Final Report

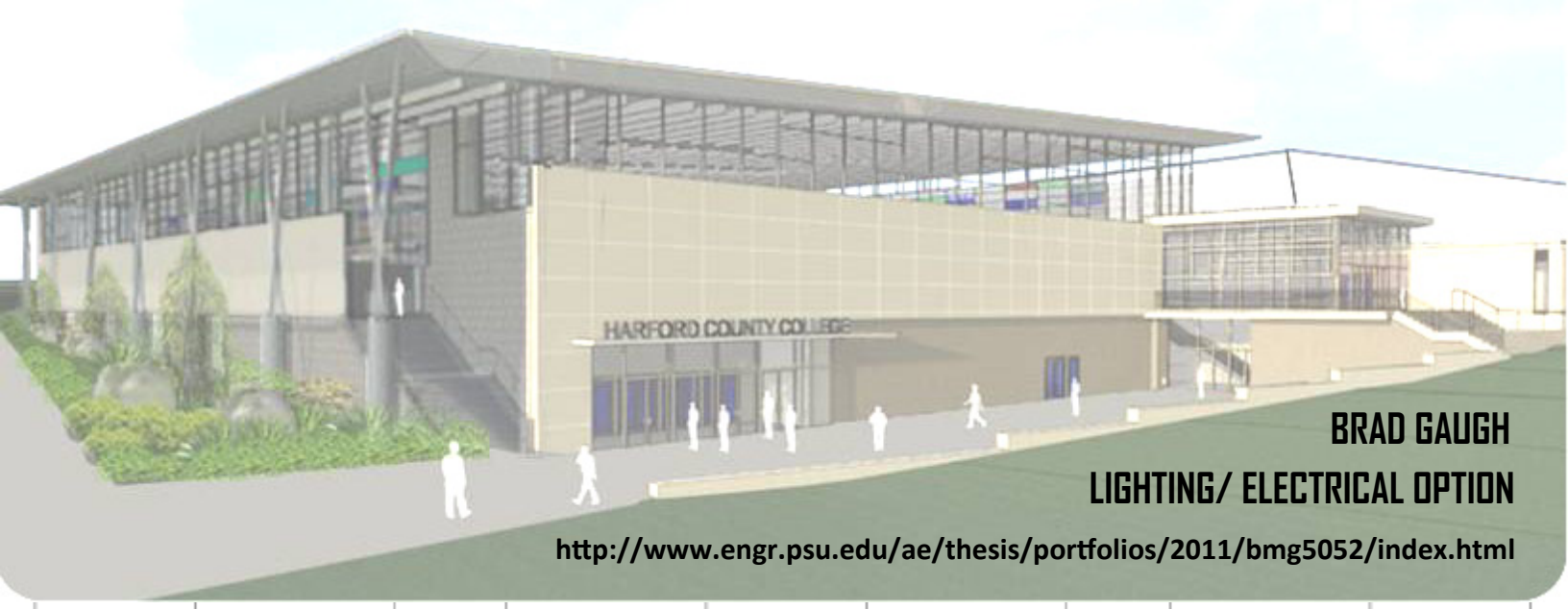
Susquehanna Center Renovations & Expansion

Brad Gaugh

April 7, 2011

SUSQUEHANNA CENTER RENOVATIONS & EXPANSIONS

BEL AIR, MARYLAND



BRAD GAUGH

LIGHTING/ ELECTRICAL OPTION

http://www.engr.psu.edu/ae/thesis/portfolios/2011/bmg5052/index.html

PROJECT TEAM

Owner —Harford Community College

Architect — Hord Coplan Macht

Construction Manager —Turner Construction

Landscape Architect —Site Resources

Civil Engineer —Site Resources

Structural Engineer —CMJ Structural Engineering

MEP Engineering —Burdette Koehler Murphy & Associates

Lighting Consultant —Dunlop Lighting Design

Telecommunications —Spexsys

Natatorium —Counsilman Hunsaker

STATISTICS

Size—110, 000 SF

Height—2 : 1 Above Ground @ 45ft

Construction Dates—April 2011—August 2012

Project Delivery Method—Design—Bid—Build

Project Cost—$28 Million

STRUCTURE

The foundation is comprised of a two way slab and the slabs' thicknesses range from 3 1/2" to 10". The super structure is composed of concrete and steel columns at varying locations. The steel columns are located in all areas except the main arena, which is supported by concrete columns. The roof system is comprised of composite decking and trusses at 8' on center in the main and auxiliary gym.

ARCHITECTURE

The athletic facility uses primarily three main types of materials on the façade to distinguish between the two main floors; the arena level and main level. The architect uses matte painted concrete block for supporting walls that start at the arena level and end at the main level. At the main level, glazing is used as the distinguishing factor and allows for interesting perspectives and views looking out of building from the concourse at the main level. Lastly, the architect uses an aesthetically appealing design for the down spouts by forming a V-shape on the sides of the main arena.

LIGHTING and ELECTRICAL

The service entrance is supplied by BGE 's pad mounted transformer, which is stepped down to 480Y/277 V, 3 PH., 4W. The main switchboard is sized at 3200 A and the emergency power is supplied by a 60 W generator at 75 KVA. The lighting is primarily linear fluorescent luminaires and the main and auxiliary gym is illuminated by metal halide pulse start fixtures.

MECHANICAL

The mechanical system takes advantage of a variable air volume fan coil system consisting of energy recovery AHU's that reduce cooling and heating demands for units. The cooling is generated by an air cooled high efficiency chiller and the extracted heat from this unit is collected in a DX refrigeration system and used to reheat the pool. There is also a rain harvest collection system, which supplies water to urinals and toilets.

Table of Contents

Executive Summary

The Susquehanna Center, located in Bel Air, Maryland is an expansion and renovation to the practice facility for the men's basketball team for Harford Community College. The Center will serve as the main hub for the sports community on campus. The expansion includes the addition of a 5,000 seat arena and a college sports program weight training room. Also, the Center upgraded its practice facilities and domestic swimming complex located in the basement. The building is LEED certified which, will create and interesting blend of energy efficiency in the exciting and festive sports world.

This report looks into the past two semester's research in its aid to redesign four spaces with the Susquehanna Center. The four spaces to be redesigned are the building façade, the main lobby, the Auxiliary Gymnasium, and the Fitness and Weight room. The main focus of the report is the redesign of the lighting and electrical systems within the four spaces. The lighting design concept was to accentuate the message that this Center is the hub of the sports community and to invoke the exciting nature that surrounds the thrill of watching college athletics.

The electrical depth of this reports looks into the branch circuitry and control systems used for the new lighting design. It also contains a comprehensive study on the protection of all electrical devices and the coordination between those devices. The protection entails a short circuit calculation by hand, a SKM power tools model to confirm short circuit calculations and an arc flash study to determine the hazards of working on certain pieces of equipment.

The mechanical and structural breadths take another step forward in the lighting redesign of the Auxiliary Gymnasium. The redesign of the Auxiliary Gymnasium introduces day-lighting into the space by the use skylights. The structural breadth analyzes how the truss system will be impacted and the mechanical breadth analyzes how the chiller's cooling load will be impacted.

Building Statistics

Building Name: Susquehanna Center Renovations and Expansion

Location and Site: Bel, Air, Maryland

Building Occupant Name: Harford Community College

Building Function Types: The building is comprised of a number of spaces that serve the community college's needs to be the center for the sports complex. Within the facility is a weight room, Auxiliary Gymnasium, indoor pool and 5,000 seat main basketball arena.

Size: 100,000 SF

Stories: 3 Stories with one story below grade

Construction Dates: April 2011 – August 2012

Project Delivery Method: $28 million

Project Team Directory:

Architect	Hord Coplan Macht	http://www.hcm2.com/
Construction Manager	Turner Construction	http://www.turnerconstruction.com/
General Contractor	Not Selected	
Landscape Architect	Site Resources	http://www.siteresourcesinc.com/
Civil Engineer	Site Resources	http://www.siteresourcesinc.com/
Structural Engineer	CMJ Structural Engineers	http://www.cmjeng.com/
MEP Engineer	Burdette Koehler Murphy & Associates	http://www.bkma.com/
Lighting Consultant	Dunlop Lighting Design	http://www.dunloplighting.com/
Telecommunications	Spexsys	http://www.spexsys.com/
Natatorium	Counsilman Hunsaker	http://chah2o.com/

Table 1. Project Team Directory

Codes:

- International Building Code IBC 2006
- International Mechanical Code IMC 2006
- International Electric Code IEC 2006
- International Plumbing Code IPC 2006
- National Life Safety/ Fire Code NFPA 101 2006

Zoning: Agricultural (AG)

Building Enclosure: The exterior of the Susquehanna Center is comprised of matte painted concrete block, sizes ranging from 4x8 to 16x24, as well as aluminum paneling to support glazing at entrances of the athletic facility. Painted aluminum down spouts are used in an appealing V-shape on the main arena side of the building. The roofing system is compiled of different membranes, with varying sizes of insulation and sheathing, which combine to make up 5 different types of roofing systems. Type one is consisted of a single ply membrane with two layers of insulation and ½" roof sheathing supported by metal deck. This type is used over main gym. The second type is 4 ply B.U. roof with an aggregate surface. Underlying this surface is tapered insulation supported by a concrete slab. The third type consists of a single ply membrane with tapered insulation supported by metal deck, and the fourth type also supported by metal is made up of a single ply membrane and ½" sheathing. The fifth type is where the roofing system joins the existing building. The components of the system are similar to the system of type two, except that the tapered insulation is used to match the thickness of the existing roof.

Sustainability Features: The Susquehanna Center is currently seeking out LEED accreditation, and thus there are numerous sustainable design features throughout most systems within the building. The bulk of the sustainable features were designed to be incorporated in the mechanical and electrical systems. The mechanical system utilizes air cooled high efficiency chillers, solar heating systems for the pool, multiple energy recovery air handling systems above the arena, and a rain harvesting system for toilets and urinals. The electrical systems take advantage of occupancy and vacancy sensors in classrooms, bathrooms and some offices. Also, electronic shading devices mounted on the west facing wall of the main entry enable proper day lighting techniques.

Construction: Construction on the Susquehanna Center has not yet begun, but the predicted construction periods are from April 2011 till August 2012. As of now the building is in the bidding phase and the general contractor has not been selected. However, Turner Construction has been hired by the owner to act as a construction manager on the project. The building method chosen for this building is design-bid-build, and the initial budget is

approximated at $28 million. The building is a renovation and expansion to the existing basketball facility that is already located on Harford Community College's campus, in which its front façade faces Thomas Run Road of Bel Air, MD

Electrical: The power distribution system for this building is a simple radial system, with the service entrance point on the North West portion of the building on the main level. The building is fed by a 2000kVA pad mounted transformer supplied by Baltimore Gas and Electric (BGE). The secondary side of the transfer is listed at 480Y/277V, 3PH, 4W. The main switchgear is rated at 3200A and 42000AIC. This switchboard then feeds distribution Panels located throughout the corners of the building, which in turn feeds lighting and receptacle Panels. These Panels and loads are listed at 480Y/277V, 3PH, 4W and 208Y/120V, 3PH, 4W respectively. There are additional transformers used to step loads down to the 208Y/120V voltage system.

Lighting: As the building is designed to meet USGBC's standards for LEED accreditation, the lighting is designed to use energy conscious fluorescent and metal halide pulse start luminaires. This allows the design to use minimum energy consumption and meet ASHRAE 90.1 standards on lighting power density. The lobby, bathrooms, classrooms, and other spaces use linear fluorescent and compact fluorescent down lights with electronic ballasts to limit power factor and light loss. The low bay metal halide luminaires in the Auxiliary Gymnasium and main arena use restrike technology on certain luminaires to allow for instant switching.

Mechanical: The mechanical system for this building utilizes variable air volume air handling units (AHU), which all have total energy recovery wheels that greatly reduce the cooling and heating demand for the units. The cooling is generated by an air cooled high efficiency chiller and the pool uses a solar heating system as the primary source of heating. The AHU for the pool has a DX refrigeration system that uses hot refrigerant gas to reheat the air, so that it can be properly de-humidified. Lastly there is a rain water harvest system, which takes water from the Arena roof and stores a 10,000 gallon underground storage tank. This water is then filtered and pumped to be used in toilets and urinals throughout the arena.

Structural: The foundation of the building is comprised of concrete column footers ranging in size from 5'x7'x1'-7" to 11'x11'x2'. The main floor is a two way slab, in which the slab's thickness is 3-1/2" and the grade beams with a thickness of 10". The superstructure of the building is composed of both concrete and steel beams. The concrete beams are 16"x16" and 18"x38", while the steel beams are primarily W10x33 and HSS 6x6x1/2. The main arena utilizes 60" deep 96SLHSP trusses to span 157' laterally.

Fire Protection: The fire alarm control Panel is located at the main level of the lobby. There are numerous signal and detection devices throughout the building. There are horn strobes located throughout the corridors and large public spaces. Smoke detectors, manual pull stations and signaling devices are also located per standard NFPA 72 requirements.

Telecommunications: There are voice/ data outlets located in offices and classrooms to allow for telephone and internet connections. There is also an intercom system that serves the main arena of the gym to allow for commentary during games.

Large Work Space – Auxiliary Gymnasium

Space Description

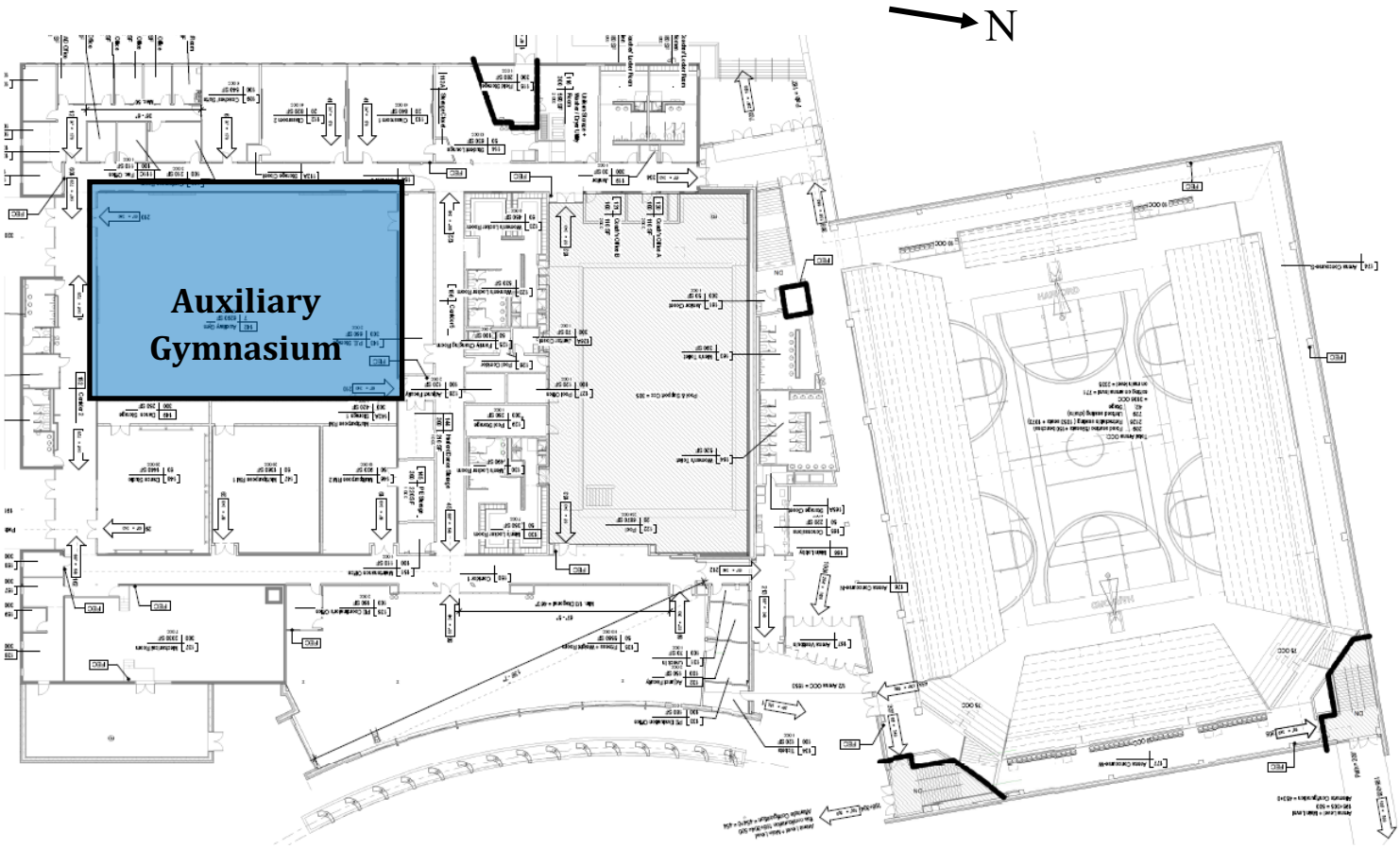
This space is rather unique as it serves multiple purposes for multiple users. It serves as a secondary court to practice for the Harford Community College's basketball team, a court for recreational basketball organizations, an indoor batting cage, and any other uses that seem feasible. There are six retractable basketball goals with backboards that allow for 3 different configurations of basketball courts. Only one of those courts is actually full size, while the other two are condensed versions. There is padding with graphics and varying colors that are located on the walls and also help create a dynamic space.

Materials

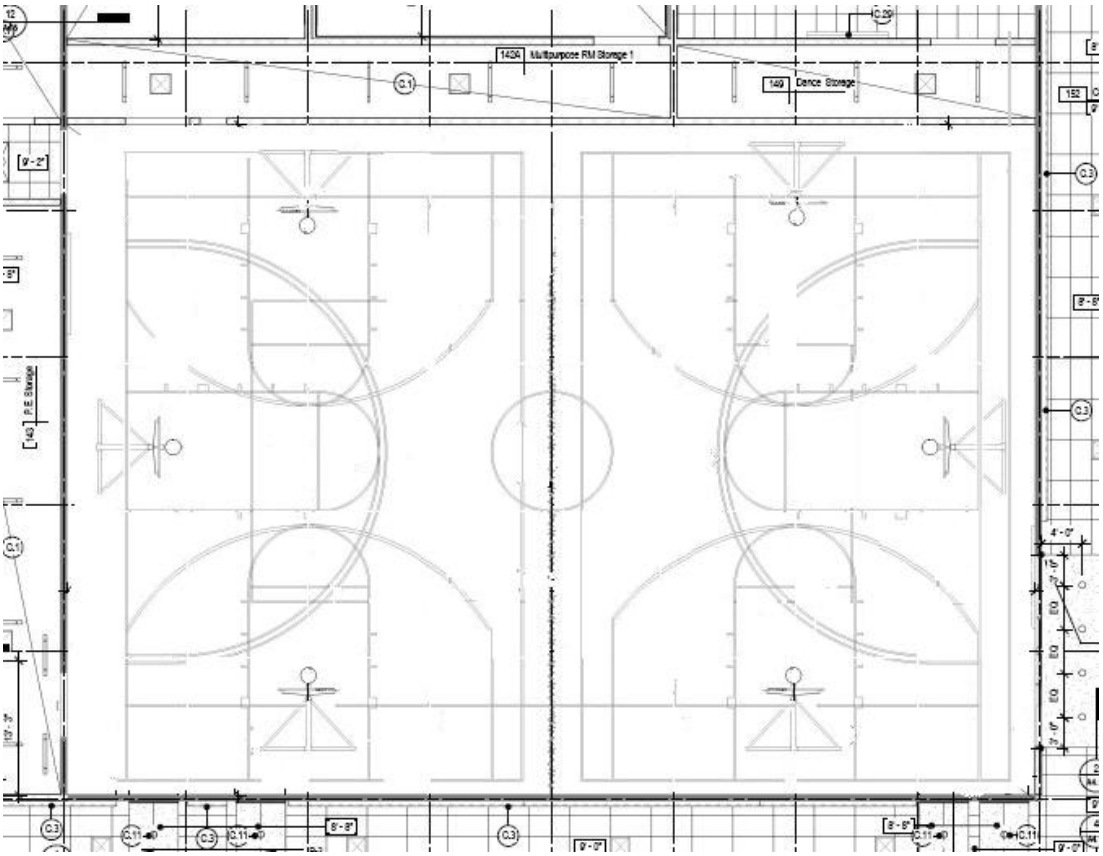
Material	Description	Properties
Floor	athletic wood flooring	ρ = 0.20
Walls	gypsum board painted matte white	ρ = 0.9
	gypsum board painted matte blue	ρ = 0.14
	cmu painted matte white	ρ = 0.9
	cmu painted matte blue	ρ = 0.14
	padding painted matte a light blue	ρ = 0.14
Ceiling	exposed ceiling structure painted matte white	ρ = 0.9

Table 2. Auxiliary Gymnasium Materials

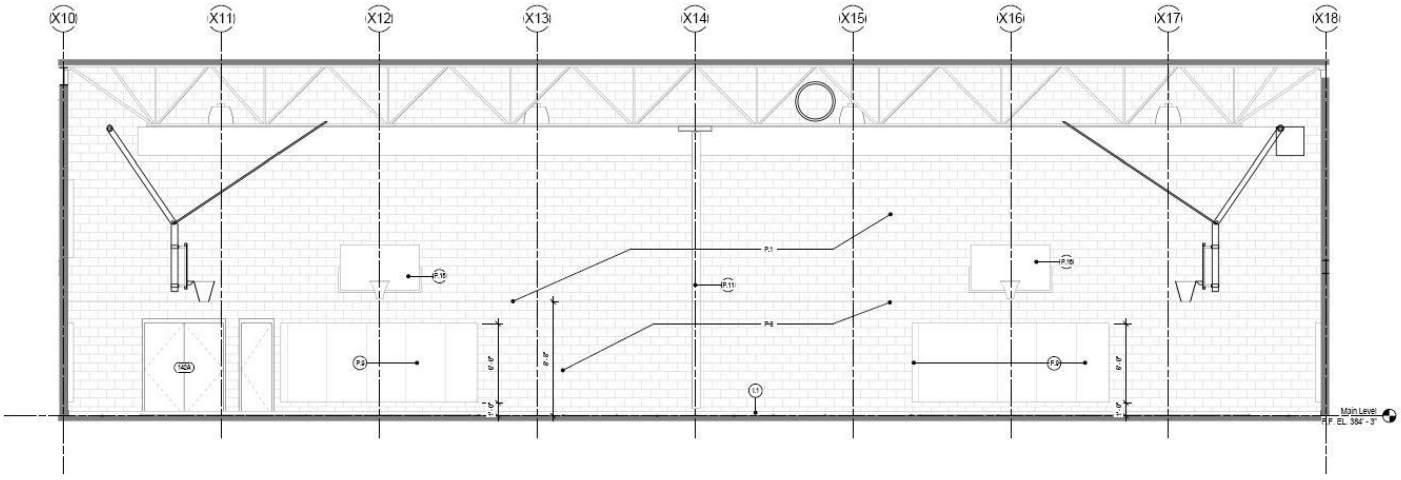
Drawings



Drawing 1. Building Floor Plan labeling Auxiliary Gymnasium



Drawing 2. Auxiliary Gymnasium Floor Plan



Drawing 3. Auxiliary Gymnasium Section

Design Concept

Since the gymnasium will not include spectators, the lighting must focus primarily on the individuals using the court and the court area itself. The light levels on the court must be uniform in order to eliminate the effect of shadowing and inappropriate modeling of 3-dimensional surfaces. When lighting the floor to a uniform level, one must be conscious of the consequences of direct glare from the luminaires. Since the primary use of the court is to be used for basketball which is an aerial sport, the individuals head will be looking up at the basket, thus the luminaires must be able to avoid discomfort from direct and reflected glare.

The gymnasium was a prime candidate to introduce day-lighting into the space to help consume the watts of energy of the high power fluorescent luminaires. A thorough and comprehensive day-lighting design will allow savings on the electrical consumption. Another aspect of the redesign was to eliminate the high intensity discharge lighting that was originally chosen for the space because these luminaires consume twice the amount of energy that a high bay fluorescent luminaire will put forth for the same light output.

Design Considerations and Criteria

IESNA 2000 Design Considerations (Sports and Recreation Class II)

Very Important Design Considerations

- Direct Glare
    - Avoiding glare is a necessity when designing a lighting scheme for a basketball court, since you do not want to blind the players on the court, so that they cannot perform the tasks at hand.
- Light Distribution on Task Plane (Uniformity)
    - Uniformity allows players to be able to see without being distracted or confused by brighter spots on the floor.
- Reflected Glare
    - Players should be able to see and perform the visible tasks necessary for playing this aerial sport. The lighting design should avoid distraction and glare issues.
- Shadows
    - Shadowing must be avoided as it may cause darkness on certain spots on the floor, which will not allow players to complete tasks as it may cause confusion.

Important Design Considerations

- Color Appearance (and Color Contrast)
  - Players must be able to distinguish between teams and team colors as well as the definition and color of the ball.
- Day-lighting Integration and Control
  - This aspect provides a psychological one. An aspect not directed at players specifically, but to all individuals within the space.
- Flicker and Strobe
  - Any type of distraction created by the lighting design must be avoided in order to allow players to complete the tasks associated with playing basketball.
- Luminaire Noise
  - Players and coaches must be able to communicate with each other on the court and thus the background noise must be kept to a minimum.
- Modeling of Faces and Objects
  - Being able to identify the basketball and players faces allows for aerial tasks to be completed and for communication to be simpler.

IESNA 2000 Design Criteria (Sports and Recreation Class II)

- Horizontal Illuminance
  - E = 800 lx or 80 fc
- Uniformity
  - CV Ratio = < 0.21
  - Max : Min = < 2.5: 1

ASHRAE Standards 90.1

- Lighting Power Density
  - Gymnasium/ Exercise Center (Exercise Area)
  - LPD = 2.3 W/ft^2

Luminaires

Type		Manufacturer	Product Name	Catalog Number	Description	Lamp	Voltage	Ballast	Watts	Location
G1		Lithonia Lighting	I-Beam	IB 454L WDS MVOLT	2x4 Fluorescent high bay luminaire utilizing cool running technology. The housing is made of heavy gauge steel with high gloss baked white enamel.	FP54 841 HO ECO	MVOLT	Mark 10 Powerline	54	Auxiliary Gymnasium

Table 3. Auxiliary Gymnasium Luminaire Schedule

NOTE: See Appendix A for complete luminaire schedule and Appendix B for specification sheets

Light Loss Factors

Luminaire Type	Lamp Lumen Depreciation	Lamp Dirt Depreciation	Room Surface Dirt Depreciation	Ballast Factor	Total Light Loss Factor
G1	0.93	0.95	0.98	1.00	0.87

Table 4. Auxiliary Gymnasium Light Loss Factors

Controls

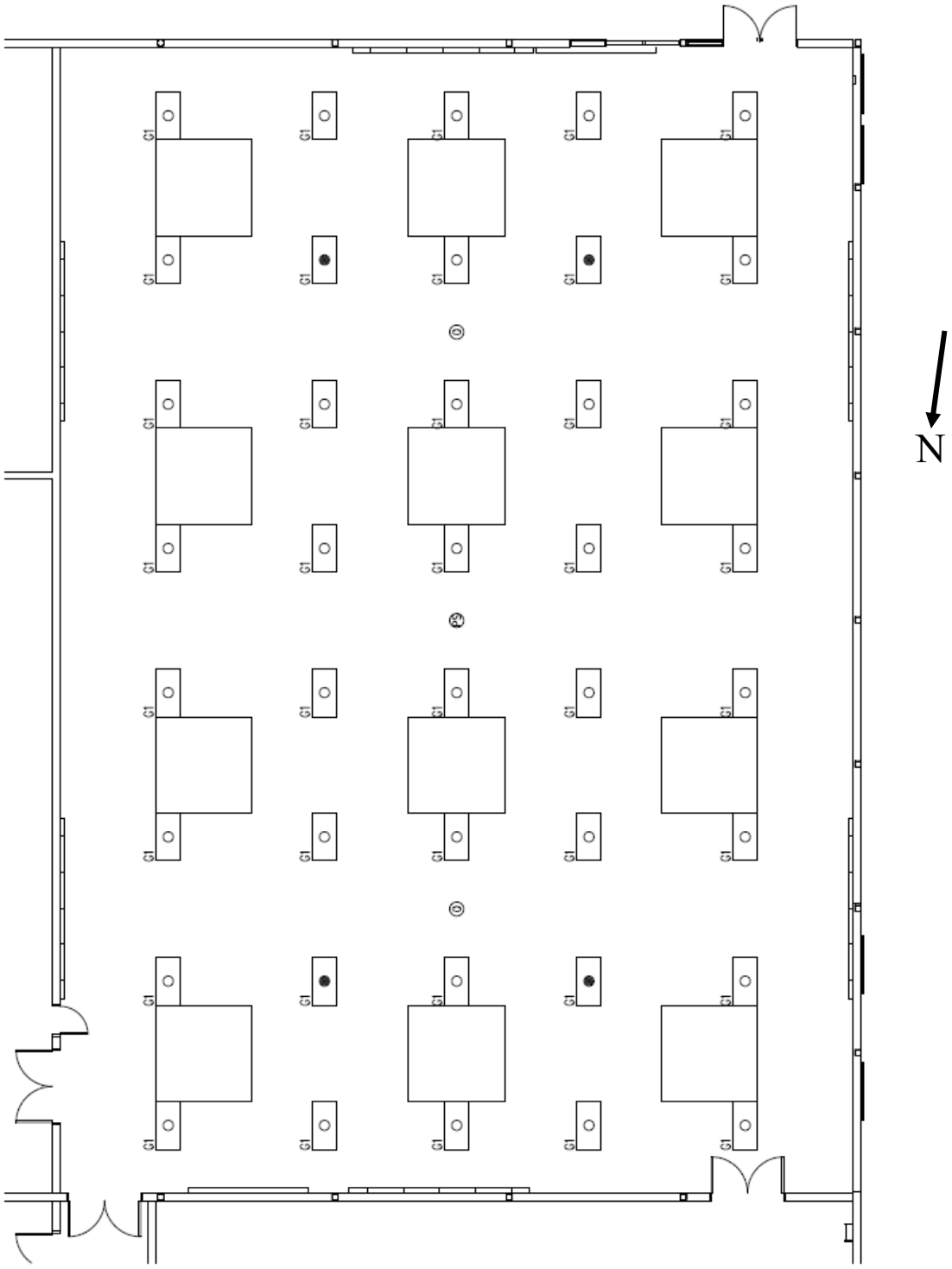
The controls within the Auxiliary Gymnasium have one main goal, which is to monitor the amount of energy that is being consumed proportionally to how much light is on the court. There is a photocell, which will be connected to a Lutron Grafik Eye to monitor the daylight levels and will dim the fluorescent high bay luminaires via a relay.

The emergency luminaires will be controlled by an emergency lighting interface that will turn on the luminaires when normal power has been lost. A control schedule and wiring diagram has been provided to illustrate the nature of the system. See Appendix A for complete control schedule.

Type		Manufacturer	Product Name	Catalog Number	Description	Location
DP		Lutron	Dimming Panel	GP8-2774T8-ML-20-CGP344	480Y/277V 3PH., 4W Dimming Panel with 8 circuits	
GE		Lutron	Grafik Eye QS	QSGRJ-xP	Interface unit that will serve as the main control unit for the entire system	Gymnasium
DC		Lutron	Automatic Day-Lighting Control	OMX-DACPI	Interface that will interpret and control photocell and dimming proportions	Gymnasium
O		Lutron	Passive Infrared Ceiling Sensor	LOS-CIR 1500-WH	Passive infrared occupancy sensor with 1500 SF coverage.	Gymnasium
PC		Lutron	Ceiling Mounted Photocell	MW-PS-WH	Ceiling mounted photocell that will measure day-light levels.	Gymnasium
EM		Lutron	Emergency Lighting Interface	LUT-ELI-3PH	Relay device that will automatically switch the emergency lights on when normal power has been lost.	Gymnasium

Table 5. Auxiliary Gymnasium Control Schedule

Lighting Plan



Drawing 4. Auxiliary Gymnasium Lighting Floor Plan

Performance Data

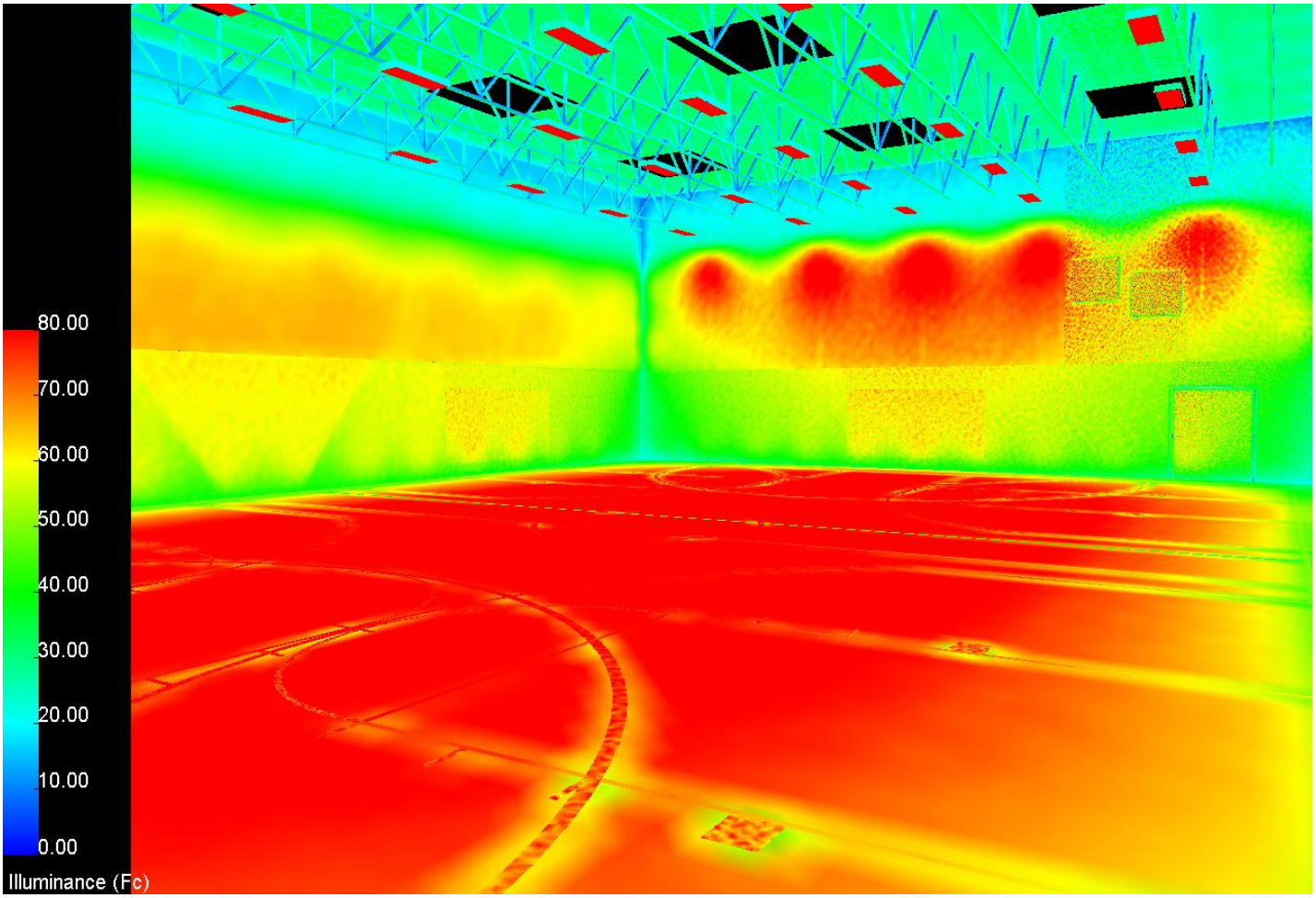


Image 1. Auxiliary Gymnasium Electric Light Only Pseudo Diagram

Daylight Contribution

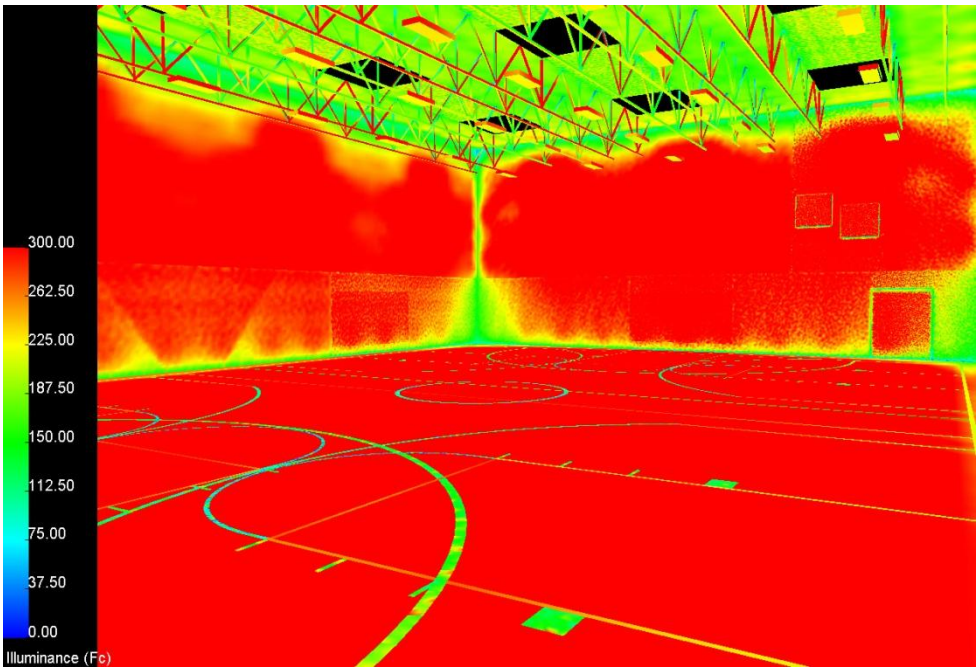


Image 2. Auxiliary Gymnasium Daylight - Summer Solstice Clear Sky Pseudo Diagram

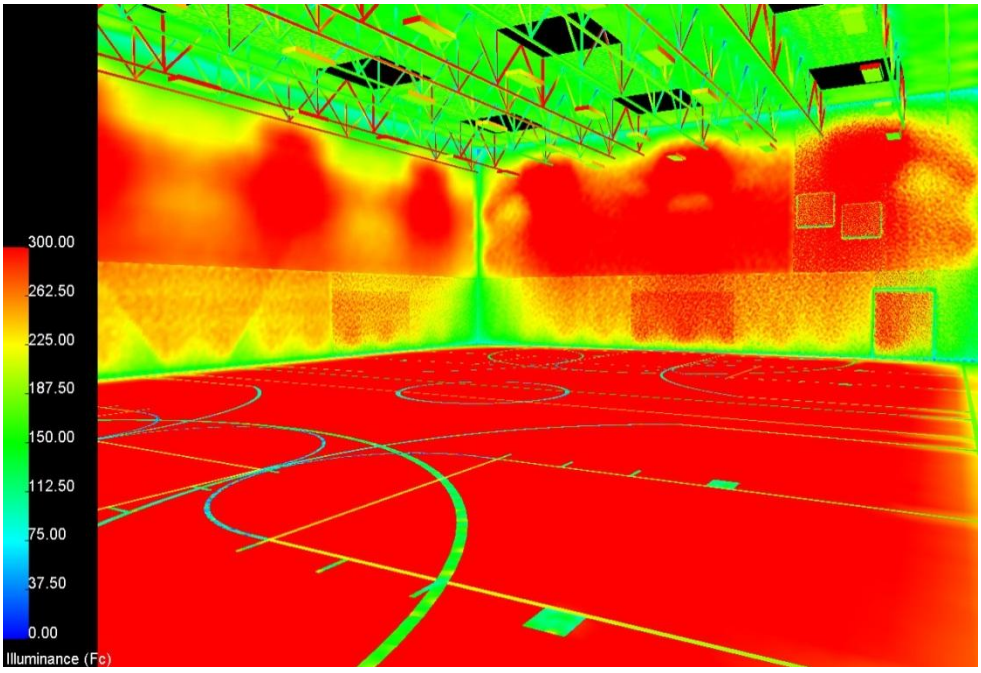


Image 3. Auxiliary Gymnasium Daylight - Summer Solstice Partly Cloudy Sky Pseudo Diagram

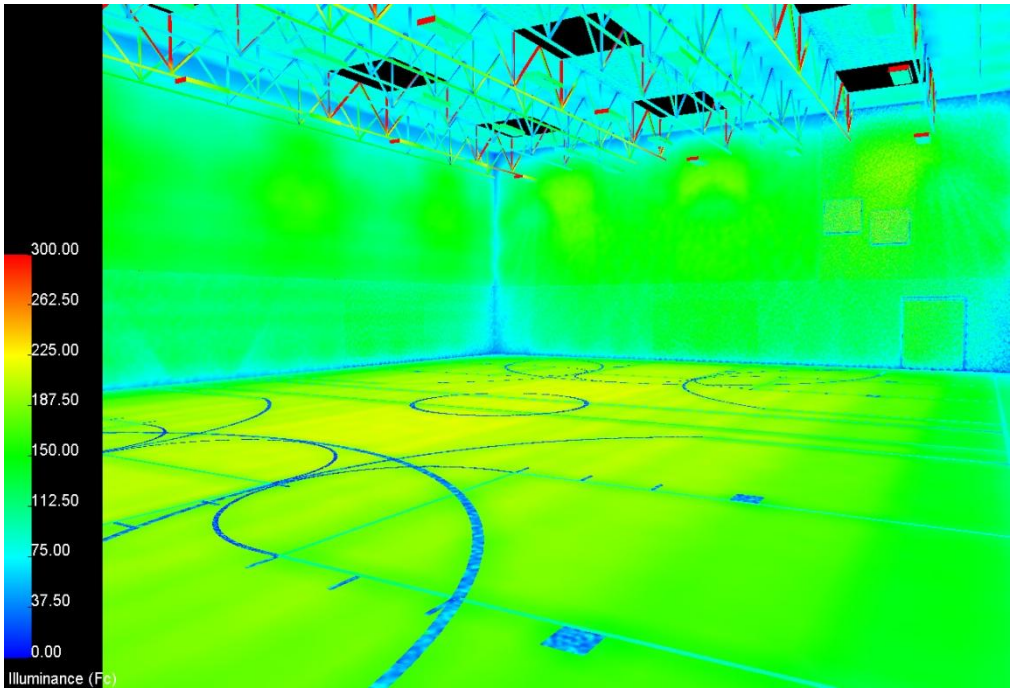


Image 4. Auxiliary Gymnasium Daylight - Winter Solstice Clear Sky Pseudo Diagram

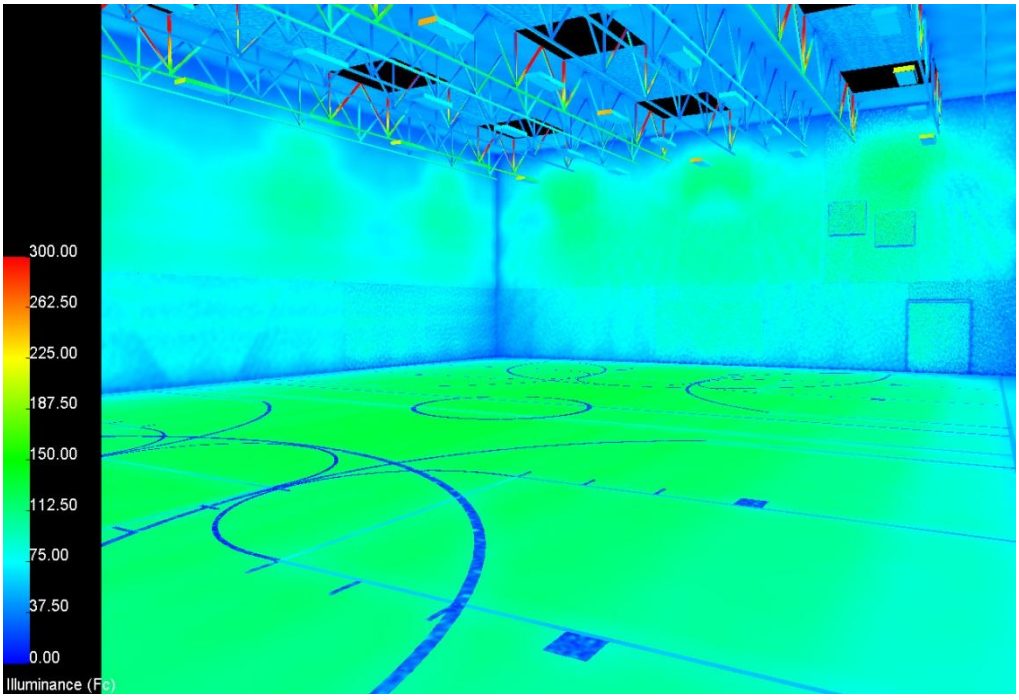


Image 5. Auxiliary Gymnasium Daylight - Winter Solstice Partly Cloudy Sky Pseudo Diagram

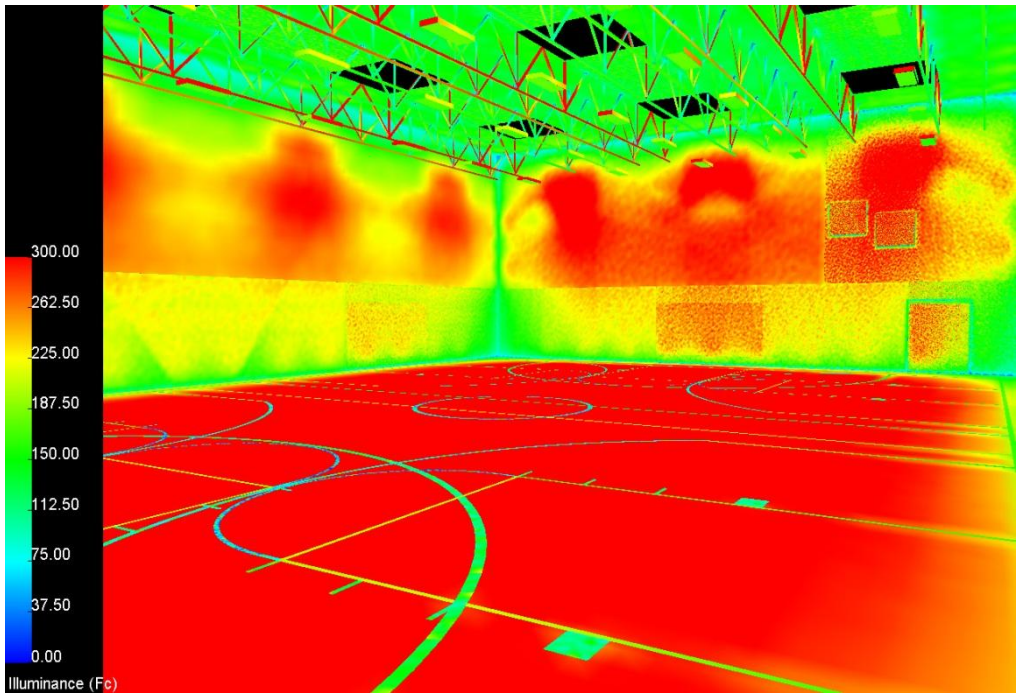


Image 6. Auxiliary Gymnasium Daylight - Equinox Clear Sky Pseudo Diagram

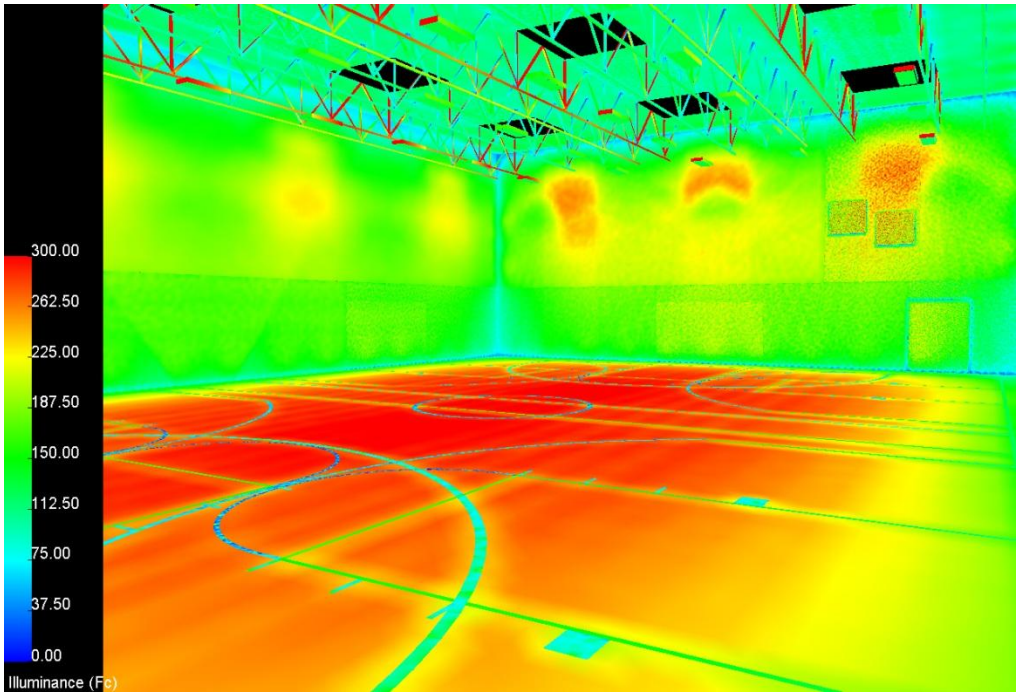


Image 7. Auxiliary Gymnasium Daylight - Equinox Partly Cloudy Sky Pseudo Diagram

Performance Summary

The space redesign was driven by the addition of skylights in order to lower and eliminate the consumption of unnecessary power. The high bay fluorescent luminaires were able to deliver the recommended IESNA illumination level at the work plane at 81fc. The integration between the skylights and dimming capabilities of the fluorescent allow for the space to accommodate the ever-changing day-light levels throughout the day and year. Even with the skylights the lighting design is still able to maintain a uniform lighting mode, which will help with the individuals using the court to see and also identify shapes and 3-dimensionsal surfaces. With the control interfaces provided by Lutron the space will be able to save unnecessary wattage during prime day-light hours of the day.

The daylight scenarios are based off the summer solstice, winter solstice, and fall and spring equinox for the year 2011. The time of day stayed constant at 1:15 PM for all scenarios. The daylight scenarios concluded that the summer time will be the highest contributing factor of direct and reflected glare throughout the entire year. The Illuminance levels for this time of year are a bit alarming in that typically foot candle levels higher than 300 can cause severe issues for direct and reflected glare. This means that a shade device should be used to help eliminate some of the unnecessary daylight. Since the lighting design contains a photocell to control the light output, the luminaires will be able to dim down to five percent total light output, which would be the ideal case for all the scenarios depicted above.

Criterion	IESNA Recommended	Designed
Average Illuminance	80 fc	81fc
Max : Min Illuminance Ratio	2.5 : 1	2.2 : 1
Coefficient of Variance	0.21	0.16
LPD (6270 SF)	2.3 W/SF (14421 W)	1.6 W/SF (9640 W)

Table 6. Auxiliary Gymnasium Electric Light Only Results

Daylight Scenario	Avg Illuminance (80 fc)	Max : Min Ratio (2.5 : 1)	Coefficient of Variance (0.21)
Summer Clear Sky	443 fc	2.2	0.14
Summer Partly Cloudy Sky	377 fc	2.2	0.14
Winter Clear Sky	184	2.2	0.14
Winter Partly Cloudy	141	2.2	0.14
Equinox Clear Sky	341	2.2	0.14
Equinox Partly Cloudy Sky	263	2.2	0.14

Table 7. Auxiliary Gymnasium Day-lighting Results

Renderings

Image 8. Auxiliary Gymnasium Electric Light Only Rendering

Special Purpose Space – Fitness and Weight Room

Space Description

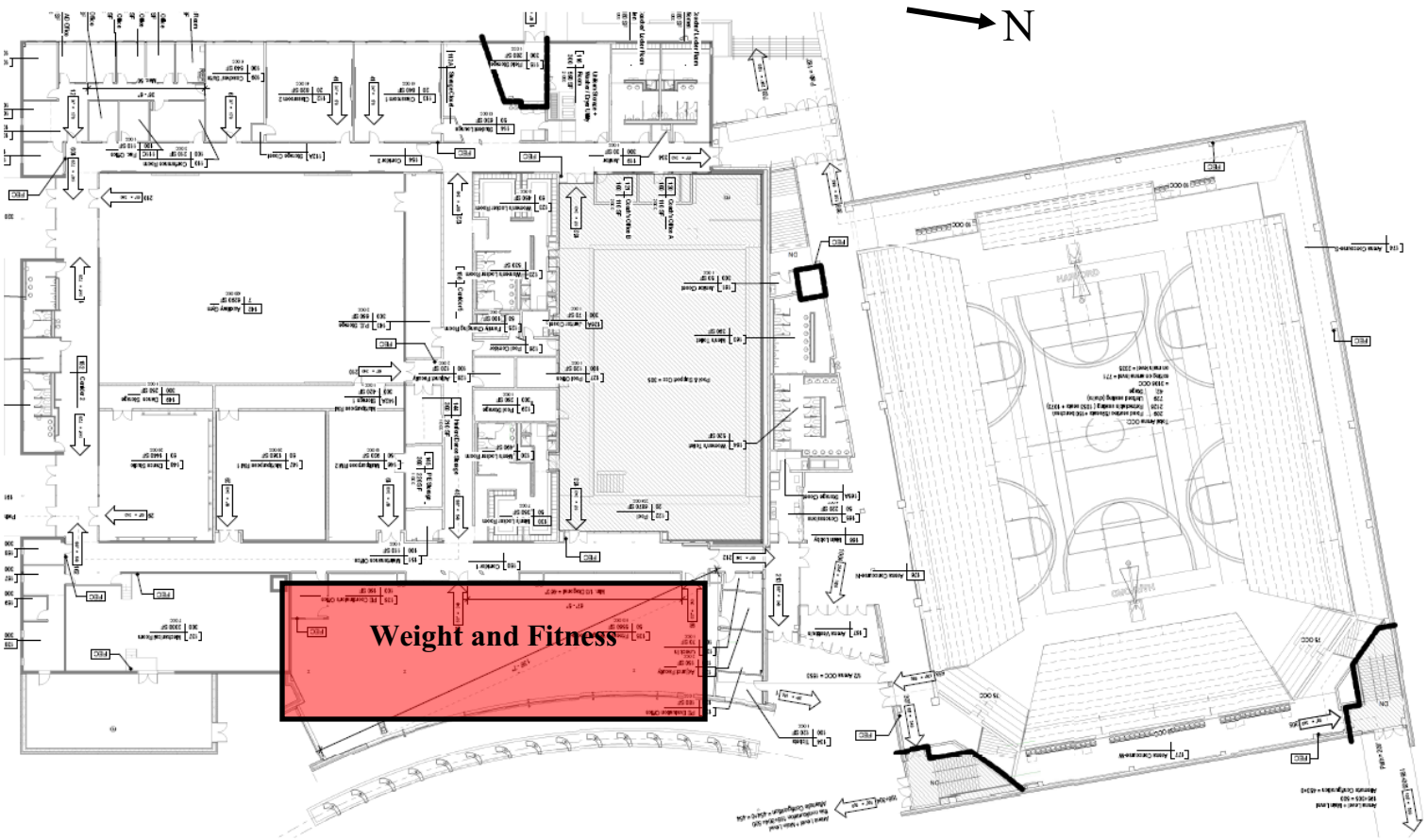
The Fitness and Weight room is a unique space due its geometry, varying ceiling heights, and materials. The ceiling varies in height throughout the space and as the height changes so does the material of the ceiling. Another interesting feature to this room is its unique geometry. The west facing wall is an exterior wall facing the parking lot and is made entirely of glass. This wall that provides outside views is also in an elegant curve. This space will primarily serves as the workout area for the athletes of Harford Community College and is filled with varying types workout equipment. This equipment ranges from treadmills, stationary bikes, weight machines, and benches for free weights.

Materials

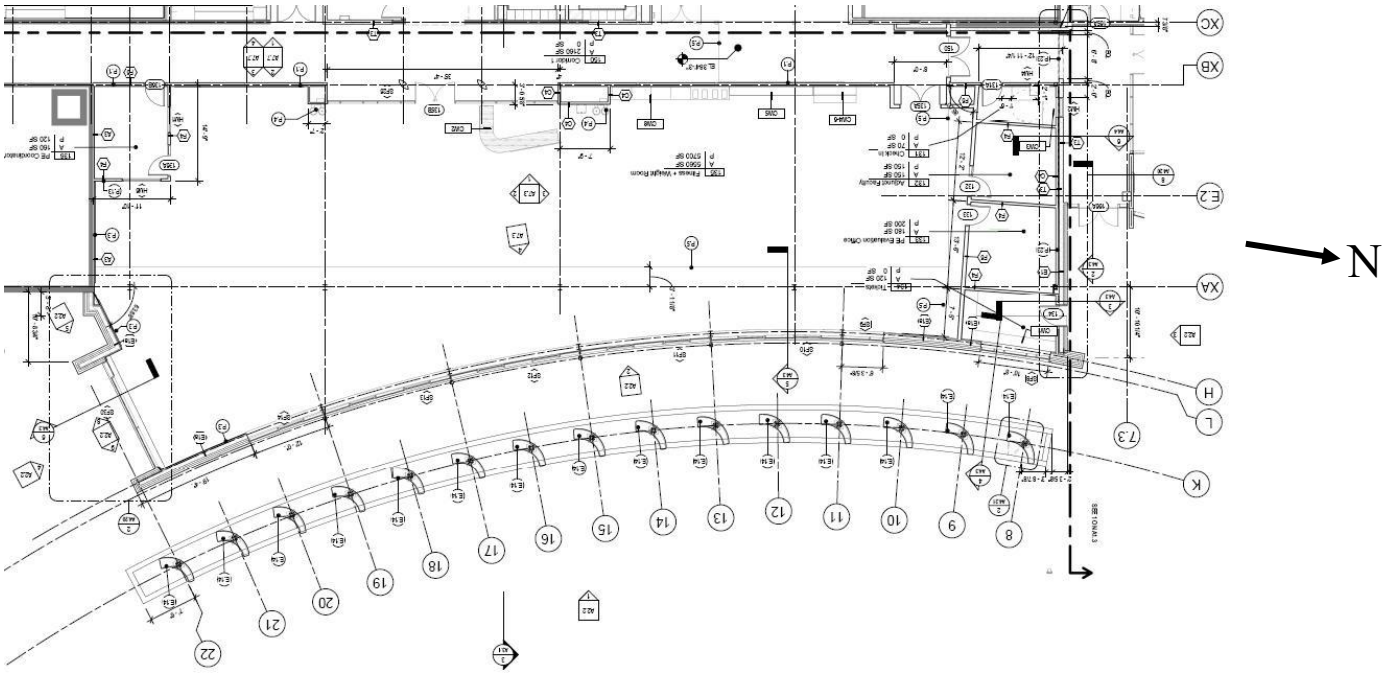
Material	Description	Properties
Floor	grey, teal, light green tiled carpet	ρ = 0.12
	grey athletic rubber flooring	ρ = 0.07
Walls	gypsum board with white finish paint	ρ = 0.9
	gypsum board with blue finish paint	ρ = 0.14
	gypsum board with dark blue finish paint	ρ = 0.10
	mirror	ρ = 0.93
	clear glazing store front system	ρ = 0.05
Ceiling	gypsum board with white finish	ρ = 0.9
	exposed structure, painted white	ρ = 0.9
	acoustical ceiling tile with white finish	ρ = 0.75

Table 8. Fitness and Weight Room Materials

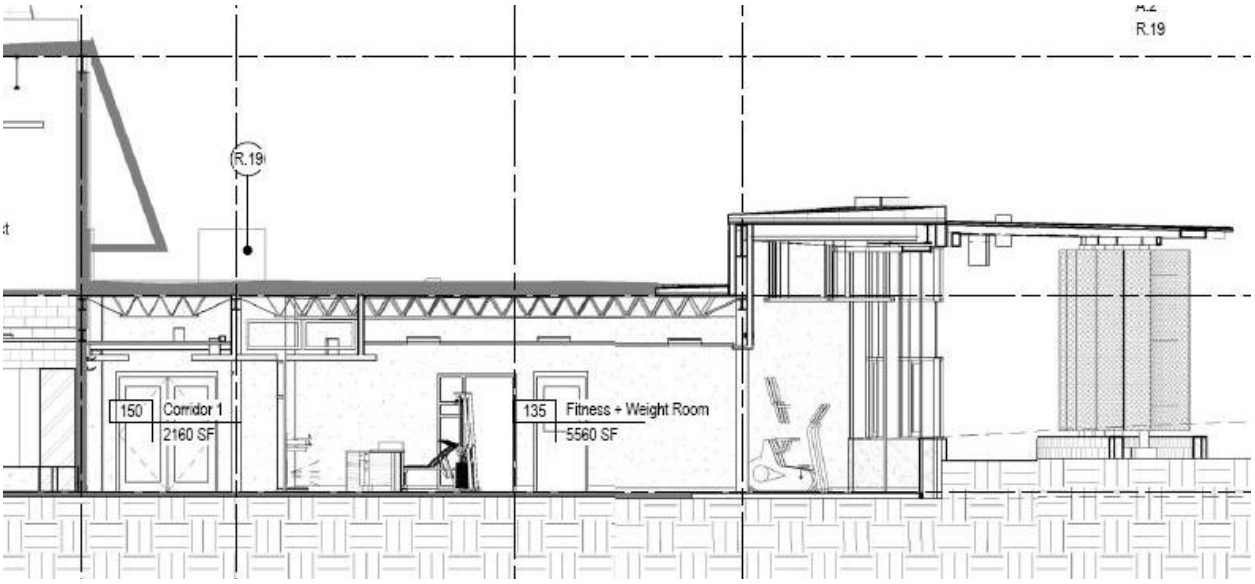
Drawings



Drawing 5. Building Floor Plan labeling Fitness and Weight Room



Drawing 6. Fitness and Weight Room Floor Plan



Drawing 7. Fitness and Weight Room Section

Design Concept

The Fitness and Weight room had a complicated yet interesting ceiling arrangement. Within this space the ceiling took on three different types of heights and three corresponding materials. With each new height a new material was presented within the space. The original lighting design neglected this fascinating arrangement and used bland down-lighting techniques to illuminate the space. The redesign will take a different approach and highlight the predominant ceiling material and height, which was gypsum board at 9'-0" above finished floor. The redesign will place emphasis on this ceiling by using a perimeter cove luminaire around the ceiling, which will use up-light to illuminate the ceiling to provide an ambient atmosphere within the weight room.

Design Considerations and Criteria

IESNA 2000 Design Considerations (Health Care Facilities – Physical Therapy Gymnasiums)

Reason:

The rehabilitation exercises that take place within a physical therapy session can be similar to those exercises condoned in a Fitness and Weight room. Both types of spaces require the ability to read, walk, lift, and stretch. These are all visual tasks that a lighting design will be required to abide by in a Fitness and Weight room or physical therapy gym.

Very Important Design Considerations

- Appearance of Space and Luminaires
    - The equipment in a Fitness and Weight room is generally organized in an orderly manner which makes it manageable for an individual to conduct proper exercise etiquette. It is also the responsibility of the lighting design to continue that relationship between furnishings and space.
- Color Appearance (and Contrast)
    - It is important that the lighting design accurately portrays the color aspects of the weights to avoid accidents and special issues.
- Daylight Integration and Control
    - Incorporating views of the exterior and outdoors is believed to be important for psychological reasons by providing cues about the time of day and weather.
- Flickering and Strobe

- Flickering and strobe affects can be annoying and distracting. When handling weights it is important that an individual not get annoyed and distracted, in case of injury and accidents.

- Luminances of Room Surfaces
  - It is crucial all pieces of equipment maintain certain brightness, so that an individual working on that piece of equipment can operate it properly.

Important Design Considerations

- Direct Glare
  - Glare causes discomfort and can affect visibility. In an environment that constantly demands an individual to be aware of its surroundings, it is important that glare be avoided.
- Light Distribution on Surfaces
  - Abnormal patterns of light can cause shadows and affect visibility. It is essential for the lighting design to avoid abnormal patterns of light.
- Modeling of Face and Objects
  - The lighting design must reveal depth, shape and texture of objects in a weight room because it must assist an individual in interpreting what he/she is seeing and lifting.

IESNA 2000 Design Criteria (Health Care Facilities – Physical Therapy Gymnasiums)

- Horizontal Illuminance
  - E = 300 lx or 30 fc

ASHRAE Standards 90.1

- Lighting Power Density
  - Gymnasium/ Exercise Center (Exercise Area)
  - LPD = 0.9 W/ft^2

Luminaires

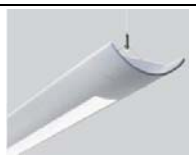
Type		Manufacturer	Product Name	Catalog Number	Description	Lamp	Voltage	Ballast	Watts	Location
W1		Gotham Lighting	AFLP	AFLP 1/32TRT 8AR LD MVOLT	8" low profile ceiling recessed down light with a galvanized steel housing and semi specular reflector.	CF32DT E IN 841 ECO	277	ICF 2S26 M1 BSQS	27	Weight
W2		Litecontrol	Acros M5	P-ID-59M 1 4 T5 PBCWM	4' direct/indirect pendant mounted luminaire with parabolic baffle with matte white finish.	FP54 841 HO ECO	277	ICN 4S5490 C2LS @277	53	Weight
W3		Focal Point	Cove light	FCVM 24 1T5 1C 277 E	Low profile luminaire with steel gauge housing and reflector fabricated of low iridescent aluminum.	FP28 841 PM ECO	277	ICN 2S54 N	29	Weight

Table 9. Fitness and Weight Room Luminaire Schedule

NOTE: See Appendix A for complete luminaire schedule and Appendix B for specification sheets

Light Loss Factors

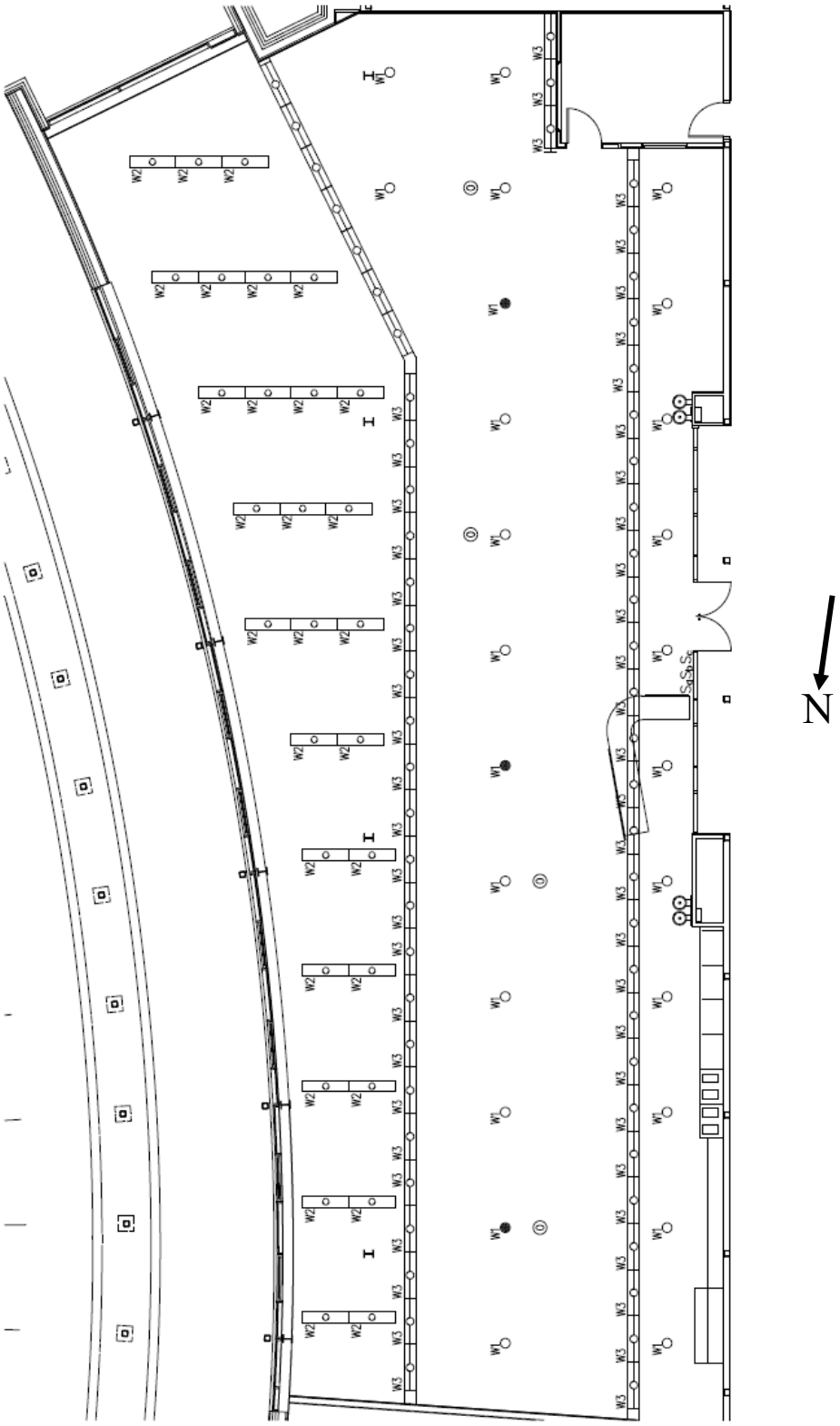
Light Loss Factors					
Luminaire Type	**Lamp Lumen Depreciation**	**Lamp Dirt Depreciation**	**Room Surface Dirt Depreciation**	**Ballast Factor**	**Total Light Loss Factor**
W1	0.83	0.92	0.98	0.98	0.73
W2	0.93	0.95	0.98	1.00	0.87
W3	0.95	0.95	0.98	1.05	0.93

Table 10. Fitness and Weight Room Light Loss Factors

Controls

The controls used in this space had two primary functions. First, the controls needed to be simple enough for any type of user to operate since the space will attract a wide variety of clientele. Secondly, the controls must adhere to ASHRAE 90.1 standards of automatic shut-off requirements for luminaires. Thus, vacancy sensors were used to override wall switches located at the entrance to the space. These sensors will use dual technology, infrared and ultrasonic technology to automatically shut-off the luminaires in a given amount of time without movement or heat detection. See Appendix A for complete control schedule.

Lighting Plan



Drawing 8. Fitness and Weight Room Lighting Floor Plan

Performance Data

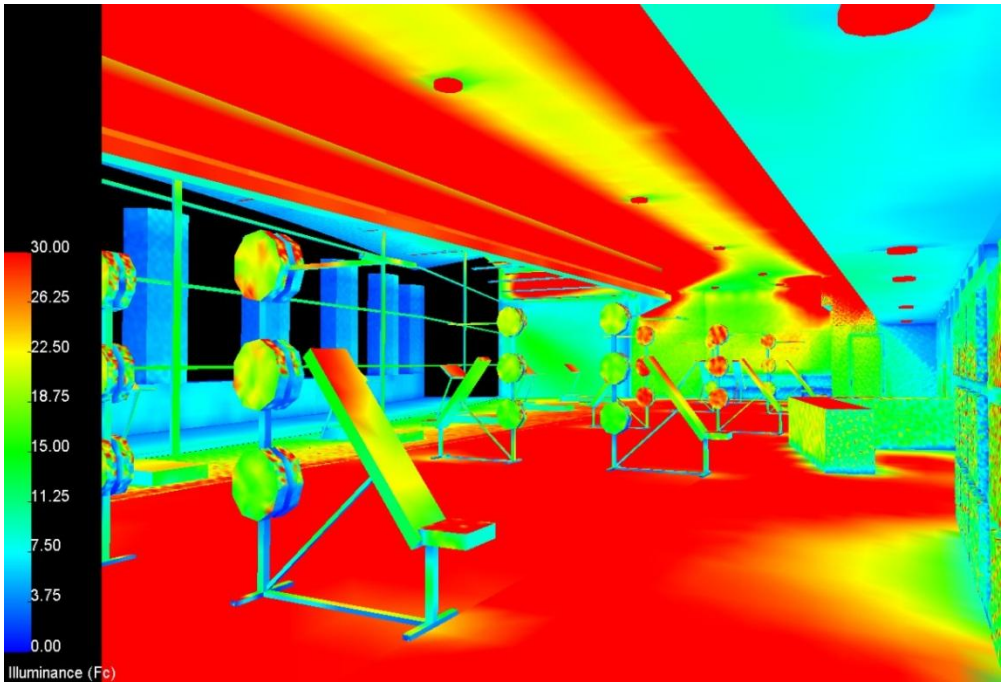


Image 7. Fitness and Weight Room Pseudo Diagram from locker area

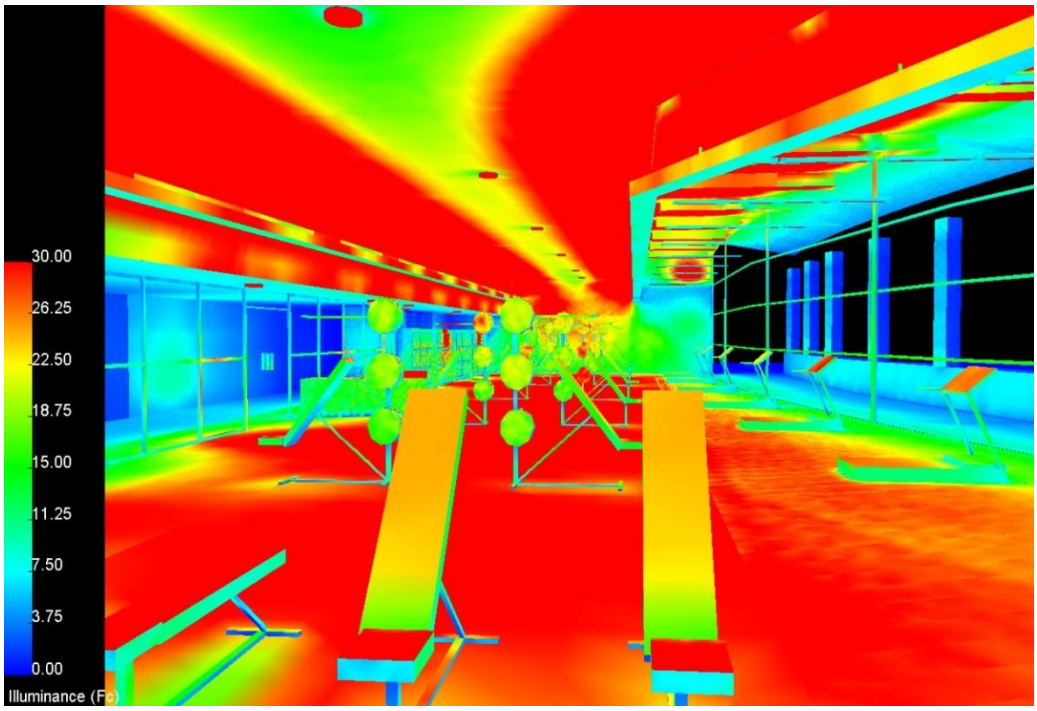


Image 8. Fitness and Weight Room Pseudo Diagram from weight area

Performance Summary

The design for the space was driven by the interesting arrangement of three different ceiling heights. Recessed down-lights were used in the gypsum board ceilings of the lower of the three ceilings. A cove light provided accent illumination on the ceiling of the second highest elevation, which covered most of the space. Down-lights were also used in this ceiling to provide additional illumination on the floor to achieve uniformity. An indirect/direct luminaire was used in the highest ceiling located near the glazed curvilinear wall. These luminaires were predominately using up-lighting with a small baffled slit in the underside of the housing to provide a small percentage of down light. These systems combined illuminated the floor to an average of 30 fc at the work plane height.

Criterion	IESNA Recommended	Designed
Average Illuminance	30 fc	29 fc
Max : Min Illuminance Ratio	-	2.2 : 1
Coefficient of Variance	-	0.16
LPD (5015 SF)	0.9 W/SF (4514 W)	0.83 W/SF (4142 W)

Table 11. Fitness and Weight Room Lighting Design Results

Renderings

Image 9. Fitness and Weight Room Rendering from locker area

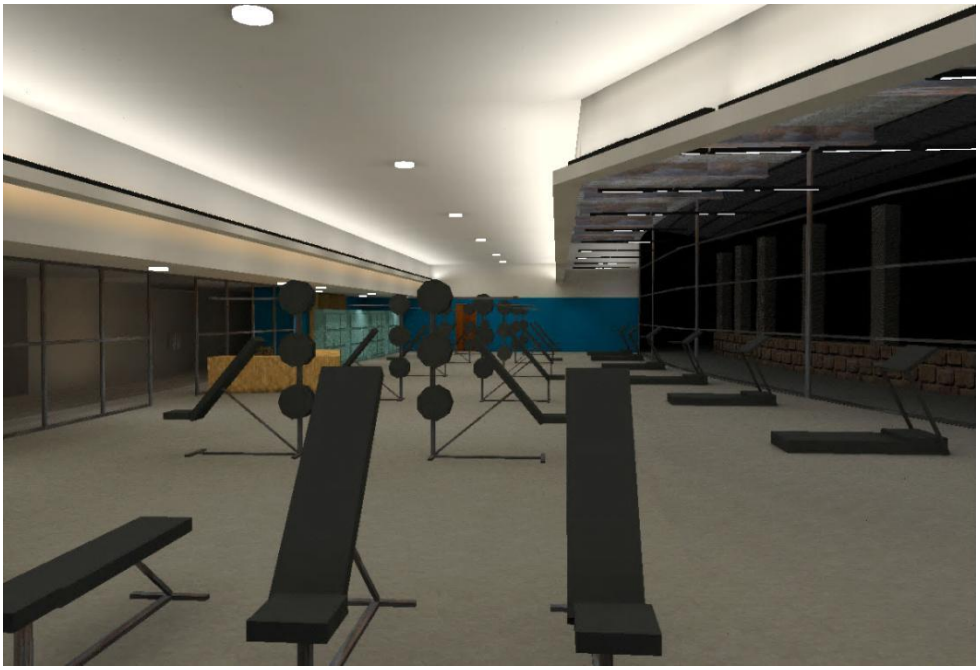


Image 10. Fitness and Weight Room Rendering from weight area

Circulation Space – Main Lobby

Space Description

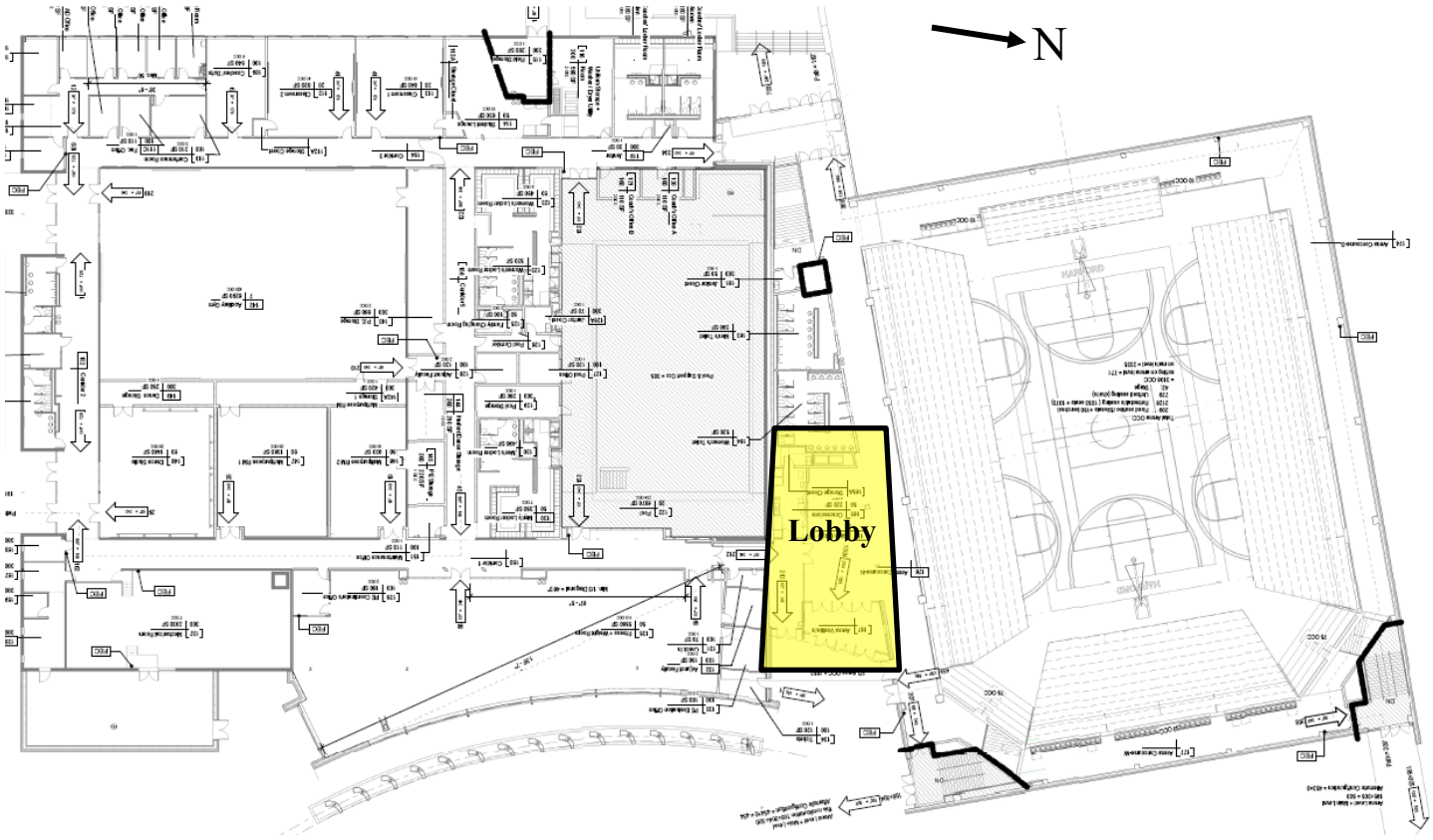
There is a small vestibule before you are greeted by the main lobby area. The main lobby is the primary circulation space for the facility as it grants access to multiple spaces within the building. It will be primarily used as the entrance and exit for the concourse of the main basketball arena. The lobby has an interesting architectural feature located in the ceiling. Although the ceiling finish is sealed concrete deck beams, there is a visual appealing wavy perforated aluminum element suspended from the ceiling. On one side of the lobby there is a display case which holds trophies plaques, and other awards.

Materials

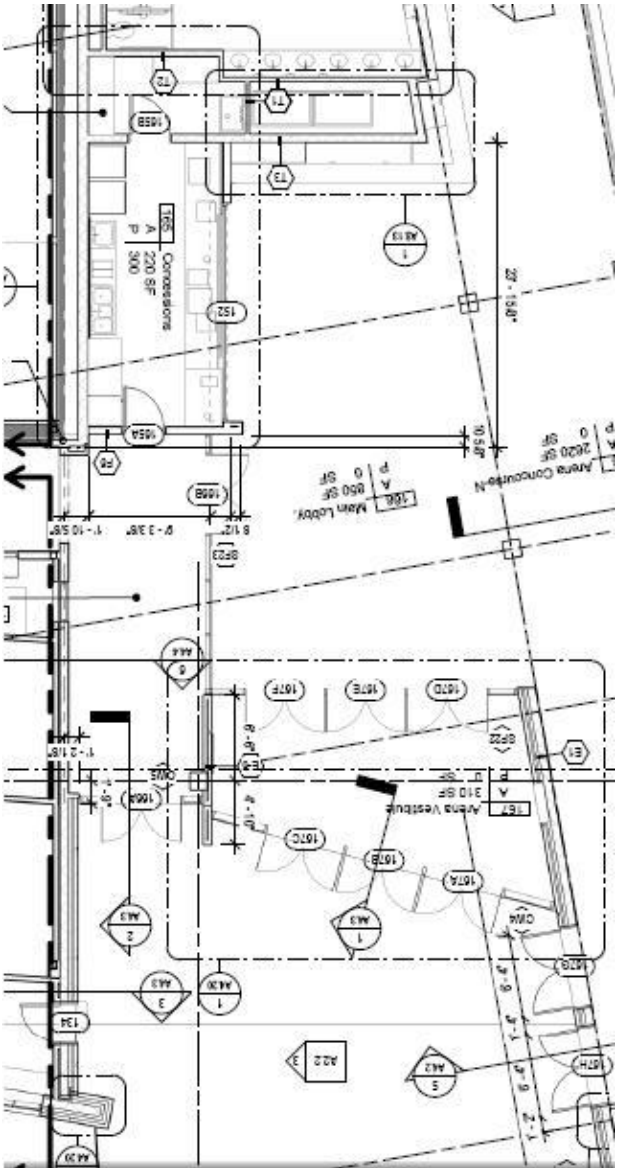
Material	Description	Properties
Vestibule Floor	carpeted Walk off mat, grey	ρ = 0.26
	carpeted Walk off mat, blue	ρ = 0.12
Vestibule Walls	gypsum Board with white finish paint	ρ = 0.9
Vestibule Ceiling	gypsum Board with white finish paint	ρ = 0.9
Storefront Doors	glazing of the storefront, clear glass	ρ = 0.05
	aluminum Paneling of storefront	ρ = 0.33
Main Lobby Floor	terrazzo tile flooring, off white	ρ = 0.7
Main Lobby Walls	gypsum Board with white finish paint	ρ = 0.9
Main Lobby Ceiling	exposed structure, painted white	ρ = 0.9
	wavy perforated aluminum Panels, painted blue	ρ = 0.14

Table 12. Main Lobby Materials

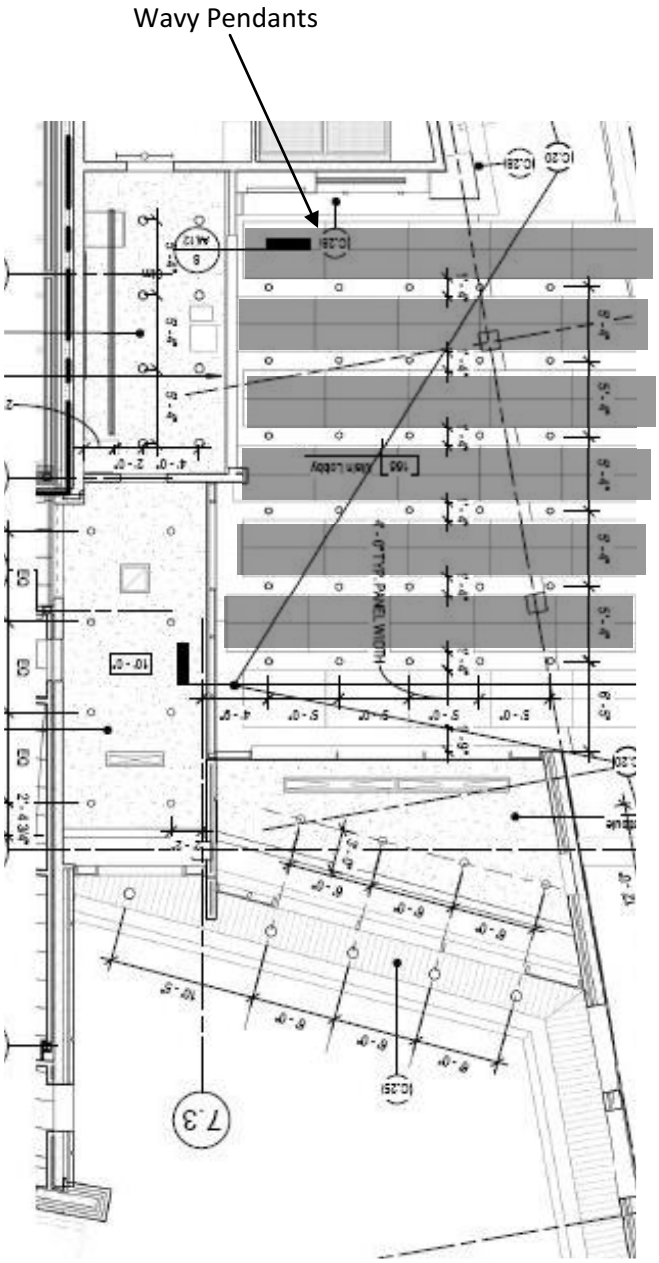
Drawings



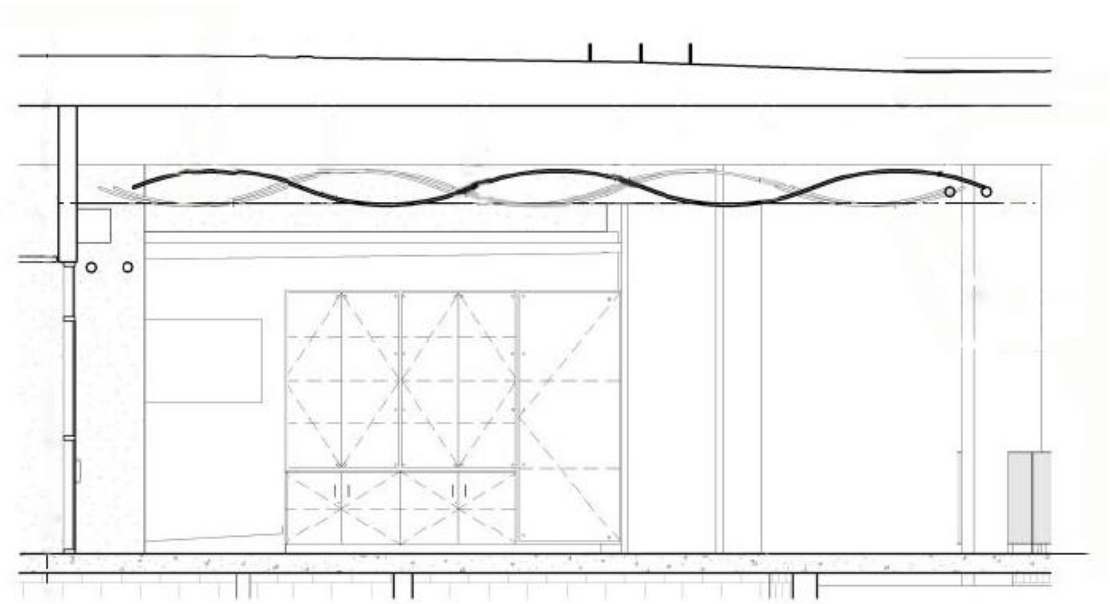
Drawing 9. Building Floor Plan labeling Main Lobby



Drawing 10. Main Lobby Floor Plan



Drawing 11. Main Lobby Floor Pendants



Drawing 11. Main Lobby Floor Section

Design Concept

The main lobby is the space that I have chosen to analyze for the psychological reinforcements created by the lighting design. The impression that the lighting design should invoke in this space is the somber/ festive system. In this case, I will mainly focus on the festive aspect of this impression system.

There are specific times when the lobby will need to come alive and create a festive atmosphere and those times include game days in the main arena. During a home game, it would be ideal to get all 5,000 home team fans in a joyous, peppy and upbeat state. A basketball event is meant to be fun and entertaining to watch with all the excitement on the court. A festive atmosphere in the lobby can prep the fans to be ready for an exhilarating experience.

Within the lobby are also certain architectural features such as a wavy pendant of two varying blue colors and honorary plaques of office members and board holders. The lighting design will need to incorporate them in the festive lighting scheme.

In order to create a gleeful, happy and upbeat environment, the lighting system will use bright light levels, non-uniform lighting mode, and movement of light. The honorary plaques will have a higher luminance than most surfaces in order to attract attention. The wavy pendants are made of perforated aluminum and using luminaires that illuminate the ceiling can create emphasis. Interesting light movement such as pulsating and slight movements can also reiterate the festive appeal.

Design Considerations and Criteria

IESNA 2000 *Design Considerations* (Lobby – General Lighting)

Very Important Design Considerations

- Appearance of Space and Luminaires
    - Since the lobby is typically the first place an individual is going to enter, then the appearance of the space needs to be impressionable and the luminaires should compliment that appearance.
- Color Appearance (and Contrast)
    - The lobby will have plaques of significant office members and board holders, thus the lighting for the plaque should demonstrate its significance. The lighting design should render the plaque in a way that embellishes the emphasis of those mentioned.

- Daylight Integration and Control
    - In a transitional space between the outdoors and indoors, the lighting design should incorporate daylight integration techniques, since it is believed that views of the outdoors provide important psychological comfort zones.
- Direct Glare
    - Glare is also a necessary design feature since it can cause discomfort and interfere with visibility as an individual enters the facility.
- Lighting Distribution on Surfaces
    - It is important to keep in mind the distribution of light hitting surfaces since awkward patterns of light can create shadows, affect task visibility, comfort and perceptions.
- Luminance of Room Surfaces
    - The lighting design in the lobby can utilize different luminances of surfaces to help attract attention to certain areas of room. For example, a higher luminance should be used to draw attention to the honorary plaques located on the wall.
- Modeling of Faces and Objects
    - The wavy pendants in the ceiling and honorary plaques are two architectural elements that will require appropriate modeling of their characteristics such as shape, texture and depth.
- Points of Interest
    - The lobby space includes wavy pendants and honorary plaques that will require the lighting design to emphasize the point of interest in this space.
- Reflected Glare
    - Glare causes issues of visibility and discomfort and should be avoided as individuals enter the building.

Important Design Considerations

- Light Distribution on Task Plane
  - Since the primary task in this space is walking, it is important to uniformly light the floor.
- Shadows
  - The lighting design should avoid creating shadows because shadows can alter visibility of tasks and place dark areas where brightness is essential.
- Sparkle/ Desirable Reflected Highlights
  - It is important that the lighting design use points of high luminance on a given spot to accentuate its elegance such as the honorary plaques.
- Surface Characteristics
  - The wavy pendant will need the lighting design's help to enhance its artistic creativity and splendor.

IESNA 2000 *Design Criteria* (Lobby – General Lighting)

- Horizontal Illuminance
  - E = 100 lx or 10 fc

ASHRAE Standards 90.1

- Lighting Power Density
  - Lobby
  - LPD = 1.1 W/ft^2

Luminaires

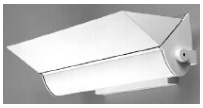
Type		Manufacturer	Product Name	Catalog Number	Description	Lamp	Voltage	Ballast	Watts	Location
W1		Gotham Lighting	AFLP	AFLP 1/32TRT 8AR LD MVOLT	8" low profile ceiling recessed down light with a galvanized steel housing and semi specular reflector.	CF32DT E IN 841 ECO	277	ICF 2S26 M1 BSQS	27	Lobby
L1		Gotham Lighting	8" PDPF	PDPF 32TRT 8AR LD CGL MVOLT	8" satin silver pendant supported by black cord. The housing is durable heavy gauge aluminum housing with specular reflector.	CF32DT E IN 841 ECO	277	ICF 2S26 M1 BSQS	27	Lobby
L2		Elliptipar	F114	F114-L140-F-02-2	Wall mounted wall washer with semi white gloss finish on the outside housing made of aluminum.	FT40DL 841 RS ECO	277	Integral Electronic Ballast	40	Lobby
L3		Philips Alkco	Slique T2	SK213-120-WHG	Sleek ¾" under cabinet fluorescent luminaire with miniature integral ballast. The housing is an extruded aluminum with a specular asymmetric reflector.	FM13 T2	120	Integral Miniature Ballast	13	Lobby

Table 13. Main Lobby Luminaire Schedule

NOTE: See Appendix A for complete luminaire schedule and Appendix B for specification sheets

Light Loss Factors

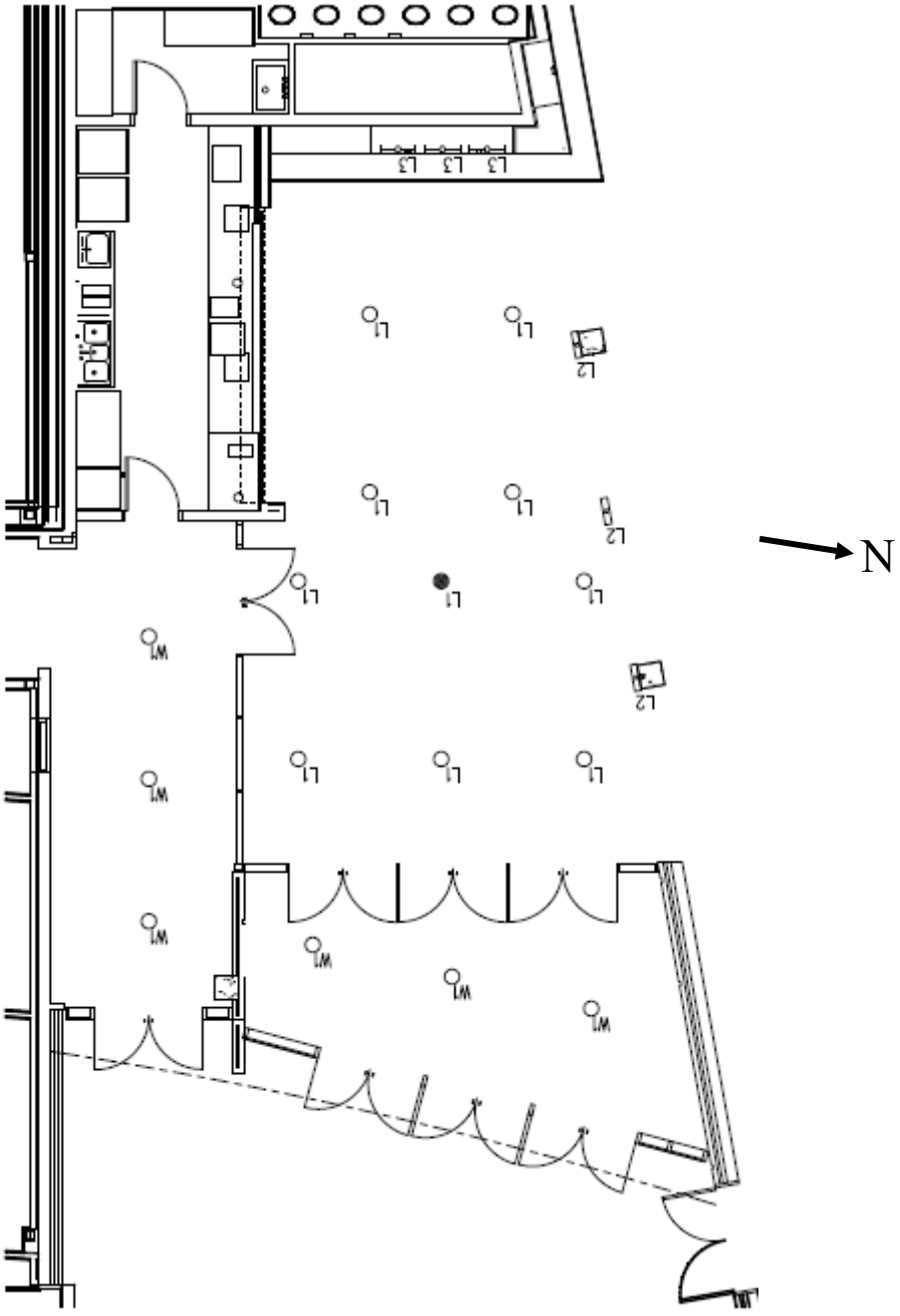
Light Loss Factors					
Luminaire Type	**Lamp Lumen Depreciation**	**Lamp Dirt Depreciation**	**Room Surface Dirt Depreciation**	**Ballast Factor**	**Total Light Loss Factor**
W1	0.83	0.92	0.97	0.98	0.73
L1	0.83	0.92	0.97	0.98	0.73
L2	0.9	0.92	0.97	1	0.80
L3	0.86	0.92	0.97	1	0.77

Table 14. Fitness and Weight Room Rendering from locker area

Controls:

The controls in this space will be controlled by a relay that is connected to an astronomical time clock located in the main electric room. Emergency lighting will use both the astronomical time clock and an emergency ballast relay, which will turn on the luminaire in the event of a power failure. See Appendix A for complete control schedule.

Lighting Plan



Drawing 9. Main Lobby Lighting Floor Plan

Performance Data

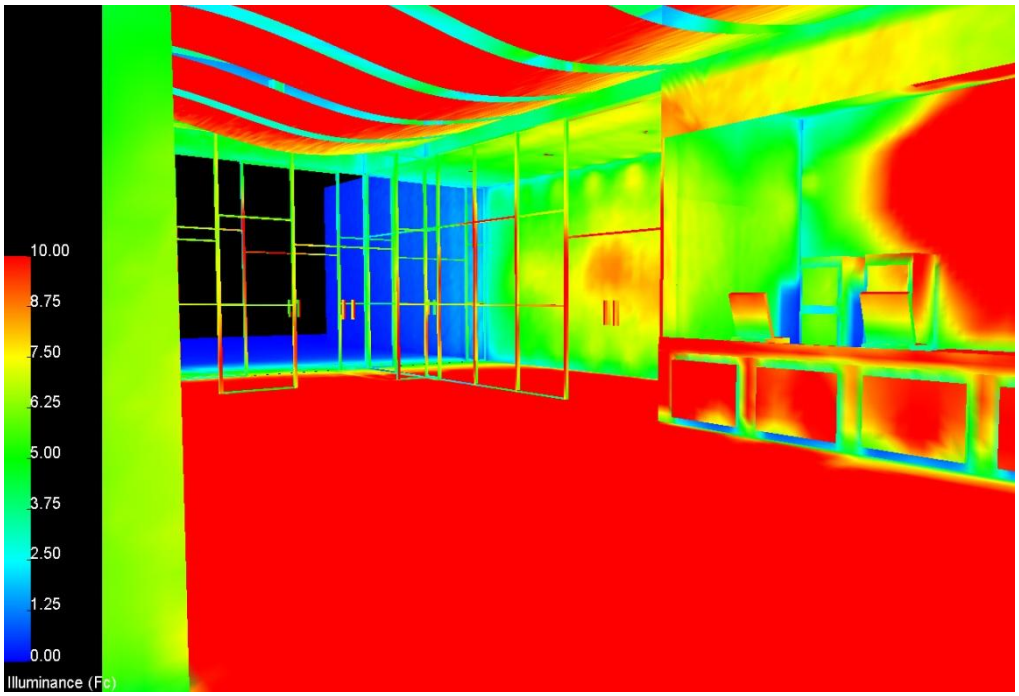


Image 11. Main Lobby Pseudo Diagram from concourse

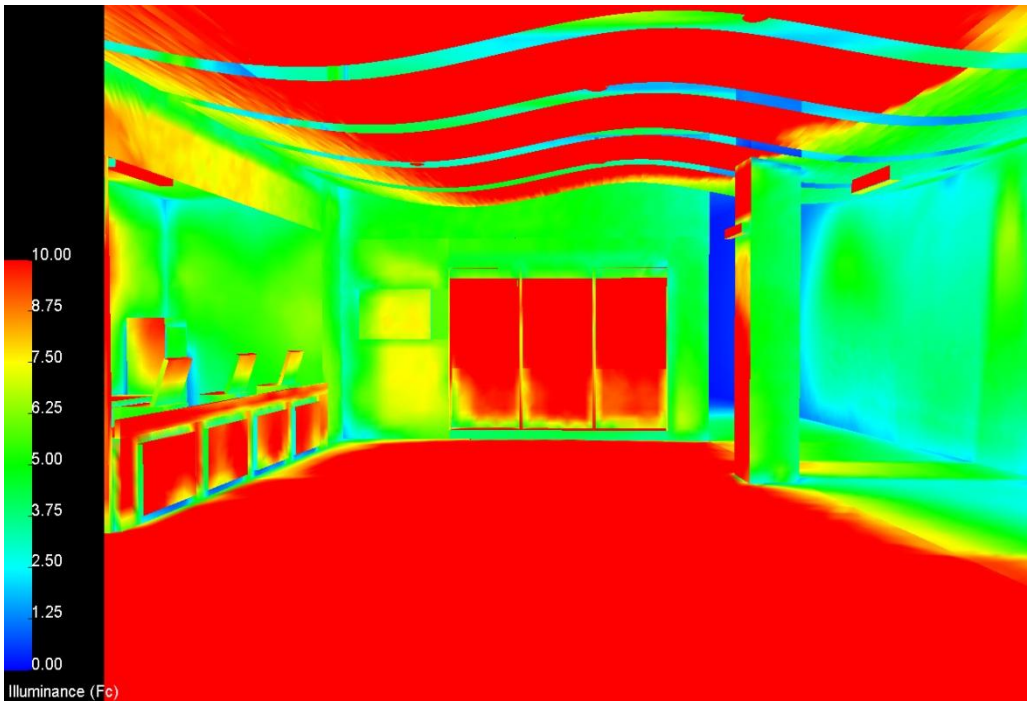


Image 12. Main Lobby Pseudo Diagram from entry

Performance Summary

The direct down-light pendant located at 12'-0" above finished floor are integrated between the spaces of the wavy architectural objects in the ceiling. These luminaires provide general illumination in the center of the space. For the same reasons, a recessed luminaire was used in the gypsum board ceiling in the adjacent vestibule. In order to create the impression of festiveness and excitement, further emphasis was placed on the architectural feature in the ceiling. Wall washers were mounted onto the columns to provide direct illumination on the wavy pendants to draw the occupant's eyes to an interesting and pleasing apparatus. Highlighting this feature also provides higher illuminances at the ceiling and thus creating a non-uniform lighting mode. A slim sleek look fluorescent luminaire was used to accentuate the display case which will house trophies and honorary plaques.

Criterion	IESNA Recommended	Designed
Average Illuminance	10 fc	12 fc
Max : Min Illuminance Ratio	-	-
Coefficient of Variance	-	-
LPD (1490 SF)	1.1 W/SF (1640 W)	0.6 W/SF (790 W)

Table 15. Main Lobby Lighting Design Results

Renderings

Image 13. Main Lobby Rendering from concourse

Image 14. Main Lobby Rendering from entry

Exterior Space – Main Entry Façade

Space Description:

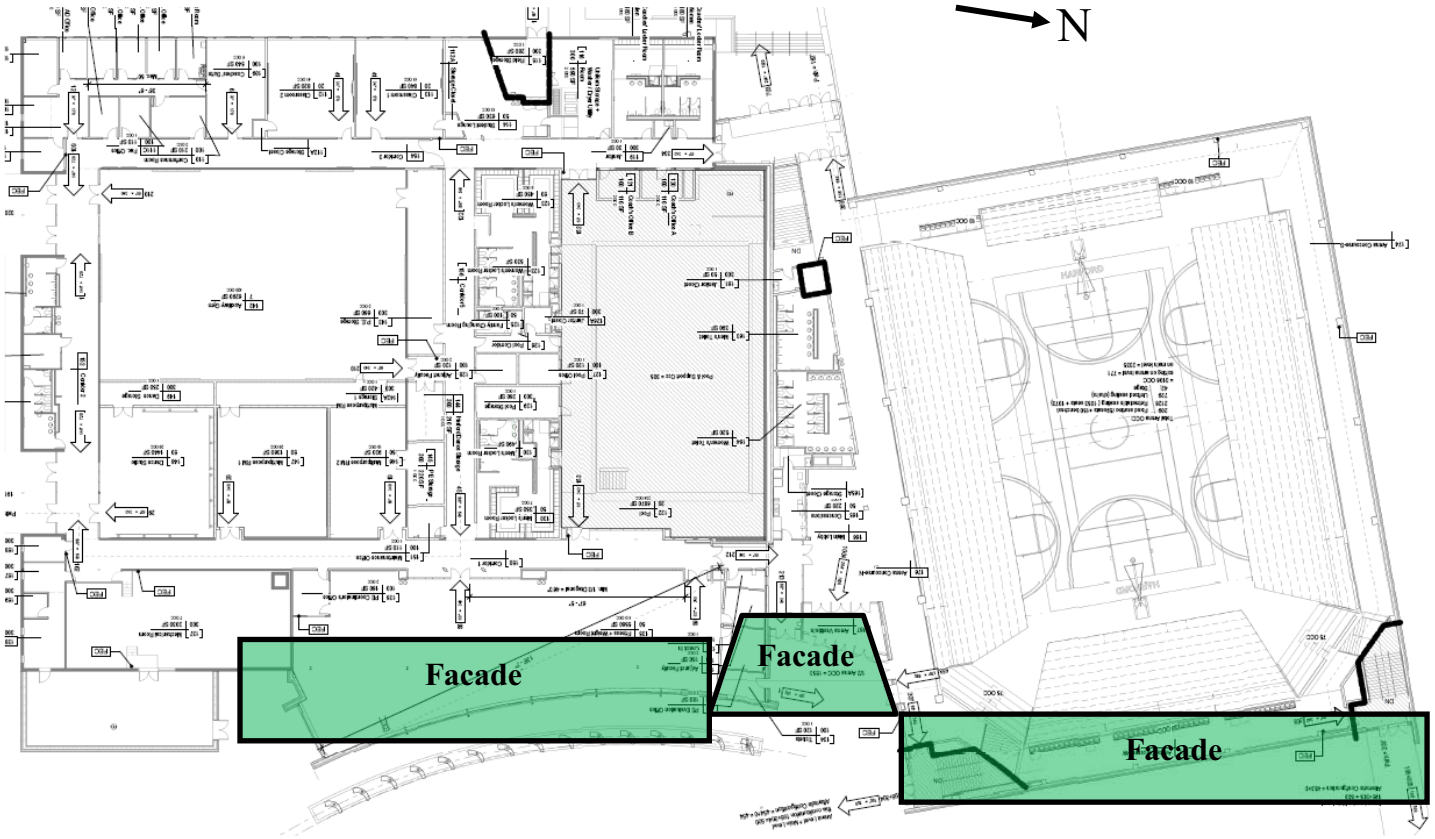
The façade of this facility is important due to the building's nature to house an athletic sporting team at the collegiate level. The facade is the first attraction of the building for fans, visitors, and players. It is important to set an admirable impression since this facility is new and could potentially be the highlight of sporting facilities in the area. The façade is composed of 4x8 and 16x24 nominal concrete block, aluminum glazing curtain wall, metal sheathing with black plastic lettering for the building sign, and concrete sidewalks.

Materials:

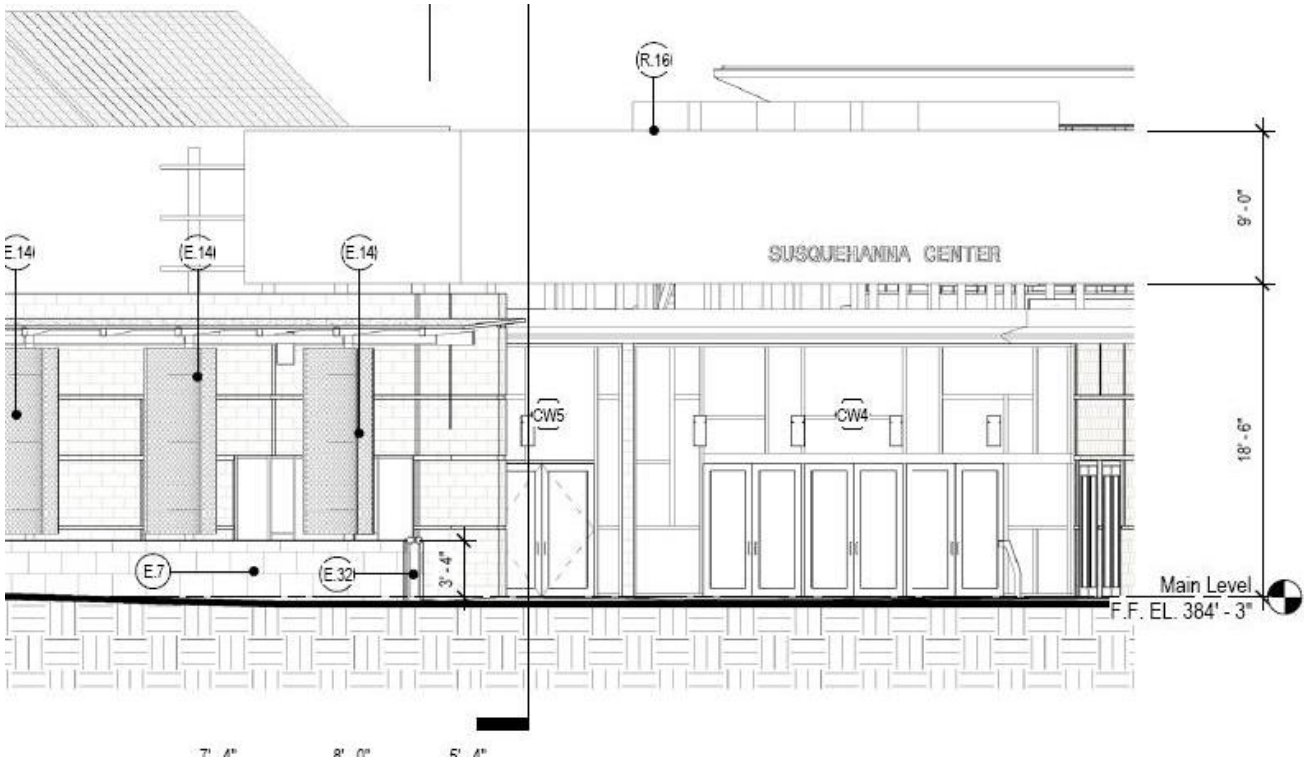
Material	Description	Properties
Sidewalk	cast in place concrete	ρ = 0.28
Facade	Brick and stone composite	ρ = 0.3
	Perforated aluminum Panels	ρ = 0.3
Curtain Wall System	glazing 1 of the curtain wall system	ρ = 0.74
	glazing 2 of the curtain wall system	ρ = 0.38
	Mullions of the curtain wall system	ρ = 0.33
Roofing	Composite aluminum Paneling	ρ = 0.33
Signage	Black plastic lettering	ρ = 0.02

Table 16. Façade Materials

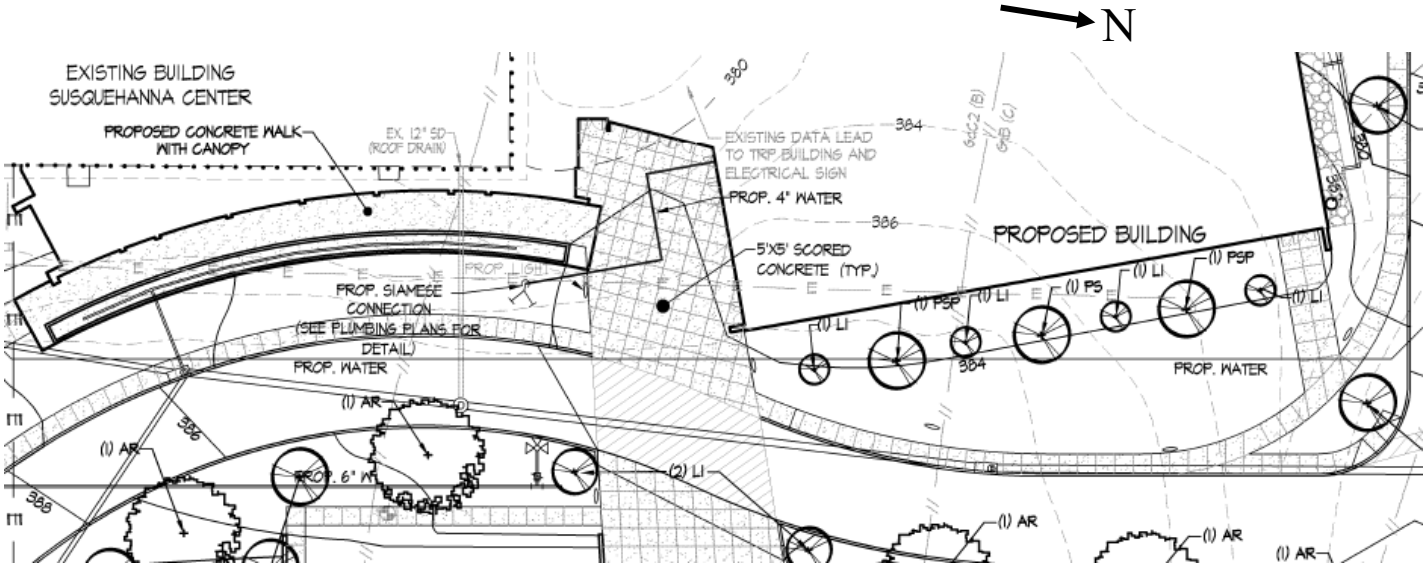
Drawings



Drawing 10. Building Floor Plan labeling Façade



Drawing 11. Façade Elevation



Drawing 12. Façade Planting Plan

Design Concept

Originally the design was to highlight the ornate nature of the roof overtop the main arena, but due to the upward light ratio, this concept proved to be inadequate. This change prompted the concept of highlighting the landscape in front of the main arena, with a LED luminaire aiming up vertically amongst the trees to cast shadows onto the façade. In the main entry sidewalk, a full cut version of the campus pole mounted luminaire will be used to illuminate the ground plane. Further emphasis of illumination was used at the entry with surface recessed circular luminaires. A wall washing luminaire will be used to illuminate the sign of the Center, which will create a higher light level at this particular location essentially guiding people to the light.

Design Considerations and Criteria

IESNA 2000 Design Considerations (Building Exteriors Entrances-Active)

Very Important Design Considerations

- Appearance and Shape of Luminaires
    - The lighting design of the façade should be appeasing and help accentuate the architectural features that define the building. The luminaires need to conform to architecture instead of protrude and take away from it.
- Color Appearance (and Color Contrast)
    - The color rendering of building materials is an essential piece of the architecture and impression that the building is trying to attain.
- Direct Glare
    - When lighting exterior facades it is key to incorporate glare because shining light into the eyes and faces of guests is not a pleasant feeling and is uncomfortable.
- Light Pollution and Trespass
    - Light pollution into the sky is an unwanted and unnecessary design practice and should be avoided to help reduce urban sky glow. Light trespass onto adjacent sites is also an unpleasant design feature and should be avoided as well.
- Modeling of Faces and Objects
    - Creating the depth, shape, and texture of objects is imperative when highlighting and emphasizing the architectural elements and features.

- Peripheral Detection
    - When an individual is gazing at the façade it is important that the lighting design help individuals interpret and inspect the textures and shapes of the architectural elements.
- Points of Interest
    - Ideally when highlighting the architecture and entrances, it is important for your design to focus on the points of interest such as certain architectural features.
- Reflected Glare
    - Reflected glare is just as important as direct glare, in which the unpleasantness of being blinded by light is not comfortable for an individual.
- Shadows
    - Shadows can help create the depth of 3D textures and materials of building.
- Source/ Task/ Eye Geometry
    - The geometry between the viewer's eyes and luminaire can be essential for creating contrast of architectural elements.
- Surface Characteristics
    - Surfaces can have different textures, specularity, and reflectance values, which can alter perceived brightness of illuminated surfaces, especially building facades.

Important Design Considerations

- Light Distributions on Surfaces
    - The spacing of luminaires can create shadows when not spaced correctly and hide certain elements of the architecture. Strange and confusing spacing of luminaires can also create brighter areas on walls.
- Sparkle/ Desired Reflected Highlights
    - Small points of high luminance can create visual interests.

IESNA 2000 Design Criteria (Building Exteriors Entrances-Active)

- Horizontal Illuminance on Sidewalk/ Entrance
  - E = 50 lx or 5 fc

ILE 2005 Guidance Notes For the Reduction of Obtrusive Light

- Category E2 – Low district brightness areas, rural, relatively dark urban locations
  - URL = 2.5%

ASHRAE Standards 90.1

- Lighting Power Density
  - Canopies – 1.25 W/SF
  - Wall/ Surfaces – 5W/lF or 0.2W/SF

Luminaires

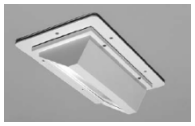
Type		Manufacturer	Product Name	Catalog Number	Description	Lamp	Voltage	Ballast	Watts	Location
S1		Elliptipar	251	M 251 70G T 07 1 00	Recessed metal halide wall wash for concrete/ outdoor applications with silicon seals and a silver corrosion resistant housing/ finish.	MC70T6/ U/ G12 /830	277	71A5237BP	85	Exterior
S2		Erco	Visor III Floor Wash Light	330304	Circular recessed floor wash light with silicon seals and corrosion resistant aluminum housing with silver finish.	MC39T6/ U/ G12 /830	277	71A50.37BP	48	Exterior
S3		Philips Gardco	Canopy	220 P 42TRF 277 NP	Circular down light with silicon seals and die cast aluminum housing and natural aluminum finish.	F42TBX/ 830/ A/ ECO	277	ICF 2S26 H1 LD@ 277	46	Exterior
S4		Erco	Beamer	34070	Hinged surface mounted direct luminaire with corrosion resistant cast aluminum and silicon seals.	MC20TC/ U/ G8.5 /830	277	71A50.37BP	25	Exterior
S5		Se'lux	Saturn 2 Cutoff	SAC2 R5 1 H070T6 830 SV 277 DS	Pole mounted die cast aluminum housing with full cutoff option and weatherproof gaskets. Match existing campus pole luminaire except with full cutoff option.	MC70T6/ U/ G12 /830	277	71A5237BP	85	Exterior
S6		Erco	Bollard	33348	Circular bollard with corrosion resistant cast aluminum and silicon seals. Reflector located at top of bollard.	MC39T6/ U/ G12 /830	277	71A50.37BP	48	Exterior
S7		Erco	Grass hopper	34035	Square LED ground mounted focal point luminaire with die cast aluminum corrosion resistant housing and silicon seals.	LED	277	N/A	14	Exterior

Table 17. Façade Luminaire Schedule

NOTE: See Appendix A for complete luminaire schedule and Appendix B for specification sheets

Light Loss Factors

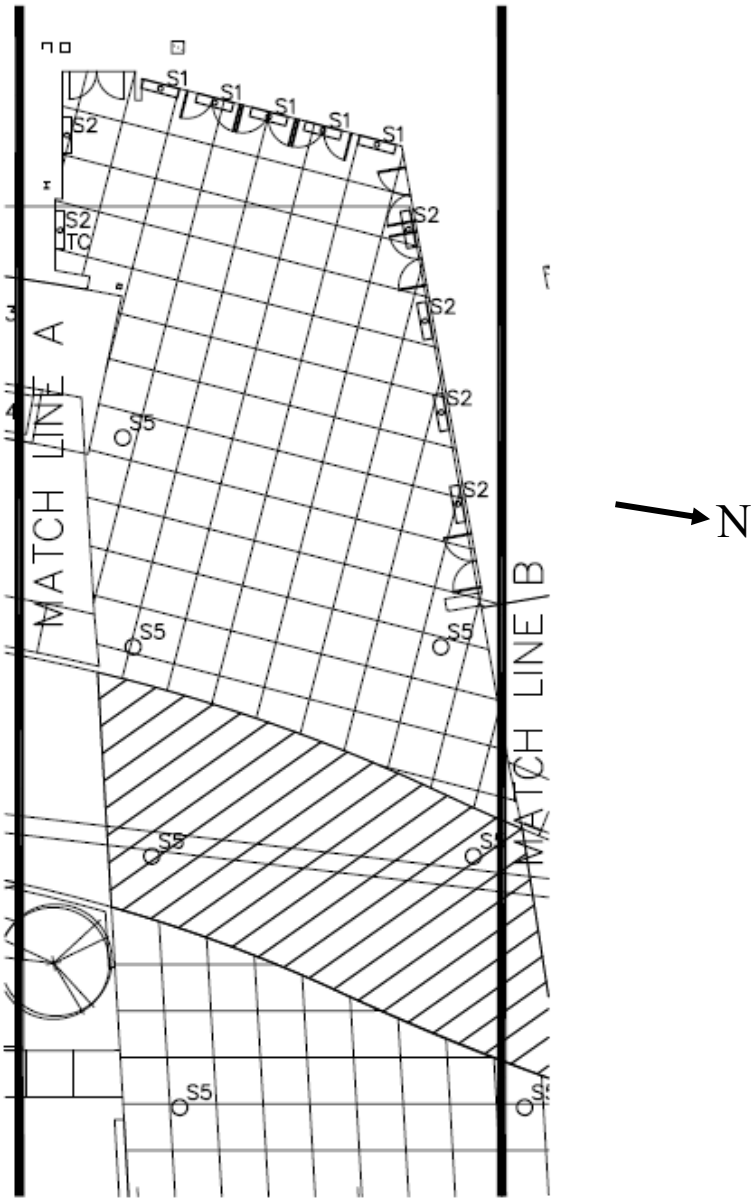
Light Loss Factors				
Luminaire Type	**Lamp Lumen Depreciation**	**Lamp Dirt Depreciation**	**Ballast Factor**	**Total Light Loss Factor**
S1	0.8	0.75	1.0	0.6
S2	0.86	0.75	1.02	0.66
S3	0.85	0.75	0.98	0.62
S4	0.85	0.75	0.98	0.62
S5	0.8	0.75	1.0	0.6
S6	0.86	0.75	1.02	0.6
S7	0.75	0.75	-	0.56

Table 18. Façade Light Loss Factors

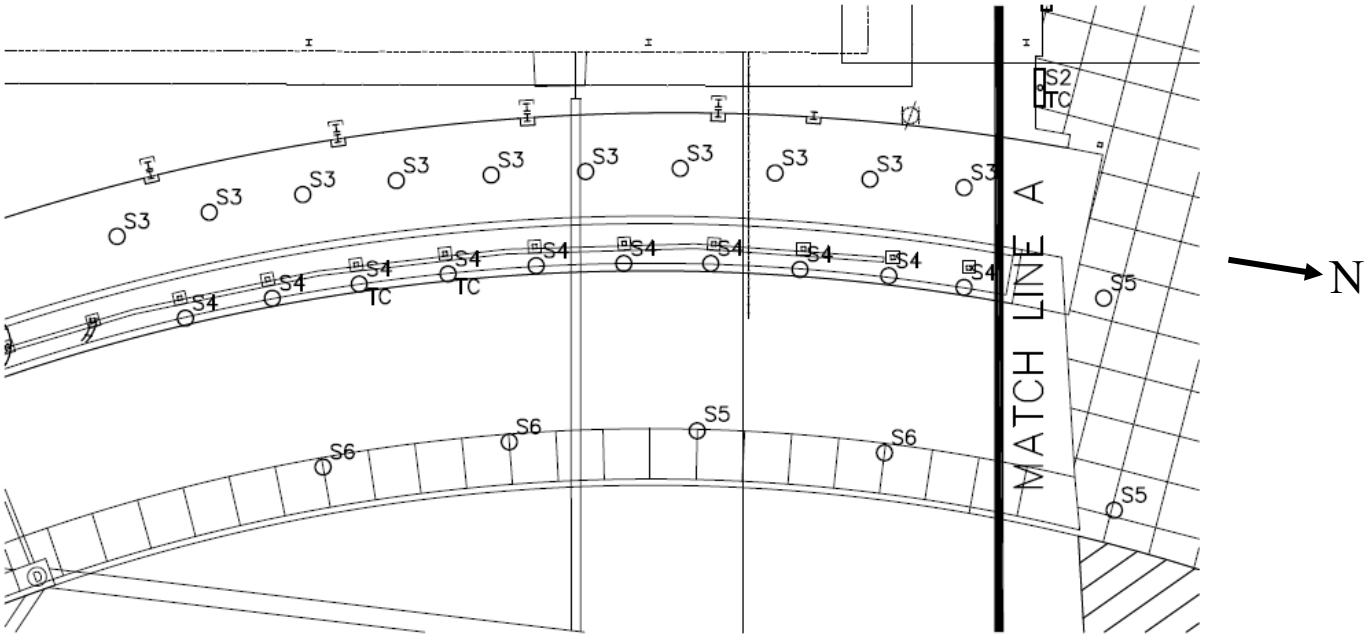
Controls

The controls in this space are typical of exterior lighting controls. Relays will connect to an astronomical time clock that will control the luminaires and allow them to turn on at the night time. See Appendix A for complete control schedule.

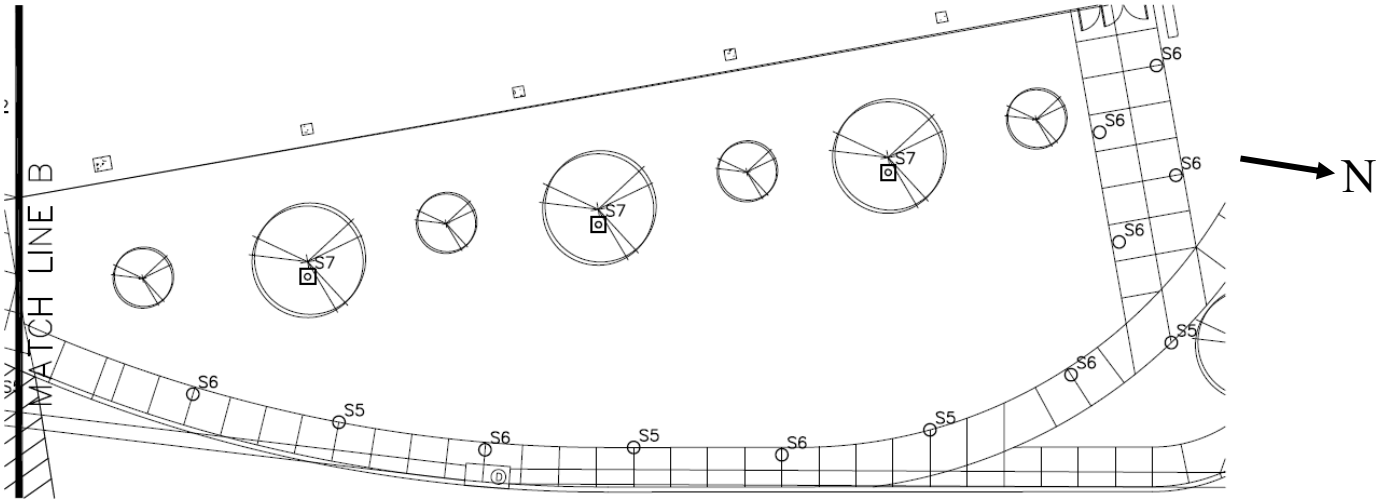
Lighting Plan



Drawing 12. Façade Lighting Plan



Drawing 13. Façade Lighting Plan



Drawing 14. Façade Lighting Plan

Performance Data

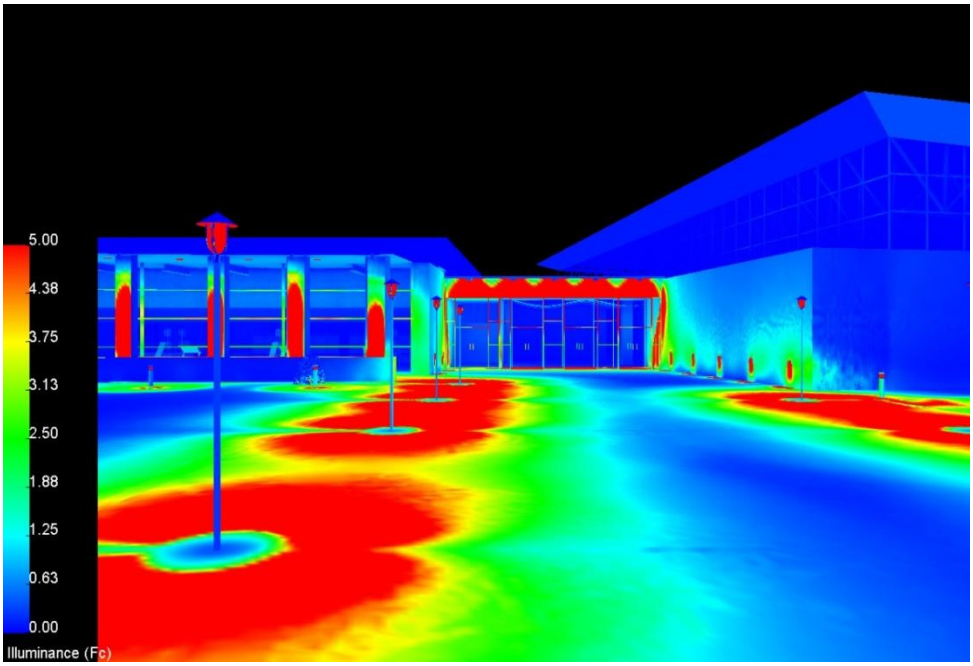


Image 15. Façade Pseudo Diagram from entry sidewalk

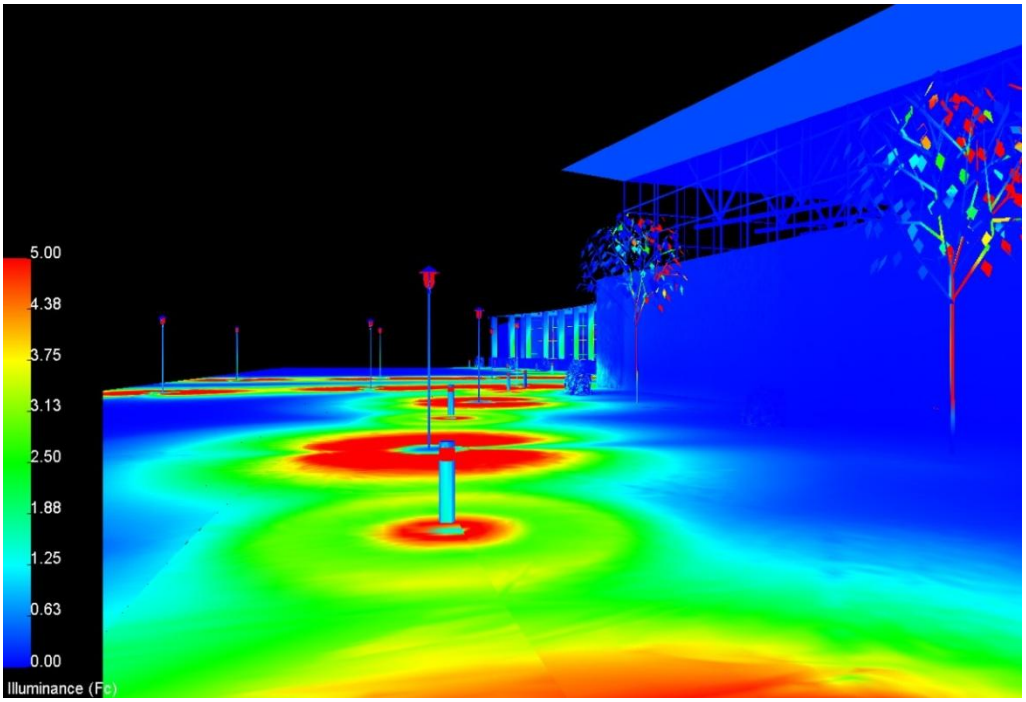


Image 16. Façade Pseudo Diagram from sidewalk on right

Performance Summary

The exterior lighting design's ultimate goal was to illuminate the pathways and put emphasis on the main entry to guide visitors and guests to the proper entrance. Harford Community College already has a standard for pole top sidewalk illumination luminaires and this luminaire was incorporated into the design with the exception that the luminaire is full-cutoff, so that it could meet dark sky requirements. Bollards that had complimented the architectural style of the pole mounted luminaire were used for smaller sidewalks to provide uniform illumination. The main entrance was emphasized with a wall washer above the door, which highlighted the Susquehanna Center sign. Further emphasis was placed on the entrance with the use of small wall recessed floor wash-lights, act as a guide for traffic. Lastly to create an aesthetic appeal to the façade direct focal point luminaires were used to illuminate the perforated shades on top of a stone wall.

Criterion	IESNA Recommended	Designed
Average Illuminance	5 fc	4.8 fc
Max : Min Illuminance Ratio	-	-
Coefficient of Variance	-	-
LPD Wall/ Surfaces (8400 SF)	0.2 W/SF (1680W)	0.23 W/SF (1950 W)
LPD Canopies (1400 SF)	1.25 W/SF (1750 W)	0.6 W/SF (775)
Total LPD (W Allowable)	3430 W	2725 W
ILE Upward Light Ratio	Category E – 0.02	0.018

Table 19. Façade Lighting Plan Results

Renderings

Image 17. Façade Rendering from entry sidewalk

Image 18. Façade Rendering from sidewalk on right

Electrical Depth – Branch Circuit Redesign

Space Descriptions:

The electrical redesigns of four spaces are the same four spaces, in which a lighting redesign was done. Those four spaces are the Auxiliary Gymnasium, Fitness and Weight Room, Main Lobby, and Main Entry Façade. The lobby is the primary circulation space that has hallways that branch off of it that will lead you to the adjacent Fitness and Weight room. The weight room is a typical fitness facility with all types of workout equipment available to students and athletes on the Harford Community College's campus. One of those branching hallways also leads to the Auxiliary Gymnasium, which is your standard full size basketball court with two smaller perpendicular courts.

The lighting redesign consisted mostly of replacing fluorescent troffers with fluorescent down-lights, wall washers, and other accent lighting hardware. All lighting in the Susquehanna Center is operated using 277 volts.

Panel Boards Affected

Panel Tag	Voltage	System	Exterior Façade	Main Lobby	Fitness and Weight Room	Auxiliary Gym
LPA	480Y/277V, 3P, 4W	N			**X**	**X**
LPB	480Y/277V, 3P, 4W	N		**X**		
SITE	480Y/277V, 3P, 4W	N	**X**			

Table 20. Panelboards Affected by Lighting Redesign

NOTE: The individual circuits that have been affected are highlighted in the following Panels with their respected colors.

Control Information and Space Layout

Auxiliary Gymnasium

The controls in the space will be primarily used to accommodate the daylight harvesting system that utilizes multiple Lutron products. The primary piece of equipment will be the photocell located in the center of the space that will relay information to the automated day-lighting control via a Lutron Grafik Eye. This Grafik Eye specializes in the utilization of daylight harvesting and will control the light output of the high bay fluorescent luminaires that provide general illumination. All luminaires in this space will be supplied with 277V and controlled by another Grafik Eye, which will be located in the main electric room. Emergency luminaires will have an emergency ballast controlled by both the Grafik Eye and Emergency Relay to switch the luminaire from normal power to emergency power. A new dimming Panel DP was introduced for this space, so that the luminaires could be dimmed. The panel is feed by Panel LPA and located in the Electric. See drawings for exact location.

Fitness and Weight Room

In this space the control system is simplistic in nature. The control system is comprised of a combination of vacancy sensors with wall switches. Wall switches will be the primary controller of the lights, but the vacancy sensor will provide the automatic shut-off requirements for ASHRAE 90.1. Emergency luminaires will have an emergency ballast controlled by both the wall switch and an emergency relay that will switch the luminaire from normal power to emergency power.

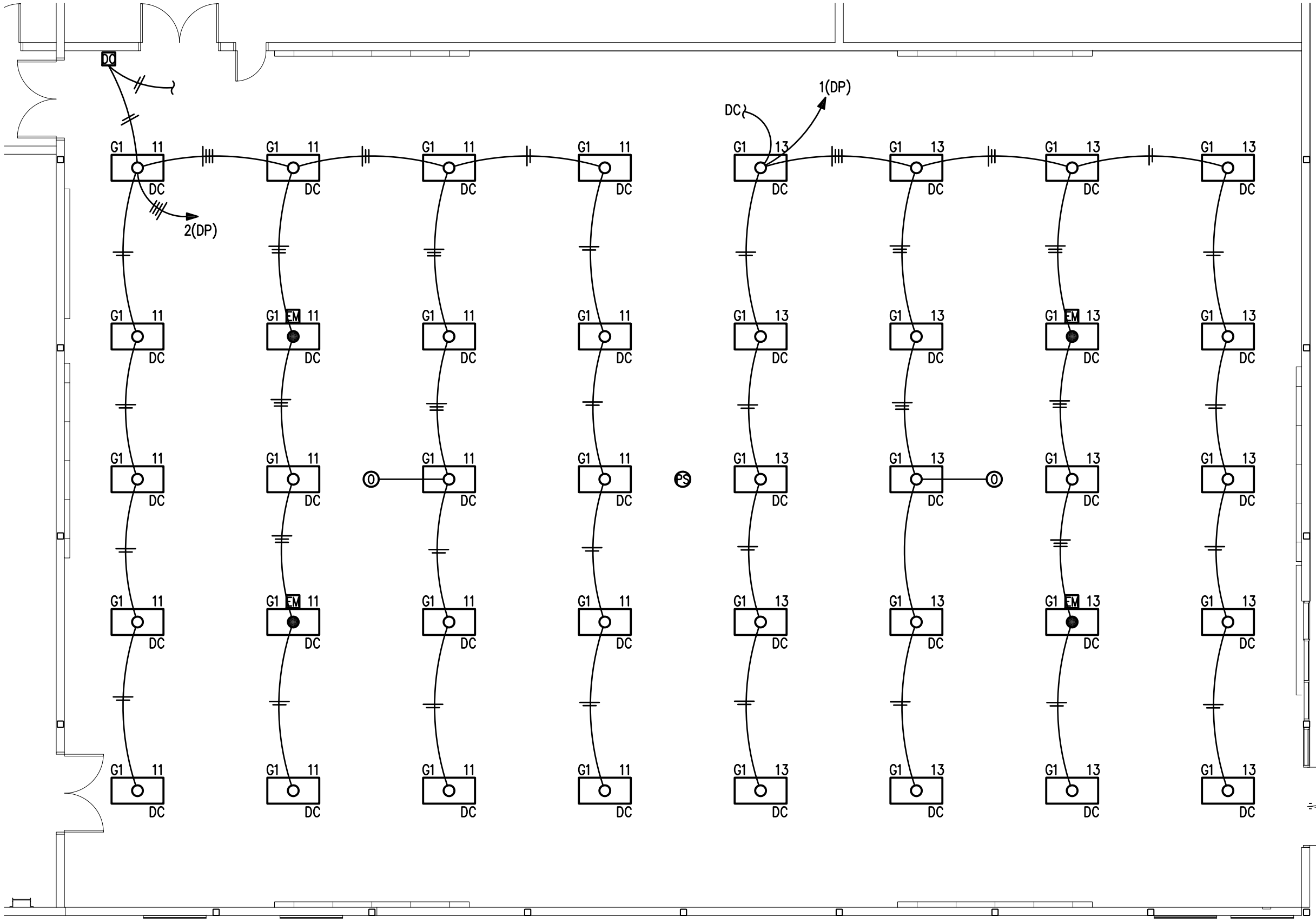
Main Lobby

Since this space is a circulation space the lighting will be controlled by an astronomical time clock. Emergency luminaires will have an emergency ballast controlled by both the astronomical time clock and an emergency relay that will switch the luminaire from normal power to emergency power.

Main Entry Façade

This space will be controlled via an astronomical time clock because it is located outside.

NOTE: See the following drawings in order above for Electrical Plans.



Studio
ARCHITECTURAL ENGINEERING
SENIOR THESIS PORTFOLIO

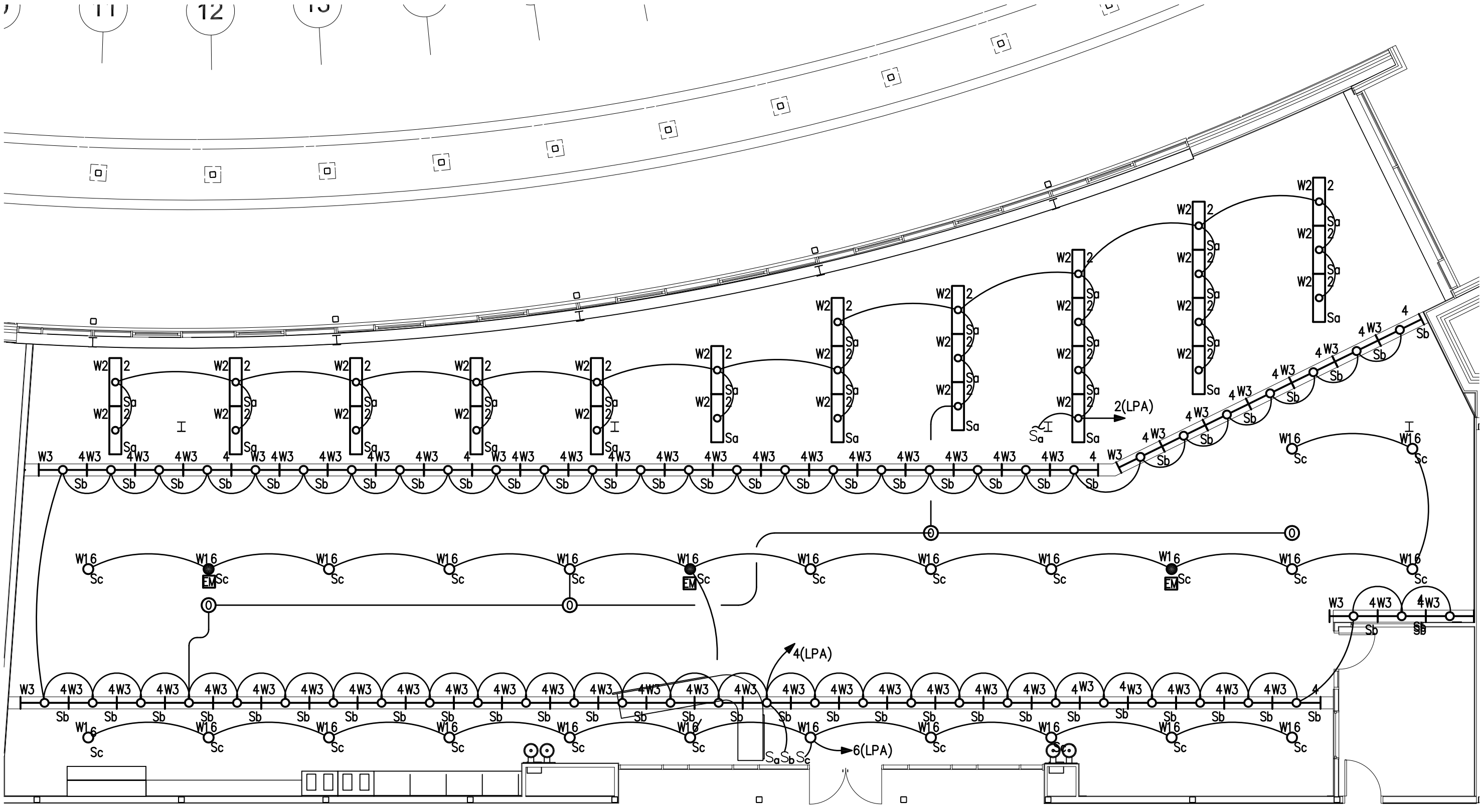
NAME: BRAD GAUGH

PROJECT NAME:
SUSQUEHANNA CENTER RENOVATIONS AND EXPANSION

DWG NAME:
AUXILIARY GYMNASIUM LIGHTING PLAN

SCALE: 1/8" = 1'0"

E-



Estudio
ARCHITECTURAL ENGINEERING
SENIOR THESIS PORTFOLIO

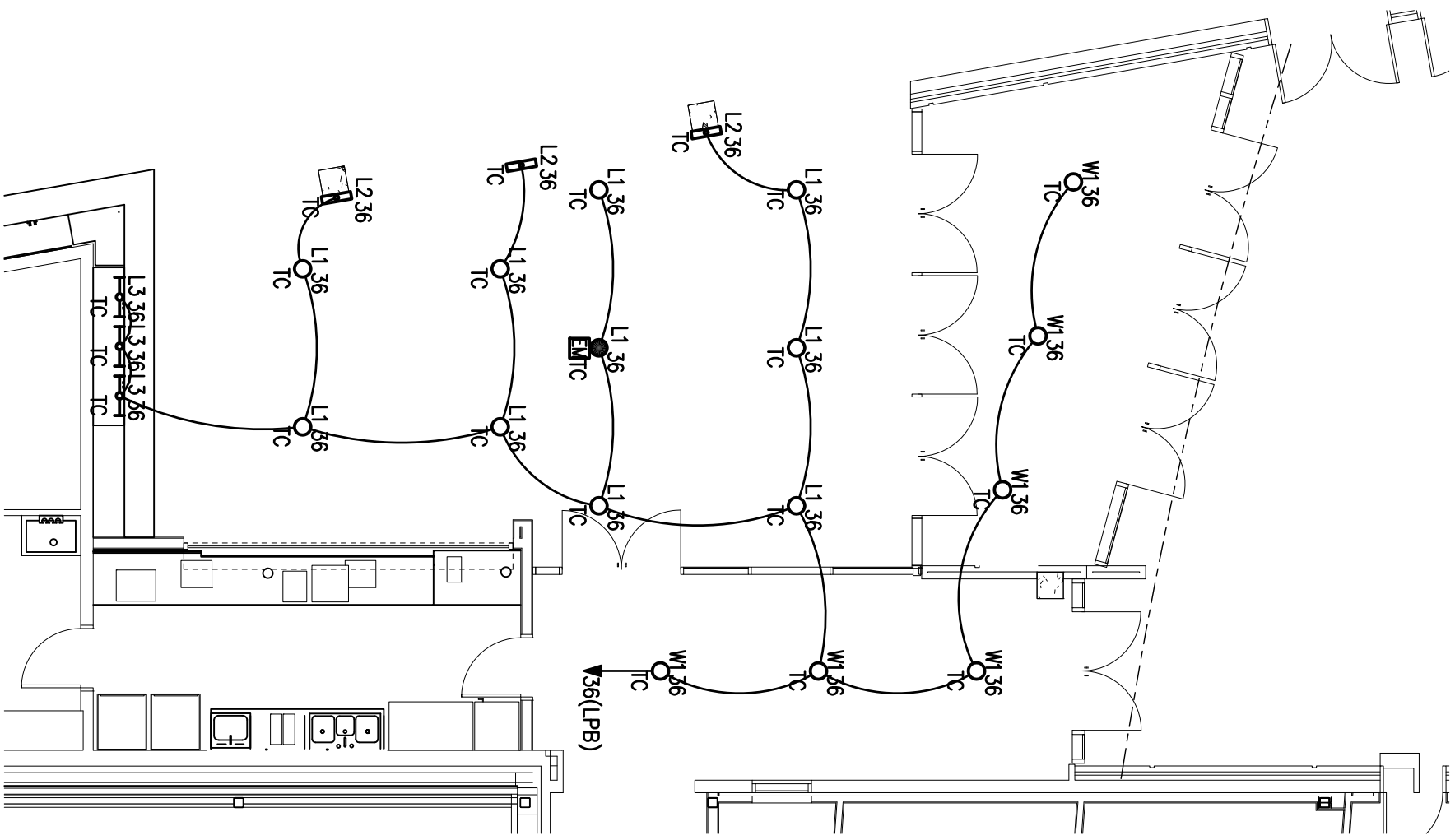
NAME: BRAD GAUGH

PROJECT NAME:
SUSQUEHANNA CENTER RENOVATIONS AND EXPANSION

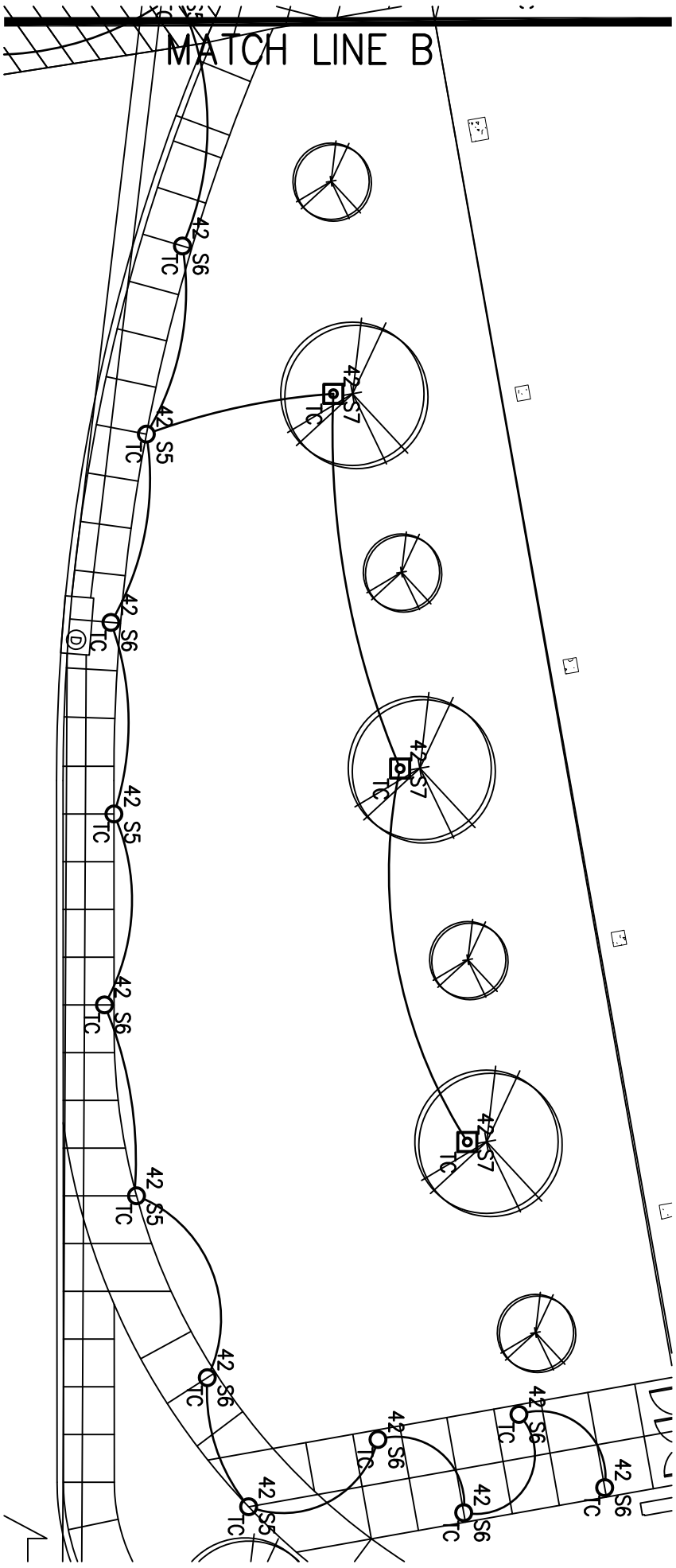
DWG NAME:
WEIGHT AND FITNESS LIGHTING PLAN

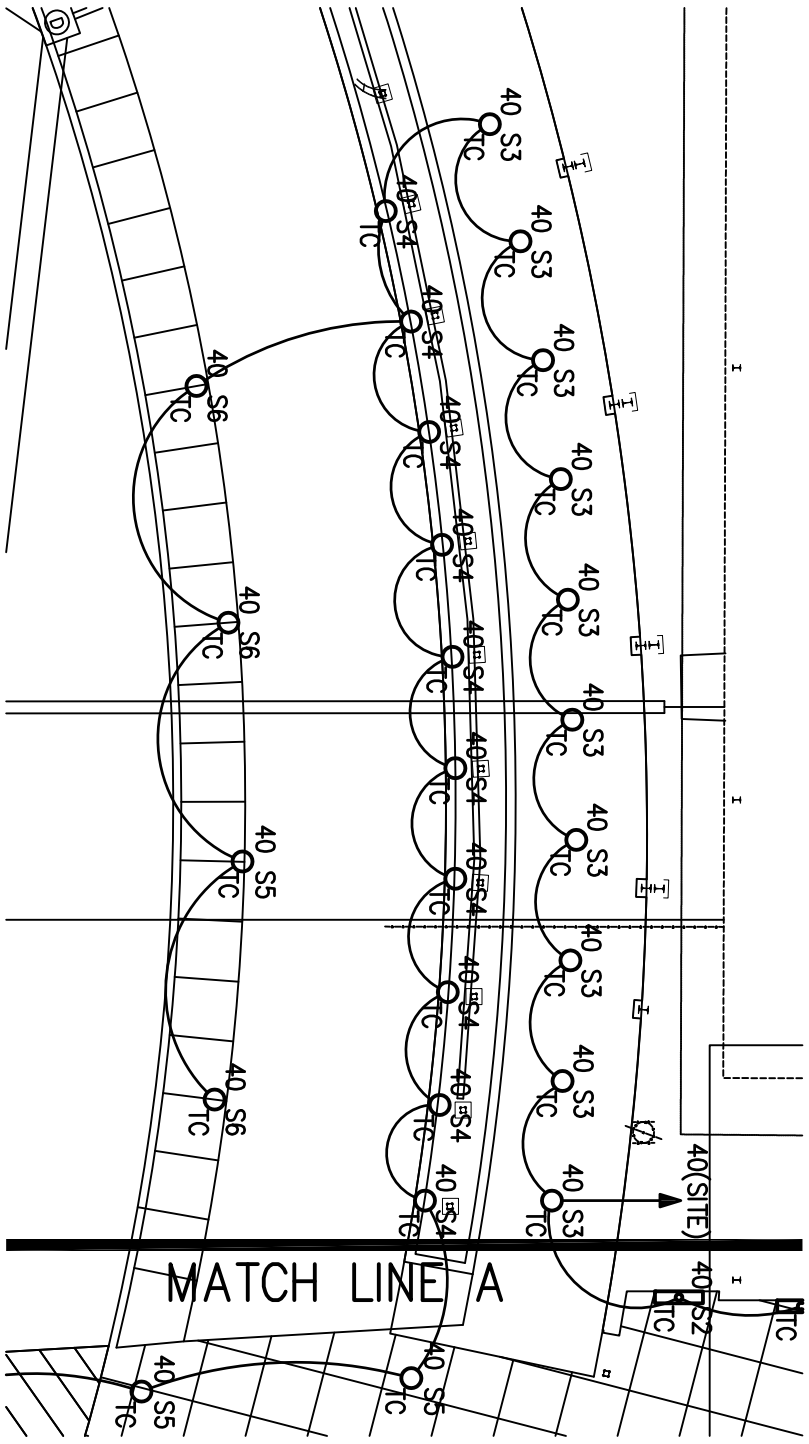
SCALE: 1/8" = 1'0"

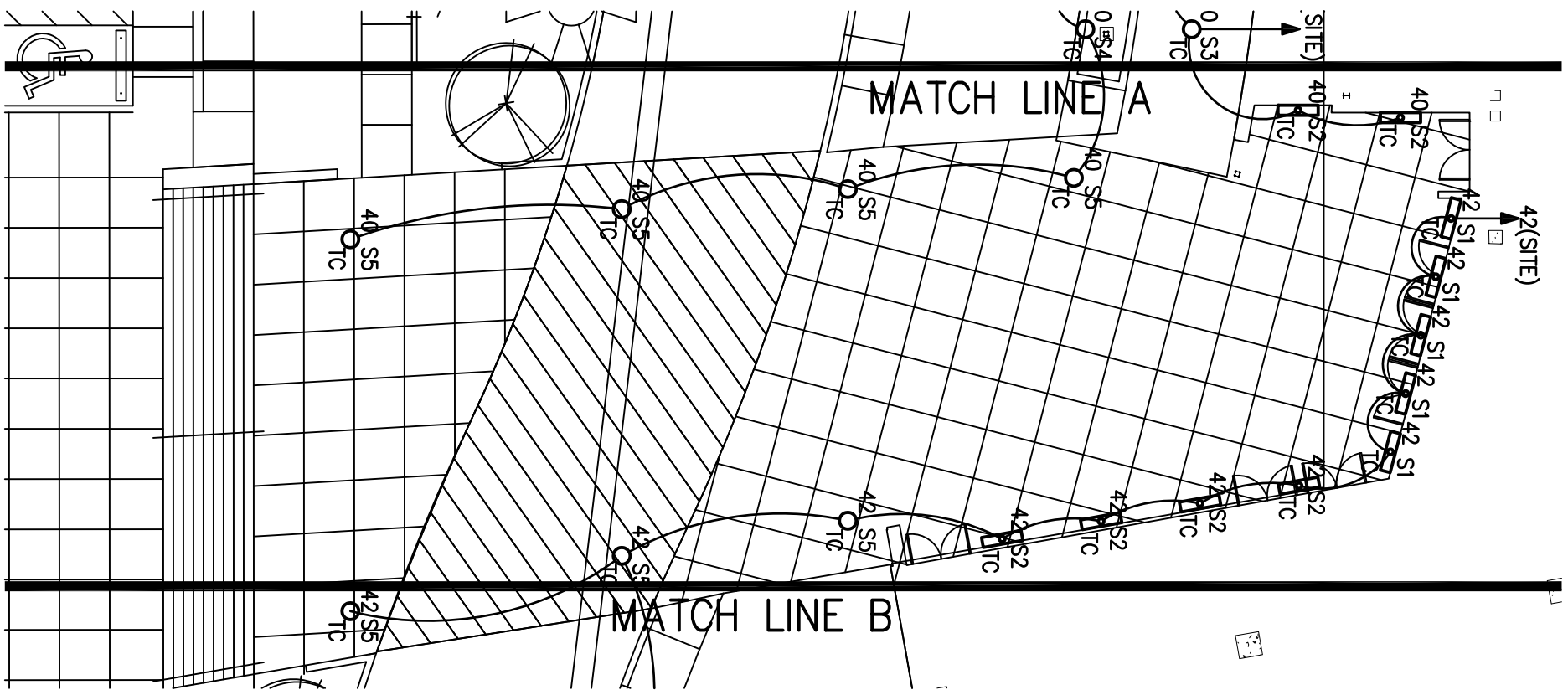
E-



E-1	SCALE: 1/8" = 1'0"	DWG NAME: MAIN LOBBY LIGHTING PLAN	PROJECT NAME: SUSQUEHANNA CENTER RENOVATIONS AND EXPANSION	NAME: BRAD GAUGH	eStudio ARCHITECTURAL ENGINEERING SENIOR THESIS PORTFOLIO







E—

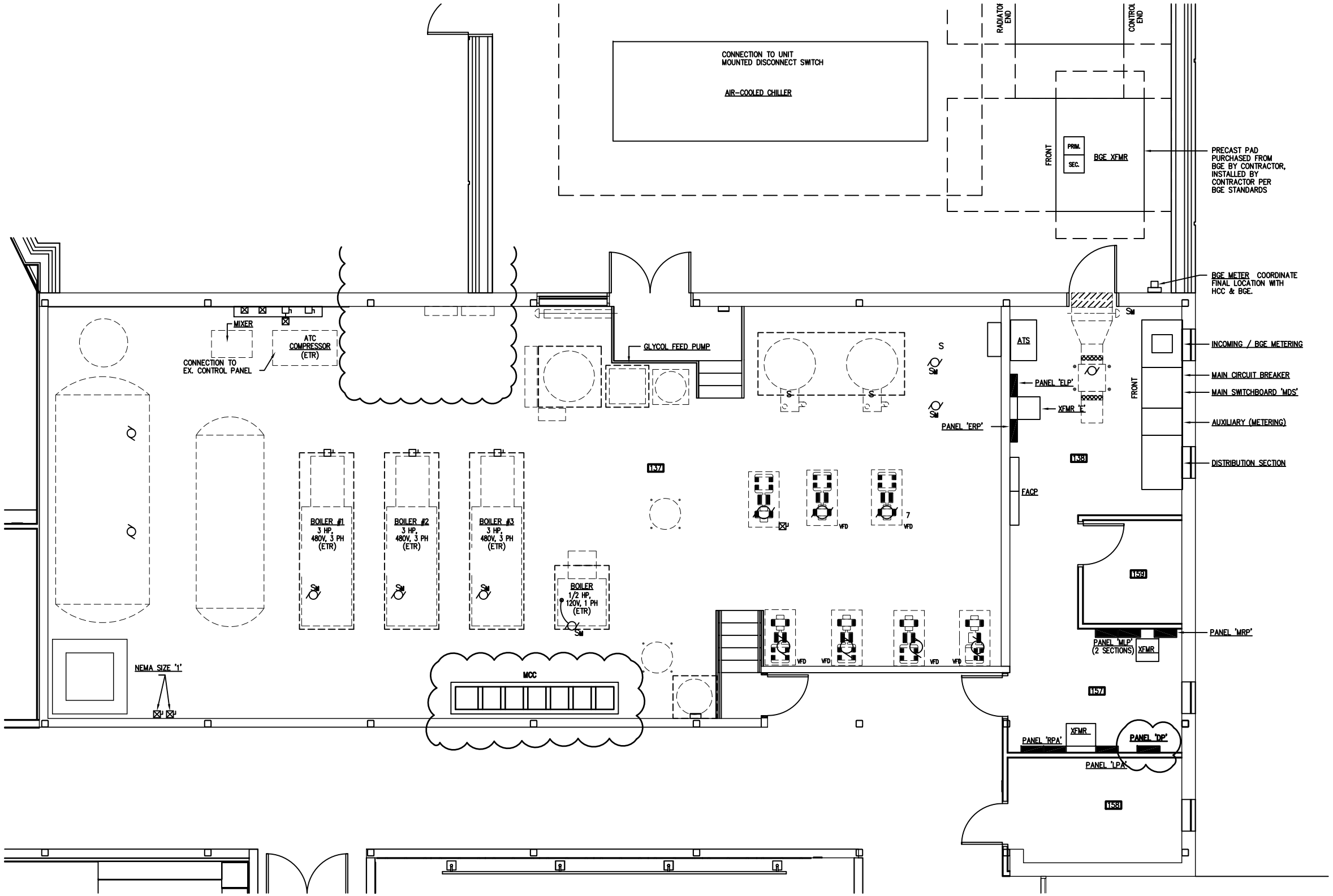
SCALE: 1/16" = 1'0"

DWG NAME: EXTERIOR LIGHTING PLAN

PROJECT NAME: SUSQUEHANNA CENTER RENOVATIONS AND EXPANSION

NAME: BRAD GAUGH

eStudio
ARCHITECTURAL ENGINEERING
SENIOR THESIS PORTFOLIO



Studio

ARCHITECTURAL ENGINEERING
SENIOR THESIS PORTFOLIO

NAME:
BRAD GAUGH

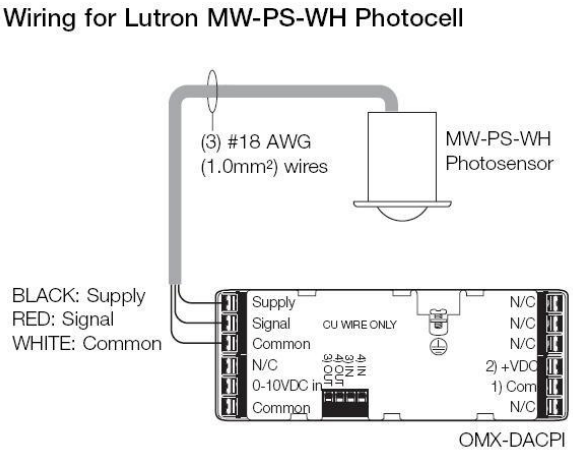
PROJECT NAME:
SUSQUEHANNA CENTER RENOVATIONS AND EXPANSION

DWG NAME:
ELECTRIC ROOM NEW EQUIPMENT LOCATIONS

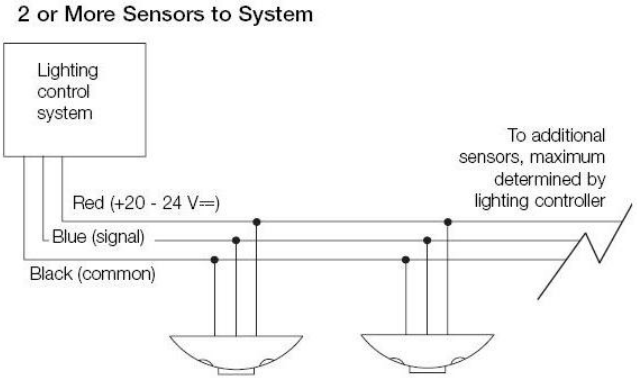
SCALE: 1/8" = 1'0"

E-

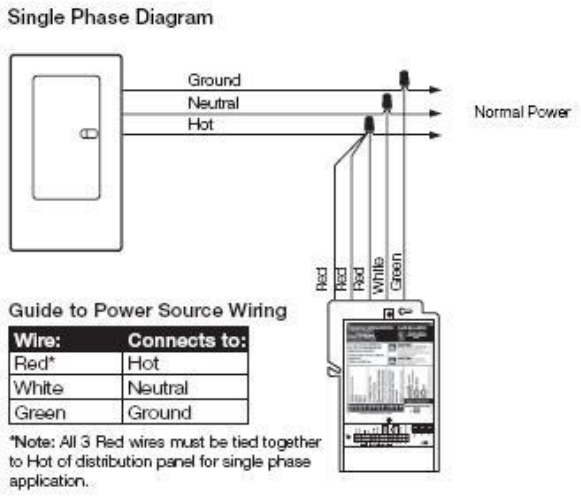
Control Wiring Diagrams



Drawing 19. Wiring Diagram of Photocell



Drawing 20. Wiring Diagram of Vacancy Sensors



Drawing 21. Wiring Diagram of Lighting Relay

Existing Panelboards and Modified Circuits

PANEL LPA — **MAIN: 225A MCB** — **VOLTAGE: 480Y/ 277 3 PH 4 W**
AIC: 35,000 — **MOUNTING: SURFACE** — **NOTE:**
LOCATION: MAIN ELECT. RM. 157 — **100% RATED NEUTRAL BUS**

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	L: 137, 38, 57-59 N TOILETS	2.3			1	20	1	20	1.7			L: FITNESS	2
3	L: CORRI 150		2.1		1	20	1	20		2.8		L: FITNESS & OFFICES	4
5	L: CORRI 152			1.7	1	20	1	20			1.3	L: FITNESS DL	6
7	L: CORRI 152 & 56	2.7			1	20	1	20				L: FITNESS COVE	8
9	L: 148		1.5		1	20	1	20		2.8		L: MULTI #1 & 2	10
11	L: AUX GYM			3.6	1	20	1	20				L: 142A, 43-45, 49 & 51	12
13	L: AUX GYM	3.6			1	20	1	20	0.4			L: EXT. BY SAIL	14
15	L: 114		0.8		1	20	1	20		3.2		L: NE OFFICES	16
17	SPARE				1	20	1	20			2.8	L: 109, 112 & 113	18
19	SPARE				1	20	1	20				SPARE	20
21	SPACE				-	-	-	-				SPACE	22
23	SPACE				-	-	-	-				SPACE	24
25	SPACE				-	-	-	-				SPACE	26
27	SPACE				-	-	-	-				SPACE	28
29	SPACE				-	-	-	-				SPACE	30
31	SPACE				-	-	-	-				SPACE	32
33	SPACE				-	-	-	-				SPACE	34
35	SPACE				-	-	-	-				SPACE	36
37	PANEL 'RPA' TRANSFORMER	25.9			3	125	3	100	15.9			PANEL 'LPC'	38
39	-----		25.6		-	-	-	-		16.2		-----	40
41	-----			24.2	-	-	-	-			13.7	-----	42
		34.55	30.03	29.5	SUB-TOTALS				18	24.96	17.76		

CONNECTED LOAD:

A:	52.5 KVA	=	190 A
B:	55.0 KVA	=	199 A
C:	47.3 KVA	=	171 A

Drawing 22. Panel LPA Existing Loads

PANEL LPB **MAIN:** 225A MCB **VOLTAGE:** 480Y/ 277 3 PH 4 W
AIC: 25,000 **MOUNTING:** SURFACE **NOTE:**
LOCATION: ELECTRICAL RM. 010 100% RATED NEUTRAL BUS

CKT	EQUIPMENT SERVED	LOAD (KVA) A	B	C	BREAKER P	AMPS	BREAKER P	AMPS	LOAD (KVA) A	B	C	EQUIPMENT SERVED	CKT
1	L: ARENA COURT	2.7			1	20	1	20	2.4			L: ARENA / THEATER	2
3	L: ARENA COURT		2.7		1	20	1	20		1.2		L: ARENA SEAT	4
5	L: ARENA COURT			2.7	1	20	1	20			1.5	L: ARENA SEAT	6
7	L: ARENA COURT	2.7			1	20	1	20	1			L: ARENA SEAT	8
9	L: ARENA COURT		2.7		1	20	1	20		0.8		L: ARENA SEAT	10
11	L: ARENA COURT			2.7	1	20	1	20			1	L: ARENA SEAT	12
13	L: ARENA COURT	2.7			1	20	1	20	0.8			L: ARENA SEAT	14
15	L: ARENA COURT		2.7		1	20	1	20		1		L: ARENA SEAT	16
17	L: ARENA COURT			2.7	1	20	1	20			0.8	L: ARENA SEAT	18
19	L: ARENA COURT	2.7			1	20	1	20	1			L: ARENA SEAT	20
21	L: ARENA DOWNLIGHT		0.4		1	20	1	20		0.8		L: ARENA SEAT	22
23	L: LOWER ENTRANCES			1.2	1	20	1	20			0.7	L: ARENA SEAT	24
25	L: TOILETS UPPER LEVEL	1.8			1	20	1	20	0.7			L: ARENA SEAT	26
27	L: TOILET LOWER LEVEL		1.8		1	20	1	20		1.7		L: ARENA SEAT	28
29	L: 010 & 011			1.2	1	20	1	20			1.7	L: ARENA SEAT	30
31	L: TOILET LOWER LEVEL	2			1	20	1	20	1.1			L: ARENA SEAT	32
33	L: CORRIDOR 116		2		1	20	1	20		1		L: ARENA SEAT	34
35	SPARE				1	20	1	20			1.3	L: CONCESSION	36
37	SPARE				1	20	1	20	0.6			L: UPPER ENTRANCES	38
39	SPARE				1	20	1	20		2.6		L: WALL LIGHTING	40
41	SPARE				1	20	1	20			0.6	L: STAIRS NW & SW	42
43	SPACE				-	-	-	-				SPACE	44
45	SPACE				-	-	-	-				SPACE	46
47	SPACE				-	-	-	-				SPACE	48
49	SPACE				-	-	-	-				SPACE	50
51	SPACE				-	-	-	-				SPACE	52
53	SPACE				-	-	-	-				SPACE	54
55	PANEL 'RPB' TRANSFORMER	18.4			3	150	-	-				SPACE	56
57	-----		17.3		-	-	-	-				SPACE	58
59	-----			17.1	-	-	-	-				SPACE	60
		33	29.6	27.6	SUB-TOTALS				7.6	9.1	7.6		

CONNECTED LOAD:

A: 40.6 KVA = 147 A
B: 38.7 KVA = 140 A
C: 35.2 KVA = 127 A

Drawing 23. Panel LPB Existing Loads

PANEL SITE — MAIN: 225A MCB — VOLTAGE: 480Y/ 277 3 PH 4 W
AIC: 25,000 — MOUNTING: SURFACE — NOTE:
LOCATION: ROOM 011 — 100% RATED NEUTRAL BUS

CKT	EQUIPMENT SERVED	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	BREAKER P	BREAKER AMPS	BREAKER P	BREAKER AMPS	LOAD (KVA) A	LOAD (KVA) B	LOAD (KVA) C	EQUIPMENT SERVED	CKT
1	TENNIS COURT	1.8			2	20	1	20	1.8			SITE LIGHTING	2
3	-----		1.8		-	-	1	20		1.8		SITE LIGHTING	4
5	TENNIS COURT			1.8	2	20	1	20			1.8	SITE LIGHTING	6
7	-----	1.8			-	-	1	20	2			SITE LIGHTING	8
9	TENNIS COURT		1.8		2	20	1	20		2		SITE LIGHTING	10
11	-----			1.8	-	-	1	20			2.7	SITE LIGHTING	12
13	TENNIS COURT	1.8			2	20	1	20	2.4			SITE LIGHTING	14
15	-----		1.8		-	-	1	20		0.5		SITE LIGHTING	16
17	TENNIS COURT			1.8	2	20	1	20				SPARE	18
19	-----	1.8			-	-	3	20	1.3			DOCK LEVELER	20
21	TENNIS COURT		1.8		2	20	-	-		1.3		-----	22
23	-----			1.8	-	-	-	-			1.3	-----	24
25	TENNIS COURT	1.8			2	20	3	20	1.2			RAIN WATER	26
27	-----		1.8		-	-	-	-		1.2		-----	28
29	TENNIS COURT			1.8	2	20	-	-			1.2	-----	30
31	-----	1.8			-	-	3	25	4.2			PUMP RWHB #1 & 2	32
33	TENNIS COURT		1.8		2	20	-	-		4.2		-----	34
35	-----			1.8	-	-	-	-			4.2	-----	36
37	TENNIS COURT	1.8			2	20	1	20	1.2			"SAIL" LIGHTING	38
39	-----		1.8		-	-	1	20		1.2		"SAIL" LIGHTING	40
41	TENNIS COURT			1.8	2	20	1	20			0.4	CANOPY LIGHTING	42
43	-----	1.8			-	-	1	20	1.8			SOFFIT LIGHTING	44
45	TENNIS COURT		1.8		2	20	1	20		1.5		SOFFIT LIGHTING	46
47	-----			1.8	-	-	1	20			0.4	ENTRANCE (2)	48
49	TENNIS COURT	1.8			2	20	-	-				SPACE	50
51	-----		1.8		-	-	-	-				SPACE	52
53	TENNIS COURT			1.8	2	20	-	-				SPACE	54
55	-----	1.8			-	-	-	-				SPACE	56
57	TENNIS COURT		1.8		2	20	-	-				SPACE	58
59	-----			1.8	-	-	-	-				SPACE	60
61	TENNIS COURT	1.8			2	20	-	-				SPACE	62
63	-----		1.8		-	-	-	-				SPACE	64
65	SPARE				1	20	-	-				SPACE	66
67	SPARE				1	20	-	-				SPACE	68
69	SPACE				-	-	-	-				SPACE	70
71	SPACE				-	-	-	-				SPACE	72
73	SPACE				-	-	-	-				SPACE	74
75	SPACE				-	-	-	-				SPACE	76
77	SPACE				-		-	-				SPACE	78
79	SPACE				-	-	-	-				SPACE	80
81	SPACE				-	-	-	-				SPACE	82
83	SPACE				-	-	-	-				SPACE	84
		19.8	19.8	18	SUB-TOTALS				15.9	13.7	12		

CONNECTED LOAD:

A: 35.7 KVA = 129 A
B: 33.5 KVA = 121 A
C: 30 KVA = 108 A

Drawing 24. Panel Site Existing Loads

Revised Panelboards and Modified Circuits

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LPA	Panel Location:			Electric Room	
Nominal Phase to Neutral Voltage------->					277	Phase:			3	
Nominal Phase to Phase Voltage-------->					480	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Lighting	3	Toilets	2300	w	0.90	2300	2556	
2	A	Lighting	3	Fitness	1566	w	0.90	1566	1740	
3	B	Lighting	3	Corridor	2100	w	0.90	2100	2333	
4	B	Lighting	3	Fitness	1711	w	0.90	1711	1901	
5	C	Lighting	3	Corridor	1700	w	0.90	1700	1889	
6	C	Lighting	3	Fitness	675	w	0.90	675	750	
7	A	Lighting	3	Corridor	2700	w	0.90	2700	3000	
8	A	Space			0	w		0	0	
9	B	Lighting	3	Dance	1500	w	0.90	1500	1667	
10	B	Lighting	3	Multi	2800	w	0.90	2800	3111	
11	C	Space	3		0	w		0	0	
12	C	Lighting	3	Storage	1800	w	0.90	1800	2000	
13	A	Space	3		0	w		0	0	
14	A	Lighting	3	Sail	400	w	0.90	400	444	
15	B	Lighting	3	Lounge	800	w	0.90	800	889	
16	B	Lighting	3	Offices	3200	w	0.90	3200	3556	
17	C	Spare	9		0	w		0	0	
18	C	Lighting	3	Classroom	2800	w	0.90	2800	3111	
19	A	Spare	9		0	w		0	0	
20	A	Space			0	w		0	0	
21	B	Space			0	w		0	0	
22	B	Space			0	w		0	0	
23	C	Space			0	w		0	0	
24	C	Space			0	w		0	0	
25	A	Space			0	w		0	0	
26	A	Space			0	w		0	0	
27	B	Space			0	w		0	0	
28	B	Space			0	w		0	0	
29	C	Space			0	w		0	0	
30	C	Space			0	w		0	0	
31	A	Space			0	w		0	0	
32	A	Space			0	w		0	0	
33	B	Panel DP	9		1080	w		1080	1350	
34	B	Space			0	w		0	0	
35	C	* * *	9	* * *	1080	w		1080	1350	
36	C	Space			0	w		0	0	
37	A	Transformer RPA	9	Electric	25900	w		25900	32375	
38	A	Panel LPC	9	Electric	15900	w		15900	19875	
39	B	* * *	9	* * *	25600	w		25600	32000	
40	B	* * *	9	* * *	16200	w		16200	20250	
41	C	* * *	9	* * *	24200	w		24200	30250	
42	C	* * *	9	* * *	13700	w		13700	17125	
PANEL TOTAL								149.7	183.5	Amps= 220.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					48.8	60.0	34%	216.6
PHASE TOTAL	B					55.0	67.1	39%	242.1
PHASE TOTAL	C					46.0	47.0	27%	169.7

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		26.1	28.9		26.1	28.9	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		123.7	154.6		123.7	154.6	0.80		
Total Demand Loads						149.7	183.5			
Spare Capacity			20%			29.9	36.7			
Total Design Loads						179.7	220.2	0.82	Amps=	265.0

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Table 20. Panel LPA New Loads

Panelboard	
Tag	LPA
Voltage System	480Y/ 277V
Calculated Design Load (kW)	180
Calculated Power Factor	0.82
Calculated Design Load (kVA)	220.226
Calculated Design Load (A)	265.0132371
Feeder	
Feeder Protection Size	400
Number of Sets	2
Wire Size	
Phase	2/0
Neutral	2/0
Ground	3
Wire Area (table 5)	
Each Phase	0.2223
Total – All phases	0.6669
Neutral	0.2223
Ground	0.0973
Total – All Wires	0.9865
Minimum Conduit Area (above * 2.5)	2.46625
Conduit Size (Table 4)	2"
Conduit Size (Table C.1)	2-1/2"
Feeder Length	25 ft
Final Voltage Drop (V)	12.3 V
Final Voltage Drop (%)	2.60%
Was feeder re-sized?	NO

Table 21. Panel LPA Feeder Sizing

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPA	MIN. C/B AIC:	35k
SIZE/TYPE BUS:	400A	PANEL LOCATION:	Electric Room	OPTIONS:	
SIZE/TYPE MAIN:	400A/3P MCB	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Toilets	2300	20A/1P	1	*			2	20A/1P	1566	Fitness	Lighting
Lighting	Corridor	2100	20A/1P	3		*		4	20A/1P	1711	Fitness	Lighting
Lighting	Corridor	1700	20A/1P	5			*	6	20A/1P	675	Fitness	Lighting
Lighting	Corridor	2700	20A/1P	7	*			8	20A/1P	0		Space
Lighting	Dance	1500	20A/1P	9		*		10	20A/1P	2800	Multi	Lighting
Space		0	20A/1P	11			*	12	20A/1P	1800	Storage	Lighting
Space		0	20A/1P	13	*			14	20A/1P	400	Sail	Lighting
Lighting	Lounge	800	20A/1P	15		*		16	20A/1P	3200	Offices	Lighting
Spare		0	20A/1P	17			*	18	20A/1P	2800	Classroom	Lighting
Spare		0	20A/1P	19	*			20	20A/1P	0		Space
Space		0	20A/1P	21		*		22	20A/1P	0		Space
Space		0	20A/1P	23			*	24	20A/1P	0		Space
Space		0	20A/1P	25	*			26	20A/1P	0		Space
Space		0	20A/1P	27		*		28	20A/1P	0		Space
Space		0	20A/1P	29			*	30	20A/1P	0		Space
Space		0	20A/1P	31	*			32	20A/1P	0		Space
Panel DP		1080	50A/2P	33		*		34	20A/1P	0		Space
* * *	* * *	1080		35			*	36	20A/1P	0		Space
Transformer RPA	Electric	25900	125A/3P	37	*			38	100A/3P	15900	Electric	Panel LPC
* * *	* * *	25600		39		*		40		16200	* * *	* * *
* * *	* * *	24200		41			*	42		13700	* * *	* * *

CONNECTED LOAD (KW) - A Ph.	48.77	TOTAL DESIGN LOAD (KW)	179.65
CONNECTED LOAD (KW) - B Ph.	54.99	POWER FACTOR	0.82
CONNECTED LOAD (KW) - C Ph.	45.96	TOTAL DESIGN LOAD (AMPS)	265

Table 22. Panel LPA Schedule

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LPB	Panel Location:			Electric Room	
Nominal Phase to Neutral Voltage------->					277	Phase:			3	
Nominal Phase to Phase Voltage-------->					480	Wires:			4	
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Lighting	3	Arena	2700	w		2700	3375	
2	A	Lighting	3	Arena	2400	w		2400	3000	
3	B	Lighting	3	Arena	2700	w		2700	3375	
4	B	Lighting	3	Arena	1200	w		1200	1500	
5	C	Lighting	3	Arena	2700	w		2700	3375	
6	C	Lighting	3	Arena	1500	w		1500	1875	
7	A	Lighting	3	Arena	2700	w		2700	3375	
8	A	Lighting	3	Arena	1000	w		1000	1250	
9	B	Lighting	3	Arena	2700	w		2700	3375	
10	B	Lighting	3	Arena	800	w		800	1000	
11	C	Lighting	3	Arena	2700	w		2700	3375	
12	C	Lighting	3	Arena	1000	w		1000	1250	
13	A	Lighting	3	Arena	2700	w		2700	3375	
14	A	Lighting	3	Arena	800	w		800	1000	
15	B	Lighting	3	Arena	2700	w		2700	3375	
16	B	Lighting	3	Arena	100	w		100	125	
17	C	Lighting	3	Arena	2700	w		2700	3375	
18	C	Lighting	3	Arena	800	w		800	1000	
19	A	Lighting	3	Arena	2700	w		2700	3375	
20	A	Lighting	3	Arena	1000	w		1000	1250	
21	B	Lighting	3	Arena	400	w		400	500	
22	B	Lighting	3	Arena	800	w		800	1000	
23	C	Lighting	3	Toilets	1200	w		1200	1500	
24	C	Lighting	3	Arena	700	w		700	875	
25	A	Lighting	3	Toilets	1800	w		1800	2250	
26	A	Lighting	3	Arena	700	w		700	875	
27	B	Lighting	3	Toilets	1800	w		1800	2250	
28	B	Lighting	3	Arena	1700	w		1700	2125	
29	C	Lighting	3	Electric	1200	w		1200	1500	
30	C	Lighting	3	Arena	1700	w		1700	2125	
31	A	Lighting	3	Toilets	2000	w		2000	2500	
32	A	Lighting	3	Arena	1100	w		1100	1375	
33	B	Lighting	3	Corridor	2000	w		2000	2500	
34	B	Lighting	3	Arena	1000	w		1000	1250	
35	C	Space	9		0	w		0	0	
36	C	Lighting	3	Lobby	564	w		564	705	
37	A	RPB XMFR	9	Electric	18400	w		18400	23000	
38	A	Space	9		0	w		0	0	
39	B	* * *	9	* * *	17300	w		17300	21625	
40	B	Lighting	3	Wall	2600	w		2600	3250	
41	C	* * *	9	* * *	17100	w		17100	21375	
42	C	Lighting	3	Stairs	600	w		600	750	
PANEL TOTAL								112.3	140.3	Amps= 168.9

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					40.0	50.0	37%	180.5
PHASE TOTAL	B					37.8	47.3	35%	170.6
PHASE TOTAL	C					34.5	38.7	28%	139.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		59.5	74.3		59.5	74.3	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		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		52.8	66.0		52.8	66.0	0.80		
Total Demand Loads						112.3	140.3			
Spare Capacity			20%			22.5	28.1			
Total Design Loads						134.7	168.4	0.80	Amps=	202.6

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Table 23. Panel LPB New Loads

Panelboard	
Tag	LPB
Voltage System	480Y/ 277V
Calculated Design Load (kW)	134.7
Calculated Power Factor	0.8
Calculated Design Load (kVA)	168.4
Calculated Design Load (A)	202.6
Feeder	
Feeder Protection Size	225
Number of Sets	1
Wire Size	
Phase	4/0
Neutral	4/0
Ground	4
Wire Area (table 5)	
Each Phase	0.3237
Total – All phases	0.9711
Neutral	0.3237
Ground	0.0824
Total – All Wires	1.3772
Minimum Conduit Area (above * 2.5)	3.443
Conduit Size (Table 4)	2- 1/2"
Conduit Size (Table C.1)	2-1/2"
Feeder Length	100ft
Final Voltage Drop (V)	10.5 V
Final Voltage Drop (%)	2.20%
Was feeder re-sized?	NO

Table 24. Panel LPB Feeder Sizing

PANELBOARD SCHEDULE

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	LPB	MIN. C/B AIC:	10K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	Electric Room	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	225A/3P C/B	PANEL MOUNTING:	SURFACE		FOR PANELBOARD 1L1B

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Arena	2700	20A/1P	1	*			2	20A/1P	2400	Arena	Lighting
Lighting	Arena	2700	20A/1P	3		*		4	20A/1P	1200	Arena	Lighting
Lighting	Arena	2700	20A/1P	5			*	6	20A/1P	1500	Arena	Lighting
Lighting	Arena	2700	20A/1P	7	*			8	20A/1P	1000	Arena	Lighting
Lighting	Arena	2700	20A/1P	9		*		10	20A/1P	800	Arena	Lighting
Lighting	Arena	2700	20A/1P	11			*	12	20A/1P	1000	Arena	Lighting
Lighting	Arena	2700	20A/1P	13	*			14	20A/1P	800	Arena	Lighting
Lighting	Arena	2700	20A/1P	15		*		16	20A/1P	100	Arena	Lighting
Lighting	Arena	2700	20A/1P	17			*	18	20A/1P	800	Arena	Lighting
Lighting	Arena	2700	20A/1P	19	*			20	20A/1P	1000	Arena	Lighting
Lighting	Arena	400	20A/1P	21		*		22	20A/1P	800	Arena	Lighting
Lighting	Toilets	1200	20A/1P	23			*	24	20A/1P	700	Arena	Lighting
Lighting	Toilets	1800	20A/1P	25	*			26	20A/1P	700	Arena	Lighting
Lighting	Toilets	1800	20A/1P	27		*		28	20A/1P	1700	Arena	Lighting
Lighting	Electric	1200	20A/1P	29			*	30	20A/1P	1700	Arena	Lighting
Lighting	Toilets	2000	20A/1P	31	*			32	20A/1P	1100	Arena	Lighting
Lighting	Corridor	2000	20A/1P	33		*		34	20A/1P	1000	Arena	Lighting
Space	0	0	20A/1P	35			*	36	20A/1P	564	Lobby	Lighting
RPB XMFR	Electric	18400	150A/3P	37	*			38	20A/1P	0		Space
* * *	* * *	17300		39		*		40	20A/1P	2600	Wall	Lighting
* * *	* * *	17100		41			*	42	20A/1P	600	Stairs	Lighting

CONNECTED LOAD (KW) - A Ph.	40.00	TOTAL DESIGN LOAD (KW)	134.72
CONNECTED LOAD (KW) - B Ph.	37.80	POWER FACTOR	0.80
CONNECTED LOAD (KW) - C Ph.	34.46	TOTAL DESIGN LOAD (AMPS)	203

Table 25. Panel LPB Schedule

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				Site	Panel Location:			Electric Room		
Nominal Phase to Neutral Voltage------->				277	Phase:			3		
Nominal Phase to Phase Voltage-------->				480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
1	A	Lighting	3	Tennis	1800	w		1800	2250	
2	A	Lighting	3	Site	1800	w		1800	2250	
3	B	* * *	3	* * *	1800	w		1800	2250	
4	B	Lighting	3	Site	1800	w		1800	2250	
5	C	Lighting	3	Tennis	1800	w		1800	2250	
6	C	Lighting	3	Site	1800	w		1800	2250	
7	A	* * *	3	* * *	1800	w		1800	2250	
8	A	Lighting	3	Site	2000	w		2000	2500	
9	B	Lighting	3	Tennis	1800	w		1800	2250	
10	B	Lighting	3	Site	200	w		200	250	
11	C	* * *	3	* * *	1800	w		1800	2250	
12	C	Lighting	3	Site	2700	w		2700	3375	
13	A	Lighting	3	Tennis	1800	w		1800	2250	
14	A	Lighting	3	Site	2400	w		2400	3000	
15	B	* * *	3	* * *	1800	w		1800	2250	
16	B	Lighting	3	Site	500	w		500	625	
17	C	Lighting	3	Tennis	1800	w		1800	2250	
18	C	Spare	9			w		0	0	
19	A	* * *	3	* * *	1800	w		1800	2250	
20	A	Dock Leveler	9	Site	1300	w		1300	1625	
21	B	Lighting	3	Tennis	1800	w		1800	2250	
22	B	* * *	9	* * *	1300	w		1300	1625	
23	C	* * *	3	* * *	1800	w		1800	2250	
24	C	* * *	9	* * *	1300	w		1300	1625	
25	A	Lighting	3	Tennis	1800	w		1800	2250	
26	A	Rain Water	9	Site	1200	w		1200	1500	
27	B	* * *	3	* * *	1800	w		1800	2250	
28	B	* * *	9	* * *	1200	w		1200	1500	
29	C	Lighting	3	Tennis	1800	w		1800	2250	
30	C	* * *	9	* * *	1200	w		1200	1500	
31	A	* * *	3	* * *	1800	w		1800	2250	
32	A	Pumps	9	Site	4200	w		4200	5250	
33	B	Lighting	3	Tennis	1800	w		1800	2250	
34	B	* * *	9	* * *	4200	w		4200	5250	
35	C	* * *	9	* * *	1800	w		1800	2250	
36	C	* * *	9	* * *	4200	w		4200	5250	
37	A	Lighting	3	Tennis	1800	w		1800	2250	
38	A	Lighting	3	Site	1200	w		1200	1500	
39	B	* * *	3	* * *	1800	w		1800	2250	
40	B	Lighting	3	Site	1375	w		1375	1719	
41	C	Lighting	3	Tennis	1800	w		1800	2250	
42	C	Lighting	3	Site	1638	w		1638	2048	
PANEL TOTAL								75.3	94.1	Amps= 113.3

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					26.7	33.4	36%	120.5
PHASE TOTAL	B					23.2	29.0	31%	104.6
PHASE TOTAL	C					25.4	30.9	33%	111.7

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		53.4	66.8		53.4	66.8	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		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		21.9	27.4		21.9	27.4	0.80		
Total Demand Loads						75.3	94.1			
Spare Capacity			20%			15.1	18.8			
Total Design Loads						90.4	113.0	0.80	Amps=	135.9

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Table 26. Panel Site New Loads on first 42 Circuits

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				Site	Panel Location:			Electric Room		
Nominal Phase to Neutral Voltage------->				277	Phase:			3		
Nominal Phase to Phase Voltage-------->				480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks
43	A	* * *	3	* * *	1800	w		1800	2250	
44	A	Lighting	3	Site	1800	w		1800	2250	
45	B	Lighting	3	Tennis	1800	w		1800	2250	
46	B	Lighting	3	Site	1500	w		1500	1875	
47	C	* * *	3	* * *	1800	w		1800	2250	
48	C	Spare	9			w		0	0	
49	A	Lighting	3	Tennis	1800	w		1800	2250	
50	A	Space				w		0	0	
51	B	* * *	3	* * *	1800	w		1800	2250	
52	B	Space				w		0	0	
53	C	Lighting	3	Tennis	1800	w		1800	2250	
54	C	Space				w		0	0	
55	A	* * *	3	* * *	1800	w		1800	2250	
56	A	Space				w		0	0	
57	B	* * *	3	* * *	1800	w		1800	2250	
58	B	Space				w		0	0	
59	C	* * *	3	* * *	1800	w		1800	2250	
60	C	Space				w		0	0	
61	A	Lighting	3	Tennis	1800	w		1800	2250	
62	A	Space				w		0	0	
63	B	* * *	3	* * *	1800	w		1800	2250	
64	B	Space				w		0	0	
65	C	Spare	9			w		0	0	
66	C	Space				w		0	0	
67	A	Spare	9			w		0	0	
68	A	Space				w		0	0	
69	B	Space				w		0	0	
70	B	Space				w		0	0	
71	C	Space				w		0	0	
72	C	Space				w		0	0	
73	A	Space				w		0	0	
74	A	Space				w		0	0	
75	B	Space				w		0	0	
76	B	Space				w		0	0	
77	C	Space				w		0	0	
78	C	Space				w		0	0	
79	A	Space				w		0	0	
80	A	Space				w		0	0	
81	B	Space				w		0	0	
82	B	Space				w		0	0	
83	C	Space				w		0	0	
84	C	Space				w		0	0	
PANEL TOTAL								23.1	28.9	Amps= 34.7

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					9.0	11.3	39%	40.6
PHASE TOTAL	B					8.7	10.9	38%	39.3
PHASE TOTAL	C					5.4	6.8	23%	24.4

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		23.1	28.9		23.1	28.9	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		0.0	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						23.1	28.9			
Spare Capacity			20%			4.6	5.8			
Total Design Loads						27.7	34.7	0.80	Amps=	41.7

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Table 27. Panel Site New Loads on second 42 Circuits

Panelboard		
Tag		Site
Voltage System		480Y/ 277V
Calculated Design Load (kW)		118.1
Calculated Power Factor		0.8
Calculated Design Load (kVA)		147.7
Calculated Design Load (A)		177.7
Feeder		
Feeder Protection Size		225
Number of Sets		1
Wire Size		
	Phase	4/0
	Neutral	4/0
	Ground	4
Wire Area (table 5)		
	Each Phase	0.3237
	Total – All phases	0.9711
	Neutral	0.3237
	Ground	0.0824
	Total – All Wires	1.3772
Minimum Conduit Area (above * 2.5)		3.443
Conduit Size (Table 4)		2- 1/2"
Conduit Size (Table C.1)		2-1/2"
Feeder Length		100ft
Final Voltage Drop (V)		10.5V
Final Voltage Drop (%)		2.20%
Was feeder re-sized?		NO

Table 28. Panel Site Feeder Sizing

PANELBOARD SCHEDULE

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	Site	MIN. C/B AIC:	10K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	Electric Room	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	225A/3P C/B	PANEL MOUNTING:	SURFACE		FOR PANELBOARD 1L1B

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Tennis	1800	20A/2P	1	*			2	20A/1P	1800	Site	Lighting
* * *	* * *	1800		3		*		4	20A/1P	1800	Site	Lighting
Lighting	Tennis	1800	20A/2P	5			*	6	20A/1P	1800	Site	Lighting
* * *	* * *	1800		7	*			8	20A/1P	2000	Site	Lighting
Lighting	Tennis	1800	20A/2P	9		*		10	20A/1P	200	Site	Lighting
* * *	* * *	1800		11			*	12	20A/1P	2700	Site	Lighting
Lighting	Tennis	1800	20A/2P	13	*			14	20A/1P	2400	Site	Lighting
* * *	* * *	1800		15		*		16	20A/1P	500	Site	Lighting
Lighting	Tennis	1800	20A/2P	17			*	18	20A/1P	0	0	Spare
* * *	* * *	1800		19	*			20	20A/3P	1300	Site	Dock Leveler
Lighting	Tennis	1800	20A/2P	21		*		22		1300	* * *	* * *
* * *	* * *	1800		23			*	24		1300	* * *	* * *
Lighting	Tennis	1800	20A/2P	25	*			26	20A/3P	1200	Site	Rain Water
* * *	* * *	1800		27		*		28		1200	* * *	* * *
Lighting	Tennis	1800	20A/2P	29			*	30		1200	* * *	* * *
* * *	* * *	1800		31	*			32	20A/3P	4200	Site	Pumps
Lighting	Tennis	1800	20A/2P	33		*		34		4200	* * *	* * *
* * *	* * *	1800		35			*	36		4200	* * *	* * *
Lighting	Tennis	1800	20A/2P	37	*			38	20A/1P	1200	Site	Lighting
* * *	* * *	1800		39		*		40	20A/1P	1375	Site	Lighting
Lighting	Tennis	1800	20A/2P	41			*	42	20A/1P	1638	Site	Lighting

CONNECTED LOAD (KW) - A Ph.	26.70	TOTAL DESIGN LOAD (KW)	90.38
CONNECTED LOAD (KW) - B Ph.	23.18	POWER FACTOR	0.80
CONNECTED LOAD (KW) - C Ph.	25.44	TOTAL DESIGN LOAD (AMPS)	136

PANELBOARD SCHEDULE

VOLTAGE:	208Y/120V,3PH,4W	PANEL TAG:	Site	MIN. C/B AIC:	10K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	Electric Room	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	225A/3P C/B	PANEL MOUNTING:	SURFACE		FOR PANELBOARD 1L1B

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
* * *	* * *	1800		43	*			44	20A/1P	1800	Site	Lighting
Lighting	Tennis	1800	20A/2P	45		*		46	20A/1P	1500	Site	Lighting
* * *	* * *	1800		47			*	48		0	0	Spare
Lighting	Tennis	1800	20A/2P	49	*			50		0	0	Space
* * *	* * *	1800		51		*		52		0	0	Space
Lighting	Tennis	1800	20A/2P	53			*	54		0	0	Space
* * *	* * *	1800		55	*			56		0	0	Space
* * *	* * *	1800	20A/2P	57		*		58		0	0	Space
* * *	* * *	1800		59			*	60		0	0	Space
Lighting	Tennis	1800	20A/2P	61	*			62		0	0	Space
* * *	* * *	1800		63		*		64		0	0	Space
Spare	0	0		65			*	66		0	0	Space
Spare	0	0		67	*			68		0	0	Space
Space	0	0		69		*		70		0	0	Space
Space	0	0		71			*	72		0	0	Space
Space	0	0		73	*			74		0	0	Space
Space	0	0		75		*		76		0	0	Space
Space	0	0		77			*	78		0	0	Space
Space	0	0		79	*			80		0	0	Space
Space	0	0		81		*		82		0	0	Space
Space	0	0		83			*	84		0	0	Space

CONNECTED LOAD (KW) - A Ph.	9.00	TOTAL DESIGN LOAD (KW)	27.72
CONNECTED LOAD (KW) - B Ph.	8.70	POWER FACTOR	0.80
CONNECTED LOAD (KW) - C Ph.	5.40	TOTAL DESIGN LOAD (AMPS)	42

Table 29. Panel Site Schedule

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				DP	Panel Location:			Electric			
Nominal Phase to Neutral Voltage------->				277	Phase:			1			
Nominal Phase to Phase Voltage-------->				554	Wires:			3			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	L1	Lighting	3	Gym	1080	w		1080	1350		
2	L1	Lighting	3	Gym	1080	w		1080	1350		
3	L2	Space			0	w		0	0		
4	L2	Space			0	w		0	0		
5	L1	Space			0	w		0	0		
6	L1	Space			0	w		0	0		
7	L2	Space			0	w		0	0		
8	L2	Space			0	w		0	0		
PANEL TOTAL								2.2	2.7	Amps=	4.9
PHASE LOADING								kW	kVA	%	Amps
LEG TOTAL			L1					2.2	2.7	100%	9.7
LEG TOTAL			L2					0.0	0.0		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		2.2	2.7		2.2	2.7	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		0.0	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	2.7			
Spare Capacity			20%			0.4	0.5			
Total Design Loads						2.6	3.2	0.80	Amps=	5.8

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Table 30. Panel DP New Loads

Panelboard	
Tag	DP
Voltage System	277V
Calculated Design Load (kW)	2.6kW
Calculated Power Factor	0.8
Calculated Design Load (kVA)	3.2kVA
Calculated Design Load (A)	6A
Feeder	
Feeder Protection Size	50
Number of Sets	1
Wire Size	
Phase	6
Neutral	6
Ground	10
Wire Area (table 5)	
Each Phase	0.0507
Total – All phases	0.1521
Neutral	0.0507
Ground	0.0211
Total – All Wires	0.1732
Minimum Conduit Area (above * 2.5)	0.433
Conduit Size (Table 4)	3/4"
Conduit Size (Table C.1)	1"
Feeder Length	100ft
Final Voltage Drop (V)	3.2V
Final Voltage Drop (%)	1.10%
Was feeder re-sized?	NO

Table 31. Panel DP Feeder Sizing

PANELBOARD SCHEDULE

VOLTAGE:	208Y/120V,3PH,4W		PANEL TAG:	DP					MIN. C/B AIC:	10K		
SIZE/TYPE BUS:	225A		PANEL LOCATION:	Electric					OPTIONS:	PROVIDE FEED THROUGH LUGS		
SIZE/TYPE MAIN:	225A/3P C/B		PANEL MOUNTING:	SURFACE						FOR PANELBOARD 1L1B		
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	L1		L2	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Gym	1080	20A/1P	1	*			2	20A/1P	1080	Gym	Lighting
Space		0	20A/1P	3			*	4	20A/1P	0		Space
Space		0	20A/1P	5	*			6	20A/1P	0		Space
Space		0	20A/1P	7			*	8	20A/1P	0		Space
CONNECTED LOAD (KW) - A Ph.		2.16								TOTAL DESIGN LOAD (KW)		2.59
CONNECTED LOAD (KW) - B Ph.										POWER FACTOR		0.80
CONNECTED LOAD (KW) - C Ph.		0.00								TOTAL DESIGN LOAD (AMPS)		6

Table 32. Panel DP Schedule

Short Circuit and Protective Device Study

Description

A short circuit and protective device study were conducted in order to determine the electrical systems reliability to protect itself from faulty wiring, over-current circumstances, and any other problems that could occur. The short circuit study looked into three components of the electrical system. Those components are the service entrance, the next downstream Panel, and a circuit within that Panel. The protective device study will break down the characteristics of the protection that each of these components have. This report assumes all equipment is to be EATON Corporation and Cutler-Hammer products because the project has not been built or bided.

Short Circuit Calculations

Below are charts that break down the three components from the main switch board 'MDS' to the branch Panel 'MLP' and the circuit for roof top unit 4. The main switch board is 480Y/277V, 3PH. 4W, with a 3200 amp frame, the branch Panel 'MLP' is 480Y/277V, 3PH., 4W with a 600 amp frame, and the roof top unit 4 circuit is a 3P 70A breaker.

Available Fault Current Calculation

by John Sokolik Ver. 6.3
jmp1jds@earthlink.net

Utility Fault Current	0 amperes	kVA =	2000		
		E =	480		
I = kVA x 1000 = trans. FLA / E x 1.732		trans. FLA =	2406		
Isca = trans. FLA x 100 / transformer Z =			2406		
			5.75 %		
Isca = ampere short-circuit current RMS symmetrical.		Isca =	41,838 amperes		
Point to Point Method				Three Phase 480/277	
	Length (distance) FEET	L =	25	Aluminum in Nonmetallic Raceway	
'f ' factor = 1.732 x L x I / N x C x E L-N	(ASC)	Isca =	41,838		
	# conductors per phase	N =	6		
	Phase conductor constant	C =	23,492	Phase Conductor	750 kcmil
	Volt Line to Line	E L-L =	480 Volt		
		f =	0.027		
	Neutral conductor constant	C =	23,492	Neutral Conductor	750 kcmil
Multiplier	Volt Line to Neutral	E L-N =	277 Volt		
		f =	0.046		
M = 1 / 1 + f	Line to Line	M =	0.974		
	Line to Neutral	M =	0.956		

Fault Current at Service Equipment

Isca x M = fault current at terminals of main disconnect L- L = → 40,747 amperes
Isca x M = fault current at terminals of main disconnect L- N = → 39,983 amperes

Table 33. Short Circuit Calculation Switchboard MDS

Fault Current from	Switchboard To Panel MLP				Copper in Metal Raceway		
					Three Phase		
Three Phase Feeder		Length (distance)	L	=	45		
'f ' factor =	1.732 x L x I / N x C x E L-N	(ASC)	Isca	=	40,747	Phase	39,983 Neutral
		# conductors per phase	N	=	2		
		Phase conductor constant	C	=	19,704	Phase Conductor	350 kcmil
		Volt Line to Line	E L-L	=	480	Volt	
			f	=	0.168		
		Neutral conductor constant	C	=	19,704	Neutral Conductor	350 kcmil
		Volt Line to Neutral	E L-N	=	277	Volt	
Multiplier			f	=	0.285		
M = 1 / 1 + f		Line to Line	M	=	0.856		
		Line to Neutral	M	=	0.778		

Isca x M = fault current at terminal of the panel L- L = **34,889** amperes
Isca x M = fault current at terminal of the panel L- N = **31,103** amperes

Calculation does not include motor contribution

Table 34. Short Circuit Calculations Panel MLP

Branch Circuit Fault from	Panel MLP To RTU-4 Branch Circuit				Copper in Metal Raceway		
					Three Phase		
Three Phase Branch		Length (distance)	L	=	300		
'f ' factor =	1.732 x L x I / N x C x E L-N	(ASC)	Isca	=	34,889	Phase	31,103 Neutral
		# conductors per phase	N	=	1		
		Phase conductor constant	C	=	3,806	Phase Conductor	4
		Volt Line to Line	E L-L	=	480	Volt	
			f	=	9.923		
		Neutral conductor constant	C	=	3,806	Neutral Conductor	4
		Volt Line to Neutral	E L-N	=	277	Volt	
Multiplier			f	=	15.329		
M = 1 / 1 + f		Line to Line	M	=	0.092		
		Line to Neutral	M	=	0.061		

Isca x M = fault current at terminal of the panel L- L = **3,194** amperes
Isca x M = fault current at terminal of the panel L- N = **1,905** amperes

Calculation does not include motor contribution

Table 35. Short Circuit Calculation RTU-4

Protective Devices

This portion of the report analyzes the coordination between protective devices used in the short circuit calculation by hand above. The devices that will be analyzed are the main circuit breaker for Switchboard MDS, Distribution Panel MLP, branch circuit RTU-4, and the motor for RTU-4. For proper coordination of protective devices the trip curve should ascend in an upstream fashion for the current rating. Thus, meaning the breaker for the RTU-4 should trip first, then the breaker for Panel MLP, and lastly the breaker for Switchboard MDS. The Time Current Curve (TCC) shown will indicate that indeed the breakers will trip in this fashion, with one altercation. As seen on the curve, if a spike of 3000A were to enter the system from one second or longer there is no differentiation between the MDS breaker and MLP breaker. This may cause little problems in the coordination process between breakers. The breaker type and color is specified for synchronization of TCC.

Switch Board 'MDS' – Magnum DS, RMS MDS-632 3200A 65kAIC

Panel 'MLP' – Thermal Magnetic M-Frame Circuit Breaker Type HLD, 600V, 3P600A, 65kAIC

Circuit 'RTU-4' –Thermal Magnetic F-Frame Circuit Breaker Type FDC, 480V, 3P70A, 35kAIC

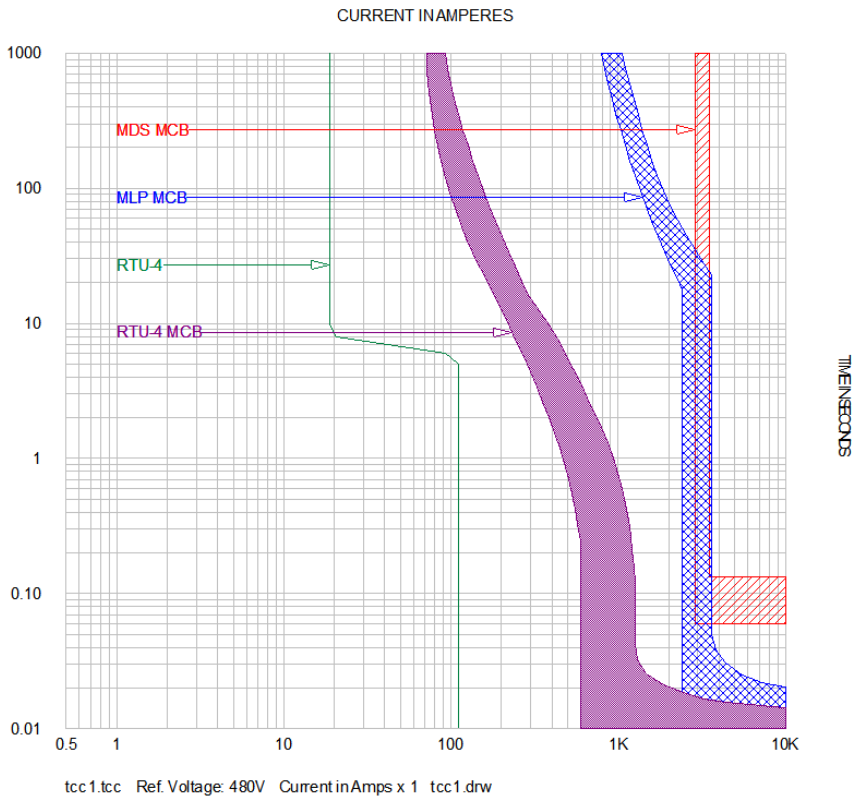


Image 24. TCC Curve for MDS, MLP, RTU-4 Coordination

Electrical Depth 1 – Motor Control Center

Description

This depth looked in to localizing a Motor Control Center within the main mechanical room. The Panel MLP was the primary load center for the space with disconnects located at individual pieces of HVAC equipment. The Motor Control Center took motors with the highest horsepower rating in the 480V Panel MLP and re-localized them with their motor starters and disconnects in the Motor Control Center. The Eaton 2006 Consulting Application Guide for Cutler-Hammer products was used in order to size to produce the layout of the Motor Control Center. Within the calculation the tables used within the guide are specified. See the following charts and drawings to see details of Motor Control Center and Appendix C for specification sheets.

							Table: 430.250 NEC			Table 30.1-88 Eaton			Table 30.1-27 & 30.1-2 Eaton	Table 30.1-27 & 30.1-2 Eaton
Tag	**Equipment**	**HP**	**Volt**	**Phase**	**PF**	**kVA**	**NEC**	**MCA**	**FLA**	**Overcurrent Protection (MCCB)**	**HVAC Controller**	**Starter Type**	**Starter (NEMA Type)**	**# Spaces**
CWP-1	CHD WTR PUMP #1 - CHESA	40	480	3	0.95	32.84	52	54.74	68.42	100	ATC	FVR	3	4
CWP-2	CHD WTR PUMP #2 - CHESA	40	480	3	0.95	32.84	52	54.74	68.42	100	ATC	FVR	3	4
HWP-3	HEATING PUMP - SUSQ	30	480	3	0.95	25.26	40	42.11	52.63	70	ATC	FVR	3	4
HWP-4	HEATING PUMP - SUSQ	30	480	3	0.95	25.26	40	42.11	52.63	70	ATC	FVR	3	4
RTU-3	RTU #3 SUPPLY	25	480	3	0.95	21.47	34	35.79	44.74	70	VFD	AFD	2	6
RTU-2	RTU #2 SUPPLY	20	480	3	0.95	17.05	27	28.42	35.53	50	VFD	AFD	2	6
RTU-1	RTU #1 SUPPLY	15	480	3	0.95	13.26	21	22.11	27.63	45	VFD	AFD	2	4
RTU-3	RTU #3 RETURN	15	480	3	0.95	13.26	21	22.11	27.63	45	VFD	AFD	2	4
RTU-2	RTU #2 RETURN	15	480	3	0.95	13.26	21	22.11	27.63	45	VFD	AFD	2	4
HWP-1	HEATING PUMP #1 - CHESA	7.5	480	3	0.95	6.95	11	11.58	14.47	25	ATC	FVR	1	3
HWP-2	HEATING PUMP #2 - CHESA	7.5	480	3	0.95	6.95	11	11.58	14.47	25	ATC	FVR	1	3
PWP	POOL PUMP	7.5	480	3	0.95	6.95	11	11.58	14.47	25	ATC	FVR	1	3
DWP-1	PUMP DWP #1	7.5	480	3	0.95	6.95	11	11.58	14.47	25	ATC	FVR	1	3
DWP-2	PUMP DWP #2	7.5	480	3	0.95	6.95	11	11.58	14.47	25	ATC	FVR	1	3
RTU-1	RTU #1 RETURN	5	480	3	0.95	4.80	7.6	8.00	10.00	15	VFD	AFD	0	4
BP-1	BOILER #1	3	480	3	0.85	3.39	4.8	5.65	7.06	15	ATC	FVR	0	3
BP-2	BOILER #2	3	480	3	0.85	3.39	4.8	5.65	7.06	15	ATC	FVR	0	3
BP-3	BOILER #3	3	480	3	0.85	3.39	4.8	5.65	7.06	15	ATC	FVR	0	3
Totals						244.23		294	367					68
													Sections:	6

Notes:
1) Manufacturer : Eaton Freedom 2100 Series, bucket size = 6"
2) MCC will be feed from the Main Switchboard (MDS)
3) The MDS will contain a 400A drawout type circuit breaker
4) The feed to the MCC will be 2 sets of 4#3/0 + 1#6GRD. in 3" C.

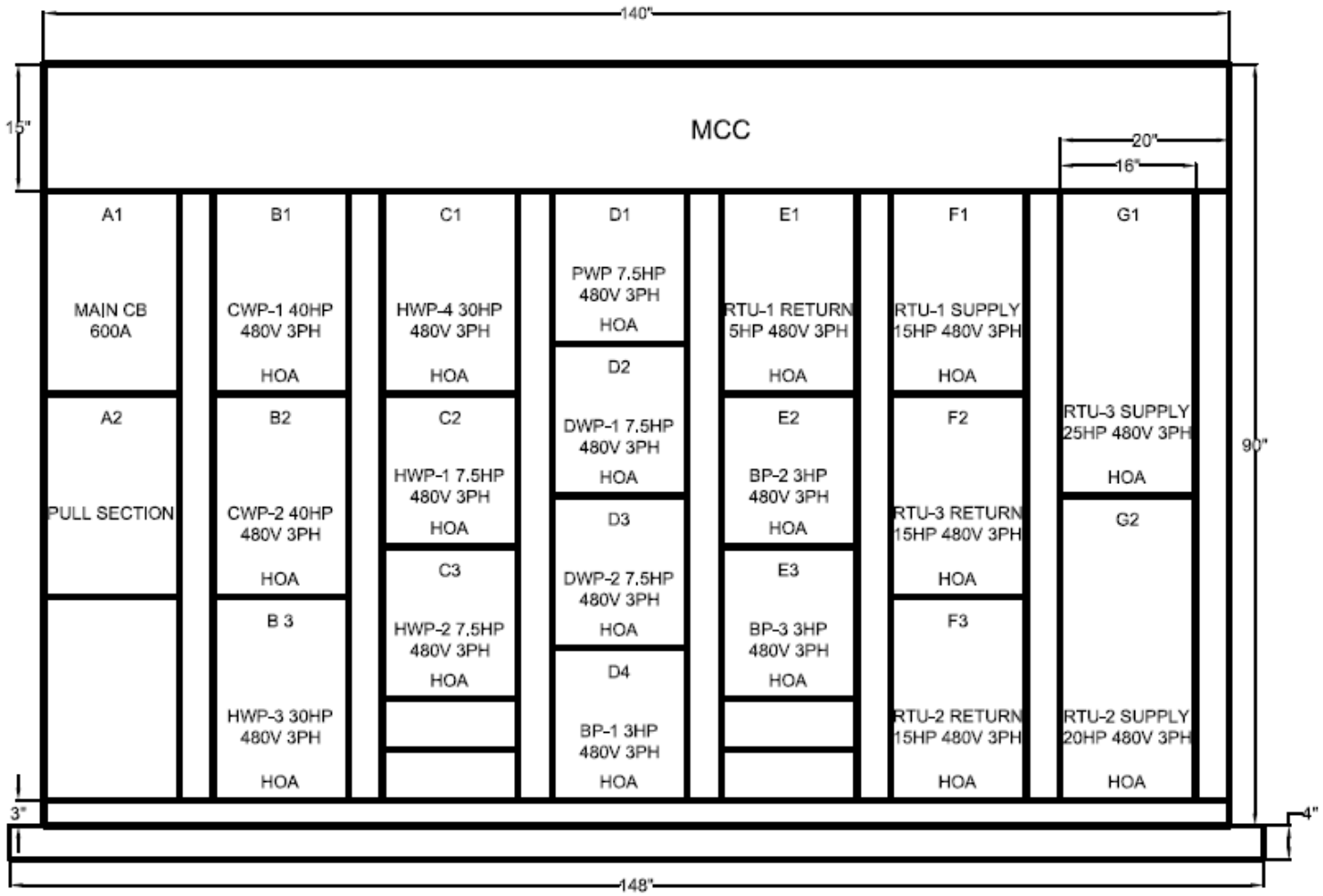
Table 36. MCC Calculations

MOTOR CONTROL CENTER: MCC LOCATION: MECHANICAL ROOM 137

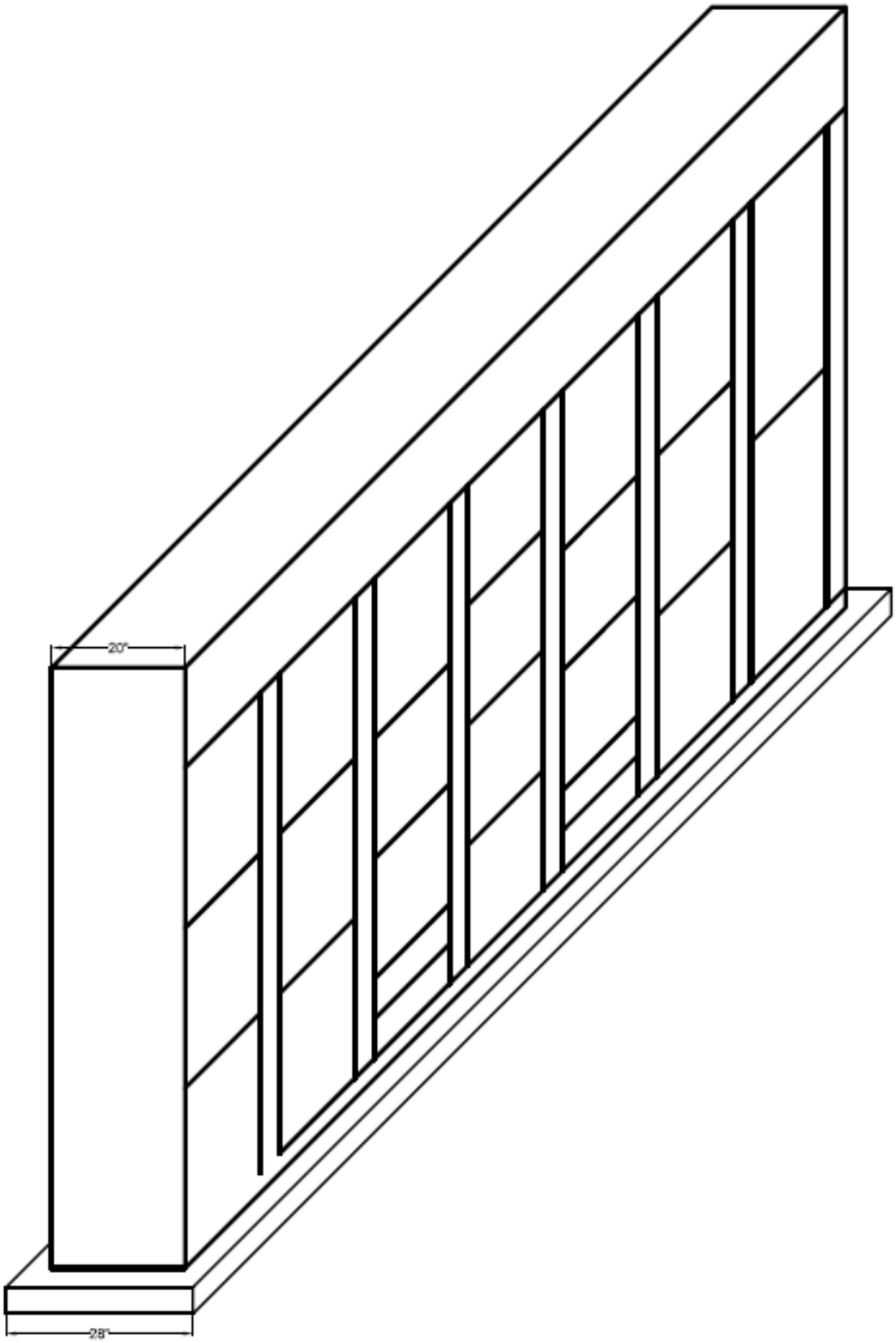
AMPS: 600 VOLTS: 480/277V 3 PH, 4 W, 60 Hz, NEMA: 2 AIC: 65,000

UNIT NO.	CIRCUIT	HP/KVA	FLA	STARTER		CIRCUIT PROTECTION		FEEDER	NOTES
				TYPE	SIZE	TYPE	TRIP		
A1	MAIN CB	–	–	-	–	-	–	(2)3#350MCM+1#6GRDIN3–1/2"C	-
A2	PULL SECTION	–	–	-	–	-	–	–	-
A3	SPARE	–	–	-	–	-	–	–	-
B1	CWP-1	40 HP	68	FVR	3	MCCB	100	3#3 + 1#8GRD. IN 1–1/4" C.	-
B2	CWP-2	40 HP	68	FVR	3	MCCB	100	3#3 + 1#8GRD. IN 1–1/4" C.	-
B3	HWP-3	30 HP	52	FVR	3	MCCB	70	3#4 + 1#8GRD. IN 1–1/4" C.	-
C1	HWP-4	30 HP	52	FVR	3	MCCB	70	3#4 + 1#8GRD. IN 1–1/4" C.	-
C2	HWP-1	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
C3	HWP-2	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D1	PWP	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D2	DWP-1	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D3	DWP-2	7.5 HP	15	FVR	1	MCCB	25	3#12 + 1#12GRD. IN 3/4" C.	-
D4	BP-1	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E1	RTU-1 RETURN	3 HP	7	AFD	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E2	BP-2	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
E3	BP-3	3 HP	7	FVR	0	MCCB	15	3#12 + 1#12GRD. IN 3/4" C.	-
F1	RTU-1 SUPPLY	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
F2	RTU-3 RETURN	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
F3	RTU-2 RETURN	15 HP	28	AFD	2	MCCB	45	3#8 + 1#10GRD. IN 3/4" C.	-
G1	RTU-3 SUPPLY	25 HP	45	AFD	2	MCCB	70	3#6 + 1#8GRD. IN 1" C.	-
G2	RUT-2 SUPPLY	20 HP	36	AFD	2	MCCB	70	3#8 + 1#10GRD. IN 3/4" C.	-

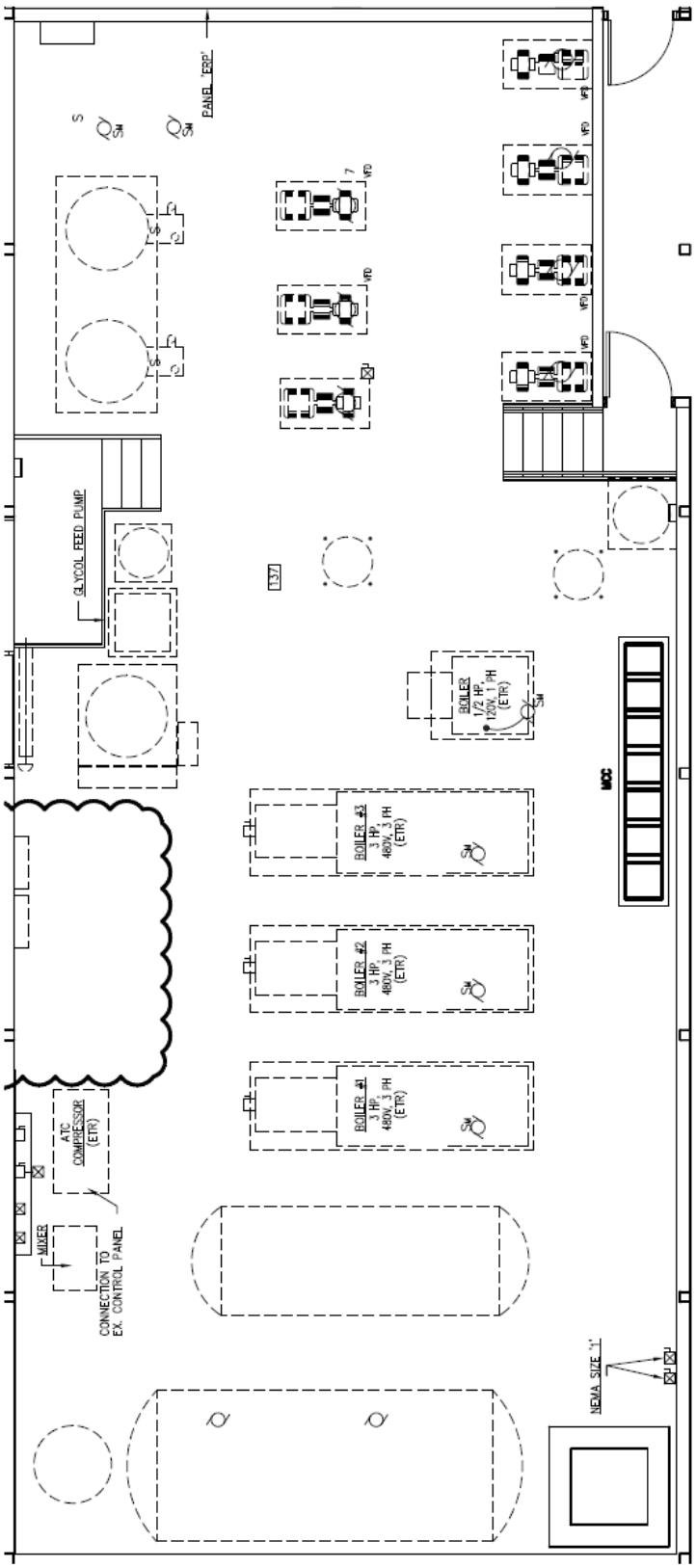
Table 37. MCC Schedule



Drawing 14. MCC Elevation



Drawing 15. MCC Isometric Veiw



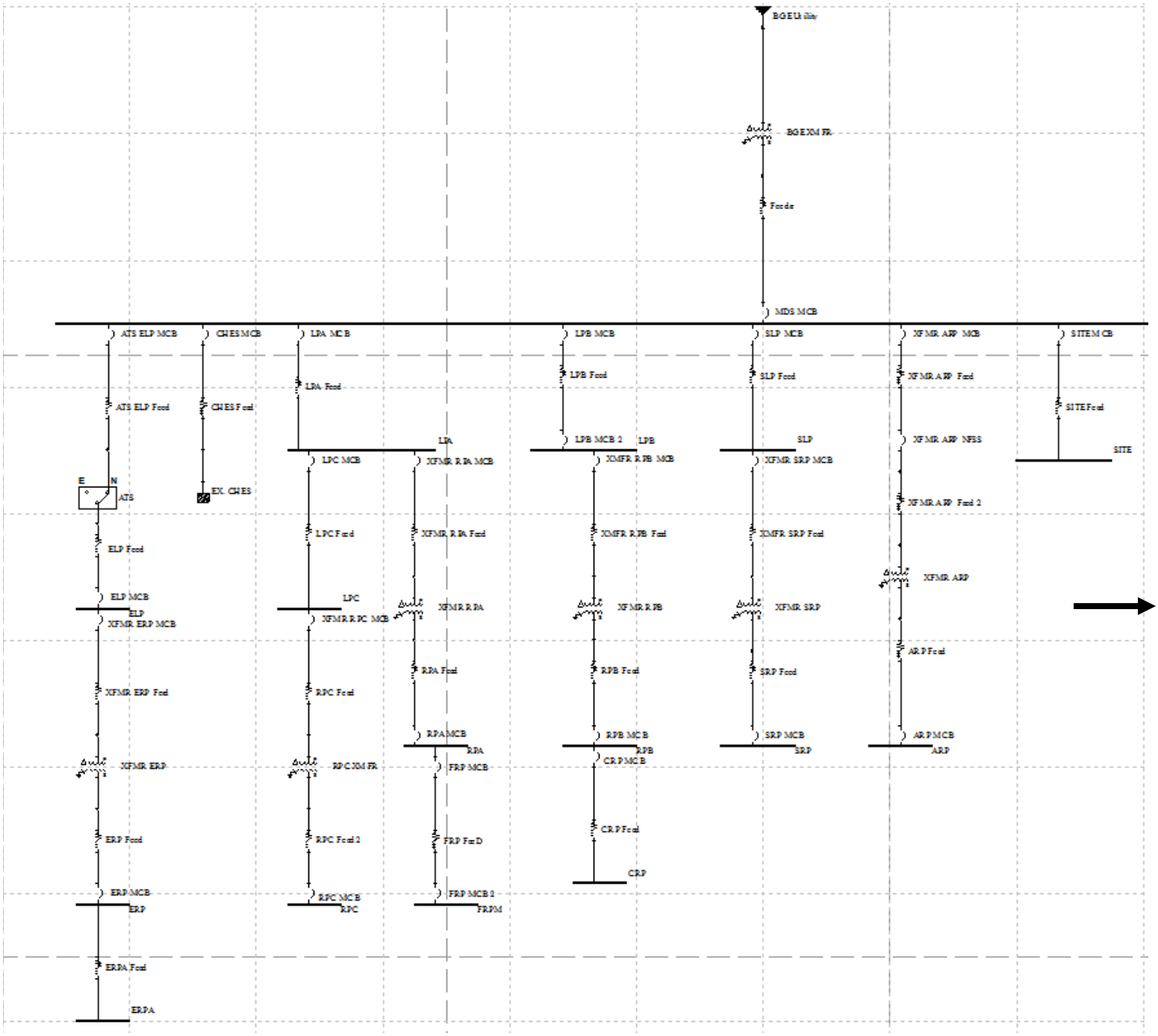
Drawing 16. Mechanical Room Floor Plan

Electrical Depth 2– SKM Analysis

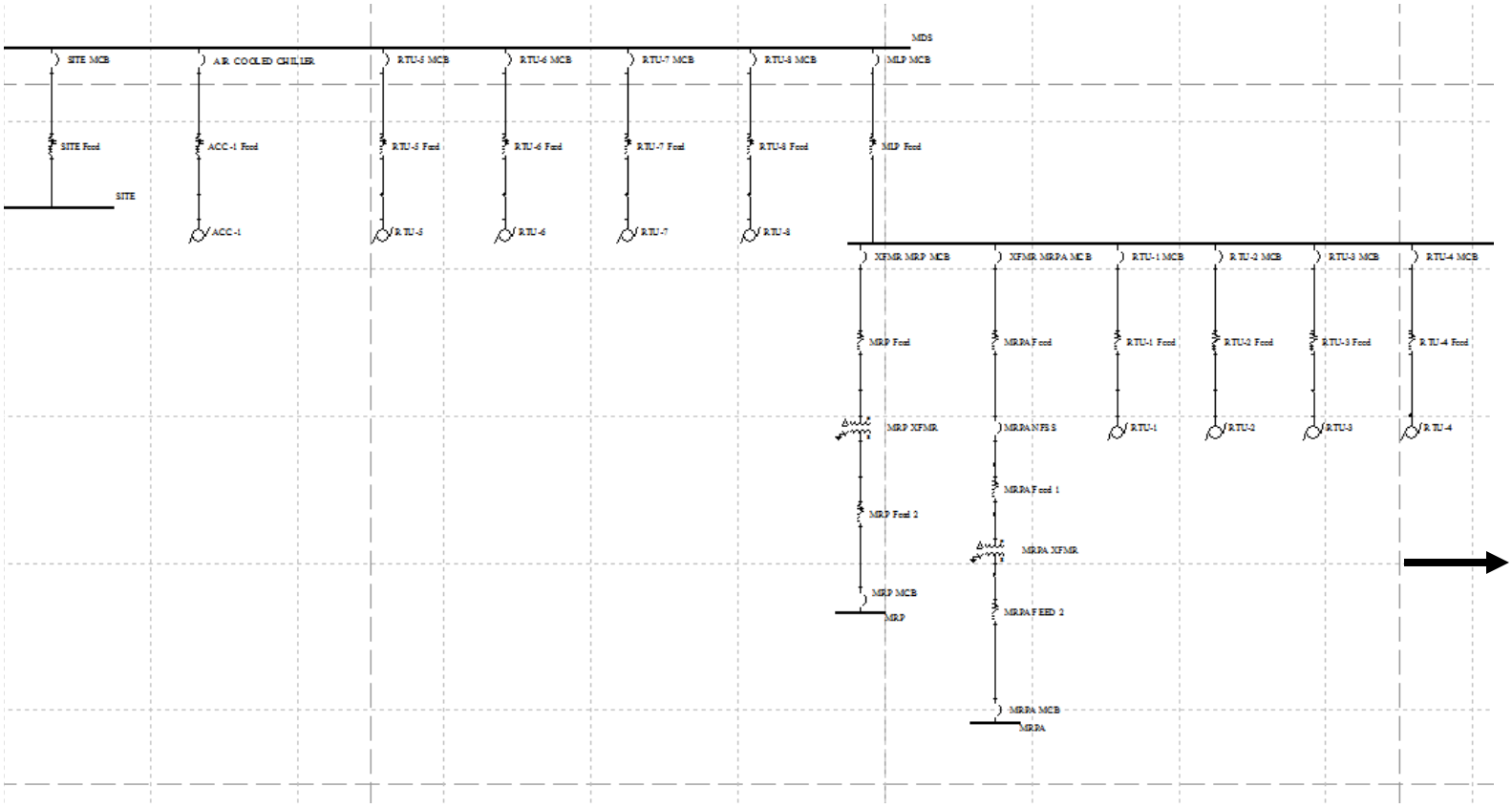
Description

This depth will use the Electrical Engineering Software known as SKM Power Tool Analysis. This program allows the user to input the main electrical components of the electrical system and run an extensive study on the equipment. This study includes short circuit analysis and arc fault studies. The model used for this analysis was based off of the riser diagram used in Tech Report II and includes all motors listed in the Motor Control Center in Electrical Depth 1. The following tables and screen shots from the program will show further details on the model and analysis completed.

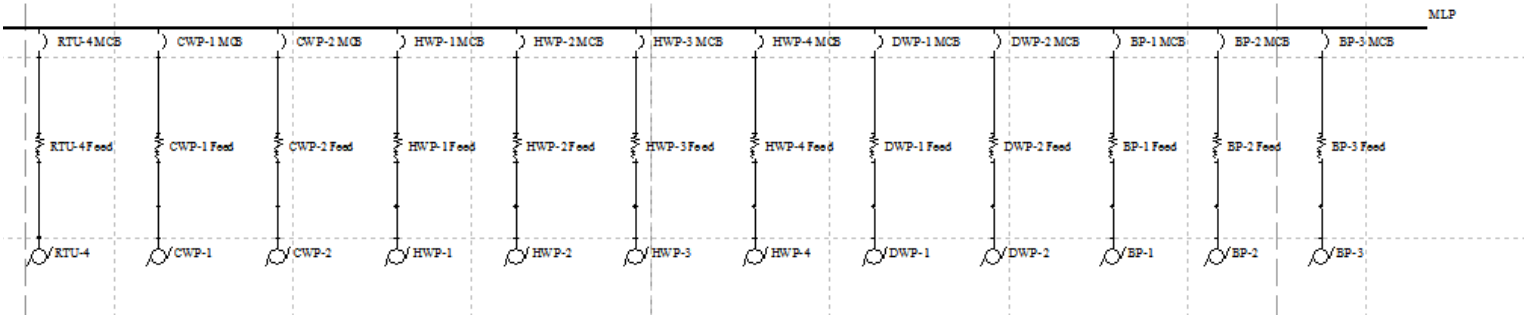
Riser Model



Drawing 17. SKM Riser Diagram Part I



Drawing 18. SKM Riser Diagram Part II



Drawing 19. SKM Riser Diagram Part III

Short Circuit Analysis

Bus Name	Voltage (L-L)	kAIC Rating	3-Phase (A)	X/R	Line/ Ground (A)	X/R	Protected
MDS	480	65	27,975	6.1	31,243	5.5	Yes
MLP	480	35	26,956	5.2	29,153	4.2	Yes
LPA	480	25	24,149	3.4	24,247	2.4	Yes
LPB	480	25	17,571	1.7	14,498	1.1	Yes
LPC	480	14	5,776	0.5	3,576	0.3	Yes
ELP	480	25	23,719	2.2	22,580	1.4	Yes
SLP	480	14	6,437	0.4	3,963	0.3	Yes
SITE	480	25	17,571	1.7	14.498	1.1	Yes
MRP	208	10	3,059	1.6	3,078	1.6	Yes
MRPA	208	10	1,649	0.7	1,676	0.6	Yes
RPA	208	35	6,907	1.6	7,054	1.5	Yes
RPB	208	35	3,008	1.7	3,044	1.6	Yes
RPC	208	10	1,588	0.6	1633	0.6	Yes
FRP	208	10	3,617	0.7	2,649	0.5	Yes
CRP	208	10	2,135	0.9	1,751	0.7	Yes
ARP	208	35	8,797	2.4	9,519	2.4	Yes
ERP	208	10	1,751	0.7	1,744	0.7	Yes
ERPA	208	10	1,741	0.7	1,728	0.7	Yes

Table 38. SKM Fault Analysis

Data Summary

The Short Circuit Study conducted by SKM illustrated that the specified fault current bus ratings on the equipment are higher than the simulated fault currents. This means that in the unlikely event of a fault, the equipment will not explode or create further damage to the system. There is, however, one section that draws attention and that is Panel LPA. Panel LPA's fault current bus rating is 25,000A, which is very near the simulated fault current that SKM is predicting could happen at this Panel. This may require Panel LPA to increase it's rating to a higher one of 35,000A.

Arc Flash Evaluation

Arc Flash Evaluation Arc Flash Evaluation IEEE 1584 - 2002/2004a Edition Bus Report Project: Susquehanna Center, Base Project

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category	Label #
1	ARP	ARP MCB	0.208	8.80	3.38	8.80	3.38	2	0.000	Yes	PNL	25	101	18	20	Category 3 (*N3) (*N9)	# 0001
2																	
3	CRP	CRP MCB	0.208	2.14	1.47	2.14	1.47	2	0.000	Yes	PNL	25	59	18	8.3	Category 3 (*N9)	# 0002
4																	
5	ELP	ELP MCB	0.48	23.72	13.71	23.72	13.71	0.013	0.000	Yes	PNL	25	12	18	0.61	Category 0	# 0003
6																	
7	ERP	ERP MCB	0.208	1.75	1.28	1.75	1.28	2	0.000	Yes	PNL	25	54	18	7.2	Category 2 (*N9)	# 0004
8																	
9	ERPA	ERP MCB	0.208	1.74	1.27	1.74	1.27	2	0.000	Yes	PNL	25	54	18	7.1	Category 2 (*N9)	# 0005
10																	
11	FRPM	FRP MCB 2	0.208	3.62	2.13	3.62	2.13	0.02	0.000	Yes	PNL	25	5	18	0.12	Category 0	# 0006
12																	
13	LPA	LPA MCB	0.48	24.15	13.93	24.15	13.93	0.01	0.000	Yes	PNL	25	10	18	0.47	Category 0	# 0007
14																	
15	LPB	LPB MCB	0.48	17.57	10.61	17.57	10.61	0.01	0.000	Yes	PNL	25	9	18	0.35	Category 0	# 0008
16																	
17	LPC	LPC MCB	0.48	5.78	4.10	5.78	4.10	0.016	0.000	Yes	PNL	25	6	18	0.20	Category 0	# 0009
18																	
19	MDS	AIR COOLED CHILLER	0.48	27.98	14.84	2.27	1.20	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
20	MDS	MLP MCB	0.48	27.98	14.84	1.95	1.03	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
21	MDS	RTU-5 MCB	0.48	27.98	14.84	0.21	0.11	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
22	MDS	RTU-6 MCB	0.48	27.98	14.84	0.21	0.11	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
23	MDS	RTU-7 MCB	0.48	27.98	14.84	0.21	0.11	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
24	MDS	RTU-8 MCB	0.48	27.98	14.84	0.21	0.11	0.083	0.000	Yes	SWG	32	42	24	2.7	Category 1 (*N2)	
25	MDS	MaxTripTime @2.0s	0.48	27.98	14.84	22.92	12.57	2	0.000	Yes	SWG	32	321	24	54	Dangerous! (*N2) (*N9)	# 0010
26																	
27	MLP	MLP MCB	0.48	26.96	15.30	25.01	14.19	0.019	0.000	Yes	PNL	25	16	18	1.00	Category 0	# 0011

Equations used with permission from IEEE 1584 *Copyright 2004*, by IEEE. The IEEE disclaims any responsibility or liability resulting from the placement and use in the described manner.
Page 1

Table 39. SKM Arc Flash Analysis Part I

Arc Flash Evaluation Arc Flash Evaluation IEEE 1584 - 2002/2004a Edition Bus Report   Project: Susquehanna Center, Base Project

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category	Label #
28	MLP	BP-1 MCB	0.48	26.96	15.30	0.02	0.01	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
29	MLP	BP-2 MCB	0.48	26.96	15.30	0.02	0.01	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
30	MLP	BP-3 MCB	0.48	26.96	15.30	0.02	0.01	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
31	MLP	CWP-1 MCB	0.48	26.96	15.30	0.31	0.17	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
32	MLP	CWP-2 MCB	0.48	26.96	15.30	0.31	0.17	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
33	MLP	DWP-1 MCB	0.48	26.96	15.30	0.06	0.03	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
34	MLP	DWP-2 MCB	0.48	26.96	15.30	0.06	0.03	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
35	MLP	HWP-1 MCB	0.48	26.96	15.30	0.06	0.03	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
36	MLP	HWP-2 MCB	0.48	26.96	15.30	0.06	0.03	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
37	MLP	HWP-3 MCB	0.48	26.96	15.30	0.23	0.13	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
38	MLP	HWP-4 MCB	0.48	26.96	15.30	0.23	0.13	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
39	MLP	RTU-1 MCB	0.48	26.96	15.30	0.12	0.07	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
40	MLP	RTU-2 MCB	0.48	26.96	15.30	0.15	0.09	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
41	MLP	RTU-3 MCB	0.48	26.96	15.30	0.19	0.11	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
42	MLP	RTU-4 MCB	0.48	26.96	15.30	0.12	0.07	0.083	0.000	Yes	PNL	25	19	18	1.3	Category 1	
43																	
44	MRP	XFMR MRP MCB	0.208	3.06	1.61	3.06	1.61	1.115	0.000	Yes	PNL	25	44	18	5.1	Category 2 (*N3)	# 0012
45																	
46	MRPA	MRPA MCB	0.208	1.65	1.04	1.65	1.04	2	0.000	Yes	PNL	25	47	18	5.7	Category 2 (*N3) (*N9)	# 0013
47																	
48	RPA	RPA MCB	0.208	6.91	2.85	6.91	2.85	1.894	0.000	Yes	PNL	25	87	18	16	Category 3 (*N3)	# 0014
49																	
50	RPB	RPB MCB	0.208	3.01	1.87	3.01	1.87	1.965	0.000	Yes	PNL	25	68	18	11	Category 3	# 0015
51																	
52	RPC	RPC MCB	0.208	1.59	1.19	1.59	1.19	2	0.000	Yes	PNL	25	51	18	6.7	Category 2 (*N9)	# 0016
53																	
54	SITE	SITE MCB	0.48	17.57	10.61	17.57	10.61	0.012	0.000	Yes	PNL	25	10	18	0.43	Category 0	# 0017
55																	

Equations used with permission from IEEE 1584 *Copyright 2004*, by IEEE. The IEEE disclaims any responsibility or liability resulting from the placement and use in the described manner.
Page 2

Table 40. SKM Arc Flash Analysis Part II

Arc Flash Evaluation Arc Flash Evaluation IEEE 1584 - 2002/2004a Edition Bus Report Project: Susquehanna Center, Base Project

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time (sec.)	Ground	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category	Label #
56	SLP	SLP MCB	0.48	6.44	4.50	6.44	4.50	0.01	0.000	Yes	PNL	25	5	18	0.14	Category 0	# 0018
57																	
58	SRP	SRP MCB	0.208	1.61	1.21	1.61	1.21	2	0.000	Yes	PNL	25	52	18	6.7	Category 2 (*N9)	# 0019
59																	
60	Category 0: Nonmelting, Flammable Materials with Weight >= 4.5 oz/sq yd	0.0 - 1.2 cal/cm^2													#Cat 0 = 8	(*N2) < 80% Cleared Fault Threshold	
61	Category 1: Arc-rated FR Shirt & Pants	1.2 - 4.0 cal/cm^2													#Cat 1 = 0	(*N3) - Arcing Current Low Tolerances Used	
62	Category 2: Arc-rated FR Shirt & Pants	4.0 - 8.0 cal/cm^2													#Cat 2 = 6	(*N9) - Max Arcing Duration Reached	
63	Category 3: Arc-rated FR Shirt & Pants & Arc Flash Suit	8.0 - 25.0 cal/cm^2													#Cat 3 = 4		
64	Category 4: Arc-rated FR Shirt & Pants & Arc Flash Suit	25.0 - 40.0 cal/cm^2													#Cat 4 = 0		
65	Category Dangerous!: No FR Category Found	Device with 80% Cleared Fault Threshold													#Danger = 1	IEEE 1584 - 2002/2004a Edition Bus Report (80% Cleared Fault Threshold, include Ind. Motors for 5.0 Cycles), mis-coordination not checked	

Table 41. SKM Arc Flash Analysis Part III

Data Summary

The Arc Flash Evaluation conducted by SKM demonstrated that most of protective devices fell into the appropriate category of protection. The main gear and higher ampacity Panels attained higher Personal Protective Equipment (PPE) ratings than Panels of smaller ampacity. One area of interest is the Main Switchboard, MDS, in which the rating was Dangerous, the highest possible rating, meaning that working on this piece of gear is of extreme hazard and no PPE clothing can protect you. This should raise a red flag and further analysis of this section needs to be conducted to further illustrate the effects.

Breadth I – Skylight Structural Analysis

Description

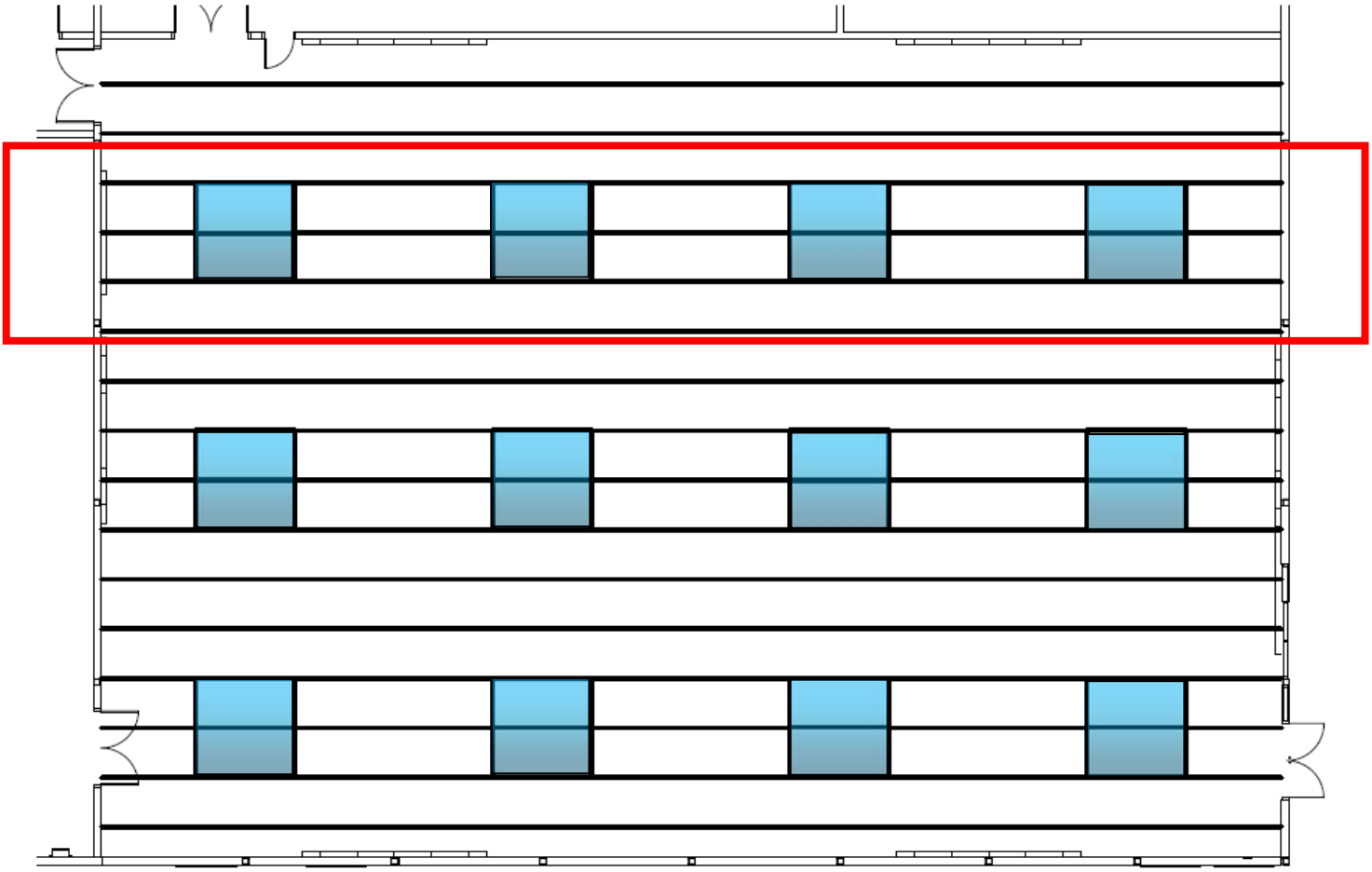
The introduction to skylights in the Auxiliary Gymnasium impacted the truss system that is supporting the roof. The truss is evenly spaced at 4'-0" on center and the truss runs on the edge and intersects the middle of the 8'-0" skylight. This analysis will look at eliminating the truss going through the skylight and adding a joist to support the roof along the edge of the skylight. This joist will be sized according to the load of the missing truss. The existing truss spacing is shown in plan with the skylights overlapping the truss to be sectioned.

Load Breakdown

Type	Source	Loading
Dead	Drawing S-10	20 PSF
Snow	Drawing S-10	30 PSF
Wind	ASCE -05 BLDG G	17.25 PSF
Total Load Eq.	1.2(DL) + 1.6(SL) – 17.25(4)	131 Plf
Factored Eq.	1.2(DL) + 1.6(SL)	288 Plf

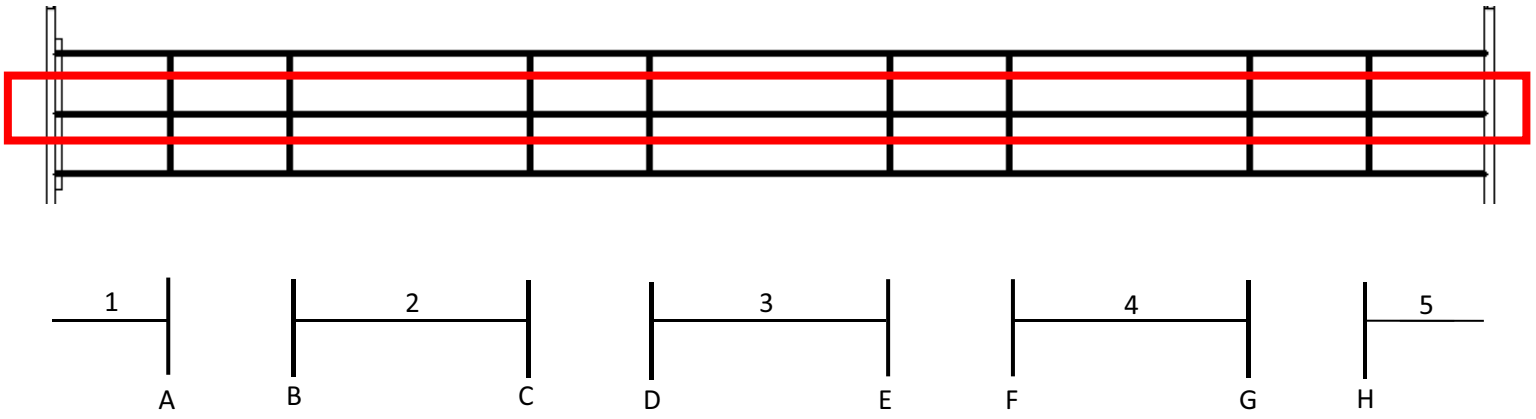
Table 42. Structural Loading

Existing Floor Plan

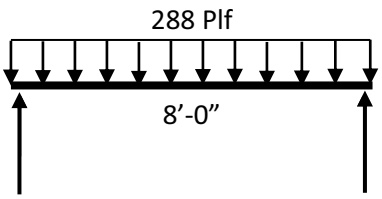


Drawing 20. Existing Roof Structure Floor Plan

Segmented

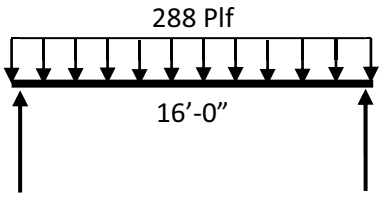


Segment 1 & Segment 5



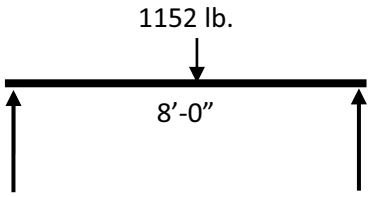
R = wl / 12 = 288(8) /12 = 1152 lb

Segment 2 & Segment 3 & Segment 4



R = wl / 12 = 288(16) /12 = 2304 lb

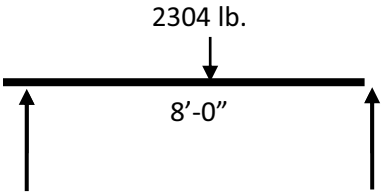
Segment A & Segment H



R = P / 2 = 1152 / 2 = 576 lb.

Moment = Pl / 4 = 1152(8) / 4 = 2304 ft-lb

Segment B, C, D, E, F, & G



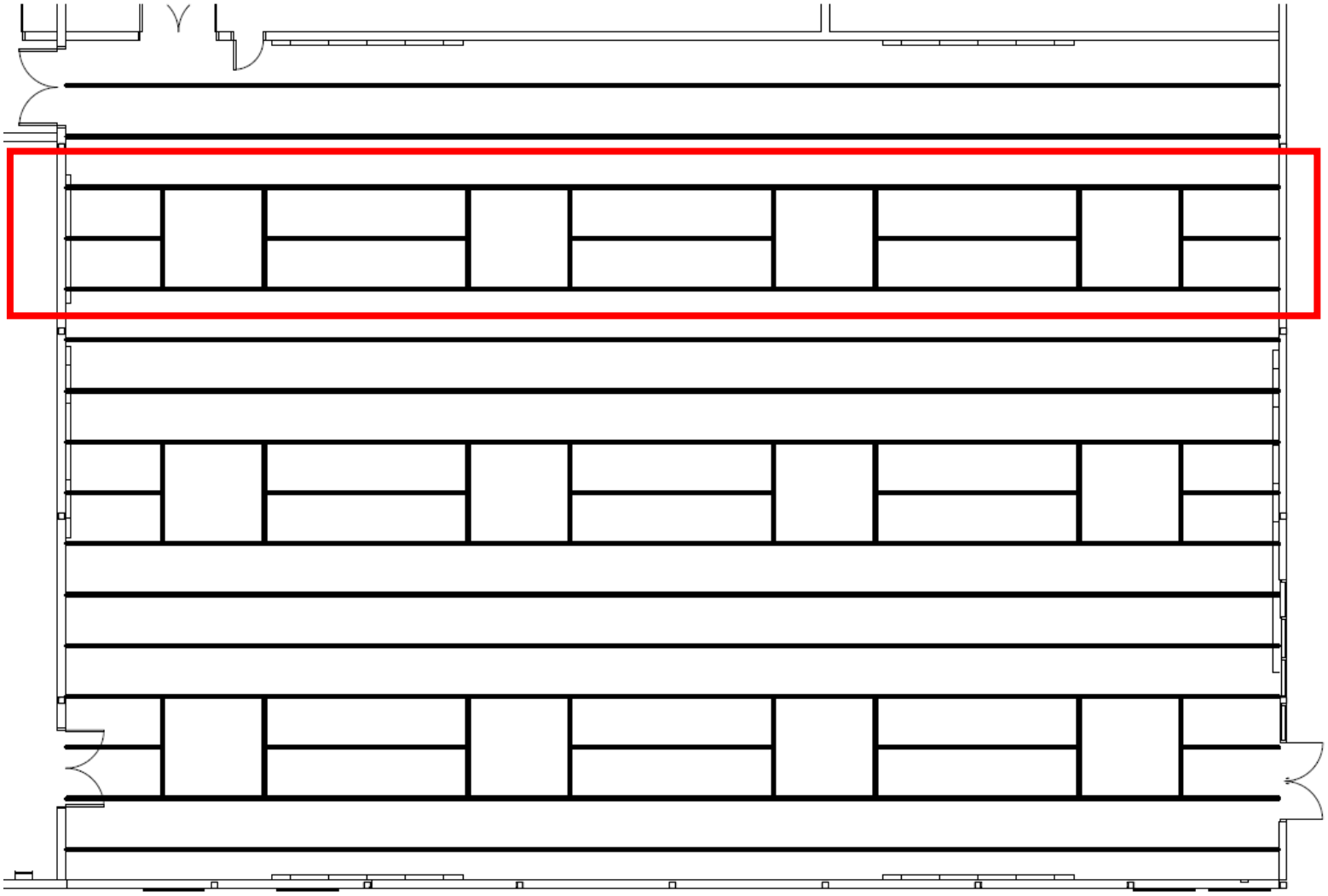
R = P / 2 = 2304 / 2 = 1152 lb.

Moment = Pl / 4 = 2304(16) / 4 = 9216 ft-lb

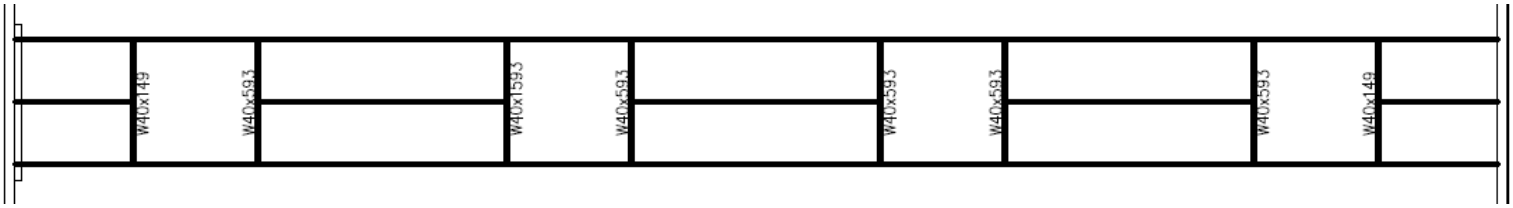
Segment	Steel Member
Segment A & H	W 40 x 149
Segment B, C, D, E, F, G	W 40 x 593

Table 42.Steel Member Selection

New Floor Plan

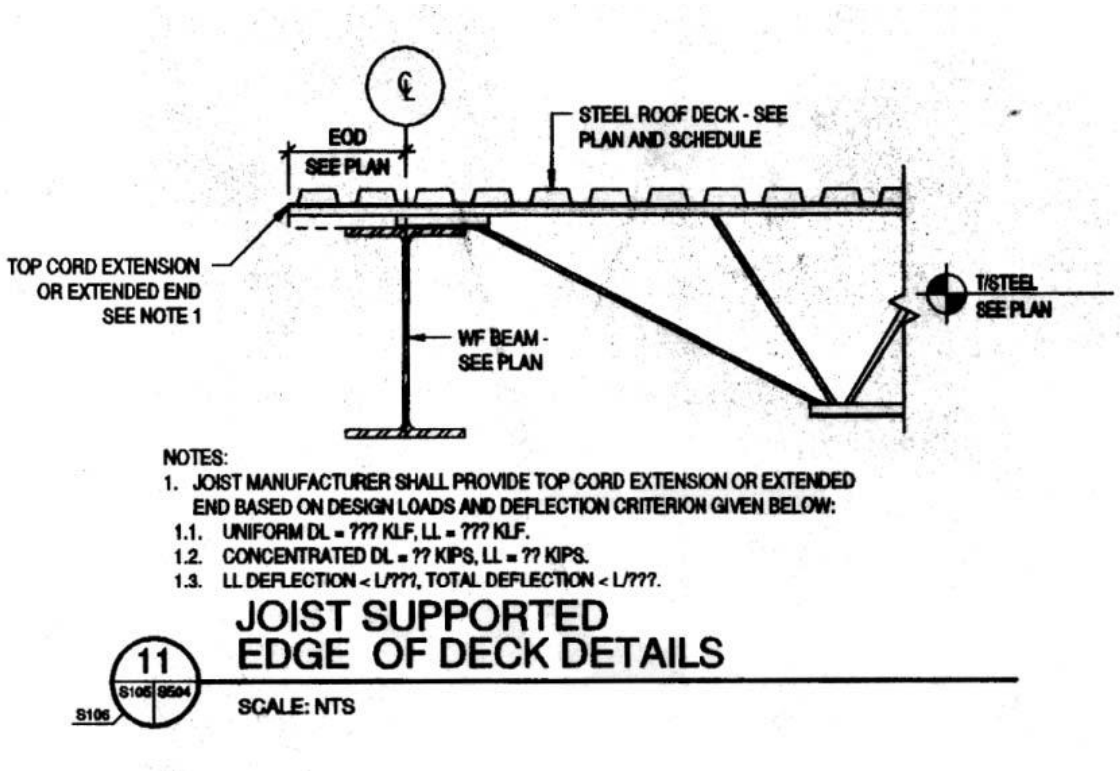


Drawing 21. Roof Structure New Floor Plan



Summary

The new joists supporting the roof on the edge of skylight eliminate the truss protruding through the center of the skylight. The load analysis on the beams used Table 3-23 of the AISC Construction Steel Manual to simplify calculations for loads and Table 3.2 of the AISC Steel Construction Steel Manual was used to size the members to their proper sheer and moment strength. The diagram bellow illustrates the details of the connection from the joist to the truss system.



Drawing 22. Joist Connection to Truss

Breadth II – Skylight Mechanical Analysis

Description

The addition of skylights in the Auxiliary Gymnasium will impact the amount of cooling needed to supply this space. This analysis will look at the new amount of cooling required with the addition of solar heat gain into the space. A Trane Trace model was built to simulate this situation and the results will dictate whether or not the specified chiller will be able to handle this new load.

The existing chiller was designed to meet all peaks at the same time, which will never occur in cooling mode due to usage of spaces and the sun's solar position. However the classrooms will peak in the middle of summer and the Fitness and Weight room will peak in the fall due to the high amount of glass in the space and solar position. The overall peak demand for the entire building is 204 tons of cooling.

Specified Chiller

Manu.	Unit Tag	Model #	Capacity (Tons)	Total kW	Volt	Min. Amp
York	CH-1	YCIV0227PA46	213.7	260.6	480	392

Table 43. Existing Chiller Schedule

Trace Model

The Trace model consisted of two identical rooms with the same material, occupancy, airflow, and lighting parameters of the Auxiliary Gymnasium. The only difference between the two rooms is that one room includes the twelve 8'-0" skylights. Below are screen shoots from the Trace outlining the parameters.

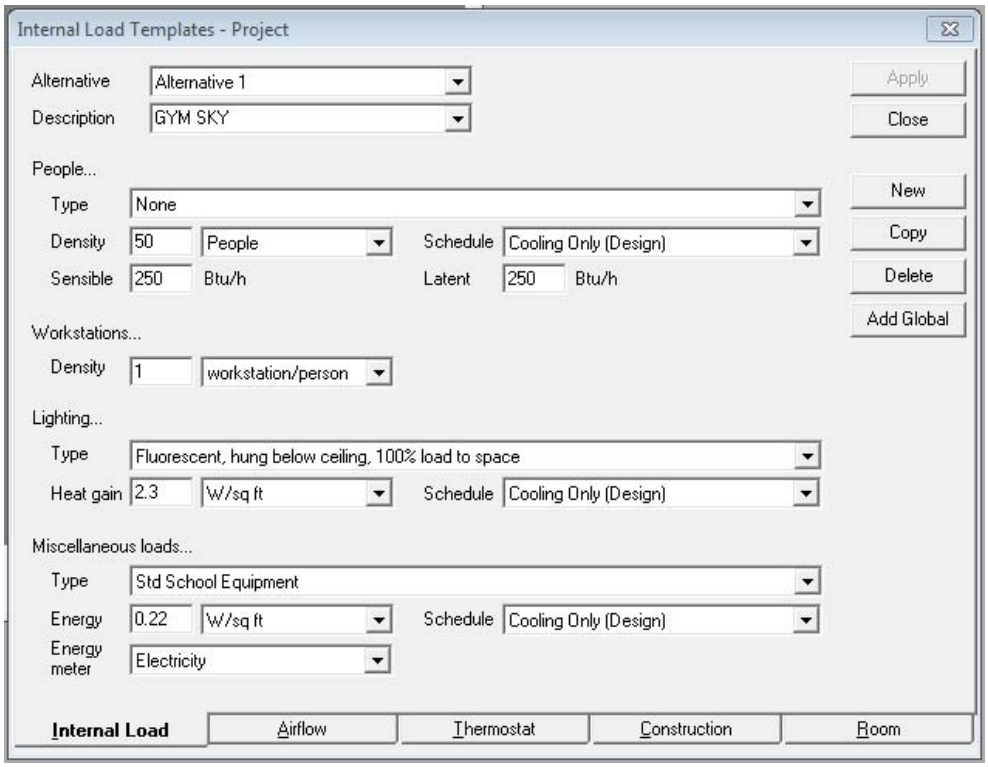


Image 26. Trace Internal Load Tab

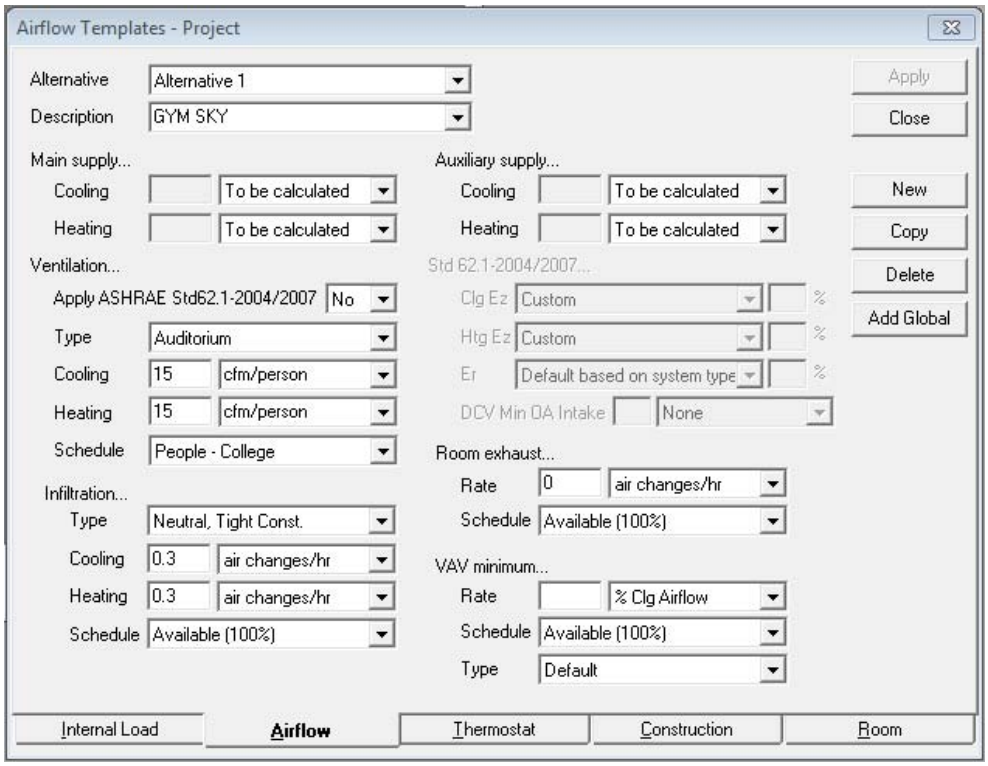


Image 27. Trace Airflow Tab

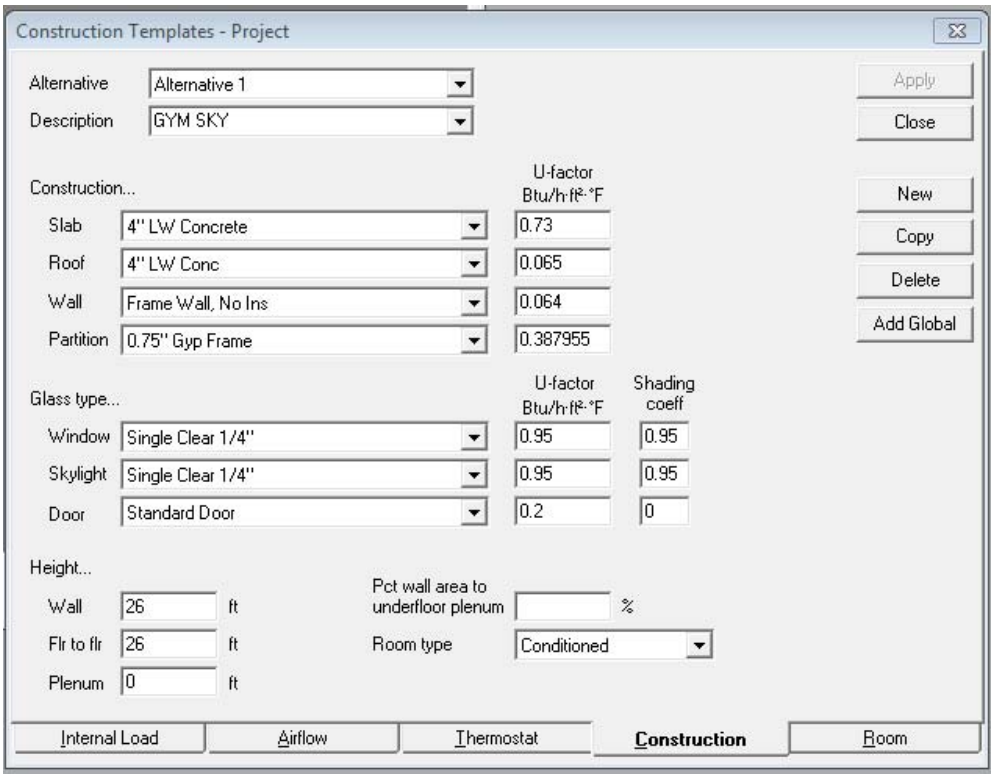


Image 28. Trace Room Construction Tab

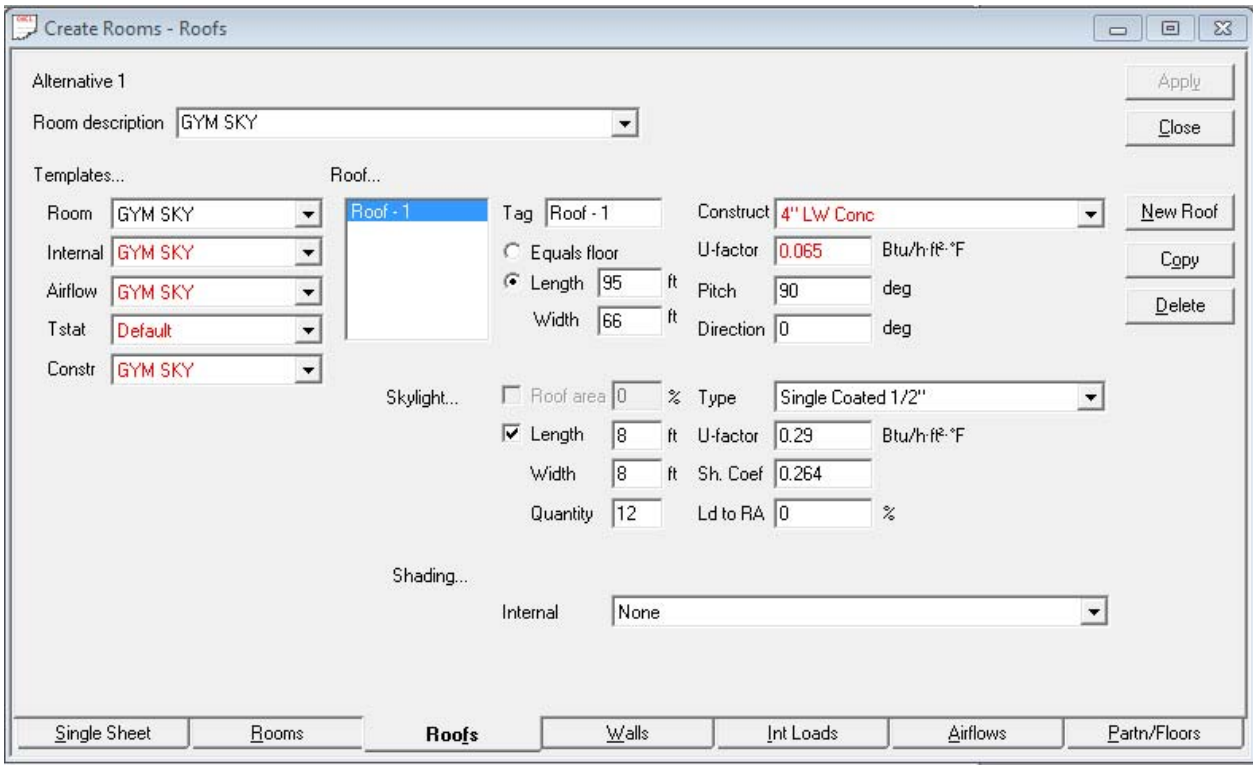


Image 29. Trace Roof Construction Tab

Summary

Originally the Auxiliary Gymnasium required 17.2 tons of the 204 tons of total cooling load on the Susquehanna Center. When skylights were added to the space the cooling load rose to 20.9 tons adding 3.7 tons on the chiller. This addition is then applied to the overall building load of 204 tons, which brings the new peak load of all systems for the building to be 207.7 tons. The specified chiller is capable of a max load of 213.7 tons, meaning that the addition of skylights will impact the chiller essentially, but it will not have to be resized.

COOLING COIL SELECTION

	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh	MBh	cfm	°F	°F	gr/lb	°F	°F	gr/lb
Main Clg	17.2	206.0	135.7	4,986	77.4	65.0	73.4	52.9	51.1	53.3
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	17.2	206.0								

Table 44. Trace Cooling Load for NO Skylights

COOLING COIL SELECTION

	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh	MBh	cfm	°F	°F	gr/lb	°F	°F	gr/lb
Main Clg	20.9	251.3	181.0	6,831	76.8	64.4	71.2	52.9	52.0	56.6
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	20.9	251.3								

Table 45. Trace Cooling Load for Skylights

Summary and Conclusions

In conclusion, the lighting redesign of the building compliments the festive and exciting atmosphere that surrounds every college athletic facility. The exterior lighting on the façade creates a visual interest into the building by high-lighting the aesthetically fascinating perforated aluminum shades. Once you are drawn to the building you enter in the lobby, which further emphasizes a stimulating atmosphere by accentuating the alternating ceiling mounted wavy pendants and higher illumination levels on a trophy display case. Past the lobby the cove lighting in the Fitness and Weight room greet and invite the visitor or guest into this relaxing open space. Further down the hallway, the Auxiliary Gymnasium's daylight incorporation draws an enlightening appeal, while playing a friendly game of basketball.

The electrical redesign continued to compliment the grandeur of this facility by adhering to power densities, providing adequate protection of electrical devices against short circuits and arc flashes. The Building is seeking LEED accreditation and the electrical design needed to be energy conscience. All lighting designs meet ASHRAE standards of Lighting Power Densities, by incorporating daylight, dimming capabilities, and energy efficient lamps. SKM provided further assurances with an accurate simulation of fault currents and arc flash studies to confirm that the electrical system was protected.

Lastly the two breadths provided additional data on the impact of the addition of skylights in the Auxiliary Gymnasium. The size and layout of the skylights required a redesign of the bracing for the truss system supporting the roof of the space. Also, the addition of solar heat gain impacted the cooling to the space, which required a redesign in the amount of cooling to space and implications to the specified chiller.

Overall the redesign reassures that the Susquehanna Center will serve as the new main attraction on the Harford Community Colleges Campus.

Acknowledgements

Thank you to Penn State Architectural Engineering Faculty for the guidance, teaching, and preparation throughout the past five years for this extraordinary experience. Thanks to Professor Robert Holland and Professor Kevin Parfitt for the direction through AE 481W/482. Special thanks go out to:

Lighting/ Thesis Advisor: Professor Kevin Houser

Lighting/ Thesis Advisor: Professor Richard Mistrick

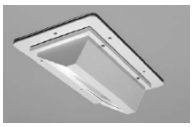
Electrical Consultant: Ted Dannerth

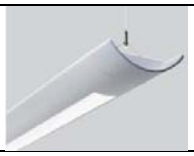
Burdette Koehler Murphy Electrical Designer: Larry Fritts

Burdette Koehler Murphy Mechanical Engineer: Jack Stitz

Lastly a special thanks to my Mom, Dad, girlfriend Ashley, fellow club baseball players, friends, and classmates for supporting me and making my five years at Penn State an amazing experience and one I will never forget.

Appendix A – Luminaire and Control Schedule

Luminaire Schedule										
Type		**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Lamp**	**Voltage**	**Ballast**	**Watts**	**Location**
G1		Lithonia Lighting	I-Beam	IB 454L WDS MVOLT	2x4 Fluorescent high bay luminaire utilizing cool running technology. The housing is made of heavy gauge steel with high gloss baked white enamel.	FP54 841 HO ECO	277	Mark 10 Powerline	54	Auxiliary Gymnasium
L1		Gotham Lighting	8" PDPF	PDPF 32TRT 8AR LD CGL MVOLT	8" satin silver pendant supported by black cord. The housing is durable heavy gauge aluminum housing with specular reflector.	CF32DT E IN 841 ECO	277	ICF 2S26 M1 BSQS	27	Lobby
L2		Elliptipar	F114	F114-L140-F-02-2	Wall mounted wall washer with semi white gloss finish on the outside housing made of aluminum.	FT40 DL 841 RS ECO	277	Integral Electronic Ballast	40	Lobby
L3		Philips Alkco	Slique T2	SK213-120-WHG	Sleek ¾" under cabinet fluorescent luminaire with miniature integral ballast. The housing is an extruded aluminum with a specular asymmetric reflector.	FM13 T2	120	Integral Miniature Ballast	13	Lobby
S1		Elliptipar	251	M 251 70G T 07 1 00	Recessed metal halide wall wash for concrete/ outdoor applications with silicon seals and a silver corrosion resistant housing/ finish.	MC70T6 U G12 830	277	71A5237BP	85	Exterior
S2		Erco	Visor III Floor Wash Light	330304	Circular recessed floor wash light with silicon seals and corrosion resistant aluminum housing with silver finish.	MC39 T6 U G12 830	277	71A50.37BP	48	Exterior
S3		Philips Gardco	Canopy	220 P 42TRF 277 NP	Circular down light with silicon seals and die cast aluminum housing and natural aluminum finish.	F42TBX 830 A ECO	277	ICF 2S26 H1 LD@ 277	46	Exterior
S4		Erco	Beamer	34070	Hinged surface mounted direct luminaire with corrosion resistant cast aluminum and silicon seals.	MC20TC U G8.5 830	277	71A50.37BP	25	Exterior
S5		Se'lux	Saturn 2 Cutoff	SAC2 R5 1 H070T6 830 SV 277 DS	Pole mounted die cast aluminum housing with full cutoff option and weatherproof gaskets. Match existing campus pole luminaire except with full cutoff option.	MC70 T6 U G12 830	277	71A5237BP	85	Exterior

S6		Erco	Bollard	33348	Circular bollard with corrosion resistant cast aluminum and silicon seals. Reflector located at top of bollard.	MC39 T6 U G12 830	277	71A50.37BP	48	Exterior
S7		Erco	Grass hopper	34035	Square LED ground mounted focal point luminaire with die cast aluminum corrosion resistant housing and silicon seals.	LED	277	N/A	14	Exterior
W1		Gotham Lighting	AFLP	AFLP 1/32TRT 8AR LD MVOLT	8” low profile ceiling recessed down light with a galvanized steel housing and semi specular reflector.	CF32DTE IN 841 ECO	277	ICF 2S26 M1 BSQS	27	Weight
W2		Litecontrol	Acros M5	P-ID-59M 1 4 T5 PBCWM	4’ direct/indirect pendant mounted luminaire with parabolic baffle with matte white finish.	FP54 841 HO ECO	277	ICN 4S5490 C2LS @277	53	Weight
W3		Focal Point	Cove light	FCVM 24 1T5 1C 277 E	Low profile luminaire with steel gauge housing and reflector fabricated of low iridescent aluminum.	FP28 841 PM ECO	277	ICN 2S54 N	29	Weight

Control Schedule						
Type		**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Location**
DC		Lutron	Automatic Day-Lighting Control	OMX-DACPI	Interface that will interpret and control photocell and dimming proportions	Gymnasium
DP		Lutron	Dimming Panel	GP8-2774T8-ML-20-CGP344	480Y/277V 3PH., 4W Dimming Panel with 8 circuits	
EM		Lutron	Emergency Lighting Interface	LUT-ELI-3PH	Relay device that will automatically switch the emergency lights on when normal power has been lost.	Gymnasium
GE		Lutron	Grafik Eye QS	QSGRJ-XP	Interface unit that will serve as the main control unit for the entire system	Gymnasium
O		Lutron	Passive Infrared Ceiling Sensor	LOS-CIR 1500-WH	Passive infrared occupancy sensor with 1500 SF coverage.	Gymnasium
PC		Lutron	Ceiling Mounted Photocell	MW-PS-WH	Ceiling mounted photocell that will measure day-light levels.	Gymnasium
RE		Lutron	Control Interface	GRX-IO	Relay device that will be used to connect to an astronomical time clock or Grafik Eye system.	
TC		Watt Stopper	Astronomical Time Clock	MSC-100	Astronomical Time Clock that will control lighting via a relay so, that lights can come on at specific time	

Appendix B – Specification Sheets

Luminaire Type G1

LITHONIA LIGHTING®

Catalog Number	
Notes	Type

FEATURES & SPECIFICATIONS

INTENDED USE — The I-BEAM fluorescent high bay is an ideal one-for-one replacement of common metal halide high bay systems. The unique Cool Running Technology provides trouble-free operation in ambient spaces up to 65°C. Applications include manufacturing, warehousing, commercial facilities and retail. The fluorescent I-BEAM fixture performs at mounting heights from 15'-40'. **Certain airborne contaminants can diminish integrity of acrylic.** Click here for Acrylic Environmental Compatibility table for suitable uses.

ATTRIBUTES — I-BEAM fixtures features Cool Running Technology for ambient operation up to 65°C. Backed by a full five-year ballast warranty at 55°C, three-year ballast warranty at 65°C. Designed for optimum performance using T5HO fluorescent lamps. The I-BEAM fixture provides the best option for applications requiring a rugged fixture construction coupled with excellent fixture performance. Optical designs for your choice of narrow distribution for aisles or wide distribution for general lighting. Typical arrangement provides over 90% luminaire efficiency. Available with four- or six-lamp cross-section with your choice of full direct component or with uplight. Easy two-point mounting with convenient aircraft cable provides reliable installation, eliminates fixture sag and provides sturdy installation. Single-point mounting available. Available in MVOLT (120-277V) or HVOLT (347-480V).

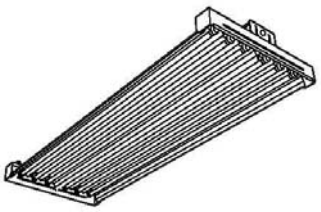
CONSTRUCTION — Channel is formed of heavy-duty code-gauge steel to stand up to the most demanding elements. Lamp holder assembly protects from incidental damage to reflectors during installation. Sockets include secure positioning rotating collars with enclosed contacts. Access plate on the back of the channel housing allows quick and easy wiring.

FINISH — Channel is high-gloss white baked enamel; five-stage iron phosphate pretreatment ensures superior paint adhesion and rust resistance.

OPTICAL SYSTEM — Two optical systems are available. Narrow distribution (ND) is ideal for narrow or aisle lighting applications and features precision-formed segmented optics utilizing Alanod Miro®4 specular aluminum reflector. Provides 95% reflectivity and warranted for 25 years. Wide distribution (WD) includes high-reflectance white finish for general or open areas.

ELECTRICAL SYSTEM — Thermally protected, resetting, Class P, HPF, A+ sound-rated electronic ballast. AWM TF or THHN wire used throughout rated for required temperatures. Ballast disconnect (BDP) is standard unless EL14 or cordset is requested.

INSTALLATION — Suitable for suspension by chain, cable, hook monopoint or pendant monopoint. Fixture should be mounted at a minimum plenum height of 18 inches.



I-BEAM® FLUORESCENT HIGH BAY LIGHTING

IB

Fluorescent High Bay
4-, 6- or 8-lamp T5

COOL RUNNING TECHNOLOGY

PATENT PENDING

T5 Technology

Specifications

Length: 48 3/8 (1,227)
Width: 17 5/8 (448)
Depth: 4 3/8 (111)
Weight: 17 lbs. (7.71 kg)
All dimensions are inches (millimeters).
Specifications subject to change without notice.

LISTING — UL/C-UL listed to US and Canadian safety standards for ambient operation up to 65°C. Suitable for damp locations. NOM Certified (see Options.)

WARRANTY — Guaranteed for one year against mechanical defects in manufacturing. Ballast warranty — Five years when operated in 55°C or less ambient conditions, three years when operated in 65°C or less ambient conditions. (Four- and six-lamp fixtures only.)

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**
Example: IB 454L

IB

Series
IB I-BEAM

Number of lamps/wattage
Lamps installed[1]
454L 4-lamp 54W T5HO
654L 6-lamp 54W T5HO
854L 8-lamp 54W T5HO
Unlamped
454 4-lamp 54W T5HO
654 6-lamp 54W T5HO
854 8-lamp 54W T5HO

Distribution
(blank) **Narrow distribution with uplight**
NDS Narrow distribution, no uplight <3%
WD Wide distribution with uplight
WDS Wide distribution, no uplight <3%

Voltage
(blank) **MVOLT; 120V-277V**
HVOLT 347V-480V

Ballast
(blank) **Program start, 1.0 BF**
LCR90 Less Cool Running[3]

Ballast configuration
(blank) **Standard configuration**[2]
2/3 Two, three-lamp ballasts
2/2 Two, two-lamp ballasts

Lamps installed
(blank) **F54T5HO/841**
LP835 F54T5HO/835
LP830 F54T5HO/830
LP865 F54T5HO/865
Amalgam lamps[4]
LP841A F54T5HO/841
LP835A F54T5HO/835
LP830A F54T5HO/830
LP850A F54T5HO/850

Options
EL14 Emergency battery pack (900 lumens)[5]
MSI Motion sensor pre-wired[6]
MSI360 360° motion sensor pre-wired[6]
OCS RELOC® OnePass® 5' installed[5]
FSP Integral side panels
NOM NOM Certified
PMP Pendant monopoint[7]
Cords: See reverse.

NOTES:
1 Lamps installed are F54T5HO/841.
2 Ballast included:
6-lamp = (1) 2-lamp ballast and (1) 4-lamp ballast
4-lamp = (1) 4-lamp ballast
3 54T5HO only ballast configuration, 1/4 1/2. Not recommended for ambient temperatures greater than 45°C. Five-year limited warranty provided by ballast manufacturer.
4 Not for use with motion sensors or EL14.
5 UL Listed for 55°C. Output in emergency mode varies with ambient temperature (approx. 944 lumens at 25°C and 911 lumens at 45°C). Single-lamp operation only. Not available with HVOLT. Requires some assembly in field for 6-lamp fixtures.
6 Specify voltage.
7 Fixture must be ordered with PMP for channel modification. Splice box ships separately. Requires two ballasts. Conduit must be minimum of 18". Not field-installable.

Accessories:

Order as a separate catalog number.

IBAC120M20	Aircraft cable 10' Y hanger (one pair)
IBAC240M20	Aircraft cable 20' Y hanger (one pair)
WGIBZ	Wireguard, zinc-coated
HC36	Chain hanger, 36"
IBHMP	Hook monopoint
IBPMP	Pendant monopoint[7]

Fluorescent **Sheet #: IB-T5** INFL-500

I-BEAM Fluorescent High Bay, T5

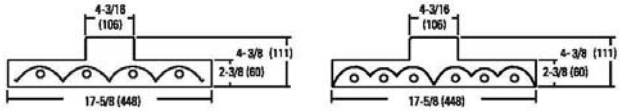
DIMENSIONS

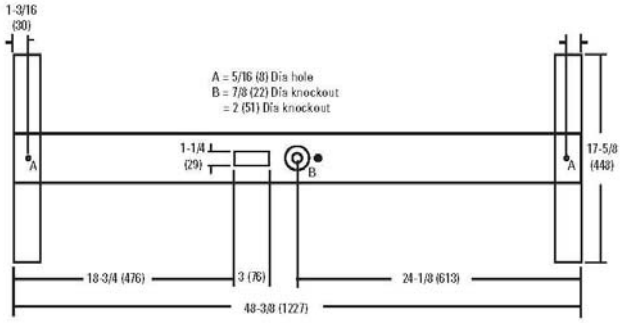
Inches (millimeters). Subject to change without notice.

Cord Set Option:

Add suffix to end of catalog number, specify voltage. All cord sets are 6', black unless otherwise noted. Other configurations available, consult factory.

Suffix	Description
CS1	Straight plug, 120V
CS3	Twist lock, 120V
CS7	Straight plug, 277V
CS11	Twist-lock, 277V
CS25	Twist-lock, 347V
CS97	Twist-lock, 480V
CS93	600V SO white cord, no plug





PHOTOMETRICS

Calculated using the zonal cavity method in accordance with IESNA LM41 procedure. Floor reflectances are 20%. Lamp configurations shown are typical. All data based on 25°C. Full photometric data on these and other configurations available upon request.

IB 454

Report: **LTL14006**
LUMENS PER LAMP **4400**

Coefficients of Utilization

pf		80%			20%			30%		
pc					50%					
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR	0	118	118	118	107	107	107	101	101	101
	1	109	104	101	96	93	91	91	89	87
	2	100	92	86	85	81	77	81	77	74
	3	92	82	75	76	71	66	73	68	64
	4	85	74	66	69	62	57	66	60	56
	5	78	67	59	62	56	51	60	54	50
	6	73	61	53	57	50	45	55	49	44
	7	68	56	48	52	46	41	51	45	40
	8	64	51	43	49	42	37	47	41	37
	9	60	48	40	45	39	34	44	38	33
	10	57	44	37	42	36	31	41	35	31

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	6218	35.3	35.3
0° - 40°	9065	51.5	51.4
0° - 60°	13684	77.7	77.6
0° - 90°	16413	93.3	93.1
90° - 180°	1214	6.9	6.9
0° - 180°	17626	100.1	100.0

IB 454 WD

Report: **LTL14005**
LUMENS PER LAMP **4400**

Coefficients of Utilization

pf		80%			20%			30%		
pc					50%					
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR	0	110	110	110	100	100	100	94	94	94
	1	100	96	92	88	85	82	83	80	78
	2	91	83	77	76	71	67	72	68	64
	3	83	73	65	67	61	56	63	58	54
	4	75	64	56	59	52	47	56	50	46
	5	69	57	49	53	46	40	50	44	39
	6	64	51	43	47	40	35	45	39	34
	7	59	46	38	43	36	31	41	35	30
	8	55	42	34	39	32	28	37	31	27
	9	51	39	31	36	29	25	34	29	24
	10	48	36	28	33	27	22	32	26	22

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	3911	22.2	23.6
0° - 40°	6432	36.5	38.8
0° - 60°	11655	66.2	70.3
0° - 90°	15190	86.3	91.7
90° - 180°	1381	7.8	8.3
0° - 180°	16571	94.2	100.0

IB 654

Report: **LTL14055**
LUMENS PER LAMP **4400**

Coefficients of Utilization

pf		80%			20%			30%		
pc					50%					
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR	0	117	117	117	108	108	108	102	102	102
	1	108	103	99	95	92	89	90	88	86
	2	98	90	84	84	79	75	80	76	72
	3	90	80	72	74	68	63	71	66	62
	4	83	71	63	67	60	55	64	58	53
	5	77	64	56	60	53	48	58	52	47
	6	71	58	50	55	48	42	53	46	42
	7	66	53	45	50	43	38	48	42	37
	8	62	49	41	46	39	34	45	38	34
	9	58	45	37	43	36	31	41	35	31
	10	54	42	34	40	33	29	39	32	28

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	8275	31.3	31.5
0° - 40°	12681	48.0	48.2
0° - 60°	20122	76.2	76.5
0° - 90°	25014	94.8	95.2
90° - 180°	1272	4.8	4.8
0° - 180°	26287	99.6	100.0

LITHONIA LIGHTING®
An AcuityBrands Company

Sheet #: IB-T5

©2005-2010 Acuity Brands Lighting, Inc. All rights reserved, Rev. 2/22/10

Lithonia Lighting
Industrial
One Lithonia Way, Conyers, GA 30012
Phone: 770-922-9000 Fax: 770-981-8141
www.lithonia.com

Luminaire Type L1

FEATURES

DECORATIVE HOUSING
- Durable, heavy-gauge aluminum housing. Textured polyester powder paint finish available in Matte Black or Satin Silver.
- Housing available in Short or Tall configurations to allow for a variety of ceiling height applications.

DECORATIVE ELEMENT
- Four configurations allow customization suitable in any space.
- No Ring (NR): Clean, simple form - no decorative element.
- Soft Ring (S): Subtle, formed black aluminum band.
- Stacked Rings (C): Four injection-molded black acrylic rings.
- Gear (G): Precision-formed black aluminum.

OPTICAL SYSTEM
- Self-flanged, specular or matte-diffuse reflector. Bounding Ray™ Optical Principle design (U.S. Patent No. 5,800,050) provides lamp before lamp image and smooth transition from top of the reflector to bottom. Reflector flange visually integrates with housing.

MOUNTING OPTIONS
- RC120 - 120" black cord is provided for electrical connection between luminaire and canopy. Canopy mounts directly to 4" square or octagonal junction box.
- SM - Luminaire is mounted directly to the surface-mounted canopy. Canopy mounts directly to 4" square or octagonal junction box.

ELECTRICAL SYSTEM
- Rugged aluminum lampholder housing.
- Vertically mounted, four-pin positive-latch, thermoplas tic socket.
- Class P, thermally protected, high power factor elec tronic ballast.

LISTING
- Fixtures are UL Listed for damp locations. Listed and la-beled to comply with Canadian Standards.

Type ..... Catalog number ....

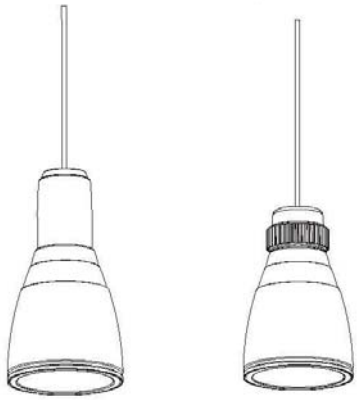
Compact Fluorescent Surface Downlights

8" PDPF

Elevations®

Performance Downlight Pendant

Vertical Triple Tube Lamp



All dimensions are inches (centimeters).

Aperture: 7-7/8 (20.1) Height: 14-7/8 (37.7) Short
Overall Diameter: 9-3/8 (23.5) Height: 17-5/8 (44.8) Tall

ORDERING INFORMATION

Example: **PDPF 32TRT 8AR MVOLT TSNR RC120**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.

PDPF

Series	Wattage/Lamp	Aperture/Trim color	Finish	Voltage	Housing	Color	Decorative Element[3]	Mounting Method[3]	Options
PDPF	18TRT 26TRT 32TRT 42TRT	8AR Clear 8PR Pewter 8WTR Wheat 8BR[1] Black 8WR[1] White	(blank) Semi-specular LD Matte-diffuse	MVOLT[2] 120 277 347	S Short T Tall	B Matte black S Satin silver	NR No ring S Soft ring C Stacked rings G Gear	RC120 Reinforced cord mount SM Surface mount	WLP With 3500°K lamp (shipped separately) GMP[2] Single slow blow fuse GLR[2] Single fast blow fuse EL[5] Emergency battery pack. Test switch integral to ballast housing GRS[5] Recessed mounting frame ELR[6] Emergency battery pack

Lens Type: (blank) No lens; CGL Clear glass lens; T73 Tempered prismatic lens

Ballast: (blank); DMHL[2,3]; ADEZ[7]

NOTES
1 Multi-volt electronic ballast capable of operating on any line voltage from 120V through 277V, 50 or 60Hz.
2 Available in 120V or 277V only.
3 Available in 26TRT or 32TRT only.
4 Refer to Page TECH-180 for decorative element and mounting method details.
5 Not available with MVOLT.
6 Requires use of 14" tall extended canopy. See page TECH-180.
7 Available with GRS option only.

gotham® An AcuityBrands Company

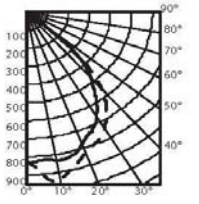
GOTHAM ARCHITECTURAL DOWNLIGHTING
1400 Lester Road Conyers Georgia 30012
P 800 315 4982 F 770 860 3129
www.gothamlighting.com

PDPF 8 DLCF-170

8" PDPF Elevations® Performance Downlight Pendant

Distribution curve | **Distribution data** | **Output data** | **Coefficient of utilization** | **Illuminance Data at 30" Above Floor for a Single Luminaire**

PDPF 26TRT 8AR, (1) PL-T 26W/30K lamp, 1800 rated lumens, 1.3 s/mh, Test No. 94021601



From 0°	Ave	Lumens
0	830	
5	870	85
15	876	246
25	762	351
35	630	388
45	354	251
55	5	15
65	0	0
75	0	0
85	0	0
90	0	

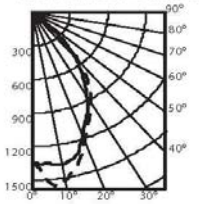
Zone	Lumens	% Lamp
0° - 30°	681.2	37.8
0° - 40°	1069.0	59.4
0° - 60°	1335.8	74.2
0° - 90°	1336.1	74.2
90° - 180°	0.0	0.0
0° - 180°	1336.1	*74.2

*Efficiency

pf / pc	80%		20% 70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.81	.79	.80	.78	.77	.75
2	.75	.72	.74	.71	.71	.69
3	.69	.65	.68	.64	.66	.63
4	.63	.59	.62	.58	.61	.57
5	.58	.53	.58	.53	.56	.52
6	.54	.49	.53	.49	.52	.48
7	.50	.45	.49	.45	.48	.44
8	.46	.41	.46	.41	.45	.41
9	.43	.38	.43	.38	.42	.38
10	.40	.35	.40	.35	.39	.35

	50% beam angle 64.0°		10% beam angle 93.7°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	27.4	6.9	13.7	11.7	2.7
10	14.8	9.4	7.4	16.0	1.5
12	9.2	11.9	4.6	20.3	0.9
14	6.3	14.4	3.1	24.5	0.6
16	4.6	16.9	2.3	28.8	0.5

PDPF 32TRT 8AR, (1) PL-T 32W/30K lamp, 2400 rated lumens, 1.1 s/mh, Test No. 94021402



From 0°	Ave	Lumens
0	1344	
5	1440	139
15	1360	378
25	1036	476
35	737	455
45	281	203
55	4	5
65	1	1
75	0	0
85	0	0
90	0	

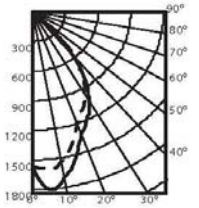
Zone	Lumens	% Lamp
0° - 30°	992.2	41.3
0° - 40°	1446.8	60.3
0° - 60°	1654.7	68.9
0° - 90°	1655.2	69.0
90° - 180°	0.0	0.0
0° - 180°	1655.2	*69.0

*Efficiency

pf / pc	80%		20% 70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.76	.74	.75	.73	.72	.71
2	.70	.67	.69	.67	.67	.65
3	.65	.62	.64	.61	.62	.60
4	.60	.56	.60	.56	.58	.55
5	.56	.52	.56	.52	.54	.51
6	.52	.48	.52	.48	.51	.47
7	.49	.44	.48	.44	.47	.44
8	.46	.41	.45	.41	.44	.41
9	.43	.38	.42	.38	.42	.38
10	.40	.36	.40	.36	.39	.35

	50% beam angle 55.2°		10% beam angle 87.5°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	44.4	5.8	22.2	10.5	4.4
10	23.9	7.9	11.9	14.4	2.4
12	14.9	9.9	7.4	18.2	1.5
14	10.2	12.0	5.1	22.0	1.0
16	7.4	14.1	3.7	25.8	0.7

PDPF 42TRT 8AR, (1) PL-T 42W/30/4P lamp, 3200 rated lumens, 1.0 s/mh, Test No. 95121902



From 0°	Ave	Lumens
0	1568	
5	1705	160
15	1467	408
25	1145	528
35	821	506
45	244	198
55	10	8
65	4	4
75	2	3
85	2	2
90	0	

Zone	Lumens	% Lamp
0° - 30°	1095.4	34.2
0° - 40°	1601.1	50.0
0° - 60°	1807.5	56.5
0° - 90°	1818.6	56.8
90° - 180°	0.0	0.0
0° - 180°	1818.6	*56.8

*Efficiency

pf / pc	80%		20% 70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.63	.61	.61	.60	.59	.58
2	.58	.55	.57	.55	.55	.53
3	.54	.51	.53	.50	.51	.49
4	.50	.48	.49	.48	.48	.45
5	.46	.43	.46	.42	.45	.42
6	.43	.39	.43	.39	.42	.39
7	.40	.37	.40	.36	.39	.36
8	.38	.34	.37	.34	.37	.34
9	.35	.32	.35	.32	.34	.31
10	.33	.30	.33	.30	.32	.29

	50% beam angle 53.8°		10% beam angle 85.7°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	51.8	5.6	25.9	10.2	5.2
10	27.9	7.6	13.9	13.9	2.8
12	17.4	9.6	8.7	17.6	1.7
14	11.9	11.7	5.9	21.4	1.2
16	8.6	13.7	4.3	25.1	0.9

ENERGY (Calculated in accordance with NEMA standard LE-5A)

LER.DOH	Annual* Energy Cost	Lamps	Lamp Lumens	Ballast Factor	Input Watts
51	$ 4.69	(1) 26W TRT	1800	1.10	29
46	$5.24	(1) 32W TRT	2400	0.98	36
37	$6.47	(1) 42W TRT	3200	0.98	48

*Comparative yearly lighting energy cost per 1000 lumens

NOTES:
1. For electrical characteristics consult Technical Bulletins tab.
2. Tested to current IES and NEMA standards under stabilized laboratory conditions. Various operating factors can cause differences between laboratory data and actual field measurements. Dimensions and specifications are based on the most current available data and are subject to change without notice.
3. Consult factory of IES file for other photometric reports.

DLCF-170

©2007, 2009 Acuity Brands Lighting, Inc. All Rights Reserved.

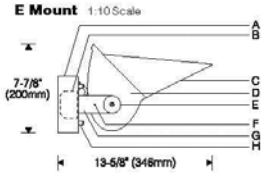
gotham
An AcuityBrands Company

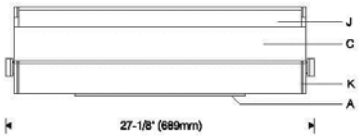
GOTHAM ARCHITECTURAL DOWNLIGHTING
A DIVISION OF ACUITY LIGHTING GROUP, INC.
1400 Lester Road Conyers Georgia 30012
P 800 315 4982 F 770 860 3129
www.gothamlighting.com

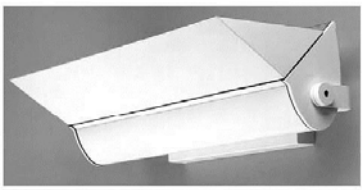
Luminaire Type L2

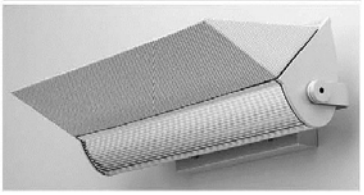
Lighting the Ceiling Large fluted or smooth, integral — Long Twin Tube Fluorescent — **4X® Style 113 / 114**

E Mount 1:10 Scale

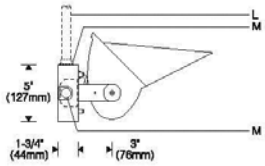




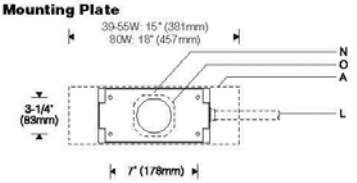




F Mount 1:10 Scale



Mounting Plate



Specifications

- **A** Aluminum canopy/ ballast housing
- **B** Integral electronic ballast (**remote** for **X** mount)
- **C** Perforated or solid cutoff visor (included)
- **D** Die-cast aluminum end plates
- **E** Machined aluminum knobs
- **F** Locking set screw
- **G** Aluminum yoke
- **H** Chrome cap nuts
- **J** Specular extruded aluminum reflector
- **K** Aluminum reveal plates (black)
- **L** Conduit (by others)
- **M** 7/8" dia. conduit entries, 3 total (**F** mount only)
- **N** Aluminum mounting plate
- **O** Recessed outlet box (by others)

Finish:

Style 113 fluted – bright clear anodized aluminum housing. Painted end plates, visor, yoke and canopy in choice of silver or semi-gloss black.

Style 114 smooth – semi-gloss white exterior.

Visor available solid or perforated. Perforated visor supplied with diffusing translucent insert.

Painted surfaces – 6 stage pretreatment and electrostatically applied thermoset powder coat.

Reflector and internal end plates – extruded high purity aluminum with clear anodized specular finish. All luminaire hardware – stainless steel. All mounting hardware – zinc or cadmium plated.

Mounting:

E mount – canopy mounts over recessed outlet box.

F mount – three 7/8" dia. entries in mounting plate with clearance openings in canopy; one top center, one on each end (surface conduit, connectors by others).

Uplight pendant (back to back) or cantilever assembly ordered separately; specify **X** mount. Supplied with **remote** ballast.

Electrical:

Use 90°C wire for supply connections.

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

X mount (for use with uplight pendant or cantilever) furnished with **remote** electronic ballast. Aluminum ballast enclosure includes four 7/8" dia. entries and a knockout for accessory fuse. **Maximum wire length between remote electronic ballast and fixture is 10' (3m) less length of pendant stem or cantilever arm.**

Optional electronic dimming ballast (**E** and **F** mount only); compatible dimmer switch required (by others). Consult sales representative for compatibility and specifications. **Dimming not available with X mount pendant or cantilever.**

For complete ballast specifications, see Accessories Section.

Standard:

UL listed or CSA certified for damp locations (Style 114 hex tube model with gasketed lens recommended for damp locations).

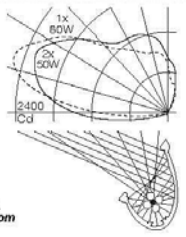
Features

- **4X** *focuses the light of two 40, 50 or 55W lamps for high performance, low energy uplighting*
- *Long twin-tube fluorescent lamps – great color, long life*
- *Integral electronic ballast – dimming, emergency optional*
- *Die-cast end plates join at articulated black reveals; machined aluminum knobs – no exposed fasteners*

C 30.0

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***

9/10

U.S. Patent RE37,310E. Canadian 2,147,106, EPO 0679835, Australia 680116, Mexico 193817, other foreign Patents Pending.

elliptipar
There is no equal™

To Order — 4X® Style 113/114

To form a Catalog Number

F [ ] - [ ] - [ ] - [ ] - [ ] - V [ ] [ ]
1 2 3 4 5 6 7 8

1 Source
F = Long twin tube compact fluorescent

2 Style
113 = Large fluted surface, **integral** ballast
114 = Large smooth surface, **integral** ballast
Note: Pendant or cantilever mounted units furnished with **remote** ballast.

3 Lamp
[ ] [ ] = **Long Twin Tube CF Lamp Code**
Lamp Wattage (see chart)
Lamp Configuration
L1 = Single-lamp cross section
X2 = **4X®** (dual-lamp) cross section (not available for 80W)

C 30.1

Lamp W	Single-lamp section		4X® dual-lamp section	
	Code	Lamp	Code	Lamps
Long Twin Tube Compact Fluorescent				
39	**L139**	1xFT36-39W/2G11	**X239**	2xFT36-39W/2G11
40	**L140**	1 x FT40W/2G11	**X240**	2 x FT40W/2G11
50	**L150**	1 x FT50W/2G11	**X250**	2 x FT50W/2G11
55	**L155**	1 x FT55W/2G11	**X255**	2 x FT55W/2G11
80	**L180**	1 x FT80W/2G11		

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

4 Mounting
E = External yoke on canopy. Mounting plate fastens over recessed outlet box (by others).
F = External yoke on canopy. Mounting plate with (3) 7/8" dia. entries, one top center, one on each end for surface conduit (by others).
X = External yoke for use with accessory uplight pendant or cantilever mounting assembly (order separately) **Note:** furnished with **remote** ballast.

Project:

5 Finish
Style 113 Fluted
Bright anodized aluminum reflector with painted end plates, yoke, canopy and visor in choice of
01 = silver, solid visor
P1 = silver, perforated visor
81 = semi-gloss black, solid visor
P8 = semi-gloss black, perforated visor

Style 114 Smooth
Semi-gloss white reflector, end plates, yoke and canopy with choice of
02 = solid visor finished white
P2 = perforated visor finished white
99 = Custom RAL or computer matched color to be specified, consult sales representative

6 Voltage/Ballast
Electronic *
1 = 120V
2 = 277V
3 = 347V (Canada)

Dimming +
T = 120V
V = 277V

* **X** mount furnished with **remote** electronic ballast.
+ Dimming not available for use with pendant or cantilever (**X** mount) – consult factory for alternatives. Availability for wattages and voltages varies with ballast manufacturer and control type – see **thelightingquotient.com** for dimming specifications and limitations.

7 Option (see Accessories Section for specifications)
V0 = Cutoff visor included, no other options
VE = Remote emergency battery pack (all lamps except L180), maximum distance from battery pack to fixture is 5' (1.5m). For use with non-dimming ballasts only. For emergency battery pack for L180 lamp, consult factory.
VX = For modification not listed, include detailed description. Consult factory prior to specification.
Note: Cutoff visor included unless specified otherwise.

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

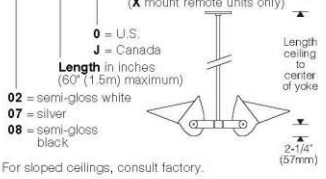
Example
F113 - X250 - E - P1 - 2 - V00
Large fluted model for use with two 50W long twin tube compact fluorescent lamps (**4X** 2-lamp cross section). External yoke on canopy for mounting over recessed outlet box (by others). Bright reflector with silver end plates, yoke and canopy. Integral 277V electronic ballast. UL listed or CSA certified for U.S. Perforated cutoff visor with silver painted finish included.

Type:

Accessories
Order separately. See Accessories Section for specifications.

VCX [ ] **36** [ ] = **Cantilever**, 36" (915mm) setback (**X** mount remote units only)
0 = U.S.
J = Canada
02 = semi-gloss white
07 = silver
08 = semi-gloss black

VDX [ ] [ ] [ ] = Uplight **pendant** (back to back), (**X** mount remote units only)
0 = U.S.
J = Canada
Length in inches (60" (1.5m) maximum)
02 = semi-gloss white
07 = silver
08 = semi-gloss black
Length ceiling to center of yoke
2-1/4" (57mm)



Note: For sloped ceilings, consult factory.

AFK000X [ ] = Ballast **fuse** kit
0 = U.S.
J = Canada

12/09

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**

Certain products illustrated may be covered by applicable patents and patents pending. These specifications supersede all prior publications and are subject to change without notice. Copyright © 2010 Sylvan R. Shemitz Designs, Inc., all rights reserved.

Luminaire Type L3

A10.0

Slique T2

3/4" Undercabinet/Display Light
T2 Fluorescent

SQ

Project	Type
Project Location	
Catalog #	

Description

Slique T2 is the sleekest fluorescent undercabinet and display luminaire avail-able. Slique T2 utilizes a T2 fluorescent lamp and an integral miniature ballast. This allows a 3/4" x 1-3/4" luminaire cross-section and eliminates the need to remote-mount a ballast. The available plug-in modules, interconnect cords and connectors simplify the installation and support different layout configurations. Slique T2 is backed by Alkco's lifetime guarantee.

Additional features:

- Specular aluminum reflector improves luminaire efficiency
- Slique T2 is available in 4 product lengths
- The acrylic lens is guaranteed not to discolor for the life of the product
- Optional glass shelf fascia extrusion simplifies mounting to glass shelves
- Slique T2 is available in three standard colors
- Backed by a Lifetime Warranty

Specifications

Construction - Extruded aluminum housing with injection molded polycarbonate endcaps and covers.

Reflector & Lens - Specular aluminum, asymmetric reflector. Extruded acrylic lens with DR additive and linear prisms.

Finish - Slique T2 is available in either a white or black polyester powder-coat paint finish. The endcaps and covers are molded to match. Slique T2 can also be specified in an acid-etched, satin aluminum finish with molded endcaps and covers to match.

Lamps - Either one or two, FM11 or FM13 T2 fluorescent lamps (with axial base) are provided with each luminaire. The supplied miniature T2 lamps have a 3000K color temperature, CRI of 80, and an average rated life of 10,000 hours. 4100K lamps can be specified as an option.

Listings - UL and CUL Listed. The luminaire is also IBEW labeled.

Electrical - Slique T2 has a proprietary, integral electronic ballast for 120 volt applications. 277 volt, 347 volt and dimming applications are not supported.

Installation - A system consists of one Power Feed (either Direct Power Feed or Portable Power Feed) for each group of interconnected luminaires. The electrical power supply is brought to a Power Feed. The Direct Power Feed accepts a 3/8" flexible metal conduit/non-metallic sheathed wiring connector and is available in either a right- or left-end version. The alternative is to use the Portable Power Feed in either a right- or left-end version. The Power Feeds can plug into the end of the Slique T2 housing or mounted remotely and connected with one of the interconnect cords. The In-line Connector continues power through multiple luminaires mounted end-to-end. Interconnect Cords can be used to connect luminaires spaced some distance apart and to navigate around corners or bypass obstructions. The maximum number of luminaires to be interconnected cannot exceed 6.0 amps, with a maximum distance between luminaires not exceeding 3 feet.

Warranty - All components, except lamps, are warranted to perform for the life of the original installation.

Ordering Information

Sample Catalog No: **SQ111 - 120 - AL - SQC**

Each individual or string of interconnected Slique T2 luminaires require a Power Feed. Select below.

NOM. LENGTH	Model Number		Voltage	Finish (standard color is WHG)		Options	
18-15/16"	SQ111	(1) FM11 T2 Fluorescent	120	WHG	White Glossy	FC[1]	In-line connector for end-to-end connections
22-15/16"	SQ113	(1) FM13 T2 Fluorescent		BLKG	Black Glossy	CCW[1]	White 12-36" coiled interconnect cord
36-15/16"	SQ211	(2) FM11 T2 Fluorescent		AL	Aluminum	CCB[1]	Black 12-36" coiled interconnect cord
44-15/16"	SQ213	(2) FM13 T2 Fluorescent				SCW[1]	White 6" straight interconnect cord
						SCB[1]	Black 6" straight interconnect cord
						41K	4100K lamp substituted for 3000K lamp
						SQGSF-4	4' Fascia extrusion for mounting to 3/8" or 1/2" glass shelf
						SQGSF-8	8' Fascia extrusion for mounting to 3/8" or 1/2" glass shelf

[1] Order one connector or interconnect cord for each connection point.

Sample Catalog No: **SQ-DWR - 120 - AL**

NOM. LENGTH	Power Feed Style		Voltage	Finish (standard color is WHG)	
4-7/8"	SQ-DWR	Direct wire power feed, right end	120	WHG	White Glossy
4-7/8"	SQ-DWL	Direct wire power feed, left end		BLKG	Black Glossy
3-1/2"	SQ-CSR	Portable power feed, right end (with 6ft. cordset)		AL	Aluminum
3-1/2"	SQ-CSL	Portable power feed, left end (with 6ft. cordset)			

11500 Melrose Avenue Franklin Park, Illinois 60131
Phone: 847-451-0700 Toll-Free: 1-866-50ALKCO
Fax: 847-451-7512 www.alkco.com 06/10
©2010 Alkco Lighting. All rights reserved. Product designs protected by copyright.
We reserve the right to change details of design, materials and finishes.

PHILIPS ALKCO

A10.0

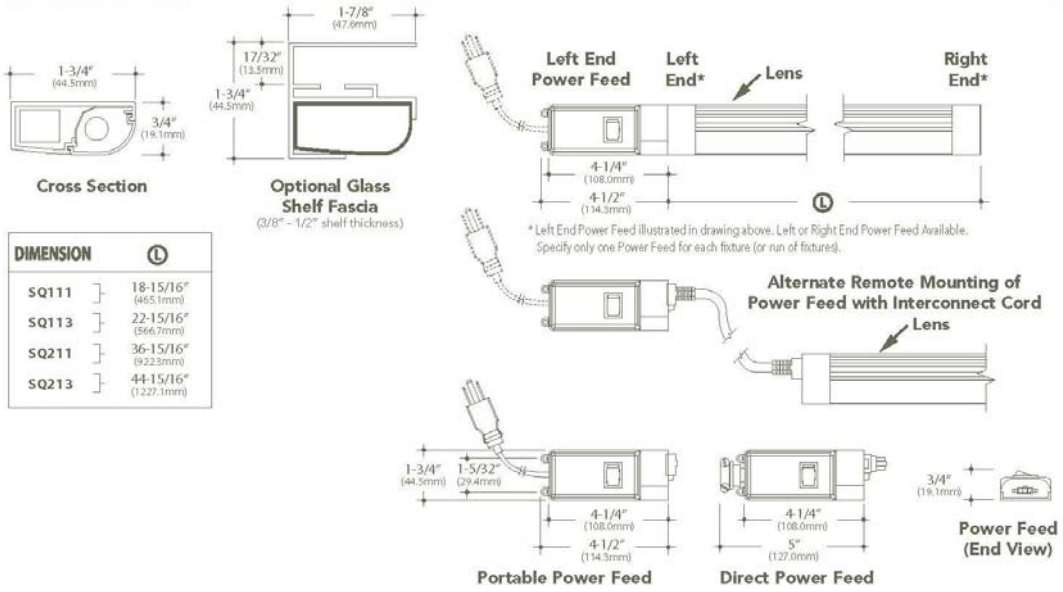
Slique T2

Project | Type

3/4" Undercabinet/Display Light
T2 Fluorescent

SQ

Dimensional Data

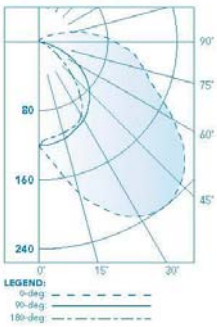


DIMENSION	Ⓛ
SQ111	18-15/16" (465.1mm)
SQ113	22-15/16" (566.7mm)
SQ211	36-15/16" (922.3mm)
SQ213	44-15/16" (1227.1mm)

Photometric Data

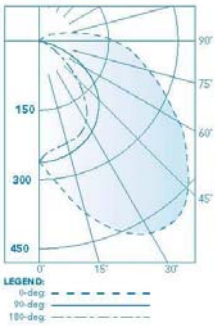
SQ113

(1) 13W T2 Fluorescent
860 lumens per lamp
Report No.: ITL51988
Efficiency: 66.9%



SQ213

(2) 13W T2 Fluorescent
860 lumens per lamp
Report No.: ITL51989
Efficiency: 68.1%



ELECTRICAL DATA

Lamp Wattage	11W	13W	(2) 11W	(2)13W
Input Watts	14	16	28	32
Max. Amps	.11	.13	.23	.27
Power Factor	>.95	>.95	>.95	>.95
THD	<15%	<15%	<15%	<15%

277V, 347V and dimming ballasts not available

Hg Some luminaires use fluorescent or high intensity discharge (HID) lamps that contain small amounts of mercury. Such lamps are labeled "Contains Mercury" and/or with the symbol "Hg". Lamps that contain mercury must be disposed of in accordance with local requirements. Information regarding lamp recycling and disposal can be found at www.lamprecycle.org

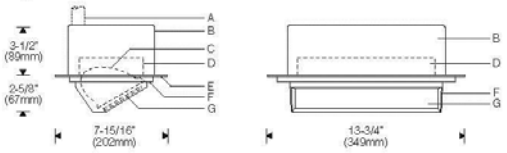
11500 Melrose Avenue Franklin Park, Illinois 60131
Phone: 847-451-0700 Toll-Free: 1-866-50ALKCO
Fax: 847-451-7512 www.alkco.com 06/10
©2010 Alkco Lighting. All rights reserved. Product designs protected by copyright. We reserve the right to change details of design, materials and finishes.

PHILIPS ALKCO

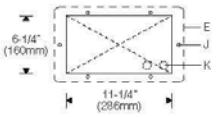
Luminaire Type S1

Lighting the Vertical Small semi-recessed outdoor — Ceramic Metal Halide — Tungsten Halogen — **Style 251 / 253**

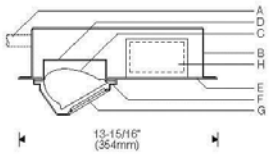
Style 251 (Halogen, metal halide remote) 1:8 Scale



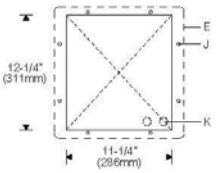
Rough Opening (Style 251)



Style 253 (Metal halide integral) 1:8 Scale



Rough Opening (Style 253)



Specifications

- **A** Conduit (by others)
- **B** Seam welded stainless steel recessed housing
- **C** Specular extruded aluminum reflector
- **D** Aluminum back box
- **E** 1/8" aluminum faceplate
- **F** Die-cast aluminum hood
- **G** Micro-prismatic, thermal and impact resistant tempered glass lens
- **H** Integral ballast compartment (Style 253)
- **J** Threaded inserts for attaching recessed housing to concrete form (hardware provided)
- **K** 7/8" dia. conduit entries (2 on top, 2 on side)

Finish:
Exterior surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish. Choice of semi-gloss colors (see ordering information).

Reflector – extruded high purity aluminum with clear anodized specular finish. All hardware and components – non-corrosive stainless steel or aluminum. Faceplate and hood secured with tamper-resistant (Torx) screws. Hood screws are captive.

Mounting:
Fixture installs into poured concrete ceiling. Recessed housing mounts to concrete form prior to pouring concrete.

Full size template provided. Threaded rod and hardware included for attachment to concrete form. Recessed housing can be ordered separately for installation prior to reflector and ballast assembly, specify **0T** option code.

For mounting in framed ceiling construction in damp locations, see Style 201/205 in Lighting the Wall Section.

Electrical:
Use 90°C wire for supply connections. Recessed housing supplied with four 7/8" dia. conduit entries (two on top of housing, two on side).

Tungsten halogen – DC bayonet lampholder retained with patented clamping supports for maximum heat dissipation.

Metal halide – G12 lampholder for use with single ended lamp. High reactance autotransformer ballast for 35W and 70W (-20°F/-30°C starting), or electronic ballast for 35W, 70W and 150W (5°F/-15°C starting). Die-cast aluminum weatherproof ballast enclosure includes four 1/2" NPT threaded entries. Electronic ballast provides improved voltage regulation, energy savings and automatic shut-off feature to eliminate end-of-life cycling. Optional remote ballast for dry indoor location.

Style 251 – remote ballast for indoor dry location. For remote wet location ballast, consult local sales representative.

Style 253 – integral ballast.

For complete ballast specifications, see Accessories Section.

Standard:
UL listed or CSA certified for wet locations. For installation in poured concrete only.

5/10

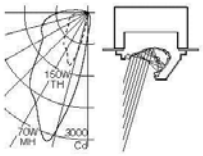
Features

- *Low profile focuses attention on luminous wall, not luminaire*
- *Evenly lights entire wall – reflector aperture is shielded*
- *Shallow recessed depth – ideal for poured concrete ceilings*
- *Built to last – all aluminum and stainless steel components*
- *Durable, secure – 1/8" aluminum faceplate, die-cast hood, thermal and impact resistant lens; tamper-resistant screws*

V 4.0

Performance

Two parabolic reflector sections drive light down the vertical plane from one edge. An elliptical section redirects its light to a parabola and shields the lamp. Asymmetry is maximized resulting in high beam efficiency and superior surface uniformity. The fast "runback" minimizes glare and spill light. Wide lateral distribution permits greater spacings.



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

elliptipar
There is no equal™

To Order

Style 251 / 253

To form a Catalog Number

1	2	3	4	5	6	7	8
			T				

1 Source
M = Metal halide
T = Tungsten halogen

2 Style
251 = Small outdoor semi-recessed, **remote** ballast
Note: Available for tungsten halogen (no ballast) and metal halide. Remote ballast is suitable for dry indoor location. For wet location ballast, consult local sales representative.
253 = Small outdoor semi-recessed, **integral** ballast
Note: Available for metal halide only.

3 Lamp

Lamp Code	Wattage	Lamp Number	Voltages	Remote Distance
Ceramic Arc Tube Pulse Start Metal Halide (80+ CRI)*				
035G	35	CDM35/T6/830	**1, 2**	15' (4.5m)
			A, B	10' (3m)
070G	70	CDM70/T6/830	**1, 2**	15' (4.5m)
			A, B	20' (6m)
150G	150	CDM150/T6/830	**1, 2**	15' (1.5m)
Tungsten Halogen				
0100	100	Q100DC	**A**	
0150	150	Q150DC	**A**	

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

V 4.1

4 Mounting
T = Recessed housing for use in poured concrete ceiling with overlapping trim/faceplate
Note: For mounting in framed ceiling construction in damp locations, see Style 201/205 in Lighting the Wall Section.

5 Finish
02 = Semi-gloss white
06 = Dark bronze
07 = Silver
08 = Semi-gloss black
12 = Green
99 = Custom RAL or computer matched color to be specified, consult sales representative.

Project:

6 Voltage/Ballast

Electronic	*Magnetic**
1 = 120V	**A** = 120V
2 = 277V	**B** = 277V

*35W or 70W Metal Halide or Tungsten Halogen (120V)

7 Option (See Accessories Section for specifications)
00 = No options
0H = Style 251 long distance remote metal halide ballast for dry indoor location (encapsulated magnetic ballast for 35 and 70W only),
35W: 15' min. up to 50' max. (4.5m - 15m),
70W: up to 50' max. (15m)
0T = Luminaire supplied less recessed housing (includes reflector, ballast and faceplate assembly).
Note: Requires previous installation of recessed housing kit in poured concrete (order separately, see Accessories).
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
M253 - 070G - T - 07 - B - 000

Small outdoor semi-recessed with hood for use with 70W metal halide lamp. Recessed housing for use in poured concrete. Overlapping trim/faceplate. Silver powder coat finish. Integral 277V ballast. UL listed or CSA certified for U.S.

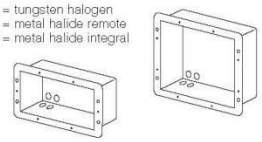
Type:

Accessories
Order separately. See Accessories Page for specifications.

AFK000X [ ] = Ballast **fuse** kit
0 = U.S.
J = Canada

VRH [ ] **0** = **Recessed housing kit** with hardware, for installation in poured concrete.
Note: Required only when installing recessed housing in advance of electrical and finish components. Order reflector, ballast and faceplate assembly separately, specify **0T** option code.

T251 = tungsten halogen
M251 = metal halide remote
M253 = metal halide integral



5/10

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**

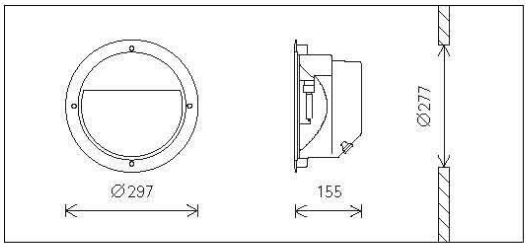
Certain products illustrated may be covered by applicable patents and patents pending. These specifications supersede all prior publications and are subject to change without notice. Copyright © 2010 Sylvan R. Shemitz Designs, Inc., all rights reserved.

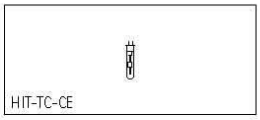
Luminaire Type S2

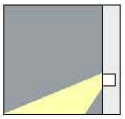
ERCO

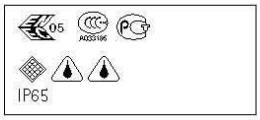
Visor III Floor washlight

for metal halide lamps



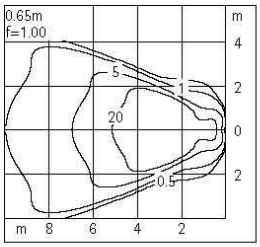






33304.000 Reflector silver
HIT-TC-CE 35W G8.5 3900lm
ECG

Product description
Housing for recessed mounting in brickwork and dry-wall partitions: corrosion-resistant cast aluminium, No-rinse surface treatment. Black double powder-coated.
Mounting by means of an adjustable bar. Clamp extension 1-35mm. Pre-drilled holes in the base of the housing. 2 cable entries. Through-wiring possible. 5-pole terminal block.
Electronic control gear.
Asymmetric reflector system: aluminium, silver anodised, mirror-finish. Anti-dazzle cover: metal. No direct light emission.
Screw-fastened cover with sculpture lens as safety glass: corrosion resistant stainless steel. Optimised surface for reduced accumulation of dirt.
Protection mode IP65: dust-proof and water jet-proof.
Weight 3.70kg
Temperature on the light aperture 60°C



HIT-TC-CE 35W G8.5 3900lm

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 25.10.2010
Current version under
www.erco.com/33304.000

Luminaire Type S3

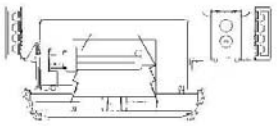
Job:
Type:
Notes:

Designer Canopy

Page 1 of 3

220 / 221 Series Recessed Luminaires
Including 220EM / 221EM Series Emergency Recessed

The Philips Gardco Designer Canopy luminaire is a family of downlight and wall wash ceiling mounted luminaires utilizing high intensity discharge and compact fluorescent lamps. The contemporary form housing is available in a variety of architectural finishes assuring compatibility with the building. Downlight optical systems are offered with prismatic or fresnel lenses and the wall washer is offered with a prismatic lens. The Designer Canopy luminaire is suitable for outdoor applications and features rugged die cast construction, silicone seals and gaskets, and polyester powdercoat finishes.



PREFIX	DISTRIBUTION	WATTAGE	VOLTAGE	FINISH	OPTIONS

Enter the order code into the appropriate box above. Note: Gardco reserves the right to refuse a configuration. Not all combinations and configurations are valid. Refer to notes below for exclusions and limitations. For questions or concerns, please consult the factory.

PREFIX

220	Downlight
221	Wall Wash
220EM[1]	Emergency Downlight
221EM[1]	Emergency Wall Wash

1. Emergency luminaires are available in 42TRF only, 120V or 277V only.

DISTRIBUTION

P	Prismatic Lens
F	Fresnel Lens *Available with 220 units only*

WATTAGE

Pulse Start MH Magnetic Ballast	50MH[5]	100MH	
	70MH	150MH	
Ceramic Pulse Start MH Electronic Ballast	50CMHE[3,4]	100CMHE[3,4]	
	70CMHE[3,4]	150CMHE[3,4] Ⓔ	
*Standard MH Magnetic Ballast**	175MH*		
High Pressure Sodium Magnetic Ballast	50HPS	100HPS	
	50HPS	150HPS[2]	
Compact Fluorescent Electronic Ballast	26QF[3]	32TRF[3]	42TRF[3]

** 175MH not available for sale in the United States.*

Ⓔ *Wattages marked with Circle "E" meet federal energy efficiency standards applicable to 150 watt through 500 watt metal halide luminaires only.*

VOLTAGE

UNIV	*120V through 277V, 50hz to 60hz, input.*
120	
277	
347	*Consult factory for 347V availability prior to ordering. Not available in Ceramic Metal Halide with Electronic Ballast (CMHE) types.*

2. ANSI S55.
3. 220 and 221 fluorescent and CMHE luminaires feature electronic ballasts that accept 120V through 277V, 50hz to 60hz, input. Specify "UNIV" voltage for 120V through 277V. Consult Factory for 347V. 220EM and 221EM luminaires are available in 42TRF only, 120V or 277V only.
4. Electronic ballast brand specified by Philips Gardco only.
5. Available in 120V or 277V only.

1611 Clovis Barker Road, San Marcos, TX 78666
(800) 227-0758 (512) 753-1000 FAX: (512) 753-7855 sitelighting.com
© 2010 Koninklijke Philips Electronics N.V. All Rights Reserved.
Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program.
79115-92/1110

PHILIPS
GARDCO

Designer Canopy

Page 2 of 3

220 / 221 Series Recessed Luminaires

FINISH

BRP	Bronze Paint
BLP	Black Paint
WP	White Paint
NP	Natural Aluminum Paint
BGP	Beige Paint
OC	Optional Color Paint *Specify Optional Color or RAL ex: OC-LGP or OC-RAL7024.*
SC	Special Paint *Specify. Must supply color chip.*

OPTIONS

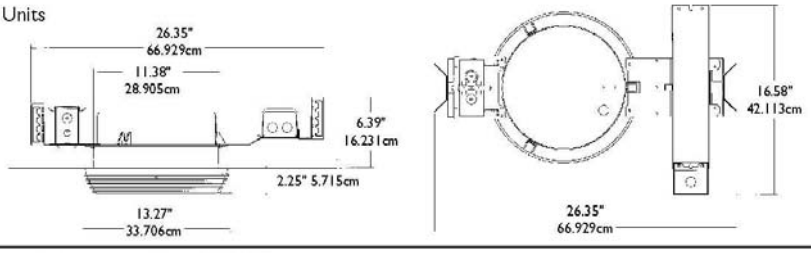
F[5]	Fusing
RS	Tamper Resistant Hardware
QS[6]	Quartz Standby
QST[6]	Quartz Restrike Timed Delay

5. Not available with EM luminaires, 347V or Ceramic Metal Halide with Electronic Ballast (CMHE) types.

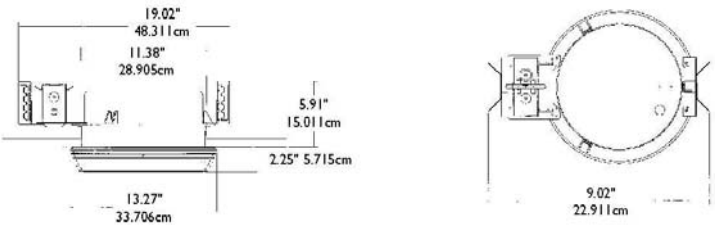
6. HID luminaires only. Limited to 100W maximum quartz lamp wattage. Not available in Ceramic Metal Halide with Electronic Ballast (CMHE) types. Available with 150 watt HID and lower only.

DIMENSIONS

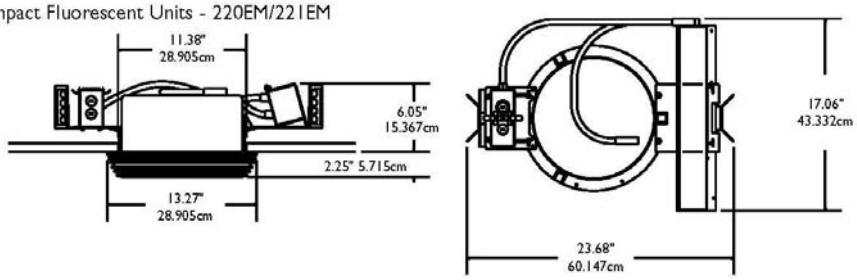
HID Units



Compact Fluorescent Units - 220/221



Compact Fluorescent Units - 220EM/221EM



1611 Clovis Barker Road, San Marcos, TX 78666
(800) 227-0758 (512) 753-1000 FAX: (512) 753-7855 sitelighting.com
© 2010 Koninklijke Philips Electronics N.V. All Rights Reserved.
Philips Gardco reserves the right to change materials or modify the design of its product without notification as part of the company's continuing product improvement program.
79115-92/1110

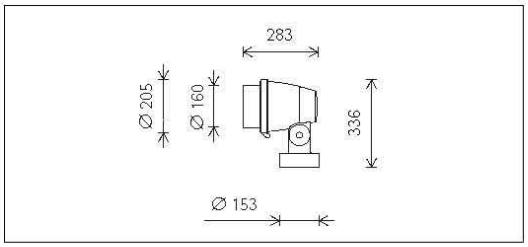
PHILIPS
GARDCO

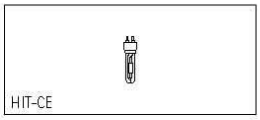
Luminaire S4

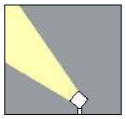
ERCO

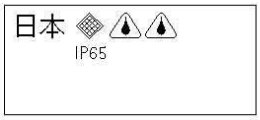
Beamer II Projector

with mounting plate for metal halide lamps



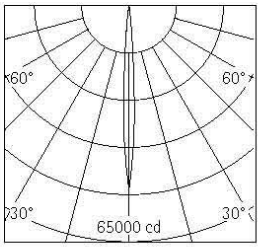






34070.000 Graphit m
HIT-CE 20W G12 1800lm
ECG
Spot reflector

Product description
Housing, hinge and mounting plate: corrosion-resistant cast aluminium, No-Rinse surface treatment. Double powder-coated. Optimised surface for reduced accumulation of dirt. Hinge with internal wiring, 130° tilt. Graduated disc: corrosion-resistant aluminium. Mounting plate rotatable through 240°. 2 cable entries. Through-wiring possible. 3-pole terminal block.
Electronic control gear.
Reflector: aluminium, silver, mirror-finish anodised.
Screw-fastened snoot with safety glass: corrosion-resistant cast aluminium, double powder-coated. Cross-baffle: metal, black lacquered. Cut-off angle 50°. Without spill light.
Protection mode IP65: dust-proof and water jet-proof.
Weight 7.00kg
Maximum wind load area 0.06m²



HIT-CE 20W G12 1800lm

h(m)	E(lx)	D(m) 7°
1	50654	0.12
2	12663	0.24
3	5628	0.37
4	3166	0.49
5	2026	0.61

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 25.10.2010
Current version under
www.erco.com/34070.000

Luminaire Type S5

Saturn 2 Cutoff

se'lux®

Project: _____

Type: _____ **Qty:** _____

SAC2 – ___ – ___ – ___ – ___ – ___ – ___ – ___ – ___

Series | Reflector | Mounting | Lamping | Lamp Color | Finish | Voltage | Option | Option

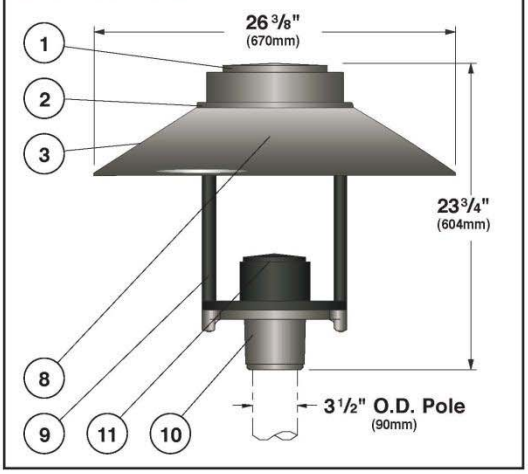
___ – ___ – ___ – ___ – ___ – ___

Pole Series | Height | Finish | Pole Options

Series	Reflector	Mounting	Lamping	Lamp Color	Finish	Voltage	Options
SAC2 Saturn 2 Cutoff	R2 Type II Aluminum Reflector R5 Type V Aluminum Reflector	1 Single 2 Double W Wall Mount	T6 Metal Halide H039T6[1] 39W T6 G12 H070T6 70W T6 G12 H150T6 150W T6 G12	830 3000° K 942 4200° K NOL Lamp not included	WH White BK Black BZ Bronze SV Silver SP Specify Premium Color	120 208 240 277 347	DS Full Cutoff Optics HS[2] House Side Shield (180°) FS[3] Single Fusing PCT Photocell Tenon

[1]Only available in 120v and 277v [2]Only available with R2 reflector [3]Not available with 347V

SAC2-XX-1-DS



1. Luminaire Cover - Die cast aluminum cover removes easily for access to field rotatable optics (rotatable 90 degrees).

2. Gasketing - Continuous gasket provides weatherproofing, dust and insect control at all fixture connections.

3. Luminaire Hood - Aluminum shade with white painted interior.

4. Reflector - (Not shown) Precision formed, completely sealed aluminum reflector system with a Type II or Type V IDA-approved "dark sky friendly" Full-cutoff distribution.

5. Lamp - (Not shown) Choose between 39 to 150 watt T6 or T7.5 G12 base ceramic metal halide lamps. Luminaire supplied with 3000° K or 4200° K lamps, other color temperatures are available, please consult factory. Horizontal lamp for R2 and R5 reflector.

6. Socket - (Not shown) Pulse rated porcelain G12 base socket. Socket is pre-wired to ballast at factory.

7. Ballast - (Not shown) A high power factor, open core and coil ballast regulates voltage for H.I.D. lamp. Consult factory for detailed ballast information.

8. Lamp Access Door - Hinged tempered glass lens, secured to luminaire with two tool-less latches. Lens gasketed to die cast aluminum shade stabilizer.

9. Hood Supports - Two aluminum arms support shade and optic assembly and attach to the die cast aluminum pole fitter (shown painted matte black for DS option).

10. Pole Fitter - Self-leveling, die-cast aluminum, fitter base secured to pole with three stainless steel, allen head set screws. Fitter for 3 1/2" (90mm) O.D. poles.

11. Ballast cover - Die cast aluminum ballast cover removes easily for access to ballast. Ballast secured to removable tray for ease of maintenance (shown painted matte black for DS option).

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

Standard exterior colors are White (WH), Black (BK), Bronze (BZ), and Silver (SV). Selux premium colors (SP) are available, please specify from your SELUX color selection guide. Hot Dip Galvanized finish (GV) on all steel parts also available.

SELUX Corp. © 2011
TEL (845) 691-7723
FAX (845) 691-6749
www.selux.com/usa
SAC2-0211-01 (ss-V1.1)

NRTL Listed (i.e. UL, CSA)

Union Made Affiliated with IBEW Local 363

Made in the USA

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

Saturn 2 Cutoff

se'lux

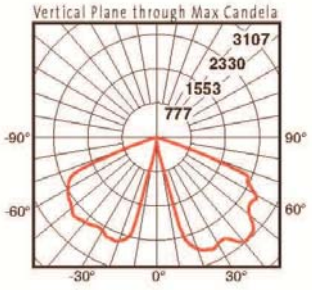
Photometry

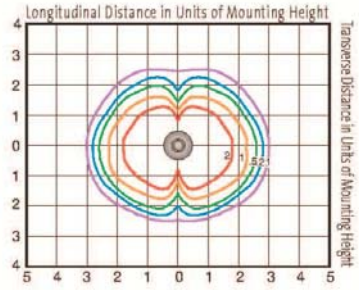
Type II Reflector / 150w MHT6 / Full Cutoff Optics

Catalog # SAC2-R2-1-H150T6-DS
Report # LTL-16224

- Precision formed aluminum reflector with to precisely control distribution.
- Maximum candela of 3107 at 41° from vertical.
- IES classification = Type II Full Cutoff.
- IDA-Approved™ dark sky friendly.

DOWNLOAD IES FILE:
http://www.selux.com/web/files/exterior/SAC2-R2-1-H150T6-DS.zip



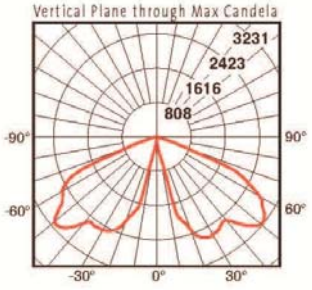


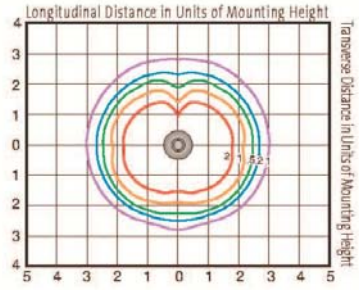
Type V Reflector / 150w MHT6 / Full Cutoff Optics

Catalog # SAC2-R5-1-H150T6-DS
Report # LTL-16225

- Ideal for applications demanding a uniform symmetric light distribution.
- Maximum candela of 3231 at 51.5° and -51.5° from vertical.
- IES classification = Type V Full Cutoff.
- IDA-Approved™ dark sky friendly.

DOWNLOAD IES FILE:
http://www.selux.com/web/files/exterior/SAC2-R5-1-H150T6-DS.zip





H.I.D. Lamp Prorate Table (Clear, G12 base)		
T6 Metal Halide		
Wattage	Factor	Initial Lumens
39	0.24	3300
70	0.47	6600
150	1.00	14000

Conversion Chart	
Values based on 12' mounting height.	
Mounting Height	Multiply
8'	1.22
10'	1.10
12'	1.00
14'	0.93
16'	0.87

SELUX Corp. © 2011
SAC2-0211-02

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

Saturn 2 Cutoff

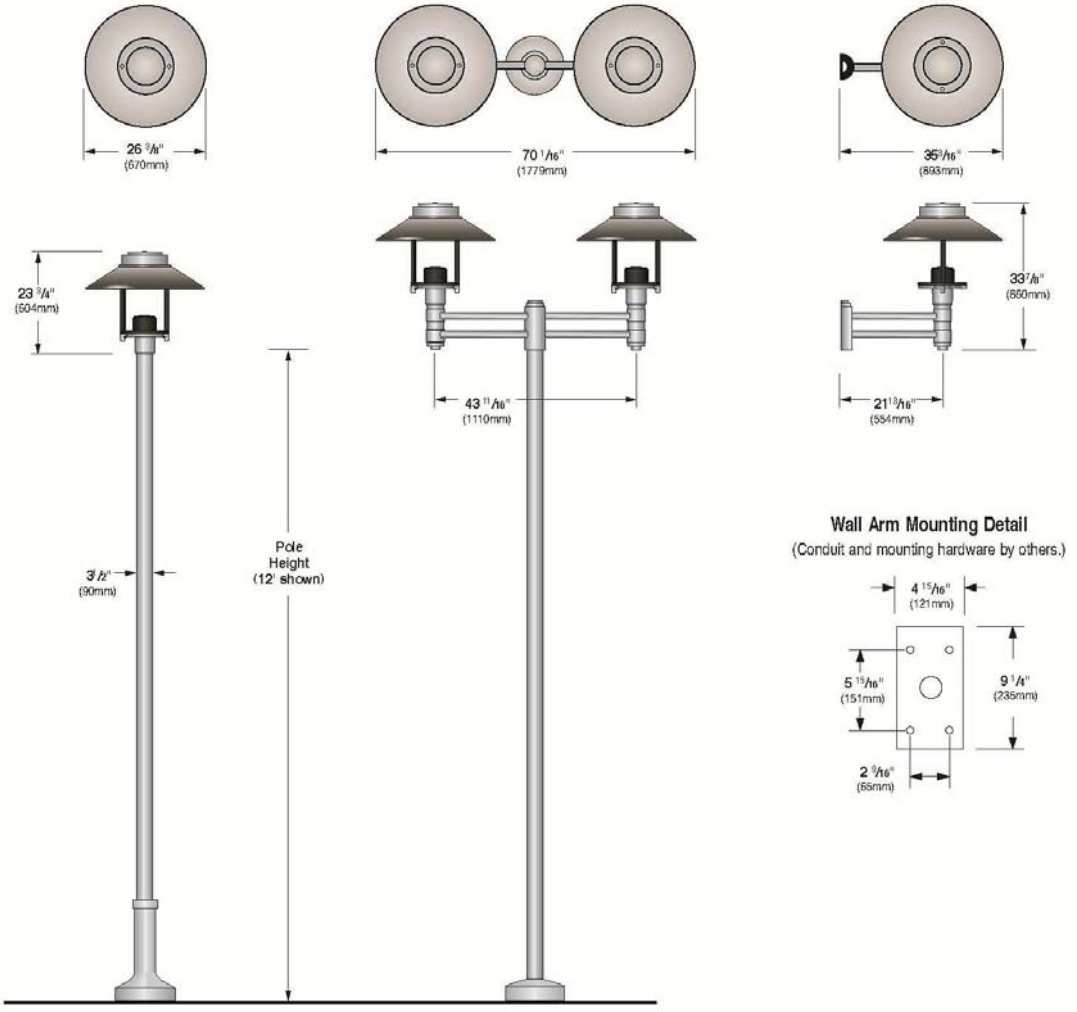
se'lux

Mounting

Single
Die-cast aluminum fitter base secured to pole with three stainless steel, Allen head set screws.

Double
Die-cast aluminum double luminaire mounting arm secured to pole with four stainless steel, Allen head set screws. Outer slip fitter for 3 ½" tenon.

Wall
Die-cast aluminum double round wall mount arm. Secured to wall with ¼" diameter threaded fasteners (by others).



Wall Arm Mounting Detail
(Conduit and mounting hardware by others.)

SELUX Corp. © 2011
SAC2-0211-03

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

Saturn 2 Cutoff

se'lux

Pole Information

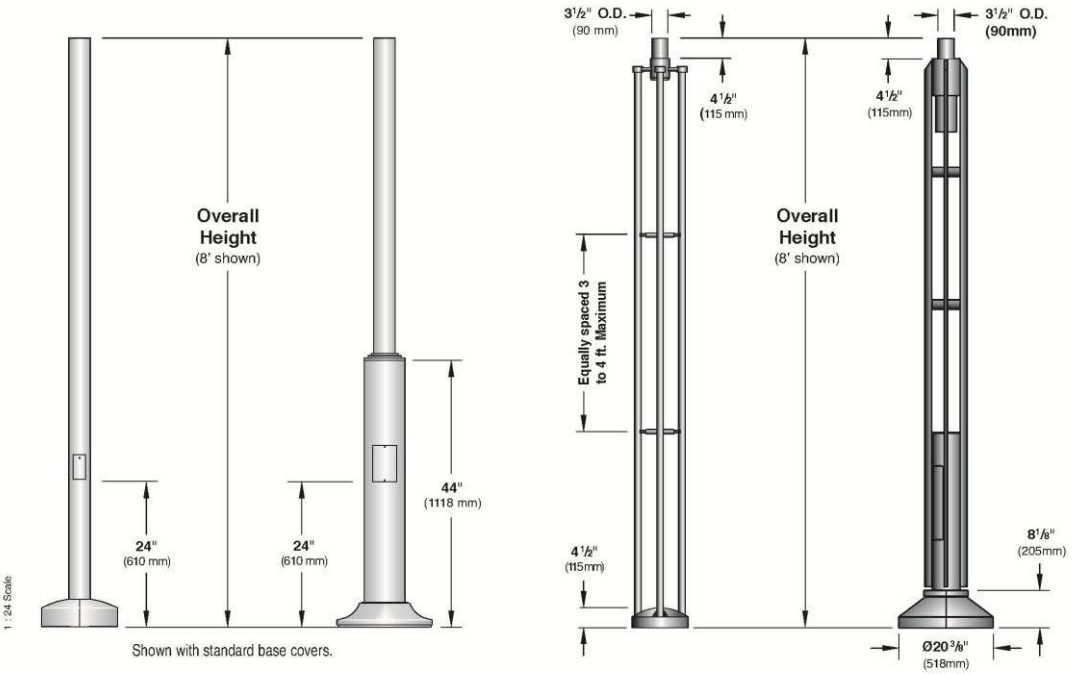
Refer to A35, A4P, S635, S4P, or S35 Pole specification sheets for construction details, anchorage information and additional options.

A35 & S35
Round Straight Aluminum
& Round Straight Steel Poles

S635
Round Stepped
Steel Pole

A4P
Quad Post
Aluminum Pole

S4P
Lattice
Steel Pole



Shown with standard base covers.

Base Cover Information

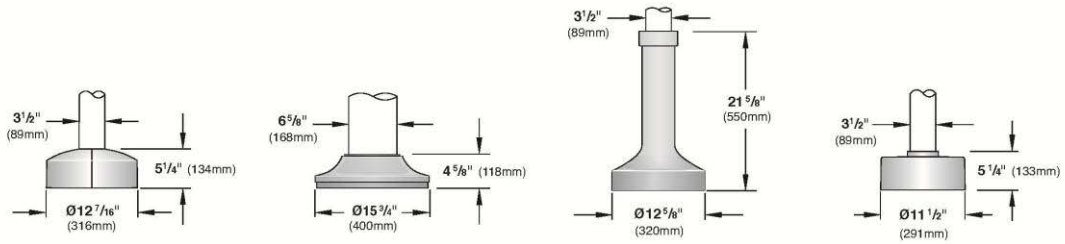
Refer to A35, A4P, S635, S4P, or S35 Pole specification sheets for construction details, anchorage information and additional options.

Straight Poles (A35 & S35)
BC5 Standard Base Cover
Two-piece cast aluminum

Stepped Steel Pole (S635)
BC6 Standard Base Cover
One-piece cast aluminum

BC1 Optional Base Cover
(A35 & S35) One-piece cast aluminum

BC4 Optional Base Cover
(A35 & S35) One-piece cast aluminum



SELUX Corp. © 2011
SAC2-0211-04

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

Saturn 2 Cutoff

selux

Pole Data Chart

Pole Series	Bolt Circle	EPA Information (ft²) 70 mph	80 mph	90 mph	100 mph	110 mph	Height
S635 3 1/2" Diameter Stepped Steel Pole	ø9"	57.6	44.3	34.6	27.5	22.8	
A35 3 1/2" Diameter Straight Aluminum Pole	ø7 3/4"	16.1	12.2	9.4	7.3	5.9	
A4P[2] 3 1/2" Diameter Quad Post Aluminum Pole	ø9 1/4"	17.39	12.84	9.73	7.50	5.85	8 8 ft.
S35 3 1/2" Diameter Straight Steel Pole	ø7 3/4"	14.8	11.3	8.6	6.7	5.4	
S4P 3 1/2" Diameter Lattice Steel Pole	ø13 15/16"	22.54	17.09	13.36	10.69	8.71	
S635 3 1/2" Diameter Stepped Steel Pole	ø9"	45.6	35.0	27.3	21.6	17.8	
A35 3 1/2" Diameter Straight Aluminum Pole	ø7 3/4"	12.4	9.3	7.1	5.4	4.3	
A4P[2] 3 1/2" Diameter Quad Post Aluminum Pole	ø9 1/4"	19.87	14.63	11.03	8.46	6.56	10 10 ft.
S35 3 1/2" Diameter Straight Steel Pole	ø7 3/4"	11.4	8.6	6.5	4.9	3.9	
S4P 3 1/2" Diameter Lattice Steel Pole	ø13 15/16"	28.87	21.87	17.06	13.63	11.08	
S635 3 1/2" Diameter Stepped Steel Pole	ø9"	37.6	28.7	22.3	17.5	14.4	
A35 3 1/2" Diameter Straight Aluminum Pole	ø7 3/4"	9.9	7.3	5.4	4.0	3.1	
A4P[2] 3 1/2" Diameter Quad Post Aluminum Pole	ø9 1/4"	9.93	6.90	4.82	3.34	2.24	12 12 ft.
S35 3 1/2" Diameter Straight Steel Pole	ø7 3/4"	9.1	6.7	4.9	3.6	2.8	
S4P 3 1/2" Diameter Lattice Steel Pole	ø13 15/16"	26.64	20.08	15.59	12.37	9.99	
S635 3 1/2" Diameter Stepped Steel Pole	ø9"	31.7	24.2	18.6	14.6	11.9	
A35 3 1/2" Diameter Straight Aluminum Pole	ø7 3/4"	8.0	5.8	4.2	3.0	2.2	
A4P[2] 3 1/2" Diameter Quad Post Aluminum Pole	ø9 1/4"	10.99	7.59	5.26	3.60	2.37	14 14 ft.
S35 3 1/2" Diameter Straight Steel Pole	ø7 3/4"	7.3	5.3	3.8	2.7	1.9	
S4P 3 1/2" Diameter Lattice Steel Pole	ø13 15/16"	12.71	9.35	7.04	5.39	4.17	
S635 3 1/2" Diameter Stepped Steel Pole	ø9"	21.7	15.8	12.3	9.6	7.6	
A35 3 1/2" Diameter Straight Aluminum Pole	ø7 3/4"	4.9	3.2	2.2	1.4	0.8	
A4P[2] 3 1/2" Diameter Quad Post Aluminum Pole	ø9 1/4"	5.70	3.43	1.87	N/A	N/A	16 16 ft.
S35 3 1/2" Diameter Straight Steel Pole	ø7 3/4"	4.4	2.8	1.9	1.2	0.6	
S4P 3 1/2" Diameter Lattice Steel Pole	ø13 15/16"	6.41	4.45	3.1	2.14	1.43	

[1]Other pole configurations available, consult factory. [2]EPA Calculations allow for 1.3 Gust Factor

Finish

WH White
BK Black
BZ Bronze
SV Silver
SP Specify Premium Color

Options

BC1 Decorative Cast Aluminum Base Cover (for A35 & S35 poles only)
BC4 One-piece Cast Aluminum Base Cover (for A35 & S35 poles only)
REC GFCI Receptacle with weather-proof cover[1,2]

For Photocell Tenon option, see p.1

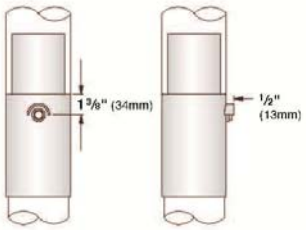
[1] Weatherproof cover intended for portable tools or other portable equipment connected to the outlet only when attended. For other requirements please consult factory.

[2] GFCI receptacle not available with A4P pole.

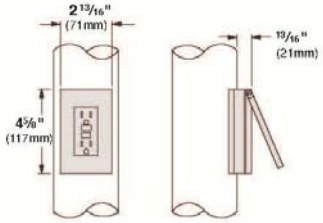
Effective Projected Area of Single Luminaire = 0.8 ft² (0.24m²) / Weight of Luminaire = 36.0 lbs (16.3kg)
Effective Projected Area of Double Luminaire = 1.6 ft² (0.49m²) / Weight of Double Luminaire (includes arms) = 72.0 lbs (32.7kg)

Optional Accessories

Photo Cell Tenon (PCT) - Button type photocell mounted in cast aluminum pole top tenon. Tenon has integral cast visor to prevent false start/stop cycle and can be oriented for optimum performance. Refer to fixture spec sheet to determine if this option is applicable.



GFCI Receptacle (REC) - GFCI duplex receptacle with cast base bolted to pole and gasketed, provided with weather-proof, self-closing cover; located 36" (915mm) from base of pole, inline with handhole. Receptacle is intended only for portable tools or other portable equipment to be connected to outlet only when attended by operating personnel. Not available for A4P Quad Post pole..



SELUX Corp. © 2011
SAC2-0211-05

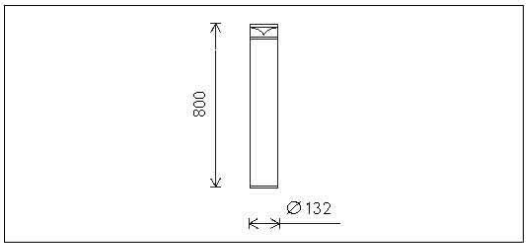
In a continuing effort to offer the best product possible, we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product. Specification sheets found at www.selux.com/usa are the most recent versions and supercede all other printed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

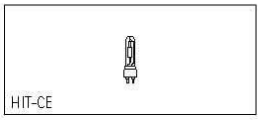
Luminaire Type S6

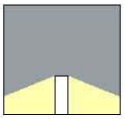
ERCO

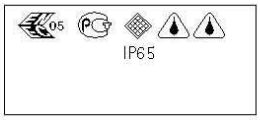
Panorama Bollard luminaire

for metal halide lamps



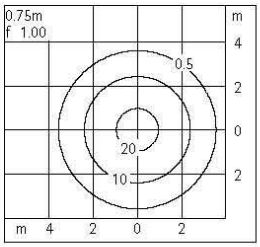






33348.000 Graphit m
HIT-CE 35W G12 3300lm

Product description
Aluminium tube: double powder-coated.
Upper cover: corrosion-resistant cast aluminium, No-Rinse surface treatment, double powder-coated. Optimised surface for reduced accumulation of dirt.
Base plate for mounting on concrete plinth or accessories.
2 cable entries. Through-wiring possible.
5-pole terminal block.
Control gear, 230V, 50Hz, with temperature controller, timer-ignitor, capacitor.
Internal parabolic reflector: aluminium, silver, mirror-finish anodised.
Anti-dazzle screen: metal, black.
360° conical Darklight reflector: aluminium, silver, mirror-finish anodised.
Glare-free above the light aperture.
Glass cylinder as lamp cover. Luminaire housing is removed from base for lamp replacement. Tamper-proof screws.
Protection mode IP65: dust-proof and water jet-proof.
Weight 6.30kg
Housing temperature 50°C
Temperature on the light aperture 47°C
Maximum wind load area 0.11m²



HIT-CE 35W G12 3300lm

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

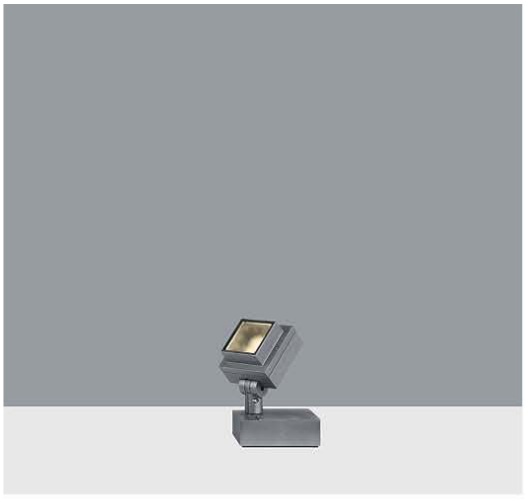
Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 25.10.2010
Current version under
www.erco.com/33348.000

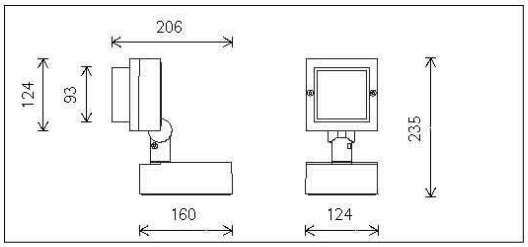
Luminaire Type S7

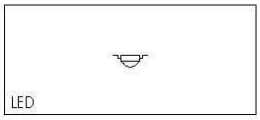
ERCO

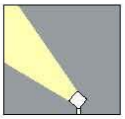
Grasshopper Projector

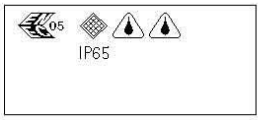
with LED





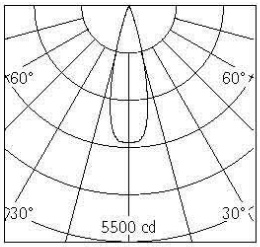






34035.000 Graphit m
LED 14W 870lm 3200K warm white
Version 3
Spherolit lens, flood

Product description
Housing, hinge and mounting plate: corrosion-resistant cast aluminium, No-Rinse surface treatment. Double powder-coated. Optimised surface for reduced accumulation of dirt. Hinge with graduations and internal wiring, 80° tilt. Mounting plate rotatable through 360°.
Electronic control gear. 2 cable entries. Through-wiring possible. 3-pole terminal block.
Replaceable LED module: high-power LEDs on metal-core PCB. Collimating lens made of optical polymer.
Compact light head with non-reflecting safety glass. Corrosion-resistant cast aluminium, double powder-coated.
Improved lamp screening for highest visual comfort.
Protection mode IP65: dust-proof and water jet-proof.
Weight 2.30kg



LED 14W 870lm 3200K

h(m)	E(lx)	D(m)
		27°
1	3177	0.48
2	794	0.96
3	353	1.44
4	199	1.92
5	127	2.40

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 25.10.2010
Current version under
www.erco.com/34035.000

1/3

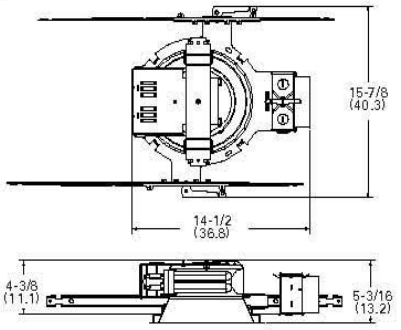
Luminaire Type W1

Type ..... Catalog number .....

Compact Fluorescent Downlights

8" AFLP

Low Profile
Triple-Tube



FEATURES

OPTICAL SYSTEM
- Reflector - Self-flanged, semi-specular or matte-diffuse reflector. Fluted vertical upper section works in conjunction with Patented Bounding Ray™ Optical Principle design (U.S. Patent No. 5,800,050) to provide lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish.
- Hinged lampdoor seals upper trim for optimal fixture efficiency and the reduction of stray light in the plenum.

MECHANICAL SYSTEM
- 16-gauge galvanized steel mounting/plaster frame. Maximum 1-1/2" ceiling thickness.
- 16-gauge galvanized steel mounting bars with continuous 4" vertical adjustment are shipped pre-installed. Post installation adjustment possible without the use of tools from above or below the ceiling.
- Galvanized steel junction box with hinged access covers and spring latch. Two combination 1/2"–3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors, rated for 90°C.
- Low profile design allows for 4-3/8" fixture depth above ceiling.

ELECTRICAL SYSTEM
- Horizontally-mounted, positive-latch, thermoplastic socket.
- Class P, thermally protected, high power factor electronic ballast mounted to the junction box.
- Simply5™ technology available.

LISTING
- Fixtures are UL Listed for thru-branch wiring, Non-IC recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards.

Aperture:	7-7/8 (20.1)
Ceiling Opening:	8-7/8 (22.5)
Overlap Trim:	9-1/4 (23.5)

All dimensions are inches (centimeters)

ORDERING INFORMATION

Example: **AFLP 1/26TRT 8AR MVOLT**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number (shipped separately).

AFLP

Series	Wattage/Lamp	Aperture/Trim color	Finish	Voltage	Ballast[2]	Options
AFLP	1/18TRT	8AR Clear	(blank) Semi-specular	MVOLT[1]	(blank) Electronic ballast	ELR[5] Emergency battery pack, remote test switch
	1/26TRT	8PR Pewter	LD Matte-diffuse	120	ECOS[3] EcoSystem H-Series architectural dimming ballast	ELRHL[5] High lumen output emergency battery pack, remote test switch provided
	1/32TRT	8WTR Wheat		277	ADEZ[3] Advance Mark 10® electronic dimming ballast. Minimum dimming level 5%	GMF[6] Single, slow-blow fuse
	1/42TRT			347	ADZT[3,4] Advance Mark VII™ electronic dimming ballast	GLR[6] Single, fast-blow fuse
	2/18TRT				S5[4] SIMPLY5™ system ballast	TRW White painted flange
	2/26TRT					TRBL Black painted flange
	2/32TRT					DS Dual switching
	2/42TRT					CP[7] Chicago Plenum
						WLP With 3500°K lamp (shipped separately)

NOTES
1 Multi-volt electronic ballast capable of operating on any voltage from 120V through 277V, 50 or 60 Hz.
2 For additional ballast types, refer to Technical Bulletins tab.
3 Available in 120V or 277V only.
4 Simply5™ includes 9' S5 MLC Reloc wiring system (shipped separately). Available in 120V or 277V only. Not available in 18W. See simply5.net for more information.
5 For dimensional changes, refer to Technical Bulletins tab.
6 Not available with MVOLT; must specify voltage.
7 Not available with ELR option.

gotham®
An RSA Company

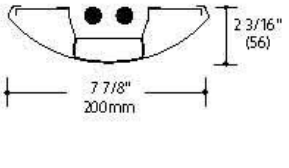
GOTHAM ARCHITECTURAL DOWNLIGHTING
1400 Lester Road Conyers Georgia 30012
P 800 315 4982 F 770 860 3129
www.gothamlighting.com

AFLP 8 TRT OPEN DCF-183

Luminaire Type W2

LITECONTROL

Fixture Type:
Project name:




Shown with Shelf Style End Cap

Arcos™ M5

P-ID-59M

Pendant-Mounted Indirect/Direct

LCS Control Solutions available

Product Description

A smaller, sleeker version of the pendant-mounted Arcos indirect-direct steel fixture. This fixture is Cradle to Cradle Silver Certified℠ by MBDC.

Ordering Guide

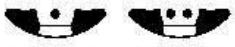
Product, Lamping & Length						Options						
P -	ID -	59M	4	8	T5HO-	SGL-	TCWM-	LP/ELB-	TW-	2CWQ-	--	120
Mounting P Pendant-mounted	Distribution ID Indirect/ Direct	Series 59M	Lamp Count 1, 2 → 4 → 2, 4 → 8 → see notes	Nominal Length (ft)	Lamp Type T5 T5HO	Baffle or Diffuser PBCWM PBCWM/O PBSS PBSS/O SGL VC1 see Baffle or Diffuser Options	Finish TCWM (textured matte white) is standard see LiteColors™ in product guide for other finishes	Ballast LP/ELB is standard LPD/CS/e LPD/D10 LPD/MK7 see Ballast Options	Tandem Wiring – → TW → see notes	Circuiting 1CWQ 2CWQ	Other Options CS/dlh* ECSS F LP/EF see Other Options	Volts 120 277

Mounting
- add to end of catalog number
Aircraft cables
✓ FA/ACC (field adjustable) *standard*

notes:
Lamp count = total number of lamps in the fixture
Tandem wiring not available for one-lamp cross-section fixtures
For ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications
*Must include a dimming ballast (LPD/ELB). See next page for details.

P-ID-59M48T5HO-SGL-TCWM-LP/ELB-TW-2CWQ-120-FA/ACC is a typical catalog number for a 4-lamp (2-lamps in cross-section), 8-foot long T5HO fixture with soft glow lens, textured matte white finish, low-profile electronic ballast, tandem-wired, two-circuit branch wiring with quick connects, 120 volts, mounted with field adjustable aircraft cables.

Cross-section lamping



Baffle & Diffuser Options

PBCWM Radiused Parabolic Baffle finished Matte White.
PBCWM/O Radiused Parabolic Baffle finished Matte White with Overlay. For additional diffusing of lamp(s), Matte White acrylic overlay provided to lay over baffle blades.
PBSS Radiused Parabolic Semi-Specular Baffle.
PBSS/O Radiused Parabolic Semi-Specular Baffle with Overlay. For additional diffusing of lamp(s), Matte White acrylic overlay provided to lay over baffle blades.
SGL Soft Glow Lens. Extruded frosted acrylic, follows contour of fixture housing.
VC1 VCOptic lens. Microstructure film overlay on a clear grooved lens that follows contour of fixture housing.

Other Options LCS dlh

CS/dlh Daylight harvesting solution. See next page for details.
ECSS End Cap Shelf-Style. Die-cast shelf-style end caps with no exposed fasteners.
F Fuse. Slow or fast blow, determined by Litecontrol.
LP/EF Low-profile Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one lamp for 1 1/2 hours.

Ballast Options LCS

To have the fixture enabled for Lutron EcoSystem compatibility:
LPD/CS/e EcoSystem low-profile dimming electronic ballasts installed at the factory, along with all required internal EcoSystem wiring. For other configurations of the Lutron EcoSystem components, including custom device connection feeds to enable connection to ceiling-mounted sensors and control devices, consult litecontrol.com/cs or contact the factory.

LPD/D10 Universal Lighting Technologies dimming ballast (T5)
LPD/MK7 Advance Mark VII dimming ballast (T5HO)

Tandem Wiring & Circuiting Options

1CWQ Fixture is wired with a single-circuit so that all lamps are switched together.
TW-2CWQ Fixtures wired with two circuits. 2-lamp in cross section fixtures, the fixture is wired such that the inline lamps are switched separately.

Questions to Ask
1. Row information, including desired fixture lengths?
2. Lamp type? **3.** Ballast options?
4. Control solutions? **5.** Other options? **6.** 120 or 277 volt?

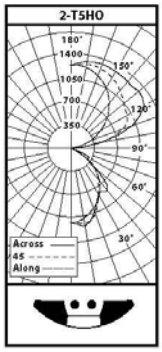
revised 2/27/2009

Click on Quick Find 59M
litecontrol.com

Arcos M5 P-ID-59M

Photometric data

2-T5HO



CANDLEPOWER SUMMARY

ANGLE	0	22.5	45	67.5	90
180	1218	1218	1218	1218	1218
175	1227	1218	1229	1244	1250
165	1186	1209	1263	1300	1305
155	1100	1162	1236	1304	1317
145	973	1066	1173	1264	1303
135	810	931	1079	1227	1279
125	626	772	985	1215	1299
115	429	612	927	1091	1137
105	233	479	689	733	735
95	60	200	204	192	184
90	2	24	24	21	18
85	12	14	18	20	22
75	40	43	45	53	72
65	114	126	146	201	313
55	363	360	393	351	356
45	588	581	579	720	770
35	764	817	726	731	777
25	908	980	948	922	918
15	1015	1047	1119	1140	1127
5	1094	1085	1102	1120	1117
0	1095	1095	1095	1095	1095

P-ID-59M24T5HO-PBSS 83.8% Efficiency
Input Watts = 122W

RCC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	86	86	86	86	77	77	77	77	61	61	61	47	47	47	33	33	33	27
1	79	76	73	70	71	68	66	63	54	53	51	42	40	40	30	29	29	23
2	72	66	62	58	65	60	56	53	48	45	43	37	35	34	27	26	25	20
3	66	59	53	48	59	53	48	44	43	39	36	33	31	29	24	23	21	17
4	60	52	46	41	54	47	42	38	38	34	31	30	27	25	22	20	19	15
5	56	46	40	35	50	42	37	33	34	30	27	27	24	22	20	18	16	13
6	51	42	35	31	46	38	32	28	31	27	24	24	21	19	18	16	15	12
7	47	38	31	27	43	34	29	25	28	24	21	22	19	17	16	14	13	11
8	44	34	28	24	39	31	26	22	25	21	18	20	17	15	15	13	12	10
9	41	31	25	21	37	28	23	20	23	19	17	18	16	14	14	12	11	9
10	38	28	23	19	34	26	21	18	21	18	15	17	14	12	13	11	10	8

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

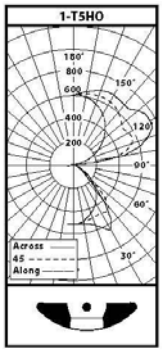
ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	5145.76	57.2	68.3
90-0°	2392.57	26.6	31.7
180-0°	7538.33	83.8	100

LUMINANCE SUMMARY (cd/m²)

ANGLE	0°	45°	90°
45°	12451	12261	16305
55°	9476	10259	9293
65°	4039	5173	11090
75°	2314	2603	4165
85°	2062	3092	3780

Litecontrol Test Report #68026340

1-T5HO



CANDLEPOWER SUMMARY

ANGLE	0	22.5	45	67.5	90
180	589	589	589	589	589
175	594	595	601	604	603
165	575	590	617	641	646
155	531	566	625	670	681
145	470	528	613	663	678
135	390	470	569	637	668
125	299	400	523	694	751
115	205	321	555	696	747
105	108	277	478	556	589
95	25	167	203	190	183
90	1	18	10	6	4
85	4	6	8	8	8
75	19	18	19	21	23
65	54	52	46	55	76
55	166	214	132	97	106
45	265	324	377	294	274
35	347	381	492	563	567
25	416	430	477	543	591
15	467	472	491	515	523
5	505	502	505	507	504
0	506	506	506	506	506

P-ID-59M14T5HO-PBSS 90.7% Efficiency
Input Watts = 61W

RCC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	93	93	93	93	83	83	83	83	65	65	65	48	48	48	33	33	33	26
1	85	81	78	75	76	73	70	68	57	56	54	43	42	41	30	29	29	23
2	78	72	67	62	69	64	60	57	51	48	46	39	37	35	27	26	25	20
3	71	63	57	52	64	57	52	48	45	42	39	34	32	30	24	23	22	18
4	65	56	50	44	58	51	45	41	40	37	33	31	28	26	22	21	19	15
5	60	50	43	38	54	45	39	35	36	32	29	28	25	23	20	18	17	14
6	55	45	38	33	49	41	35	31	33	28	25	25	22	20	18	16	15	12
7	51	41	34	29	46	37	31	27	30	25	22	23	20	18	17	15	13	11
8	47	37	30	26	42	33	28	24	27	23	20	21	18	16	15	13	12	10
9	44	33	27	23	39	30	25	21	25	21	18	19	16	14	14	12	11	9
10	41	31	24	20	37	28	22	19	23	19	16	18	15	13	13	11	10	8

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	2913.18	64.7	71.4
90-0°	1169.75	26	28.6
180-0°	4082.93	90.7	100

LUMINANCE SUMMARY (cd/m²)

ANGLE	0°	45°	90°
45°	5611	7983	5802
55°	4307	3446	2767
65°	1913	1630	2693
75°	1099	1099	1331
85°	687	1374	1374

Litecontrol Test Report #68116602

LITECONTROL
employee owned | customer driven
100 Hawks Avenue Hanson, MA 02341
781 294 0100 f: 781 293 2849 litecontrol.com

Click on
Quick Find 59M
litecontrol.com

Luminaire Type W3

covelight™ 26

FOCAL POINT

features

Low profile indirect luminaire designed for concealed cove applications.

Luminaires are provided with quick connect thru-wire harness for easy installation in continuous runs.

Luminaire housing length designed around specified lamp length to minimize socket shadow.

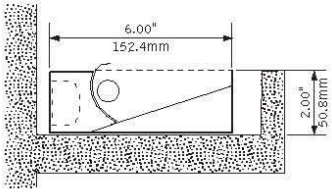
Continuous run lengths may be configured with combinations of luminaire lengths up to 8'.

Covelight™ provides pleasing and even illumination that highlights architectural details.

details

thru-wire harness

dimensional data



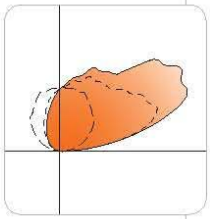
lamping options

T8 LAMPS

T5/T5HO LAMPS

performance

1-Lamp T5HO
76.6% Efficiency
3843 cd @ 125°



Visit focalpointlights.com for complete photometric data.

july 2008 A

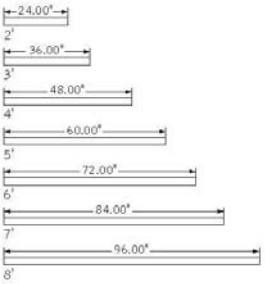
www.focalpointlights.com | 1.773.247.9494

fixture:
project:

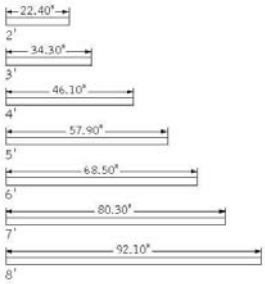
details

fixture lengths

t8



t5/t5ho



specifications

construction

One-piece 20 Ga. housing.
20 Ga. steel socket bridges and galvanized end caps.
Luminaires are available up to 8' nominal lengths.
T5 and T5HO luminaires are shorter due to lamp length.

4' unit weight: 7 lbs
8' unit weight: 14 lbs

optic

Reflector fabricated of low iridescent, semi specular premium grade aluminum.

electrical

Luminaires are pre-wired with factory installed branch circuit wiring and over-molded quick connects.
Electronic ballasts are thermally protected and have a Class "P" rating.
Consult factory for dimming specifications and availability.
UL and cUL listed.

finish

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

ordering

luminaire series		____
Covelight T5/T5HO	FCVM	
Covelight T8	FCVA	
profile		26
2" X 6"	26	
lamping		____
One Lamp T8 (FCVA only)	1T8	
One Lamp T5	1T5	
One Lamp T5HO	1T5HO	
Two Lamp T5	2T5	
Two Lamp T5HO (T5 units supplied to match lamp length See Luminaire Lengths chart for more information)	2T5HO	
circuit		____
Single Circuit	1C	
Dual Circuit (Two lamps only)	2C	
voltage		____
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		____
Electronic Instant Start <20% THD (T8 Only)	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
mounting		CV
Cove	CV	
factory options		
Emergency Circuit*	EC	____
Emergency Battery Pack*	EM	
HLR/GLR Fuse	FU	____
Include 3000K Lamp	L830	____
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
finish		HW
High Reflectance White	HW	
luminaire length		____
Designate length in feet (Nominal lengths: 2',3',4',5',6',7',8')	XX'	

* for more information see Reference section.

Focal Point LLC | 414 S. Pulaski Rd, Chicago, IL 60624 | T: 773.247.8484 | F: 773.247.8494 | info@focalpointlight.com | www.fvalocalights.com.
Focal Point LLC reserves the right to change specifications for product improvement without notification.

perimeter

Ballast Type for G1

BALLAST SPECIFICATION

SECTION II – Controllable Light Output Electronic (Fluorescent)

Ballast Specification for Controllable Light Output Electronic Fluorescent

Mark 7® 0-10V

Section I - Physical Characteristics

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

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

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

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall be provided with integral protection circuitry to withstand connection of low voltage control leads to mains power supply. In this event, ballast shall default to maximum light output.

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

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

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

2.6 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.7 Ballast shall have a minimum ballast factor of 1.00 (1.18 for HL version) at maximum light output and 0.03 at minimum light output for primary lamp.

2.8 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less throughout the dimming range in accordance with lamp manufacturer recommendations.

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

2.10 Ballast shall have a Class A sound rating.

2.11 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.12 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.13 Ballast shall control lamp light output from 100% - 3% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.14 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

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

Section III - Regulatory Requirements

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

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

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

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

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

Section IV - Other

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

4.2 Ballast shall carry a _____warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of _____ (Go to our web site for up-to-date warranty information: www.advancetransformer.com/warranty).

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

4.4 Ballast shall be controlled by a Class 1 or Class 2 low voltage 0-10VDC controller.

4.5 Ballast shall be Advance part # _____ or approved equal.

REFERENCE MATERIALS

Ballast Type for L1 and W1

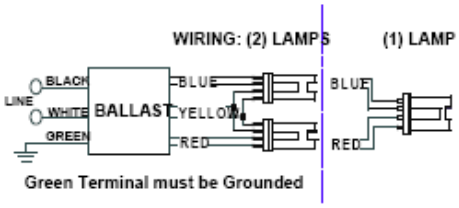
PHILIPS ADVANCE

ICF2S26M1BSQS@120	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Rapid Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFQ26W/G24Q	1	26	0/-18	0.23	27	1.00	10	0.99	1.7	3.70
CFQ26W/G24Q	2	26	0/-18	0.43	51	1.00	10	0.99	1.7	1.96
CFTR26W/GX24Q	1	26	0/-18	0.24	29	1.10	10	0.99	1.7	3.79
CFTR26W/GX24Q	2	26	0/-18	0.45	54	1.00	10	0.99	1.7	1.85
* CFTR32W/GX24Q	1	32	0/-18	0.31	36	0.98	10	0.98	1.7	2.72
CFTR42W/GX24Q	1	42	0/-18	0.38	46	0.98	10	0.98	1.7	2.13

Wiring Diagram



Green Terminal must be Grounded

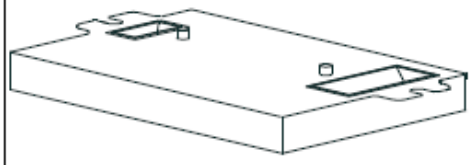
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

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

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

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.40 "	0.98 "	2.00 "
4 49/50	2 2/5	0 49/50	2
12.6 cm	6.1 cm	2.5 cm	5.1 cm

Revised 03/03/2010

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Ballast Type for L3

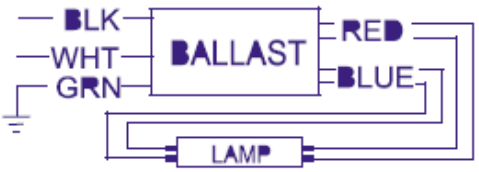
PHILIPS ADVANCE

RMB-1P13-S1	
Brand Name	AMBISTAR
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	120
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFQ13W/G24Q	1	13	0/-18	0.20	14	1.00	150	0.58	1.7	7.14
CFT7W/2G7	1	7	0/-18	0.13	08	1.00	150	0.51	1.7	12.50
CFT9W/2G7	1	9	0/-18	0.16	10	1.10	150	0.52	1.7	11.00
CFTR13W/GX24Q	1	13	0/-18	0.20	14	1.00	150	0.58	1.7	7.14
* F13T5	1	13	0/-18	0.21	14	1.00	150	0.56	1.7	7.14
F14T5	1	14	0/-18	0.21	14	0.95	150	0.50	1.7	6.79
F8T5	1	8	0/-18	0.16	10	1.30	150	0.52	1.7	13.00

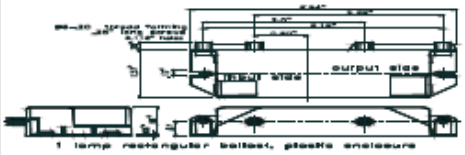
Wiring Diagram



Green terminal must be grounded

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

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
3.54 "	1.85 "	.94 "	3.15 "
3 27/50	1 17/20	0 47/50	3 3/20
9 cm	4.7 cm	2.4 cm	8 cm

Standard Lead Length (inches)

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

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

Revised 03/02/2010

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Ballast Type for S1 and S5

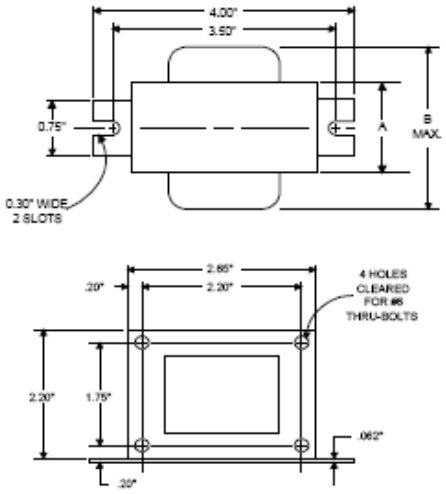
PHILIPS ADVANCE

Metal Halide Lamp Ballast

Catalog Number 71A5237BP
For 70W M98/M143
60 Hz R-HPF
Status: Active

DIMENSIONS AND DATA

2 5/8 X 2 3/16 CORE



INPUT VOLTS		277				
CIRCUIT TYPE	R-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.32				
Open Circuit		0.80				
Starting		0.50				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	277					
INPUT VOLTAGE AT LAMP DROPOUT		190				
INPUT WATTS	85					
RECOMMENDED FUSE (Amps)		2				
CORE and COIL						
Dimension (A)	1.50					
Dimension (B)	2.90					
Weight (lbs.)	2.9					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	8.0					
Volts (min.)	280					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	260-290					
Short-Circuit Current Test (Amps)						
Secondary Current	0.85-1.25					
Input Current		0.20-0.45	-	-	-	-

Capacitor: 7C080L30RA

Capacitance: 8
Dia/Oval Dim: 1.25
Height: 2.75
Temp Rating: 105°C

Wiring Diagram:

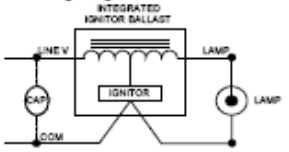


Fig. H

Ignitor: INTEGRAL

An ignitor integral to the core and coil assembly is used to start the lamp.

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 125°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 07/31/09

Ballast Type for S2

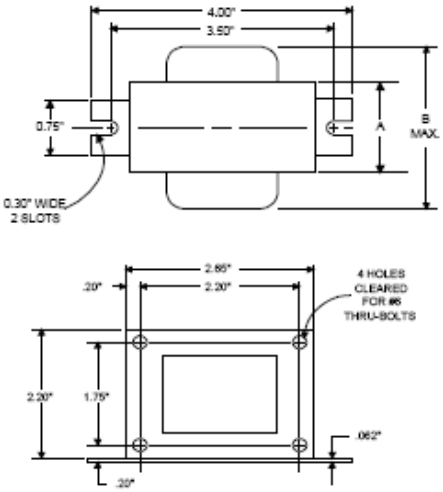
PHILIPS ADVANCE

Metal Halide Lamp Ballast

Catalog Number 71A5037BP
For 35/39W M130
60 Hz R-HPF
Status: Active

DIMENSIONS AND DATA

2 5/8 X 2 3/16 CORE



INPUT VOLTS		277				
CIRCUIT TYPE	R-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.19				
Open Circuit		0.52				
Starting		0.30				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	277					
INPUT VOLTAGE AT LAMP DROPOUT		190				
INPUT WATTS	48					
RECOMMENDED FUSE (Amps)		2				
CORE and COIL						
Dimension (A)	0.95					
Dimension (B)	2.70					
Weight (lbs.)	1.9					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	5.0					
Volts (min.)	280					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Philips Lighting Electronics N.A. TEST Procedure for HID Ballasts - Form 127						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	260-290					
Short-Circuit Current Test (Amps)						
Secondary Current	0.50-0.80					
Input Current		0.10-0.16	-	-	-	-

Capacitor: 7C050L30RA

Capacitance: 5
Dia/Oval Dim: 1.25
Height: 2.25
Temp Rating: 105°C

Wiring Diagram:

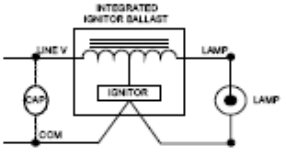


Fig. H

UL RECOGNIZED

Ignitor: INTEGRAL

An ignitor integral to the core and coil assembly is used to start the lamp.

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 125°C

Typical Ordering Information

(please call Philips Lighting Electronics N.A. for suffix availability)

Order Suffix	Description

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Revised: 07/31/09

Ballast Type for S3

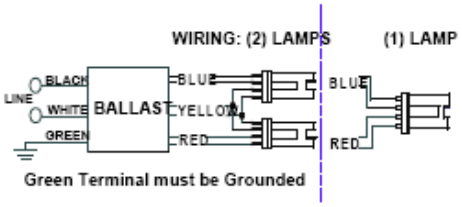
PHILIPS ADVANCE

ICF-2S26-H1-LD@120	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFM26W/GX24Q	1	26	0/-18	0.24	29	1.10	10	0.98	1.5	3.79
CFM26W/GX24q	2	26	0/-18	0.45	54	1.00	10	0.99	1.5	1.85
CFM32W/GX24q	1	32	0/-18	0.31	36	0.98	10	0.98	1.5	2.72
* CFM42W/GX24q	1	42	0/-18	0.38	46	0.98	10	0.98	1.5	2.13
CFQ26W/G24q	1	26	0/-18	0.23	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24q	2	26	0/-18	0.43	51	1.00	10	0.99	1.5	1.96
CFS21W/GR10q	2	21	0/-18	0.42	51	1.12	10	0.99	1.5	2.20
FT24W/2G11	2	24	0/-18	0.41	48	0.93	10	0.99	1.5	1.94

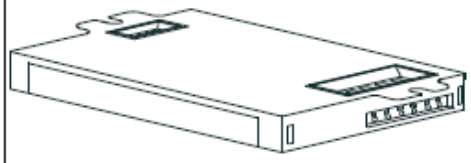
Wiring Diagram



Green Terminal must be Grounded

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

Enclosure



Enclosure Dimensions

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

Standard Lead Length (inches)

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

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

Revised 09/02/2004

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Ballast Type for S4

GE Consumer & Industrial
Lighting

20 Watt Mini Electronic HID Ballast

ULTRAMAX eHID Superior Lumen Maintenance

GE's line of ultra cool UltraMax® eHID electronic ballasts provide up to 70% energy savings and 2-4 times the life of standard halogen. End users get the cost savings and the advantages offered in meeting strict watts per square foot requirements with these systems. UltraMax® eHID is a high energy efficiency ballast that uses less wattage to provide full light output.

The UltraMax® 20W Mini is 56% smaller than the industry standard 20W housing, but does not sacrifice energy savings or heat management to ensure a full 5 year ballast warranty.

You can count on GE to answer your lamp and ballast questions at 1-888-GEBALLAST.

Performance Features

- Saves energy: 70% less power than 75W standard halogen.
- Reduce operating costs by up to $108.00 per fixture* when replacing a 50 W Halogen HIR.
- 22.5 W system (89% efficient ballast).
- Long lamp life: 12,000 hr. design life vs. 3,000 for halogen. GE CMH® 20W lamp life extended by 3,000 hours with UltraMax eHID ballast.
- Low watts per square foot and long lamp life provide lower cost of ownership compared to halogen.
- Low frequency square wave electronic ballast maximizes ceramic metal halide performance and lamp life.
- 56% smaller than industry standard can size.
- 1" height allows ballast to run flush along standard 1.5" track.
- Normal power factor - meets IEC and ANSI power factor and THD requirements for task and recessed lighting.
- Ultra cool - 80C/5 year warranty.
- 2% output regulation over accepted ANSI lamp voltages reduces visual flicker and maintains consistent lamp color. EM lag ballasts have up to 20% change in output power over the same lamp variation range which results in an increase in power (watts) to the lamp as the voltage increases over the life of the lamp.

Applications

- Replacement of electromagnetic HID ballasts.
- Replacement of 50W HIR halogen to 70W or 90W standard halogen.
- Any track, outdoor landscape or wall pack application where watts per square foot and color quality are critical.

Benefits of Electronic Systems

System - 120V Track Lamp	Ballast	Performance					Benefits Comparison		
		Initial Lumens	CBCP	Watts	LPW	Lamp Life (hrs)	% Lumens	% Savings (W)	Lamp Life (X)
90PAR/H		1310		90	15	2500			
75PAR/H		1050		75	14	2500			
80PAR/HIR		1500		80	19	3000			
70PAR/HIR		1260		70	18	3000			
CMH20T/GU6.5	UltraMax eHID 20W	1615		22.5	72	12000	23%	-75%	4.8
Q50MR16/C/NSP15			9100	50		4000			
CMH20MR16/SPL	UltraMax eHID 20W	1000	9000	22.5	44	12000		-55%	3.0

CMH20T/GU6.5 lamps with UltraMax eHID provide 23% more light, 75% energy savings and 4.8 times the life of standard 90PAR38 halogen lamps. The CMH20MR16 spot with UltraMax eHID provides 55% energy savings with 3 times the life and nearly the same center beam candle power (CBCP).

imagination at work

* @ $.10 kwh over life of ballast (approximately 4 lamp replacements). Ballasts and system specs listed on back.

Ballast Type for W2

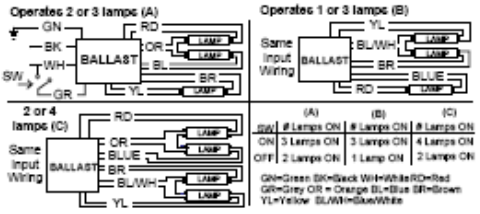
PHILIPS ADVANCE

ICN4S5490C2LS@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series/Parallel
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* F54T5/HO	1	54	-20/-29	0.24	62	0.99	30	0.90	1.7	1.60
F54T5/HO	2	54	-20/-29	0.43	117	0.99	10	0.98	1.7	0.85
F54T5/HO	3	54	-20/-29	0.66	179	1.00	10	0.98	1.7	0.56
F54T5/HO	4	54	-20/-29	0.86	234	1.00	10	0.98	1.7	0.43

Wiring Diagram



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

Standard Lead Length (inches)

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

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

Enclosure

Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
24 "	1.18 "	1 "	23.64 "
24	1 9/50	1	23 16/25
61 cm	3 cm	2.5 cm	60 cm

Revised 09/10/2010

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

Ballast Type for W3

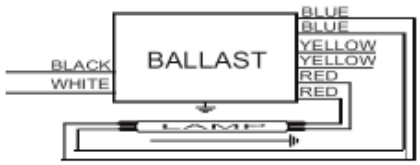
PHILIPS ADVANCE

ICN-2S28-N@120	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.14	17	1.07	10	0.98	1.7	6.29
F14T5	2	14	0/-18	0.28	33	1.04	10	0.98	1.7	3.15
F21T5	1	21	0/-18	0.22	25	1.06	10	0.98	1.7	4.24
F21T5	2	21	0/-18	0.39	49	1.02	10	0.98	1.7	2.08
* F28T5	1	28	0/-18	0.29	31	1.05	10	0.98	1.7	3.39
F28T5	2	28	0/-18	0.53	62	1.00	10	0.98	1.7	1.61
F28T5/ES (25W)	1	25	32/00	0.25	30	1.00	10	0.98	1.7	3.33
F28T5/ES (25W)	2	25	32/00	0.49	58	1.00	10	0.98	1.7	1.72

Wiring Diagram



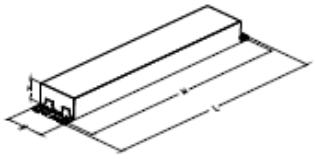
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	23	58.4
White	23	58.4
Blue	27	68.6
Red	27	68.6
Yellow	42	106.7
Gray		0
Violet		0

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

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.5 "	1.3 "	1.0 "	8.9 "
9 1/2	1 3/10	1	8 9/10
24.1 cm	3.3 cm	2.5 cm	22.6 cm

Revised 09/07/2010

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

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

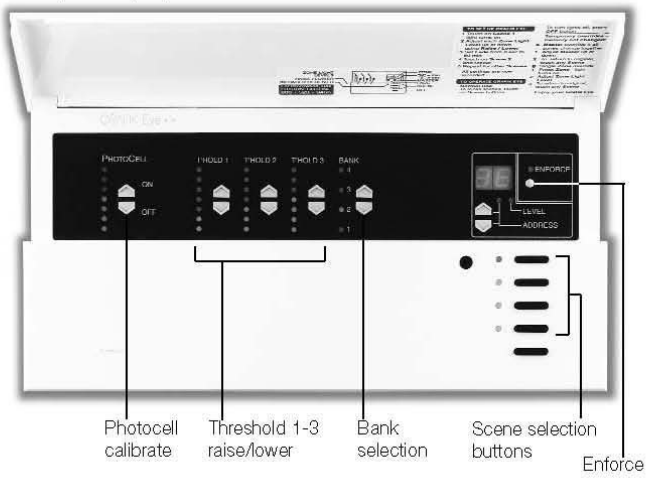
Control Type DC

GRAFIK Systems | OMX-DACPI | Control Interfaces

omx-dacpi-1 05.03.04

OMX-DACPI Automatic Daylighting Control

Cover (shown open)



Description

- Saves energy in spaces with windows, skylights, or doors. Automatically dims lights when the sun is bright.
- Monitors ambient daylight via Lutron's MW-PS-WH photosensor or 0-10V photosensor by others.
- Automatically selects scenes based on the amount of daylight available.
- Helps maximize energy savings with "enforce" mode – automatic control overrides lighting set by occupants.
- Eliminates "passing cloud" effect with a two-minute "range qualification" timer.
- Works with GRAFIK 5000, 6000, and 7000 Systems.

Functionality

- In the OMX-DACPI Daylighting Control, thresholds are set to define different ranges of daylight.
- The OMX-DACPI monitors ambient light, automatically selecting scenes as daylight levels cross thresholds.
- The OMX-DACPI allows setup of four "banks" of thresholds and scenes.
- Three different thresholds can be set up for each bank.
- Use the bank select keys to select which bank the OMX-DACPI uses.
- The OMX-DACPI automatically selects scenes based on the bank selected and the amount of daylight available. This provides 12 different thresholds that call 16 different Control Unit lighting scenes. Create thresholds and scenes for different times of the day (morning vs. afternoon) or year (winter vs. spring).

- Thresholds define ranges. Ranges call scenes.
- The OMX-DACPI provides four banks.
- Enter three thresholds for each bank.
- The four scenes shown below are automatically called when thresholds are crossed.

	Range 1 0-25%	Threshold 1 = 25%	**Range 2** 26-50%	Threshold 2 = 50%	**Range 3** 51-75%	Threshold 3 = 75%	**Range 4** 76-100%
Bank 1	Scene 1		Scene 2		Scene 3		Scene 4
Bank 2	Scene 5		Scene 6		Scene 7		Scene 8
Bank 3	Scene 9		Scene 10		Scene 11		Scene 12
Bank 4	Scene 13		Scene 14		Scene 15		Scene 16

LUTRON. SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

GRAFIK Systems | OMX-DACPI | Control Interfaces

omx-dacpi-2 05.03.04

Specifications

Power

Low-voltage Class 2 (PELV)
Operating Voltage: 32 V Direct Current.

Automatic Daylighting Control

- Automatically selects preset lighting scenes in response to ambient daylight.
- Provides four "banks". Each bank provides three thresholds (levels of ambient daylight) and four scenes.
- Allows photosensor input to override manual scene selection.
- Features a "Range Qualification" timer. When changes in daylight cause a scene change, the OMX-DACPI waits 2 minutes before another "automatic" scene change. (Scene selection buttons work immediately.)

Photosensor Input

- Accepts up to three MW-PS-WH photosensors wired in parallel or one 0-10V photosensor by others.
- Averages readings from up to three photosensors wired in parallel.
- Provides push-button photosensor calibration.

Key Design Features

- Meets IEC 801-2. Tested to withstand 15kV electrostatic discharge without damage or memory loss.
- Faceplate snaps on with no visible means of attachment.

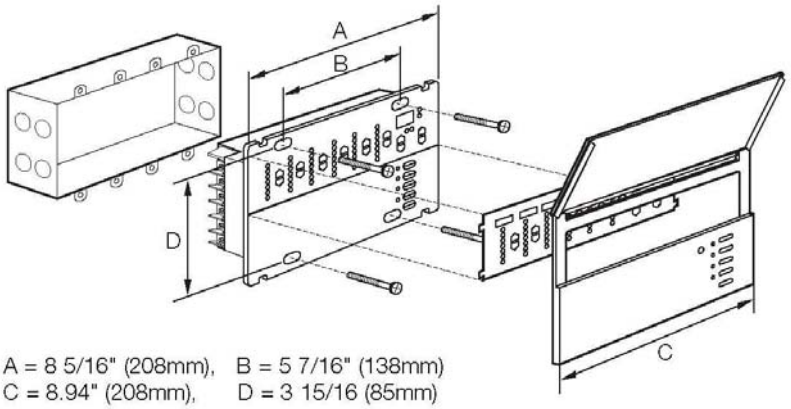
System Communications and Capacity

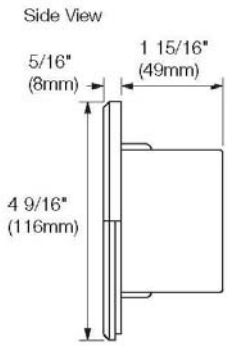
Low-voltage Class 2 (PELV) wiring connects the OMX-DACPI to Processor Panels.

Environment

32-104°F (0-40°C). 90% non-condensing relative humidity.

Dimensions And Mounting





A = 8 5/16" (208mm), B = 5 7/16" (138mm)
C = 8.94" (208mm), D = 3 15/16 (85mm)

LUTRON® SPECIFICATION SUBMITTAL Page 2

Job Name:	Model Numbers:	
Job Number:		

Control Type DP

GRAFIK Systems | GP Dimming Panels | Power Equipment

GP Dimming Panels 1 11.13.08

GP Dimming Panels
120-127 / 277 Volt

GP3/4 Mini Panels

GP8-24 Standard-Size Panels

GP36 Large-Size Panels

GP48-144 Large-Size Panels

GP Dimming Panels provide power and dimming for up to 144 load circuits and control any light source, including full-conduction non-dim.

Models available with:

- 120-127 V and 277 V input power.
- 3 to 144 circuits.
- Different feed types and breakers.

GP Dimming Panels work with:

- GRAFIK Eye® 4000 Control Units.
- GRAFIK 5000™, GRAFIK 6000®, and GRAFIK 7000™ Systems.
- LP Dimming Panels.
- XP Softswitch® Panels.
- DMX512 dimming systems via the 2LINK™ option.

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Specifications - 120-127 / 277 Volt

Standards

- UL Listed (Reference: UL File 42071).
- Complies with CSA or NOM (where appropriate).
- California Energy Commission Listed

Power

- Input power: 100-127 V and 277 V, 50/60 Hz, phase-to-neutral.
- Branch Circuit Capacity:
  - 120-127 V - up to 2000 W/VA
  - 277 V - 4500 W/VA
- Number of Circuits: 3-144
- Branch Circuit Breakers: UL-rated thermal magnetic.
  AIC ratings (other ratings available):
  - 100-127 V – 10,000 A
  - 277 V – 14,000 A
- Lightning strike protection: Meets ANSI/IEEE standard 62.41-1980. Can withstand voltage surges of up to 6000 V and current surges of up to 3000 A.
- 10-year power failure memory: Automatically restores lighting to scene selected prior to power interruption.

Sources/Load Types

Operates these sources with a smooth continuous Square Law dimming curve or on a full conduction non-dim basis:

- Incandescent (Tungsten)/Halogen
- Magnetic Low Voltage Transformer
- Electronic Low Voltage Transformer[1]
- Lutron Electronic Fluorescent Dimming Ballasts
- Magnetic Fluorescent Lamp Ballasts
- Optional modules allow for control of 0-10 V, DSI, and PWM load types.
- Operates HID sources on a full conduction non-dim basis.

Wiring

- Internal: Prewired by Lutron.
- System communications: Low-voltage Class 2 (PELV) wiring connects Dimming Panels to other components.
- Line (mains) voltage: Feed, load, and control circuit wiring only. No other wiring or assembly required.

Filter Chokes

- Load current rise time is measured at a 90 degree conduction angle.
- 10-90% of load current waveform:
  - 350 µSec rise time at 50% dimmer capacity.
  - 400 µSec rise time at 100% dimmer capacity.
- 0-100% of load current waveform:
  - 525 µSec rise time at 50% dimmer capacity.
  - 600 µSec rise time at 100% dimmer capacity.
- At no point in the waveform can the rate of current change exceed 300 mA per µSec.
- Consult Lutron for higher rise time options.

Dimming Cards

- Panel current ratings are listed for continuous operation - UL-listed specifically for each light source.
- RTISS™ filter circuit technology compensates for incoming line voltage variations: No visible flicker with +/-2% change in RMS voltage/cycle and +/-2% Hz change in frequency/ second.
- Arcless-relay air gap-off switches (one per load circuit) ensure open load circuits when off function selected. Eliminate arcing at mechanical contacts when loads are switched.

Physical Design

- Enclosure: NEMA-Type 1 (Type 2 available upon request), IP-20 protection; #16 U.S. Gauge Steel. Indoors only.
- Weight: 30-1300 pounds (14-590 kg).
- Mounting: Surface mount only. Allow space for ventilating.

Environment/Heat Dissipation

- Patented, ribbed aluminum heat sink base cools Panel by convection. No fans.
- 32-104 °F (0-40 °C). Relative humidity less than 90% non-condensing.

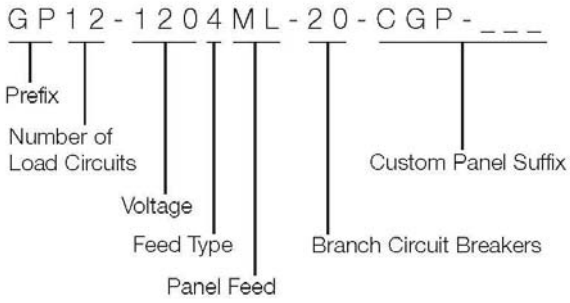
[1] Reverse-phase control transformers require an ELVI Power Interface. Check phase with transformer manufacturer.

Job Name:	Model Numbers:	
Job Number:		

GRAFIK Systems | GP Dimming Panels | Power Equipment

GP Dimming Panels 8 11.13.08

How to Build a GP Model Number



Prefix:
GP for GP Dimming Panel

Number of Load Circuits:
Indicates number of load circuits in the panel

Voltage:
120 for 120-127 V
277 for 277 V

Feed Type:
2 for 1 phase 2 wire
3 for 1 phase 3 wire (split phase)
4 for 3 phase 4 wire

Panel Feed:
ML for Main Lugs only
Mxx for Main Breaker with **xx** = breaker size in Amps

Branch Circuit Breakers:
20 for 20 A branch circuit breakers
15 for 15 A branch circuit breakers

Custom Panel Suffix:
Indicates panel with special options

LUTRON SPECIFICATION SUBMITTAL Page 4

Job Name:	Model Numbers:	
Job Number:		

GP3/4 Mini Models

Only standard panels listed. Consult Lutron for further options.

120-127 V Power

Number Of Circuits	Feed Type	Maximum Feed	Panel Branch Ratings: Circuit Breakers [1]	Panel Branch Ratings: Maximum Dimmed Hot Load [2]
GP3	1Ø, 2 W	40 A	15 A	1500 W/VA
		40 A	20 A	2000 W/VA
	1Ø, 3 W	30 A	15 A	1500 W/VA
		40 A	20 A	2000 W/VA
	3Ø, 4 W	15 A	15 A	1500 W/VA
		20 A	20 A	2000 W/VA
GP4	Feed Through	20 A	15 A[3]	1500 W/VA
		20 A	20 A[3]	2000 W/VA

277 V Power

Number Of Circuits	Feed Type	Maximum Feed	Panel Branch Ratings: Circuit Breakers[1]	Panel Branch Ratings: Maximum Dimmed Hot Load[2]
GP3	1Ø, 2 W	40 A	20 A	4500 W/VA
	3Ø, 4 W	20 A	20 A	4500 W/VA
GP4	Feed Through	20 A	20 A[3]	4500 W/VA

[1] 20/16 A, 15/12 A continuous load rating.
[2] Measured current will not exceed continuous load rating due to voltage drop in the dimmer.
[3] Breakers located in distribution panel supplied by others.

Job Name:	Model Numbers:	
Job Number:		

Control Type EM

LUTRON® | LUT-ELI-3PH | Power Accessories

P/N 369-299B 1 11.11.10

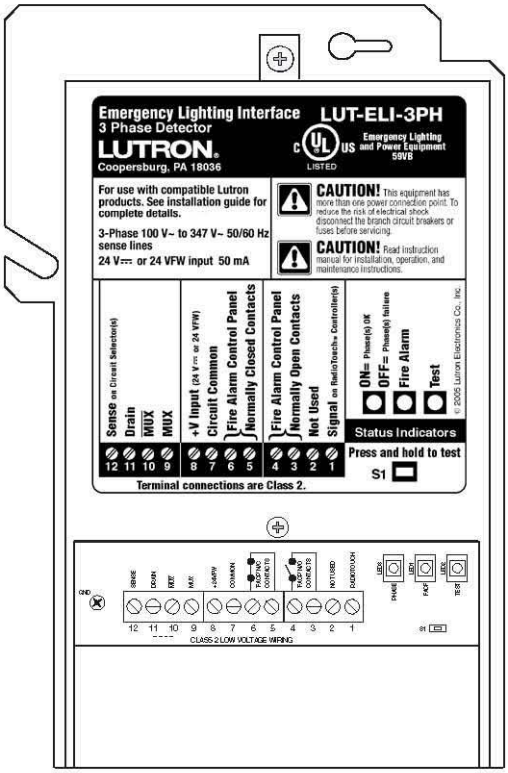
LUT-ELI-3PH
Emergency Lighting Interface

Description

- The LUT-ELI-3PH unit is to be used in conjunction with *Lutron* GP, LP, LCP, XP, and XPS panels, RadioTouch® controllers, EcoSystem® bus supplies, Energi Savr Node™ units, GRAFIK Eye® QS units, and Quantum® lighting management hubs.
- The LUT-ELI-3PH unit is UL924 Listed as "Emergency Lighting and Power Equipment."
- The LUT-ELI-3PH senses the normal (non-essential) line voltage on all three phases of normal power. When one or more phases of power are lost, the LUT-ELI-3PH unit will send a signal to the *RadioTouch* controller, panel circuit selector/controller, *EcoSystem* bus supply, *Energi Savr Node* unit, *GRAFIK Eye* QS system or *Quantum* bus supply with emergency (essential) power, causing it to enter the emergency lighting mode. Any lights controlled by these devices will go to the emergency light level setting.
- When used with a *Energi Savr Node* unit, *EcoSystem* or *Quantum* bus supply, a separate 24 V⎓ 50 mA power supply must be used to power the LUT-ELI-3PH unit.

Features

- Can be added to an existing system.
- Status indicator, indicates the phase status. Indicator ON is normal mode, OFF is emergency mode.
- A test button is provided to perform a functional test of the system by simulating an emergency situation.
- The interface has inputs for a Fire Alarm Control Panel (FACP). A maintained dry contact closure received between the FACP inputs will actuate the emergency mode.



LUTRON. SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

LUTRON® LUT-ELI-3PH Power Accessories

P/N 369-299B 2 11.11.10

Specifications

Power

- Sense voltage input to the LUT-ELI-3PH unit must be from the Normal (Non-Essential) power source.
- Sense voltage range: 100-347 V~ 50/60 Hz 30 mA, 1 Phase or 3 Phase.
- Proper short-circuit and over-current protection must be provided at the distribution panel. A 20 A maximum circuit breaker may be used for the installation.

Standards

- UL 924 Listed.
- *Lutron* Quality Systems registered to ISO 9001.2000.

Environment

- Ambient Temperature Operating Range: 32-104 °F (0-40 °C).
- Relative humidity: less than 90% non-condensing.
- For indoor use only.

Inputs

- 2 inputs for a Fire Alarm Control Panel (FACP). A normally open or normally closed dry contact input on the FACP inputs will activate the emergency mode.

Status Light

- Status light indicates the phase status. Status light "ON" is normal mode, "OFF" is emergency mode.

Test Button

- A test button is provided to perform a functional test of the system by simulating an emergency situation.

System Communications and Capacity

- May be added to an existing *Lutron* system.
- One LUT-ELI-3PH unit may be used with up to 32 circuit selectors or controllers, 100 RadioTouch® controllers, or 32 EcoSystem® bus supplies, 32 Energi Savr Node™ units, 32 GRAFIK Eye® QS units or 32 Quantum® bus supplies.
- There are 4 *Quantum* bus supplies in a *Quantum* hub. Only 1 *Quantum* bus supply per hub needs to be connected per LUT-ELI-3PH unit. There can be up to 8 *Quantum* hubs connected to one LUT-ELI-3PH unit.

Mounting

- The interface mounts to a standard 4 x 4 in (102 x 102 mm) junction box.

LUTRON. SPECIFICATION SUBMITTAL Page 2

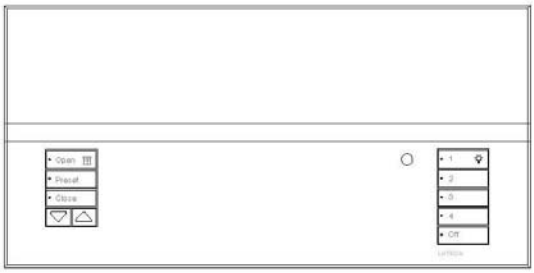
Job Name:	Model Numbers:	
Job Number:		

Control Type GE

LUTRON® GRAFIK Eye® QS Wireless Control Unit Preset Dimming Controls

qsgrj-1 10.07.10

GRAFIK Eye® QS Wireless Control Unit

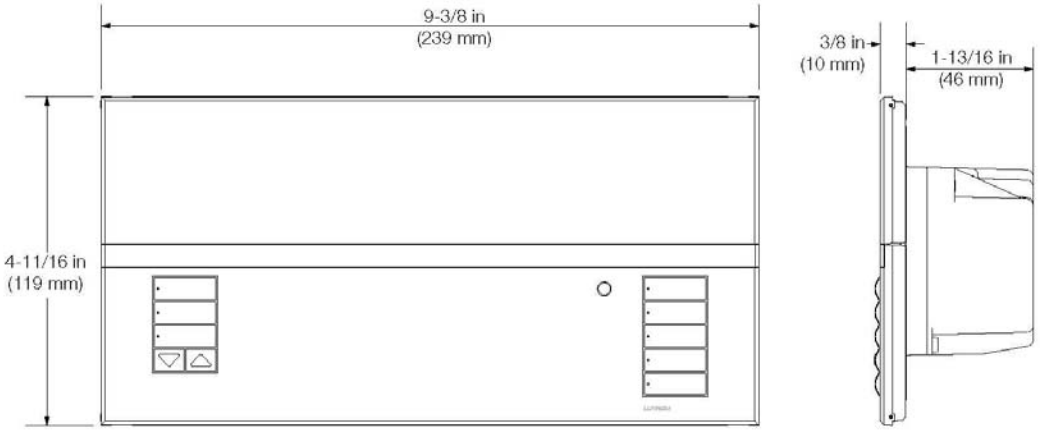


Description

GRAFIK Eye QS Wireless is the premier energy-saving light and shade control. *GRAFIK Eye* QS includes an astronomic timeclock, intuitive lighting presets, and direct shade control. Now with wireless technology, you can use the *GRAFIK Eye* QS Wireless to seamlessly integrate with a variety of Lutron wireless products and systems, including RadioRA® 2, Radio Powr Savr™ occupancy, vacancy, and daylight sensors, Sivoia® QS Wireless shades, Pico® wireless control, and other *GRAFIK Eye* QS Wireless control units. Additionally, the *GRAFIK Eye* QS Wireless is compatible with all Lutron wired QS products and systems.

GRAFIK Eye QS Wireless is compatible with Quantum®.

Mechanical Dimensions



Front View Side View

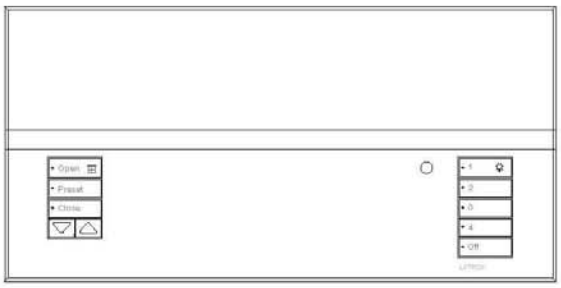
Fits into a 4-gang U.S. backbox, 3.5 in (89 mm) deep; Lutron P/N 241-400

LUTRON® SPECIFICATION SUBMITTAL Page 1

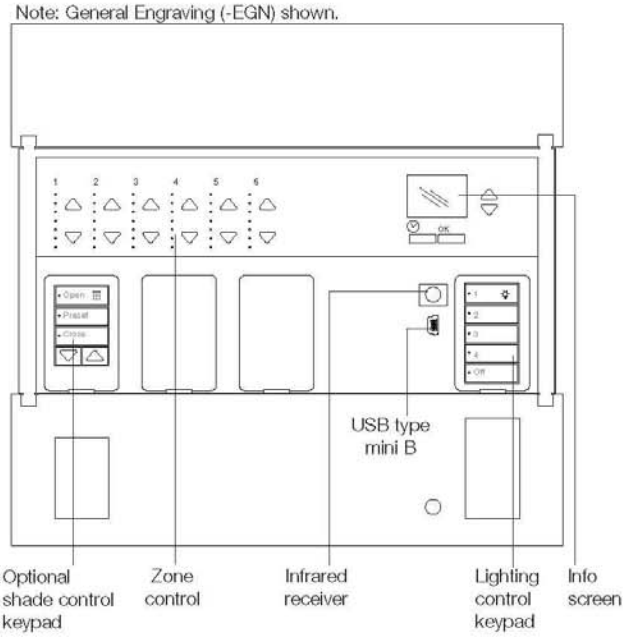
Job Name:	Model Numbers:	
Job Number:		

LUTRON® GRAFIK Eye® QS Wireless Control Unit — Preset Dimming Controls

qsgrj-3 10.07.10



Note: General Engraving (-EGN) shown.



Features

- Lutron's proprietary Clear Connect™ RF technology. Operates in the 434 MHz band.
- Pushbutton recall of four preset lighting scenes, plus Off.
- Twelve (12) additional scenes accessible through other QS devices, such as seeTouch® QS wallstations.
- Optional integrated shade control buttons, which can also be added to the unit after installation.
- Master override buttons to raise and lower all lights.
- Allows setup of lighting scenes and shade presets using buttons on the control unit.
- Built-in infrared (IR) receiver.
- External IR connection.
- Built-in astronomic timeclock.
- Info screen shows zone light level percentage, energy savings, zone labeling, and programming.
- Lockout option prevents accidental changes.
- One occupancy sensor input and 24 V⎓ power for occupancy sensor.
- QS communication link for seamless integration of lights, motorized window treatments, occupancy sensors, wallstations, and integration interfaces.
- Compatible with all Lutron QS system components.
- Wireless communication for seamless integration with a variety of Lutron wireless products and systems, including Radio RA® 2, Radio Powr Savr™ occupancy, vacancy, and daylight sensors, Sivoia® QS wireless shades, Pico® wireless control, and other *GRAFIK Eye* QS wireless control units.
- Backlit buttons with engraving make unit easy to locate and operate.
- Available in a variety of colors and finishes.

LUTRON® SPECIFICATION SUBMITTAL — Page 3

Job Name:	Model Numbers:	
Job Number:		

Control Type O

Sensors	LOS-CIR Series	Occupant Sensors

LOS-CIR 1 09.04.08

Infrared Ceiling Mount Sensor

The LOS-CIR Series ceiling-mount passive infrared sensors can integrate into Lutron systems or function as stand-alone controls using a Lutron power pack. The sensor uses a small semiconductor heat detector that resides behind a multi-zone optical lens. The sensor's detector is sensitive to the heat emitted by the human body. In order to trigger the sensor, the source of heat must move from one range of detection to another. Non-moving hot objects will not cause the lights to turn on.

Features

- Intelligent, continually adapting passive infrared (PIR) sensor
- Passive infrared sensing
- Reliable motion detection with high error immunity
- Snap-locks to ceiling-mounted cover plate
- Non-Volatile Memory: settings saved in protected memory are not lost during power outages
- 450 to 1500 sq.ft. (42 to 140 m²) coverage when mounted on an 8 - 12 ft. (2.4 - 3.7 m) ceiling
- Affords choice of turning lights off or dimming to a preset level in the unoccupied state when integrated with a Lutron system.

Models Available

Cat. No.	Color	Coverage	Field of View
LOS-CIR-450-WH	White	450 sq.ft. (42 m²)	360°
LOS-CIR-1500-WH	White	1500 sq. ft. (140 m²)	360°

Self-Adaptive Feature

The LOS-CIR Series ceiling-mount occupant sensors provides reliable detection with high error immunity. The internal microprocessor analyzes the information from the PIR technology and determines the optimum setting to use in order to properly cover the space.

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Sensors	LOS-CIR Series	Occupant Sensors

LOS-CIR 2 09.04.08

Specifications

Timer Adjustment

- Automatic mode: Continually adapting sensor automatically adjusts settings to the space
- Manual mode: 8 to 30 minutes
- Test mode: 8 seconds

LED Lamp

- Red: infrared motion detected

Housing

- Rugged, high-impact, injection-molded plastic
- Color-coded leads 6 in. (15 cm)

Power

- Operating voltage: 20 - 24 V⎓, PELV (Class 2: USA) low-voltage
- Operating current: 33 mA nominal
- Control output: 20 - 24 V⎓ active high logic control signal with short-circuit protection, open collector when unoccupied
- UL and CUL listed

Operating Environment

- Temperature: 32 to 104 °F (0 to 40 °C)
- Relative humidity: less than 95%, non-condensing
- For indoor use only

Dimensions

Front View

Side View

Measurements are in inches (mm)

Job Name:	Model Numbers:	
Job Number:		

Control Type PC

Digital microWATT. MW-PS-WH Daylight Sensor

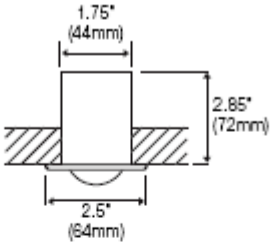
mw-ps-1 04.01.04

microPS™ Daylight Sensor

Type PS

Description

- Provides daylight harvesting capability.
- May be used with the Digital microWATT® Lighting Zone Controller, GRX/OMX-DACPI, or RadioTouch Controller.
- Allows controllers to automatically dim lights when available daylight is high and brighten lights when daylight is low in order to maintain a specific light level in the space.
- May be calibrated for daylight sensitivity.
- Mounts easily on any ceiling tile with one 2" diameter hole.



2" (50mm) diameter hole required for installation

Specifications

Power

Low-voltage Class 2
Operating Voltage: 24 V Direct Current.

Key Design Features

Meets IEC 801-2. Tested to withstand 15kV electro-static discharge without damage or memory loss.

Environment

- Temperature: 32-104°F (0-40°C).
- Relative humidity: less than 90% non-condensing.

Delivery

Ships in 3-4 weeks.

LUTRON. SPECIFICATION SUBMITTAL Page

Job Name:	Model Numbers:
Job Number:	

Control Type RE

GRAFIK Eye® | GRX-IO | Control Interfaces

grx-io-1 06.16.07

GRX-IO Control Interface

Description

- Integrates a *GRAFIK Eye* lighting control system with equipment that has contact-closure I/O, including:
  - Motion and occupant sensors.
  - Timeclocks and push buttons.
  - Motorized projection screens, skylights, window shades, and movable walls.
  - AV equipment.
  - Security systems.
- May be programmed to control any combination of one to eight *GRAFIK Eye* 3000 or 4000 Series control units.

Inputs/Outputs

- Provides five inputs and five outputs.
- Provides both normally open (NO) and normally closed (NC) contacts.
- Using the inputs, contact closures in other equipment can operate control units to:
  - Select scenes.
  - Adjust scenes to reflect status of movable walls.
  - Turn lights on or off based on room occupancy.
- Using the outputs, scene changes in control units can:
  - Trigger outputs to control other equipment.
  - Provide status feedback to other equipment.

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

GRAFIK Eye® GRX-IO Control Interfaces

grx-io-2 06.16.07

Specifications

Power

- Low-voltage PELV (Class 2: USA). Operating voltage: 12-24 V⎓.
- Provides 2-way interface between preset lighting controls and dry contact closure devices.
- Provides 5 inputs and 5 outputs. Outputs can control other manufacturers' equipment.

Operating Modes

- Scene selection
- Special functions
- Partitioning
- Occupant sensor

Five Input Terminals

- Accept maintained inputs and momentary inputs with 40 msec minimum pulse times.
- Off-state leakage current must be less than 100 µA.
- Open circuit voltage: 24 V⎓ maximum.
- Inputs must be dry contact closure, solid state, open collector, or active-low (NPN)/active high (PNP) output.
  - Open collector NPN or active-low on-state voltage must be less than 2 V⎓ and sink 3.0 mA.
  - Open collector PNP or active-high on-state voltage must be greater than 12 V⎓ and source 3.0 mA.

Five Output Terminals

- Provide maintained or momentary (1-second) outputs.
- The GRX-IO is not rated to control unclamped, inductive loads. Inductive loads include, but are not limited to, relays, solenoids, and motors. To control these types of equipment, a flyback diode must be used (DC voltages only). See diagram at right.

Supply Voltage	Resistive Load
0-24 V⎓	1.0 A
0-24 V~	0.5 A

Status LEDs

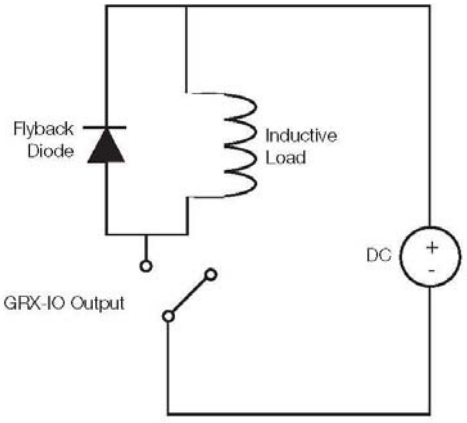
Five Status LEDs light when associated output is active (on).

System Communications and Capacity

Low-voltage type PELV (Class 2: USA) wiring connects GRX-IO Interface to control units and other components. Counts toward system maximum of 16 wallstations/control interfaces (3 powered from one *GRAFIK Eye* control unit without external 12 V⎓ power supply; GRX-IO counts as two devices toward the maximum of three connected to one *GRAFIK Eye* 3000 control unit).

Environment

32-104 °F (0-40 °C). Relative humidity less than 90% non-condensing.



LUTRON® SPECIFICATION SUBMITTAL Page 2

Job Name:	Model Numbers:	
Job Number:		

Control Type TC

WIRELESS LIGHTING CONTROLS

MSC-100 Astronomic Time Clock

PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's MSC-100 Astronomic Time Clock is a five-channel clock used for fully automating a Wireless Miro lighting control system. It offers simple programming, yet advanced control features. The Time Clock is used with at least one Wireless Miro Scene Interfaces.

Operation

The MSC-100 provides ON/OFF control signals based on time of day, day of week, holiday, and calculated sunrise/sunset (astronomic) time. Control signals are transmitted via hardwire connection to relay channels, giving the clock the ability to work in a range of applications from simple to complex. Clock schedules are programmed events that command channels on or off. Each schedule is assigned a number, type, time of day, channel, day, and may include other information for specific clock event operation. Schedules can be assigned to operate any combination of days or holiday types.

Programming

Programming the MSC-100 is easy. Users simply complete fill-in-the-blank prompts on the device keypad and can follow along on the LCD screen. Each clock channel can be programmed independently. All programming is securely stored in non-volatile memory.

Applications

When used in conjunction with Wireless Miro lighting controls, one MSC-100 will support connection to up to two Scene Interfaces, depending on the number of scenes required. Unused channels can be used to control third-party devices such as fountains or sprinklers.

Features

- Single date, perpetual date, perpetual day of week and perpetual Easter holidays
- 32 holidays, each up to 120 days with three holiday schedule types
- Temporary schedules that execute once then self-delete
- Repeating schedule 5 minutes to 10 hours
- 120 schedules assignable to one or more weekday or holiday
- Duration time scheduling from 1 second to 18 hours
- Continually self-adjusting astronomic control based on sunrise and sunset times
- Astronomic offset +/- 120 minutes
- Manual ON/OFF override from keypad
- Selectable 12- or 24-hour format
- Adjustable channel stagger from 1-60 seconds

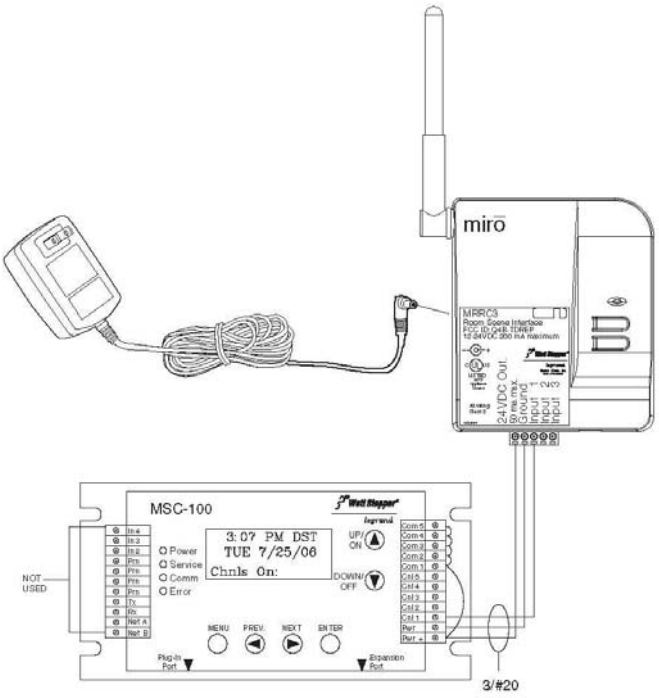
WattStopper
www.wattstopper.com
800.879.8585

Specifications

- Input voltage: 24 VAC or 24 VDC
- Five normally open isolated relays rated 1 amp 24 VAC/VDC, assigned to channels 1-5
- Battery backed clock operation for up to 8 years
- Non-volatile program memory storage
- Power-up sequence, executes missed schedules following power outage
- Dimensions: 3.6" x 6.7" x 1.3" (91.4mm x 177.8mm x 33mm) L x W x D
- FCC compliant; CE certified
- One year warranty

System Layout & Wiring

MSC-100 Controls & Wiring



The MSC-100 Time Clock interfaces to the Wireless Miro RF network through a Miro Room or House Scene Interface. The Scene Interface supplies 24 VDC to power the Time Clock. Wiring shown is typical for one channel.

Ordering Information

Catalog No.	Product Description
☐ MSC-100	5-channel astronomic time clock
Works in conjunction with:	
Catalog No.	Description
☐ MRHC3	House Scene Interface
☐ MRRC3	Room Scene Interface

Pub. No. 22402 rev. 11/2009

www.wattstopper.com | 800.879.8585

WIRELESS LIGHTING CONTROLS

Motor Control Center

30.1-12 **Motor Control Centers — Low Voltage**
Freedom & Advantage

EATON | Cutler-Hammer

TOC | Index | Master TOC

June 2006
Sheet 1296

General Description

2100 Series Motor Control Center

Freedom and Advantage Motor Control Center

30

Quick Reference Layout Guide Index

For more information visit: www.EatonElectrical.com

CA08104001E

MCC Freedom FVR Table

Table 30.1-2. Combination Starters with Series C Motor Circuit Protectors or Molded Case Circuit Breakers (Continued)

NEMA Size	Maximum Horsepower					HMCP Frame ①	MCCB Frame ②	Freedom Unit Size		Advantage Unit Size	
	208 V	240 V	380 V	480 V	600 V			Inches (mm)	X Space	Inches (mm)	X Space
Two-Speed One Winding, Constant/Variable Torque								**Type F946**		**Type W946**	
1	7.5	7.5	10	10	10	150	HFD/FDC	24 (609.6) ③	4X	24 (609.6) ③	4X
2	10	15	25	25	25	150	HFD/FDC	24 (609.6) ③	4X	24 (609.6) ③	4X
3	25	30	50	50	50	150	HJD/JDC	36 (914.4) ③④	6X	36 (914.4) ③④	6X
4	40	50	75	100	100	150	HJD/JDC	36 (914.4) ③④	6X	36 (914.4) ③④	6X
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72 (1828.8) ⑧	12X	72 (1828.8) ⑧	12X
Two-Speed Two Winding, Constant/Variable Torque								**Type F956**		**Type W956**	
1	7.5	7.5	10	10	10	150	HFD/FDC	24 (609.6)	4X	24 (609.6) ③	4X
2	10	15	25	25	25	150	HFD/FDC	24 (609.6)	4X	24 (609.6) ③	4X
3	25	30	50	50	50	150	HFD/FDC	30 (762.0)	5X	30 (762.0) ③	5X
4	30 40	40 50	60 75	75 100	100 —	150 250	HFD/FDC HJD/JDC	30 (762.0) 30 (762.0) ⑧	5X 5X	30 (762.0) ③ 30 (762.0) ③	5X 5X
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72 (1828.8) ⑧	12X	72 (1828.8) ⑧	12X
Reduced Voltage Autotransformer								**Type F606**		**Type W606**	
2	10	15	25	25	25	150	HFD/FDC	36 (914.4)	6X	36 (914.4)	6X
3	25	30	50	50	50	150	HFD/FDC	48 (1219.2)	8X	54 (1371.6)	9X
4	30	50	75	100	100	150	HJD/JDC	54 (1371.6)	9X	54 (1371.6)	9X
5	50 75	60 100	100 150	125 200	150 200	250 400	HJD/JDC HKD/KDC	72 (1828.8)	12X	72 (1828.8)	12X
6	150	200	300	400	400	600	HLD/LDC	72 (1828.8) ⑦	12X	72 (1828.8) ⑦	12X
7	—	300	—	600	600	1200	HND	72 (1828.8) ⑦	12X	72 (1828.8) ⑦	12X
Reduced Voltage Part Winding								**Type F706**		**Type W706**	
1PW	10	10	15	15	15	150	HFD/FDC	24 (609.6)	4X	24 (609.6) ③	4X
2PW	20	25	40	40	40	150	HFD/FDC	24 (609.6)	4X	24 (609.6) ③	4X
3PW	40	50	75	75	75	150	HFD/FDC	30 (762.0)	5X	30 (762.0) ③	5X
4PW	— 60 75	— 60 75	— 125 150	100 150 —	125 150 —	150 250 400	HFD/FDC HJD/JDC HKD/KDC	36 (914.4) ⑧	6X	36 (914.4) ③	6X
5PW	100 150	125 150	— 250	250 350	300 350	400 600	HKD/KDC HLD/LDC	72 (1828.8) ⑦	12X	72 (1828.8) ⑦	12X
Reduced Voltage Wye Delta Open Transition								**Type F806**		**Type W806**	
2YD	20	25	40	40	40	150	HFD/FDC	30 (762.0)	5X	30 (762.0)	5X
3YD	30 40	40 50	75 —	75 —	5 —	150 250	HFD/FDC HJD/JDC	42 (1066.8)	7X	42 (1066.8)	7X
4YD	60 —	75 —	125 150	150 —	150 —	250 400	HJD/JDC HKD/KDC	48 (1219.2)	8X	42 (1066.8)	7X
5YD	100 150	125 150	200 250	250 300	300 —	400 600	HKD/KDC HLD/LDC	72 (1828.8) ⑦	12X	72 (1828.8) ⑦	12X
Reduced Voltage Wye Delta Closed Transition								**Type F896**		**Type W896**	
2YD	20	25	40	40	40	150	HFD/FDC	42 (1066.8)	7X	42 (1066.8)	7X
3YD	40	50	—	—	—	250	HFD/FDC	54 (1371.6)	9X	54 (1371.6)	9X
4YD	60 —	75 —	125 150	150 —	150 —	250 400	HJD/JDC HKD/KDC	60 (1524.0)	10X	60 (1524.0)	10X
5YD	100 150	125 150	200 250	250 300	300 —	400 600	HKD/KDC HLD/LDC	72 (1828.8) ⑦	12X	72 (1828.8) ⑦	12X

① Standard Combination Starter Units with HMCP Magnetic Only disconnect have short circuit ratings of 65,000 amperes at 480 volts. Optional HMCP combination starter units are available with 100,000 amperes at 480 volts.
② Optional Combination Starter Units with Thermal-Magnetic breaker disconnects are available with either 65,000 amperes or 100,000 amperes at 480 volts.
③ Add 6-inch (152.4 mm) space for low speed disconnect.
④ 42-inch (1066.8 mm) space needed with Thermal-Magnetic Circuit Breaker. 48-inch (1219.2 mm) space needed with Thermal-Magnetic Circuit Breaker.
⑤ Requires 28-inch (711.2 mm) wide structure.
⑥ 36-inch (914.4 mm) space needed for Thermal-Magnetic Circuit Breaker.
⑦ Requires 21-inch (533.4 mm) deep, 28-inch (711.2 mm) wide structure.
⑧ For starting speed disconnect, add 6-inch (152.4 mm) space.

Note: For HMCP motor circuit protectors continuous ampere ratings by motor hp, see Table 30.1-88 on Page 30.1-39.

MCC Freedom AFD Table

SVX9000 1 – 30 hp at 480 V Plug-in Adjustable Frequency Drive Units

All Eaton's Cutler-Hammer standard units include a disconnect, an ac choke, output reactor and a door-mounted keypad. All plug-in units have a built-in Dynamic Braking Circuit, M3 frame. Standard unit drives do not include a CPT.

Note: Output reactor not included on 240 V units. Standard on 380 – 500 V drives up to 125 hp (CT rating).

CT: Constant Torque drives are capable of producing 200% starting torque for 10 seconds and are rated 150% overload for one minute.

VT: Variable Torque drives are capable of producing 200% starting torque for 10 seconds and are rated 110% overload for one minute.

Table 30.1-27. SVX9000 Adjustable Frequency Drives — Dimensions in Inches (mm)

CT/VT Amperes	Nominal hp CT/VT or (kW)	CB Type ① HMCP	CB Type ① MCCB	Standard Unit Space Dim.	Standard Unit Space (X)	Typical Options Unit Space Dim. ①	Typical Options Unit Space (X)	Max. Option Unit Space Dim.	Max. Option Unit Space (X)
200 – 240 Volts									
3.6	.75	7	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
4.7	1	15	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
5.6	1.5	15	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
7	2	15	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
10	3	15	25	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
16	5	30	40	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
22	7.5	50	50	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
30	10	50	70	36 (914.4)	7X	48 (1219.2)	8X	54 (1371.6)	9X
43	15	100	100	36 (914.4)	7X	48 (1219.2)	8X	54 (1371.6)	9X
57	20	100	125	36 (914.4)	7X	48 (1219.2)	8X	54 (1371.6)	9X
380 – 500 Volts									
2.5	1	7	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
3	1.5	7	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
3.5	2	7	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
5	3	15	15	18 (457.2)	3X	30 (762.0)	5X	36 (914.4)	6X
8	5	15	15	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
11	7.5	30	25	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
15	10	30	35	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
21	15	30	50	24 (609.6)	4X	36 (914.4)	6X	42 (1066.8)	7X
27	20	50	60	36 (914.4)	6X	48 (1219.2)	8X	54 (1371.6)	9X
34	25	50	80	36 (914.4)	6X	48 (1219.2)	8X	54 (1371.6)	9X
40	30	100	100	36 (914.4)	6X	48 (1219.2)	8X	54 (1371.6)	9X

① For fusible disconnect use typical option unit.

Note: Drive units fit into a standard 20-inch (508.0 mm) wide MCC structure.

Table 30.1-28. Plug-in Options

Plug-in Options	
Option Boards ⑦	
I/O Expander	⑦
Encoder Expander	⑦
Interbus S Communications	⑦
Modbus Communications	⑦
PROFIBUS® DP Communications	⑦
LonWorks Communications	⑦
Can Open (Slave) Communications	⑦
DeviceNet Communications	⑦
Johnson Controls® N2 Communications	⑦
PROFIBUS DP (D9 Connector)	⑦
Modbus (D9 Connector)	⑦
Plug-in Control Relays	
1 Relay	⑧
2 Relays	⑧
3 Relays	⑧
Other Options	
Automatic Bypass Circuit	⑦
Bypass Drive Test Switch	⑦
7 Relay 120 V Control with CPT	⑧
Isolated Signal Processor	⑦
3-15 PSIG Interface	⑦
Dynamic Breaking Resistors	⑧
Graphics Keypad	④
Line Fuses	⑦⑩
RFI Filter	④
Deduct to Remove Output Filter	⑨
KLC 2000 ft. (610 m) DV/DT Filter	⑧
Output Contactor	⑦
Dual Overloads	⑦⑩
3 Contactor Bypass	⑦⑩
RWT Filter	
NEMA 1	⑬
NEMA 4X and Class 1, Division 2	⑬

⑦ Up to 5 Option Boards may be selected. Please see Section 32 for detailed information.
④ All options will fit in typical and maximum option unit.
⑧ This option will fit in all units.
⑨ One of these options will fit in 5 – 30 hp CT at 480 V frame standard units, 1 – 30 hp CT at 480 V typical and maximum option units.
⑧ All options will fit in maximum option unit.
⑦ Use with bypass option.
④ DB resistors are to be mounted by the customer external to the MCC.
⑩ Not available for 240 V units.
⑬ RWT is mounted at the motor. See Section 35 for Reflected Wave Trap (RWT).

Note: Output reactor or DV/DT filter not required for motor lead lengths shorter than 100 feet (30.4 m) — 30 feet (9.1 m) for 2 hp and below), or when a RWT filter is used at the motor.

Note: Maximum motor lead length is 160 feet (48.8 m) for 1.5 hp and below, 330 feet (100.6 m) for 2 hp and 400 feet (121.9 m) for 3 hp and larger when using a standard output reactor.

Note: Motor lead lengths up to 2000 feet (609.6 m) can be achieved by using the KLC DV/DT filter.

MCC Freedom Main Sizing Table

Table 30.1-60. Main Incoming Line and Feeder Circuit Breakers — Molded Case Circuit Breakers — Dimensions in Inches (mm)
Frames reflect standard circuit breakers. Unit spacings shown include sufficient space to terminate cables on any standard breaker lug. If cable sizes exceed those listed, add 12-inch (304.8 mm) space for lug adapters.

Frame Size (Amperes)	Circuit Breaker Frame ①	Interrupting Capacity (kAIC) 240 V	480 V	575 V	Main Unit Size Inches (mm) ⑤	X Space	Feeder Unit Size Inches (mm)	X Space	Maximum Cable Size See circuit breaker terminal data for variations.
150	HFD FDC	100 100	65 100	25 35	18 (457.2) T, B	3X	12 (304.8)	2X	4/0 (1 per Phase)
225	HFD FDC	100 100	65 100	35 35	18 (457.2) T, B	3X	18 (457.2)	3X	4/0 (1 per Phase)
250	HJD JDC	100 100	65 100	35 35	30 (762.0) T, B	5X	18 (457.2)	3X	350 kcmil (1 per Phase)
400	HKD KDC	100 100	65 100	25 50	30 (762.0) T, B	5X	18 (457.2)	4X	250 kcmil (2 per Phase) or 500 kcmil (1 per Phase)
	CHKD ③ CKDC ③	100 100	65 100	25 50	30 (762.0) T, B	5X	30 (762.0)	5X	250 kcmil (2 per Phase) or 500 kcmil (1 per Phase)
600	HLD LDC	100 100	65 100	35 50	24 (609.6) B ⑧⑨ 30 (762.0) T	4X 5X	30 (762.0) ⑨	5X	500 kcmil (2 per Phase)
	CHLD ⑧⑨ CLDC ⑧⑨	100 100	65 100	35 50	24 (609.6) B ⑧⑨ 30 (762.0) T	4X 5X	24 (609.6) ⑨	4X	500 kcmil (2 per Phase)
800	HMDL	100	65	35	30 (762.0) T, B ⑥	5X	30 (762.0) ⑨	5X	750 kcmil (3 per Phase)
	CHMDL ⑧⑨	100	65	35	48 (1219.2) T, B ⑥	8X	48 (1219.2) ⑨	8X	750 kcmil (3 per Phase)
	NDC	100	100	50	42 (1066.8) T, B ⑥	7X	42 (1066.8) ⑨	7X	750 kcmil (3 per Phase)
	CHND ② CNDC ⑤	100 100	65 100	35 50	72 (1828.8) T, B	12X	72 (1828.8)	12X	750 kcmil (3 per Phase)
1200	HND ⑦ NDC ⑦	100 100	65 100	35 50	42 (1066.8) T, B ⑥	7X	42 (1066.8) ⑨	7X	750 kcmil (3 per Phase)
	CHND ②⑧ CNDC ⑤⑧	100 100	65 100	35 50	72 (1828.8) T, B	12X	72 (1828.8)	12X	750 kcmil (3 per Phase)
2000	RD ⑤ RDC ⑦ CRD ⑤ CRDC ⑤	100 100 100 100	65 100 65 100	50 65 50 65	72 (1828.8) ④	12X	72 (1828.8)	12X	750 kcmil (6 per Phase)
2500	RD RDC	100 100	65 100	50 65	72 (1828.8) ④⑩	12X	72 (1828.8)	12X	750 kcmil (6 per Phase)

① For 100% rated application, please refer to Page 21.4-61 Application Information — 100% Rated Circuit Breakers.
② T = top, B = bottom.
③ 100% Rated when 90° cable is applied at 75°C ampacity for 100% rating. RMS 310 LS is required and included in the price.
④ Add 6-inch (152.4 mm) for top entry of incoming cables.
⑤ Install at top or cable top entry or at bottom for bottom cable entry.
⑥ NEMA 1 gasketed only.
⑦ Digitrip RMS 310 LS is standard and included in the pricing.
⑧ The main breaker requires the complete vertical section. The rear is unusable.
⑨ 24-inch (609.6 mm) wide.
⑩ Install at top of vertical section for top entry cable and at bottom for bottom entry.

Table 30.1-61. Dual Feeder Units — Molded Case Circuit Breakers — Dimensions in Inches (mm)

Maximum Amperes	Circuit Breaker Frame	Interrupting Ratings (kAIC) 240 V	480 V	600 V	Enclosure Width Inches (mm)	Main Unit Size Inches (mm)	X Space	Feeder Unit Size Inches (mm)	X Space	Maximum Cable Size
50/50	HFD FDC	100 200	65 100	25 35	Standard 20 (508.0)	N/A		12 (304.8)	2X	See above breaker frame information
50/100	HFD FDC	100 200	65 100	25 35				12 (304.8)	2X	
100/100	HFD FDC	100 200	65 100	25 35				12 (304.8)	2X	
100/100	HFD FDC	100 200	65 100	25 35				12 (304.8)	2X	
150/150	HFD FDC	100 200	65 100	25 35				12 (304.8)	2X	

MCC Freedom Motor Circuit Protection Table

Motor Protection

In line with 2005 NEC 430.6(A) circuit breaker, HMCP and fuse rating selections are based on full load currents for induction motors running at speeds normal for belted motors and motors with normal torque characteristics using data taken from NEC Table 130.250 (3-phase). Actual motor nameplate ratings shall be used for selecting motor running overload protection. Motors built special for low speeds, high torque characteristics, special starting conditions and applications will require other considerations as defined in the application section of the NEC.

These additional considerations may require the use of a higher rated HMCP, or at least one with higher magnetic pickup settings.

Circuit breaker, HMCP and fuse ampere rating selections are in line with maximum rules given in NEC 430.52 and Table 430.250. Based on known characteristics of Eaton's Cutler-Hammer type breakers, specific units are recommended. The current ratings are no more than the maximum limits set by the NEC rules for motors with code letters F to V or without code letters. Motors with lower code letters will require further considerations.

In general, these selections were based on:

1. Ambient — Outside enclosure not more than 40°C (104°F).
2. Motor starting — Infrequent starting, stopping or reversing.
3. Motor accelerating time — 10 seconds or less.
4. Locked rotor — Maximum 6 times motor FLA.

Type HMCP motor circuit protector may not set at more than 1300% of the motor full-load current to comply with NEC 430.52. (Except for NEMA Design B energy high-efficiency motors which can be set up to 1700%.)

Circuit breaker selections are based on types with standard interrupting ratings. Higher interrupting rating types may be required to satisfy specific system application requirements.

For motor full load currents of 208 and 200 volts, increase the corresponding 230-volt motor values by 10 and 15% respectively.

Table 30.1-88. Motor Circuit Protector (MCP), Circuit Breaker and Fusible Switch Selection Guide

Horsepower	Full Load Amperes (NEC) FLA	Fuse Size NEC 430.52 Maximum Amperes		Recommended Cutler-Hammer			
				Circuit Breaker		Motor Circuit Protector Type HMCP	
		Time Delay	Non-Time Delay	Amperes	Type	Amperes	Adj. Range
230 Volts, 3-Phase							
1	3.6	10	15	15	HFD	7	21 – 70
1-1/2	5.2	10	20	15	HFD	15	45 – 150
2	6.8	15	25	15	HFD	15	45 – 150
3	9.6	20	30	20	HFD	30	90 – 300
5	15.2	30	50	30	HFD	30	90 – 300
7-1/2	22	40	70	50	HFD	50	150 – 500
10	28	50	90	60	HFD	50	150 – 500
15	42	80	150	90	HFD	100	300 – 1000
20	54	100	175	100	HFD	100	300 – 1000
25	68	125	225	125	HFD	150	450 – 1500
30	80	150	250	150	HFD	150	450 – 1500
40	104	200	350	150	HFD	150	750 – 2500
50	130	250	400	200	HFD	150	750 – 2500
60	154	300	500	225	HFD	250	1250 – 2500
75	192	350	600	300	HKD	400	2000 – 4000
100	248	450	800	400	HKD	400	2000 – 4000
125	312	600	1000	500	HLD	600	1800 – 6000
150	360	700	1200	600	HLD	600	1800 – 6000
200	480	1000	1600	700	HND	600	1800 – 6000
460 Volts, 3-Phase							
1	1.8	6	6	15	HFD	7	21 – 70
1-1/2	2.6	6	10	15	HFD	7	21 – 70
2	3.4	6	15	15	HFD	7	21 – 70
3	4.8	10	15	15	HFD	15	45 – 150
5	7.6	15	25	15	HFD	15	45 – 150
7-1/2	11	20	35	25	HFD	30	90 – 300
10	14	25	45	35	HFD	30	90 – 300
15	21	40	70	45	HFD	50	150 – 500
20	27	50	90	50	HFD	50	150 – 500
25	34	60	110	70	HFD	70	210 – 700
30	40	70	125	70	HFD	100	300 – 1000
40	52	100	175	100	HFD	100	300 – 1000
50	65	125	200	110	HFD	150	450 – 1500
60	77	150	150	125	HFD	150	750 – 2500
75	96	175	300	150	HJD	150	750 – 2500
100	124	225	400	175	HJD	150	750 – 2500
125	156	300	500	225	HKD	400	2000 – 4000
150	180	350	600	250	HJD	400	2000 – 4000
200	240	450	800	350	L600	600	1800 – 6000
575 Volts, 3-Phase							
1	1.4	3	6	15	HFD	3	9 – 30
1-1/2	2.1	6	10	15	HFD	7	21 – 70
2	2.7	6	10	15	HFD	7	21 – 70
3	3.9	10	15	15	HFD	7	21 – 70
5	6.1	15	20	15	HFD	15	45 – 150
7-1/2	9	20	30	20	HFD	30	90 – 300
10	11	20	35	25	HFD	30	90 – 300
15	17	30	60	40	HFD	30	90 – 300
20	22	40	70	50	HFD	50	150 – 500
25	27	50	90	60	HFD	50	150 – 500
30	32	60	100	60	HFD	70	210 – 500
40	41	80	125	80	HFD	100	300 – 1000
50	52	100	175	100	HFD	100	300 – 1000
60	62	110	200	125	HFD	150	750 – 2500
75	77	150	250	150	HFD	150	750 – 2500
100	99	175	300	175	HJD	150	750 – 2500
125	125	225	400	200	HJD	250	1250 – 2500
150	144	300	450	225	HJD	250	1250 – 2500
200	192	350	600	300	HKD	400	2000 – 4000

30