram
Eff. 30% S/M 0° .98 S/M 90° .92

°	0° 1800*	90° 1800*
0	375	375
5	368	375
10	354	361
15	336	329
20	308	289
25	268	251
30	225	201
35	188	176
40	157	164
45	123	149
50	89	120
55	45	76
60	14	30
65	8	9
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

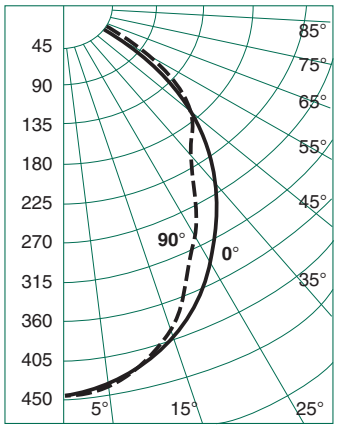
° Vertical Angles
* Initial Lamp Lumens



H8443 One 32W Triple Tube Philips
Eff. 34% S/M 0° 1.04 S/M 90° .96

°	0° 2400*	90° 2400*
0	531	531
5	528	532
10	510	506
15	484	475
20	449	436
25	404	378
30	359	310
35	310	272
40	257	247
45	200	201
50	139	155
55	78	105
60	28	50
65	12	13
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

° Vertical Angles
* Initial Lamp Lumens



H8443 One 32W Triple Tube Osram
Eff. 28% S/M 0° 1.03 S/M 90° .93

°	0° 2400*	90° 2400*
0	449	449
5	445	443
10	428	426
15	405	391
20	373	349
25	338	303
30	299	244
35	259	209
40	219	190
45	168	174
50	115	141
55	60	89
60	18	34
65	10	10
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

° Vertical Angles
* Initial Lamp Lumens

Notes

1 Softglow® cone multipliers: Gold x .89, Wheat x .87, Pewter x .73, Mocha x .75, Graphite x .70, Titanium x .70, Bronze x .68.

2 Single unit Datachart pattern diameters are determined by the number of degrees from each side of nadir. Therefore a 20° diameter represents a total 40° pattern width at the work plane 30" above the floor. Footcandle values are at the edge of that diameter.

3 Datachart spacing is rounded off to the nearest foot.

4 Data by IES methods. Compact fluorescent data vary due to lamp lumen differences, power input, burning position, ambient temperature and ballast characteristics. A modification factor should be applied.

FLEXIBLE CATHODE LIGHT STRIP
(MODEL FCLS)

Crystal Plaza - Alexandria,VA • Lighting design: C.M. Kling & Associates Photo: Eric Long

The Flexible Cathode Light Strip (FCLS) effectively brings cold cathode lighting into the 21st century. All the best features of shadowless long-life, cold-cathode fluorescent lighting have been engineered into a simple, self-contained, discreet, flexible luminaire. FCLS combines low electricity consumption and high lumens, and long lamp life, effectively eliminating the need for the bulky inefficient magnetic transformers, ballasts, and fixture dimensions associated with traditional component-based cold-cathode lighting systems.

Each beautifully-designed luminaire can conform to almost any shape or size (straight, curved or bent) of our custom or standardized lamps, in an almost infinite variety of deeply-saturated colors and high color-rendering whites. The Flexible Cathode Light Strip (FCLS) is completely modular, low profile (only 2 3/4" tall, including the lamp), installs in minutes, and offers the convenience of "plug-and-play" connections between fixtures. Lamps simply snap in and out, and all luminaires are provided as standard with integral, inaudible 1% electronic dimming ballasts.

"FLEXIBLE CATHODE LIGHT STRIP...BECAUSE THE WORLD IS ROUND"

c UL us LISTED

Patent 7,293,895
Patent 6,454,431

CLS CATHODE LIGHTING SYSTEMS
INNOVATIVE LIGHTING TECHNOLOGY®

8020 Queenair Drive, Gaithersburg, MD 20879 USA • ph: 301 921 4120 • fax: 301 963 3050
email: info@CathodeLightingSystems.com • website: www.CathodeLightingSystems.com

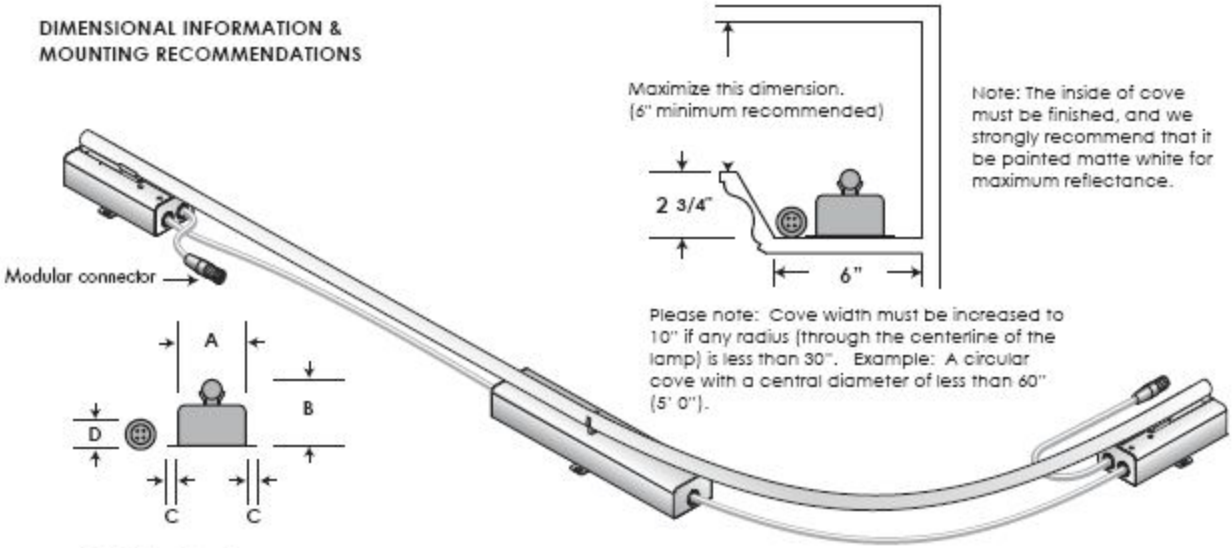
PRODUCT DATA SHEET

FLEXIBLE CATHODE LIGHT STRIP (FCLS)

FEATURES & BENEFITS

- Illumination is seamless from end to end, with no dark spots or socket shadow
- Each luminaire can flex or conform to almost any shape or size of lamp (straight, curved or bent) up to 7' 6" long
- Reliable, long-life high-output T6 cold cathode lamps (up to 50,000 hours of life) are available in standard or custom straight lengths, and can be custom-curved or bent to confor m to almost any architectural requirement
- Up to 322 feet of fixtures on one 20-amp circuit @ 277 volts, or 135 feet of fixtures @120 volts
- Lamps snap in and out of luminaires via innovative zero-clearance lamp bases and lampholders
- New electronic ballast technology offers inaudible operation and a power factor >.95
- Extremely low profile - only 2 3/4" tall with lamp installed
- External "plug and play" modular connectors allow rapid installation and eliminate all manual wiring between luminaires
- Luminaires are completely self contained. Absolutely no disassembly of the luminaire is required to install. Simply install the luminaire on its mounting surface, snap lamp in, and plug into the next luminaire.
- All luminaires come equipped with 1% dimming ballasts, and are compatible with 3-wire fluorescent dimmers
- All luminaires dim at the same rate, regardless of variations in lamp length or shape.
- Wide color selection, and up to 10 different white hues from to choose from
- UL-Listed c UL us LISTED

DIMENSIONAL INFORMATION & MOUNTING RECOMMENDATIONS



A. Width: 2 3/4"

B. Height (with lamp): 2 3/4"

C. Mounting tab width: 5/8"

D. Modular connector diameter: 1 5/16"

CATHODE LIGHTING SYSTEMS
INNOVATIVE LIGHTING TECHNOLOGY®

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email: info@CathodeLightingSystems.com • website: www.CathodeLightingSystems.com

FLEXIBLE CATHODE LIGHT STRIP (FCLS) — LAMP COLORS & ORDERING INFORMATION

LAMP COLORS

WHITE LAMPS: All whites are triphosphor with a CRI of 92

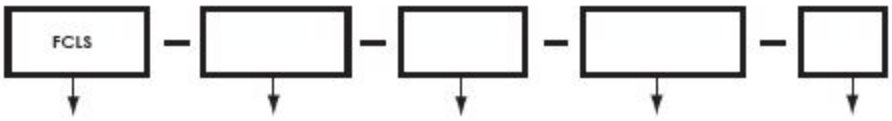
Cat. No.	Shade of White	Lumens per foot	Efficacy
28TC	Incandescent white - 2800°K	772	77.2 lumens/watt
30TC	Warm white - 3000°K	759	76.2 lumens/watt
35TC	Soft white - 3500°K	780	78.2 lumens/watt
42TC	Cool white - 4200°K	750	75.3 lumens/watt
50TC	Ice white - 5000°K	738	73.2 lumens/watt
65TC	Daylight - 6500°K	751	75.4 lumens/watt

Photometric information: All photometric values provided by LTL (Luminaire Testing Laboratories, Allentown, PA) .

COLORED LAMPS:

Pink White (PW)
Hot Pink (HP)
Red (RD)
Lavender (LV)
Purple (PR)
Sky Blue (SB)
Deep Blue (DB)
Turquoise (TQ)
Aquamarine (AQ)
Standard Green (GR)
Bright Green (BG)
Gold (GD)
Canary Yellow (CY)
Orange (OR)
Amber (AM)

ORDERING INFORMATION



Fixture Type:
CLS (Flexible Cathode Light Strip)

Lamp footage:
Round up to the nearest foot.

Lamp type:
S - Straight
C - Curved

Lamp color:
See color chart above for correct catalog numbers.

If color has not been chosen at time of specification, please write: TBD

Voltage:
120 - 120 volts
277 - 277 volts

Example: One circular light cove, 157' in circumference. Lamp color is 2800°K incandescent white. Fixtures will operate at 120 volts.

FCLS - 157 - C - 28TC - 120

- Model FCLS
- Length: 157 feet
- Curved lamps
- 2800°K incandescent-white lamps
- 120 volts

CATHODE LIGHTING SYSTEMS
INNOVATIVE LIGHTING TECHNOLOGY®

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email: info@CathodeLightingSystems.com • website: www.CathodeLightingSystems.com

ELECTRICAL INFORMATION

Ballast type	Primary voltage	Primary amps / VA	Watts per foot*	Dimming protocol	Maximum luminaires per 20-amp circuit*	Maximum lamp footage per 20-amp circuit*
Electronic	120 volts 50/60 Hz	.85 amps / 102 VA	13.6	3-wire fluorescent	18 @ 120 volts	135 feet
Electronic	277 volts 50/60 Hz	.37 amps / 102 VA	13.6	3-wire fluorescent	43 @ 277 volts	322 feet

*Values are based on maximizing all lamp lengths at 7'6". Actual values may vary depending upon the selection of luminaire lengths.

Dimming: Three-wire fluorescent (switched hot, dimmed hot, and neutral). Lutron is recommended.

Primary Wiring: Branch circuit wiring must contain three (3) conductors + ground in order to utilize dimming feature.

Branch circuit requirements: H-FCLS must be powered by a dedicated circuit only. Maximum breaker size is 20 amps.

SPECIFICATIONS

Luminaire: Shall be Cathode Lighting Systems model FCLS (Flexible Cathode Light Strip), and shall be field-adjustable to accommodate straight, curved or bent lamps up to 7'6" in length. Luminaires shall provide a continuous, uninterrupted line of light when installed as instructed. Luminaires shall be provided with integral male and female power connectors at each end to electrically connect each luminaire to the next. Luminaires shall be satin-anodized .050" aluminum and stainless steel and shall be permanently connected with matching flexible cable. No disassembly or entry into the internal parts of the luminaire shall be required during installation, either for wiring or for mounting.

Lamps: Shall be 50,000-hour T6 cold-cathode fluorescent, color as specified, in curvatures, shapes and sizes dictated by the architectural requirements. Lamps shall be provided with single-pin bases for zero-clearance snap-in installation and removal from lampholders. (Lamps that are hard-wired to the power supply in parallel or series are not acceptable alternatives). Lamps shall be manufactured with butt-sealed ends to provide complete illumination at each lamp end and shall have provisions to be locked into place, utilizing the luminaire's lamp-locking clips. Lamps shall produce 759 lumens per foot (35TC) and manufacturer shall provide independent test lab reports to substantiate.

Integral Ballasts: Shall be noiseless, electronic 990-volt, high-output, instant-start cold cathode, class P thermally protected, and shall automatically de-energize upon removal of lamps from the luminaire. Ballast power factor shall be >.95

Approvals: Luminaire shall be UL and cUL-listed under UL category: IEUZ Fluorescent surface-mounted luminaires.

Manufacturer: Shall be Cathode Lighting Systems Inc., Gaithersburg, MD - USA (800) 551-5012.
Website: www.CathodeLightingSystems.com

8020 Queenair Drive, Gaithersburg, MD 20879 USA • ph: 301 921 4120 • fax: 301 963 3050
email: info@CathodeLightingSystems.com • website: www.CathodeLightingSystems.com

Catalog Number
PAR38

Fixture Type:

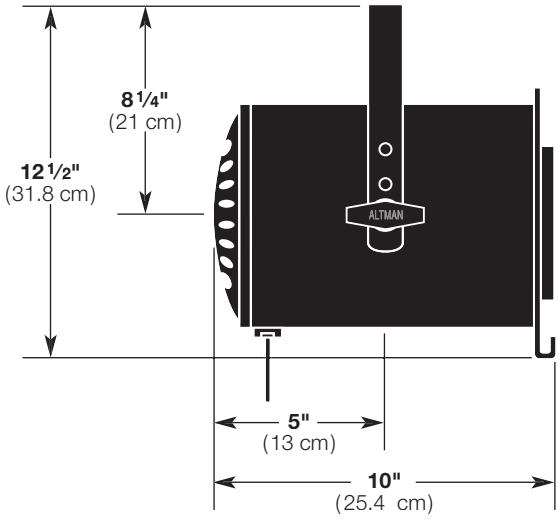
The PAR38 fixture is a low cost, versatile luminaire designed for diverse applications. Intensities and beam spreads are functions of the lamp selected for use in the fixture. One luminaire can serve multiple purposes simply by changing the lamp type. The small size of the PAR38 and a wide range of lamps to choose from make it an ideal luminaire for many lighting applications. Typical installations are found in night-clubs, concerts, theatres and architectural situations where maximum flexibility is desired from a small compact package.

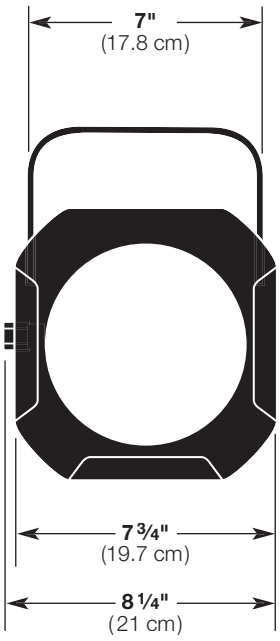
Specifications subject to change without notice

300 WATT
PAR38
spotlight/floodlight

Features

- Rugged sheet steel construction
- Medium screw base socket
- 3 position yoke adjustment
- Color frame and safety cable with spring clip included
- Three 36" Teflon lead wires
- Up to 25 Feet Hi-Temp rubber cable optional
- U.L. and c.U.L. listed for 300 watts
- Made in the USA





ALTMAN Lighting, Inc.
BRINGING IMAGINATION TO LIGHT

Specifications

Housing: Sheet steel construction.

Materials: Construction employs all corrosion-resistant materials and hardware.

Yoke: Rigid flat steel.

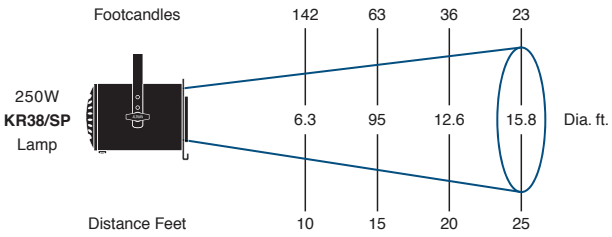
Socket: Medium screw base. Tool free relamping.

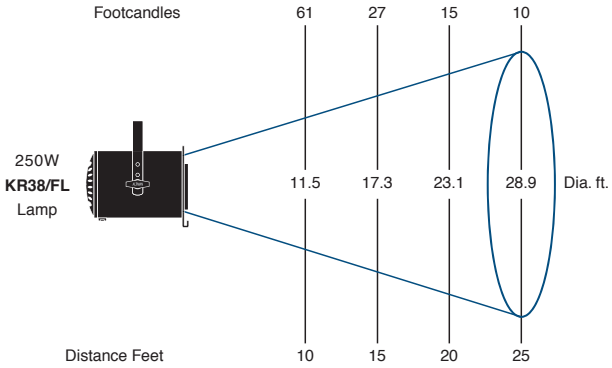
Rating: 120/240 volts AC/DC operation. 2.5/1.3 amps, 300 watts maximum.

Cable: 36" Teflon leads encased in black sleeving. Hi-Temp rubber cable optional, up to 25'.

Finish: Black epoxy sandtex, electrostatic application.

Weight: Approx; 4 lbs. (1.8 kg).





ACCESSORIES Supplied with Luminaire	
6-CF	Color Frame
SC-36-BK	Safety Cable with Spring Clip

ADDITIONAL ACCESSORIES	
510	Malleable Iron Pipe Clamp
6-BD-4	4-Way Barn Doors
6-SN	Snoot
404-6	Motorized Color Wheel

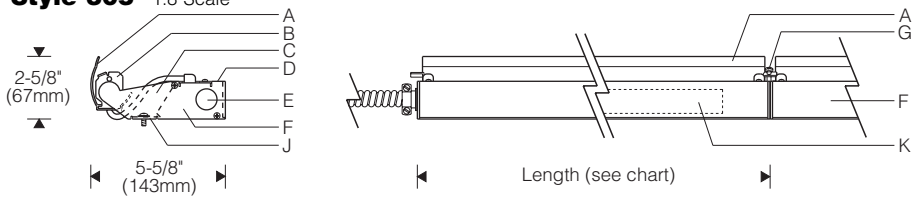
LAMP DATA

Manufacturers Lamp Code	Watts	Candlepower (Candela)	Color Temp (°K)	Rated Life (Hours)	Field Angle (Degrees°)
100R/FL	100	900	2700	2,000	60°
100R/SP	100	5,000	2775	2,000	36°
120BR40/FL	120	—	2900	2,000	60°
120BR40/SP	120	—	2900	2,000	20°
120PAR/CAP/FL30°	120	4,600	2950	3,000	30°
120PAR/CAP/SP9°	120	22,500	2950	3,000	9°
250KR38/FL	250	6,100	2850	4,000	60°
250KR38/SP	250	14,200	2850	4,000	35°
Q250PAR38/FL	250	6,500	2900	6,000	60°
Q250PAR38/SP	250	28,000	2900	6,000	24°
300R/FL	300	2,900	2775	2,000	60°
300R/SP	300	14,000	2775	2,000	24°

ALTMAN Lighting, Inc.
BRINGING IMAGINATION TO LIGHT

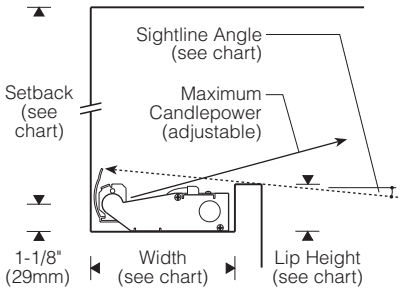
57 Alexander Street, Yonkers, NY 10701 Tel: 914.476.7987, 212.569.7777, Fax: 914.963.7304, Toll free: 800.4.ALTMAN or
Visit our website at http://www.altmanltg.com

Style 305 1:8 Scale



Lamp Length	*Luminaire Length*
1 x 2'	23-1/16" (586mm)
1 x 3'	34-7/8" (886mm)
1 x 4'	46-11/16" (1186mm)
1 x 5'	58-1/2" (1486mm)
2 x 3'	69-1/2" (1765mm)
2 x 4'	93-1/8" (2365mm)
2 x 5'	116-5/8" (2963mm)

Cove



Cove Dimensions

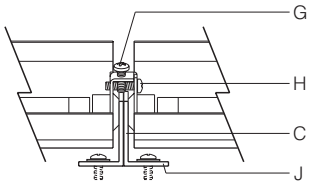
(max. candlepower aimed 15° above horiz.)

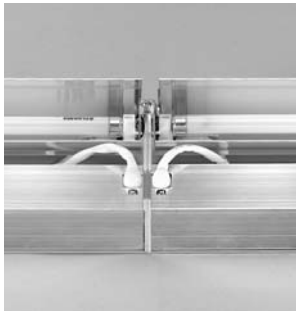
Sightline	0° (horiz. cutoff)	5°	10°
Width *(inside)*	6-1/2" (165mm)	5-7/8" (150mm)	5-7/8" (150mm)
Lip *(inside)*	2-5/8" (67mm)	2-1/8" (54mm)	1-5/8" (41mm)
Setback *(varies)*	Recommended minimum: 12" T5, 18" T5HO		

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

Joint 1:4 Scale

(ballast compartment not shown for clarity)





Specifications

- **A** Specular extruded aluminum reflector
- **B** Stainless steel lamp-holder/support brackets
- **C** Aluminum sidearm with mounting tab
- **D** Extruded aluminum ballast/wireway channel cover
- **E** Conduit entry (one each end, conduit and connector by others)
- **F** Extruded aluminum ballast/wireway compartment
- **G** Rotation locking screw
- **H** Joiner/alignment screw
- **J** Mounting tab (fastener by others)
- **K** Integral electronic ballast

Finish:

Reflector – extruded high purity aluminum with clear anodized specular finish. Sidearms and ballast/wireway compartment – mill finish aluminum. All luminaire hardware – stainless steel.

Mounting:

Lay-in installation requires only one fastener per joint (by others). Sidearms with mounting tabs can be base or wall mounted. Luminaires can be mounted individually or joined together to form a continuous row.

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

Standard:

UL listed or CSA certified for damp locations (Style 124 painted model with lens recommended for damp locations).

Electrical:

Use 90°C wire for supply connections.

Integral electronic HPF thermally protected class P ballast with end-of-life protection. Ballast/wireway compartment includes one conduit entry at each end. Channel cover removes for access to ballast and wiring. Luminaires may be butted end-to-end (connectors by others) for through wiring. Optional #12 AWG prewired modular through wiring with quick connectors.

Master/satellite combination is available (Configuration **3**, see Ordering Information). Master supplied with 2-lamp ballast (wiring, conduit and connectors between master and satellite units by others).

Optional electronic dimming ballast; compatible dimmer switch required (by others). Consult sales representative for compatibility and specifications.

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

For complete ballast specifications, see Accessories Section.

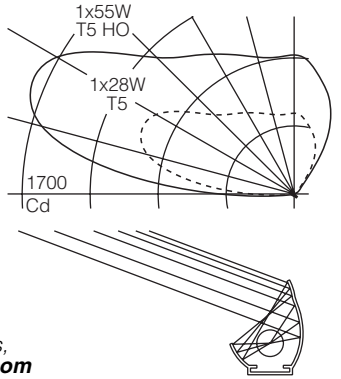
Features

- *T5 fluorescent – precise optical control for unequaled projection of light from perimeter coves*
- *Adjustable – all reflectors in a row join and aim together; rotation locking screws secure position**
- *Only 2-5/8" high – fits in low profile coves*
- *Integral electronic ballast, thru wiring for easy installation*

C 19.0

Performance

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



For complete photometrics, visit ***thelightingquotient.com***

***U.S. Patents 5,550,725 and D432,696; EPO 0710796.**

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To form a Catalog Number

F 3 0 5 - T [ ] - S - 0 0 - [ ] - [ ] [ ]

1 2 3 4 5 6 7 8

1 Source

F = Linear fluorescent

2 Style

305 = Xtra small concealed, **integral** ballast

3 Lamp

Note: To order by overall row length, enter **ROW CODE** in place of Lamp Code below (see Row Charts on page C-19.2). Row Code specifies a row complete with all necessary reflectors and ballasts.

T [ ] [ ] = **Lamp Code** (to specify individual units)

Lamp Wattage (see chart below)

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

Example: **T228** = two 28W T5 lamps in nominal 8' reflector; one 2-lamp ballast

Reflector Configuration

1	1 - Lamp Ballast 1-Lamp Reflector
2	2 - Lamp Ballast 2-Lamp Reflector
3	2 - Lamp Ballast 1-Lamp Reflector (Master) 1-Lamp Reflector (Satellite)

Lamp Wattage	*Lamp Length*	*Lamp Number*
T5 Fluorescent		
14	2'	F14T5
21	3'	F21T5
28	4'	F28T5
35	5'	F35T5
T5 HO Fluorescent*		
24	2'	F24T5/HO
39	3'	F39T5/HO
55	4'	F54T5/HO
80	5'	F80T5/HO

For complete lamp and ballast information, see Accessories Section. Standard T5 and T5HO lamp color is 3000K/80+ CRI.

C 19.1

Project:

4 Mounting

S = Sidearms with mounting tabs

5 Finish

00 = Bright anodized reflector with mill finish ballast compartment

6 Voltage/Ballast

Electronic

1 = 120V
2 = 277V
3 = 347V (Canada)

*Dimming**

T = 120V
V = 277V

* Consult sales representative for dimming 5' lamps (lamp codes **Tx35**, **Tx80**) and for Reflector Configuration **3**. Availability for wattages and voltages varies with ballast manufacturer and control type – see **thelightingquotient.com** for additional dimming specifications and limitations.

7 Option (see Accessories Section for specifications)

00 = No options
0E = Integral emergency battery pack with indicator lamp and test button. Operates one lamp. Available in nominal 4', 6' and 8' units only (lamp codes **T128**, **T221**, **T228**, **T328**, **T155**, **T239**, **T255** and **T355**).
0K = Prewired modular #12 AWG through wiring with quick connectors
EK = Combination of emergency battery pack and prewired modular through wiring as described above
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Destination Requirement

0 = UL listed or CSA certified for U.S.
J = UL listed or CSA certified for Canada

Example

F305 - T221 - S - 00 - 1 - 000

Xtra small concealed fluorescent unit consisting of one nominal 6' reflector with two 21W T5 lamps. Integral 120V electronic 2-lamp ballast. Sidearms with mounting tabs. UL listed or CSA certified for U.S.

Type:

Accessories

Order separately. See Accessories Section for specifications.

AFK000X [ ] = Ballast **fuse** kit

0 = U.S.
J = Canada

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elliptipar *from* **The Lighting Quotient**
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **thelightingquotient.com**

To order by Row Code – T5 lamps

When the Style 305 xtra small concealed T5 fluorescent is run continuously in **straight** coves, **elliptipar** offers the option of specifying and ordering the entire row as one catalog number. Ordering by row eliminates the need to calculate length, type and quantity of reflectors.

Steps to specify Row Code:

1. Determine clear inside length of cove.
2. Round up to nearest foot and find the nominal row length in chart.
3. Determine what lengths/wattages of lamps will be used and select the corresponding lamp combination codes.
   Example: If only 3' and 4' lamps are to be used on the project, specify row codes ending with **A**, **B** and/or **D** only.
4. If for a given nominal row length a preferred lamp combination is not listed, select the next shorter row that is available in the desired lamp combination.
5. Once the nominal row length and lamp combination has been found in the chart, note the actual overall row length (last column).
6. Consider the unlighted length at each end of the row (subtract the overall row length from the clear inside length, and divide the remainder by two). It is generally recommended that the unlighted length at each end be between 6" and 12".
7. Enter the four character Row Code in place of the Lamp Code described on page C-19.1. The remainder of the catalog number is formed as shown on page C-19.1.

Features

- *Time saving – simplifies specification and ordering*
- *One catalog number – includes all necessary reflectors to install row*
- *Assured fit – all you need is the clear inside length of the cove*

3 Row Code

Note: Enter row code in place of Lamp Code described on page C-19.1.

= **Row Code**

Lamp Combination*
A = All nominal 3' lamps
B = All nominal 4' lamps
C = All nominal 5' lamps
D = Nominal 3' and 4' lamps
F = Nominal 3' and 5' lamps
G = Nominal 4' and 5' lamps

Nominal Row Length in feet, between 3' and 50' **

S = T5 fluorescent
V = T5/HO fluorescent

* Not all lamp combinations are available for each nominal row length (see chart).

** Nominal row lengths over 50' can be formed by combining shorter row lengths (Example: a nominal 60' row can be ordered as two nominal 30' rows).

Example

F305 - S15A - S - 00 - 2 - 000

Nominal 15' long row of Style 305 xtra small concealed T5 fluorescent using only nominal 3' (21W) lamps. Row includes two nominal 6' luminaires for use with two 3' lamps each, one nominal 3' luminaire for use with one 3' lamp and integral 277V electronic ballasts. Overall row length is 14' 5-7/8".

Nominal Row Length (feet)	*Lamp Combination*	*Nominal 3' Luminaire (1 x nominal 3' lamp)*	*Nominal 4' Luminaire (1 x nominal 4' lamp)*	*Nominal 5' Luminaire (1 x nominal 5' lamp)*	*Nominal 6' Luminaire (2 x nominal 3' lamps)*	*Nominal 8' Luminaire (2 x nominal 4' lamps)*	*Nominal 10' Luminaire (2 x nominal 5' lamps)*	*Overall Row Length*
03	**A**	1						2' 10-7/8"
04	**B**		1					3' 10-11/16"
05	**C**			1				4' 10-1/2"
06	**A**				1			5' 9-1/2"
07	**D**	1	1					6' 9-9/16"
08	**B**					1		7' 9-1/8"
08	**F**	1		1				7' 9-3/8"
09	**A**	1			1			8' 8-3/8"
09	**G**		1	1				8' 9-3/16"
10	**C**						1	9' 8-5/8"
10	**D**		1		1			9' 8-3/16"
11	**D**	1				1		10' 8"
11	**F**			1	1			10' 8"
12	**A**				2			11' 7"
12	**B**		1			1		11' 7-13/16"
13	**D**	1	1		1			12' 7-1/16"
13	**F**	1					1	12' 7-1/2"
13	**G**			1		1		12' 7-5/8"
14	**D**				1	1		13' 6-5/8"
14	**F**	1		1	1			13' 6-7/8"
14	**G**		1				1	13' 7-5/16"
15	**A**	1			2			14' 5-7/8"
15	**C**			1			1	14' 7-1/8"
15	**D**	1	1			1		14' 6-11/16"
16	**B**					2		15' 6-1/4"
16	**F**				1		1	15' 6-1/8"
17	**D**	1			1	1		16' 5-1/2"
17	**F**			1	2			16' 5-1/2"
17	**G**		1	1		1		16' 6-5/16"
18	**A**				3			17' 4-1/2"
18	**D**		1		1	1		17' 5-5/16"
18	**F**	1		1			1	17' 6"
18	**G**					1	1	17' 5-3/4"
19	**D**	1				2		18' 5-1/8"
19	**F**	1			1		1	18' 5"
19	**G**		1	1			1	18' 5-13/16"

To order by Row Code – T5 Lamps

Project:

Type:

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
20	**B**		1			2		19' 4-15/16"
20	**C**						2	19' 5-1/4"
21	**A**	1			3			20' 3-3/8"
21	**D**	1	1		1	1		20' 4-3/16"
21	**F**			1	1		1	20' 4-5/8"
21	**G**			1		2		20' 4-3/4"
22	**D**		1		3			21' 3-3/16"
22	**F**				2		1	21' 3-5/8"
22	**G**		1			1	1	21' 4-7/16"
23	**D**	1	1			2		22' 3-13/16"
23	**F**	1					2	22' 4-1/8"
23	**G**			1		1	1	22' 4-1/4"
24	**A**				4			23' 2"
24	**B**					3		23' 3-3/8"
24	**F**	1		1	1		1	23' 3-1/2"
24	**G**		1				2	23' 3-15/16"
25	**C**			1			2	24' 3-3/4"
25	**D**	1			1	2		24' 2-5/8"
26	**D**		1		1	2		25' 2-7/16"
26	**F**				1		2	25' 2-3/4"
26	**G**					2	1	25' 2-7/8"
27	**A**	1			4			26' 0-7/8"
27	**D**	1				3		26' 2-1/4"
27	**F**			1	2		1	26' 2-1/8"
27	**G**		1	1		1	1	26' 2-15/16"
28	**B**		1			3		27' 2-1/16"
28	**F**	1		1			2	27' 2-5/8"
28	**G**					1	2	27' 2-3/8"
29	**D**	1	1		1	2		28' 1-5/16"
29	**F**	1			1		2	28' 1-5/8"
29	**G**		1	1			2	28' 2-7/16"
30	**A**				5			28' 11-1/2"
30	**C**						3	29' 1-7/8"
30	**D**				1	3		29' 0-7/8"
31	**D**	1	1			3		30' 0-15/16"
31	**F**			1	1		2	30' 1-1/4"
31	**G**			1		2	1	30' 1-3/8"

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
32	**A**	1			5			31' 10-3/8"
32	**B**					4		31' 0-1/2"
32	**D**	1			1	3		31' 11-3/4"
32	**F**				2		2	31' 0-1/4"
32	**G**		1			1	2	31' 1-1/16"
33	**D**		1		1	3		32' 11-9/16"
33	**F**	1					3	32' 0-3/4"
33	**G**			1		1	2	32' 0-7/8"
34	**D**	1				4		33' 11-3/8"
34	**F**	1		1	1		2	33' 0-1/8"
34	**G**					3	1	33' 0"
35	**A**				6			34' 9"
35	**B**		1			4		34' 11-3/16"
35	**C**			1			3	34' 0-3/8"
36	**D**	1	1		1	3		35' 10-7/16"
36	**G**			1		4		35' 11"
37	**D**				1	4		36' 10"
37	**F**				3		2	36' 9-3/4"
37	**G**					1	3	36' 11"
38	**A**	1			6			37' 7-7/8"
38	**D**	1	1			4		37' 10-1/16"
38	**G**		1	1			3	37' 11-1/16"
39	**B**					5		38' 9-5/8"
39	**C**						4	38' 10-1/2"
40	**D**	1			1	4		39' 8-7/8"
40	**F**			1	1		3	39' 9-7/8"
40	**G**			1		2	2	39' 10"
41	**A**				7			40' 6-1/2"
41	**D**		1		1	4		40' 8-11/16"
41	**F**				2		3	40' 8-7/8"
41	**G**		1			1	3	40' 9-11/16"
42	**D**	1				5		41' 8-1/2"
42	**F**	1					4	41' 9-3/8"
42	**G**		1	1		3	1	41' 9-3/16"
43	**B**		1			5		42' 8-5/16"
43	**F**				4		2	42' 7-1/4"
43	**G**		1				4	42' 9-3/16"

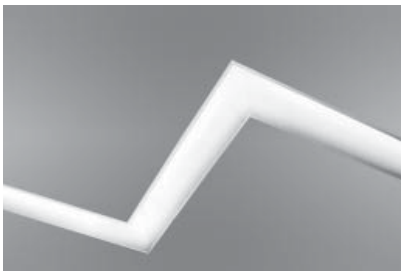
Nominal Row Length (feet)	Lamp Combination	Nominal 3' Luminaire (1 x nominal 3' lamp)	Nominal 4' Luminaire (1 x nominal 4' lamp)	Nominal 5' Luminaire (1 x nominal 5' lamp)	Nominal 6' Luminaire (2 x nominal 3' lamps)	Nominal 8' Luminaire (2 x nominal 4' lamps)	Nominal 10' Luminaire (2 x nominal 5' lamps)	Overall Row Length
44	**A**	1			7			43' 5-3/8"
44	**C**			1			4	43' 9"
44	**D**	1	1		1	4		43' 7-9/16"
45	**D**				1	5		44' 7-1/8"
45	**F**				1		4	44' 8"
45	**G**					2	3	44' 8-1/8"
46	**D**	1	1			5		45' 7-3/16"
46	**F**			1	2		3	45' 7-3/8"
46	**G**		1	1		1	3	45' 8-3/16"
47	**A**				8			46' 4"
47	**B**					6		46' 6-3/4"
47	**F**	1		1			4	46' 7-7/8"
47	**G**					1	4	46' 7-5/8"
48	**D**	1			1	5		47' 6"
48	**F**	1			1		4	47' 6-7/8"
48	**G**		1	1			4	47' 7-11/16"
49	**C**						5	48' 7-1/8"
49	**D**				3	4		48' 5"
50	**A**	1			8			49' 2-7/8"
50	**D**	1				6		49' 5-5/8"
50	**F**			1	1		4	49' 6-1/2"
50	**G**			1		2	3	49' 6-5/8"

C 19.3

elliptipar There is no equal™

elliptipar *from* **The Lighting Quotient**
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **thelightingquotient.com**

MARK®
ARCHITECTURAL
LIGHTING



The **Perimeter Plus** Series

With up to 40 feet of seamless reflector, Perimeter Plus is perfect for corridors and other long spaces. The white or semi-diffuse silver reflector can be field trimmed at job sites to accommodate any run length.

Standard 9-inch staggering of T5, T5HO or T8 lamps eliminates socket shadows and provides perimeter lighting for less than 8 watts per linear foot. Molded 90-degree inside and outside corners allow easy installation, and telescoping housing and lamp trays are standard.

Type:

Project:

Catalog Number:
DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing
Die-formed, 20-gauge, cold-rolled steel.

Ceiling and Wall Trim
Precision-extruded aluminum.

Finish
Matte white.

Reflector
Opaque white or silver metallic reflector in standard lengths up to 40 feet. Reflector can be field-trimmed with scissors or utility knife at job site to accommodate any run length.

Shielding
Unshielded. Open parabolic, silver or white reflector options available.

Lamps
Standard 9" stagger, (1) or (2) T5, T5HO or T8. Lamps provided by others.

Ballast
Thermally protected Class P energy-saving electronic ballast.

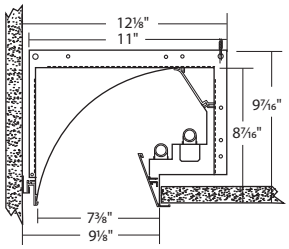
Mounting
Recessed perimeter wall wash in 8', 6', 4', 3' and 2' sections. Telescoping housing and lamp sections provided in all runs and patterns.

Corners
90-degree inside or outside molded corners.

Certification
cULus Listed, IBEW (Local 3) Union-made in the USA.

Technical Drawings

2T5



Ordering

Example: PPL 16FT WH 2T5S EBPR 120

Series	Length[1]	Color	Corner configurations	No. of lamps/Lamp type[2]	Ballast	Voltage	Options
PPL Perimeter Plus	**_ ft.** Provide wall-to-wall dimensions	**SL** Silver **WH** White	**90IC** 90° inside molded corner **90OC** 90° outside molded corner	Number of lamps: **1**, **2** Lamp type[2]: **T5S**, **T5HOS**, **T8S**	**EBPR** Program rapid start (standard) **EBIS** Instant start **EDB** Dimming (specify) **EDHL** Lutron Hi-Lume® dimming **EDE10** Lutron Eco-10® dimming **EDES** Lutron Eco System®	**120** **277** **347**[3]	**EMPK** Emergency battery pack **CP** Chicago plenum

Notes
1 Provide field dimensions when placing order. For patterns, clearly indicate inside or outside corners. Upon request, factory will prepare installation drawings for approval.
2 Consult factory for other lamps.
3 Consult factory for lamp and ballast compatibility.

marklighting.com 3 Kilmer Rd, Edison NJ 08817 T (732) 985 2600 F (732) 985 8441

DESCRIPTION

Coronado 740 is a compact accent/flood fixture for use with PAR38 ceramic metal halide lamps. It is fully adjustable from all mounting positions and features a patented locking clutch mechanism to ensure positive fixture aiming (U.S. patents 5,713,662 and D373,437). Various lenses, louvers and color or dichroic filters can be combined - up to three at once - to create multiple lighting effects. Lumière's exclusive Siphon Protection System (S.P.S.) prevents water from siphoning into the fixture through its own lead wires.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Material
Hood is precision-machined from corrosion-resistant 6061-T6 aluminum billet. Housing and stem assembly are die-cast aluminum.

B ... Finish
Fixtures are double protected by a chromate conversion undercoating and polyester powdercoat paint finish, surpassing the rigorous demands of the outdoor environment. A variety of standard colors are available.

C ... Hood
Hood is removable for easy relamping and accepts up to three internal accessories at once (lenses, louvers, filters) to achieve multiple lighting effects. The flush lens design sheds water and minimizes debris collection.

D ... Gasket
Housing and hood are sealed with a high temperature silicone o-ring gasket to prevent water intrusion.

E ... Lens
Tempered glass lens, factory sealed with high temperature adhesive to prevent water intrusion and breakage due to thermal shock.

F ... Mounting Stem
Mounting stem is fully adjustable from all mounting positions and features a patented locking clutch mechanism to ensure positive fixture aiming (U.S. patents 5,713,662 and D373,437). Equipped with standard 1/2" NPS threaded male fitting. Lumière's exclusive Siphon Protection System (S.P.S.) prevents water from siphoning into the fixture through its own lead wires.

G ... Hardware
Stainless steel hardware is standard to provide maximum corrosion-resistance.

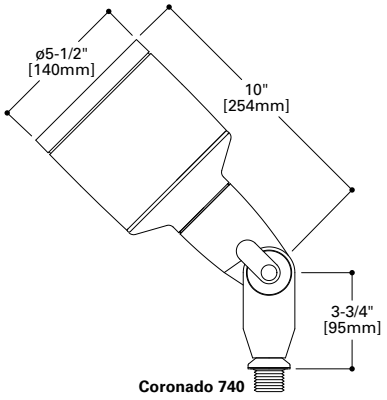
H ... Socket
Ceramic socket with 250° C Teflon® coated lead wires and medium base.

I ... Ballast
Remote core & coil ballast is standard (120/208/240/277/347V). Maximum remote mounting distance for a core & coil ballast is 50'. Remote electronic ballast (120/277V) is available as an option by adding the prefix "EL" to the ballast/mounting code. Maximum remote mounting distance for an electronic ballast depends upon the ballast manufacturer and may require the use of special low capacitance wire, separate conduit runs for lead wires, or other special installation requirements. See ballast manufacturer's installation instructions or contact the factory for remote mounting distance and installation requirements.

J ... Lamp
Not included. Available from Lumière as an accessory - see reverse side of this page.

K ... Labels & Approvals
UL and cUL listed, standard wet label. IP65 rated. Manufactured to ISO 9001-2000 Quality Systems Standard. IBEW union made.

L ... Warranty
Lumière warrants its fixtures against defects in materials & workmanship for three (3) years. Auxiliary equipment such as transformers, ballasts and lamps carry the original manufacturer's warranty.



Coronado 740

CORONADO

740

100W (max.) PAR38
Metal Halide

Accent/Flood

IP65

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

Lamp	ANSI Code	Watts	Beam Spread	CBCP	°K	Life (hrs.)	Base	Volts
CDM100PAR38/SP	M90	100	15°	40,000	3000	7500	medium	120-347
CDM100PAR38/FL	M90	100	30°	20,000	3000	7500	medium	120-347
CDM70PAR38/SP	M98	70	10°	28,000	3000	7500	medium	120-347
CDM70PAR38/FL	M98	70	30°	16,000	3000	7500	medium	120-347

NOTE: Inferior quality lamps may adversely affect the performance of this product. Use only name brand lamps from reputable lamp manufacturers.

NOTES AND FORMULAS

- Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.
- Footcandle values are initial. Apply appropriate light loss factors where necessary.
- Bare lamp data shown. Consult lamp manufacturers to obtain detailed specifications for their lamps.

ORDERING INFORMATION

Series
740=PAR38 Coronado w/Locking Clutch Aiming

Source
Metal Halide
MH70PAR38=70W Metal Halide PAR38, Medium Base
MH100PAR38=100W Metal Halide PAR38, Medium Base

Voltage
120=120V
277=277V
208=208V
240=240V
347=347V

Ballast
__=Standard Core and Coil Ballast
EL=Electronic Ballast
ELM=Electronic Ballast, Mini Housing[1]

Mounting
MB=Fixture mounts to inground ballast container
MBR=Fixture mounts to flat surface, remote inground ballast container
SM=Fixture mounts to wall mounted ballast housing, bottom conduit entry
WM=Fixture mounts to wall mounted ballast housing, over J-box
WR=Fixture mounts to flat surface, remote ballast housing
TS=Fixture mounts to ballast housing strapped to tree, bottom conduit entry
TSR=Fixture strapped to tree, remote inground ballast container
TSR2=Fixture strapped to tree, remote ballast housing strapped to tree

Finish
Painted
BK=Black
BZ=Bronze
CS=City Silver
VE=Verde
WT=White

Accessories
Glare Shield
FH38=Angled Glare Shield, (Specify finish: BK, BZ, CS, VE, WT)
Glare Shield Finish
BK=Black
BZ=Bronze
CS=City Silver
VE=Verde
WT=White
Filters
F71-38=Peach Dichroic Filter, 4.95" Dia
F72-38=Amber Dichroic Filter, 4.95" Dia
F73-38=Green Dichroic Filter, 4.95" Dia
F74-38=Medium Blue Dichroic Filter, 4.95" Dia
F75-38=Yellow Dichroic Filter, 4.95" Dia
F76-38=Red Dichroic Filter, 4.95" Dia
F77-38=Dark Blue Dichroic Filter, 4.95" Dia
F78-38=Light Blue Dichroic Filter, 4.95" Dia
F79-38=Neutral Density Dichroic Filter, 4.95" Dia
F80-38=Magenta Dichroic Filter, 4.95" Dia
F22-38=Red Color Filter, 4.95" Dia
F33-38=Blue Color Filter, 4.95" Dia
F44-38=Green Color Filter, 4.95" Dia
F55-38=Yellow Color Filter, 4.95" Dia
F66-38=Mercury Vapor Color Filter, 4.95" Dia
Optical Lenses
LSL-38: Linear Spread Lens (elongate standard beam spread), 4.95" Dia
OSL-38: Overall Spread Lens (increase beam spread), 4.95" Dia
DIF-38: Diffused Lens (provide even illumination), 4.95" Dia
Optical Louver
LVR-38: Hex Cell Louver (reduce glare), 4.95" Dia
Lamps
MHP38100-SP: 100W PAR38 Metal Halide Spot
MHP38100-FL: 100W PAR38 Metal Halide Flood
MHP38100-WFL: 100W PAR38 Metal Halide Wide Flood

Notes: 1 ELM Ballast available with WM, SM & TS Mounting only.
* Lamp not included.
* Consult your Cooper Lighting representative for additional options and finishes.

PHOTOMETRIC DATA

Coronado 740
Lamp=
CDM100PAR38/SP
(M90)
CBCP=40,000

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
25'0"	65	6'6"
20'0"	102	5'0"
15'0"	181	4'0"
12'0"	283	3'0"
10'0"	408	2'6"
8'0"	637	2'0"

Lamp Wattage Multiplier
70W x 0.70

Coronado 740
Lamp=
CDM100PAR38/FL
(M90)
CBCP=20,000

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
25'0"	33	12'6"
20'0"	51	10'0"
15'0"	91	7'6"
12'0"	142	6'0"
10'0"	204	5'0"
8'0"	320	4'0"

Lamp Wattage Multiplier
70W x 0.76

luxrail™

For Amber only.

Application

ANSI and ADA compliant, **luxrail** is an indoor/outdoor LED-based handrail that delivers functional illumination. Two intensities may be specified: standard output and high output. The standard light output version delivers illuminance levels appropriate for exterior applications (2 footcandles at grade) as well as for dark interior environments with low ambient illumination levels (e.g., themed environments, theatres and residential areas). The high output version delivers illuminance levels applicable to interior environments – providing in excess of 10 footcandles along the path of egress (ANSI required for stair treads). Independent photometric test reports and IES Format data are available at **www.iolighting.com**.

luxrail's standard handrail gripping surfaces are circular in cross section and meet 2004 ADAAG (Americans with Disability Act Accessibility Guidelines). Patented optical assemblies deliver 10˚, 45˚ and 65˚ beam spreads. The 45˚ and 65˚ beam patterns are most suitable for illuminating pathways, while the 10˚ beam spread offers accent lighting for optional glass or stainless steel cable railing infills. Reference page 44 of this catalog for information regarding infill options. **io** ensures that each LED is provided thermal and electrical management properties in accordance with the LED manufacturers recommendations. Projected average rated life is 50,000 hours at 70% of lamp lumen output. Contact factory for IES LM-80 compliance. To ensure proper performance, architectural details should allow for ventilation and air flow around the fixture. Ambient temperature surrounding the fixture shall not exceed 120˚F *(48.9˚C).*

Light Output

Two luminous intensities are available for white light. All values below are initial lumens per foot. IES LM-79 format files may be obtained from the factory or downloaded from **www.iolighting.com.**

	Standard Output	High Output
2700K White:	48 lms/ft	180 lms/ft
3000K White:	48 lms/ft	180 lms/ft
5000K White:	63 lms/ft	240 lms/ft

Construction

luxrail may be post mounted or wall mounted. Mounting hardware (post or wall) is typically required up to 5' O.C., depending on the handrail alloy. Final post and wall bracket spacing must be determined by a licensed architect or structural engineer. **io** can provide engineering upon request. **luxrail** is available in stainless steel and aluminum. **grab bars** are available in aluminum only. The lighting fixture component of the **luxrail** is a stand alone unit and is available in incremental nominal lengths that range from 6" to 60". Vandal resistant access chamber allows units to be removed for maintenance purposes.

All handrail component parts are engineered for quick installation. Field welding or cutting is typically not required. All parts are prefabricated to field dimensions and are assembled in the field with mechanical connection or epoxy. Contact **io** Lighting for recommended handrail installers.

The light fixture's housing is made of a light weight, yet durable aluminum, providing the recommended heat sink requirements for the LEDs. Housing, patented optical assembly and stainless steel end caps are bonded to prevent water infiltration.

Electrical

luxrail houses a low voltage LED-based light fixture that is integrated into the underside of the handrail. 24 volt 96 watt power supplies are provided as a standard. For detailed information regarding daisy chain limitations, remote distance limitations, power supply options, and dimming options consult the **io** website, the **io** catalog (pages 98-100) or an **io** representative.

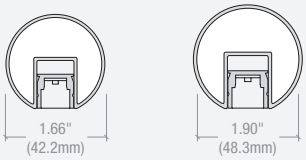
Dimming modules must be specified separately. For detailed information, see page 98 of this brochure or download the power supply specification sheet from **www.iolighting.com**.

Power Consumption

Standard Output: 1.44 w/ft **High Output: 7.62 w/ft**

Power consumption does not include power supply losses.

Dimensions



io luxrail 65°, 3KHO

lighting facts℠
A Program of the U.S. DOE

Light Output (Lumens)	244
Watts	20.9
Lumens per Watt (Efficacy)	11
Color Accuracy Color Rendering Index (CRI)	72
Light Color Correlated Color Temperature (CCT)	3027 (Bright White)

Warm White | Bright White | Daylight
2700K 3000K 4500K 6500K

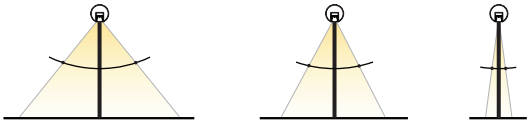
All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting.* The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide.*

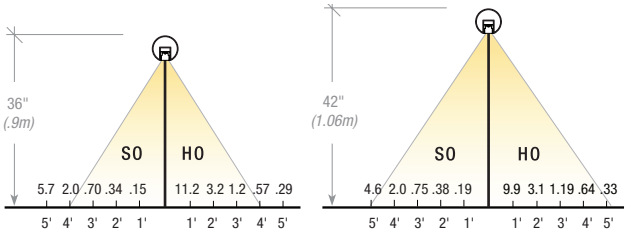
Registration Number: 6PRA-7ZBT8B
Model Number: 0.03.I.3KHO.65.1.05.2
Type: Outdoor path lights

Label references 30" **luxrail** fixture with a 65˚ beam spread in High Output 3000K. Lighting Facts for additional beam spreads and light output levels may be obtained from **io** Lighting.

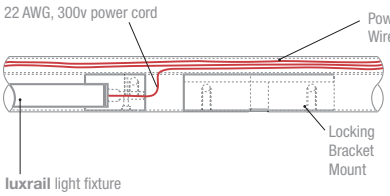
BEAM SPREAD OPTIONS

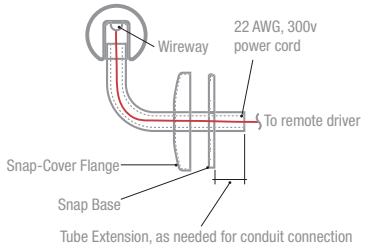


LIGHT OUTPUT - 65 DEGREE WARM WHITE



WALL MOUNT DETAILS*

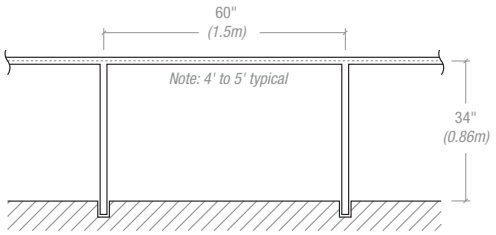




* Wall mounted **luxrail** may be mounted to new or existing guardrail (by others).

Post and wall bracket spacing must be determined by a licensed architect or structural engineer.

POST MOUNT APPLICATION



Wildlife Friendly Fixtures

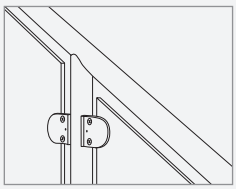
IDA's Fixture Seal of Approval

Light Output / Distributions

Mounting / Infill Options

PM (post mounted)

WM (wall mount intermediate)



Glass infill
(glass provided by others)

Stainless steel cable infill
(only available on flat surfaces)

Order Code

0	.	06	.		.		.		.		.		.		.		.		.	
io		1		2		3		4		5		6		7		8		9		10

1. PRODUCT FAMILY
06 luxrail

2. ALLOY / FINISH
SSS Stainless steel satin
SSP Stainless steel polished
CAA Clear anodized aluminum [7]

3. SIZE
1 1.66" O.D. (1¼" pipe size) [7] (available for SS & CAA)
2 1.90" O.D. (1½" pipe size) (available for SS & CAA)

4. MOUNTING
PM Post mounted [7]
WM Wall or guard rail mounted

5. INFILL
AC Stainless steel cable [5]
GL Glass (provided by others)
C Custom
NR Not required

6. LIGHT DISTRIBUTION
10 10 Degree
45 45 Degree
65 65 Degree
NI Handrail only (not illuminated)

7. LIGHT COLOR
27K Warm White
3K Warm White [3]
5K Cool White [3]
27KHO Warm White
3KHO Warm White [3]
5KHO Cool White [3]
R Red[4]
G Green[4]
B Blue[4]
A Amber[4]

8. LENGTH
GB2 2' nominal[8]
GB3 3' nominal[8]
GB4 4' nominal[8]
GB5 5' nominal[8]
HR In Feet / Inches (provide overall length of each handrail section)[2][6]

9. VOLTAGE / DIMMING
1 120v
2 277v
3 120v w/dim
4 277v w/dim
5 Other

10. SPECIFY DRIVER / DIMMING[1]
Note: If not specified otherwise, ***io*** *will supply 96 watt drivers. Download Power Supply specification sheet from* ***www.iolighting.com****.*

SSL Chromaticity Standard: ANSI C78.337		
Color	**Nominal CCT**	**Target CCT & Tolerance (K)**
White	2700K	2725 ±145
White	3000K	3045 ± 175
White	5000K	5028 ± 283

For Metric Conversion		
1"	**1"**	**1'**
25.4mm	2.54cm	0.3m

Footnotes

1. ***Power Supply Specification Sheet*** *may be downloaded from* ***www.iolighting.com****.*
2. *Each handrail application will be custom to accommodate varying field conditions and design requirements. Shop drawings will be required to manage specifics of each handrail section.*
3. *White light variance between LEDs within a single fixture will not exceed ANSI Binning Standards.*
4. *Only available in 7.6 w/ft.*
5. *Stainless Steel cable available for flat surfaces only.*
6. *Detailed elevation drawings of handrail section are required for quote.*
7. ***grab bars*** *available in aluminum only.*

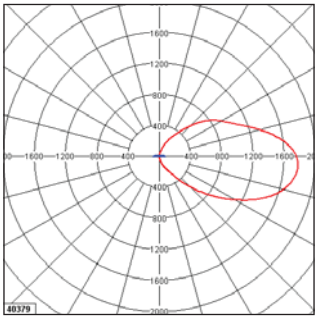
LUMINAIRE SPECIFICATION

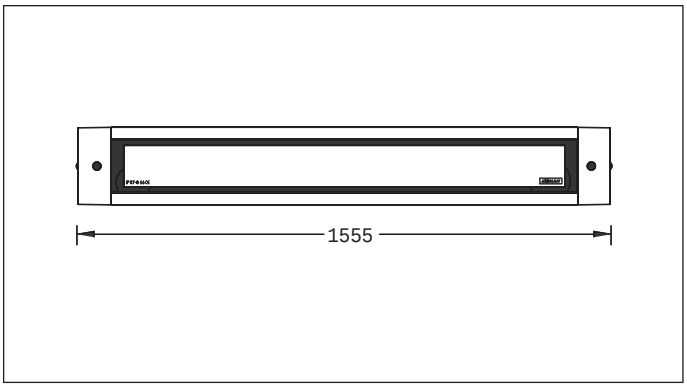
LIGMAN
The quality of life...

PROJECT : _____ DATE : _____

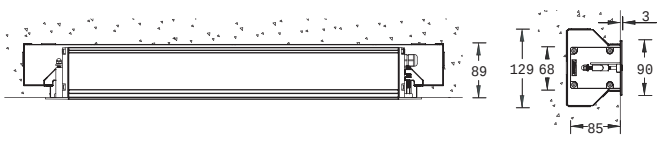
LOCATION : _____

QUANTITY : _____ NOTE : _____





Mounting Detail



40379
Light linear recessed wall light luminaire

IP67 /EN 60598/CLASS I / / IK07

Product Type
Recessed Wall light luminaire.

Product Information
Light linear luminaires are designed to offer functional, a wide range of lighting solutions and dramatic highlighting of the architectural facades of different buildings through the linear design with superior finishing. They are suitable for many other applications incluing commercial and ancient or modern architectural interiors/exteriors. The luminaires are fetures such as long life, limited maintenance and constant lifetime performance, suitable for high efficiency long-life lampsavailable with different colour temperatures and easy to hot-restrike and reduced dimensions. The FH T5 lamps work at –20º to +50º C while FQ T5 lamps work at 0º to +50º C ambient temperatures but it has to be considered that lamp output is sensibly lower at low temperatures .

Material Characteristics
Die-cast aluminium and extrudsion aluminium with high corrosion resistance.Aluminium end caps by one cap provided one cable gland PG 11 entry for wiring is standard.And two cable glands PG 11 is available upon requested. Stainless steel screws. Durable silicone rubber gasket and clear toughened glass. Anodized high purity aluminium reflector with asymmetrical reflectors. Supplied with T5 fluorescent lamps, operating from integral electronic control gear. Choice of wattages and colour temperature 3000 or 6000 K. Luminaire is possibility of uplighting as well as downlighting and available in 4 lengths. Powder paint with high corrosion resistance with chemical chromatised protection.

Physical Data
Length: 1555 mm.
Weight: 7.3 Kg.

Colour
- ☐ Black - RAL 9011
- ☐ White - RAL 9003
- ☐ Matt Silver - RAL 9006
- ☐ Dark Grey - RAL 7043
- ☐ Custom - RAL _____

Reflector
Asymmetrical reflector.

Lamp
T5(T16) FQ 80w.220-240v. G5 6150 lm.

Note
- Integral control gear.

LIGMAN

Branch : Business contact address / Showroom
2912 Ladprao Rd., Klongjun, Bangkapi,
Bangkok 10240 Thailand
Email : info@ligmanlighting.com

Tel : +66 (0) 2 7339140 (9 lines)
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Head office : Chachoengsao factory office
17/2 Moo 4, Monthong, Bangnampreaw,
Chachoengsao 24150 Thailand

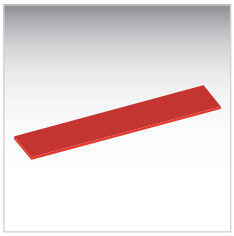
Tel : +66 (0) 38 581676-81
Fax : +66 (0) 38 581415
Email : factory@ligmanlighting.com
Website : www.ligmanlighting.com

LUMINAIRE SPECIFICATION

LIGMAN
The quality of life...

40379
Light linear recessed wall light luminaire

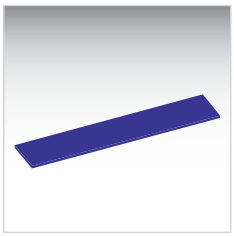
ACCESSORIES



☐ A60716

Red Coloured filter 1470 mm.

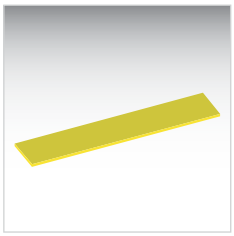
Supplied with holder.



☐ A60717

Blue Coloured filter 1470 mm.

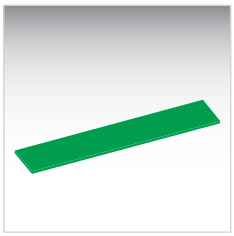
Supplied with holder.



☐ A60718

Yellow Coloured filter 1470 mm.

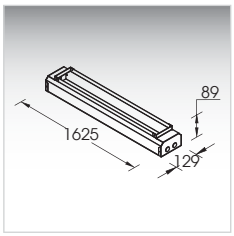
Supplied with holder.



☐ A60719

Green Coloured filter 1470 mm.

Supplied with holder.



☐ A41051

Recessing box in aluminium

(for recessed wall in concrete)

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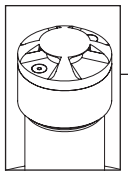


MINI-MICRO™ DRIVESTAR™

PROJECT:	
TYPE:	
CATALOG NUMBER:	
NOTES:	

CATALOG NUMBER LOGIC

			MD	LED								
Example	**B**	-	**MD**	-	**LED**	-	**e28**	-	**F**	-	**MIT**	-	**1**	-	**B**

Material

Blank - Aluminum
B - Brass
S - Stainless Steel

Series

MD - Mini-Micro™ DriveStar™

Source

LED - **'e'** technology with Integral Driver

LED Type *LED's within each group are interchangeable*

GROUP 1
e34 - 3W LED/3K/Side

GROUP 2
e28 - 1W LED/3K/Side
e29 - 1W LED/4K/Side
e31 - 1WLED/Blue/Side
e32 - 1WLED/Green/Side

GROUP 3
e30 - 1W LED/Red/Side
e33 - 1W LED/Amber/Side

Installation

F - Flush mount
S - Surface mount

Finish

Aluminum & Brass Finish

Powder Coat Color	Satin	Wrinkle
Bronze	**BZP**	**BZW**
Black	**BLP**	**BLW**
White (Gloss)	**WHP**	**WHW**
Aluminum	**SAP**	—
Verde	—	**VER**

Brass Finish

Machined	**MAC**
Polished	**POL**
Mitique™	**MIT**

Stainless Finish

Machined	**MAC**
Polished	**POL**
Brushed *Interior Use Only*	**BRU**

Also available in Premium Finishes
See submittal SUB-1439-00

Optical Openings

1 - Single **2** - 2 at 180° **4** - 4 at 90°

Faceplate Style

A - Solid **B** - Round Accent

LM79 DATA

Group	BK No.	CCT(Typ.)	Input Watts	CRI (Typ.)
1	e34	3000K White	2.8	72
2	e28	3000K White	1.1	72
2	e29	4000K White	1.1	66
2	e31	Blue (460nm)	1.1	~
2	e32	Green (525nm)	1.1	~
3	e30	Red (625nm)	1.1	~
3	e33	Amber (592nm)	1.1	~

L70 DATA

Minimum Rated Life (hrs.) 70% of initial lumens (L_{70})
35,000
35,000
35,000
50,000
50,000
50,000
50,000

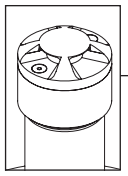
*OPTICAL DATA

Beam Type	Angle
Radial	360°h x 270°v
Radial	360°h x 270°v
Radial	360°h x 270°v
Radial	360°h x 270°v
Radial	360°h x 270°v
Radial	360°h x 270°v
Radial	360°h x 270°v

B-K LIGHTING
40429 Brickyard Drive • Madera, CA 93636 • USA
559.438.5800 • FAX 559.438.5900
www.bklighting.com • info@bklighting.com

SUBMITTAL DATE 3-18-11

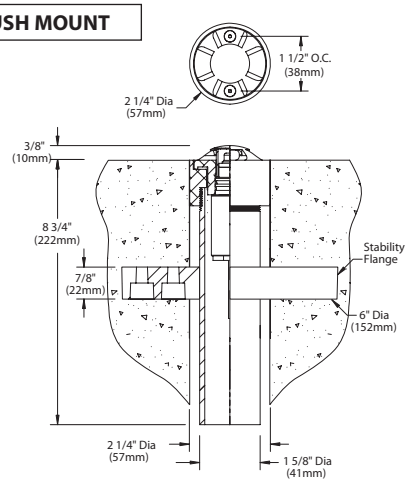
DRAWING NUMBER SUB001068



MINI-MICRO™ DRIVESTAR™

PROJECT:	
TYPE:	

FLUSH MOUNT

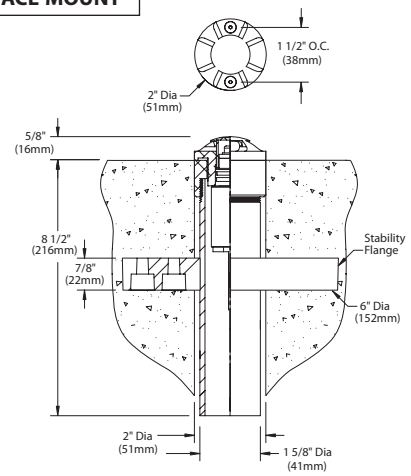


FACEPLATE DETAIL

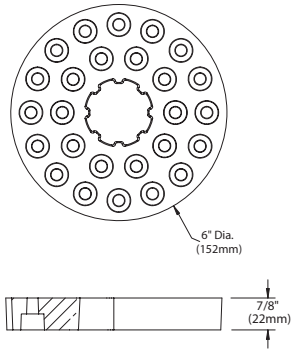
STYLE 'A'

STYLE 'B'

SURFACE MOUNT



STABILITY FLANGE



SPECIFICATIONS

GreenSource Initiative™
Metal and packaging components are made from recycled materials. Manufactured using renewable solar energy, produced onsite. Returnable to manufacturer at end of life to ensure cradle-to-cradle handling. Packaging contains no chlorofluorocarbons (CFC's). Use of this product may qualify for GreenSource efficacy and recycling rebate(s). Consult www.bklighting.com/greensource for program requirements.

Materials
Furnished in Copper-Free Aluminum (Type 6061-T6), Brass (Type 360) or Stainless Steel (Type 304).

Body
Fully machined from solid billet. Unibody design provides enclosed, water-proof wireway and integral heat sink for maximum component life. High temperature, silicone 'O' Ring provides water-tight seal. Provided with hard-coat (Type III) black anodize finish for maximum corrosion resistance. Weather-tight cable connector with 14" 18Ga., 2 wire low voltage cable.

Housing
Fixture provided with 1-5/8" dia., Schedule 80 PVC housing for direct burial into soil or concrete. 6" dia., molded stability flange projects into substrate to simplify installation and reinforce housing stability.

Faceplate
Machined from solid, copper-free aluminum, brass or stainless steel. Available with one, two, or four optical openings. Specify solid faceplate (A) or center aperture (B). Countersunk holes provide for flush hardware mounting.

Lens
Shock resistant, tempered, translucent glass lens is factory adhered to faceplate and provides hermetically sealed optical compartment.

BKSSL™
Screw-based, side-emitting, multi-directional, integrated solid state system with 'e' technology is scalable for field upgrade. Modular design with electrical quick disconnects permit field maintenance. Refer to LED Type to determine component interchangeability.

Integral non-dimming driver. Up to 50,000 hour rated life at 70% of initial lumens (L70). BKSSL technology provides long life, significant energy reduction and exceptional thermal management.

Installation
Flush Mount features integral concrete pour collar. Top edge of collar to be installed flush with finished grade. Collar material and finish to match faceplate. (2) Threaded holes for faceplate installation. Faceplate style 'A' is suitable for walk-over and drive-over applications to 35,000 lbs. GVW.

Surface Mount features fully machined copper-free aluminum installation collar. Provided with hard-coat (Type III) black anodize finish for maximum corrosion resistance. (2) Threaded holes for faceplate installation.

Transformer
For use with 12VAC BKSSL remote transformer.

Wiring
Teflon® coated, 18AWG, 600V, 250° C rated and certified to UL 1659 standard.

Hardware
Tamper-resistant, stainless steel hardware. Faceplate screws are additionally black oxide treated for additional corrosion resistance.

Finish
StarGuard® (Pat. Pend.), a RoHs compliant, 15 stage chromate-free process cleans and conversion coats aluminum components prior to application of Class 'A' TGIC polyester powder coating. Brass components are available in powder coat or handcrafted metal finish. Stainless steel components are available in handcrafted metal finish. (Brushed finish for interior use only).

Warranty
5 year limited warranty.

Certification and Listing
ITL tested to IESNA LM-79. Lighting Facts Registration per USDOE (www.lightingfacts.com). ETL Listed to ANSI/UL Standard 1838 and UL Subject 8750 and Certified to CAN/CSA Standard C22.2 No. 9. RoHs compliant. Suitable for use in wet locations. Suitable for ground-mounted recessed. Made in USA.

®Teflon is a registered trademark of DuPont Corporation.
®Energy Star is a registered trademark of the United States Environmental Protection Agency.

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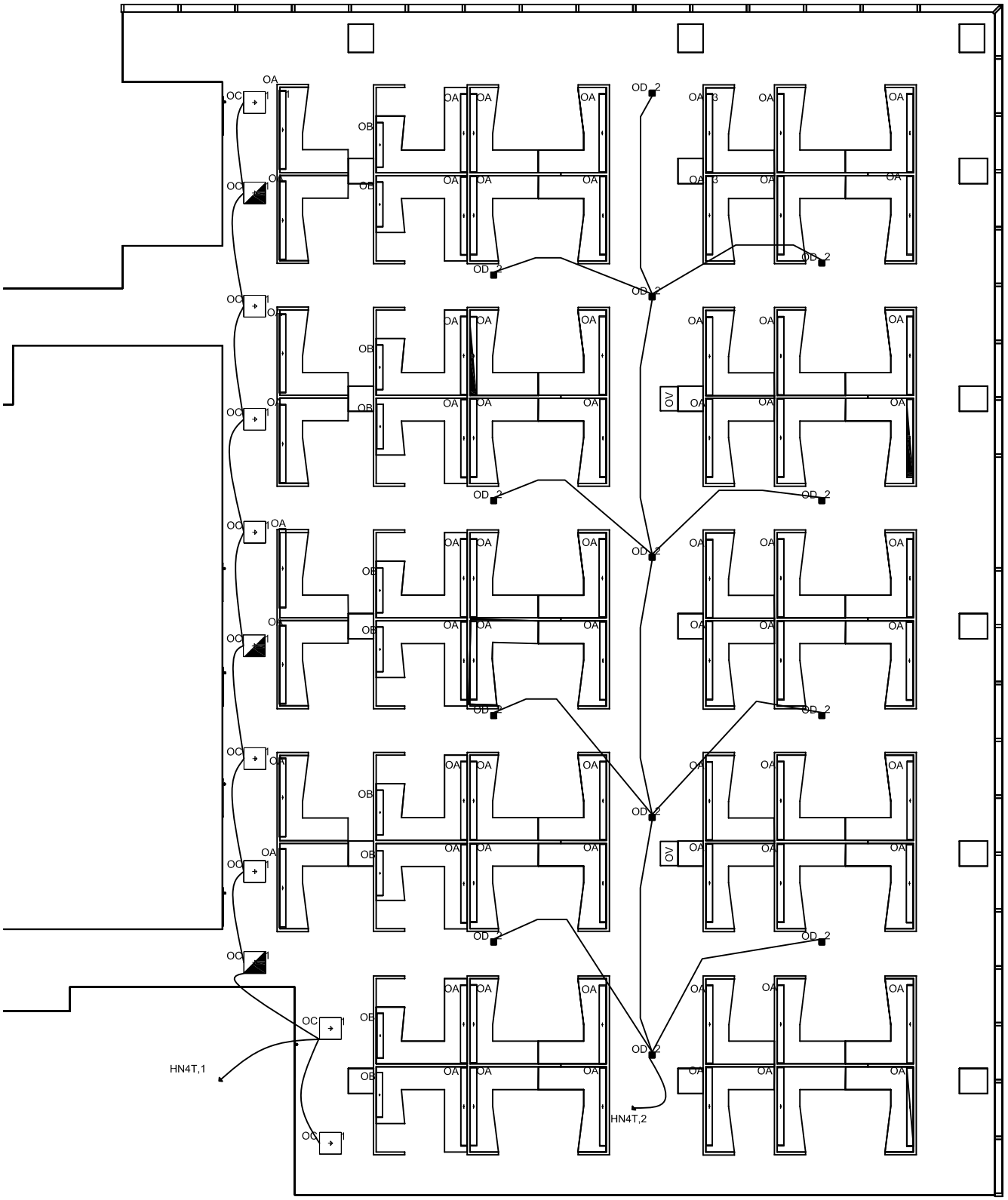
SUBMITTAL DATE	DRAWING NUMBER
3-18-11	SUB001068

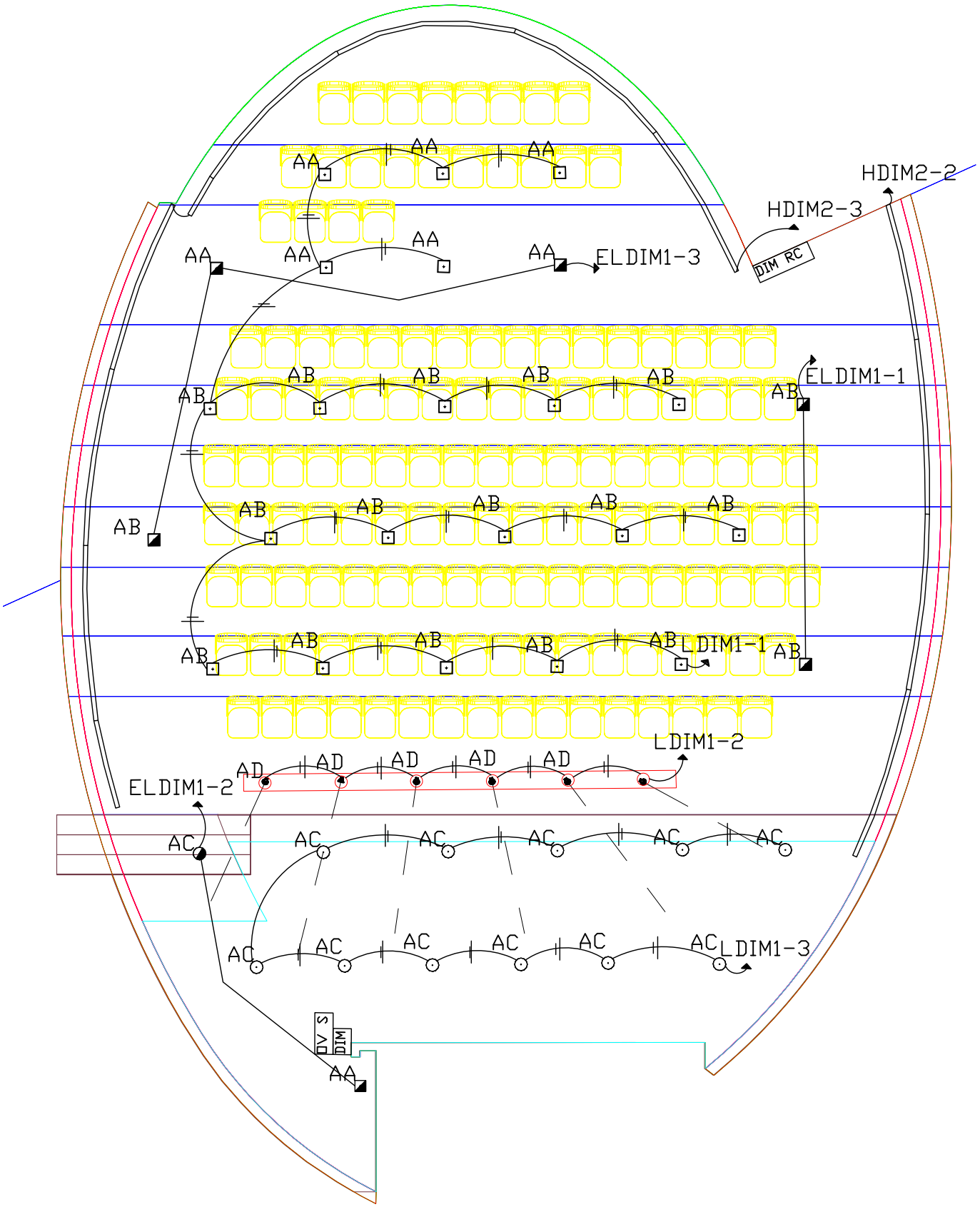
APPENDIX B



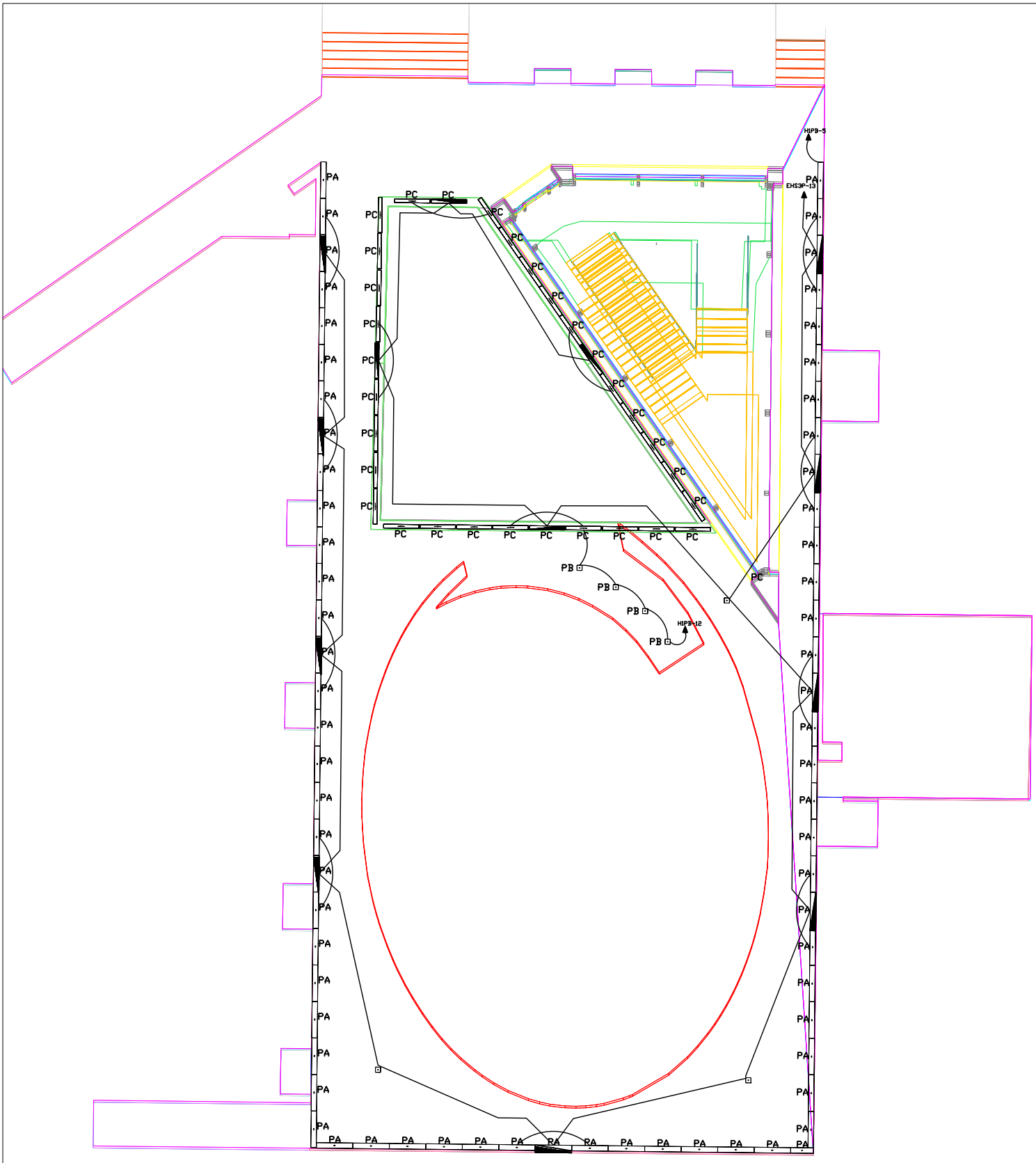
IAN HERRON

OPEN OFFICE

LIGHTING PLAN



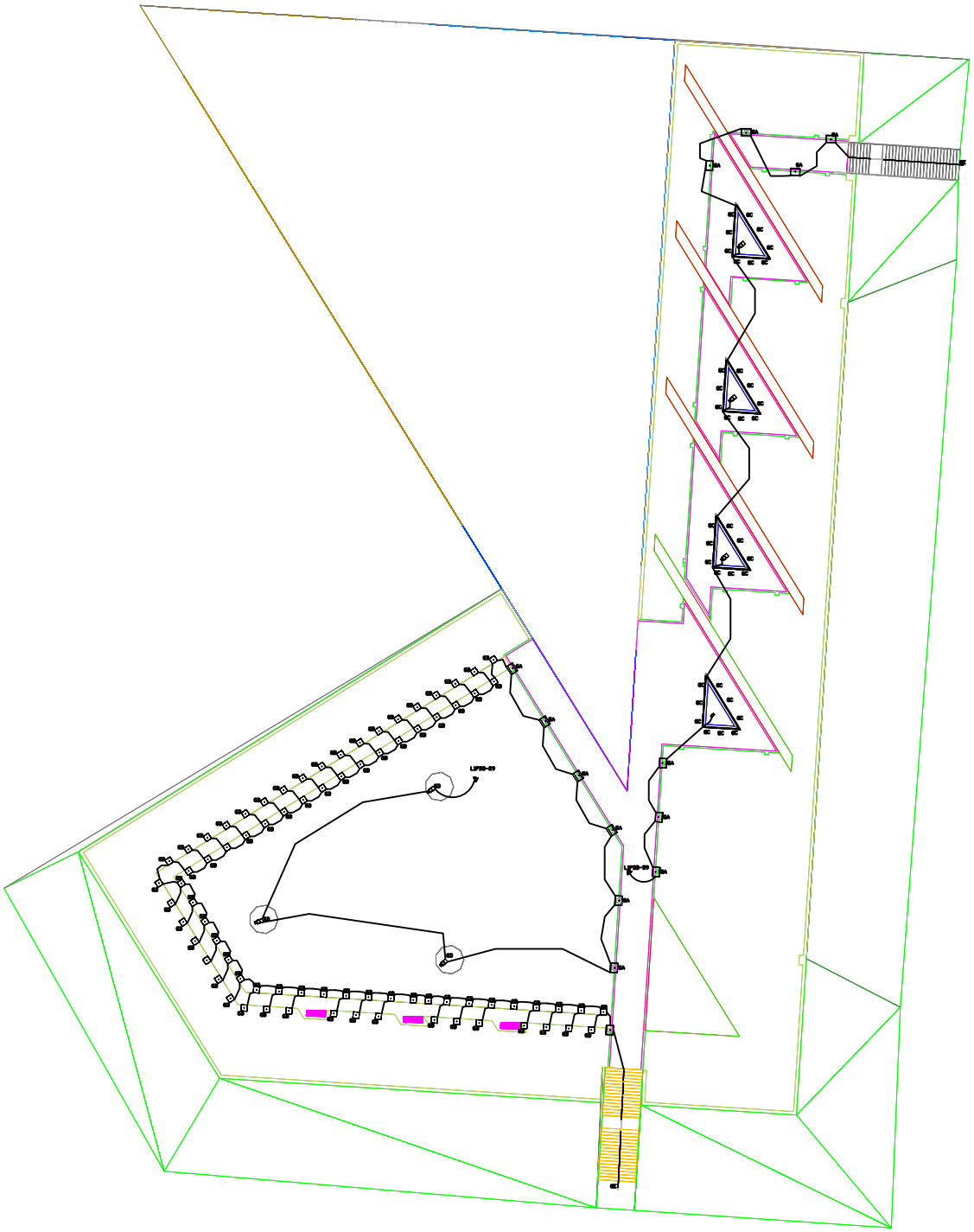
	IAN HERRON
	AUDITORIUM
	LIGHTING PLAN



IAN HERRON

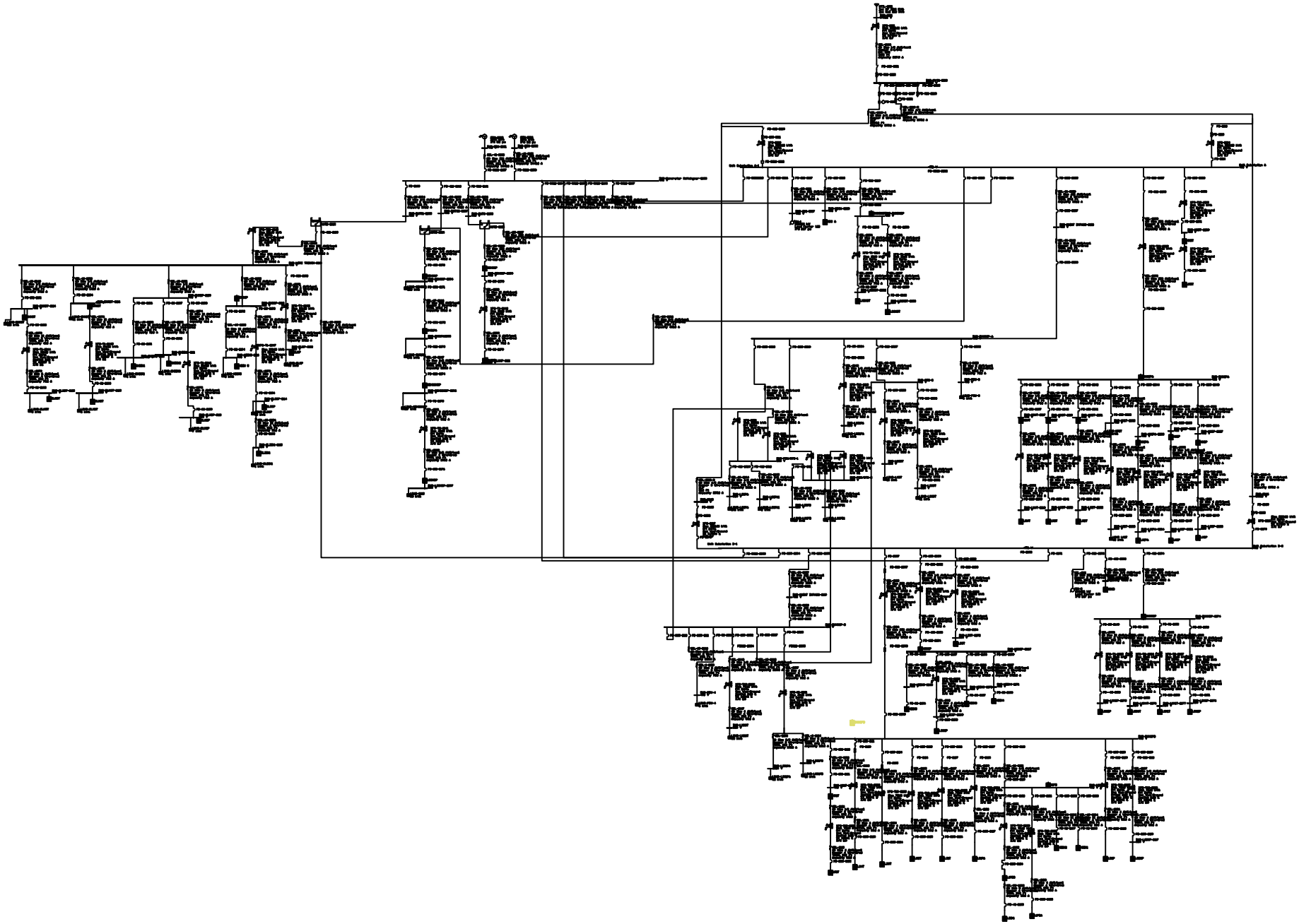
PREFUNCTION

LIGHTING PLAN



	IAN HERRON
	PLAZA
	LIGHTING PLAN

APPENDIX C



Project: Senior Thesis

Scenario: Base Project

Bus

Isc 3P (A)mps	Isc LL (A)mps	@ (deg)	Isc LLG (A)mps	@ (deg)	Isc SLG (A)mps	@ (deg)	Asym3P 1/2 Cycle (A)mps
1818	0	0.0	0	0.0	487	-76.4	2513
2015	0	0.0	0	0.0	1826	-84.2	2671
2015	0	0.0	0	0.0	1826	-84.2	2671
0	0	0.0	0	0.0	0	0.0	0
0	0	0.0	0	0.0	0	0.0	0
2014	0	0.0	0	0.0	1824	-84.2	2669
2014	0	0.0	0	0.0	1824	-84.2	2669
27438	0	0.0	0	0.0	25078	-81.2	27697
32741	0	0.0	0	0.0	31165	-90.5	33997
24787	0	0.0	0	0.0	21714	-84.0	25116
24787	0	0.0	0	0.0	21714	-84.0	25116
24770	0	0.0	0	0.0	21705	-84.0	25097
31325	0	0.0	0	0.0	29395	-87.2	32114
5260	0	0.0	0	0.0	177	-61.4	5265
18040	0	0.0	0	0.0	15381	-74.3	18068
4970	0	0.0	0	0.0	177	-61.4	4974
31325	0	0.0	0	0.0	29395	-87.2	32114
15572	0	0.0	0	0.0	13222	-67.6	15576
2960	0	0.0	0	0.0	106	-61.3	2961
5260	0	0.0	0	0.0	177	-61.4	5265
25560	0	0.0	0	0.0	23105	-72.6	25616
3063	0	0.0	0	0.0	106	-61.3	3064
2282	0	0.0	0	0.0	150	-62.9	2291
3196	0	0.0	0	0.0	353	-94.3	3232
2190	0	0.0	0	0.0	149	-63.0	2196
3120	0	0.0	0	0.0	352	-94.3	3150
1988	0	0.0	0	0.0	148	-63.2	1991

2944	0	0.0	0	0.0	350	-94.4	2963
2900	0	0.0	0	0.0	350	-94.4	2917
1940	0	0.0	0	0.0	148	-63.3	1943
2864	0	0.0	0	0.0	153	-62.7	2945
3621	0	0.0	0	0.0	357	-94.2	3752
7347	0	0.0	0	0.0	5912	-68.8	7348
2704	0	0.0	0	0.0	106	-61.4	2705
10642	0	0.0	0	0.0	9031	-50.1	10642
2152	0	0.0	0	0.0	62	-61.2	2153
12157	0	0.0	0	0.0	10401	-46.4	12157
1250	0	0.0	0	0.0	35	-61.2	1251
12157	0	0.0	0	0.0	10401	-46.4	12157
1250	0	0.0	0	0.0	35	-61.2	1251
48881	0	0.0	0	0.0	57136	-106.4	60458
8593	0	0.0	0	0.0	9142	-138.5	10698
6009	0	0.0	0	0.0	5565	-120.8	6212
4118	0	0.0	0	0.0	181	-91.8	4130
4144	0	0.0	0	0.0	181	-91.7	4156
6121	0	0.0	0	0.0	5699	-121.4	6347
6036	0	0.0	0	0.0	5598	-120.9	6245
4124	0	0.0	0	0.0	181	-91.7	4137
3831	0	0.0	0	0.0	180	-91.8	3837
4977	0	0.0	0	0.0	4475	-107.3	4998
4833	0	0.0	0	0.0	4324	-106.4	4850
3791	0	0.0	0	0.0	180	-91.8	3796
3752	0	0.0	0	0.0	180	-91.8	3756
4696	0	0.0	0	0.0	4183	-105.6	4710
4566	0	0.0	0	0.0	4049	-104.9	4577
3713	0	0.0	0	0.0	180	-91.8	3717
20917	0	0.0	0	0.0	17284	-83.8	21156
41027	0	0.0	0	0.0	43212	-88.8	42803
19274	0	0.0	0	0.0	1191	-63.3	22716

41027	0	0.0	0	0.0	43212	-88.8	42803
8352	0	0.0	0	0.0	516	-63.3	9844
48881	0	0.0	0	0.0	57136	-106.4	60457
8593	0	0.0	0	0.0	517	-63.3	10698
7476	0	0.0	0	0.0	508	-63.5	7874
10090	0	0.0	0	0.0	1198	-95.3	11133
5601	0	0.0	0	0.0	491	-64.4	5651
3994	0	0.0	0	0.0	180	-91.7	4001
4605	0	0.0	0	0.0	479	-64.9	4617
3725	0	0.0	0	0.0	180	-91.8	3729
4954	0	0.0	0	0.0	484	-64.7	4974
3825	0	0.0	0	0.0	180	-91.8	3830
5152	0	0.0	0	0.0	486	-64.6	5178
3879	0	0.0	0	0.0	180	-91.8	3885
3944	0	0.0	0	0.0	180	-91.7	3950
5401	0	0.0	0	0.0	489	-64.5	5439
4045	0	0.0	0	0.0	181	-91.7	4052
5812	0	0.0	0	0.0	493	-64.3	5879
5981	0	0.0	0	0.0	499	-64.6	6179
4112	0	0.0	0	0.0	181	-91.8	4124
5981	0	0.0	0	0.0	499	-64.6	6179
4112	0	0.0	0	0.0	181	-91.8	4124
6959	0	0.0	0	0.0	504	-63.9	7248
4248	0	0.0	0	0.0	176	-91.7	4259
6604	0	0.0	0	0.0	501	-64.0	6790
4223	0	0.0	0	0.0	181	-91.7	4234
1247	0	0.0	0	0.0	35	-61.2	1248
11486	0	0.0	0	0.0	9801	-47.0	11486
15207	0	0.0	0	0.0	13146	-51.5	15207
1620	0	0.0	0	0.0	70	-61.3	1620
1620	0	0.0	0	0.0	70	-61.3	1620
15207	0	0.0	0	0.0	13146	-51.5	15207

11486	0	0.0	0	0.0	9801	-47.0	11486
1247	0	0.0	0	0.0	35	-61.2	1248
20674	0	0.0	0	0.0	17833	-79.5	20774
19110	0	0.0	0	0.0	16289	-79.0	19186
2952	0	0.0	0	0.0	153	-62.6	3056
2058	0	0.0	0	0.0	1918	-87.5	2805
27438	0	0.0	0	0.0	25078	-81.2	27697
32741	0	0.0	0	0.0	31165	-90.5	33997
20674	0	0.0	0	0.0	17833	-79.5	20774
47983	0	0.0	0	0.0	53924	-101.6	56210
40704	0	0.0	0	0.0	41754	-92.4	43302
46859	0	0.0	0	0.0	51896	-97.2	52320
26626	0	0.0	0	0.0	23262	-86.8	27194
8521	0	0.0	0	0.0	9025	-138.0	10517
8521	0	0.0	0	0.0	517	-63.3	10517
37985	0	0.0	0	0.0	38056	-99.4	42318
37985	0	0.0	0	0.0	38056	-99.4	42318
44522	0	0.0	0	0.0	48691	-101.0	51027
38880	0	0.0	0	0.0	39698	-91.6	40940
280	0	0.0	0	0.0	95	-63.3	280
524	0	0.0	0	0.0	117	-63.3	524
2213	0	0.0	0	0.0	150	-63.2	2225
2449	0	0.0	0	0.0	151	-63.0	2473
2557	0	0.0	0	0.0	152	-62.9	2590
2157	0	0.0	0	0.0	149	-63.2	2166
863	0	0.0	0	0.0	254	-94.3	863
2558	0	0.0	0	0.0	340	-94.5	2562
2701	0	0.0	0	0.0	342	-94.4	2706
2763	0	0.0	0	0.0	343	-94.4	2770
1755	0	0.0	0	0.0	61	-61.2	1756
3518	0	0.0	0	0.0	356	-94.4	3633
2522	0	0.0	0	0.0	340	-94.5	2526

54879	0	0.0	0	0.0	67157	-110.4	75490
54879	0	0.0	0	0.0	67157	-110.4	75490
55959	0	0.0	0	0.0	70745	-112.2	78002
6193	0	0.0	0	0.0	501	-64.5	6460
2131	0	0.0	0	0.0	411	-64.4	2131
2131	0	0.0	0	0.0	411	-64.4	2131
7655	0	0.0	0	0.0	510	-63.5	8202
7655	0	0.0	0	0.0	510	-63.5	8202
7374	0	0.0	0	0.0	509	-63.7	7868
1305	0	0.0	0	0.0	140	-63.3	1305
6251	0	0.0	0	0.0	5849	-122.9	6533
5152	0	0.0	0	0.0	4661	-108.3	5178
5812	0	0.0	0	0.0	493	-64.3	5879
6340	0	0.0	0	0.0	5958	-123.4	6646
5000	0	0.0	0	0.0	4499	-107.4	5021
6222	0	0.0	0	0.0	5813	-122.8	6496
4855	0	0.0	0	0.0	4347	-106.5	4872
4717	0	0.0	0	0.0	4204	-105.7	4731
2363	0	0.0	0	0.0	77	-61.4	2366
7787	0	0.0	0	0.0	510	-63.4	8361
3602	0	0.0	0	0.0	179	-91.8	3605
3602	0	0.0	0	0.0	179	-91.8	3605
9154	0	0.0	0	0.0	684	-64.0	9277
9123	0	0.0	0	0.0	688	-63.8	9190
9122	0	0.0	0	0.0	668	-63.9	9254
9094	0	0.0	0	0.0	672	-63.7	9166
2136	0	0.0	0	0.0	171	-92.0	2136
3612	0	0.0	0	0.0	179	-91.8	3615
3371	0	0.0	0	0.0	179	-91.9	3372
3501	0	0.0	0	0.0	179	-91.8	3502
3627	0	0.0	0	0.0	179	-91.8	3631
3339	0	0.0	0	0.0	179	-91.9	3340

3607	0	0.0	0	0.0	179	-91.8	3610
3307	0	0.0	0	0.0	178	-91.9	3308
3276	0	0.0	0	0.0	178	-91.9	3277
1320	0	0.0	0	0.0	1436	-121.2	1320
4396	0	0.0	0	0.0	175	-61.5	4397
4396	0	0.0	0	0.0	175	-61.5	4397
4187	0	0.0	0	0.0	175	-61.5	4188
1164	0	0.0	0	0.0	35	-61.2	1164
1563	0	0.0	0	0.0	70	-61.3	1563
1161	0	0.0	0	0.0	35	-61.2	1162
1563	0	0.0	0	0.0	70	-61.3	1563
3541	0	0.0	0	0.0	179	-91.8	3543
3461	0	0.0	0	0.0	179	-91.8	3462
3691	0	0.0	0	0.0	175	-91.8	3694
3409	0	0.0	0	0.0	179	-91.8	3410
3233	0	0.0	0	0.0	178	-91.9	3234
3285	0	0.0	0	0.0	178	-91.9	3287
12541	0	0.0	0	0.0	1122	-63.8	12568
2932	0	0.0	0	0.0	106	-61.3	2933
2077	0	0.0	0	0.0	104	-61.6	2077
2838	0	0.0	0	0.0	106	-61.4	2838
2602	0	0.0	0	0.0	105	-61.4	2602
1164	0	0.0	0	0.0	35	-61.2	1164
8008	0	0.0	0	0.0	1130	-95.7	8083
3683	0	0.0	0	0.0	179	-91.8	3686
1161	0	0.0	0	0.0	35	-61.2	1162
41726	0	0.0	0	0.0	43938	-102.0	48116
41726	0	0.0	0	0.0	43938	-102.0	48117
22482	0	0.0	0	0.0	19729	-77.6	22571
24274	0	0.0	0	0.0	21587	-78.9	24406
2059	0	0.0	0	0.0	1917	-87.3	2805
4546	0	0.0	0	0.0	3805	-42.9	4546

4546	0	0.0	0	0.0	3805	-42.9	4546
13332	0	0.0	0	0.0	709	-62.7	13962
13389	0	0.0	0	0.0	693	-62.7	14101
22434	0	0.0	0	0.0	19712	-77.6	22523
30313	0	0.0	0	0.0	28167	-88.8	31181
8390	0	0.0	0	0.0	6714	-72.9	8394
10328	0	0.0	0	0.0	8323	-74.9	10337
20739	0	0.0	0	0.0	17933	-78.0	20817
2922	0	0.0	0	0.0	153	-62.7	3020
51361	0	0.0	0	0.0	62322	-109.9	67293
51575	0	0.0	0	0.0	62424	-110.1	67819
51361	0	0.0	0	0.0	62322	-109.9	67291
51573	0	0.0	0	0.0	62421	-110.1	67802

Cable

Bus1	Isc 3P to Bus1 (A)mps	@(deg)	Isc 3P to Bus2 (A)mps	@ (deg)	IscSLG Bus1 (A)mps	@ (deg)	IscSLG Bus2 (A)mps
BUS-MVS1-0003	487	122.6	1551	-94.7	274	90.6	1526
BUS-MVS1-0003	487	122.6	1551	-94.7	274	90.6	1526
	0	0.0	0	0.0	0	0.0	0
	0	0.0	0	0.0	0	0.0	0
BUS-0035	259	116.9	1780	-90.3	150	89.1	1675
BUS-0036	262	116.2	1776	-90.3	152	88.9	1673
	0	0.0	0	0.0	0	0.0	0
BUS-0229	0	0.0	19110	-78.8	0	0.0	16289
BUS-WIRE TROUGH-0118	0	0.0	2864	-120.7	0	0.0	153
BUS-0167	0	0.0	3518	-151.7	0	0.0	356
BUS-EHS3P-0113	0	0.0	1940	-103.6	0	0.0	148
BUS-0164	0	0.0	2522	-133.9	0	0.0	340
BUS-EHN2P-0109	0	0.0	1988	-104.3	0	0.0	148
BUS-0163	0	0.0	2558	-134.3	0	0.0	340
BUS-EHN2T-0106	0	0.0	2190	-107.1	0	0.0	149
BUS-0161	0	0.0	2701	-135.8	0	0.0	342

BUS-EHN5T-0104	0	0.0	2282	-108.4	0	0.0	150
BUS-0159	0	0.0	2763	-136.5	0	0.0	343
BUS-SDHNMP-0099	0	0.0	10642	-51.2	0	0.0	9031
BUS-SDHSCM3P-0096	0	0.0	7347	-65.4	0	0.0	5912
BUS-0169	0	0.0	2602	-95.4	0	0.0	105
BUS-0171	0	0.0	1755	-93.2	0	0.0	61
BUS-DHNCM2P	0	0.0	12157	-48.9	0	0.0	10401
BUS-0173	0	0.0	1164	-97.5	0	0.0	35
BUS-DHNCM2P	0	0.0	12157	-48.9	0	0.0	10401
BUS-0175	0	0.0	1164	-97.5	0	0.0	35
BUS-DHNM2P-0074	0	0.0	11486	-49.1	0	0.0	9801
Unit Substation A	0	0.0	48881	-108.2	0	0.0	57136
BUS-0177	0	0.0	8521	-138.1	0	0.0	9025
BUS-HN4T-0017	0	0.0	4566	-106.3	0	0.0	4049
BUS-0191	0	0.0	3276	-128.6	0	0.0	178
BUS-HN3T-0019	0	0.0	4696	-107.2	0	0.0	4183
BUS-0188	0	0.0	3307	-128.8	0	0.0	178
BUS-HN2T-0021	0	0.0	4833	-108.1	0	0.0	4324
BUS-0187	0	0.0	3339	-129.0	0	0.0	179
BUS-0183	0	0.0	3612	-132.0	0	0.0	179
BUS-HN1PA-0023	0	0.0	6036	-122.1	0	0.0	5598
BUS-HN2P-0025	0	0.0	6121	-122.5	0	0.0	5699
BUS-0180	0	0.0	3627	-132.0	0	0.0	179
BUS-0179	0	0.0	3607	-131.9	0	0.0	179
BUS-HN3P-0027	0	0.0	6009	-121.9	0	0.0	5565
Unit Substation B-1	0	0.0	48881	-108.2	0	0.0	57136
BUS-0198	0	0.0	8521	-138.1	0	0.0	517
Unit Substation B-1	0	0.0	41027	-93.7	0	0.0	43212
BUS-0196	0	0.0	7787	-127.9	0	0.0	510
Unit Substation B-1	0	0.0	41027	-93.7	0	0.0	43212
BUS-0194	0	0.0	12541	-105.9	0	0.0	1122
BUS-HSC3P-0067	0	0.0	7476	-125.3	0	0.0	508

BUS-0200	0	0.0	8008	-143.5	0	0.0	1130
Unit Substation B-2	1649	68.1	19444	-82.2	1330	69.0	16469
BUS-0221	0	0.0	1161	-97.4	0	0.0	35
BUS-DHNM2P-0074	0	0.0	11486	-49.1	0	0.0	9801
BUS-0228	0	0.0	1161	-97.4	0	0.0	35
BUS-0202	0	0.0	3501	-130.0	0	0.0	179
BUS-DHNM2P-0074	0	0.0	15207	-54.4	0	0.0	13146
BUS-0224	0	0.0	1563	-88.0	0	0.0	70
BUS-DHNM2P-0074	0	0.0	15207	-54.4	0	0.0	13146
BUS-0225	0	0.0	1563	-88.0	0	0.0	70
BUS-HN1T-0052	0	0.0	5601	-113.3	0	0.0	491
BUS-0204	0	0.0	3285	-128.7	0	0.0	178
BUS-DHN2PB	0	0.0	4605	-106.6	0	0.0	479
BUS-DHN2PB	0	0.0	4954	-108.9	0	0.0	484
BUS-0206	0	0.0	3233	-127.9	0	0.0	178
BUS-DHN2PB	0	0.0	5152	-110.2	0	0.0	486
BUS-0208	0	0.0	3409	-129.4	0	0.0	179
BUS-DHN2PB	0	0.0	5401	-111.9	0	0.0	489
BUS-0209	0	0.0	3461	-129.8	0	0.0	179
BUS-DHN2PB	0	0.0	5812	-114.8	0	0.0	493
BUS-0211	0	0.0	3541	-130.3	0	0.0	179
BUS-H1PB	0	0.0	5981	-121.8	0	0.0	499
BUS-0214	0	0.0	3602	-131.9	0	0.0	179
BUS-0216	0	0.0	3602	-131.9	0	0.0	179
BUS-H1PB	0	0.0	5981	-121.8	0	0.0	499
BUS-DHN2PB	0	0.0	6959	-123.4	0	0.0	504
BUS-0218	0	0.0	3691	-131.3	0	0.0	175
BUS-DHN2PB	0	0.0	6604	-120.6	0	0.0	501
BUS-0220	0	0.0	3683	-131.2	0	0.0	179
BUS-HN1T-0022	0	0.0	4977	-109.0	0	0.0	4475
BUS-0184	0	0.0	3371	-129.2	0	0.0	179
BUS-DHNC2P-A	0	0.0	31325	-89.9	0	0.0	29395

BUS-0140	0	0.0	4396	-96.5	0	0.0	175
BUS-0144	0	0.0	4187	-96.0	0	0.0	175
BUS-STS-3	0	0.0	18040	-74.4	0	0.0	15381
BUS-0148	0	0.0	4396	-96.5	0	0.0	175
BUS-DHNC2P-B	0	0.0	31325	-89.9	0	0.0	29395
BUS-STS-3	0	0.0	15572	-67.7	0	0.0	13222
BUS-0147	0	0.0	2838	-95.5	0	0.0	106
BUS-DHNC2P-B	0	0.0	25560	-75.9	0	0.0	23105
BUS-0150	0	0.0	2932	-95.9	0	0.0	106
BUS-0231	0	0.0	2922	-121.9	0	0.0	153
BUS-0232	973	122.7	1324	-110.7	548	90.5	1369
BUS-DHNC2P-A	0	0.0	4546	-42.5	0	0.0	3805
BUS-DHNC2P-B	0	0.0	4546	-42.5	0	0.0	3805
BUS-DHN2PA	0	0.0	4717	-107.3	0	0.0	4204
BUS-DHN2PA	0	0.0	4855	-108.2	0	0.0	4347
BUS-DHN2PA	0	0.0	5000	-109.2	0	0.0	4499
BUS-DHN2PA	0	0.0	5152	-110.2	0	0.0	4661
BUS-DHN2PB	0	0.0	5812	-114.8	0	0.0	493
BUS-WIRE TROUGH-0118	0	0.0	2557	-115.5	0	0.0	152
BUS-WIRE TROUGH-0118	0	0.0	2449	-113.8	0	0.0	151
BUS-WIRE TROUGH-0118	0	0.0	2213	-110.0	0	0.0	150
BUS-WIRE TROUGH-0118	0	0.0	2157	-109.1	0	0.0	149
BUS-SHS1PA0095	0	0.0	8390	-69.5	0	0.0	6714
BUS-DHNC2P-B	2804	97.9	10369	-78.5	3007	99.6	8967
BUS-DHNC2P-A	2804	97.9	10369	-78.5	3007	99.6	8967
	0	0.0	0	0.0	0	0.0	0
BUS-Generator Switchgear-0083	0	0.0	40704	-96.3	0	0.0	41754
BUS-Auto1 to Sub B0090	20674	100.1	0	0.0	17833	100.5	0
BUS-DHNC2P-B	577	63.9	23829	-84.5	385	66.0	21154
BUS-DHNC2P-B	564	62.8	23842	-84.4	377	65.0	21162
BUS-DHNC2P-A	577	63.9	23829	-84.5	385	66.0	21154
BUS-DHN2PA	0	0.0	6251	-124.0	0	0.0	5849

BUS-DHN2PA	0	0.0	6340	-124.5	0	0.0	5958
BUS-DHN2PA	0	0.0	6222	-123.9	0	0.0	5813
BUS-DHN2PB	0	0.0	6193	-123.7	0	0.0	501
BUS-PDU/STS-1	0	0.0	9154	-115.8	0	0.0	684
BUS-PDU/STS-2	0	0.0	9122	-116.2	0	0.0	668
BUS-SDHNMP-0094	0	0.0	10328	-72.0	0	0.0	8323
Unit Substation A-1	0	0.0	22482	-78.8	0	0.0	19729
Unit Substation B-2	0	0.0	24274	-80.5	0	0.0	21587
Unit Substation B-2	0	0.0	38880	-95.3	0	0.0	39698
BUS-Generator Switchgear-0083	0	0.0	46859	-101.3	0	0.0	51896
BUS-Auto 2 to Sub A-0089	27438	96.4	0	0.0	25078	98.8	0
BUS-0093	0	0.0	22434	-78.8	0	0.0	19712
BUS-PDU/STS-1	0	0.0	9123	-112.2	0	0.0	688
BUS-PDU/STS-2	0	0.0	9094	-112.5	0	0.0	672
Unit Substation A-1	1672	67.2	25090	-87.0	1349	68.1	22365
Unit Substation A-1	0	0.0	44522	-103.7	0	0.0	48691
BUS-Generator Switchgear-0083	0	0.0	47983	-104.7	0	0.0	53924
BUS-Auto 3 to Sub A-0091	32741	87.2	0	0.0	31165	89.5	0
BUS-0098	0	0.0	30313	-90.7	0	0.0	28167
Unit Substation B-1	1066	84.0	38786	-104.9	1233	87.7	40991
BUS-MAINT BYPASS-0119	2991	86.0	34246	-102.6	3028	90.8	34485
Unit Substation A	1066	84.0	38786	-104.9	1233	87.7	40991
BUS-MAINT BYPASS-0120	2991	86.1	34246	-102.6	3028	90.8	34485
BUS-GEN-0081	41740	59.2	14871	-86.8	53743	71.1	13314
BUS-GEN-0082	41740	59.2	14871	-86.8	53743	71.1	13314
BUS-Generator Switchgear-0083	8663	45.5	41323	-104.5	11684	70.4	46622
BUS-Generator Switchgear-0083	7342	40.4	41688	-104.8	10420	70.3	46712
BUS-Generator Switchgear-0083	7345	40.3	41687	-104.8	10422	70.2	46710
BUS-Generator Switchgear-0083	8695	45.4	41304	-104.5	11704	70.3	46605
BUS-H1PB	0	0.0	2131	-80.3	0	0.0	411
BUS-H1PB	0	0.0	2131	-80.3	0	0.0	411

BUS-HSC3P-0067	0	0.0	7374	-127.1	0	0.0	509
BUS-HSC3P-0067	0	0.0	7655	-127.6	0	0.0	510
BUS-HSC3P-0067	0	0.0	7655	-127.6	0	0.0	510
BUS-EHN2P-0109	0	0.0	524	-72.9	0	0.0	117
BUS-EHN2P-0109	0	0.0	280	-68.2	0	0.0	95
BUS-ELS3P-0114	0	0.0	863	-105.8	0	0.0	254
BUS-EHS3P-0113	0	0.0	1305	-88.8	0	0.0	140
BUS-L1PBB-0060	0	0.0	2136	-115.6	0	0.0	171
BUS-0150	0	0.0	2077	-88.7	0	0.0	104

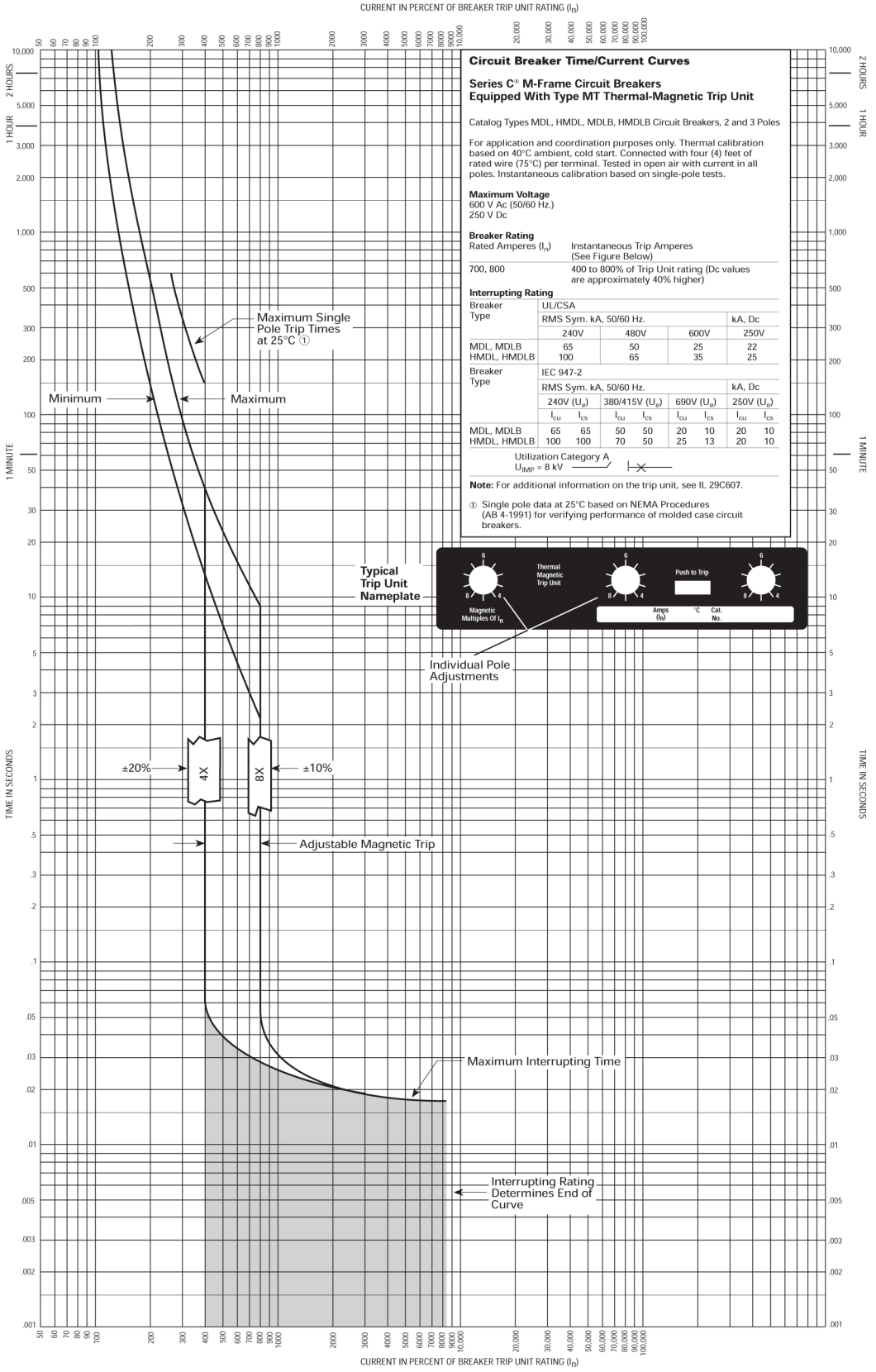
2-Winding Transformer

Bus	Isc 3P to Bus1 (A)mps	@ (deg)	Isc 3P to Bus2 (A)mps	@ (deg)	IscSLG to Bus1 (A)mps	@ (deg)	IscSLG to Bus2 (A)mps
BUS-0001	245	154.2	1326	-110.9	42	103.7	1371
BUS-0035	262	-63.8	10001	41.4	152	-91.2	14542
BUS-0036	259	-63.1	10036	41.3	150	-90.9	14506
BUS-0045	260	116.8	10032	-138.6	150	89.1	14503
BUS-0046	263	116.1	9999	-138.6	152	88.8	14540
BUS-0124	1083	-112.7	6666	55.6	632	-111.1	355
BUS-0125	1083	-112.7	6666	55.6	632	-111.1	355
BUS-DHNC2P-A	564	62.8	6852	-126.2	377	65.0	352
BUS-0136	1058	-113.8	6539	55.6	618	-112.2	341
BUS-0146	0	0.0	2960	-96.1	0	13.3	106
BUS-0149	0	0.0	3063	-96.5	0	16.4	106
BUS-0195	0	0.0	8352	-135.5	0	50.9	516
BUS-0199	0	0.0	10090	-160.7	0	77.7	1198
BUS-0193	0	0.0	19274	-135.5	0	50.9	1191
BUS-0172	0	0.0	1250	-100.1	0	-113.5	35
BUS-0174	0	0.0	1250	-100.1	0	-113.5	35
BUS-0222	0	0.0	1247	80.0	0	66.0	35
BUS-0227	0	0.0	1247	-100.0	0	-114.0	35
BUS-0170	0	0.0	2152	-100.0	0	-115.0	62
BUS-0158	0	0.0	3196	-144.6	0	-121.2	353

BUS-0160	0	0.0	3120	-143.6	0	-122.6	352
BUS-0162	0	0.0	2944	-141.4	0	-125.5	350
BUS-0165	0	0.0	2900	39.1	0	53.8	350
BUS-HN5T-0029	0	0.0	1320	-122.2	0	0.0	1436
BUS-0190	0	0.0	3713	-133.0	0	145.7	180
BUS-0189	0	0.0	3752	46.8	0	-34.2	180
BUS-0186	0	0.0	3791	-133.5	0	145.9	180
BUS-0182	0	0.0	4124	-137.3	0	145.4	181
BUS-0181	0	0.0	4144	42.6	0	-34.5	181
BUS-0178	0	0.0	4118	-137.3	0	145.4	181
BUS-0185	0	0.0	3831	46.2	0	-34.0	180
BUS-0139	0	0.0	5260	-102.5	0	177.0	177
BUS-0201	0	0.0	3994	-134.9	0	-166.8	180
BUS-0203	0	0.0	3725	-133.1	0	-174.0	180
BUS-0205	0	0.0	3825	-133.7	0	-171.5	180
BUS-0207	0	0.0	3879	-134.1	0	-170.1	180
BUS-0210	0	0.0	3944	45.4	0	11.7	180
BUS-0212	0	0.0	4045	44.7	0	14.8	181
BUS-0217	0	0.0	4248	-136.9	0	-156.1	176
BUS-0213	0	0.0	4112	-137.3	0	-158.6	181
BUS-0215	0	0.0	4112	-137.3	0	-158.6	181
BUS-0219	0	0.0	4223	-136.5	0	-159.1	181
BUS-0143	0	0.0	4970	-101.5	0	174.4	177
BUS-0145	0	0.0	5260	-102.5	0	177.0	177
Unit Substation A	0	0.0	2363	-102.8	0	-176.0	77
BUS-0223	0	0.0	1620	-88.5	0	-69.7	70
BUS-0226	0	0.0	1620	91.5	0	110.3	70
BUS-0230	0	0.0	2952	-122.2	0	-136.7	153
BUS-0176	0	0.0	8593	-138.5	0	148.3	9142
BUS-0197	0	0.0	8593	-138.5	0	157.8	517
BUS-0168	0	0.0	2704	-95.9	0	9.8	106
BUS-0166	0	0.0	3621	-152.4	0	-108.6	357

APPENDIX D

Types MDL, HMDL, MDLB, and HMDLB Equipped with Type MT Thermal-Magnetic Trip Unit, 700 and 800 Amperes



Circuit Breaker Time/Current Curves

Series C® M-Frame Circuit Breakers Equipped With Type MT Thermal-Magnetic Trip Unit

Catalog Types MDL, HMDL, MDLB, HMDLB Circuit Breakers, 2 and 3 Poles

For application and coordination purposes only. Thermal calibration based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (75°C) per terminal. Tested in open air with current in all poles. Instantaneous calibration based on single-pole tests.

Maximum Voltage
600 V Ac (50/60 Hz.)
250 V Dc

Breaker Rating

Rated Amperes (I_n)	Instantaneous Trip Amperes (See Figure Below)
700, 800	400 to 800% of Trip Unit rating (Dc values are approximately 40% higher)

Interrupting Rating

Breaker Type	UL/CSA							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V		480V		600V		250V	
MDL, MDLB	65		50		25		22	
HMDL, HMDLB	100		65		35		25	
Breaker Type	IEC 947-2							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V (U_e)		380/415V (U_e)		690V (U_e)		250V (U_e)	
	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}
MDL, MDLB	65	65	50	50	20	10	20	10
HMDL, HMDLB	100	100	70	50	25	13	20	10

Utilization Category A
U_{IMP} = 8 kV

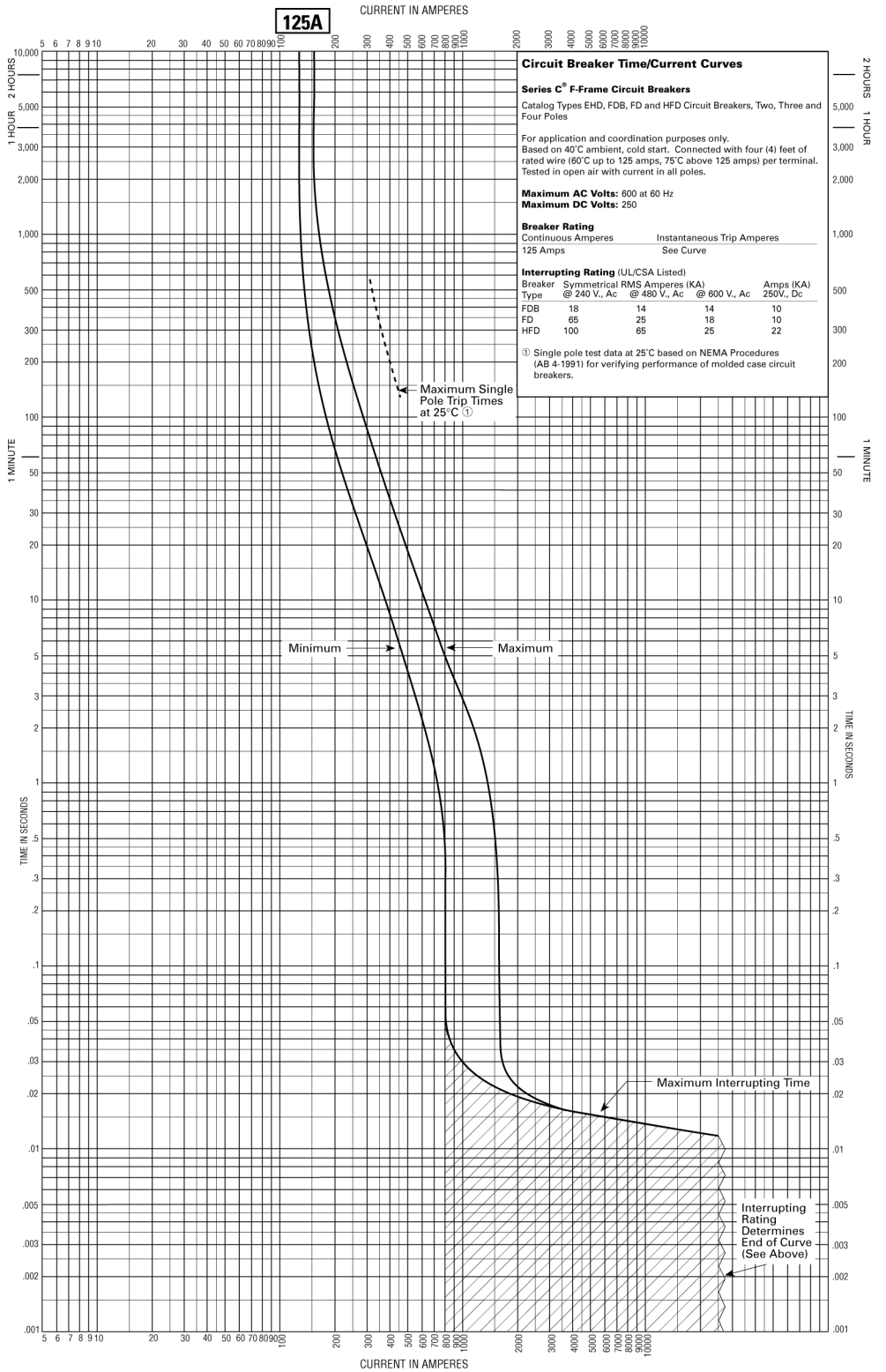
Note: For additional information on the trip unit, see IL 29C607.

① Single pole data at 25°C based on NEMA Procedures (AB 4-1991) for verifying performance of molded case circuit breakers.

Curve No. SC-6912-98

AB DE-ION Circuit Breakers

Types FDB, FD and HFD 125 Amperes



Curve No. SC-4148-87B

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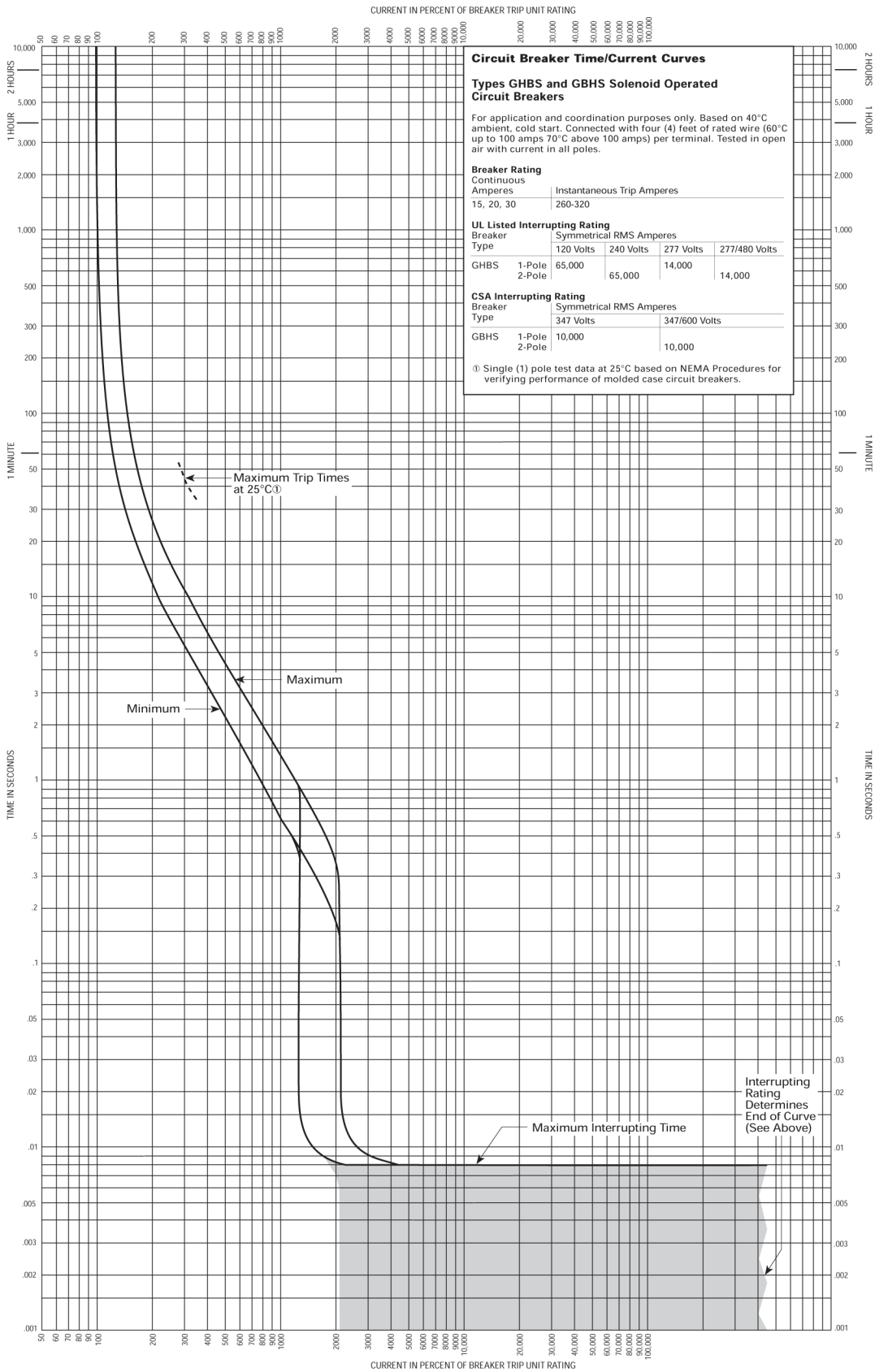
Type GHBS 15-30 Amperes, 1, 2 Poles



Circuit Breaker Time/Current Curves

Types GHBS and GBHS Solenoid Operated Circuit Breakers

For application and coordination purposes only. Based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (60°C up to 100 amps 70°C above 100 amps) per terminal. Tested in open air with current in all poles.

Breaker Rating

Continuous Amperes	Instantaneous Trip Amperes
15, 20, 30	260-320

UL Listed Interrupting Rating

Breaker Type		Symmetrical RMS Amperes			
		120 Volts	240 Volts	277 Volts	277/480 Volts
GHBS	1-Pole	65,000		14,000	
	2-Pole		65,000		14,000

CSA Interrupting Rating

Breaker Type		Symmetrical RMS Amperes	
		347 Volts	347/600 Volts
GBHS	1-Pole	10,000	
	2-Pole		10,000

① Single (1) pole test data at 25°C based on NEMA Procedures for verifying performance of molded case circuit breakers.

Curve No. SC 5695-93B