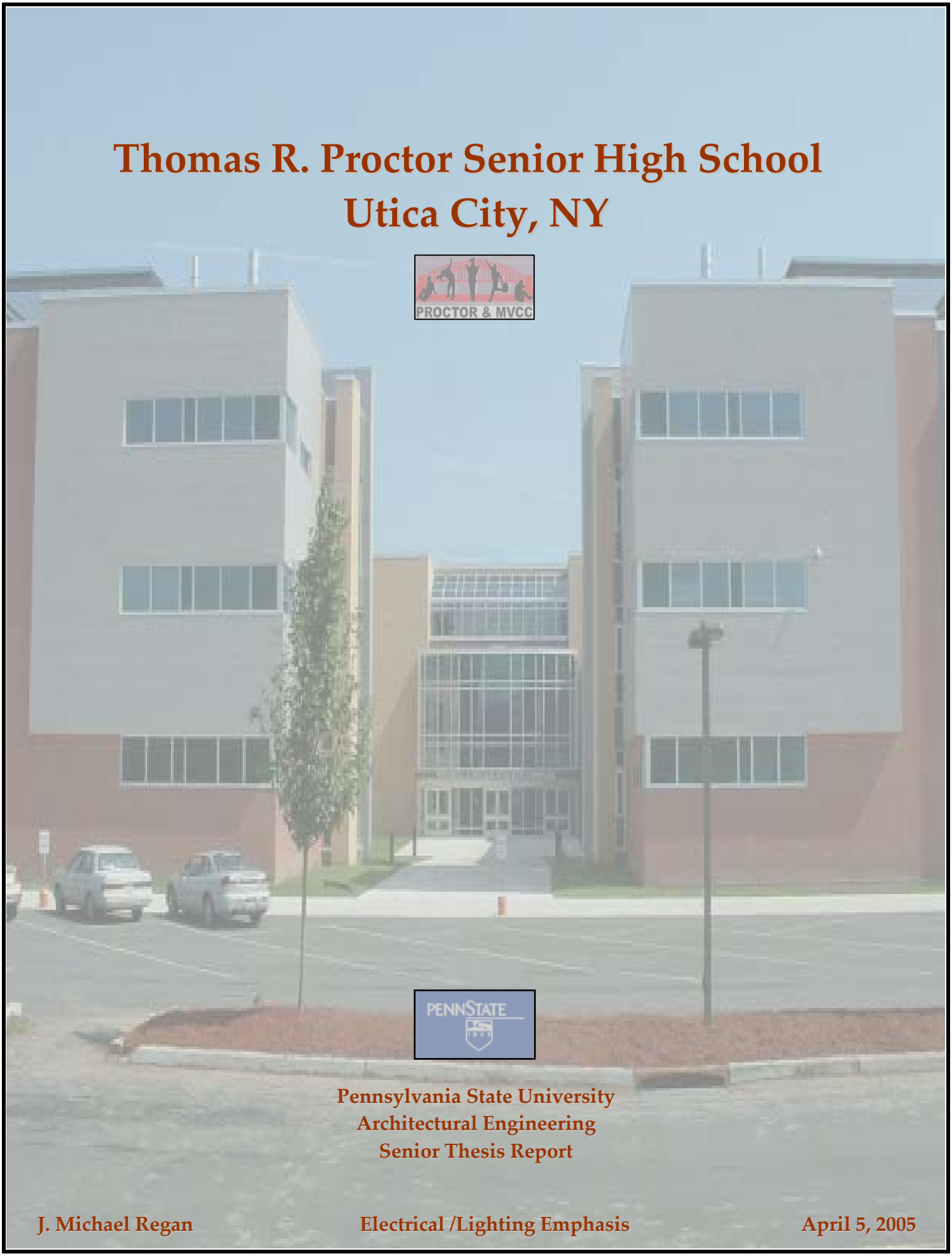
Thomas R. Proctor Senior High School
Utica City, NY



Pennsylvania State University
Architectural Engineering
Senior Thesis Report

J. Michael Regan

Electrical /Lighting Emphasis

April 5, 2005

Thomas R. Proctor High School
Utica City, NY

Michael Regan
Lighting/Electrical

http://www.arche.psu.edu/thesis/2005/jmr370

Construction

Owner: Utica City School District
Architect: The Hillier Group
Civil: Hillier Engineering and Technologies
Structural: Greenman-Pedersen, Inc.
MEP: Greenman-Pedersen, Inc.
CM: Turner Construction Company
Project Delivery Method: Design-Bid-Build
Project Cost: $35,810,000

Architecture

Size:
- 190,000 sq. ft, 3-story of addition to an existing 250,000 sq. ft, 4-story building
- Combination exterior of red brick and gray/sand architectural concrete finish

Structural System

- CMU base wall construction
- Concrete slab floor
- High strength, low alloy structural steel beams and columns
- Galvanized, zinc-coated floor decking

Mechanical System

- 2-350 ton lead/lag chiller units
- 3-500 hp gas-fired full-modulating boiler units
- VAV air-handler units with terminal hot water reheat
- Unit ventilators in classrooms

Electrical System

- Main unit substation with 600 amp, fused disconnect switch
- 1500 KVA, 13.2kV-480Y/277V main transformer
- 3000 A, 480Y-277V, 3ø-4W main switchboard
- 500 KW/ 625 KVA diesel fuel emergency generator

Lighting System

- Indirect recessed 2x2 luminaires in hallways
- Indirect pendant strips and 2x2 recessed luminaires in library
- Bollards for exterior garden lighting
- 2x4 parabolic fluorescent luminaries in classroom/offices

Table of Contents

Executive Summary

The following report is a culmination of research, analysis and redesign of several systems at Thomas R. Proctor Senior High School. The report examines a redesign of three different lighting spaces, an implementation of an emergency data recovery system, a structural system adjustment, and an addition to the present telecommunications system.

The lighting spaces analyzed in the report are the school's lobby, library and auditorium. All three of these spaces have unique features that allow for interesting design approaches.

The lobby redesign involves illuminating the center metal panel ceiling and washing the artwork while providing complete dimmable control. This allows for the space to best serve whichever of the many functions it is to serve.

The redesign in the library of the school involves the implementation of various different fixtures for specific reasons. Compact fluorescent downlights are used to light the pathways through the library while the wallwash/downlights illuminate the wall book stacks. Recessed parabolic fixtures are used over the reading/computer tables while indirect pendant fixtures illuminate the floor stacks. A daylight analysis was conducted to verify that a photosensor dimming system would be a practical approach to the space as well.

The auditorium heavily draws from the abundant daylight while providing the necessary illumination for evening activities. High wattage and standard compact fluorescents illuminate the seating areas while gold/crystal decorative fixtures add value to the historic architecture. The lighting systems in all three spaces successfully achieved the desired design objectives while meeting the necessary design criteria.

The electrical system design involves an adaptation for the building to serve as an emergency data recovery center. This process involves a conversion of the two (usually vacant) auxiliary gymnasiums into localized emergency power/data epicenters for the surrounding business community and schools in times of crisis. The plan also entails backing up all of the clean power panels in the school for times of incoming spillover of personnel. A design has been laid out for the gymnasiums with new panelboards to serve them. The entire system is to be served from a new 600kW/750kVA generator. All of the new and existing panels in the scheme will be fed by the newer switchboard 2 and will all be backed by emergency power. A UPS system has been added to the design to

provide redundancy to the system. A price estimate has been compiled show what the new recovery system would cost.

A study has also been performed to compare the use of bus duct vs. the existing conduit/cable system feeding the stacked electrical closets at several locations in the school. It was determined that the existing system was a more efficient system due to first cost.

Two additional breadth studies that corresponded to the depth areas of study were completed. The first involves a structural redesign due to the relocation of a span of four columns from the lobby lighting redesign. The new column and girder members have been sized according to the loads that are expected. The second breadth study is a telecommunications system addition to accompany the new emergency power system. This design adds two additional closets to the present system which are each designed to serve the gymnasiums with telephone and data service.

Background Information Summary

This statistics summary provides information of the physical existing conditions of Thomas R. Proctor High School. It includes summary information relative to the individual systems and design concepts and contains a broad overview of the scope, cost, and delivery of the project.

General Project Data

Building Name: Thomas R. Proctor High School

Location and Site

The school is located in Utica City, NY. It is located in a residential area of single-family homes near the center of the city. The suburban neighborhood lies on a large, relatively flat plot of land that includes exterior tennis courts, baseball/softball fields, and a football field, among other features.

Building Occupant Name

The school is part of the Utica City school district and is under the city's jurisdiction:
Utica City School District
1115 Mohawk Street
Utica, NY 13501-3709

Occupancy/ Function Types

The functionality of the school is directly geared towards student activities: The school contains a full-size gymnasium for basketball/volleyball, swimming pool, an approximately 1,500-seat auditorium, giant cafeteria, library, and NCAA regulated football field, among the typical student-related facilities.

Size

Overall Size: 441,200 sq. ft.
Existing Building: 272,969 sq. ft.
New Addition: 168,231 sq. ft.

Number of Stories Above Grade/ Total Levels

The existing school has four floors, three of which are above grade. The addition to the school has three total floors, all of which are above grade.

Primary Project Team

The project team consists completely of multiple prime contractors with a CM. There is no GC for Proctor High School. The following is a list of the design and engineering team:

Architect
The Hillier Group
Architects/Planners
744 Broad Suite 3000
Newark, NJ 07102
Phone: (973) 242-8899

Civil, Structural, MEP
Hillier Engineering & Technologies
(currently Greenman-Pedersen Inc.)
Suite 301, 50 Glenmaura National Blvd.
Scranton, PA 18505-5777
Phone: (570) 342-4080

Construction Manager
Turner Construction Company
8195 Cazenovia Road
P.O. Box 450
Manilius, NY 13104-00450
Phone (315) 682-2310

Dates of Construction

February, 2002 to August 2004

Cost Information

The following list is a bid-cost breakdown according to system:

Site work:	$4,227,755.00
General Work:	$15,669,637.00
HVAC:	$5,940,000.00
Plumbing:	$1,565,000.00
Electrical:	$4,116,866.00
Structural:	$2,059,900.00

Roofing: $632,370.00
Casework: $1,598,000.00

Total: $35,809,528.00

Project Delivery Method

Design-Bid-Build

Architecture

The exterior architecture of the existing school is very different from the design of the new addition to the school. The existing school is over 65 years old and is comprised completely of standard red brick design with long vertical windows and arches. The new design of the addition is a very modern look, using many colors and materials in its design. The new design wings of the school are made up of gray and tan concrete block, with red brick and green fascia. The windows of the addition are square, giving the building a more commercial feel than the existing school. The gym entrance, serving as a main entrance to the building, is comprised of structural steel with complete curtain windows spanning the entire height of the building entrance.

Major National Model Code/s

The school follows the standard BOCA codes as per the Utica City School District as well as NY SE

Zoning and Historical

Since the schools inception in 1938, the zoning requirements have always been residential, with no known concerns.

Building Envelope

The building envelope is a combination of concrete and brick with a steel frame. Almost the entire exterior is made of a concrete block base with a brick or architectural block exterior. The old sector of the school contains long vertical windows and traditional arched doorways while the new addition of the building has more squared edges to its casework, including doors and windows. The areas of the exterior that are not concrete block or brick consist of structural steel with floor-roof curtain walls. Overall, the addition to the school was meant to be a complete readjustment to the existing building, rather than a continuation of the design.

Electrical

Thomas R. Proctor High School has been upgraded from an existing radial electrical system to an expanded radial system. The new system incorporates two separate substations, one located in the main electrical room of the existing building and one located in the main electrical room of a new wing of the addition. Both main electrical rooms are located in the basement of their respective areas. Before the incoming electrical service reaches the school, the 13.2 kV underground it enters new metal enclosed outdoor switchgear, containing a 600A fused disconnect switch. The utility metering equipment is located on the primary side of this switchgear. The service is stepped down in each main substation from 13.2 kV to 480Y/277V via a Δ-Y transformer. Each transformer is protected on the primary side by a 600A fused disconnect switch. All the loads in the school that operate at 208Y/120V are stepped down by 480Y/277 - 208Y/120 V transformers. The electrical system is backed by a 500W/625kVA diesel emergency generator.

Lighting

The lighting is comprised mostly of 2'x2' indirect recessed troffers and recessed compact fluorescent downlights in the hallways. 2'x4' parabolic recessed troffers are found throughout the classrooms and offices. Specialty luminaires exist where they are appropriate. Examples include indirect suspended luminaires in the lobby and direct/indirect strip pendant luminaires in the library. The sidewalks and walking areas around the exterior of the building are mostly provided by free-standing bollards and metal halide downlights.

Mechanical

The school relies on two large air cooled chiller units that feed AHU cooling coils, unit ventilators, fan coils, and sensible cooler units. Three fire tube hot water boiler units and two cast iron hot water boiler units are used for heating. These units feed the AHU main heating coils, unit ventilators, fan coils, radiant/convection units, and terminal reheat coils. In addition, the gymnasium has two indirect fired roof top units for auxiliary heating.

Structural

The construction of the school utilizes high strength, low alloy structural steel beams and columns. The floor is comprised of galvanized, zinc-coated floor decking below a concrete slab floor. The exterior walls of the school are made up of concrete masonry units, while brick and aesthetic concrete finish exists over the new addition.

Fire Alarm System

The addressable fire alarm system provides the new and renovated spaces consists of manual pull stations, smoke detectors, heat detectors, duct detectors, flow switches, supervisory valves, PIV's and audible/visual devices as required by NFPA 72A. In addition, the school is provided with an automatic sprinkler system. A class I standpipe system (2-1/2" connections) for use by the local fire department. A new fire pump was installed to account for this new system.

Transportation System

The elevator system in the new addition to the school consists of an elevator in each new wing. These elevators are backed by the emergency generator and are integrated with the smoke detectors and heat detectors. These elevators have shunt trip in case of a fire emergency.

Telecommunications System

Each office workstation in the school is provided with 2 data and 1 telephone outlet. Each computer workstation is also provided with one data outlet. Each classroom is provided with 7 data outlets near clean power outlets. All of the cable used is Category 6, four pair, 24 UTP in a plenum rated jacket. All of the cables terminate into RJ-45 jacks at both ends.

Special Systems

New MATV coaxial television cable was run to classrooms and a new clock/paging system was provided to cover both the new addition and renovated spaces. New CCTV monitoring equipment was installed in the corridors and new monitors were installed in the security office. In addition, new access control equipment for all entry doors was installed.

Section 1 - Lighting Depth Work

1.1 Lobby Lighting Redesign

1.1.1 Appearance Description

The lobby of Thomas R. Proctor High School is a very unique area because it is a main connection point for many important spaces in the school. It is the first major room that is seen when entering the building from its main existing entrance and serves as a circulation space, social gathering place, and gateway to both the library and auditorium. The space has been completely renovated and now has taken on a very unique appearance. The room is approximately 2177 square feet and has a wall perimeter of 233 feet. The ceiling is the most unique characteristic of the entire space. The perimeter of the ceiling is made up of 2'x2' acoustic ceiling tile but the center of the room has a concave ceiling made up of matte gray perforated metal panel (68'x12'9"=867 square foot area). The distance from base of the metal panel ceiling to its apex is approximately 18 inches. This metal panel ceiling has a 9" gap between it and the perimeter acoustic ceiling tile. This gap exposes the above ceiling, which is also acoustic ceiling tile. Underneath the metal panel is a series of four steel columns that are enclosed by 2' round plaster. The walls are painted gypsum board and have the same color as the columns (beige). The floor is made up of vinyl composition tile. The space contains no windows; therefore, there is no daylight contribution in the space. This factor will greatly impact the design criteria.

Reflectances:

Floor surface: (R:184 G:128 B:87) ρ= .35
Wall surface: (R:255 G:218 B:145) ρ=.68
Acoustic ceiling surface: (R:233 G:253 B:152) ρ=.89
Metal panel ceiling surface (R: 154 G:151 B:152) ρ=.50

1.1.2 Design Focus

The lobby of the high school is perhaps the most crucial space because of its location and use. Since it is the first space to be seen, the overall aesthetics and appearance of the space and its luminaires are of the utmost importance. The lighting must depict the space as being inviting while establishing the idea that the school has been a reputable institution for over 65 years. Since the space serves multiple purposes (main hallway during the school day, social gathering space during the evening), different appearance schemes must be achievable.

The columns in the space are burdensome and actually take away from the circulation of the space and also need to be contended with. In general, the majority of light in the space should be ambient lighting for social gathering, aside from the accents that have been mentioned.

1.1.3 Design Criteria

Since the lobby is used as a circulation space (corridor) during the school day and a gathering place for non-daytime activities, its focus is more for ambient light than task driven light. Therefore, I feel that between 10-20fc on the floor should be enough to appropriately illuminate the area. Since paintings will fill the walls on both sides of the lobby I would recommend a higher illuminance of 15-fc on the walls. Since there is no daylight in the space, a higher color temperature of the lamps would be helpful in the space to make up for the lack of daylight. However, I feel that lamps with a good CRI would be more effective on the walls in order to effectively render the paintings off of the yellow background. One of the most important design criterions for the lobby is its situation with direct and reflected glare. Since the floor of the lobby has some specularity, it is important to have a good luminance ratio on the ceiling to prevent reflected glare. Providing indirect light would also eliminate the problem of direct glare. Another important issue in the space is the acoustic ceiling tile above the metal panel ceiling. It is important maintain an even luminance on this surface as well (whether illuminating fully or not illuminating at all) in order to avoid reflected glare problems off of the floor and more importantly, shadows. The paintings on the walls should be accented to draw attention onto the walls rather than on the floor.

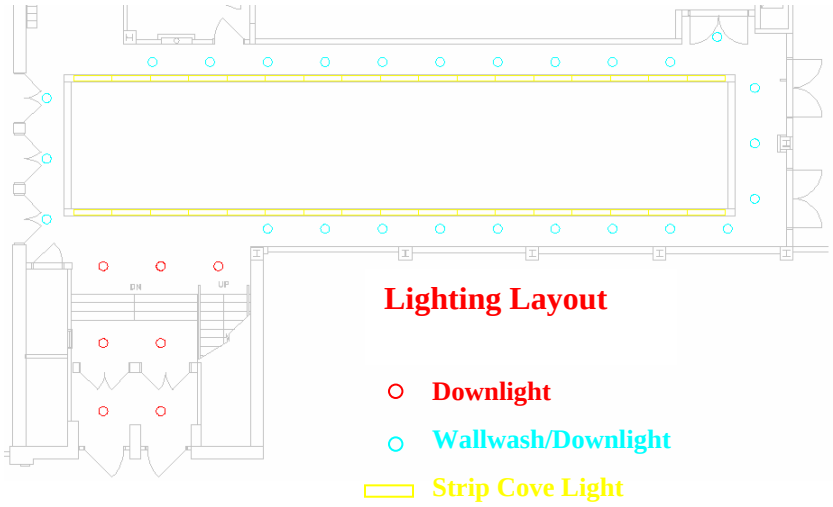
1.1.4 Design Solution

The most obvious characteristic of the space that demands attention is the obtrusive columns that span the length of the lobby underneath the metal panel ceiling. In order to establish the lobby as a gathering and circulation space, I felt that these columns would need to be moved. Therefore, my lighting redesign involves moving the column span an additional 10'-10" and raising the suspended metal panel ceiling 8" (the details of the structural redesign of the space are included in the Structural System Redesign section of the report). The redesigned lighting system in the lobby consists of the following luminaires:

1. 6" Aperture compact fluorescent downlight
2. 6" Aperture compact fluorescent wallwash/downlight

3. 4' strip cove light

The compact fluorescent downlights in the lobby are mainly used to mark the pathway into and out of the lobby.

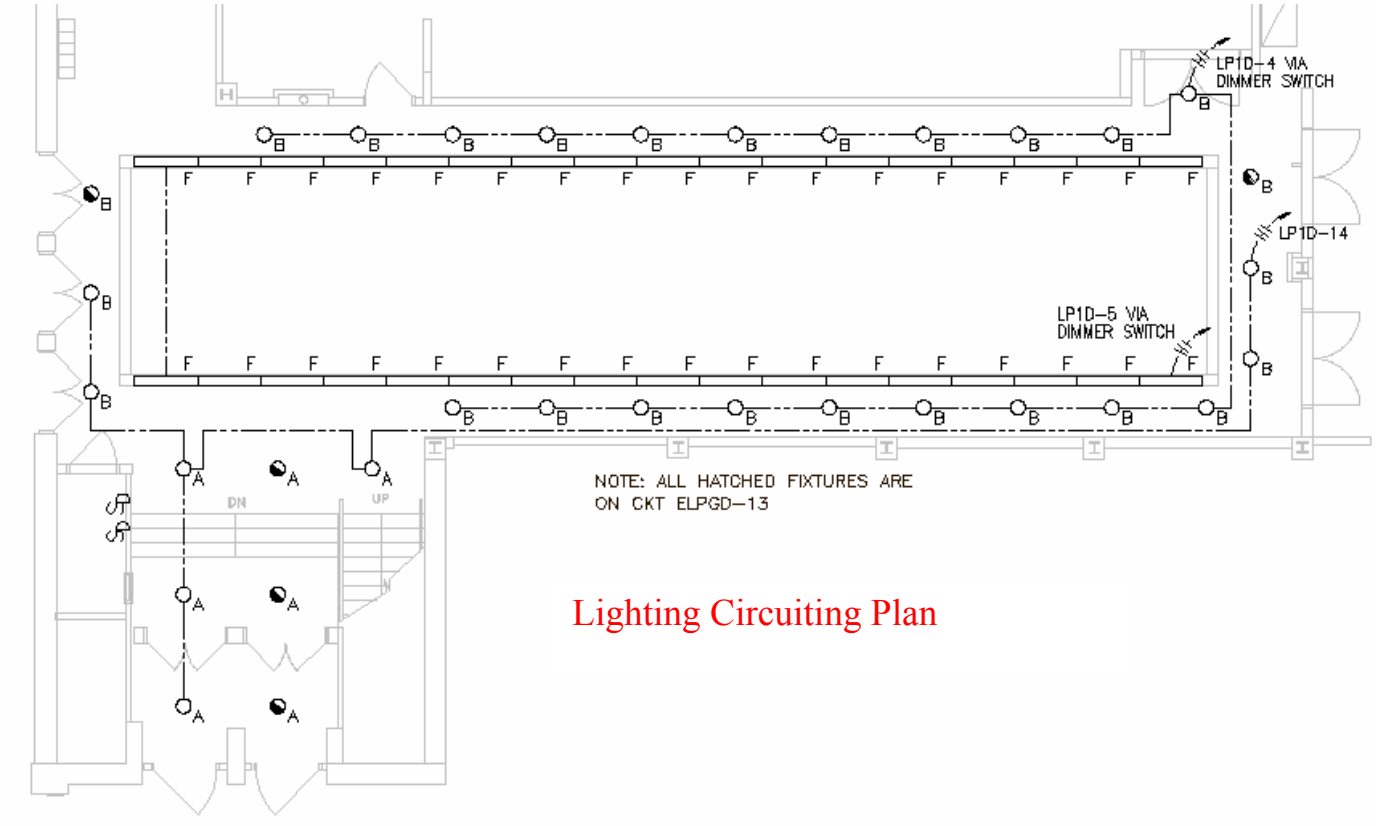


The compact fluorescent wallwash/downlights are used to highlight the paintings that will run the length of the lobby. Additionally, these luminaires will highlight the doors that lead into the auditorium and those that lead to the remainder of the school.

The strip cove lights, which are used to highlight the metal panel ceiling, are recessed into a white gypsum board perimeter ceiling shelf that will match the existing ceiling. This will hide the luminaires while still allowing light to cover the metal ceiling effectively.

1.1.5 Controls

Since one of the design goals is to provide variable appearance schemes, the lighting controls in the space allow for adjustability. Specifically, the wallwash/downlights along the long walls and the strip cove lights are fully dimmable. The dimming switches are located in the adjacent ticket booth room D140. This arrangement will allow for a supervisor in the room to regulate the lighting system based on the appropriate scene. Full control would be possible so that a supervisor could manage how much light covers the paintings on the wall versus how much light would illuminate the ceiling to light the floor. The remaining luminaires are controlled via the existing programmable lighting control panels.



Lighting Circuiting Plan

1.1.6 Circuit and Panelboard Data

Each of the three types of luminaires in the lobby are circuited and switched independently. An additional fourth circuit is designated for the emergency luminaires. Lighting panel LP1D, located in sector D, feeds all of the non-emergency lighting circuits. The hatched fixtures on the circuit layout refer to luminaires that are backed by the emergency generator and are circuited together from panel ELPGD (refer to the lighting circuiting plan). The calculations for each lighting circuit in the lobby are listed below:

CKT LPD1D-4: 20 x 50W = 1.00 kVA, 3.60A
CKT LPD1D-5: 34 x 36W = 1.22 kVA, 4.40A
CKT LPD1D-14: (4 x 32W) + (4 x 32) = .328 kVA, 1.18A
CKT ELPGD-14: (3 x 50W) + (2 x 32) = .22 kVA, 0.79A

None of the branch circuits were near exceeding the designed current limit of 16 amps, even with a 1.25 continuous load factor.

Panelboards:

The impact of the lighting circuits to the overall panelboard load is given below (Note: The wire size for each of the new lighting circuits is #10 AWG since none of the circuits exceed 16 amps and there are no voltage drop issues):

DESIGNATION: LP1D

VOLTAGE: 480/277V-3ø-4W
MAINS: 100A MLO
TYPE: LIGHTING
O.C. DEVICE: CIRCUIT BREAKER
MOUNTING: SURFACE

LOCATION: ELECTRIC ROOM D109
FED BY: LPGD
MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
AUXILIARY GYM LIGHTING	1	20	1	3.5	3.0					1	20	2	AUXILIARY GYM LIGHTING
LIGHTING CONTROL AUX. GYM LTG	3	20	1			0.1	1.0			1	20	4	LOBBY LIGHTING
LOBBY LIGHTING	5	20	1					1.22	1.3	1	20	6	CORR C109, D131
ROOMS D120 THRU D125	7	20	1	1.3	1.6					1	20	8	ROOMS D113 THRU D118
LIBRARY LIGHTING	9	20	1			1.66	1.4			1	20	10	LIBRARY LIGHTING
LIBRARY LIGHTING	11	20	1					1.06	1.12	1	20	12	LIBRARY LIGHTING
LIBRARY LIGHTING	13	20	1	1.06	.328					1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1			2.24						16	
AUDITORIUM LIGHTING	17	20	1					2.9				18	
	19											20	
	21											22	
	23											24	
SPARE BREAKER	25	20	1							1	20	26	SPARE BREAKER
SPARE BREAKER	27	20	1							1	20	28	SPARE BREAKER
SPARE BREAKER	29	20	1							1	20	30	SPARE BREAKER
TOTAL KVA/ø				10.8		6.4		7.6		TOTAL KVA			24.8

DESIGNATION: ELPGD

VOLTAGE: 480/277V-3ø-4W
MAINS: 100 AMPS - MLO
TYPE: EMEGENCY LIGHTING
O.C. DEVICE: CIRCUIT BREAKER
MOUNTING: SURFACE

LOCATION: ELECTRIC ROOM DG22
FED BY: EDP
MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
BASEMENT LTG	1	20	1	0.8	0.8					1	20	2	AUXILIARY GYM
AUXILIARY GYM LTG CONTROL	3	20	1			0.1	1.6			1	20	4	CORRIDOR B202/B319
TOILETS D329/334	5	20	1					1.8	1.0	1	20	6	TOILETS D310/D312
GALLERY C201	7	20	1	0.8	3.2					1	20	8	CORRIDOR DG15
TEACHERS DINING	9	20	1			1.0	0.9			1	20	10	LOBBY D112
CORRIDOR D119	11	20	1					1.6	1.9	1	20	12	CORRIDOR C109, D131
LIBRARY LIGHTING	13	20	1	0.81	.22					1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1			.34						16	
	17											18	
	19											20	
	21											22	
	23											24	
SPARE	25	20	1							1	20	26	SPARE
SPARE	27	20	1							1	20	28	SPARE
SPARE	29	20	1							1	20	30	SPARE
TOTAL KVA/ø				6.6		3.9		6.3		TOTAL KVA			16.8

None of the lighting circuits had a significant impact on the overall capacity of the existing panelboards. The total load on panel LP1D is 29.83A and the total load on panel ELPGD is 20.20A.

1.1.7 Calculation Parameters

Light Loss Factors:

Type A:
LLD: 1530/1800= **.85**
LDD: Type IV, cleaned annually = **.89**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(7)(233')/(1856 ft^2) = 2.19
RSDD: **.967**
BF: **1.1**
LLF = (.85)(.89)(.967)(1.1) = .80

Type B:
LLD: 2040/2400 = **.85**
LDD: Type IV, cleaned annually = **.89**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(7)(233')/(1856 ft^2) = 2.19
RSDD: **.967**
BF: **.98**
LLF = (.85)(.89)(.967)(.98) = .72

Type F:
LLD: 2950/3100=**.95**
LDD: Type IV, cleaned annually = **.89**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(7)(233')/(1856 ft^2) = 2.19
RSDD: **.96**
BF: **.99**
LLF = (.95)(.89)(.967)(.99)=.80

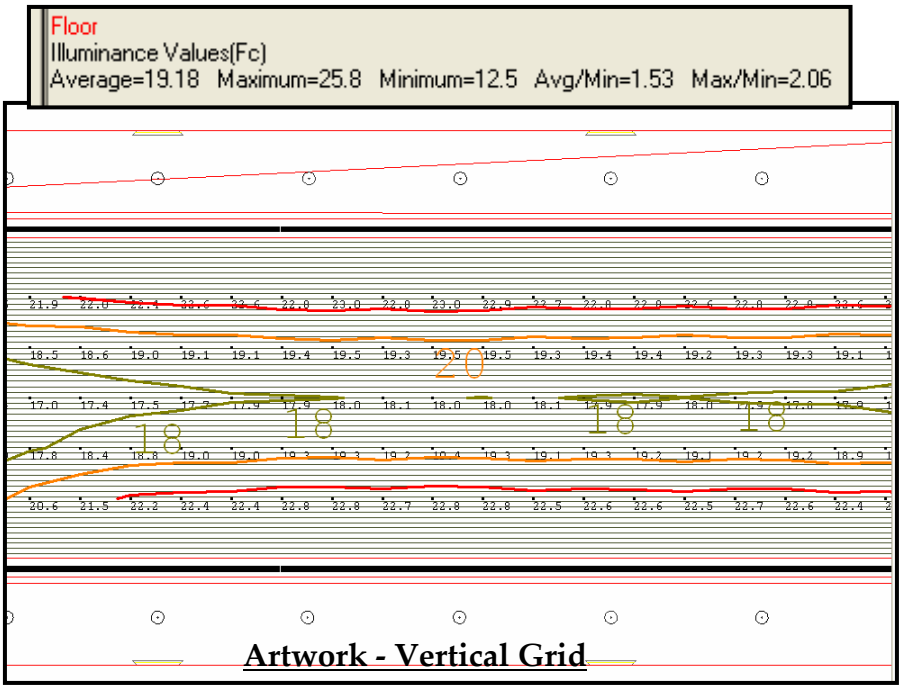
Power Density:

Type A: 7 x 50W = 350W
Type B: 26 x 36W = 936W
Type F: 34 x 31W = 1054W
2340W

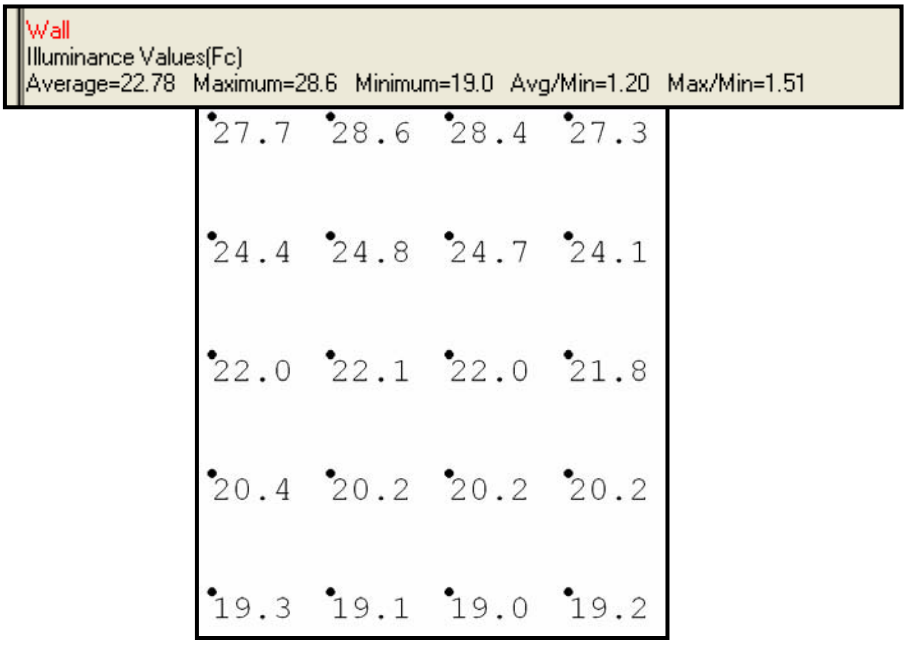
Total Power Density = 2340W/2177 ft^2 = **1.07W/ft^2 < 1.3W/ft^2**

1.1.8 Calculation Results

Floor – Horizontal Grid



Artwork - Vertical Grid



1.1.9 Renderings

View of lobby leading to main hallway

View of lobby leading to auditorium

1.1.10 Luminaire Schedule

Luminaire Schedule							
Type	**Description**	**Manufacturer-Model #**	**Voltage**	**Mounting**	**No. and Type of Lamp**	**Lamp Manufacturer-Designation**	**Ballast**
A	Compact Fluorescent 6" Aperture Downlight	Portfolio – C6-226-2D-6251-LI	277	Recessed	2-26-CF	Philips - CFQ26W/G24q/830	Advance - ICF-2S26-M1-LS@277
B	Compact Fluorescent 6” Aperture Wallwash/Downlight	Lithonia – 6W7A	277	Recessed	1-32-CF	Philips – PL-T 32w/830/4P/ALTO	Advance – REZ-123-1T32
F	4’ Linear Strip Cove Light	Elliptipar – F301-2-S-00V	277	Surface	1-32 T8	Philips - F32T8/AD830/ALTO	Advance - VZT - 132

1.2 Library Lighting Redesign

1.2.1 Appearance Description

The library at Thomas R. Proctor High School is located adjacent to the lobby. The library has an area of approximately 7795 square feet with a perimeter of 552 feet. The ceiling continues the 2'x2' acoustic tile pattern from the lobby throughout the entire space. The walls are also painted gypsum board that is the same color as is in the lobby. The floor of the space is vinyl composition tile covered with gray carpet. The south side wall of the library has 10' high windows spanning the entire length of the wall. The north wall also contains 3'-6" x 6'-0" windows of transmittance= .80. Book stacks are found throughout the library. The stacks that are free-standing are about 4-1/2' high, while the wall stacks are about 7' high. The stacks are a cream-colored painted metal. The space also contains an ample amount of wooden furniture. Such furniture includes a large circulation desk and study tables.

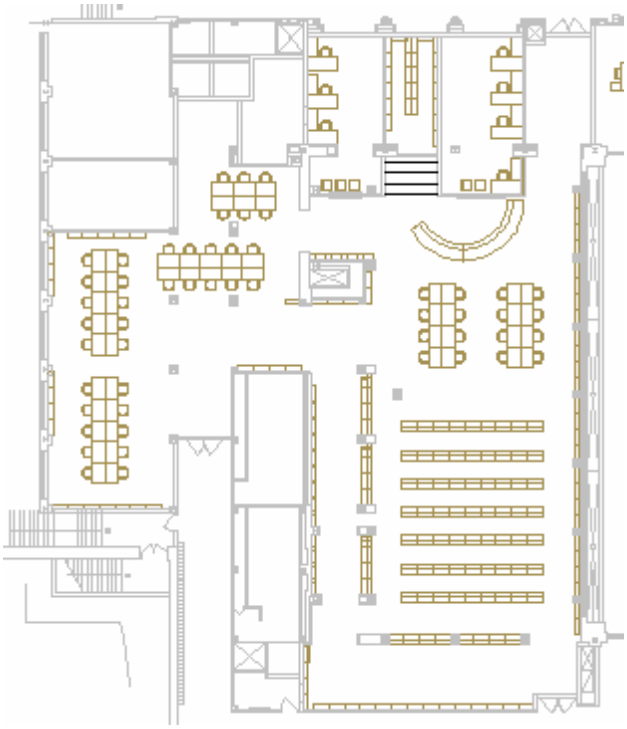
Reflectance:
Floor surface: (R:122 G:111 B:94) ϱ=.28
Wall surface: (R:248 G:226 B:184) ϱ=.68
Ceiling surface: (R:198 G:213 B:218) ϱ=.89
Wooden surface: (R:156 G:118 B:89) ϱ=.44
Book stacks surface: (R:208 G:181 B:131) ϱ=.51

1.2.2 Design Focus

The library is a very large space in Thomas R. Proctor High School. The most important characteristic to consider while designing the lighting system is the creation of a bright environment that encourages learning. It is also important to note that the library is comprised of distinctly different spaces. Specifically, the library consists of a book stacks/circulation area and a computer/reading area. It is very important to visually establish the two areas as two separate spaces and also implement a lighting system that provides a logical progression from the stacks to the reading area. In addition to these two spaces, the library has three entrances/exits that also need to be easily identifiable as a perimeter circulation space so that occupants can easily navigate through the space.

1.2.3 Design Criteria

In order to find an appropriate design solution for the library, it is important that certain criteria be met. Since the library is a very task oriented space (reading and working intensive), it is very important that light levels are maintained. Specifically, the reading areas, tables, and circulation desk should have a maintained illuminance of at least 30-fc. Exactly where computers would be placed in the space is unknown, so it must be assumed that any table in the reading area could have a computer on it. As a result, the possibility of reflected glare on VDT screens must be eliminated in these areas. It is also essential to provide a uniform vertical illuminance on the book stacks (both wall stacks and small stacks). It is important to try to avoid shadows that the free-standing book stacks might cast on each other. Lastly, daylight integration of the south row of windows is very important in the space during the day to increase occupant alertness and conserve energy.



Library Layout

1.2.4 Design Solution

The lighting design in the library was developed out of the need to address the design criteria while maintaining the design focus. The design consists of four types of luminaires:

4. 6" Aperture compact fluorescent downlight
5. 6" Aperture compact fluorescent wallwash/downlight
6. 2'x2' Recessed fluorescent 2-lamp fluorescent
7. Indirect/Direct fluorescent pendant

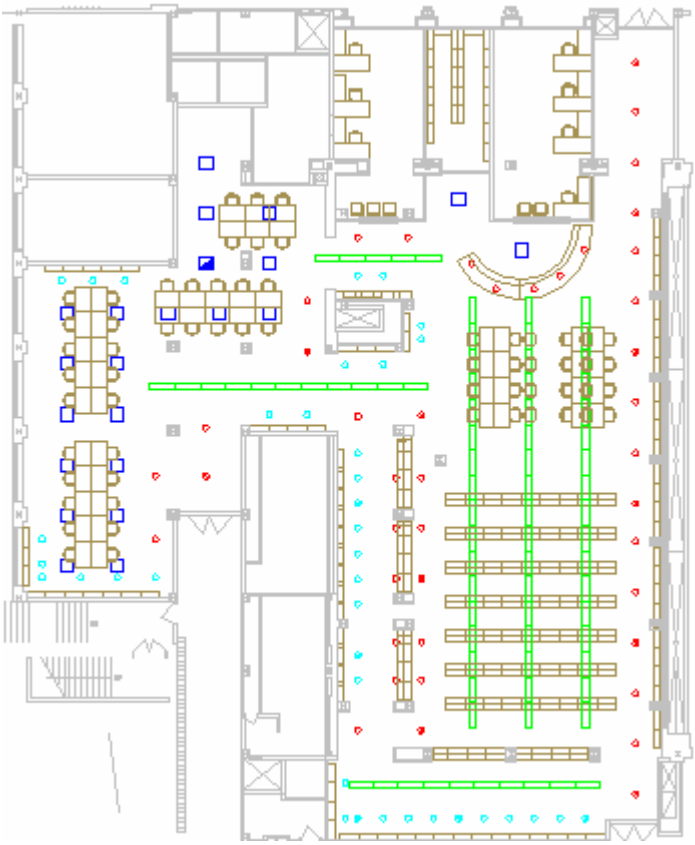
Compact fluorescent downlights are used primarily to mark the entrance/exit pathways through the space for safety. The downlights are also used near interior windows to avoid direct glare into the adjacent offices. The

last place that downlights are used is on the surface of the reception desk. This is because the unique reception desk warrants a design that can follow its shape.

Compact fluorescent wallwash/downlights are used in the space as a means of uniformly illuminating the wall stacks while still providing downlight illumination for walking in the aisles.

The 2x2 recessed fluorescent fixtures are used mainly in the reading area. The purpose of this is to supply light to students who are reading and focus the light directly onto the workplane, avoiding glare on potential VDT monitors. The spacing of these luminaires in the ceiling grid is close to the edge of the tables to avoid direct glare onto any monitors by raising the incident angle of the luminaire with respect to the sight plane.

Indirect pendants make up the majority of the luminaires in the space. They have been chosen to illuminate the main stacks area of the library because of their ability to indirectly illuminate the ceiling of the space. By lighting the ceiling uniformly, reflected light can more adequately reach the vertical surfaces in the space (books) without casting shadows. The final place that the pendants were used is in the hallways that lead from the stacks space to the reading area. The use of pendants here was to visually transition between the stacks room and the reading room.



Lighting Layout

Downlight

Wallwash/Downlight

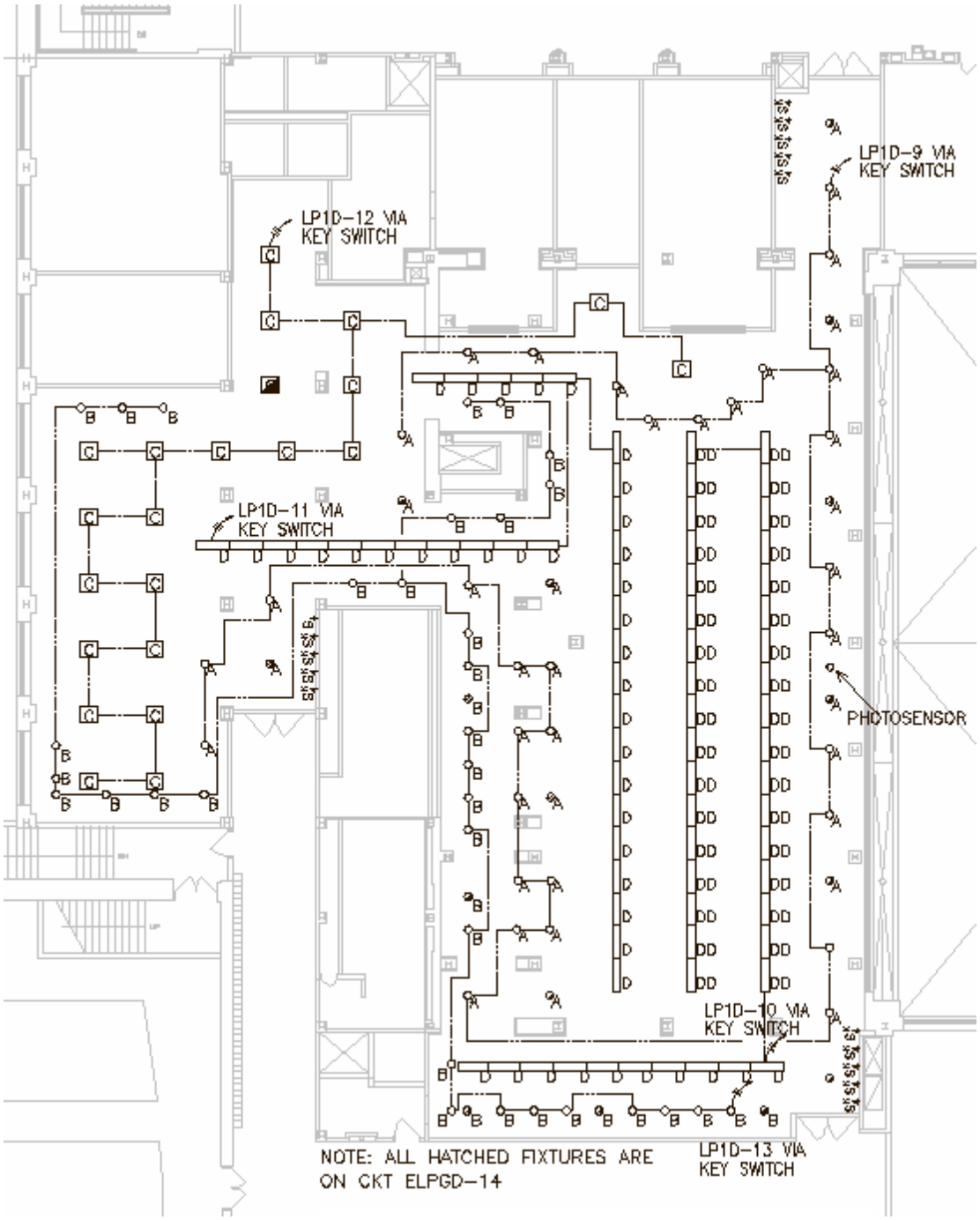
2x2 Recessed Fluorescent

Indirect/Direct Pendant

1.2.5 Controls

Most of the spaces in Proctor High School are very public and will receive extensive use from students at all times during the day. For security reasons, it is important that the library continues the same key-switch control scheme that is used in the other spaces of the school. Five key switches are provided at each of

the three entrances to the library. Four of the five key switches are designated for each of the four types of luminaires. The fifth key switch is designated for luminaires that require an emergency backup. For energy saving purposes, a photosensor dimming system has been instituted on the two parallel pendant rows closest to the south window.



Lighting Circuiting Plan

1.2.6 Circuit and Panelboard Data

Each of the four types of luminaires is switched and circuited independently. A fifth circuit is designated for emergency luminaires for a total of five circuits and five switches. The four non-emergency lighting circuits have been circuited to panel LP1D, located in sector D. The hatched fixtures on the circuit layout refer to luminaires that are backed by the emergency generator and are circuited together from panel ELPGD (refer to the lighting circuiting plan). The calculations for each lighting circuit in the library are listed below:

CKT LPD1D-9: 33 x 50W = 1.66 kVA, 5.96A
CKT LPD1D-10: 44 x 32W = 1.41 kVA, 5.08A
CKT LPD1D-11: 33 x 32W = 1.06 kVA, 3.81A
CKT LPD1D-12: 20 x 56W = 1.12 kVA, 4.04A
CKT LPD1D-13: 33 x 32W = 1.06 kVA, 3.83A
CKT ELPGD-14: (11 x 50W) + (5 x 36W) + (1 x 80) = .81 kVA, 2.92A

None of the branch circuits were near exceeding the designed current limit of 16 amps, even with a 1.25 continuous load factor.

Panelboards:

The impact of the lighting circuits to the overall panelboard load is given below (Note: The wire size for each of the new lighting circuits is #10 AWG since none of the circuits exceed 16 amps and there are no voltage drop issues):

DESIGNATION: LP1D	VOLTAGE: 480/277V-3ø-4W						LOCATION: ELECTRIC ROOM D109					
	MAINS: 100A MLO						FED BY: LPGD					
	TYPE: LIGHTING											
	O.C. DEVICE: CIRCUIT BREAKER						MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC					
	MOUNTING: SURFACE											

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
AUXILIARY GYM LIGHTING	1	20	1	3.5	3.0					1	20	2	AUXILIARY GYM LIGHTING
LIGHTING CONTROL AUX. GYM LTG	3	20	1			0.1	1.0			1	20	4	LOBBY LIGHTING
LOBBY LIGHTING	5	20	1					1.22	1.3	1	20	6	CORR C109, D131
ROOMS D120 THRU D125	7	20	1	1.3	1.6					1	20	8	ROOMS D113 THRU D118
LIBRARY LIGHTING	9	20	1			1.66	1.4			1	20	10	LIBRARY LIGHTING
LIBRARY LIGHTING	11	20	1					1.06	1.12	1	20	12	LIBRARY LIGHTING
LIBRARY LIGHTING	13	20	1	1.06	.328					1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1			2.24						16	
AUDITORIUM LIGHTING	17	20	1					2.9				18	
	19											20	
	21											22	
	23											24	
SPARE BREAKER	25	20	1							1	20	26	SPARE BREAKER
SPARE BREAKER	27	20	1							1	20	28	SPARE BREAKER
SPARE BREAKER	29	20	1							1	20	30	SPARE BREAKER
	TOTAL KVA/ø			10.8		6.4		7.6				TOTAL KVA	24.8

DESIGNATION:	VOLTAGE: 480/277V-3ø-4W	LOCATION: ELECTRIC ROOM DG22
	MAINS: 100 AMPS - MLO	FED BY: EDP
ELPGD	TYPE: EMEGENCY LIGHTING	
	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
BASEMENT LTG	1	20	1	0.8	0.8					1	20	2	AUXILIARY GYM
AUXILIARY GYM LTG CONTROL	3	20	1			0.1	1.6			1	20	4	CORRIDOR B202/B319
TOILETS D329/334	5	20	1					1.8	1.0	1	20	6	TOILETS D310/D312
GALLERY C201	7	20	1	0.8	3.2					1	20	8	CORRIDOR DG15
TEACHERS DINING	9	20	1			1.0	0.9			1	20	10	LOBBY D112
CORRIDOR D119	11	20	1					1.6	1.9	1	20	12	CORRIDOR C109, D131
LIBRARY LIGHTING	13	20	1	0.81	.22					1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1			.34						16	
	17											18	
	19											20	
	21											22	
	23											24	
SPARE	25	20	1							1	20	26	SPARE
SPARE	27	20	1							1	20	28	SPARE
SPARE	29	20	1							1	20	30	SPARE
	TOTAL KVA/ø			6.6		3.9		6.3				TOTAL KVA	16.8

None of the lighting circuits had a significant impact on the overall capacity of the existing panelboards. The total load on panel LP1D is 29.83A and the total load on panel ELPGD is 20.20A.

1.2.7 Calculation Parameters

Light Loss Factors:

Type A:

LLD: 1530/1800= **.85**

LDD: Type IV, cleaned annually = **.89**

RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)

= (2.5)(7)(552')/(7795 ft^2) = 1.24

RSDD: **.967**

BF: **1.1**

LLF = (.85)(.89)(.967)(1.1) = .80

Type B:

LLD: 2040/2400 = **.85**

LDD: Type IV, cleaned annually = **.89**

RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)

= (2.5)(7)(552')/(7795 ft^2) = 1.24

RSDD: **.967**
BF: **.98**
LLF = (.85)(.89)(.967)(.98) = .72

Type C:
LLD: 4750/5000= **.95**
LDD: Type IV, cleaned annually = **.89**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(7)(552')/(7795 ft^2) = 1.24
RSDD: **.967**
BF: **.99**
LLF = (.95)(.89)(.967)(.99)=.81

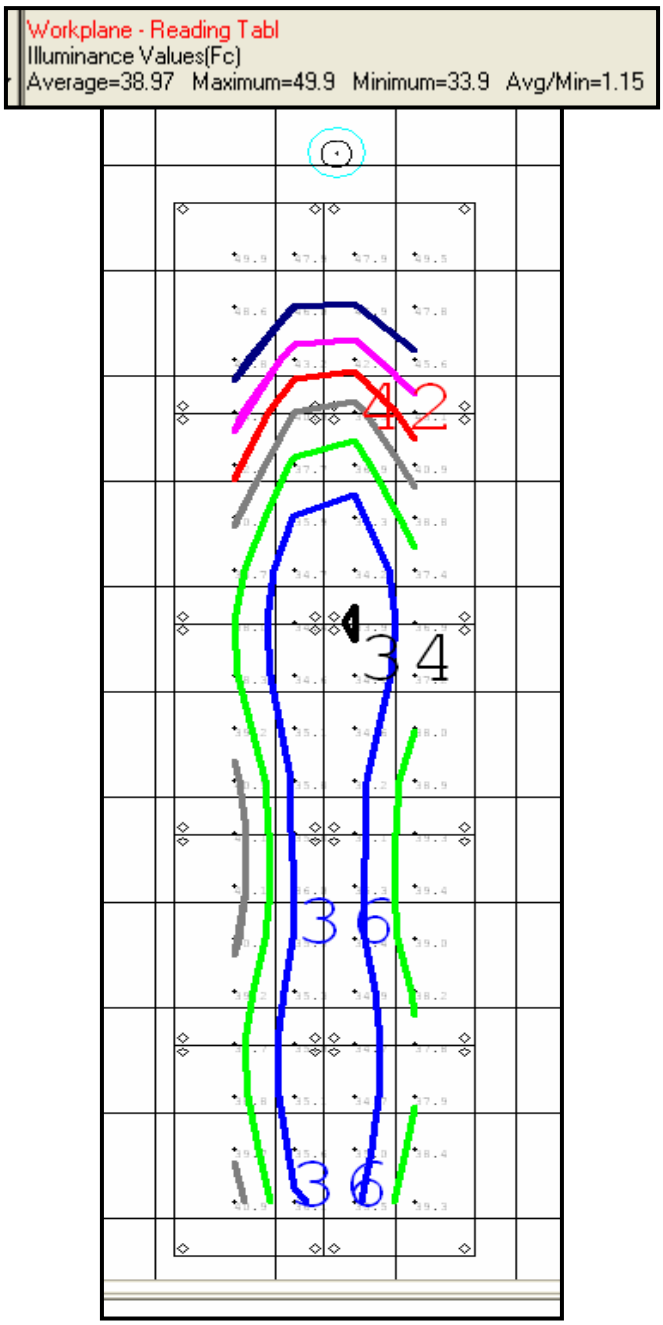
Type D:
LLD: 2950/3100=**.95**
LDD: Type II, cleaned annually = **.94**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(5.5)(552')/(7795 ft^2) = .97
RSDD: **.94**
BF: **1.0**
LLF = (.95)(.94)(.94)(1.0)= .83

Power Density:
Type A: 44 x 50W = 2200W
Type B: 38 x 36W = 1368W
Type C: 22 x 80W = 1760W
Type D: 77 x 36W = 2722W
8050W
Total Power Density = 8050W/7955 ft^2 = **1.01W/ft^2 < 1.2W/ft^2**

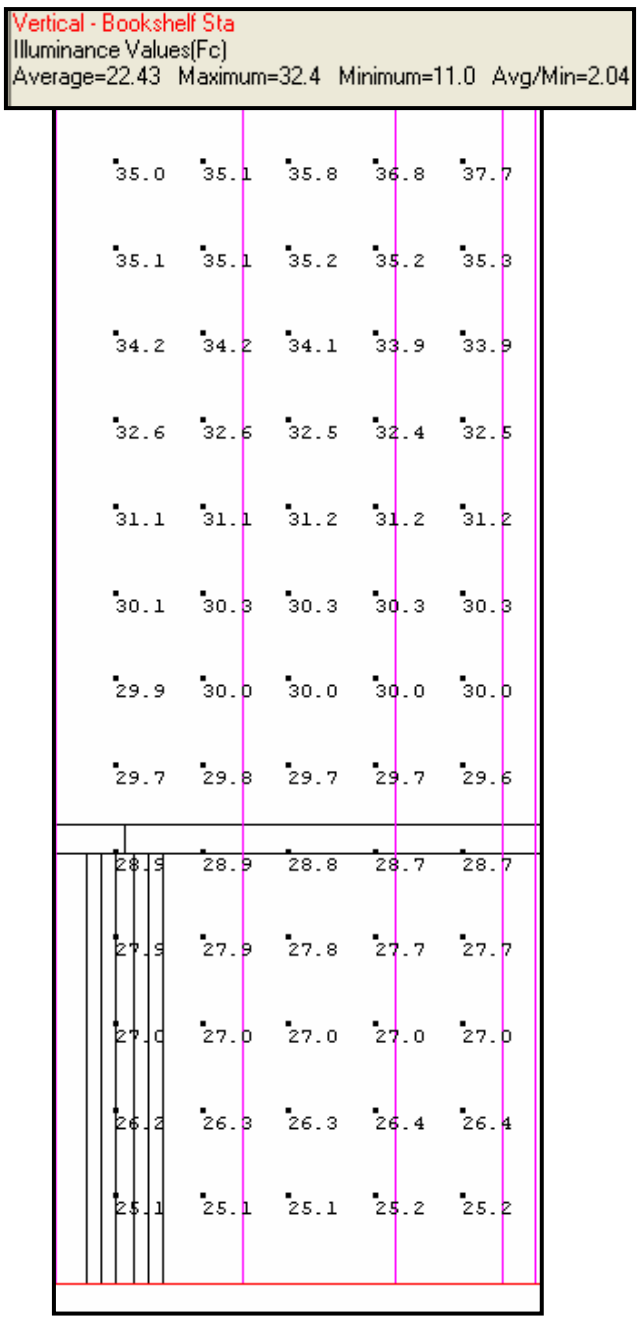
1.2.8 Calculation Results

The following results were calculated without daylight:

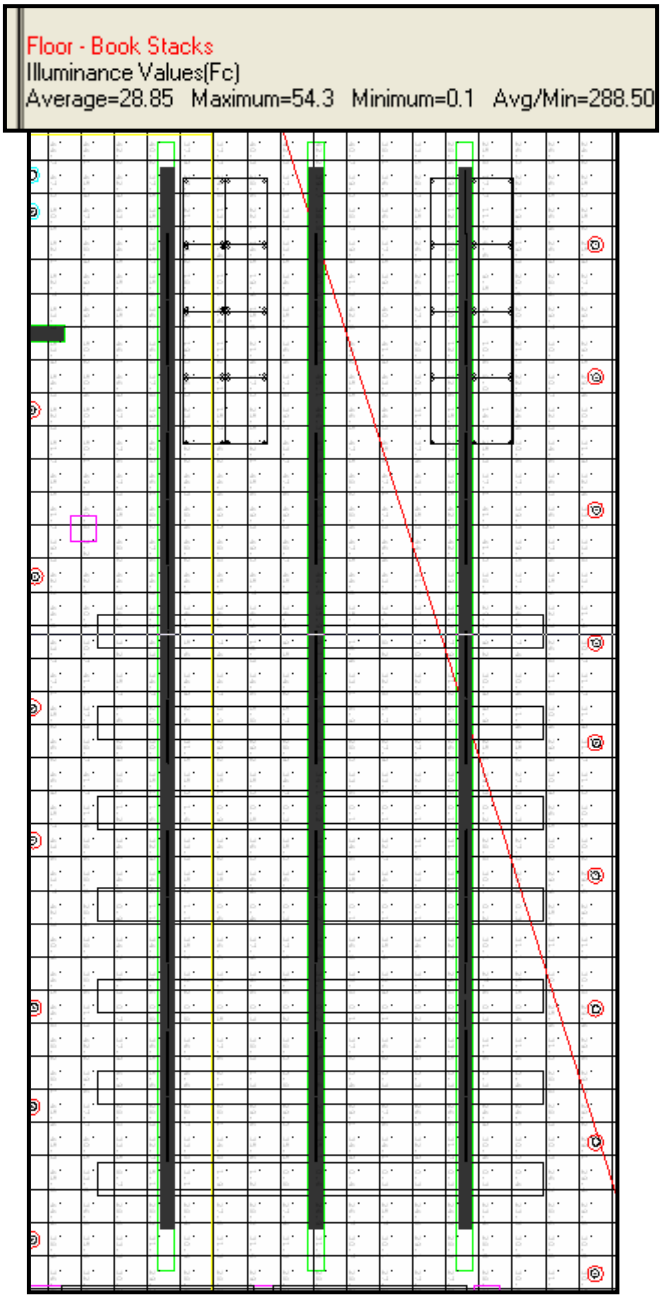
Reading Table –Workplane Grid



Wall Book Stacks – Vertical Grid



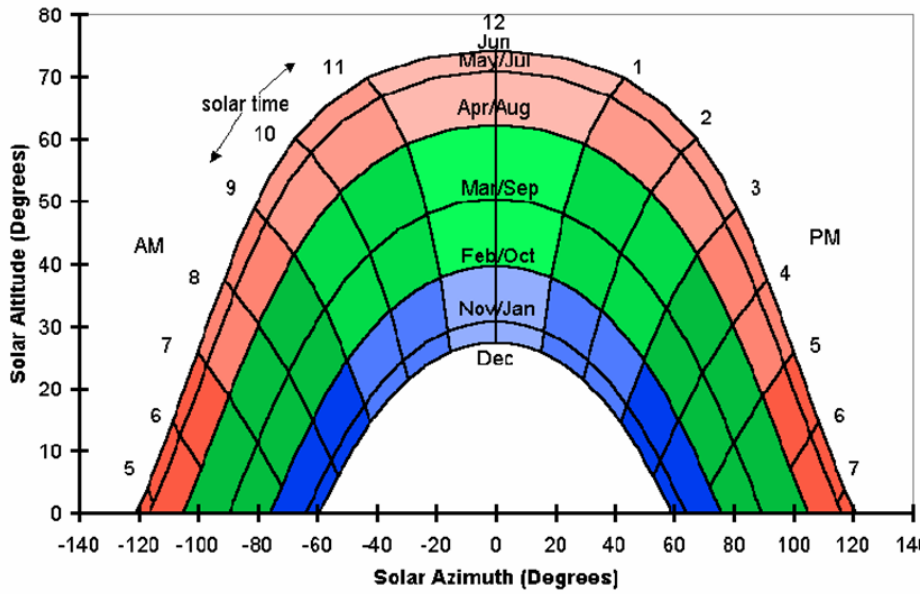
Small Book Stacks – Vertical Grid



NOTE: The results on the book stacks have a very small minimum illuminance level and a very high avg/min ratio. This is due to the fact that the book stacks in the space rest on top of the calculation grid, causing imprecise results.

1.2.9 Daylight Dimming System Analysis

Since the library has an entire northeast wall of 6' high windows, I investigated the option of incorporating an automatic photosensor dimming system into the lighting design. The zone of the library that was analyzed in the daylight study was the workplane of the library book stacks. The design was analyzed on practicality and potential cost savings. In the analysis, three specific days were chosen to represent the overall daylight conditions throughout the year. December 21 at 3pm was chosen to represent a low-daylight scenario. This day represented the months of November, December, January and February. March 21 at 12pm was used to represent March, April, September and October. Finally, June 21 at 11pm was used to represent daylight conditions for the months of May, June, July and August. For each day listed, three specific sky scenarios (clear, cloudy, and overcast) were used for study totaling 9 different scenarios. After the results of the calculation grid were tabulated for the different conditions, the critical point was determined. This was done using the following steps:



1. determining the target illuminance level based on the full electric light
   * 30-fc was used as the target illuminance as per the IES Handbook
2. determining the additional illuminance needed
3. determining the full contribution from the dimmed lighting system
4. determining the dimming level using the following equation:

$$\% \text{ dimmed} = \frac{\text{target} - (\text{undimmed} + \text{daylight})}{\text{dimmed}}$$

The critical point is the point that requires the largest percent of electric daylight to meet the target illuminance of 30-fc. After determining the dimming levels that are required for the ballasts, it is necessary to convert the ballast factor into input watts. This is done by multiplying the % of electric light output required

by the maximum ballast factor. The input watts for a given % electric light output is obtained from an interpolation of information given on the ballast specification sheet. The calculations for each scenario are as follows:

Day	Condition	% Electric Light Output Required	Input Ballast Watts Required
21-Mar	Clear	0	0
	Cloudy	0	0
	Overcast	25.13	15
21-Jun	Clear	0	0
	Cloudy	0	0
	Overcast	0	0
21-Dec-05	Clear	26.7	15.27
	Cloudy	47.12	20.31
	Overcast	61.26	23.7

With the acquired information it becomes possible to start a cost analysis to compare a non-dimming vs. dimming system. To consider how many of the sky condition scenarios would actually exist in Utica, I used the weather history data for Syracuse, NY, the closest major city. The data is as follows:

Weather History												
Sky	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Clear	3	3	5	6	6	7	8	7	7	6	2	2
Cloudy	7	6	7	7	10	11	12	11	10	8	6	5
Overcast	22	19	19	17	15	12	11	13	13	17	22	24

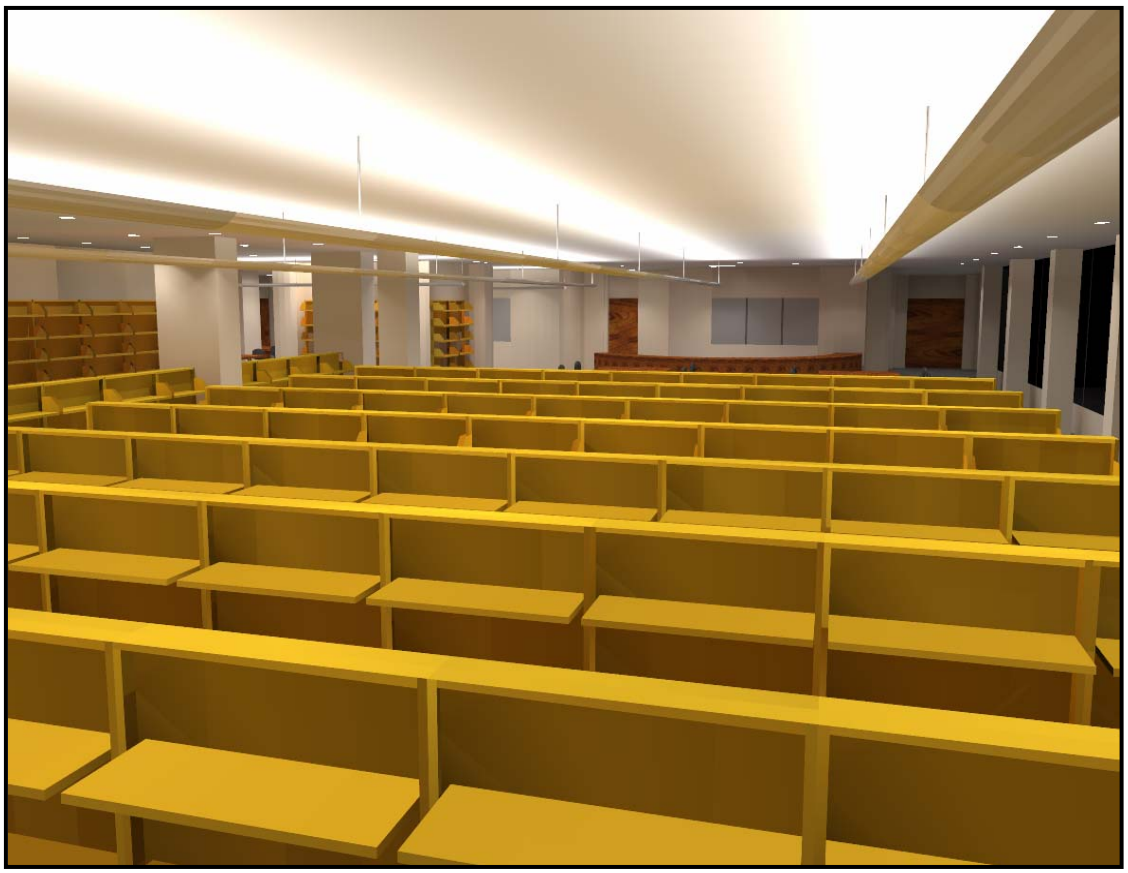
In order to more accurately replicate the hours of use of the library's lighting system, the typical summer days (June 7 – August 25) were eliminated and the remaining days were multiplied by 5/7 to account for the 5 days/week the lights would be on. The following tables provide the results of the cost analysis:

Dimming System			
Months	**Total kWH**	**Cost/kWH**	**Total Cost/Year**
Nov-Feb	7342.5210	0.0691	$507.5885
Mar/Apr/Oct/Nov	6931.4560	0.0691	$479.1716
May/June/August	3167.2640	0.0691	$218.9530
Total	**17441.2410**	**0.0691**	**$1205.7130**

Non-Dimming System			
Months	**Total kWH**	**Cost/kWH**	**Total Cost/Year**
Total	**19384.3500**	**0.0691**	**$1340.0401**

If the two rows of pendant luminaires closest to the window used dimmable electronic ballasts instead of standard electronic ballasts, the result would be an approximate cost savings of $134.33 per year. Since a dimmable electronic ballast costs approximately $65 more than a standard electronic ballast, the pay-back period of using a dimmable system with a photosensor would be approximately 17 years. Since the library would be a well-maintained space that wouldn't likely change in the next 20-30 years, the dimming system is viable energy-saving method.

1.2.10 Renderings



View from Main Lobby Entrance

View of hallway through book stacks with daylight

View of tables in reading area

View of tables in book stacks area (with daylight)

View from behind circulation desk

1.2.11 Luminaire Schedule

Luminaire Schedule							
Type	**Description**	**Manufacturer-Model #**	**Voltage**	**Mounting**	**No. and Type of Lamp**	**Lamp Manufacturer-Designation**	**Ballast**
A	Compact Fluorescent 6" Aperture Downlight	Portfolio – C6-226-2D-6251-LI	277	Recessed	2-26-CF	Philips - CFQ26W/G24q/830	Advance - ICF-2S26-M1-LS@277
B	Compact Fluorescent 6” Aperture Wallwash/Downlight	Lithonia – 6W7A	277	Recessed	1-32-CF	Philips – PL-T 32w/830/4P/ALTO	Advance – ICF-2S26-H1-LD
C	2'x2' Recessed Fluorescent	Zumtobel Staff - SCS-22-2285-DX-S-277	277	Recessed	2-28 T5 HO	Philips – F28T5/835/HO/ALTO	Advance – VCN – 2S28
D	Indirect Pendant	LiteControl – P-I-5418T8	277	Pendant	1-32 T8	Philips - F32T8/AD830/ALTO	Advance - VEL-1P32-SC
DD	Indirect Pendant	LiteControl – P-I-5418T8	277	Pendant	1-32 T8	Philips - F32T8/AD830/ALTO	Advance – VZT - 132

1.3 Auditorium Lighting Redesign

1.3.1 Appearance Description

Unlike most of the spaces in Proctor High School, the auditorium is one of the few that did not undergo a previous lighting renovation. Ironically, it is definitely the space in the 440,000 square foot building that needs it the most. The most obvious characteristic of the auditorium is that it relies almost solely and completely on daylighting to illuminate the space. The space has an area of roughly 12,400 square feet and seats approximately 1,500 people and is comprised almost completely of windows. Nine 4'x12' windows and twelve 8'-4"x 18' windows of .75 transmittance run along the length the auditorium. The entire auditorium is made of the existing dark wood that has been in place since 1932. The top area of the walls is a painted white wooden trim that extends around the entire perimeter of the auditorium and the ceiling is white painted gypsum board. The floor is composition tile covered with gray carpet. In front of the stage, which is 4'-8" off the ground, space is available for an orchestra pit. The pit is separated from the audience by an oval 2 1/2' high oval curtain. The red curtains in the auditorium match the red fabric upholstery on the seats.

Reflectance:
Floor surface: (R:122 G:111 B:94) ρ=.33
Ceiling surface: (R:248 G:226 B:189) ρ=.86
Wood Surface: (R:156 G:118 B:89) ρ=.16

1.3.2 Design Focus

The auditorium is the one major space in Proctor High School that still maintains a historical significance after the renovation of the building. Although certain systems in the space have undergone renovation, it still keeps its original architecture and feel. Therefore, it is important to understand that aesthetics play a very important role in the design of the space. A more traditional and classic approach would be a better fit for the large space than a modernistic one. The lighting design should prominently show off the deep wooden architecture to capture the original feel of the room. Full lighting control will also be necessary because the space serves multiple purposes. Overall, the design has to present the occupant with the feeling that the auditorium holds a distinguished quality.

1.3.3 Design Criteria

Perhaps the most important issue that would come to mind in a daylight-friendly space such as the auditorium is glare. Direct glare should not be too much of a concern though, since the auditorium has a northern exposure. Since the bottom half of the walls are wood (low reflectance) as compared to the white tops, reflected glare should also be lessened. The auditorium is used for study halls during the day, so the proper horizontal task illuminance (>30-fc) will be necessary on the workplane during the school day. During evening activities a horizontal illuminance of 10-fc should be maintained. Vertical illuminance should not be an issue since the walls will not have anything on them that needs illumination. The lighting system must be able to adjust for the auditorium's many purposes.

1.3.4 Design Solution

The design for the auditorium was developed from the idea of preserving and enhancing the architecture in the space. The design consists of three types of luminaires:

1. 6" Aperture compact fluorescent downlight
2. 8" Aperture high wattage compact fluorescent downlight
3. 49" Diameter, 53" high decorative chandelier

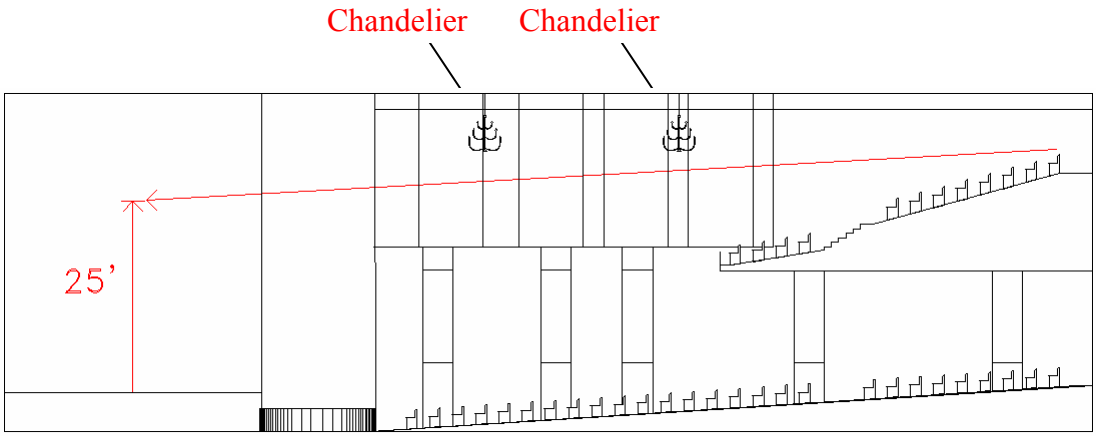
The 6" aperture compact fluorescent downlights have been designed both in the ceiling above the balcony and the ceiling below the balcony. These fixtures are meant to provide general lighting to get the occupant to his/her seat safely while marking the aisles.

Closer to the stage, the (2) 26W CFL fixtures are not enough to contend with the 44 foot span from the auditorium ceiling to the carpeted floor. As a result, a stronger downlight is necessary. Metal halide fixtures would easily be able to adequately illuminate the floor, but high wattage compact fluorescents would achieve the same objective while lending itself to full dimming control. Therefore, 70W compact fluorescent downlights have been designed for the general lighting of the main space.

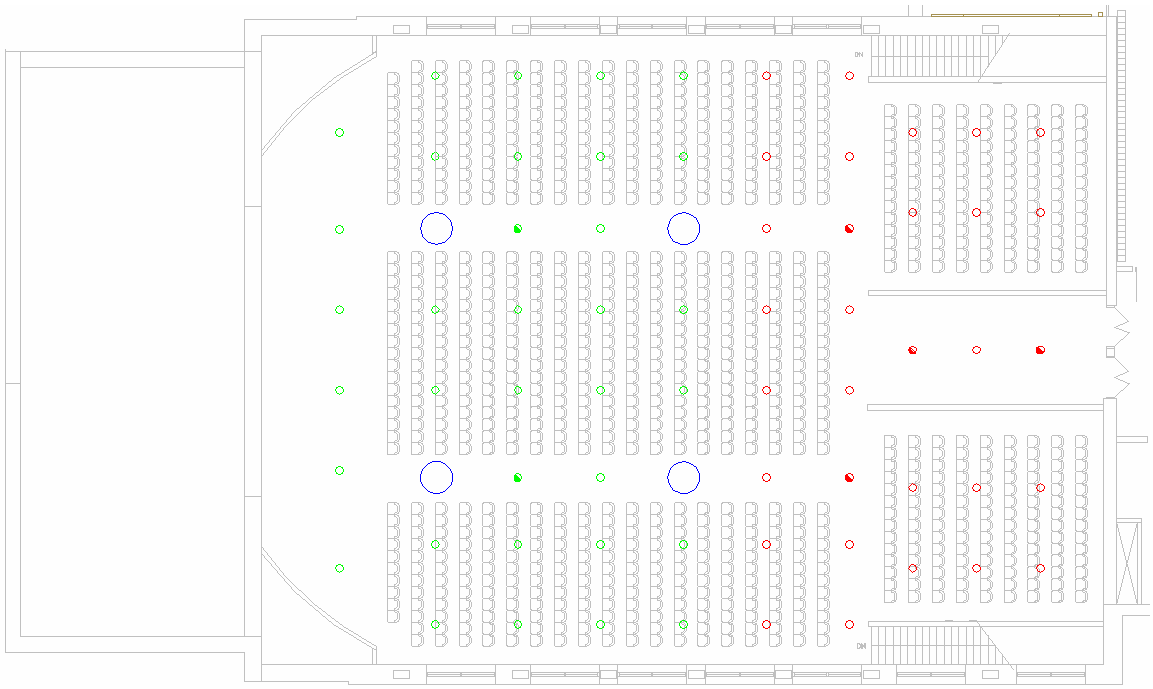
Auditorium Chandelier Fixture

The combination of the two types of downlights specified is a viable option for the auditorium, however, the design focus in the space was to preserve and enhance the architecture. Therefore, four 49" diameter decorative chandelier fixtures have been designed around the central area of the auditorium. These gold and crystal

chandeliers will complement the historic architecture of the auditorium while drawing attention away from the downlights. The fixtures are large enough to deliver a strong message to an entering audience, but are still small enough to allow complete visibility of the stage from the highest point in the balcony.



Auditorium Elevation

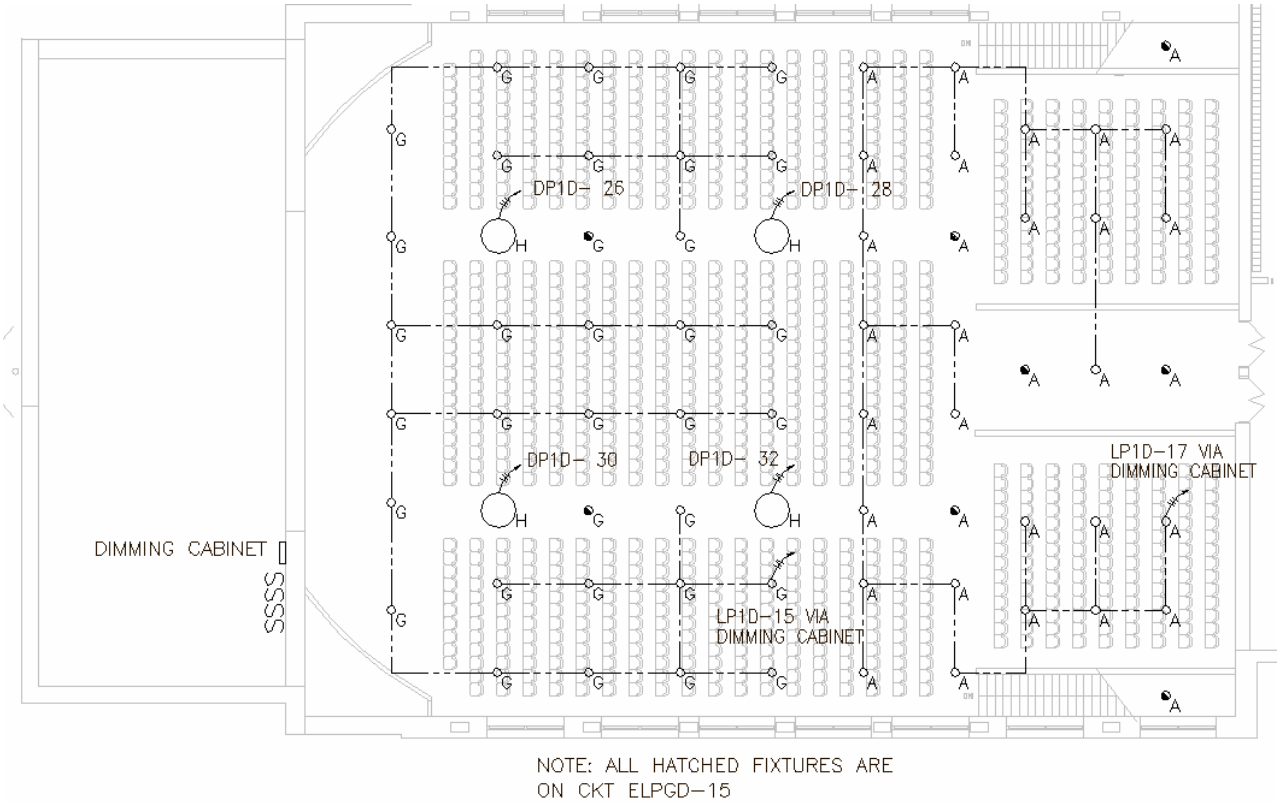


Lighting Layout

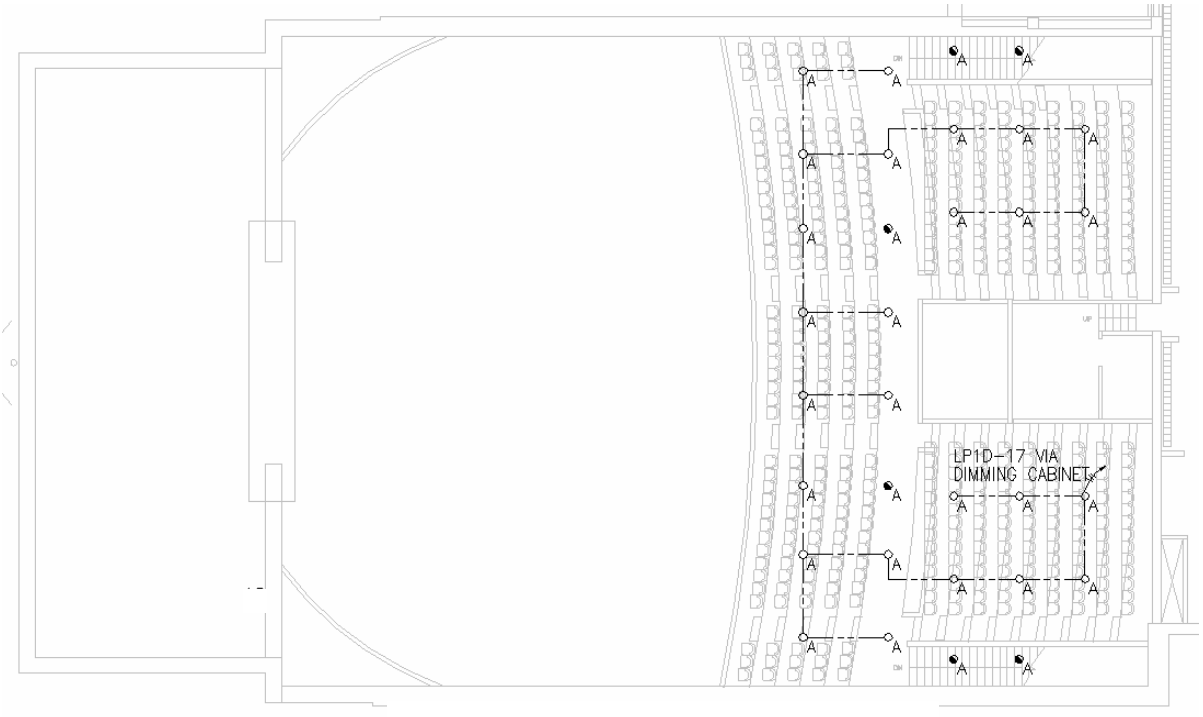
- Downlight
- High Wattage Downlight
- Decorative Chandelier

1.3.5 Controls

A principal criterion for the auditorium is the ability to have dimmable control. This is important mainly for evening activities, when house lights may need to be dimmed up and down for a performance. As a result, most of the luminaires in the design are on dimmable control. Specifically, a 277V dimming cabinet is designed to be installed in the stage area. This dimming cabinet will control all of the type A and G fixtures and allow room for additional lighting. A likely scenario for dimming control would be to dim the type A fixtures independently from the type G fixtures. Each type H chandelier fixture will have its own switch located next to the dimming cabinet. Since these luminaires are for decorative appearance more than light level requirements, keeping them off of the dimming system should not be of concern. The dimming zones can actually benefit daytime activities as well. For example, during a daytime assembly in which the occupants underneath the balcony are not receiving enough light, the type G fixtures can remain off while the type A fixtures are turned on and dimmed to an appropriate level.



Lighting Circuiting Plan – Ground Floor



Lighting Circuiting Plan - Balcony

1.3.6 Circuit and Panelboard Data

Each of the three types of three types of luminaires in the space will be circuited independently. A fourth circuit is dedicated to emergency fixtures. One individual circuit, from panel LP1D in sector D, is dedicated to type A fixtures and another is dedicated to type G fixtures. Since the type H fixtures operate at 120V, each of the four fixtures will have a dedicated circuit on panel DP1D. The hatched fixtures on the circuit layout refer to luminaires that are backed by the emergency generator and are circuited together from panel ELPGD (refer to the lighting circuiting plan). The calculations for each lighting circuit in the library are listed below:

CKT LPD1D-15: 32 x 50W = 2.24 kVA, 8.08A
CKT LPD1D-17: 44 x 32W = 2.9 kVA, 10.47A
CKT DP1D-26: 1 x 1260W = 1.26 kVA, 10.50A
CKT DP1D-28: 1 x 1260W = 1.26 kVA, 10.50A
CKT DP1D-30: 1 x 1260W = 1.26 kVA, 10.50A
CKT DP1D-32: 1 x 1260W = 1.26 kVA, 10.50A
CKT ELPGD-15: (4 x 50W) + (2 x 70W) = .34 kVA, 1.23A

None of the branch circuits were near exceeding the designed current limit of 16 amps, even with a 1.25 continuous load factor.

Panelboards

The impact of the lighting circuits to the overall panelboard load is given below (Note: The wire size for each of the new lighting circuits is #10 AWG since none of the circuits exceed 16 amps and there are no voltage drop issues):

DESIGNATION:	VOLTAGE: 480/277V–3ø–4W	LOCATION: ELECTRIC ROOM D109
LP1D	MAINS: 100A MLO	FED BY: LPGD
	TYPE: LIGHTING	
	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
AUXILIARY GYM LIGHTING	1	20	1	3.5	3.0					1	20	2	AUXILIARY GYM LIGHTING
LIGHTING CONTROL AUX. GYM LTG	3	20	1			0.1	1.0			1	20	4	LOBBY LIGHTING
LOBBY LIGHTING	5	20	1					1.22	1.3	1	20	6	CORR C109, D131
ROOMS D120 THRU D125	7	20	1	1.3	1.6					1	20	8	ROOMS D113 THRU D118
LIBRARY LIGHTING	9	20	1			1.66	1.4			1	20	10	LIBRARY LIGHTING
LIBRARY LIGHTING	11	20	1					1.06	1.12	1	20	12	LIBRARY LIGHTING
LIBRARY LIGHTING	13	20	1	1.06	.328					1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1			2.24						16	
AUDITORIUM LIGHTING	17	20	1					2.9				18	
	19											20	
	21											22	
	23											24	
SPARE BREAKER	25	20	1							1	20	26	SPARE BREAKER
SPARE BREAKER	27	20	1							1	20	28	SPARE BREAKER
SPARE BREAKER	29	20	1							1	20	30	SPARE BREAKER
	TOTAL KVA/ø			10.8		6.4		7.6				TOTAL KVA	24.8

DESIGNATION:	VOLTAGE: 208/120V–3ø–4W	LOCATION: ELECTRIC ROOM D109 – SECTOR D – 1ST FLR
DP1D	MAINS: 225 AMP MAIN BREAKER	FED BY: XXX
	TYPE: POWER	
	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 10,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
RECEP – SECTOR D	1	20	1	1.20	1.20					1	20	2	RECEP – SECTOR D
RECEP – SECTOR D	3	20	1			1.20	1.20			1	20	4	RECEP – SECTOR D
RECEP – SECTOR D	5	20	1					1.20	1.20	1	20	6	RECEP – SECTOR D
RECEP – SECTOR D	7	20	1	1.20	1.20					1	20	8	RECEP – SECTOR D
RECEP – SECTOR D	9	20	1			1.20	1.20			1	20	10	RECEP – SECTOR D
RECEP – SECTOR D	11	20	1					1.20	1.20	1	20	12	RECEP – SECTOR D
RECEP – SECTOR D	13	20	1	1.20	1.20					1	20	14	RECEP – SECTOR D
RECEP – SECTOR D	15	20	1			1.20	1.20			1	20	16	RECEP – SECTOR D
RECEP – SECTOR D	17	20	1					1.20	1.20	1	20	18	RECEP – SECTOR D
RECEP – SECTOR D	19	20	1	1.20	1.20					1	20	20	RECEP – SECTOR D
RECEP – SECTOR D	21	20	1			1.20	1.20			1	20	22	RECEP – SECTOR D
RECEP – SECTOR D	23	20	1					1.20	1.0	1	20	24	CAB HTR.
CAB HTR	25	20	1	1.00	1.26					1	20	26	AUDITORIUM CHANDELIER
CAB HTR	27	20	1			0.7	1.26			1	20	28	AUDITORIUM CHANDELIER
SPARE	29	20	1						1.26	1	20	30	AUDITORIUM CHANDELIER
	31			15.0	1.26					1	20	32	AUDITORIUM CHANDELIER
PANEL DPGD	33	100	3			15.0						34	SPACE
	35							15.0				36	
SPARE BREAKER	37	20	1									38	
	39											40	
	41											42	
	TOTAL KVA/ø			27.12		26.56		25.66				TOTAL KVA	79.34

DESIGNATION:	VOLTAGE: 480/277V-3ø-4W	LOCATION: ELECTRIC ROOM DG22
	MAINS: 100 AMPS – MLO	FED BY: EDP
	TYPE: EMEGENCY LIGHTING	
ELPGD	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 14,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A	KVA Ø B	KVA Ø C	P	O.C. AMP	CKT.	Description
BASEMENT LTG	1	20	1	0.8			1	20	2	AUXILIARY GYM
AUXILIARY GYM LTG CONTROL	3	20	1		0.1		1	20	4	CORRIDOR B202/B319
TOILETS D329/334	5	20	1			1.8	1	20	6	TOILETS D310/D312
GALLERY C201	7	20	1	0.8			1	20	8	CORRIDOR DG15
TEACHERS DINING	9	20	1		1.0		1	20	10	LOBBY D112
CORRIDOR D119	11	20	1			1.6	1	20	12	CORRIDOR C109, D131
LIBRARY LIGHTING	13	20	1	0.81			1	20	14	LOBBY LIGHTING
AUDITORIUM LIGHTING	15	20	1		.34				16	
	17								18	
	19								20	
	21								22	
	23								24	
SPARE	25	20	1				1	20	26	SPARE
SPARE	27	20	1				1	20	28	SPARE
SPARE	29	20	1				1	20	30	SPARE
	TOTAL KVA/ø			6.6	3.9	6.3			TOTAL KVA	16.8

None of the lighting circuits had a significant impact on the overall capacity of the existing panelboards. The total load on panel LP1D is 29.83A, the load on DP1D is 95.43A and the total load on panel ELPGD is 20.20A.

1.3.7 Calculation Parameters

Light Loss Factors:

Type A:

LLD: 1530/1800= **.85**

LDD: Type IV, cleaned annually = **.89**

RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)

= (2.5)(42.5')(336')/(12400 ft^2) = 2.88

RSDD: **.98**

BF: **1.1**

LLF = (.85)(.89)(.967)(1.1) = .82

Type G:

LLD: 4470/5200 = **.86**

LDD: Type IV, cleaned annually = **.89**

RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)

= (2.5)(42.5')(336')/(12400 ft^2) = 2.88
RSDD: **.967**
BF: **.95**
LLF: .71

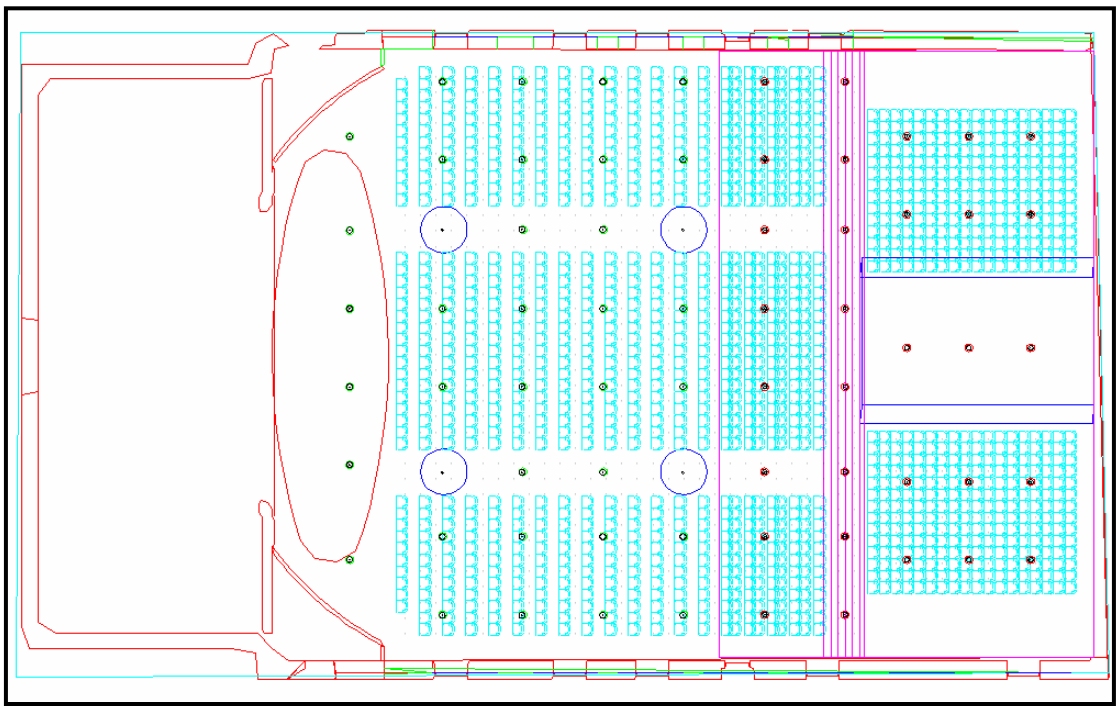
Type H:
LLD: 495/550 = **.9**
LDD: Type IV, cleaned annually = **.89**
RCR: (2.5)(cavity height)(cavity perimeter)/(area of cavity)
= (2.5)(42.5')(336')/(12400 ft^2) = 2.88
RSDD: **.967**
BF: **----**
LLF: **.78**

Power Density:
Type A: 44 x 50W = 2200W
Type G: 34 x 70W = 2380W
Type H: 4 x 1260W = 5040W
9620W
Total Power Density = 9620W/12400 ft^2 = **.78W/ft^2 < .9W/ft^2**

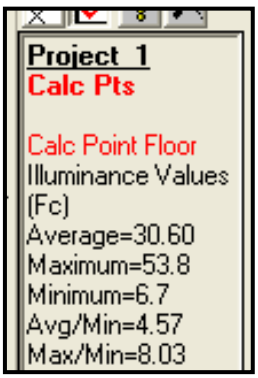
1.3.8 Calculation Results

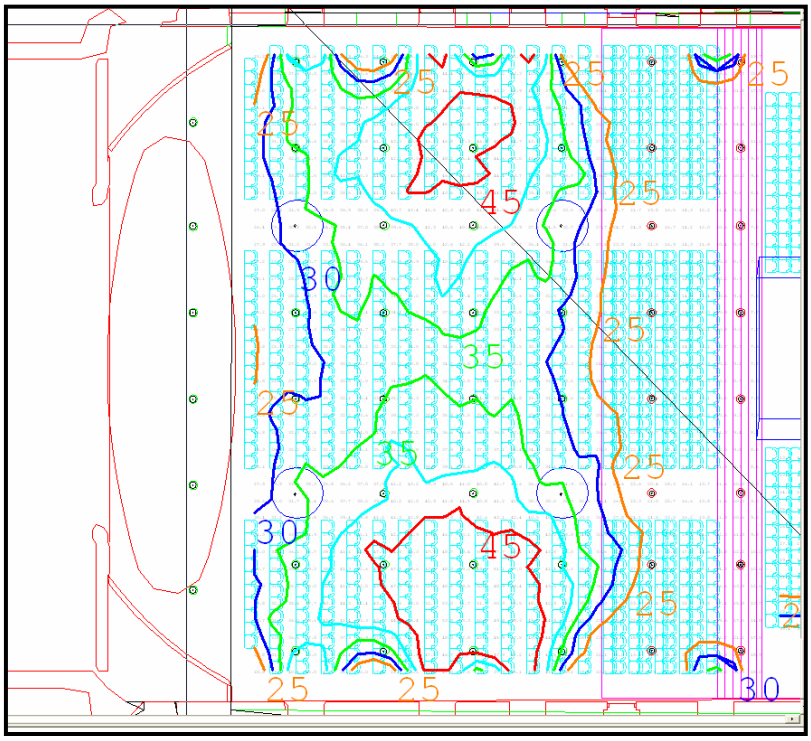
Since a main concern for the lighting design in the auditorium is whether the space will receive adequate light for reading intensive activities (such as study halls) during the day, the model space in AGI-32 was calculated using only daylight (an overcast day at 3:00 pm on December 21, 2005, was used as the daylight parameter) in order to get a "poor-case scenario" of how much daylight can enter the space. Even in such a scenario, the auditorium received an average illuminance of more than 30-fc. Therefore, the space can operate throughout the school day without needing any lights. To verify that the necessary 10-fc horizontal illuminance in the audience was maintained during evening performances, the model space was also calculated using only electric light. The ground floor and balcony both received more than the 10-fc of horizontal illuminance necessary in an auditorium seating space.

Auditorium AGI-32 Model



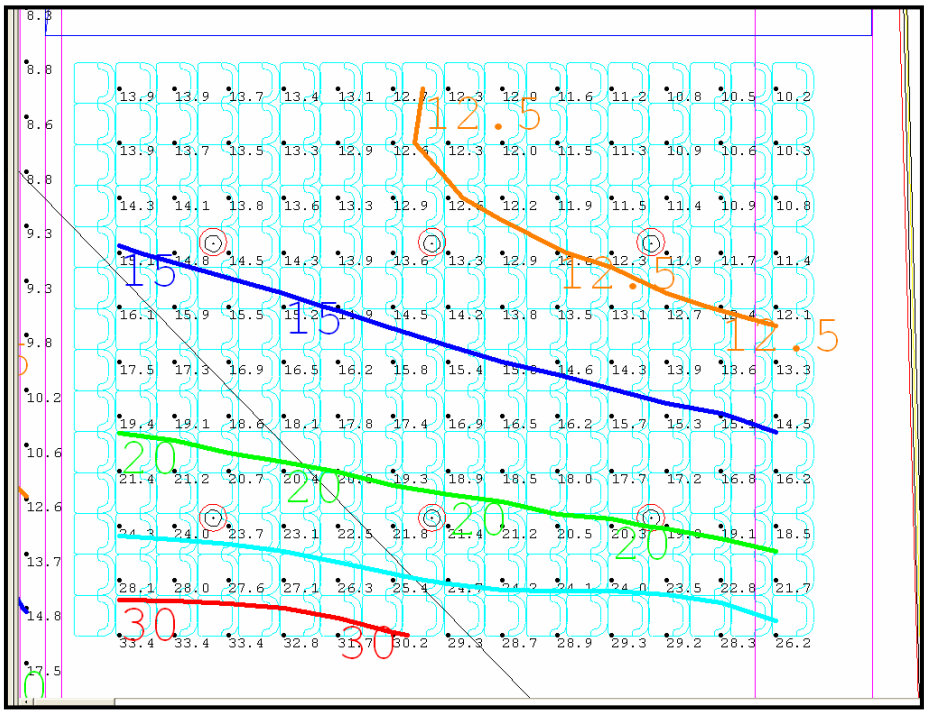
Daylight Only - Illuminance Values – Ground Floor





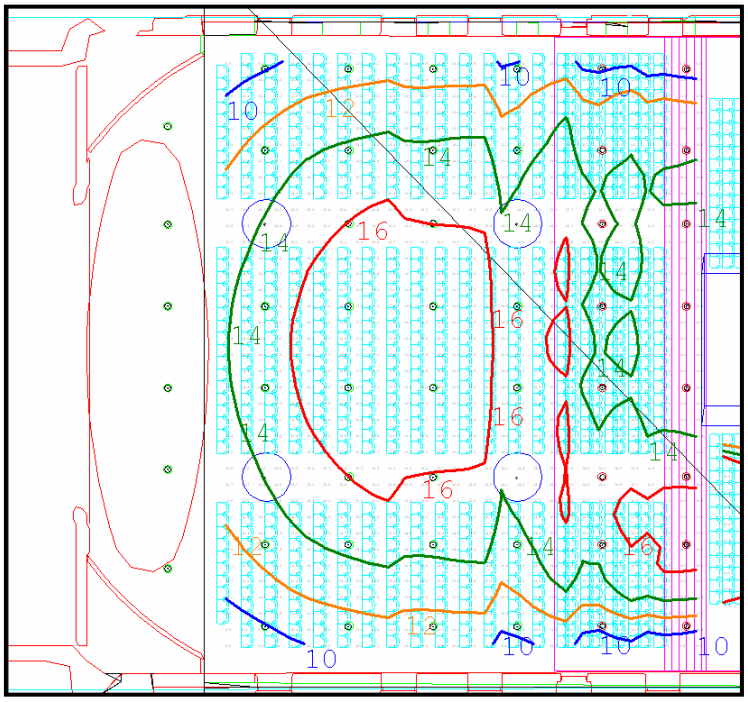
Daylight Only - Illuminance Values - Balcony

Balcony Floor
Illuminance Values
(Fc)
Average=17.53
Maximum=33.4
Minimum=10.2
Avg/Min=1.72
Max/Min=3.27

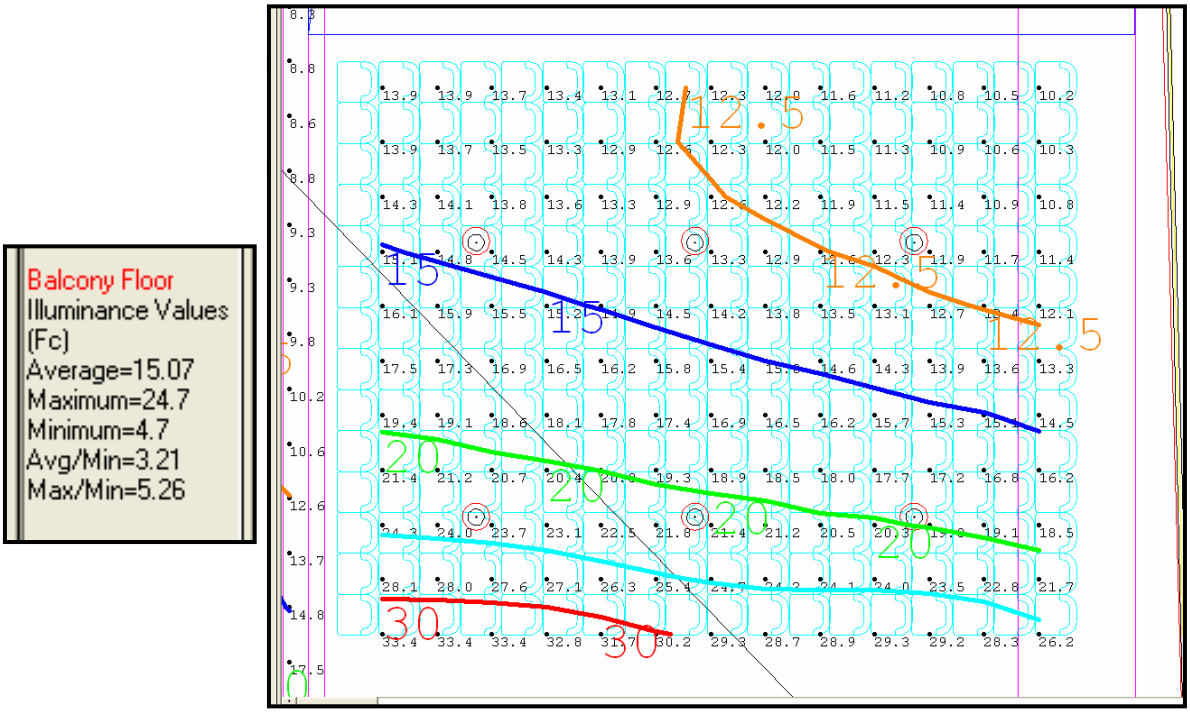


Daylight Only - Illuminance Values – Ground Floor

Calc Point Floor
Illuminance Values
(Fc)
Average=14.09
Maximum=17.6
Minimum=8.3
Avg/Min=1.70
Max/Min=2.12



No Daylight - Illuminance Values – Balcony



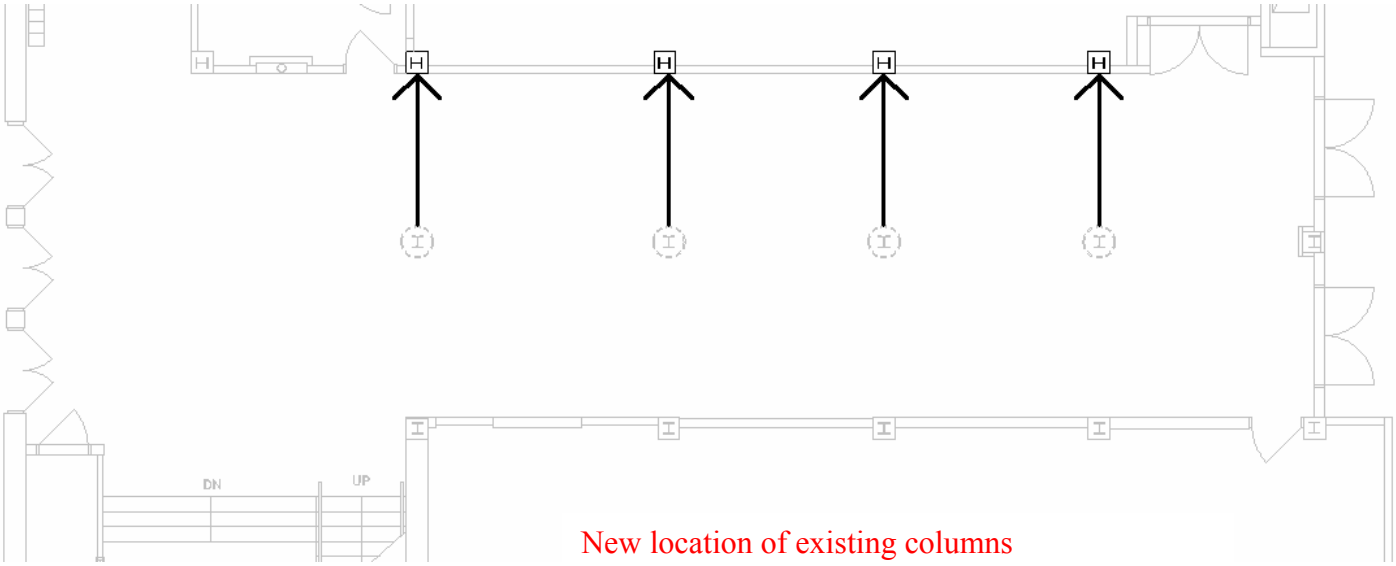
1.3.9 Luminaire Schedule

Luminaire Schedule							
Type	**Description**	**Manufacturer-Model #**	**Voltage**	**Mounting**	**No. and Type of Lamp**	**Lamp Manufacturer-Designation**	**Ballast**
A	Compact Fluorescent 6" Aperture Downlight	Portfolio – C6-226-2D-6251-LI	277	Recessed	2-26-CF	Philips - CFQ26W/G24q/830	Advance - ICF-2S26-M1-LS@277
G	Compact Fluorescent 8" Aperture High Wattage Downlight	Prescolite - CFT870EB-DM-STF87/70HZ	277	Recessed	1-70W Double Quad Tube CFL	General Electric - F70QBX835A4P/EOL	Advance – REZ-2T42-M3-BS
H	Decorative Pendant Chandelier	ELK Lighting – 6858/12+6+3	120	Suspended	21-60W B10	Philips – 60B10-1/2/CL 130V	---

Section 2 - Structural Breadth Work

2.1 Structural System Redesign

The lighting redesign in the lobby of Thomas R. Proctor High School involves removing a span of 4 existing steel columns that are in the center of the lobby. These columns, which were previously 10'-10" from the closest span of columns, have been relocated to be 21'-10" apart from this span. As a result, these new columns and associated girders need to be sized according to the new dimensions and loading. The new steel members of the design were calculated using SAP 2000.



2.1.1 Member Sizing Calculations

Columns

The span of new columns in the lobby is located along the wall that separates the lobby from the adjacent library. These columns were sized using the following data:

1. Live loads – classrooms = 150 psf (from ASCE-7-02)
2. Live loads – roof = 30 psf (from ASCE-7-02)
3. Dead loads – floors (8" slab) = 75 psf
4. Dead loads – roof (4" slab) = 40 psf
   *assumed light-weight concrete = 115 pcf (including wire mesh)
5. Column 1 effective area = 347 sf
6. Column 2,3,4 effective area = 267 sf

The data for the anticipated loading of columns 1-4 is shown below:

Column 1 Takedown								
Level	Effective Area (sf)	DL (psf)	SDL (psf)	LL (psf)	Total DL (k)	Cum. DL (k)	Total LL (k)	Cum. LL (k)
3	347	30	35	30	22.555	22.6	10.41	10.4
2	347	75	35	150	38.17	60.7	52.05	62.5
1	347	75	35	150	38.17	98.9	52.05	114.5
G	347	75	35	150	38.17	137.1	52.05	166.6

Columns 2,3,& 4 Takedown								
Level	Effective Area (sf)	DL (psf)	SDL (psf)	LL (psf)	Total DL (k)	Cum. DL (k)	Total LL (k)	Cum. LL (k)
3	267	30	35	30	17.355	17.4	8.01	8.0
2	267	75	35	150	29.37	46.7	40.05	48.1
1	267	75	35	150	29.37	76.1	40.05	88.1
G	267	75	35	150	29.37	105.5	40.05	128.2

Although this data is close to the loading that can be expected, the design of the columns has to take into account a 1.2 dead load and a 1.6 live load combination. This "worst-case scenario" total design load is shown below:

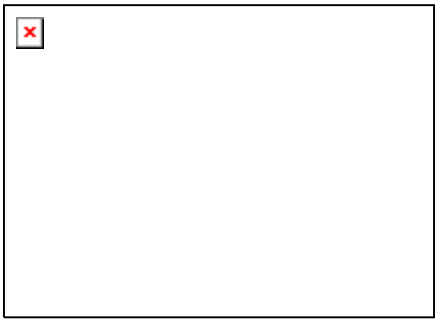
Column 1			
1.2D + 1.6L			
Level	DL (k)	LL (k)	Total Design Load (k)
3	27.1	16.7	43.7
2	72.9	99.9	172.8
1	118.7	183.2	301.9
G	164.5	266.5	431.0

Columns 2,3,& 4			
1.2D + 1.6L			
Level	DL (k)	LL (k)	Total Design Load (k)
3	20.8	12.8	33.6
2	56.1	76.9	133.0
1	91.3	141.0	232.3
G	126.6	205.1	331.6

Transfer Girders

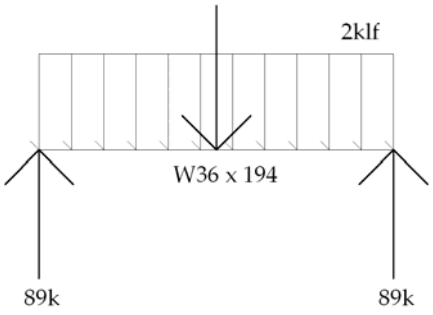
In addition to sizing the newly located columns, the transfer girders supporting the 21'-8" span also need to be sized. Using SAP 2000, the following transfer girder sizes were calculated:

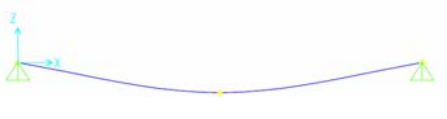
Girder 1



Δmax = **-.1796**

Girder 2,3,4





Δmax = **-.1653**

To verify the results from SAP 2000, the following equations were also used to size the girders:

Equation for Simple Beam – Concentrated Load at Center (LRFD Steel Manual):

Δmax = PL^3 / 48EI

Girder 1: Δmax = (226k)((264")^3) / (48)(29,000ksi)(15,000in^4) = **.1992"**

Girder 2,3,4: Δmax = (177k)((264"^3) / (48)(29,000ksi)(12,000in^4) = **.1934"**

Both maximum deflection values are similar to those calculated by SAP 2000 and are well under the allowable limit of L/480=.55.

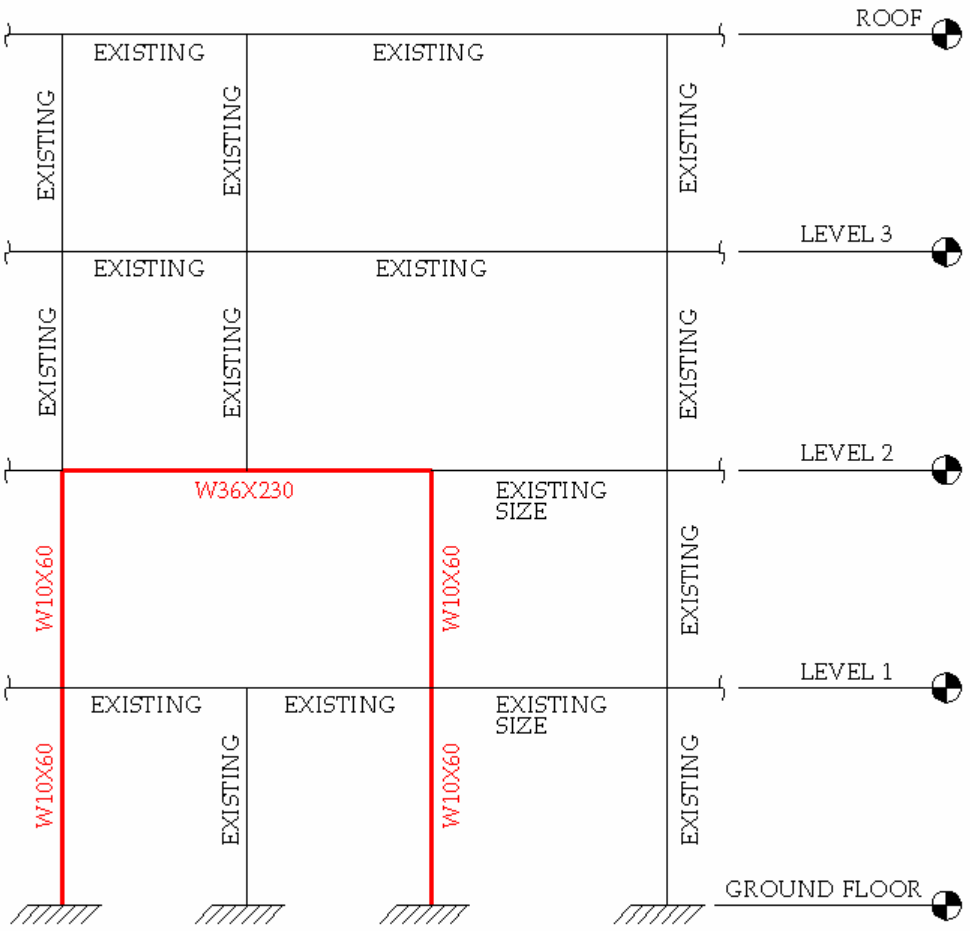
2.1.2 Results

Based on the above calculations, the columns and girders have been sized to support the appropriate loads:

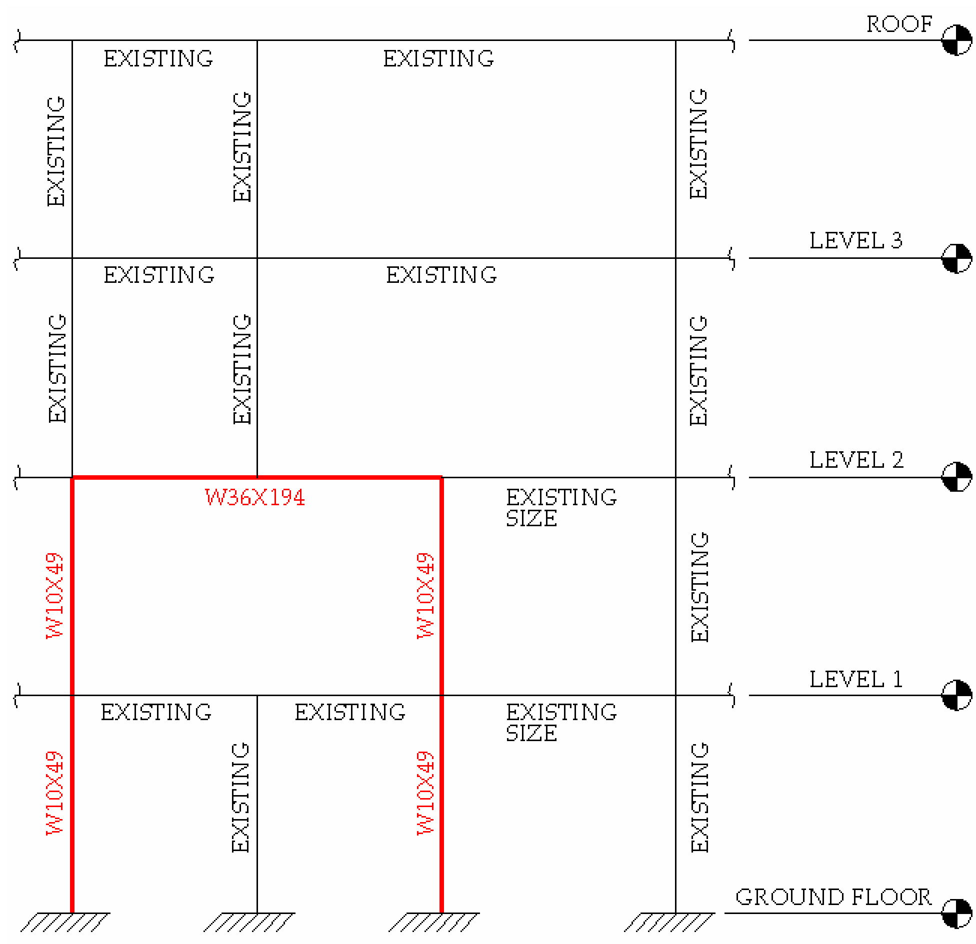
1. Column 1: **W10 x 60**
2. Column 2,3,4: **W10 x 49**
3. Girder 1: **W36 x 230**
4. Girder 2,3,4: **W36 x 194**

The following diagrams show the new members in red as they would appear in the new structural system (Note: the existing columns under the lobby would be sized to be the same as the specified columns):

Column 1/Girder1



Column 2,3,4/Girder2,3,4



All calculations in this structural breadth report were completed as per the guidelines of the following resources:

1. *Manual of Steel Construction/Load and Resistance Factor Design (Third Edition), American Institute of Steel Construction, 2002*
2. *SAP 2000, Integrated Software for Structural Analysis and Design, 2000*

Section 3 – Electrical Depth Work

3.1 Emergency Data Recovery System

The NIMO power corporation, supplying power to the city of Utica and surrounding areas, serves approximately 134,000 business customers. In 2004, the area had a total of 1,598 electrical interruptions totaling 401,301 hours. In 1996, the area suffered from an ice storm that resulted in a regional power loss for 3 weeks. Commonly, the area loses power for at least one 24-48 hour period each year due to storms (information from Niagara Mohawk Power Corporation).

Because of the vast size of Thomas R. Proctor High School and the fact that it is the lone high school in the district of Utica (located near the downtown area) I have investigated the plan of adapting the building to serve electrically as an emergency data recovery epicenter for businesses in the community and K-8 grade schools in the district. The volume of the building allows for such outside institutions to temporarily set up vital equipment within the high school in times of natural disaster, power loss, or other events. In the design, the usually vacant auxiliary gymnasiums have been converted into localized data epicenters to be able to assist a centralized group. To accompany additional groups, many of the classrooms in the school have also been supported.

Upon the initial design of the new emergency system, the first point to be addressed is exactly which areas of the school should be backed with emergency power. Since the intent of the recovery system is to support computer loads, I proposed a design in which all of the clean power panels in the school would be supported. This would not only allow for the optimal amount of outside workers to set up equipment throughout the school, but it would also handle all of the computer equipment of the present staff and employees of the school. Although the main focus of the design is to provide a localized recovery site in the two auxiliary gymnasiums, additional backup of all of the clean power in the school would account for any extra spillover of people.

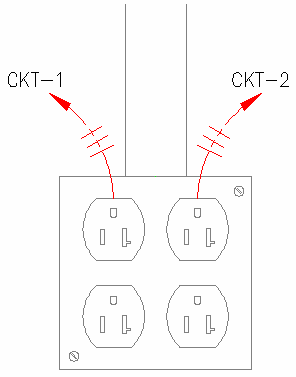
After determining which of the new and existing areas are to be backed with emergency power, the next step is determining the necessary equipment and its arrangement in the new emergency power scheme. The new design will consist of an automatic transfer switch, additional generator, an uninterruptible power supply, transformer, and distribution panels. A detailed description of the equipment and emergency power procedure is given in the Equipment Description and Procedure section.

3.1.1 Design Layout and Load Calculations

Auxiliary Gymnasiums

The new electrical design involves providing clean emergency power to each of the two adjacent auxiliary gymnasiums. Auxiliary Gym 1 is located on the first floor of Sector G and is part of the original school. Auxiliary Gym 2 is situated next to Auxiliary Gym 1 at the ground level. This new gym is part of the newest addition to the high school.

Although neither of the two spaces is used as the primary gymnasium (the main gymnasium is located in Sector F), the electrical design in each of the auxiliary gymnasiums has to take into account the main function of the space as a recreational area. As a result, many limitations arise on the available locations for receptacles. Since floor receptacles are not an option, a design has to be implemented that would maximize the available areas for receptacles. Because both gyms have CMU walls, the new design utilizes conduit and surface mounted double duplex receptacle boxes spaced approximately every 14 feet along the walls. Every receptacle will have its own dedicated circuit (two circuits per receptacle box). This arrangement will allow for each receptacle to tolerate a very large load while minimizing the amount of conduit and receptacles.



Receptacle circuiting

Due to the reduced number of receptacles in the gymnasiums, there is a significant amount of coordination among the school personnel that is necessary. Specifically, tables, chairs, surge protecting power strips, and extension cords would be needed to get the maximum use of the gyms. Coordination would also be necessary to determine how many people could efficiently conduct their work in the two gymnasiums. There are many different seating arrangements that could be viable for temporary equipment set up. The setup in the following circuiting plans assumes that each receptacle is designated to a table. Therefore, two people at each table would share a receptacle (most efficiently executed with a power strip at each receptacle.) This specific sample layout would allow for 48 people to be situated in Gym 1 and 64 people in Gym 2. At maximum capacity, 72 people can work in Gym 1 and 96 people in Gym 2 (a total of 168 people, assuming 3 people per receptacle operating at no more than 5 amps each).

A panelboard will be placed in close proximity to each gymnasium. In Gym 1, panelboard CP1G is located in the locker room attached to the gym. In Gym 2, panelboard CPGG is located in the equipment room of the gymnasium. To determine the total connected load and demand load in each space for panelboard sizing, several assumptions were made for both spaces:

1. Since the electrical design of the two gyms is intended to handle a very large load at a single time, a demand factor of 1 was used to size the panelboards. Therefore, the total connected load and demand load will equal for each gym.
2. Each circuit was assumed to have a load of 15 amps (3 computer stations at 5 amps per computer).
3. A power factor of .85 was used for both spaces.
4. A future growth factor of 25% was used for both spaces.

Total Connected Load/Demand Load – Gym 1: 43.20 kVA
+ 10.80 kVA (25% growth)
54.00 kVA

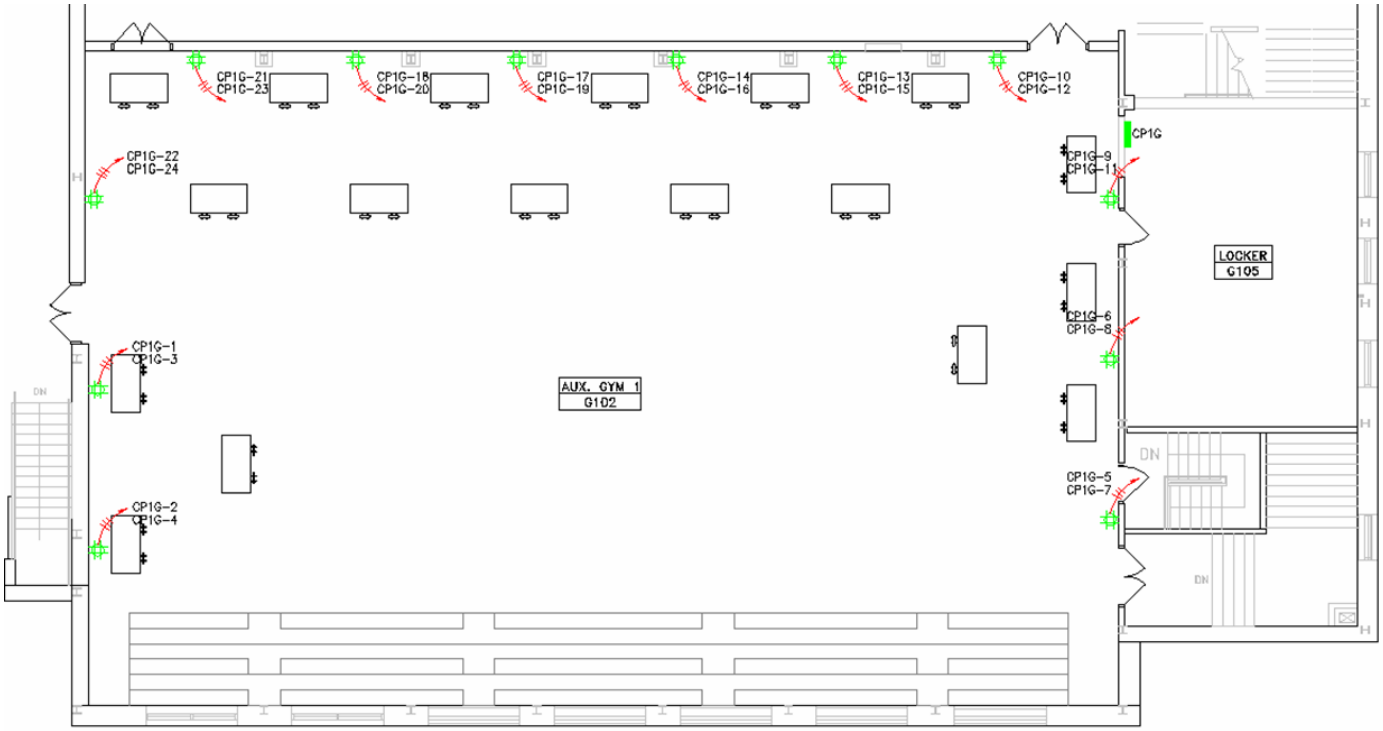
54.00 kVA/(1.732)(.208) = **150A**

Panelboard CP1G Main Breaker: **225A**

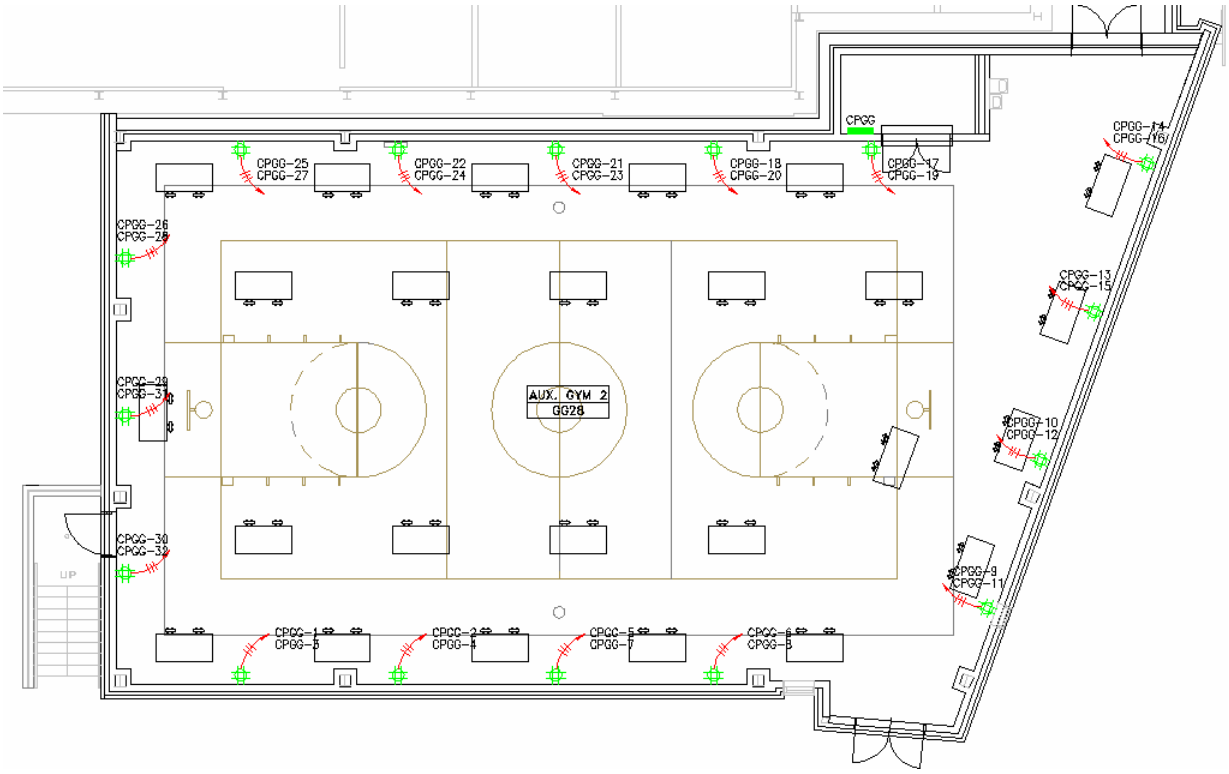
Total Connected Load/Demand Load – Gym2: 57.60 kVA
+ 14.40 kVA (25% growth)
72.00 kVA

72.00 kVA/(1.732)(.208) = **200A**

Panelboard CPGG Main Breaker: **225 A**



Auxiliary Gym 1 – First Floor - Circuiting Plan and Sample Furniture Arrangement



Auxiliary Gym 2 – Ground Floor - Circuiting Plan and Sample Furniture Arrangement

New Panelboard Schedules

DESIGNATION: CP1G	VOLTAGE: 208/120V–3ø–4W	LOCATION: LOCKER G105
	MAINS: 225 AMP MAIN BREAKER	FED BY: ECP-1
	TYPE: CLEAN POWER	
	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 10,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
RECEPTACLE – AUXILIARY GYM 1	1	20	1	1.8	1.8					1	20	2	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	3	20	1			1.8	1.8			1	20	4	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	5	20	1					1.8	1.8	1	20	6	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	7	20	1	1.8	1.8					1	20	8	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	9	20	1			1.8	1.8			1	20	10	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	11	20	1					1.8	1.8	1	20	12	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	13	20	1	1.8	1.8							14	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	15					1.8	1.8					16	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	17							1.8	1.8			18	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	19			1.8	1.8							20	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	21					1.8	1.8					22	RECEPTACLE – AUXILIARY GYM 1
RECEPTACLE – AUXILIARY GYM 1	23							1.8	1.8			24	RECEPTACLE – AUXILIARY GYM 1
	25											26	
	27											28	
	29											30	
	31											32	
	33											34	
	35											36	
SPARE	37	20	1							1	20	38	SPARE
SPARE	39	20	1							1	20	40	SPARE
SPARE	41	20	1							1	20	42	SPARE
TOTAL KVA/ø				14.4		14.4		14.4		TOTAL KVA			43.2

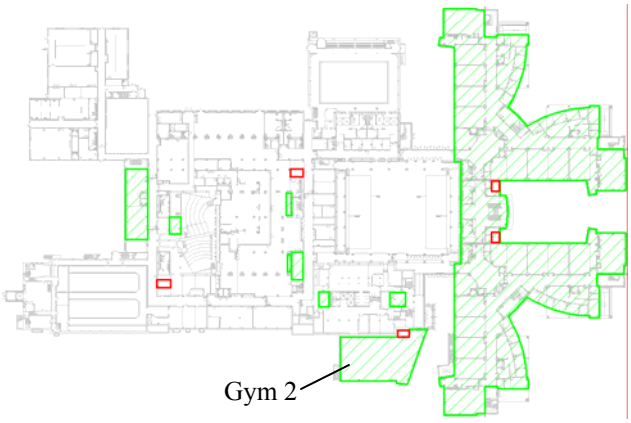
DESIGNATION: CPGG	VOLTAGE: 208/120V–3ø–4W	LOCATION: AUXILIARY GYM GG28
	MAINS: 225 AMP MAIN BREAKER	FED BY: ECP-1
	TYPE: CLEAN POWER	
	O.C. DEVICE: CIRCUIT BREAKER	MINIMUM O.C. DEVICE INTERRUPTING RATING: 10,000 AIC
	MOUNTING: SURFACE	

Description	CKT.	O.C. AMP	P	KVA Ø A		KVA Ø B		KVA Ø C		P	O.C. AMP	CKT.	Description
RECEPTACLE – AUXILIARY GYM 2	1	20	1	1.5	1.5					1	20	2	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	3	20	1			1.8	1.8			1	20	4	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	5	20	1					1.8	1.8	1	20	6	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	7	20	1	1.8	1.8					1	20	8	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	9	20	1			1.8	1.8			1	20	10	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	11	20	1					1.8	1.8	1	20	12	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	13	20	1	1.8	1.8					1	20	14	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	15	20	1			1.8	1.8			1	20	16	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	17	20	1					1.8	1.8	1	20	18	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	19	20	1	1.8	1.8					1	20	20	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	21	20	1			1.8	1.8			1	20	22	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	23	20	1					1.8	1.8	1	20	24	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	25	20	1	1.8	1.8					1	20	26	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	27	20	1			1.8	1.8			1	20	28	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	29	20	1					1.8	1.8	1	20	30	RECEPTACLE – AUXILIARY GYM 2
RECEPTACLE – AUXILIARY GYM 2	31	20	1	1.8	1.8					1	20	32	RECEPTACLE – AUXILIARY GYM 2
	33											34	
	35											36	
SPARE	37	20	1							1	20	38	SPARE
SPARE	39	20	1							1	20	40	SPARE
SPARE	41	20	1							1	20	42	SPARE
TOTAL KVA/ø				21.6		18		18		TOTAL KVA			57.6

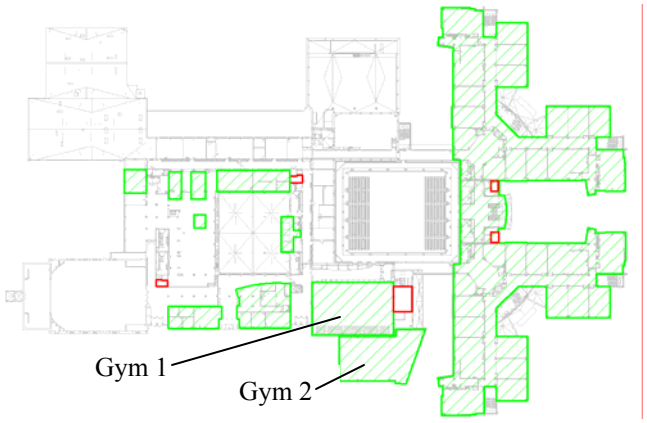
Classrooms/Offices

Since all of the clean power panels in the school are on emergency power, the design also allows many classrooms, offices and other spaces throughout the school to be converted into emergency recovery sites in times of need. Nearly every room in the newest addition to the school (consisting of all floors of sectors H, J, K) is backed by the new generator. In addition, many spaces in the older section of the building are supported under the new design:

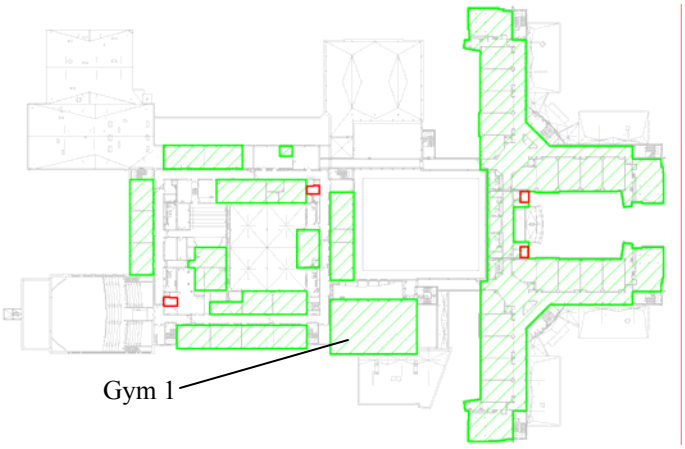
1. Ground Floor – music classroom, life skills office, training room, cafeteria computers, and general office
2. First Floor – library, general classrooms, teacher workroom, computer room, nurse area, conference rooms, community outreach room, reception area, staff workroom, principal's office
3. Second Floor – general classrooms, student activities rooms, department head classroom, computer classrooms, social studies workroom, foreign language classrooms, television production studios, faculty workroom
4. Third Floor – ceramics/sculpture room, art gallery/studio, business classrooms, math faculty workrooms, department head offices, drawing/painting studios



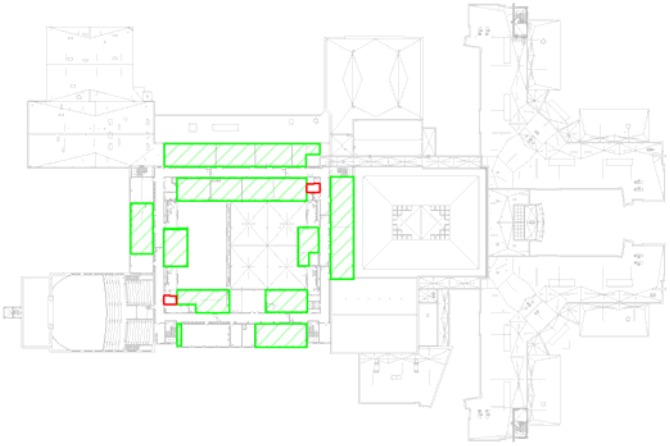
Ground Floor
Main areas housing existing clean power panels
Emergency areas



First Floor
Main areas housing existing clean power panels
Emergency areas



Second Floor
Main areas housing existing clean power panels
Emergency areas



Third Floor
Main areas housing existing clean power panels
Emergency areas

The clean power receptacles throughout the school were added to determine the total connected load and demand load. Although all of this clean power in the labeled emergency areas is to be backed with emergency power, it is unlikely that all of the areas would be used simultaneously in times of emergency. As a result, a demand factor of .5 is used for all receptacle loads over 10 kVA. A power factor of .85 was used for calculations.

Panel	CPGH	CP1H	CP2H	CPGK	CP1K	CP2K	CPGC	CP1C
Load (kVA)	56.5	50	46.5	55	46	34.5	19	36

Panel	CP2C	CP3C	CPGD	CP1D	CP2D	CP3D	F301	C215
Load (kVA)	10.5	18.9	16.5	19.5	30	19.5	21	21
Panel	**C301**	**C302**	**C303**	**D201**	**D202**	**D203**		
Load (kVA)	27	22.5	22.5	19.5	21	21		

Total connected kVA in emergency designated areas as determined from the connected load of each clean power panel on the new emergency system

Total Connected Load – Classrooms/Offices:

633.9 kVA @ .85 pf = 538.86 + j333.85 kVA

Total Demand Load:

(8.5 + j5.27 kVA) **(1st 10 kVA)**

(530.36 + j328.58) x (.5) = (265.18 + 164.29 kVA) **(remaining kVA)**

(8.5 + j5.27) kVA
+ (265.18 + 164.29) kVA
273.68 + j169.56 kVA = **321.95 kVA**

Due to the demand factor applied to the loads in the classroom/office areas in the school, it is important to make sure the load used in an emergency does not exceed the demand load. A safe estimate for the number of people who can conduct their work without overloading the emergency system is 80% of the demand load. Therefore, it is has been estimated that 450 people outside of the centralized gymnasiums can work safely on computers in any of the areas labeled "emergency areas" (assuming 600 VA/person). The specific areas to locate outside workers would be coordinated by personnel of the school.

Total Emergency System Load

@ .85 power factor:

(36.72 + j22.75 kVA) (Gym 1)
(48.96 + j30.34 kVA) (Gym 2)
+ (273.68 + j164.29 kVA) (Classrooms/Offices)
359.36 + j217.38 = **420 kVA**

Although the new emergency system requires 420 kVA demand load, only 228 kVA of the demand load is from what is presently on switchboard 1. Since the new switchboard 2 is rated for 3000A, the additional demand load would only increase the total demand load on the switchboard to 2266A. This still leaves 25% capacity for future growth; therefore, switchboard 2 was chosen to support the new system.

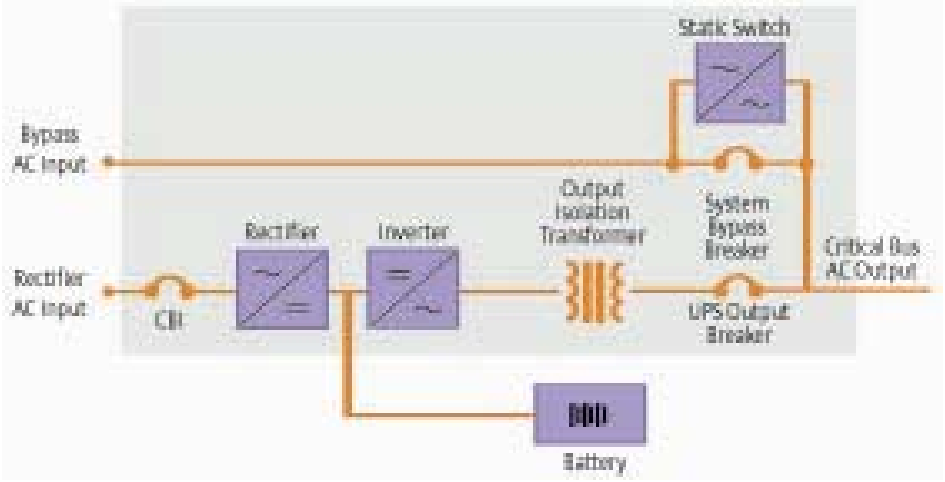
3.1.2 Equipment Description, Procedure, and Layout

After determining the layout and demand load of the new emergency system, equipment must be specified and arranged to carry out the new scheme (refer to the appendix for a full single-line diagram of the school incorporating the design).
The following is a list of the equipment necessary to carry out the design:

UPS System

As is typical with most emergency data recovery centers, added redundancy is necessary to ensure that power is always present. As a result, a UPS was incorporated into the design.

The main purpose of a UPS (uninterruptible power supply) is to provide immediate power to a system in times of source failure. Under normal condition, the specified UPS receives AC utility power and converts it to DC through a rectifier. This DC power then charges a battery pack that is in a cabinet attached to the UPS. The DC power is converted back to AC via an inverter and filtered through an output isolation transformer before it is delivered to the system. Upon power failure (AC power loss), the uninterrupted power would temporarily pick up the system load until the generator is fully synchronized to power the system. When the generator or utility power is operational, the UPS is transferred back into normal operation and begins recharging the battery pack. The standard features on the UPS include a backlit LCD display panel, an internal bypass for fault current, automatic retransfer, emergency power off, and a static switch to be able to bypass the battery cabinet for maintenance.



Single Module UPS configuration

There are many options for batteries, battery monitoring, and energy storage for UPS systems. The specified UPS contains 240 cells of lead acid

batteries that can support 125% of the full load for 10 minutes (generator is specified to be fully operational within 10 seconds). Since 125% of the full load is an unlikely scenario for this particular case, 30 minutes would be a more appropriate estimation for battery time. This should provide ample time to get the generator running if it was to fail. However, if further backup time is desired, the UPS has the ability for additional equipment to be added. Multiple battery packs can be added to the system through paralleling cabinets. Additionally, a flywheel energy storage system can be used to supplement battery packs. Such a backup enhancement would provide 20 seconds of backup (enough time to protect against short interruptions), allowing the batteries to be saved for long interruptions and improving battery life and reliability.

The UPS was sized according to the entire demand load of the new emergency system. Since the design of the new system addresses the maximum amount of computer loads to be in use at one time, there is no need to allow for much future growth of these types of loads. As a result, a 500 kVA UPS was chosen (420 kVA demand load) for the system.

Static Bypass Switch

Although the UPS allows for further redundancy in the system, protection still must be implemented in case the UPS system was to fail. Such occasions would be if the UPS received a large power surge (lighting) or more commonly when the batteries discharge after a potential generator failure. For such occurrences, it is necessary to be able to perform maintenance on the UPS without losing the loads downstream. A 600A static bypass switch was designed for such instances. The switch, normally in the open position, would close any time the UPS would lose power. This process would occur within 4 milliseconds and prevent the loads served by the UPS from losing power when the UPS is down or is being serviced.

Distribution Panelboards

EMDP

The UPS was incorporated into the design to support all of the clean power, however there may be emergency equipment added in the future that will not need to be backed by the UPS. For example, the design counts on the existing emergency lighting throughout the school to suit the set up of outside workforce. In case additional emergency lighting is desired, a setup must be in place to supply additional power. As a result, a 480/277V, 800A main emergency

distribution panelboard EMDP was selected to handle all of the emergency loads. The specified panel allows for complete flexibilitiy with the ability to place any size branch breaker (up to the size of the main breaker rating) next to a 15A breaker. Therefore, smaller load circuits, such as lighting, can be in the same panel as the breaker serving the new emergency clean power panel. Also, each breaker can mount anywhere on the vertical bus of the panel, independent of other breakers.

ECP1

Panel ECP1, which serves the entire emergency data recovery system, is fed from panel EMDP and is backed by the UPS system. This 1200A panel (the same type of panel as EMDP) effectively feeds all of the 24 clean power panels in the school and directly feeds 8 main panels in the building. This new design arrangement isolates the emergency clean power from the rest of the power on the system.

Transformer

Since panel EDMP is operating at 480/277V to account for additional loads, such as lighting, a transformer will be necessary to step down to a usable 208/120V. The existing 480V-480V output isolation transformer on the UPS eliminates common noise, transients, and harmonics on the system. As a result, the step-down transformer does not need to be an isolation transformer. Instead, a 500 kVA k-13 factor rated transformer was chosen. The specified k-rated transformer is designed for non-linear loads, such as personal computers, which standard transformers cannot handle. It is manufactured with heavy gauge copper and a double sized neutral conductor, which enables it to handle heat generated by harmonic current.

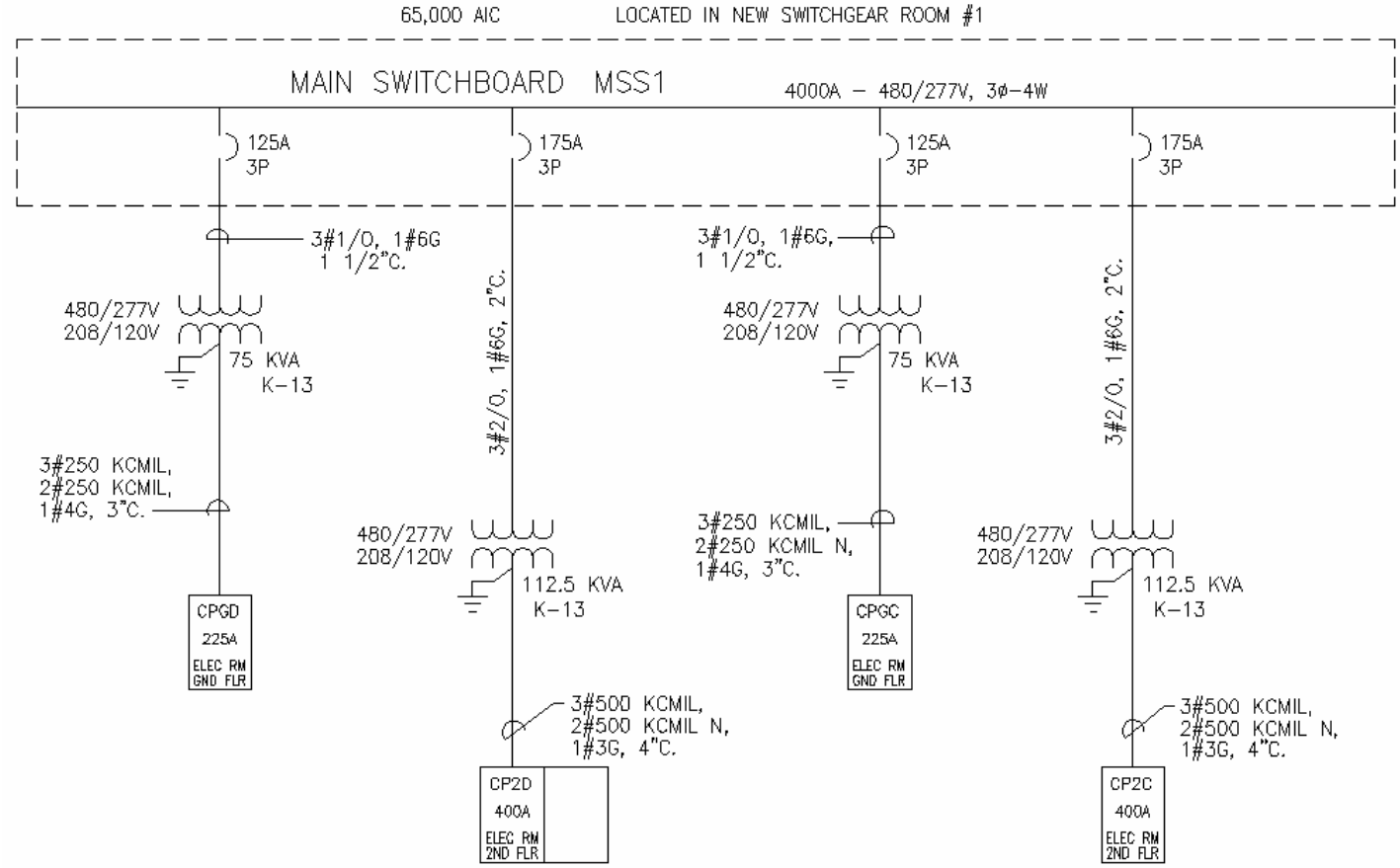
ATS

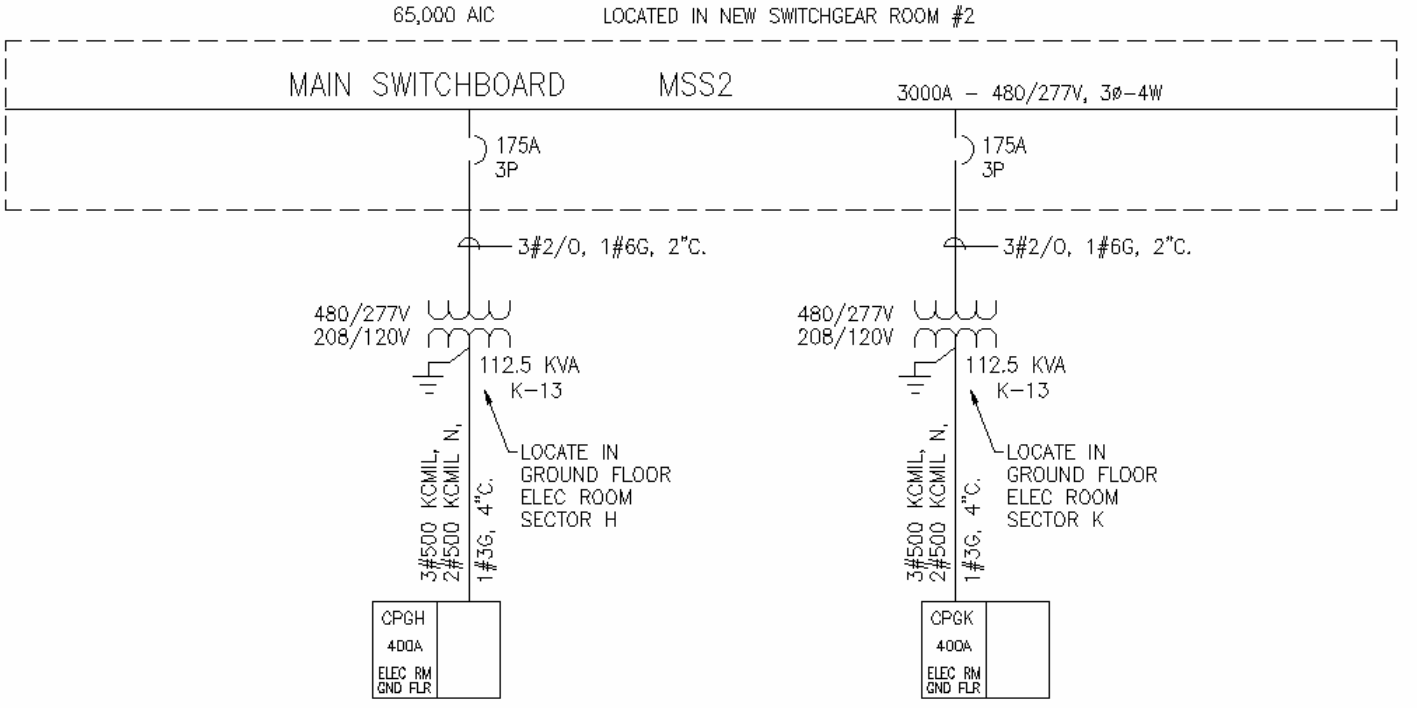
In order to transfer from normal power to emergency generator power in times of emergency, an automatic transfer switch is necessary. The ATS senses loss of utility power and switches to generator power. The specified 800A ATS offers many user-programmable options regarding voltage sensitivity and time delays. Upon power failure, the ATS offers an adjustable 0-5 minute transfer time delay to generator power (there is a manual override push button to bypass the time delay). An adjustable 0-30 minute time delay is also provided upon return to normal power. This time delay for retransfer will be automatically bypassed upon generator failure if normal power is acceptable.

Generator

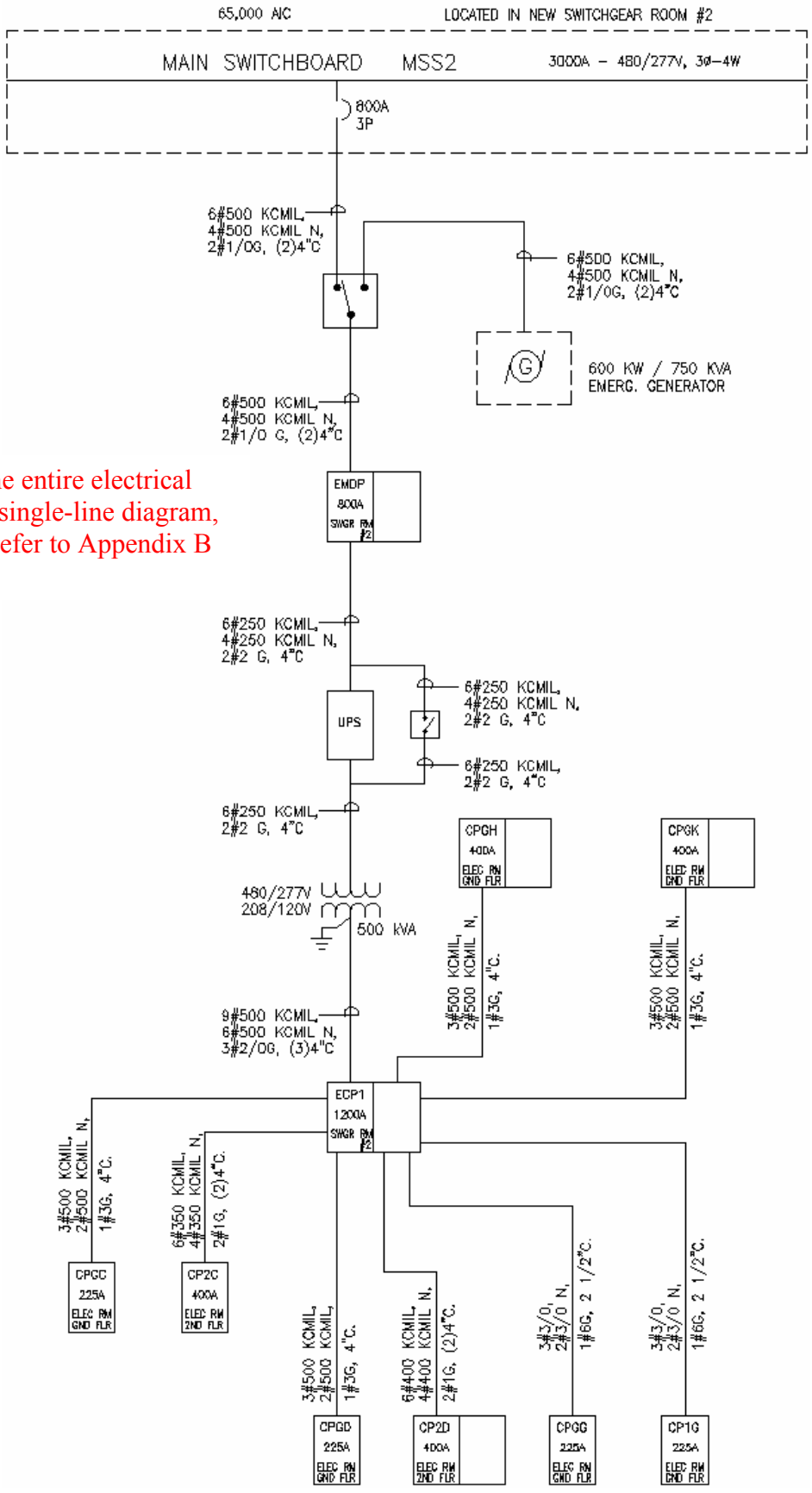
Different options existed for the emergency power generation for the new emergency recovery plan. One possibility would be to resize the existing 500kW/625 kVA diesel fuel generator to serve the new emergency system. However, since this existing generator backs life safety loads and has specialized shunt trip for load shedding in emergency situations, it would be more cumbersome to add loads and resize the generator than to design a new system. Therefore, a new 600kW/750 kVA diesel generator was sized to manage the new load. Since the demand load is 420 kVA, this generator would only be loaded to 56% of its capacity under expected emergency conditions. This would allow for considerable growth in the future. The specified generator has a selectable alternator, electronic control system, cooling system, and skid base. In addition to the generator, a diesel fuel tank must be sized to provide fuel to the generator. The fuel tank specified is a 780 gallon fuel tank that will provide 24 hours of fuel at 75% load. At 50% load, the fuel tank could provide 33 hours of fuel.

Emergency System Single-Line Diagrams





Portion of Existing System to Be Changed

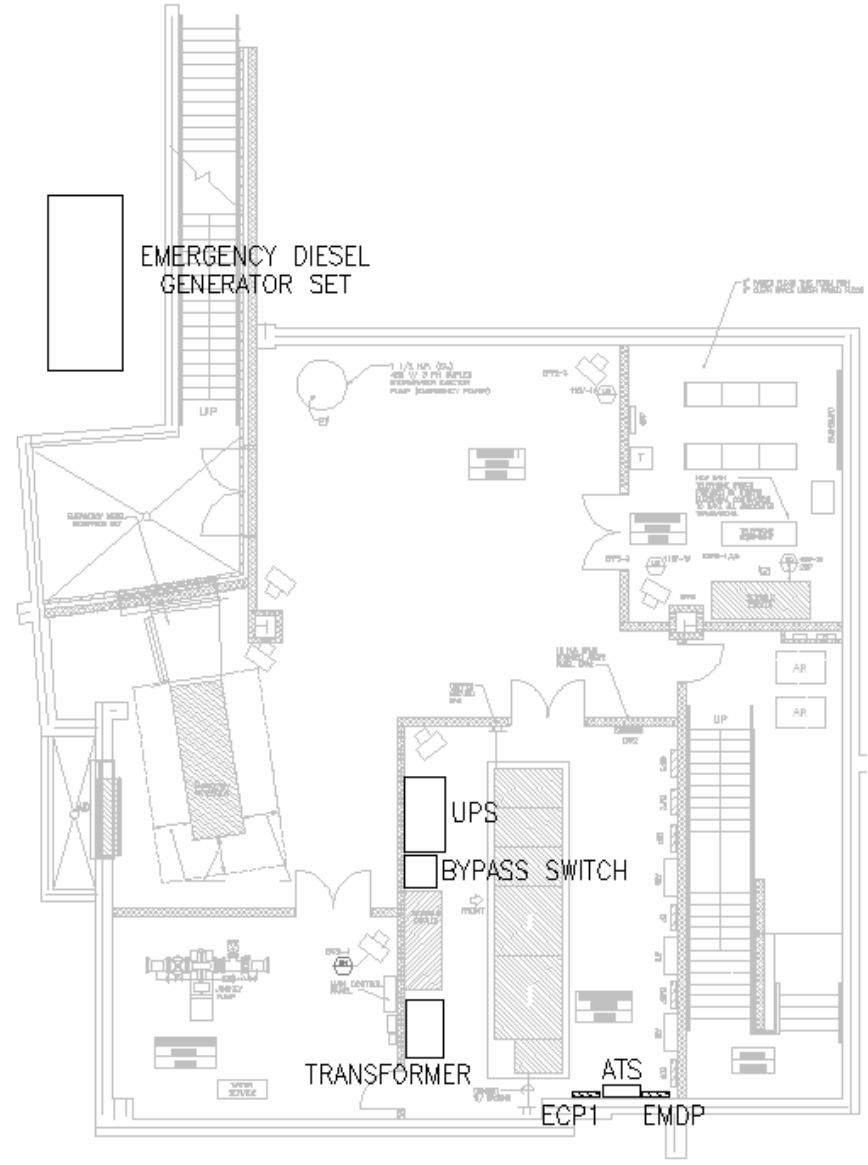


* For the entire electrical system single-line diagram, please refer to Appendix B

New Emergency Data Recovery Plan

Equipment Location

The added equipment in the new design would successfully fit in the new main switchboard room. According to code, there must be three feet of space for access to the new UPS, transformer, ATS, and distribution panelboards. Due to the close proximity of the generator to the school, it would be necessary to house the generator and fuel tank in a steel sound attenuated enclosure with door latches.



Equipment Location Plan

3.1.3 Equipment Feeder Sizing

The following is a list of the feeder and conduit sizes for the new equipment in the emergency system. Additionally, several existing panels that are now being fed from panel ECP1 needed to be resized due to a large voltage drop. Two neutrals (the same size as the phase conductors) were run with each set of feeders. This was done to account for the harmonic current that is commonly associated with non-linear loads such as computers. Results of feeder and conduit sizes for the equipment are as follows:

Equipment	Model #	Feeder Size	Conduit Size
ASCO Series 300 800A ATS	300B3800NIC	(2) 5#500 KCMIL, 1#1/0G	(2) 4"
Liebert Series 610 500 kVA UPS	SL-25142	(2) 5#250 KCMIL, 1#2G	4"
Square D 800A I-Line Panelboard	HCM-800A MCB	(2) 5#500 KCMIL, 1#1/0G	(2) 4"
Square D 1200A I-Line Panelboard	HCR-U-1200A MCB	(3) 5#500 KCMIL, 1#2/0G	(3) 4"
Square D NLP 480/277V - 208/120V Transformer	500T90HSFISNLP	(2) 3#250 KCMIL,1#2G	4"
Panel CPGC	Existing	(1) 5#500 KCMIL, 1#3 G	4"
Panel CP2C	Existing	(2) 5#350 KCMIL, 1#1G	(2) 4"
Panel CPGD	Existing	(1) 5#500 KCMIL, 1#3 G	4"
Panel CP2D	Existing	(2) 5#400 KCMIL, 1#1G	(2) 4"
Panel CPGG	Existing	(1) 5#3/0, 1#6G	(1) 2-1/2"
Panel CP1G	Existing	(1) 5#3/0, 1#6G	(1) 2-1/2"

3.1.4 Fault Current Analysis

In order to properly rate the equipment in the new recovery system, it is necessary to perform a short-circuit analysis. I have chosen the longest path through the new emergency system, from the main switchboard transformer to panel CP2D. The fault current for each piece of equipment was sized using Electrical Designer's Reference (EDR) fault current calculator software. The following assumptions were made in the analysis:

1. 1500 kVA transformer : %Z=3.5%
2. 500 kVA transformer: %Z=1.3%

The results from the fault current analysis are as follows:

Equipment	Feeder Size	Length (feet)	Isc	AIC Rating
1500kVA 13.2kV-480V Transformer	3#3/0 15kV	--	51,551	65,000
Switchboard 2	(5) 4#500 kcmil	10	50,701	65,000
Panel EMDP	(2) 5#500 kcmil	20	54,000	65,000
500kVA 480V-208V Transformer	(2) 3#250 kcmil	20	39,836	45,000
ECP1	(3) 5#500 kcmil	20	36,226	45,000
CP2D	(2) 5#400 kcmil	533	7,380	10,000

3.1.5 Equipment Cost

The following is a price estimate of the equipment for the new system:

Equipment	Quantity	Price/Quantity ($)	Labor	Total Price	Total Price w/ Labor
Cummins Power 600kW / 750kVA Generator	1	108,997	4,700	108997	113697
TAW Power Systems 600kW Fuel Tank	1	4,707	4450	4707	9157
ASCO Series 300 800A ATS	1	4,503	200	4503	4703
Liebert Series 610 500 kVA UPS (including bypass switch)	1	129,119.40	18,240	129119.4	147359.4
Square D NLP 480/277V - 208/120V Δ-Y Transformer	1	56,530	11,200	56530	67730
Square D 800A I-Line Panelboard	1	9,701	960	9701	10661
Square D 1200A I-Line Panelboard	1	11,675	960	11675	12635
CPGG 225A Panelboard (42 Circuit)	1	1025	960	1025	1985
CPG1G 225A Panelboard (42 Circuit)	1	1025	960	1025	1985
EMDP 600A Type LI Circuit Breaker	1	6,438	2702	6438	9140
ECP1 225A TYPE LH Circuit Breaker	4	3,714	945	14856	18636
ECP1 400A TYPE LH Circuit Breaker	4	4,627	1,654	18508	25124
3/0 copper cable (feet)	2672	1.46	1.3	3901.12	7374.72
250 kcmil copper cable (feet)	100	2.16	1.63	216	379
350 kcmil copper cable (feet)	952	2.97	1.81	2827.44	4550.56
400 kcmil copper cable (feet)	1066	3.4	1.92	3624.4	5671.12
500 kcmil copper cable (feet)	1289	4.2	2.04	5413.8	8043.36
2-1/2" EMT (feet)	2672	2.94	3.14	7855.68	16245.76
4" EMT	3407	5.67	5.02	19317.69	36420.83
				410240.53	501497.75
TOTAL				**$410,240.53**	**$501,497.75**

If the new system is implemented, the cost would likely be assessed by the Utica City School District. The 9 elementary schools and 2 middle schools in the school district would pay for at least a portion of the cost. Other cost options include a contractual agreement with the outside businesses that might use the school in times of emergency.

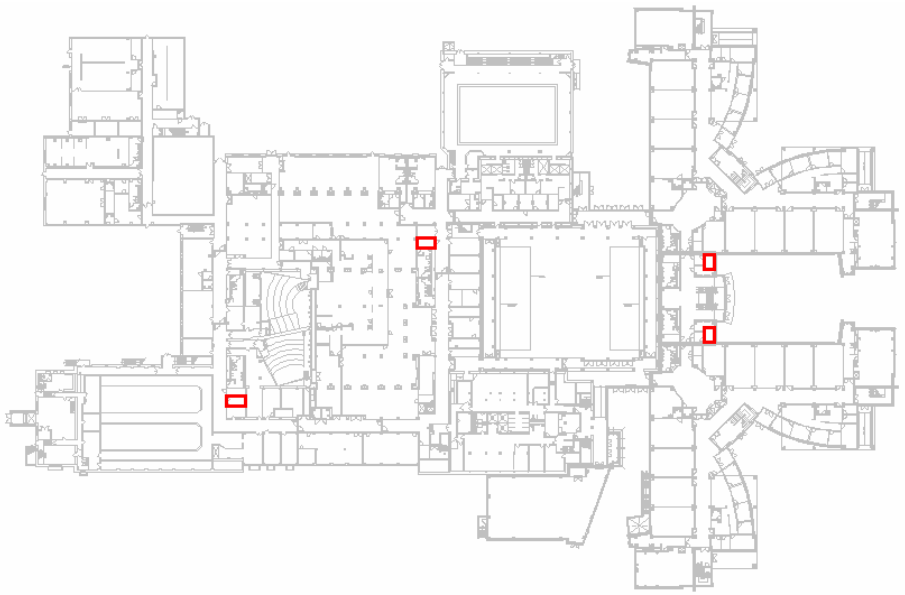
3.2 Bus Duct vs. Conduit/Cable

Since Thomas R. Proctor High School has various locations of stacked electrical closets, an analysis was done to decide whether or not vertical bus duct would have been a better solution than the decided cable/conduit system in these closets.

Bus duct is made up of a copper or aluminum conductor that is completely enclosed to ensure for protection against mechanical damage and dust accumulation. The conductors inside bus duct can be a bar type conductors or round cable conductors. Bus duct is commonly used in areas where there is limited space or multiple conduit runs may be obtrusive. Overall, bus duct holds several advantages over a normal cable/conduit system:

1. takes up less space, lighter and more aesthetically pleasing
2. lower impedance and voltage drop
3. convenient installation
4. larger short-circuit capacity
5. easy maintenance

A comparison was made based on the cost of implementing both systems in the four stacked electrical close locations. The electrical closets in sector C and sector D span 4 floors. The electrical closets in sector J span 3 floors. The analysis contrasted using bus duct, elbows, and fusible switches versus using cable and conduit.



Locations of Stacked Electrical Closets

The results from the cost analysis are as follows:

Bus Duct System					
Equipment	**Quantity**	**Price/Quantity ($)**	**Labor**	**Total Price**	**Total Price w/ Labor**
1000A Bus Duct (feet)	168	18.5	36	3108	9156
1000A Elbows	8	1000	251	8000	10008
100A Fusible Switch	50	860	121	43000	49050
600A Fusible Switch	3	5100	725	15300	17475
225A Panelboard	(-)18	245	345	(-)4410	(-)10620
400A Panelboard	(-)5	1620	1350	(-)8100	(-)14850
				56898	60219
TOTAL				**$56,898**	**$60,219**

Conduit/Cable System					
Equipment	**Quantity**	**Price/Quantity ($)**	**Labor**	**Total Price**	**Total Price w/ Labor**
#2 AWG copper cable (feet)	1018	0.475	0.408	483.55	898.894
1/0 copper cable (feet)	15	0.725	0.471	10.875	17.94
2/0 copper cable (feet)	570	0.895	0.502	510.15	796.29
250 kcmil copper cable (feet)	1121	2.16	1.63	2421.36	4248.59
350 kcmil copper cable (feet)	495	2.97	1.81	1470.15	2366.1
500 kcmil copper cable (feet)	928	4.2	2.04	3897.6	5790.72
1-1/2" EMT	1033	1.59	2.51	1642.47	4235.3
2" EMT	570	1.95	3.14	1111.5	2901.3
3" EMT	1121	3.75	4.39	4203.75	9124.94
3-1/2" EMT	990	5.17	5.02	5118.3	10088.1
4" EMT	1316	5.67	5.65	7461.72	14897.12
				28331.425	55365.294
Total				**$28,331.43**	**$55,365.29**

The cost analysis shows that the bus duct and conduit/cable systems are very similar in installation cost. Some important assumptions used in the analysis is that each panel must have its own fused disconnect switch off of the bus duct. As a result, it was assumed that that the panels would be able to be reduced to 100 amps. Also, the analysis of the bus duct only assumes material for the vertical chase of the electrical closets (it is assumed that the bus duct would receive power from the switchboard). If either of these two assumptions was unfeasible, a very significant cost would be added to the bus duct system. The advantages of the bus duct system would probably outweigh the advantages of the conduit/cable system if the school was two or more stories higher than it presently is. However, since the layout of the distribution system probably will

not change much, I have concluded that the existing conduit/cable system is a more effective system due to the overall cost.

All calculations in this electrical depth report were completed as per the guidelines of the following resources:

1. *National Electric Code 2002, National Fire Protection Agency, 2002*
2. *Electrical Systems in Buildings, Hughes, 1988*
3. *Electrical Designer's Reference Fault Current Calculator, Electrical Designer's Reference, 2003*
4. *2004 National Electrical Estimator, Tyler, 2004*
5. *R.S. Means Electrical Cost Data 21st Edition, 2002, R.S Means Company, Inc, 2002*

The following personnel were contacted for various information and statistics in the report:

1. *Karen Lascala, Consumer Relations Representative, Niagara Mohawk Power Corporation*
2. *Bob Ricci, Account Representative, Liebert Corporation Total Support Systems*

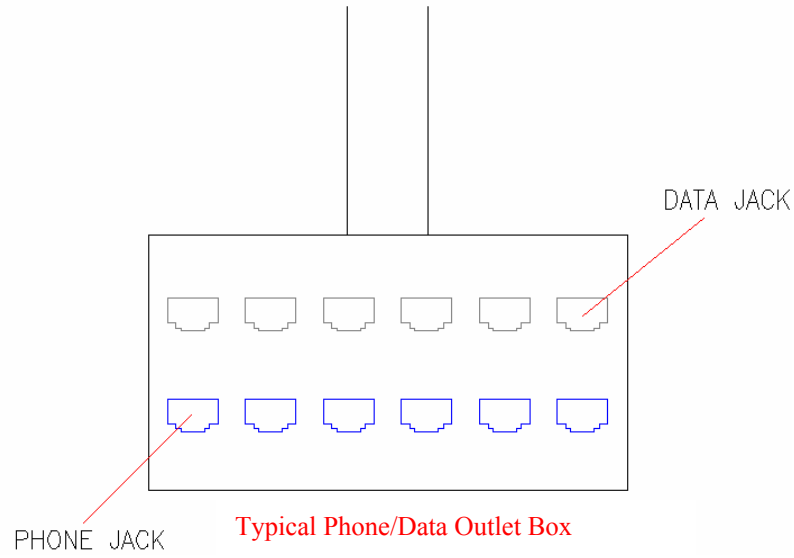
Section 4 – Telecommunications Breadth Work

4.1 Telecommunications System Addition

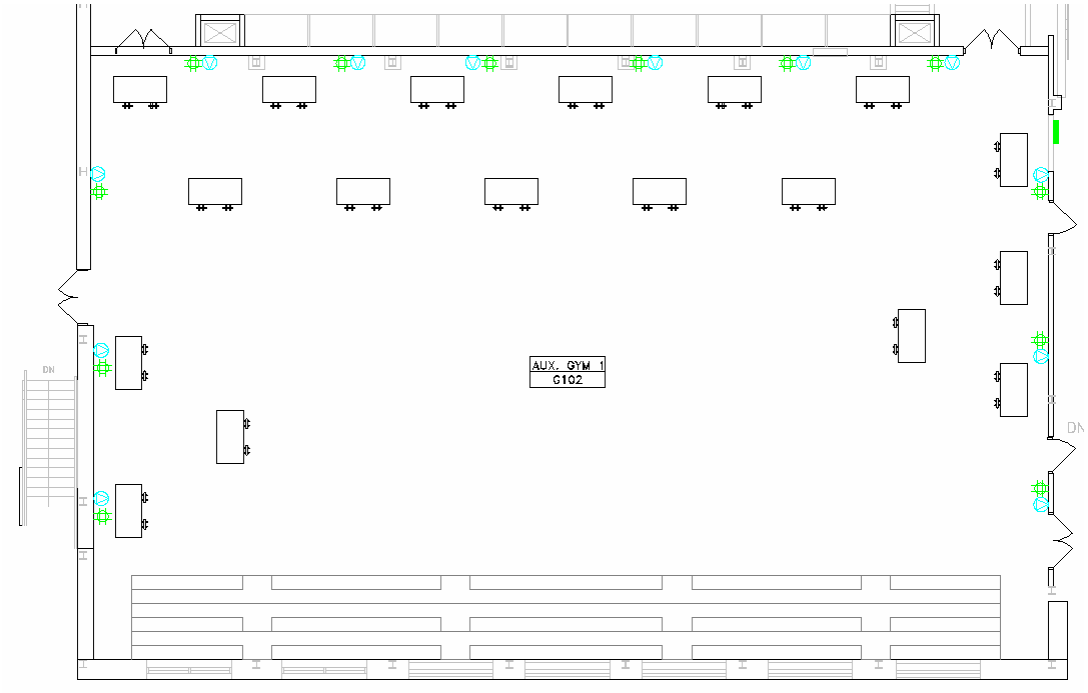
In order for Thomas R. Proctor High School to be considered an emergency data recovery site, emergency power cannot be the only feature that is available to incoming personnel in times of crisis. In addition, telephone and computer data service must be easily accessible.

4.1.1 Design Layout

Under the current emergency electrical design, all of the servers in the school, which are fed by clean power panels, are backed in the new emergency system. However, the auxiliary gymnasiums also need to be to be integrated into the existing telecommunications system. As a result, the new telecommunications design accounts for the addition of telephone and data outlets in the auxiliary gymnasiums. Since a maximum of 6 people can be operating from each electrical outlet station in each gym, the telecommunications design has to account for the same 6 people using a telephone and/or data jack at the same time. Therefore phone/data outlets need to be run to the same locations as the electrical outlets in each auxiliary gymnasium. Each phone/data combination box will be comprised of 12 RJ-45 jacks (6 for phone and 6 for data). Each phone and data jack will be fed by Category 6 cable. The 12-port outlet box will be fed by 1" conduit in a similar arrangement to the new emergency electrical system. The outlet stations will be located directly next to each electrical outlet station, approximately 14 feet apart.

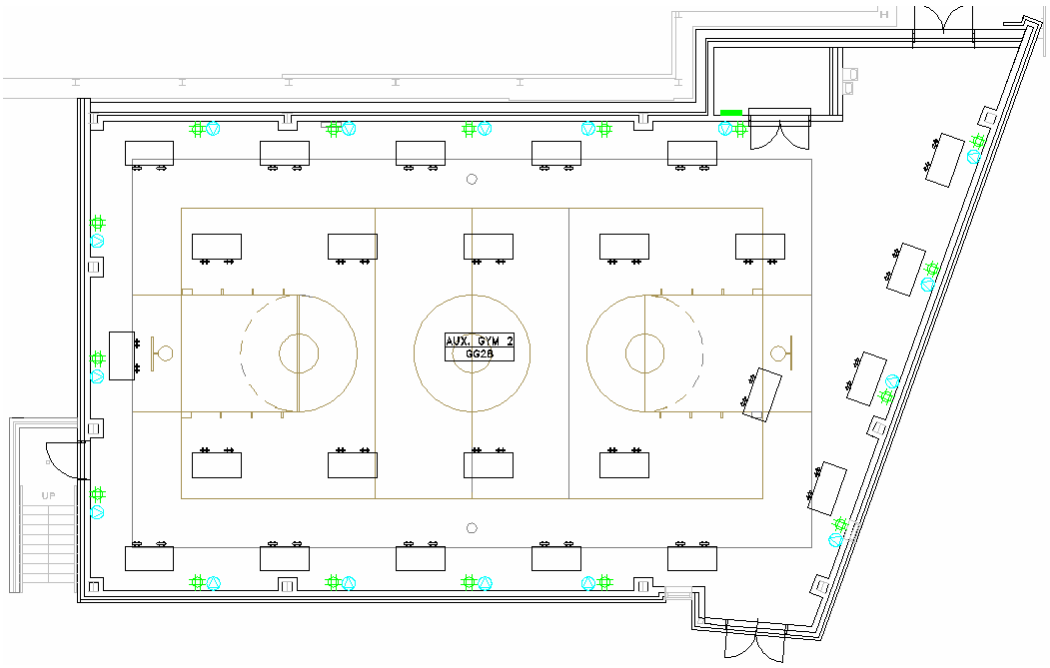


Typical Phone/Data Outlet Box



Auxiliary Gym 1 – Phone/Data Location Plan

- Electrical Outlet
- Telecom Outlet

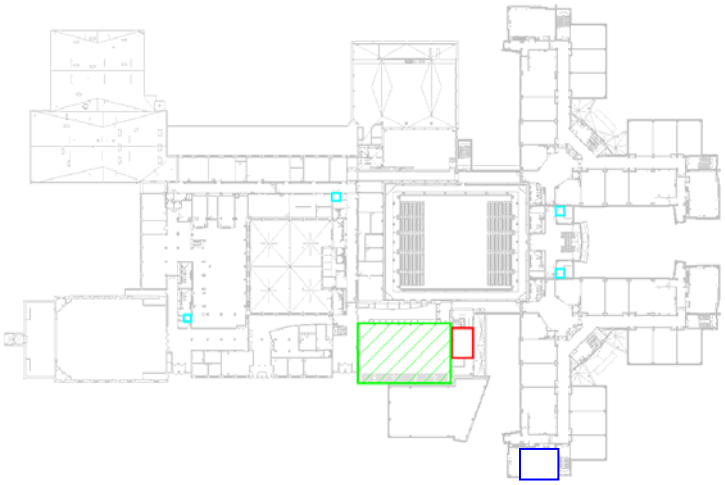


Auxiliary Gym 1 – Phone/Data Location Plan

- Electrical Outlet
- Telecom Outlet

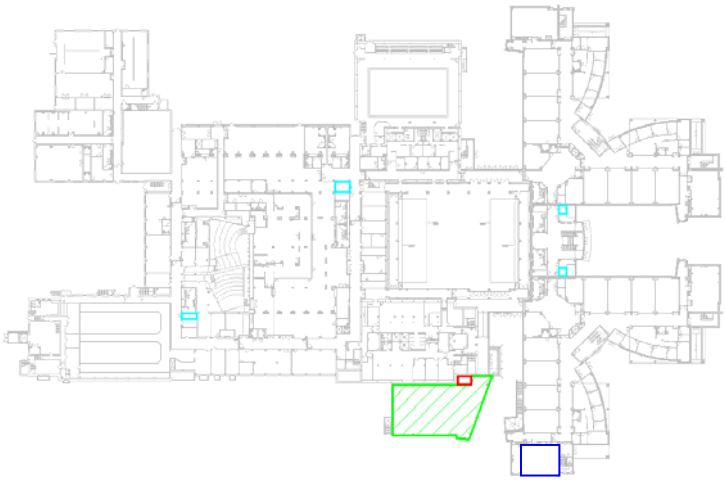
4.1.2 Telecommunications Closets

There are several main locations of vertically stacked telecommunications closets in the high school (generally located adjacent to an electrical closet). These closets serve the entire existing phone and data system of the school. To serve the new auxiliary gymnasiums, room GG28B and G105 will also serve as telecommunications closets. Each closet will be fed from the new main telephone room MDF in sector K with two 12 strand multi-mode fiber cables and one 6 strand single fiber cables to match the existing telecommunications closets. Each closet will be fed with four 2" conduits (3 for the fiber cables and 1 spare).



Auxiliary Gym 1 – Telecommunications Closet Location Plan

- Existing Telecommunications closets
- New Telecommunications closet
- Auxiliary Gym 1
- Main Telephone Room



Auxiliary Gym 2 – Telecommunications Closet Location Plan

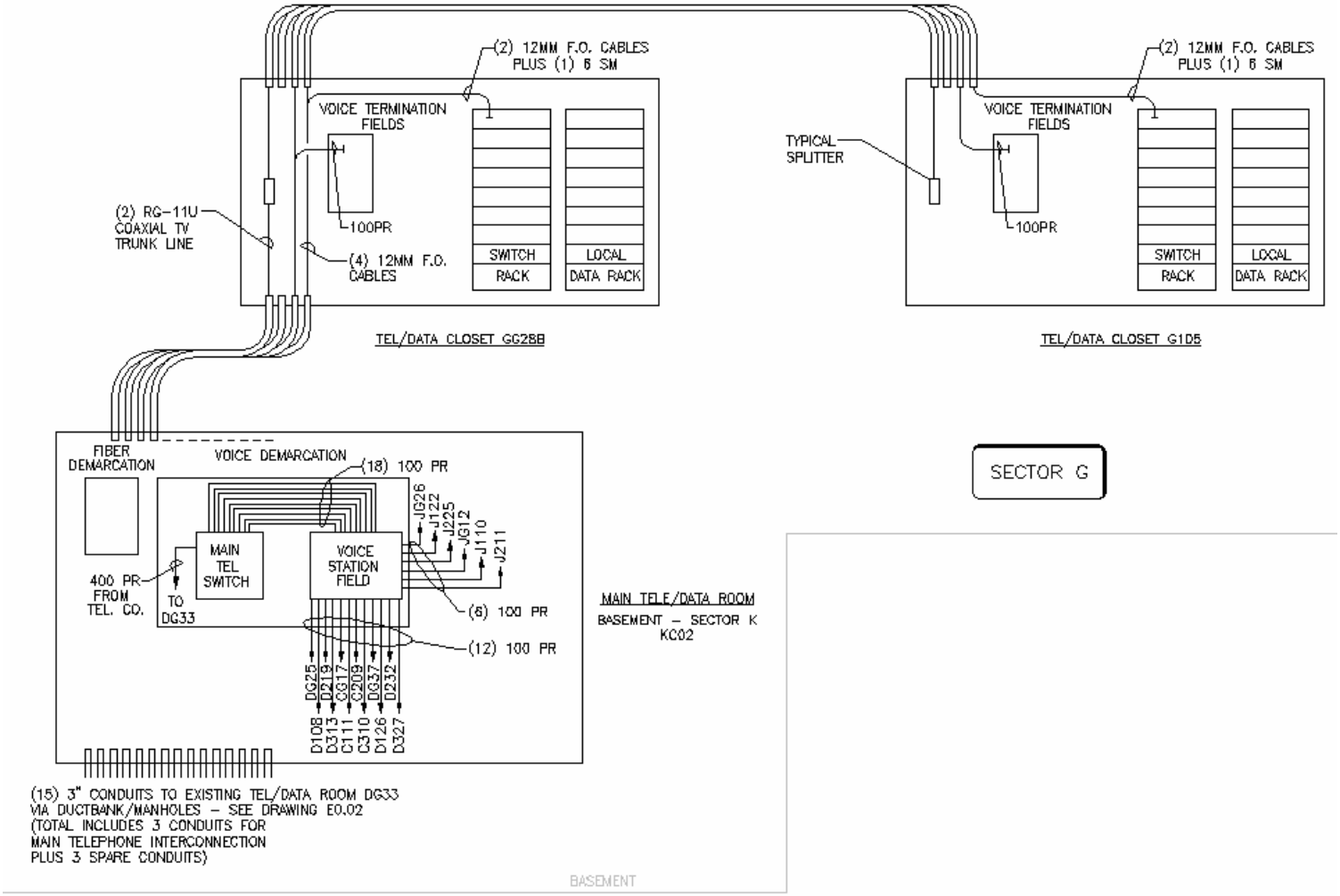
- Existing Telecommunications closets
- New Telecommunications closet
- Auxiliary Gym 2
- Main Telephone Room

It is important to note that although the entire telecommunications system is backed by emergency power, it could still be interrupted. The personnel can use the school network phone and computer system to communicate to each other internally in the school, however, if telephone service is lost from the outside feed to the school then communication via internet or non-network

phone will not be possible. A remedy for this situation would be to have a satellite link telecommunications system and/or the addition of a redundant input to the school.

4.1.3 Telecommunications Addition Riser Diagram

The following is a riser diagram of the new telecommunications closets that were added to the existing system. A riser diagram of the full system can be found in Appendix C.



References

Lighting Resources

IESNA Lighting Handbook, Rea, 2000
ANSI/ASHRAE/IESNA Standard 90-1-2004, ASHRAE Standards Committee, 2004
Autodesk AutoCAD 2005
Lighting Analysts - AGI-32

Electrical Resources

National Electric Code 2002, National Fire Protection Agency, Inc., 2002
Electrical Systems in Buildings, Hughes, 1988
Electrical Designer's Reference Fault Current Calculator, Electrical Designer's Reference, 2003
2004 National Electrical Estimator, Tyler, 2004
R.S. Means Electrical Cost Data 21st Edition, 2002, R.S Means Company, Inc, 2002

Structural Resources

Manual of Steel Construction/Load and Resistance Factor Design (Third Edition), American Institute of Steel Construction, 2002
SAP 2000, Integrated Software for Structural Analysis and Design, 2000

Telecommunications Breadth Resources

Structured Media Systems, Leviton Integrated Networks, 2001

Acknowledgements

I would specifically like to thank several people who have made the completion of this senior thesis report possible:

Family - Leanne, Barbara and Jim Regan for your continuous support throughout my five years of college and beyond.

Faculty – Professor Kevin Parfitt and Dr. Richard Mistrick for guidance throughout the senior thesis.

Consultants – Jim Pluger
Greenman-Pedersen Inc.
Civil, Structural, MEP

The Hillier Group
Architect

Jim Regan
Phasor Corporation
Electrical Consultant

John Reese
Reese Engineering, Inc.
Electrical Consultant

Karen Lascala
Consumer Relations Representative
Niagara Mohawk Power Corporation

Bob Ricci
Account Representative
Liebert Corporation Total Support Systems

Peers – Selim Ercan, Ben Ardary, Ben Mitten, Andrew Nolt, Joe Lookup, Chris Rush and all of the AEs for always being there to lend a helping hand.

Appendix A - Lighting

Luminaire Schedule

Type	Description	Manufacturer-Model #	Voltage	Mounting	No. and Type of Lamp	Lamp Manufacturer-Designation	Ballast
A	Compact Fluorescent 6" Aperture Downlight	Portfolio – C6-226-2D-6251-LI	277	Recessed	2-26-CF	Philips - CFQ26W/G24q/830	Advance - ICF-2S26-M1-LS@277
B	Compact Fluorescent 6” Aperture Wallwash/Downlight	Lithonia – 6W7A	277	Recessed	1-32-CF	Philips – PL-T 32W/830/4P/ALTO	Advance - ICF-2S26-M1-LS@277 Advance – REZ-123-1T32
C	2'x2' Recessed Fluorescent	Zumtobel Staff - SCS-22-2285-DX-S-277	277	Recessed	2-28 T5 HO	Philips – F28T5/835/HO/ALTO	Advance – VCN – 2S28
D	Indirect Pendant	LiteControl – P-I-5418T8	277	Pendant	1-32 T8	Philips - F32T8/AD830/ALTO	Advance - VEL-1P32-SC
DD	Indirect Pendant	LiteControl – P-I-5418T8	277	Pendant	1-32 T8	Philips - F32T8/AD830/ALTO	Advance – VZT - 132
F	4’ Linear Strip Cove Light	Elliptipar - F301-1-S00-2	277	Surface	1-32 T8	Philips - F32T8/AD830/ALTO	Advance – VZT - 132
G	Compact Fluorescent 8” Aperture High Wattage Downlight	Prescolite - CFT870EB-DM-STF87/70HZ	277	Recessed	1-70W Double Quad Tube CFL	General Electric - F70QBX835A4P/EOL	Advance – REZ-2T42-M3-BS
H	Decorative Pendant Chandelier	ELK Lighting – 6858/12+6+3	120	Suspended	21-60W B10	Philips – 60B10-1/2/CL 130V	---

TYPE: A

CATALOG#:

PORTFOLIO

DESCRIPTION

Low brightness 6" aperture reflector for use with either 13W, 18W or 26W Quad Tube 4-pin compact fluorescent lamps. The precisely formed non-imaging optical reflector ensures a maximum 55° cutoff to lamp and lamp image and the one piece design eliminates light leaks at the ceiling. Standard features include low iridescent finish on all reflector colors to eliminate "rainbowing" and venting to ensure maximum lamp life and lumen output. Optics offer unparalleled performance in glare free lighting with a smooth beam. Lens downlights and open wall wash trims are also available for the same housing.

SPECIFICATION FEATURES

A···Reflector

Low iridescent Alzak® finishes in specular clear, haze, straw and wheat, .050 thick aluminum, in a one piece spun parabolic contour. Positive reflector mounting, without tools, pulls trim tight to ceiling. Other finish options available upon request. Also available with white or black baffle.

SPECIFICATION FEATURES

B···Trim Ring Options

High impact polymer with satin white finish, metal trim, rimless trim self flanged reflector.

C···Socket Connector

One piece die cast aluminum connection allows venting for maximum thermal performance.

D···Housing Mounting Frame

One piece precision die cast aluminum 1 1/2" deep collar accommodates varying dimensions of ceiling materials.

E···Universal Mounting Bracket

Accepts 1/2" EMT, C Channel, T bar fasteners, and bar hangers. Adjusts 5" vertically from above or below ceiling.

F···Conduit Fittings

Die cast screw tight connectors.

G···Junction Box

Listed for eight #12AWG (four in, four out) 90°C conductors feed through branch wiring. 1/2" and two 3/4" pry outs. Positioned to allow straight conduit runs. Access to junction box by removing reflector.

H···Socket

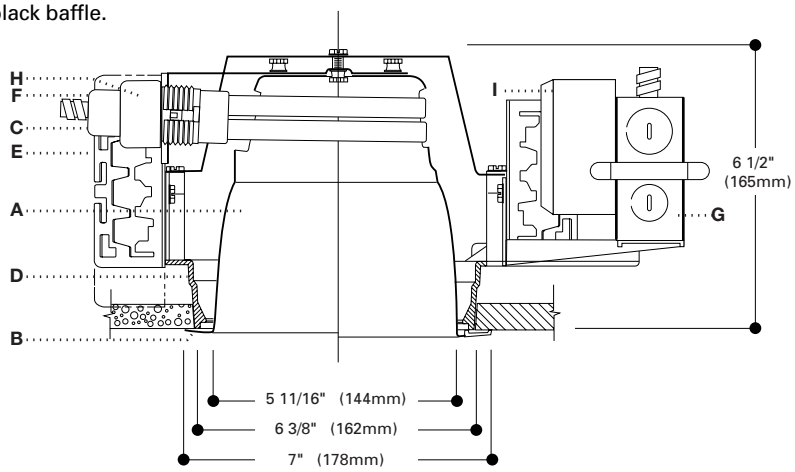
26W lamps: 4-pin G24q3.
18W lamps: 4-pin G24q2 base.
13W lamps:4-pin G24q1
Bases have fatigue free stainless steel lamp spring to ensure positive lamp retention.

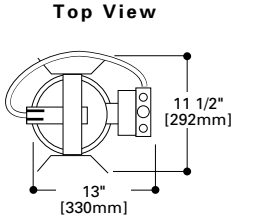
I···Ballasts

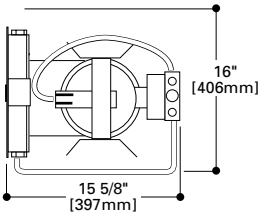
Thermally protected, fused, encased and potted high frequency electronic ballast provides full light output and rated lamp life. Provides flicker free and noise free operation and starting. End of lamp life protection is standard.

Labels

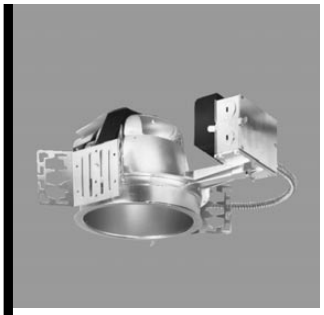
U.L. listed,
C.S.A. certified,
standard damp label,
IBEW union made.







With IEM Option



C6213-6250
C6218-6250
C6226-6250

13W Quad
18W Quad
26W Quad
Compact Fluorescent

6" OPEN REFLECTOR

Energy Data

(2) 18W Quad 4-pin
Ballast: Electronic
120V input watts: 37
Line Amps: 0.32
277V Input Watts: 37
Line Amps: 0.14
Power Factor: >.99
THD: <10%
Min. Starting Temp.: -10°C (15°F)
Sound Rating: A

(2) 26W Quad 4-pin
Ballast: Electronic
120V input watts: 50
Line Amps: 0.45
277V Input Watts: 50
Line Amps: 0.20
Power Factor: >.99
THD: <10%
Min. Starting Temp.: -10°C (15°F)
Sound Rating: A

Luminaire Efficacy Rating:
C6218-6250LI=30.49

NOTES:
Accessories should be ordered separately.
For additional options please consult your Cooper Lighting Representative.
Alzak is a registered trademark of Aluminum Company of America.

ORDERING INFORMATION

SAMPLE NUMBER: C6218E-6250LI

Complete unit consists of housing, ballast and trim.

Housing

C6213=(2) lamp 13W Quad
C6218=(2) lamp 18W Quad
C6226=(2) lamp 26W Quad

Ballast

E, EIEM*, ECP*, E2CMS*(2) =120V through 277V electronic

3E=347V Electronic
1D, 1DCP*=120V Dimming**
2D, 2DCP*=277V Dimming**
***IEM**=Internal Emergency Module Option
***CP**=Chicago Plenum Option
***2C**= 2 ballasts for hi-low switching of 2 lamp fixture
***2CMS**= 2 Circuit Master Satellite. Same s 2C but with two housings pre-wired together with a 10' flexible cable.

Trims (2)

6250=Reflector with Polymer Trim
6251=Self Flanged Reflector (1)

Lutron Hi-Lume or 100% compatible. Use with 4-pin lamp only

Color

LI=Specular Clear, Low Iridescent
H=Haze
S=Straw
WH=Wheat
BB=Black Baffle (On 6250 only)
WB=White Baffle (On 6250 only)

Accessories

Trim Rings
TRM6-P=White
TRM6-MB=Black
TRR6=Rimless

Slope Ceiling Adapter
HSA-6-XX=Specify Slope

HB26=26" Long bar hangers
HB50=50" Long bar hangers
RMB22=22" Long wood joist mounting bars

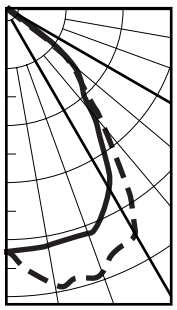
(1) For White Painted Flange (on self flanged reflector) add WF to Reflector Finish.
(2) the 2CMS option requires 2 trims for each fixture ordered.

COOPER LIGHTING

ADP023272

PHOTOMETRICS

Candlepower Distribution



Test No. H22270

C6218-6251LI

Open Reflector
Lamp=(2) 18W DTT
Lumens=1200 each

Spacing Criteria=
0°=1.2, 90°=1.4

Efficiency=47.0%

0°
90°

Candlepower

Deg.	CD 0°	90°
0	575	575
5	573	596
15	559	663
25	547	628
35	413	518
45	256	281
55	100	101
65	7	7
75	3	3
85	1	1
90	0	0

Average Luminance

Deg.	CD/SQ M 0°	90°
45	22060	24180
55	10613	10698
65	966	980
75	612	639
85	419	419

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
4'6"	28	6'0"
5'6"	19	7'0"
6'6"	14	8'6"
8'0"	9	10'6"
10'0"	6	13'0"
12'0"	4	16'0"

Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.

Footcandle values are initial, apply appropriate light loss factors where necessary.

Reflector Multiplier:
Haze=.95
Straw=.9
Wheat=.9

EM Multiplier (in emergency mode)
EM=.26

Zonal Lumen Summary

Zone	Lumens	%Lamp	%Luminaire
0-30	520	21.6	46.1
0-40	818	34.1	72.5
0-60	1117	46.5	99.1
0-90	1127	47.0	100.0
90-180	0	0.0	0.0
0-180	1127	47.0	100.0

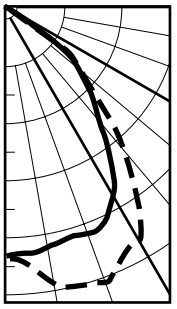
Coefficient of Utilization

rc	80%				70%			50%		30%		10%		0%
rw	70	50	30	10	50	30	10	50	10	50	10	50	10	0
RCR														
0	56	56	56	56	55	55	55	52	52	50	50	48	48	47
1	53	52	50	49	51	49	48	49	47	47	46	45	44	43
2	50	48	46	44	47	45	44	45	43	44	42	43	41	40
3	47	44	42	40	44	41	39	42	39	41	38	40	37	37
4	45	41	38	36	40	38	36	39	35	38	35	37	34	34
5	42	38	35	32	37	34	32	36	32	36	32	35	31	31
6	39	35	32	29	34	31	29	34	29	33	29	32	29	28
7	37	32	29	26	32	28	26	31	26	30	26	30	26	25
8	34	29	26	24	29	26	24	28	24	28	24	27	23	23
9	32	27	24	21	27	24	21	26	21	26	21	25	21	20
10	30	25	22	19	24	21	19	24	19	24	19	23	19	18

rc=Ceiling reflectance, rw=Wall reflectance, RCR=Room cavity ratio

CU Data Based on 20% Effective Floor Cavity Reflectance.

Candlepower Distribution



Test No. H22271

C6226-6251LI
Open Reflector

Lamp=(2) 26W DTT
Lumens=1800 each

Spacing Criteria=
0°=1.3, 90°=1.4

Efficiency=40.6%

0°
90°

Candlepower

Deg.	CD 0°	90°
0	732	732
5	728	759
15	702	846
25	699	806
35	545	660
45	348	384
55	126	130
65	9	9
75	3	4
85	1	1
90	0	0

Average Luminance

Deg.	CD/SQ M 0°	90°
45	30023	33056
55	13364	13842
65	1254	1298
75	800	824
85	489	489

Cone of Light

Distance to Illuminated Plane	Initial Nadir Footcandles	Beam Diameter
5'6"	24	7'6"
6'6"	17	8'6"
8'0"	11	10'6"
10'0"	7	13'6"
12'0"	5	16'0"
14'0"	4	18'6"

Beam diameter is to 50% of maximum footcandles, rounded to the nearest half-foot.

Footcandle values are initial, apply appropriate light loss factors where necessary.

Reflector Multiplier:
Haze=.95
Straw=.9
Wheat=.9

EM Multiplier (in emergency mode)
EM=.18

Zonal Lumen Summary

Zone	Lumens	%Lamp	%Luminaire
0-30	663	18.4	45.3
0-40	1051	29.2	71.3
0-60	1449	40.3	99.1
0-90	1463	40.6	100.0
90-180	0	0.0	0.0
0-180	1463	40.6	100.0

Coefficient of Utilization

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

rc=Ceiling reflectance, rw=Wall reflectance, RCR=Room cavity ratio

CU Data Based on 20% Effective Floor Cavity Reflectance.

Note: Specifications and Dimensions subject to change without notice.

LITHONIA LIGHTING®

Catalog Number	
Notes	Type B

FEATURES & SPECIFICATIONS

INTENDED USE

For use in Non-IC applications with LP6F rough-in.

Wallwash reflector intended to direct light with a horizontal component to increase light intensity on walls, as well as provide downward light on horizontal surfaces. Kicker must face wall to be illuminated.

CONSTRUCTION

Aluminum reflector with kicker.

Diffuse kicker used for wallwash.

Integral flange.

FINISH

Anodized reflectors available in clear specular and clear diffuse.

INSTALLATION

Socket-to-trim interface.

Retaining clips packed with reflector for installation on rough-in.

Maximum ceiling thickness 1-1/2".

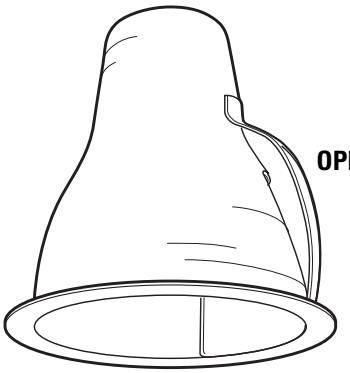
LISTING

U.L. Listed to U.S. and Canadian safety standards.

Damp location listed.

6" Finishing Reflector

6W7

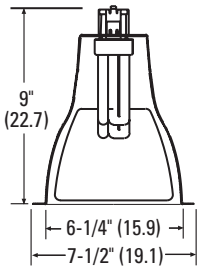


OPEN WALLWASH WITH KICKER

Vertical Lamp

Specifications

Height: 9 (22.9)
Lamp Opening: 6-1/4 (15.9)
Diameter: 7-1/2 (19.1)



All dimensions are inches (centimeters).

ORDERING INFORMATION

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

Example: **6W7**

6W7

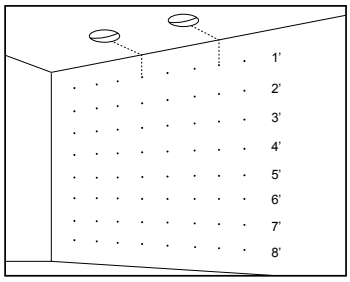
Series	Finish		Options	
6W7	**AZ**	Clear specular	**TRW**	White flange with anodized reflectors
	A	Clear diffuse		

Housing Compatibility

Housing and trim ordered separately.

Application	*Source*	*Maximum wattage*	*Housing*
Non-IC	Fluorescent	32 TRT	**LP6F**

6W7 6" Wallwash Full Reflector Trim



Footcandle values are initial and tables are based on a minimum of 6 units. For fixture-to-wall distance other than those shown, use maximum of 1 to 1 spacing (distance between fixtures not more than distance to wall) for best results.

6W7A, 32W TRT lamp, 2400 rated lumens, test no. LTL11817

WALLWASH ILLUMINANCE STUDY

Footcandles on Wall from 6 luminaires

ft. from ceiling	Units 3' From Wall (3')			Units 4' From Wall (4')			Units 5' From Wall (5')		
	Fixture	Center	Fixture	Fixture	Center	Fixture	Fixture	Center	Fixture
1	10.4	9.7	10.4	8.6	6.4	8.6	7.9	4.3	7.9
2	19.5	18.5	19.5	16.1	12.4	16.1	14.6	8.4	14.6
3	22.7	21.9	22.7	18.1	15.3	18.1	16.0	11.0	16.0
4	22.0	22.0	22.0	16.5	16.7	16.5	13.9	12.7	13.9
5	19.0	19.3	19.0	14.6	14.5	14.6	11.4	11.8	11.4
6	15.9	15.9	15.9	12.0	12.2	12.0	9.7	9.7	9.7
7	13.0	13.0	13.0	9.8	10.1	9.8	7.9	8.0	7.9
8	10.5	10.7	10.5	8.2	8.2	8.2	6.5	6.7	6.5
9	8.5	8.7	8.5	6.8	6.8	6.8	5.4	5.6	5.4
10	7.0	7.1	7.0	5.6	5.7	5.6	4.6	4.6	4.6
11	5.7	5.8	5.7	4.7	4.8	4.7	3.9	3.9	3.9
12	4.7	4.8	4.7	4.0	4.1	4.0	3.4	3.4	3.4

6W7A, 18W TRT lamp, 1200 rated lumens, test no. LTL11818

WALLWASH ILLUMINANCE STUDY

Footcandles on Wall from 6 luminaires

ft. from ceiling	Units 3' From Wall (3')			Units 4' From Wall (4')			Units 5' From Wall (5')		
	Fixture	Center	Fixture	Fixture	Center	Fixture	Fixture	Center	Fixture
1	4.0	3.7	4.0	3.2	2.5	3.2	3.0	1.7	3.0
2	6.0	5.8	6.0	4.7	4.0	4.7	4.2	2.8	4.2
3	6.7	5.9	6.7	5.4	4.0	5.4	4.8	3.0	4.8
4	7.4	7.6	7.4	5.7	5.7	5.7	5.1	3.9	5.1
5	7.3	7.1	7.3	5.3	5.6	5.3	4.3	4.5	4.3
6	6.3	6.3	6.3	4.8	4.7	4.8	3.7	3.9	3.7
7	5.3	5.4	5.3	4.1	4.1	4.1	3.3	3.2	3.3
8	4.5	4.6	4.5	3.4	3.5	3.4	2.8	2.7	2.8
9	3.7	3.8	3.7	2.9	2.9	2.9	2.3	2.4	2.3
10	3.1	3.2	3.1	2.5	2.5	2.5	2.0	2.0	2.0
11	2.6	2.7	2.6	2.1	2.1	2.1	1.7	1.7	1.7
12	2.2	2.3	2.2	1.8	1.8	1.8	1.5	1.5	1.5

6W7A, 18W DTT lamp, 1250 rated lumens, test no. LTL11819

WALLWASH ILLUMINANCE STUDY

Footcandles on Wall from 6 luminaires

ft. from ceiling	Units 3' From Wall (3')			Units 4' From Wall (4')			Units 5' From Wall (5')		
	Fixture	Center	Fixture	Fixture	Center	Fixture	Fixture	Center	Fixture
1	4.7	4.3	4.7	3.9	2.8	3.9	3.5	1.9	3.5
2	9.0	8.6	9.0	7.3	5.8	7.3	6.7	4.0	6.7
3	10.3	9.9	10.3	8.0	7.1	8.0	7.1	5.1	7.1
4	9.9	10.0	9.9	7.5	7.6	7.5	6.2	5.8	6.2
5	8.7	8.8	8.7	6.6	6.6	6.6	5.3	5.3	5.3
6	7.2	7.3	7.2	5.5	5.5	5.5	4.4	4.4	4.4
7	5.8	6.0	5.8	4.5	4.5	4.5	3.6	3.6	3.6
8	4.7	4.9	4.7	3.7	3.7	3.7	3.0	3.0	3.0
9	3.8	3.9	3.8	3.0	3.1	3.0	2.5	2.5	2.5
10	3.1	3.2	3.1	2.5	2.6	2.5	2.1	2.1	2.1
11	2.6	2.6	2.6	2.1	2.2	2.1	1.8	1.8	1.8
12	2.1	2.2	2.1	1.8	1.8	1.8	1.5	1.5	1.5

LITHONIA LIGHTING®

An AcuityBrands Company

Lithonia Lighting
Acuity Lighting Group, Inc.
Recessed Downlighting
One Lithonia Way, Conyers, GA 30012
Phone: 800-315-4935 Fax: 770-860-3106
In Canada: 160 avenue Labrosse, Pointe-Claire, P.Q., H9R 1A1
www.lithonia.com

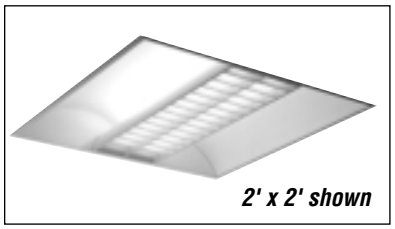
©2000 Acuity Lighting Group, Inc., Rev. 09/04

SYNTO SC

Fluorescent
Two Lamp 28W T5 or 54W T5 HO

Recessed 2' x 4'

Lay-In and Slot-Grid Ceilings



2' x 2' shown

Applications: The SYNTO family of fixtures supplies the best of both worlds—indirect illumination with a direct component that has controlled brightness. The upper reflectors provide illuminance in the ceiling plane, minimizing the "cave effect" and the Bivergence® louver contributes downlight without glare. This solution is best for open offices, retail spaces and institutions.

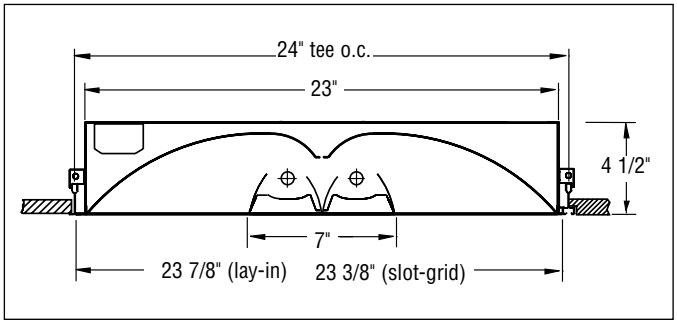
Type: C

Project: _____

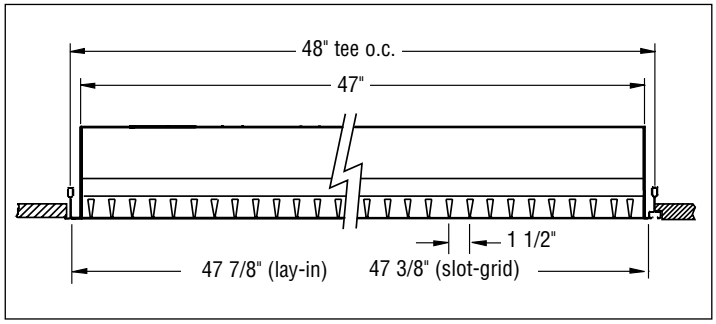
ORDERING NOTE: Specify fixture/ceiling type, lamping, louver, reflector, voltage and options.

▼ Fixture/Ceiling Type	▼ Length	▼ Lamping	▼ Louver	▼ Reflector	▼ Voltage	▼ Options
	24					
SCI 2' x 4' Recessed, Lay-In Ceiling **SCS** 2' x 4' Recessed, Slot-Grid Ceiling **Note: For Gypsum board and concealed spline ceilings, consult factory.**	**24** 2' x 4'	**2285** (2) 28W T5 **2545** (2) 54W T5 HO	**C** Matte **DX** Specular	**W** White **S** Stepped	**1** 120V **2** 277V **3** 347V* *consult factory	**WF** Whip Flex 3/8" x 6 14/3 AWG **WN** Whip Flex 3/8" x 6 14/3 AWG (NYC) **DM** Dimming (Lutron ECO-10) **EMT5** Stand-by Battery Pack/ 1 Lamp, 28W T5 **SS** Separate Switching (Consult Factory) **F** Fusing **AR** Air Return **CP** Chicago Plenum

Cross Section, Lay-In/Slot-Grid Ceilings



Side View, Lay-In/Slot-Grid Ceilings



c UL us
LISTED

Suitable for damp locations
NYC Approved

IBEW Union Made

1. Housing - 20 gauge cold-rolled steel. Finish is powder-coated gloss white.

2. Reflectors - **White** reflectors are 24 gauge cold-rolled steel painted matte. **Stepped** reflectors are extruded aluminum with a matte silver finish. Reflectors may be removed for access to ballast.

3. Louver - The 62-cell louver (two rows of 31 each) has blades 13/16" high by 1 1/2" o.c. Finished in matte silver or specular. Louver pulls out for ease of maintenance.

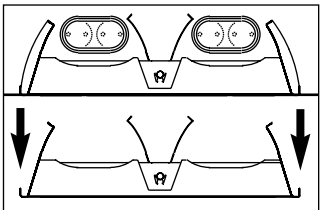
4. Lamps/Sockets - Two 28W T5 or 54W T5 HO (high output) fluorescent lamps with twist-lock miniature bi-pin sockets. Lamps supplied by others.

5. Ballast - Electronic ballast mounted in housing of luminaire.

6. Mounting - Integral bend-out tabs provided in the lay-in (**SCI**) and slot-grid ceiling (**SCS**) fixture types. Consult factory for mounting in gypsum board ceilings.

7. Stand-by Battery Pack - Integral stand-by battery pack with integral test switch. For remote test switch, consult factory.

8. Weight - 31.0 lbs.



Removable Louver

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. Technical specification sheets that appear on www.zumtobelstaffusa.com are the most recent version and supersede all other versions that exist in any other printed or electronic form.

Zumtobel Staff Lighting, Inc. ©2003
3300 Route 9W • Highland, NY 12528-2630
TEL (845) 691-6262 • (800) 932-0633 • FAX (845) 691-6289
www.zumtobelstaffusa.com
89 00206 8/03

ZUMTOBEL STAFF
THE LIGHT ®

Photometric Data

SC 24 2285 C W (2) 28W T5

RECESSED MATTE SILVER LOUVER, WHITE REFLECTOR

LTL 05099

Total Luminaire Efficiency 79%

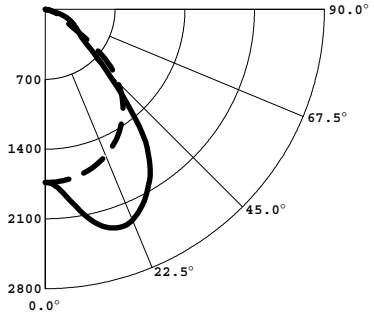
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.2	1.5

TOTAL LAMP LUMENS = 5800
INPUT WATTS = 62

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	1734	1734	1734	
5°	1730	1780	1826	163.4
15°	1673	2053	2253	567.6
25°	1547	2127	2230	926.8
35°	1347	1858	1812	1086.1
45°	1033	1280	872	886.6
55°	450	548	420	494.0
65°	165	294	290	272.0
75°	81	151	113	137.0
85°	19	13	11	21.3
90°	2	0	1	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	2095	2596	1768
55°	1125	1370	1050
65°	560	997	984
75°	449	837	626
85°	313	214	181

Coefficients of Utilization

Effective Floor Cavity Reflectance = 20%

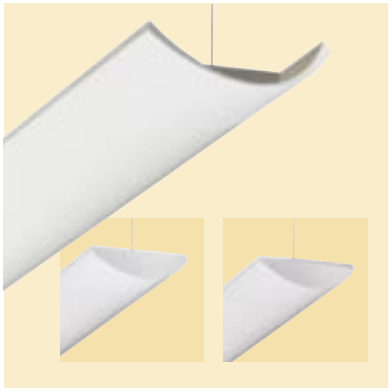
pcc	0.8				0.7				0.5			0.3		
pw	0.7	0.5	0.3	0.1	0.7	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
0	94	94	94	94	92	92	92	92	88	88	88	84	84	84
1	88	84	82	79	85	83	80	78	79	77	76	76	75	73
2	81	75	71	67	79	74	70	66	71	68	65	69	66	64
3	75	68	62	58	73	66	61	57	64	60	56	62	58	55
4	69	61	55	50	68	60	54	50	58	53	49	56	52	49
5	64	55	49	44	63	54	48	44	53	48	44	51	47	43
6	60	50	44	39	58	49	43	39	48	43	39	47	42	38
7	56	46	40	35	54	45	39	35	44	39	35	43	38	35
8	52	42	36	32	51	42	36	32	41	35	31	40	35	31
9	49	39	33	29	47	38	33	29	37	32	28	37	32	28

Zumtobel Staff Lighting, Inc. ©2003
3300 Route 9W • Highland, NY 12528-2630
TEL (845) 691-6262 • (800) 932-0633 • FAX (845) 691-6289
www.zumtobelstaffusa.com
89 00206 8/03

ZUMTOBEL STAFF
THE LIGHT ®

LITECONTROL

Type: D
Project:

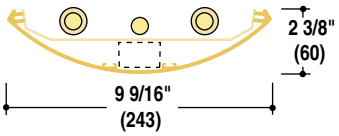


Arcos™

P-I-5400

Pendant-Mounted Indirect

Specifications



HOUSING. One-piece extruded aluminum, wall thickness .125".
END CAPS. Required at each end of row and at both ends of an individual fixture. Flat end caps are standard; of 14-gauge steel with no holes or knockouts. **ECS** option: die-cast sculpted end caps with no exposed fasteners. **ECSS** option: die-cast shelf-style end caps with no exposed fasteners. All end caps finished to match housing.
REFLECTOR. Die-formed steel with high-reflectance white finish with areas of specular aluminum.
BALLAST. Low-Profile: electronic, high power factor, thermally protected Class P, Sound Rated A, manufactured by a UL Listed manufacturer, as available, determined by Litecontrol. The minimum number of ballasts will be used.
TANDEM WIRING. Where listed in Ordering guide below, fixtures wired to switch in-line lamps separately, providing two or three (three-lamp cross-section fixtures only) levels of light.
PRE-WIRING. Fixtures are supplied with #12 AWG type THHN wire for branch circuits. One end will have factory installed push-in quick-connects. The other end will be stripped back 1/2" for quick connection in field. For fixtures to accommodate special circuits such as night light and emergency, etc., in-field wiring will be required. See Pre-Wiring Information for details.
SYSTEM CONNECTORS. Corners, tees, and crosses available. Connectors are .125" thick extruded aluminum, to be smooth with no exposed fasteners or knockouts. Each system connector shall have a rigid cross-member with a .687" diameter stem hole at center to accept any of Litecontrol's pendant assemblies.
SUSPENSION. Aircraft cable or rigid stem pendants attach to fixture using Litecontrol's easy-hang system, with one attachment plate for use at any support point. Standard suspension provided is field adjustable aircraft cable (**FAI/ACC**) with a 51" length cable. See Aircraft Cables and Stems for details.
CERTIFICATION. Fixture and electrical components shall be UL and/or CUL Listed and shall bear the I.B.E.W., A.F. of L. label. UL LISTED

Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

Ordering guide

Product, Lamping, & Length

P -	I -	54	4	8	T8 -
Mounting	Distribution	Series	Lamp Count	Nominal Length (ft)	Lamp Type
P= Pendant-Mounted	**I**= Indirect		**1, 2, 3** → **4** **2, 4, 6** → **8** **3, 6, 9** → **12** **4, 8, 12** → **16** **5, 10, 15** → **20** **6, 12, 18** → **24**		**T8** **T5HO** **T5**
			4 → **4** **8** → **8** **12** → **12** **16** → **16** **20** → **20** **24** → **24**		**BX40**
			see **notes**		

Mounting Options
- add to end of order number

Aircraft Cables
- ☐ **FAI/ACC** (field adjustable) *standard*
- ☐ **ACC** (fixed)

Stems
- ☐ **P6S** (stem)
- ☐ **SC/P6** (sloped ceiling)
- ☐ **EQ/P6** (earthquake)

Options

TCWM-	TW -	LP/ELB -	2CWQ -	LP/EF -	120
Color	Tandem Wiring	Ballast	Pre-Wiring	Option	Volts
TCWM (Textured Matte White) is standard see **page 9** for other colors	**--** → **TW** → see **notes**	**LP/ELB** **LPD/ELB** 2-lamp T8 only **ELB10** **DA-ELB** **HEL/ELB** **ECO/ELB** see **Ballast options**	**1CWQ** **2CWQ**	**LP/EF** **F** **ECS** **ECSS** see **Options**	**120** **277**

notes:
Lamp Count = the total number of lamps in fixture
T5 and T5HO fixtures also available in a four-lamp cross-section.
T8 and BX40 fixtures also available in 2', 3', 5', 6', and 10'.
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.

Cross-section lamping

P-I-5448T8-TCWM-TW-LP/ELB-2CWQ-LP/EF-120-FAI/ACC is a typical catalog number for a four-lamp (2 lamps in cross-section), 8-foot long T8 fixture, painted Textured Matte White, tandem wired, with low-profile electronic ballast, pre-wired with two-circuit branch wiring and emergency fluorescent ballast, 120 volts, mounted with field adjustable aircraft cables.
P-I-5448T5HO-TCWM-LP/ELB-2CWQ-LP/EF-120-FAI/ACC is a typical catalog number for a four-lamp (2 lamps in cross-section), 8-foot long high-output T5 fixture, painted Textured Matte White, with a low-profile electronic ballast, pre-wired with two-circuit branch wiring and emergency fluorescent ballast, 120 volts, mounted with field adjustable aircraft cables.

Questions to Ask
1. 120 or 277 volt? **2.** Row information, including desired fixture lengths?
3. White, *LiteColor*, or special color? **4.** Tandem wiring? **5.** Cables or stems, what length?
6. End caps, standard or optional? **7.** Other options?

Ballast options

LPD/ELB Low-profile dimming ballast. Manufactured by a UL Listed manufacturer, as available, contact factory for availability.

Following available on two-lamp T8 Fixtures only:

Contact factory for availability/compatibility with lamping:

ELB10 Electronic ballast, same specification as **ELB**, except less than 10% THD.

DA-ELB Advance Mark VII dimming ballast.

HEL/ELB Osram Helios dimming ballast.

ECO/ELB Lutron ECO-10 dimming ballast.

Options

LP/EF Emergency fluorescent ballast. Battery-powered ballast from a UL Listed manufacturer will operate one T8, T5, or T5HO lamp for 1 1/2 hours.

F Fuse. Slow or fast blow, determined by Litecontrol.

ECS End Cap Sculpted. Die-cast sculpted end caps with no exposed fasteners.

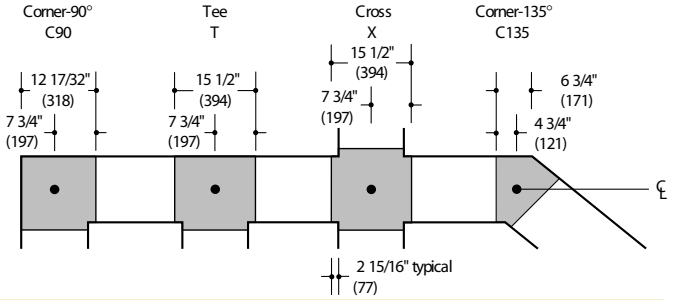
ECSS End Cap Shelf-Style. Die-cast shelf-style end caps with no exposed fasteners.

System connectors

Catalog Number

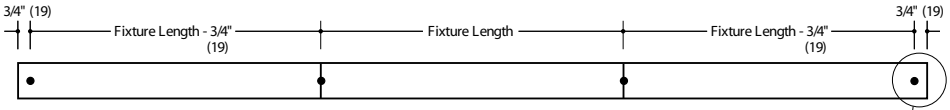
Series	-	Connector	-	Finish
P-I-5400		C90		
P-I-5400		C135		
P-I-5400		T		
P-I-5400		X		

P-I-5400-C90-TCWM is a typical catalog number for a 90° corner connector finished Textured Matte White.



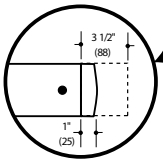
Row diagrams

Row Diagram

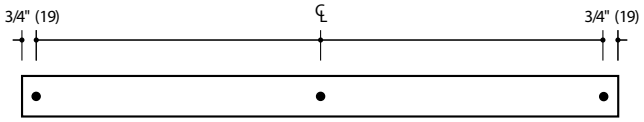


Optional **ECS** (sculpted) end cap adds 1" length to each end of row or individual fixture.

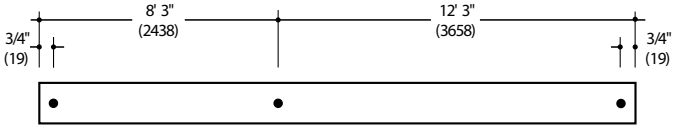
Optional **ECSS** (shelf style) end cap adds 3 1/2" length to each end of row or individual fixture.



ADDITIONAL SUSPENSION FOR FIXTURES 16' AND OVER



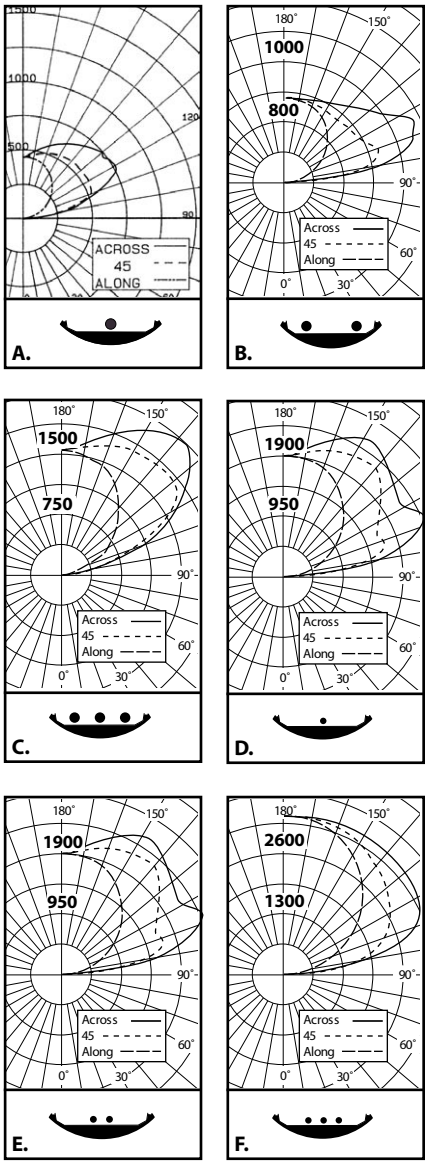
16' 6" and 24' 6" fixtures require an additional mounting location at the centerline (℄) of fixture.



20' 6" fixture requires an additional mounting location 8' 3" from one end (12'3" from the other end) of the fixture.

Fixture Lengths: 4'-3", 8'-3", 12'-3", 16'-6", 20'-6", or 24'-6"
● Indicates pendant locations

Photometric data



A. P-I-5414T8-LP/ELB 89.8 % Efficiency
Litecontrol Certified Test Report #23411000

B. P-I-5424T8-LP/ELB 85.2 % Efficiency
Litecontrol Certified Test Report #234210001

C. P-I-5434T8-LP/ELB 83.2 % Efficiency
Litecontrol Certified Test Report #234310001

D. P-I-5414T5HO-LP/ELB 93.8 % Efficiency
ITL Certified Test Report #ITL49048
LC#27416000

E. P-I-5424T5HO-LP/ELB 94.2 % Efficiency
ITL Certified Test Report #ITL49049
LC#27426000

F. P-I-5434T5HO-LP/ELB 94.1 % Efficiency
ITL Certified Test Report #ITL49050
LC#27436000

online
Quick Find
Click on 54

PHOTOMETRIC DATA: *Low Profile Ballast*

CANDLEPOWER SUMMARY

0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	448	448	448	448	448	
175	449	450	457	463	468	44
170	443	454	473	492	498	
165	434	455	490	521	532	139
160	420	454	505	550	566	
155	402	450	519	578	599	237
150	381	442	530	604	630	
145	357	432	539	628	660	331
140	328	419	545	650	689	
135	297	401	547	672	718	412
130	264	381	546	687	745	
125	229	360	547	698	755	471
120	192	337	549	709	769	
115	155	312	538	690	705	481
110	119	289	518	568	572	
105	82	263	406	426	439	358
100	49	221	275	304	306	
95	20	117	142	142	139	136
90	2	14	14	12	11	

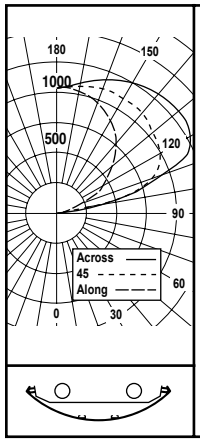
P-I-5414T8-LP/ELB 89.8 % Efficiency
Litecontrol Certified Test Report #23411000

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	.73	.73	.73	.73	.50	.50	.50	.29	.29	.29	.09	.09	.09	.00
1	.78	.74	.71	.68	.66	.63	.61	.58	.43	.42	.40	.25	.24	.24	.08	.08	.08	.00
2	.71	.64	.59	.55	.60	.55	.51	.48	.38	.35	.33	.22	.21	.19	.07	.07	.06	.00
3	.64	.57	.51	.46	.55	.49	.44	.40	.33	.30	.28	.19	.18	.17	.06	.06	.05	.00
4	.59	.50	.43	.39	.50	.43	.38	.33	.29	.26	.24	.17	.15	.14	.05	.05	.05	.00
5	.54	.43	.38	.33	.46	.38	.33	.28	.26	.23	.20	.15	.13	.12	.05	.04	.04	.00
6	.49	.39	.33	.28	.42	.34	.28	.24	.23	.20	.17	.14	.12	.10	.04	.04	.03	.00
7	.45	.35	.29	.24	.38	.30	.25	.21	.21	.17	.15	.12	.10	.09	.04	.03	.03	.00
8	.42	.32	.25	.21	.35	.27	.22	.18	.19	.15	.13	.11	.09	.08	.04	.03	.03	.00
9	.39	.28	.22	.18	.33	.25	.19	.16	.17	.14	.11	.10	.08	.07	.03	.03	.02	.00
10	.36	.26	.20	.16	.31	.22	.17	.14	.16	.12	.10	.09	.07	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	2603	89.79	100
90-0°	0	0	0
180-0°	2603	89.79	100



CANDLEPOWER SUMMARY

0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	1032	1032	1032	1032	1032	
175	1039	1041	1046	1046	1052	100
170	1028	1043	1067	1078	1091	
165	1007	1040	1083	1111	1131	305
160	978	1030	1096	1143	1170	
155	940	1012	1104	1176	1211	506
150	892	988	1109	1205	1247	
145	835	955	1105	1224	1272	680
140	772	913	1096	1235	1289	
135	703	866	1077	1241	1307	810
130	627	818	1052	1243	1312	
125	545	763	1025	1229	1300	680
120	461	698	988	1192	1255	
115	372	632	932	1136	1193	856
110	280	566	853	988	967	
105	192	486	673	723	693	613
100	105	385	423	479	451	
95	34	188	182	215	178	191
90	0	0	0	0	0	

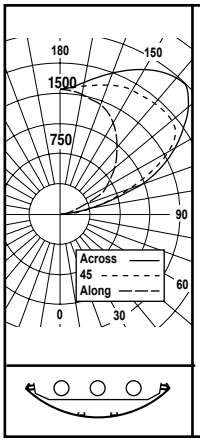
P-I-5424T8-LP/ELB 85.2 % Efficiency
Litecontrol Certified Test Report #234210001

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	.81	.81	.81	.81	.69	.69	.69	.69	.47	.47	.47	.27	.27	.27	.09	.09	.09	.00
1	.74	.70	.67	.65	.63	.60	.58	.56	.41	.40	.38	.24	.23	.22	.08	.07	.07	.00
2	.67	.61	.57	.53	.57	.53	.49	.45	.36	.34	.32	.21	.20	.19	.07	.06	.06	.00
3	.61	.54	.48	.44	.52	.46	.42	.38	.32	.29	.27	.18	.17	.16	.06	.05	.05	.00
4	.56	.47	.41	.37	.47	.41	.36	.32	.28	.25	.22	.16	.15	.13	.05	.05	.04	.00
5	.51	.42	.36	.31	.43	.36	.31	.27	.25	.22	.19	.14	.13	.11	.05	.04	.04	.00
6	.47	.37	.31	.27	.40	.32	.27	.20	.20	.17	.14	.12	.10	.08	.04	.03	.03	.00
7	.43	.33	.27	.23	.37	.29	.24	.20	.20	.17	.14	.12	.10	.08	.04	.03	.03	.00
8	.40	.30	.24	.20	.34	.26	.21	.17	.18	.15	.12	.10	.09	.07	.03	.03	.02	.00
9	.37	.27	.21	.17	.31	.23	.19	.15	.16	.13	.11	.09	.08	.06	.03	.03	.02	.00
10	.34	.25	.19	.15	.29	.21	.17	.13	.15	.12	.09	.09	.07	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	4943	85.2	100
90-0°	0	0	0
180-0°	4943	85.2	100



CANDLEPOWER SUMMARY

0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	1506	1506	1506	1506	1506	
175	1515	1515	1534	1532	1548	147
170	1499	1528	1586	1614	1641	
165	1469	1534	1637	1699	1739	460
160	1428	1534	1685	1785	1842	
155	1369	1522	1724	1868	1938	783
150	1298	1498	1754	1944	2031	
145	1217	1464	1777	2012	2113	1086
140	1121	1419	1789	2066	2181	
135	1021	1363	1789	2109	2184	1321
130	912	1299	1777	2017	2047	
125	788	1228	1706	1839	1854	1361
120	669	1147	1525	1622	1615	
115	536	1057	1293	1355	1363	1156
110	403	934	1014	1114	1089	
105	273	711	759	804	768	735
100	151	447	457	482	447	
95	47	197	170	191	157	192
90	0	0	0	0	0	

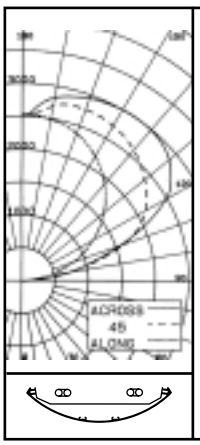
P-I-5434T8-LP/ELB 83.2 % Efficiency
Litecontrol Certified Test Report #234310001

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	.79	.79	.79	.79	.68	.68	.68	.68	.46	.46	.46	.27	.27	.27	.08	.08	.08	.00
1	.72	.69	.66	.63	.61	.59	.56	.54	.40	.39	.38	.23	.22	.22	.07	.07	.07	.00
2	.66	.60	.55	.51	.56	.51	.48	.44	.35	.33	.31	.20	.19	.18	.07	.06	.06	.00
3	.60	.53	.47	.43	.51	.45	.41	.37	.31	.28	.26	.18	.16	.15	.06	.05	.05	.00
4	.54	.46	.40	.36	.46	.40	.35	.31	.27	.24	.22	.16	.14	.13	.05	.05	.04	.00
5	.50	.41	.35	.30	.42	.35	.30	.26	.24	.21	.19	.14	.12	.11	.05	.04	.04	.00
6	.46	.36	.30	.26	.39	.31	.26	.23	.22	.18	.16	.13	.11	.09	.04	.04	.03	.00
7	.42	.33	.27	.22	.36	.28	.23	.19	.19	.16	.14	.11	.10	.08	.04	.03	.03	.00
8	.39	.29	.23	.19	.33	.25	.20	.17	.17	.14	.12	.10	.08	.07	.03	.03	.02	.00
9	.36	.27	.21	.17	.31	.23	.18	.15	.16	.13	.11	.09	.08	.06	.03	.02	.02	.00
10	.33	.24	.19	.15	.28	.21	.16	.13	.14	.11	.09	.08	.07	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	7242	83.2	100
90-0°	0	0	0
180-0°	7242	83.2	100



CANDLEPOWER SUMMARY

0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	2528	2528	2528	2528	2528	
175	2522	2524	2564	2626	2662	248
170	2491	2544	2697	2805	2832	
165	2450	2584	2768	2868	2901	770
160	2382	2597	2772	2909	2956	
155	2298	2566	2760	2929	2983	1258
150	2190	2490	2724	2931	3006	
145	2064	2389	2672	2920	3009	1649
140	1927	2270	2601	2891	2995	
135	1767	2123	2512	2844	2957	1900
130	1599	1973	2397	2735	2875	
125	1423	1806	2280	2607	2691	1957
120	1232	1632	2138	2428	2475	
115	1027	1449	1935	2068	2052	1719
110	815	1252	1619	1603	1557	
105	586	1025	1164	1103	1083	1098
100	360	719	711	720	712	
95	155	325	333	306	292	352
90	11	34	26	22	20	

P-I-5444BX40-LP/ELB 86.9 % Efficiency
Litecontrol Certified Test Report #23440000

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	.83	.83	.83	.83	.71	.71	.71	.71	.48	.48	.48	.28	.28	.28	.09	.09	.09	.00
1	.75	.72	.69	.66	.64	.61	.59	.56	.42	.41	.39	.24	.23	.23	.08	.08	.07	.00
2	.68	.62	.58	.53	.58	.53	.49	.46	.37	.34	.32	.21	.20	.19	.07	.06	.06	.00
3	.62	.55	.49	.45	.53	.47	.42	.39	.32	.29	.27	.19	.17	.16	.06	.06	.05	.00
4	.57	.48	.42	.37	.48	.42	.36	.32	.28	.25	.23	.17	.15	.13	.05	.05	.04	.00
5	.52	.42	.36	.32	.44	.37	.31	.27	.25	.22	.19	.15	.13	.12	.05	.04	.04	.00
6	.48	.38	.32	.27	.40	.33	.27	.24	.23	.19	.17	.13	.11	.10	.04	.04	.03	.00
7	.44	.34	.28	.23	.37	.29	.24	.20	.20	.17	.14	.12	.10	.09	.04	.03	.03	.00
8	.40	.31	.24	.20	.34	.26	.21	.18	.18	.15	.12	.11	.09	.07	.03	.03	.02	.00
9	.37	.28	.22	.18	.32	.24	.19	.15	.16	.13	.11	.10	.08	.07	.03	.03	.02	.00
10	.35	.25	.19	.15	.30	.22	.17	.13	.15	.12	.10	.09	.07	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	10946	86.88	100
90-0°	0	0	0
180-0°	10946	86.88	100

LITECONTROL . . . an employee owned company
100 HAWKS AVENUE HANSON MA 02341 781 294 0100 FAX 781 293 2849 info@litecontrol.com www.litecontrol.com

PHOTOMETRIC DATA: *Typical Size Ballast*

CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	1116	1116	1116	1116	1116	
175	1113	1117	1123	1130	1139	108
170	1100	1112	1133	1156	1165	
165	1078	1103	1143	1179	1193	323
160	1046	1084	1145	1197	1218	
155	1006	1060	1143	1212	1241	525
150	958	1025	1132	1220	1256	
145	901	984	1117	1223	1263	691
140	837	938	1094	1215	1261	
135	763	881	1057	1200	1255	801
130	686	820	1014	1166	1227	
125	604	757	968	1116	1154	834
120	519	684	913	1053	1104	
115	429	607	828	967	1006	767
110	337	528	728	814	820	
105	243	431	576	597	598	533
100	154	310	371	393	396	
95	71	151	176	177	177	182
90	5	12	15	14	14	

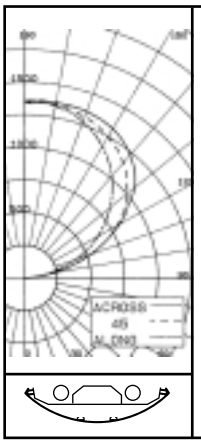
P-I-5424T8-ELB* 82.0 % Efficiency
Litecontrol Certified Test Report #23621000
***with ballast cover for single ballast**

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	.78	.78	.78	.78	.67	.67	.67	.67	.46	.46	.46	.26	.26	.26	.08	.08	.08	.00
1	.71	.68	.65	.62	.61	.58	.56	.53	.40	.38	.37	.23	.22	.21	.07	.07	.07	.00
2	.64	.59	.54	.50	.55	.50	.47	.43	.35	.32	.30	.20	.19	.18	.06	.06	.06	.00
3	.59	.52	.46	.42	.50	.44	.40	.37	.31	.28	.26	.18	.16	.15	.06	.05	.05	.00
4	.54	.46	.40	.35	.46	.39	.34	.31	.27	.24	.22	.16	.14	.13	.05	.05	.04	.00
5	.49	.40	.34	.30	.42	.35	.30	.26	.24	.21	.18	.14	.12	.11	.04	.04	.04	.00
6	.45	.36	.30	.26	.38	.31	.26	.22	.21	.18	.16	.12	.11	.09	.04	.03	.03	.00
7	.41	.32	.26	.22	.35	.28	.23	.19	.19	.16	.14	.11	.09	.08	.04	.03	.03	.00
8	.38	.29	.23	.19	.32	.25	.20	.17	.17	.14	.12	.10	.08	.07	.03	.03	.02	.00
9	.35	.26	.20	.17	.30	.22	.18	.14	.16	.12	.10	.09	.07	.06	.03	.02	.02	.00
10	.33	.24	.18	.15	.28	.20	.16	.13	.14	.11	.09	.08	.07	.05	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	4758	82.04	100
90-0°	0	0	0
180-0°	4758	82.04	100



CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	1355	1355	1355	1355	1355	
175	1356	1353	1351	1356	1366	130
170	1339	1339	1347	1362	1366	
165	1314	1319	1336	1356	1364	379
160	1276	1287	1314	1346	1359	
155	1228	1245	1288	1330	1345	595
150	1168	1193	1252	1304	1322	
145	1099	1134	1209	1264	1285	753
140	1021	1068	1154	1214	1233	
135	931	990	1086	1151	1169	826
130	837	909	1003	1060	1078	
125	738	820	914	947	940	788
120	632	724	807	821	819	
115	522	621	672	675	673	636
110	410	512	526	528	523	
105	291	373	377	373	368	385
100	174	232	229	223	218	
95	69	103	94	93	89	114
90	4	10	14	15	15	

P-I-5424T8-ELB* 79.3 % Efficiency
Litecontrol Certified Test Report #23521000
***with full length ballast cover**

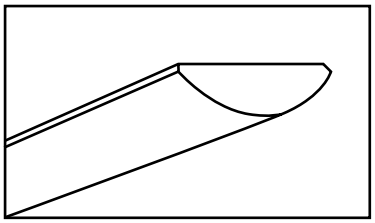
RCC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
RCR																		
0	.76	.76	.76	.76	.65	.65	.65	.65	.44	.44	.44	.25	.25	.25	.08	.08	.08	.00
1	.69	.66	.63	.60	.59	.56	.54	.51	.38	.37	.36	.22	.21	.21	.07	.07	.07	.00
2	.62	.57	.53	.49	.53	.49	.45	.42	.33	.31	.29	.19	.18	.17	.06	.06	.06	.00
3	.57	.50	.45	.41	.48	.43	.39	.35	.30	.27	.25	.17	.16	.15	.05	.05	.05	.00
4	.52	.44	.38	.34	.44	.38	.33	.30	.26	.23	.21	.15	.14	.12	.05	.04	.04	.00
5	.47	.38	.33	.29	.40	.34	.29	.25	.23	.20	.18	.13	.12	.11	.04	.04	.03	.00
6	.43	.35	.29	.25	.37	.30	.25	.21	.21	.18	.15	.12	.10	.09	.04	.03	.03	.00
7	.40	.31	.25	.21	.34	.27	.22	.18	.18	.15	.13	.11	.09	.08	.03	.03	.03	.00
8	.37	.28	.22	.18	.31	.24	.19	.16	.17	.14	.11	.10	.08	.07	.03	.03	.02	.00
9	.34	.25	.20	.16	.29	.22	.17	.14	.15	.12	.10	.09	.07	.06	.03	.02	.02	.00
10	.32	.23	.18	.14	.27	.20	.15	.12	.14	.11	.09	.08	.06	.05	.03	.02	.02	.00

Floor Cavity Reflectance .20

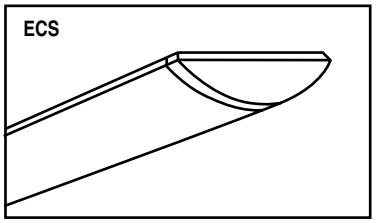
ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	4600	79.33	100
90-0°	0	0	0
180-0°	4600	79.33	100

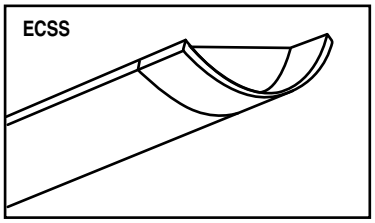
END CAP ILLUSTRATIONS



Flat End Cap
(standard)



Sculpted End Cap (ECS)
(optional)
To specify, add "ECS" to catalog designation

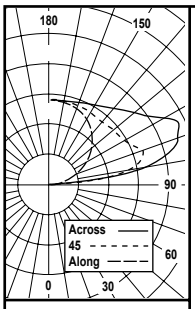


Shelf-Style End Cap (ECSS)
(optional)
To specify, add "ECSS" to catalog designation

See "Planning for Installation" on next page for fixture lengths with end caps included.

LITECONTROL . . . an employee owned company
100 HAWKS AVENUE HANSON MA 02341 781 294 0100 FAX 781 293 2849 info@litecontrol.com www.litecontrol.com

PHOTOMETRIC DATA: *T5 Lamps*



CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	859	859	859	859	859	
175	862	864	858	856	855	82
170	851	858	856	857	858	
165	835	845	850	861	868	242
160	811	826	845	878	890	
155	778	801	847	891	907	391
150	741	770	843	896	928	
145	696	740	829	920	971	523
140	644	712	824	965	1020	
135	586	674	836	1004	1074	648
130	525	630	846	1051	1139	
125	457	581	853	1108	1218	762
120	387	546	874	1213	1374	
115	312	521	925	1315	1408	890
110	235	483	986	1242	1342	
105	159	472	907	1122	1174	832
100	87	449	729	853	874	
95	31	296	358	314	285	323
90	0	0	0	0	0	

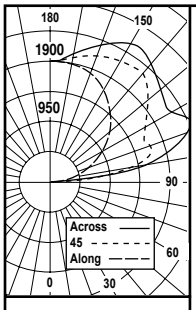
P-I-5414T5HO-LP/ELB 93.8 % Efficiency
ITL Certified Test Report #ITL49048 LC#27416000

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	.89	.89	.89	.89	.76	.76	.76	.76	.52	.52	.52	.30	.30	.30	.10	.10	.10	.00
1	.81	.78	.74	.71	.69	.66	.64	.61	.45	.44	.42	.26	.25	.25	.08	.08	.08	.00
2	.74	.68	.62	.58	.63	.58	.54	.50	.40	.37	.35	.23	.22	.20	.07	.07	.07	.00
3	.67	.59	.53	.48	.57	.51	.46	.42	.35	.32	.29	.20	.19	.17	.06	.06	.06	.00
4	.61	.52	.45	.40	.52	.45	.39	.35	.31	.27	.25	.18	.16	.15	.06	.05	.05	.00
5	.56	.46	.39	.34	.48	.40	.34	.30	.27	.24	.21	.16	.14	.12	.05	.05	.04	.00
6	.51	.41	.34	.29	.44	.35	.30	.25	.24	.21	.18	.14	.12	.11	.05	.04	.04	.00
7	.47	.37	.30	.25	.40	.32	.26	.22	.22	.18	.16	.13	.11	.09	.04	.04	.03	.00
8	.44	.33	.26	.22	.37	.29	.23	.19	.20	.16	.14	.11	.10	.08	.04	.03	.03	.00
9	.40	.30	.24	.19	.34	.26	.20	.17	.18	.14	.12	.10	.08	.07	.03	.03	.02	.00
10	.38	.27	.21	.17	.32	.23	.18	.15	.16	.13	.10	.09	.08	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	4691	93.8	100
90-0°	0	0	0
180-0°	4691	93.8	100



CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	1857	1857	1857	1857	1857	
175	1856	1870	1878	1885	1892	181
170	1836	1881	1937	1978	1999	
165	1802	1887	1999	2080	2119	563
160	1752	1885	2053	2179	2236	
155	1683	1870	2101	2276	2354	957
150	1603	1842	2140	2363	2443	
145	1504	1799	2167	2377	2431	1301
140	1397	1746	2154	2302	2354	
135	1271	1682	2062	2209	2282	1493
130	1138	1604	1922	2104	2173	
125	996	1503	1784	1990	2089	1531
120	844	1362	1631	1973	2163	
115	681	1171	1551	2116	2305	1563
110	514	978	1610	2019	2117	
105	349	825	1464	1716	1779	1333
100	192	785	1109	1264	1279	
95	68	461	501	499	467	500
90	0	0	0	0	0	

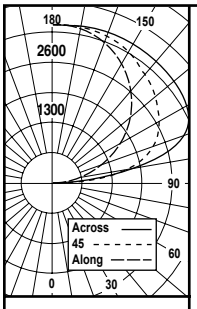
P-I-5424T5HO-LP/ELB 94.2 % Efficiency
ITL Certified Test Report #ITL49049 LC#27426000

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	.90	.90	.90	.90	.77	.77	.77	.77	.52	.52	.52	.30	.30	.30	.10	.10	.10	.00
1	.82	.78	.74	.71	.70	.67	.64	.61	.46	.44	.43	.26	.25	.25	.08	.08	.08	.00
2	.74	.68	.63	.58	.63	.58	.54	.50	.40	.37	.35	.23	.22	.21	.07	.07	.07	.00
3	.68	.59	.53	.48	.57	.51	.46	.42	.35	.32	.29	.20	.19	.17	.06	.06	.06	.00
4	.62	.52	.46	.40	.52	.45	.39	.35	.31	.27	.25	.18	.16	.15	.06	.05	.05	.00
5	.56	.46	.39	.34	.48	.40	.34	.30	.27	.24	.21	.16	.14	.12	.05	.05	.04	.00
6	.52	.41	.34	.29	.44	.35	.30	.26	.24	.21	.18	.14	.12	.11	.05	.04	.04	.00
7	.48	.37	.30	.25	.40	.32	.26	.22	.22	.18	.16	.13	.11	.09	.04	.04	.03	.00
8	.44	.33	.27	.22	.37	.29	.23	.19	.20	.16	.14	.12	.10	.08	.04	.03	.03	.00
9	.41	.30	.24	.19	.35	.26	.20	.17	.18	.14	.12	.10	.09	.07	.03	.03	.02	.00
10	.38	.27	.21	.17	.32	.24	.18	.15	.16	.13	.10	.10	.08	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	9421	94.2	100
90-0°	0	0	0
180-0°	9421	94.2	100



CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	3381	3381	3381	3381	3381	
175	3385	3391	3382	3369	3374	323
170	3349	3364	3376	3383	3395	
165	3286	3319	3361	3398	3422	950
160	3192	3248	3329	3388	3419	
155	3075	3158	3274	3369	3415	1506
150	2931	3044	3201	3335	3394	
145	2756	2911	3109	3289	3371	1940
140	2560	2749	3003	3247	3353	
135	2343	2570	2890	3210	3341	2226
130	2100	2373	2785	3177	3328	
125	1838	2168	2686	3132	3294	2364
120	1566	1957	2584	3055	3228	
115	1274	1763	2449	2943	3116	2312
110	971	1581	2262	2748	2901	
105	655	1384	2001	2392	2474	1892
100	363	1048	1524	1553	1484	
95	122	654	588	579	541	606
90	0	0	0	0	0	

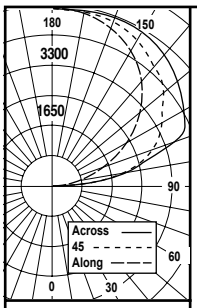
P-I-5434T5HO-LP/ELB 94.1 % Efficiency
ITL Certified Test Report #ITL49050 LC#27436000

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	.90	.90	.90	.90	.77	.77	.77	.77	.52	.52	.52	.30	.30	.30	.10	.10	.10	.00
1	.82	.78	.74	.71	.70	.67	.64	.61	.46	.44	.42	.26	.25	.25	.08	.08	.08	.00
2	.74	.68	.63	.58	.63	.58	.54	.50	.40	.37	.35	.23	.22	.21	.07	.07	.07	.00
3	.68	.59	.53	.58	.57	.51	.46	.42	.35	.32	.29	.20	.19	.17	.06	.06	.06	.00
4	.62	.52	.46	.40	.52	.45	.39	.35	.31	.27	.25	.18	.16	.15	.06	.05	.05	.00
5	.56	.46	.39	.34	.48	.40	.34	.30	.27	.24	.21	.16	.14	.12	.05	.05	.04	.00
6	.52	.41	.34	.29	.44	.35	.30	.26	.24	.21	.18	.14	.12	.11	.05	.04	.04	.00
7	.47	.37	.30	.25	.40	.32	.26	.22	.22	.18	.16	.13	.11	.09	.04	.04	.03	.00
8	.44	.33	.27	.22	.37	.29	.23	.19	.20	.16	.14	.12	.10	.08	.04	.03	.03	.00
9	.41	.30	.24	.19	.35	.26	.20	.17	.18	.14	.12	.10	.08	.07	.03	.03	.02	.00
10	.38	.27	.21	.17	.32	.23	.18	.15	.16	.13	.10	.10	.08	.06	.03	.02	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	14118	94.1	100
90-0°	0	0	0
180-0°	14118	94.1	100



CANDLEPOWER SUMMARY
0° PLANE PARALLEL TO LAMPS

ANGLE	0	22.5	45	67.5	90	OUTPUT LUMENS
180	4836	4836	4836	4836	4836	
175	4869	4861	4853	4832	4845	461
170	4796	4812	4824	4836	4861	
165	4706	4743	4804	4845	4877	1357
160	4575	4649	4747	4828	4877	
155	4412	4514	4661	4788	4853	2147
150	4200	4351	4547	4730	4820	
145	3980	4164	4433	4669	4763	2764
140	3686	3939	4274	4563	4682	
135	3385	3678	4094	4437	4567	3126
130	3042	3397	3882	4274	4429	
125	2675	3111	3646	4102	4282	3210
120	2284	2797	3389	3923	4111	
115	1868	2463	3140	3719	3923	3022
110	1444	2092	2875	3348	3409	
105	971	1721	2402	2602	2651	2217
100	546	1378	1582	1590	1525	
95	196	673	599	599	571	636
90	0	0	0	0	0	

P-I-5444T5HO-LP/ELB 94.7 % Efficiency
ITL Certified Test Report #ITL49051 LC#27446000

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	.90	.90	.90	.90	.77	.77	.77	.77	.53	.53	.53	.30	.30	.30	.10	.10	.10	.00
1	.82	.78	.75	.72	.70	.67	.64	.62	.46	.44	.43	.26	.26	.25	.08	.08	.08	.00
2	.75	.68	.63	.58	.63	.58	.54	.51	.40	.37	.35	.23	.22	.21	.07	.07	.07	.00
3	.68	.60	.54	.48	.58	.51	.46	.42	.35	.32	.29	.20	.19	.17	.07	.06	.06	.00
4	.62	.53	.46	.41	.53	.45	.40	.35	.31	.28	.25	.18	.16	.15	.06	.05	.05	.00
5	.57	.47	.40	.34	.48	.40	.34	.30	.28	.24	.21	.16	.14	.13	.05	.05	.04	.00
6	.52	.41	.34	.29	.44	.36	.30	.26	.25	.21	.18	.14	.12	.11	.05	.04	.04	.00
7	.48	.37	.30	.25	.41	.32	.26	.22	.22.	18	.16	.13	.11	.09	.04	.04	.03	.00
8	.44	.33	.27	.22	.37	.29	.23	.19	.20	.16	.14	.12	.10	.08	.04	.03	.03	.00
9	.41	.30	.24	.19	.35	.26	.21	.17	.18	.14	.12	.11	.09	.07	.03	.03	.02	.00
10	.38	.27	.21	.17	.32	.24	.18	.15	.16	.13	.11	.10	.08	.06	.03	.03	.02	.00

Floor Cavity Reflectance .20

ZONAL LUMEN SUMMARY

ZONE	LUMENS	% LAMP	% LUMINAIRE
180-90°	18941	94.7	100
90-0°	0	0	0
180-0°	18941	94.7	100

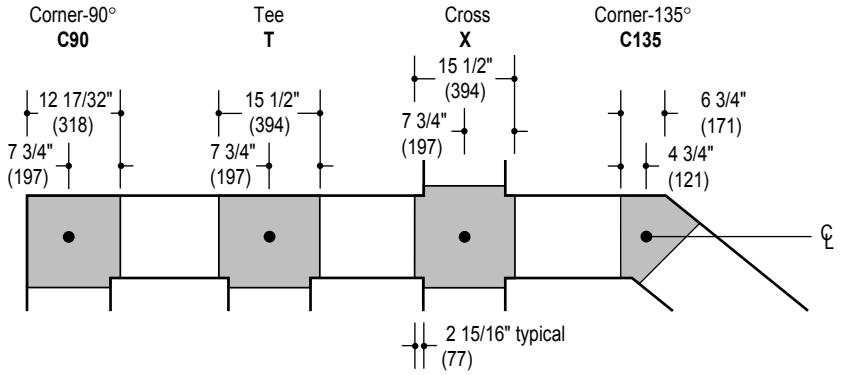
LITECONTROL . . . an employee owned company
100 HAWKS AVENUE HANSON MA 02341 781 294 0100 FAX 781 293 2849 info@litecontrol.com www.litecontrol.com

SYSTEM CONNECTORS

Catalog Number

Series	-	Connector	-	Finish
P-I-5400		C90		
P-I-5400		C135		
P-I-5400		T		
P-I-5400		X		

P-I-5400-C90-CWM is a typical catalog number for a 90° corner connector finished Matte White.



PLANNING FOR INSTALLATION

SUSPENSION ASSEMBLIES

Provided with P6S (5/8" dia., 3/8" NPT) stems, or 3/32" diameter aircraft cable assemblies. Stems with 0-45° swivel joints are available. Aircraft cable is provided at fixed lengths (with 1/4-20 stud adjustment for leveling purposes), or may be ordered with "field-adjustable" fittings that allow unlimited vertical positioning and adjustment. See *Stems & Aircraft Cables* sheet for further details.

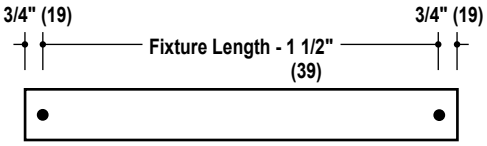
STEM LENGTHS

P6S stems are available in eight standard lengths from 6" to 36" (nominal). For Arcos, the actual ceiling-to-top-of-fixture dimensions for each of the standard lengths are: 6", 9", 12", 15", 18", 24", 28", and 36". Refer to *Standard Length Stem Assemblies* sheet for dimensional information on sloped ceiling (SC/P6) and earthquake (EQ/P6) stem assemblies.

SUSPENSION MOUNTING LOCATIONS

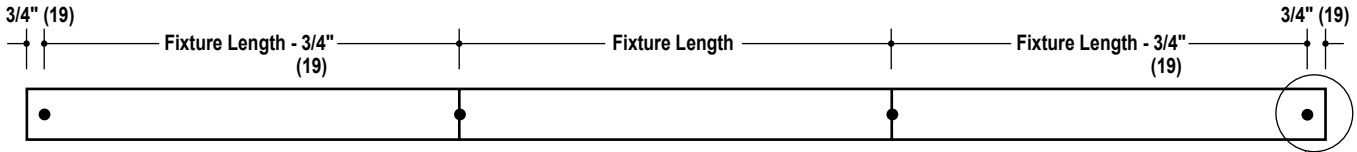
Pendant locations at ends of rows (or individual fixtures) are 3/4" from fixture end. Pendant locations at in-row joints are at the joint. All pendant types (cable or stem) attach to universal flat strap for mounting either at a fixture end or across two fixtures at a row joint. Strap attachment allows for horizontal adjustment to "fine-tune" side-to-side leveling.

INDIVIDUAL FIXTURE

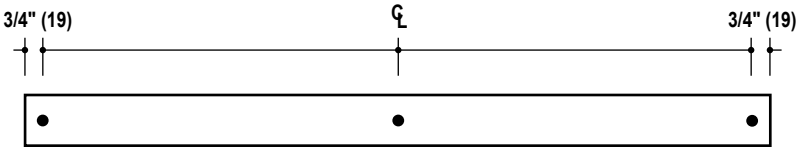


Fixture Lengths: 4'-3", 8'-3", 12'-3", 16'-6", 20'-6", or
● 24'-6" Indicates pendant locations

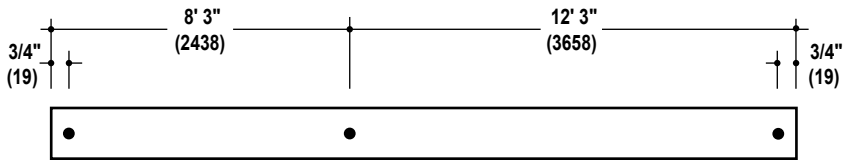
ROW DIAGRAM



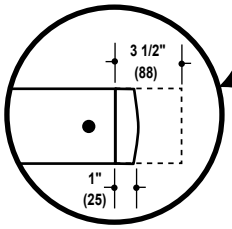
ADDITIONAL SUSPENSION FOR FIXTURES 16' AND OVER



16' 6" and 24' 6" fixtures require an additional mounting location at the centerline (℄) of fixture.



20' 6" fixture requires and additional mounting location 8' 3" from one end (12' 3" from the other end) of the fixture.



Optional **ECS** (sculpted) end cap adds 1" length to each end of row or individual fixture.

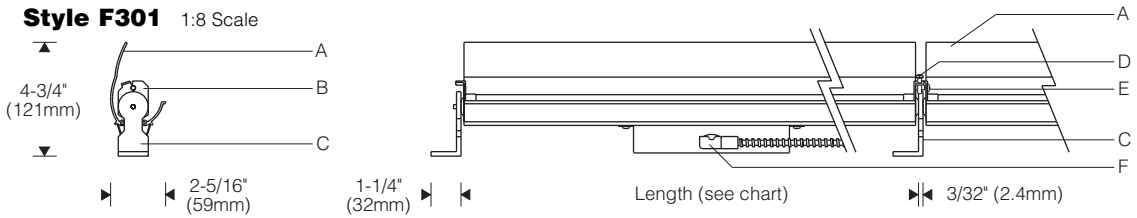
Optional **ECSS** (shelf style) end cap adds 3 1/2" length to each end of row or individual fixture.

QUESTIONS TO ASK:

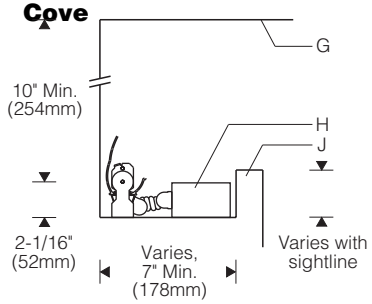
1. 120 or 277 volt?
2. Row information, including desired fixture lengths?
3. White, LiteColor, or special color?
4. Tandem wiring?
5. Cables or stems, what length?
6. Other options?

LITECONTROL . . . an employee owned company
100 HAWKS AVENUE HANSON MA 02341 781 294 0100 FAX 781 293 2849 info@litecontrol.com www.litecontrol.com

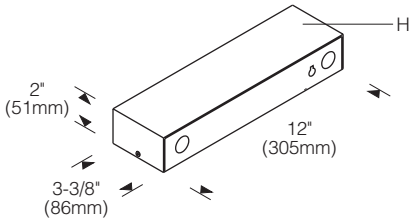
Style F301 1:8 Scale



Cove



Remote Ballast



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

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

Specifications

A Specular extruded aluminum reflector
B Stainless steel lamp-holder/support brackets
C Aluminum L-shaped mounting brackets
D Rotation locking screw
E Joiner/alignment screw
F Flexible metal conduit with 90° connector
G Ceiling
H Remote ballast in aluminum enclosure
J Architectural cove (for design guidance, see Applications Section)

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

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

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

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

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

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

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

For complete ballast specifications, see Accessories Section.

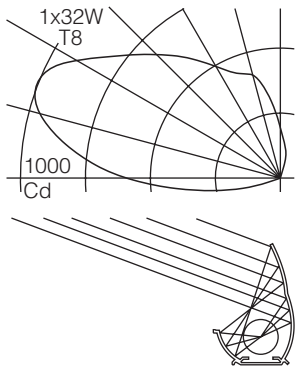
Features

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

C 11.0

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 www.elliptipar.com

elliptipar

To form a Catalog Number

F	3 0 1	-		-	S	-	0 0	-			-		
1	2		3		4		5		6			7	8

Project: Type:

1 Source

F = Linear fluorescent

2 Style

301 = Small concealed, **remote** ballast

3 Lamp

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

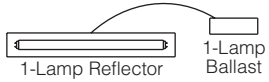
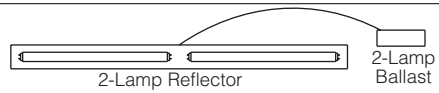
A [ ] [ ] = **Lamp Code** (to specify individual units)

Lamp Wattage (see chart below)

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

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

Reflector Configuration

1	
2	
3	

C 11.1

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

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

4 Mounting

S = L-shaped brackets for wall or base mounting

5 Finish

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

6 Voltage/Ballast

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

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

7 Option (see Accessories Section for specifications)

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

8 Standard

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

Example

F301 - A225 - S - 00 - 1 - 000

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

Accessories

Order separately. See Accessories Section for specifications.

AFK000X [ ] = Ballast **fuse** kit
0 = UL
J = CSA

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

The external shapes of the asymmetric reflectors are trademarks of **elliptipar.** *Certain products illustrated may be covered by applicable patents and patents pending. For a list of patents, see Contents pages. These specifications supersede all prior publications and are subject to change without notice.* © 2004 **elliptipar.**

To order by Row Code - T5 lamps

When the Style 301 small concealed T8 fluorescent is run continuously in **straight** coves, **elliptipar** offers the option of specifying and ordering the entire row as one catalog number. Ordering by row eliminates the need to calculate length, type and quantity of reflectors.

Steps to specify Row Code:

1. Determine clear inside length of cove.
2. Round up to nearest foot and find the nominal row length in chart.
3. Determine what lengths/wattages of lamps will be used and select the corresponding lamp combination codes.

   Example: If only 3' and 4' lamps are to be used on the project, specify row codes ending with **A**, **B** and/or **D** only.
4. If for a given nominal row length a preferred lamp combination is not listed, select the next shorter row that is available in the desired lamp combination.
5. Once the nominal row length and lamp combination has been found in the chart, note the actual overall row length (last column).
6. Consider the unlighted length at each end of the row. (Subtract the overall row length from the clear inside length, and divide the remainder by two.) It is generally recommended that the unlighted length at each end be between 6" and 12".
7. Enter the four character Row Code in place of the Lamp Code described on page C-11.1. The remainder of the catalog number is formed as shown on page C-11.1.

Features

- *Time saving - simplifies specification and ordering*
- *One catalog number - includes all necessary reflectors, brackets and remote ballasts to install row*
- *Economical use of 3- and 4-lamp ballasts (when available)*
- *Assured fit - all you need is the clear inside length of the cove*

3 Row Code

Note: Enter row code in place of Lamp Code described on page C-11.1.

R [ ][ ] = **Row Code**

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

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

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

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

Example

F301 - R15D - S - 00 - 2 - 000

Nominal 15' long row of Style 301 small concealed T8 fluorescent using only 3' (25W) and 4' (32W) lamps. Row includes one nominal 8' 2x32W reflector, one nominal 6' 2x25W reflector, mounting brackets and remote 277V electronic ballasts. Overall row length is 14' 2-1/2".

Nominal Row Length (feet)	*Lamp Combination*	*Nominal 3' Reflector (1 x F25T8 lamp)*	*Nominal 4' Reflector (1 x F32T8 lamp)*	*Nominal 5' Reflector (1 x F40T8 lamp)*	*Nominal 6' Reflector (2 x F25T8 lamps)*	*Nominal 8' Reflector (2 x F32T8 lamps)*	*Nominal 10' Reflector (2 x F40T8 lamps)*	*Overall Row Length*
04	**A**	1						3' 1-7/8"
05	**B**		1					4' 1-7/8"
06	**C**			1				5' 1-3/4"
07	**A**				1			6' 2-3/8"
08	**D**	1	1					7' 2-1/2"
09	**B**					1		8' 2-3/8"
09	**F**	1		1				8' 2-3/8"
10	**A**	1			1			9' 3"
10	**G**		1	1				9' 2-3/8"
11	**C**						1	10' 2-1/8"
11	**D**		1		1			10' 3"
12	**D**	1				1		11' 3"
12	**F**			1	1			11' 2-7/8"
13	**A**				2			12' 3-1/2"
13	**B**		1			1		12' 3"
14	**D**	1	1		1			13' 3-5/8"
14	**F**	1					1	13' 2-3/4"
14	**G**			1		1		13' 2-7/8"
15	**D**				1	1		14' 3-1/2"
15	**F**	1		1	1			14' 3-1/2"
15	**G**		1				1	14' 2-3/4"
16	**C**			1			1	15' 2-5/8"
16	**D**	1	1			1		15' 3-5/8"
17	**B**					2		16' 3-1/2"
17	**F**				1		1	16' 3-1/4"
18	**D**	1			1	1		17' 4-1/8"
18	**F**			1	2			17' 4"
18	**G**		1	1		1		17' 3-1/2"
19	**A**				3			18' 4-5/8"
19	**D**		1		1	1		18' 4-1/8"
19	**F**	1		1			1	18' 3-1/4"
19	**G**					1	1	18' 3-1/4"
20	**D**	1				2		19' 4-1/8"
20	**F**	1			1		1	19' 3-7/8"
20	**G**		1	1			1	19' 3-1/4"

To order by Row Code - T8 lamps

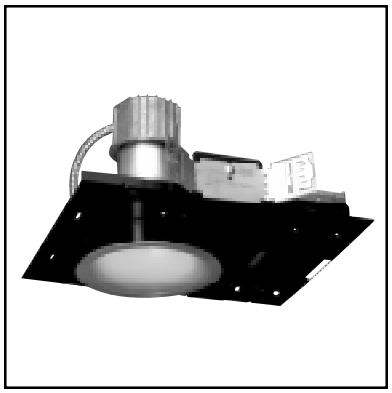
Project: _____ Type: _____

Nominal Row Length (feet)	Lamp Combination	Nominal 3' Reflector (1 x F25T8 lamp)	Nominal 4' Reflector (1 x F32T8 lamp)	Nominal 5' Reflector (1 x F40T8 lamp)	Nominal 6' Reflector (2 x F25T8 lamps)	Nominal 8' Reflector (2 x F32T8 lamps)	Nominal 10' Reflector (2 x F40T8 lamps)	Overall Row Length
21	**B**		1			2		20' 4-1/8"
21	**C**						2	20' 3"
22	**A**	1			3			21' 5-1/8"
22	**F**			1	1		1	21' 3-3/4"
22	**G**			1		2		21' 4"
23	**D**				1	2		22' 4-5/8"
23	**F**				2		1	22' 4-3/8"
23	**G**		1			1	1	22' 3-7/8"
24	**D**	1	1			2		23' 4-5/8"
24	**F**	1					2	23' 3-5/8"
24	**G**			1		1	1	23' 3-3/4"
25	**B**					3		24' 4-5/8"
25	**G**		1				2	24' 3-5/8"
26	**C**			1			2	25' 3-1/2"
26	**D**	1			1	2		25' 5-1/8"
26	**G**		1	1		2		25' 4-1/2"
27	**D**		1		1	2		26' 5-1/8"
27	**F**				1		2	26' 4-1/8"
27	**G**					2	1	26' 4-3/8"
28	**A**	1			4			27' 6-1/4"
28	**D**	1				3		27' 5-1/8"
28	**G**		1	1		1	1	27' 4-1/4"
29	**B**		1			3		28' 5-1/8"
29	**F**	1		1			2	28' 4"
29	**G**					1	2	28' 4-1/8"
30	**D**	1	1		1	2		29' 5-3/4"
30	**F**	1			1		2	29' 4-5/8"
30	**G**		1	1			2	29' 4"
31	**A**				5			30' 6-3/4"
31	**C**						3	30' 3-7/8"
31	**D**				1	3		30' 5-5/8"
31	**G**		1			2	1	30' 4-7/8"
32	**D**	1	1			3		31' 5-3/4"
32	**F**			1	1		2	31' 4-1/2"
32	**G**			1		2	1	31' 4-3/4"
33	**B**					4		32' 5-5/8"
33	**F**				2		2	32' 5-1/8"
33	**G**		1			1	2	32' 4-5/8"
34	**A**	1			5			33' 7-3/8"
34	**F**	1					3	33' 4-3/8"
34	**G**			1		1	2	33' 4-1/2"
35	**D**		1		1	3		34' 6-1/4"
35	**F**	1		1	1		2	34' 5-1/8"
35	**G**		1				3	34' 4-3/8"
36	**C**			1			3	35' 4-1/4"
36	**D**	1				4		35' 6-1/4"
37	**A**				6			36' 7-1/8"
37	**B**		1			4		36' 6-1/4"
37	**F**				1		3	36' 4-7/8"
37	**G**					2	2	36' 5-1/8"
38	**D**	1	1		1	3		37' 6-7/8"
38	**F**			1	2		2	37' 5-5/8"
38	**G**			1		4		37' 6-1/8"
39	**D**				1	4		38' 6-3/4"
39	**F**	1		1			3	38' 4-7/8"
39	**G**					1	3	38' 4-7/8"
40	**A**	1			6			39' 8-1/2"
40	**D**	1	1			4		39' 6-7/8"
40	**G**		1	1			3	39' 4-7/8"
41	**B**					5		40' 6-3/4"
41	**C**						4	40' 4-5/8"
41	**D**		1		2	3		40' 7-3/8"
42	**D**	1			1	4		41' 7-3/8"
42	**F**			1	1		3	41' 5-3/8"
42	**G**		1	1		4		41' 6-3/4"
43	**A**				7			42' 9"
43	**D**		1		1	4		42' 7-3/8"
43	**F**				2		3	42' 6"
43	**G**					4	1	42' 6-1/2"
44	**D**	1				5		43' 7-3/8"
44	**F**	1					4	43' 5-1/4"
44	**G**			1		1	3	43' 5-3/8"
45	**B**		1			5		44' 7-3/8"
45	**F**	1		1	1		3	44' 6"
45	**G**		1				4	44' 5-1/4"
46	**A**	1			7			45' 9-1/2"
46	**C**			1			4	45' 5-1/8"
46	**G**			1		5		45' 7-1/4"
47	**D**				1	5		46' 7-7/8"
47	**F**				1		4	46' 5-3/4"
47	**G**					2	3	46' 6"
48	**D**	1	1			5		47' 8"
48	**F**			1	2		3	47' 6-1/2"
48	**G**		1	1		1	3	47' 6"
49	**A**				8			48' 10"
49	**B**					6		48' 7-7/8"
49	**F**	1		1			4	48' 5-3/4"
49	**G**					1	4	48' 5-3/4"
50	**D**	1			1	5		49' 8-1/2"
50	**F**	1			1		4	49' 6-3/8"
50	**G**		1	1			4	49' 5-3/4"

C 11.3

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

The external shapes of the asymmetric reflectors are trademarks of ***elliptipar.*** *Certain products illustrated may be covered by applicable patents and patents pending. For a list of patents, see Contents pages. These specifications supersede all prior publications and are subject to change without notice.* © 2004 ***elliptipar.***



Featuring VirtualS•urce® Reflectors

8" Vertical Open, Lensed, & Wall Wash Downlight

CFT870EB

One 70W Double Quad Tube
4-Pin Lamp
Non-IC Rated
120V – 277V

DATE: TYPE: G

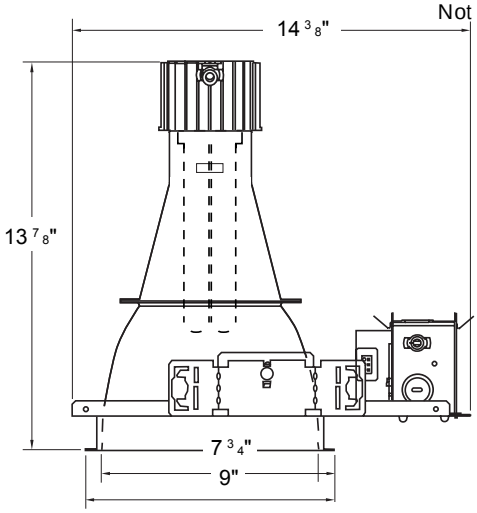
FIRM NAME:

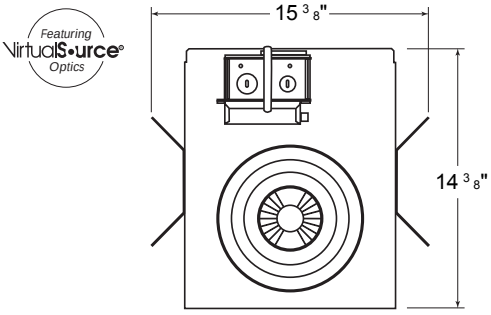
PROJECT:

Architektūr

Ceiling Cutout: 8¼"
Maximum Ceiling Thickness: 1¼"
For conversion to millimeters, multiply inches by 25.4

Not to Scale





APPLICATIONS:

The CFT870EB offers a vertical lamped compact fluorescent downlight, lensed, and wall wash fixture that provides superior brightness and glare control. The multi-volt ballast provides the capacity for voltages from 120 – 277V. This luminaire is ideal for a wide variety of medium to high ceiling applications including commercial, retail, and hospitality. The CFT870EB luminaire is compatible with the Signos8 family of architectural elements.

HOUSING:

One-piece 18-gauge galvaneal steel platform. Prewired J-box with snap-on cover for easy access. Vented at lamp tip and socket for maximum light output. Same housing accommodates downlight, lensed, and wall wash reflectors. Diecast aluminum heat sink.

REFLECTOR:

High purity aluminum Alzak® Virtual Source® iridescence suppressed reflector. Self-trim (ST) standard. Painted white self-trim (WT) available.

BALLAST:

One (1) compact fluorescent Class 'P' electronic ballast suitable for operating all 70W double quad tube. HPF and EOL protection standard. Accessible from below or above ceiling.

LAMP:

One (1) 70W (GX24q-6 base), 4-pin double quad tube compact fluorescent lamp. Lamp furnished by others.

SOCKET:

One (1) injection molded socket suitable for 70W double quad tube lamps (vented).

INSTALLATION:

Universal adjustable mounting brackets accommodate 1½" or ¾" lathing channel (by others) or Prescolite 24" bar hangers (B24 or B6).

LABELS:

Wet location when used with lensed trims. UL, CSA listed for damp locations. Approved for through wiring Non-type I.C.

CATALOG NUMBER: EXAMPLE: CFT870EB-STF857/70CG-B6

HOUSING

- ❑ **CFT870EB**
  8", (1) 70W Double quad tube, multi-volt electronic ballast

HOUSING OPTIONS

- ❑ **CP**
  Chicago Plenum. Fixture construction and/or specifications may vary. Refer to specification sheets on www.prescolite.com for details.
- ❑ **DM**
  Electronic analog dimming ballast
- ❑ **FSDFA**
  Fuse kit installed at factory
- ❑ **RIF1**
  Radio interference filter (single circuit)
- ❑ **EM**
  Emergency battery pack with remote test switch and indicator light

REFLECTOR FINISH

- ❑ **STF857/70**
  8" Specular clear Alzak
- ❑ **STF857/70MFC**
  8" American Matte™ clear
- ❑ **STF857/70HZ**
  8" Haze clear Alzak
- ❑ **STF857/70SS**
  8" Semi-specular clear Alzak

REFLECTOR COLOR

- ❑ **CG**
  8" Champagne Gold Alzak
- ❑ **PW**
  8" Pewter Alzak
- ❑ **BL**
  8" Black Alzak
- ❑ **WE**
  8" Wheat Alzak
- ❑ **LW**
  8" Light Wheat Alzak

Painted Options*

- ❑ **WC**-White Cone
- ❑ **BC**-Black Cone

*All painted options come standard with an upper specular clear Alzak reflector. For regressed lens only.

REFLECTOR OPTIONS

- ❑ **DL**
  Regressed diffuse lens
- ❑ **CL**
  Regressed clear lens
- ❑ **PL**
  Regressed prismatic lens
- ❑ **TRG**
  Trim ring gasket (factory installed)
- ❑ **WT**
  Painted white self-flange (substitute WT for ST)
- ❑ **WW**
  Wall wash reflector (not available with baffle or lensed trims)

ACCESSORIES

- ❑ **B24**
  Set of two (2) 24" bar hangers for T-bar ceilings
- ❑ **B6**
  Set of two (2) bar hangers for ceiling joists up to 24" centers
- ❑ **FSDFI**
  Fuse kit for field installation
- ❑ **SCA8D**
  Sloped ceiling adapter (see note on back page)
- ❑ **Signos8**
  Architectural glass elements Refer to specification sheets ARCH-SIG-005 through -008

prescolite
An Affiliate of Hubbell Lighting, Inc.

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.
Web: **www.prescolite.com** · Tech Support: **(888) 777-4832**

PHOTOMETRIC DATA

Architektūr - 8" Vertical Open & Wall Wash Downlights - CFT870EB

BALLAST DATA	70W Double Quad	
	120V	***277V***
Total System Watts	75W	75W
Input Current (Amps)	0.63	0.27
Input Frequency in Hz	50/60	50/60
Power Factor	>98%	>98%
Ballast Factor	>96%	>96%
Total Harmonic Distortion	<10%	<10%
Minimum Starting Temperature	0°C (32°F)	0°C (32°F)

LAMP DATA

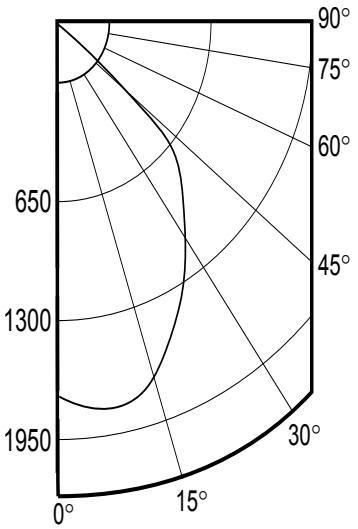
Rated Watts	70W Double Quad
Rates Lumens	5200
Efficacy (LPW)	74
Rated Life	12,000 hours
CRI	82
Min. Starting Temp.	-10º F

CFT870EB-STF870

Lamp: One 70W Double Quad
Rated Lumens: 5200
Spacing Criteria:
0° = 0.9
Efficiency = 38.6%

CANDLEPOWER DISTRIBUTION

Test No. 2003096



CANDLEPOWER SUMMARY

Angle	Mean CP
0	1845
5	1877
10	1768
15	1602
20	1436
25	1241
30	1061
35	836
40	642
45	406
50	81
55	16
60	7
65	4
70	2
75	2
80	1
85	1
90	0

LUMINANCE DATA IN CANDELA/SQ. METER

Angle	Mean CD/SQ. M.
DEG.	0-DEG
45°	17697
55°	860
65°	292
75°	238
85°	354

AVERAGE INITIAL FOOTCANDLES

Multiple Units (Square Array)
Ceiling 80% Wall 50% Floor 20%
Assumptions:
1. 4 fixtures evenly spaced in the center of the room.
2. The room is square and has a width and length equal to twice the lamp spacing.
3. The lumen depreciation factor is .8
4. The dirt depreciation factor is .98

70W Double Quad

SPACING	RCR1	RCR3	RCR7
7.0	26	22	17
8.0	20	17	13
9.0	16	14	10
10.0	13	11	8
11.0	11	9	7
12.0	9	8	6
13.0	8	6	5
14.0	7	6	4
15.0	6	5	4

COEFFICIENTS OF UTILIZATION

Zonal Cavity Method

Room Cavity Ratio	% Effective Floor Cavity Reflectance: 80%				70%				50%			30%			10%			0%
	20% Effective Floor Cavity Reflectance																	
	% Wall Reflectance																	
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
0	.34	.34	.34	.34	.33	.33	.33	.33	.32	.32	.32	.31	.31	.31	.29	.29	.29	.29
1	.32	.32	.31	.30	.32	.31	.30	.30	.30	.29	.29	.29	.28	.28	.28	.27	.27	.27
2	.31	.29	.28	.27	.30	.29	.28	.27	.28	.27	.26	.27	.26	.26	.26	.26	.25	.25
3	.29	.27	.26	.24	.28	.27	.25	.24	.26	.25	.24	.25	.24	.23	.25	.24	.23	.23
4	.27	.25	.23	.22	.27	.25	.23	.22	.24	.23	.22	.24	.22	.21	.23	.22	.21	.21
5	.26	.23	.22	.20	.25	.23	.21	.20	.23	.21	.20	.22	.21	.20	.22	.20	.20	.19
6	.24	.22	.20	.19	.24	.21	.20	.18	.21	.19	.18	.21	.19	.18	.20	.19	.18	.18
7	.23	.20	.18	.17	.23	.20	.18	.17	.20	.18	.17	.19	.18	.17	.19	.18	.17	.16
8	.22	.19	.17	.16	.21	.19	.17	.16	.18	.17	.16	.18	.17	.16	.18	.17	.16	.15
9	.21	.18	.16	.15	.20	.18	.16	.15	.17	.16	.15	.17	.16	.15	.17	.15	.15	.14
10	.20	.17	.15	.14	.19	.17	.15	.14	.16	.15	.14	.16	.15	.14	.16	.15	.14	.13

CFT870EB-STF857 Test No. 2003096

NOTES

Ⓢ Denotes a Virtual Source reflector.

Refer to www.prescolite.com for additional photometric tests (IES Files).

When ordering a sloped ceiling adapter, specify the degree of slope in 5° increments, max. of 35°. For a more precise degree or wet ceiling applications, please contact factory. Sloped ceiling adapter and housing must be installed at the same time.

prescolite
Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**
101 Corporate Drive, Suite L • Spartanburg, SC 29303 U.S.A. • Phone (864) 599-6000
Prescolite is an affiliate of Hubbell Lighting, Inc., with representatives' offices throughout North America

Copyright ©2005 Prescolite, All Rights Reserved • Specifications subject to change without notice. • Printed in U.S.A. • ARCH-CFL-049 • 01/05

HUBBELL
Hubbell Lighting, Inc.

TYPE H

Description: Antique gold collection accented by crystal adorned arms and crystal bobeches

Finish: Polished Brass/Gold/Gold Whitewash

Model number 6858/12+6+3

Height	53"
Material	Polished Brass/Gold/Gold Whitewash
Diameter	49"
Maximum Wattage	60
Number of Lights	21
Number of tiers	3
Bulb time	BulbType
Weight	89 (lbs)
Type	Chandelier

back to index

101 West White Street Summit Hill, PA 18250 800-613-3261 Fax: 570-645-4574 elk@elklighting.com

PHILIPS

PL-T Triple 4-Pin Fluorescent Lamp

Feature	High color rendering, high efficacy lamps feature 4-pin base for use with preheat, rapid start, electronic and dimming circuits. Featuring **ALTO®** Lamp Technology
Watts	26
Bulb	PL-T
Base	GX24q-3
Product Number	046677-26823-5
Ordering Code	PL-T26W/830/4P/ALTO
Generic Designation	CFTR26W/GX24q/830
Package Quantity	12
Description	3000K
CRI	82
Avg. Hrs. Life	10,000
Design Lumens	1530
M.O.L.	5
Lumens	1800

Images

+ ALTO Product Logo
+ Family Photo
+ Product Photo

Literature

+ ALTO Family Brochure
+ MSDS S08-98001

Other Information

• Energy Saving Product
+ Printable Page
+ View Compatible Ballasts
+ Send this Link
+ Bookmark this Page

Footnotes

+ This Product Contains Amalgam
+ High Color Rendering Lamp
+ Features **ALTO®** Lamp Technology
+ Rated average life under specified test conditions with Programmed Start ballasts with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently.

+ Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions.
+ Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions.

Information for this product last modified on September 25, 2001

©2004-2005 Koninklijke Philips Electronics N.V. All rights reserved. Privacy policy
Philips. Access to and use of this Web Site is subject to these Terms of use.

PHILIPS

PL-T Triple 4-Pin Fluorescent Lamp

Feature	High color rendering, high efficacy lamps feature 4-pin base for use with preheat, rapid start, electronic and dimming circuits. Featuring **ALTO®** Lamp Technology
Watts	32
Bulb	PL-T
Base	GX24q-3
Product Number	046677-26832-6
Ordering Code	PL-T 32W/830/4P/ALTO
Generic Designation	CFTR32W/GX24q/830
Package Quantity	12
Description	3000K
CRI	82
Avg. Hrs. Life	10,000
Design Lumens	2040
M.O.L.	5 5/8
Lumens	2400

Images

+ ALTO Product Logo
+ Family Photo
+ Product Photo

Literature

+ ALTO Family Brochure
+ MSDS S08-98001

Other Information

• Energy Saving Product
+ Printable Page
+ View Compatible Ballasts
+ Send this Link
+ Bookmark this Page

Footnotes

+ This Product Contains Amalgam
+ High Color Rendering Lamp
+ Features **ALTO®** Lamp Technology
+ Rated average life under specified test conditions with Programmed Start ballasts with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently.

+ Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions.
+ Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions.

Information for this product last modified on September 25, 2001

©2004-2005 Koninklijke Philips Electronics N.V. All rights reserved. Privacy policy
Philips. Access to and use of this Web Site is subject to these Terms of use.

PHILIPS

SILHOUETTE™ Programmed Start

Feature	T5 Miniature Bipin Fluorescent Lamps
Watts	28
Bulb	T5
Base	Min. Bipin
Product Number	046677-23084-7
Ordering Code	F28T5/830 ALTO
Package Quantity	40
Description	TL 830, 3000K
CRI	85
Rated Avg. Life (Hrs.)	20,000
Design Lumens	2750
Nominal Length	46
Approximate Initial Lumens	2900

Images

+ Product Logo
+ Product Photo

Literature

+ MSDS S06-99001
+ Product Brochure
+ Product Bulletin

Other Information

• Energy Saving Product
• Meets US Federal Minimum Efficiency Standard
+ Printable Page
+ View Compatible Ballasts
+ Send this Link
+ Bookmark this Page

Footnotes

+ Rated average life under specified test conditions with Programmed Start ballasts with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently.
+ Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions.
+ For expected lamp lumen output, commercial ballast manufacturers can advise the appropriate Ballast Factor for each of their ballasts when they are informed of the designated lamp. The Ballast Factor is a multiplier applied to the designated lamp lumen output.
+ Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions.
+ **Silhouette™**, T5 nominal lamp lengths are shorter than standard sizes. See dimension chart for

details.

+ Highest Color Rendering Lamps (CRI>=80)
+ Features **ALTO®** Lamp Technology

Information for this product last modified on March 31 2004.

©2004-2005 Koninklijke Philips Electronics N.V. All rights reserved. Privacy policy Philips. Access to and use of this Web Site is subject to these Terms of use.

PHILIPS

Advantage Rapid Start Ultimate Perfromance Fluorescent Lamps

Feature	T8 Medium Bipin Featuring **Hi-Vision Phosphor**
Watts	32
Bulb	T8
Base	Med. Bipin
Product Number	046677-13987-3
Ordering Code	F32T8/AD830/ALTO
Package Quantity	25
Description	Advantage 830,T8, 3000K
CRI	85
Rated Avg. Life (Hrs.)	20,000
Design Lumens	2950
Nominal Length	48
Approximate Initial Lumens	3100

Other Information

- Energy Saving Product
- Meets US Federal Minimum Efficiency Standard

+ Printable Page
+ Send this Link
+ Bookmark this Page

Footnotes

+ Features **ALTO®** Lamp Technology

Information for this product last modified on September 28 2004.

©2004-2005 Koninklijke Philips Electronics N.V. All rights reserved. Privacy policy Philips. Access to and use of this Web Site is subject to these Terms of use.

Home

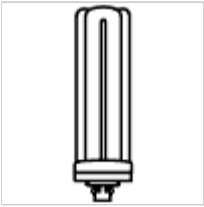
Products

Compact Fluorescent

- Self-Ballasted Lamps Spiral®
- Self-Ballasted Lamps Biax®
- Self-Ballasted Lamps Genura™
- Self-Ballasted Lamps Reflectors
- Self-Ballasted Lamps Decorative Shapes
- Lamp and Adapter Circlite
- Lamp and Adapter 2D®-Electronic
- Lamp and Adapter Replacement Adapters
- Plug-in 2-Pin Low Wattage Biax®
- Plug-in 2-Pin Double Biax®
- Plug-in 4-Pin Double Biax®
- Plug-in 4-Pin Triple Biax®
- Plug-in 4-Pin High Lumen Biax®
- Plug-in 4-Pin 2D®
- Accessories Locking Devices
- Plug-in 4-Pin High Output Biax®
- Bright Stick® Lighting Units

Plug-in 4-Pin High Output Biax® Item Detail

Basic | LSB



Subcategory	Plug-in 4-Pin High Output Biax®
Product Code	48867 ✒
Description	F70QBX835A4P/EOL
Watts	70
Average Rated Life	12000
Lumens (Initial)	5200
Lumens (Mean)	4470
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Bulb Type	BiaxQ (T4)
Base Type	GX24q-6
Nominal Length (In.)	8.2
Nominal Length (mm)	200
Sales Unit UPC	043168488679
Case UPC	043168488679
Case Quantity	10
Additional Information	NEMA Generic Designation: CFM70W/GX24q/835 or CFTR70W/GX24q/835, Diameter
Footnotes	Fluorescent lamp lumens decline during life.Based on 60Hz reference circuit. minimum starting temperature is a function of the ballast. Most ballasts are ra minimum starting temperature of 50° F (10° C). Ballasts are also available tha reliable starting to 0° F (-18° C) and -20° F (-29° C).Amalgam product experie brightness over a wider temperature range and in various operating positions.

✒ Reduced Wattage

☑ Set the current view to the default view

Return to product list

Copyright General Electric Company 1997-2005

PHILIPS

Visit Philips Global Support Center

Choose Country/Language search in Lighting

About Philips | Consumer Products | Lighting | Medical Systems | Semiconductors

eCatalog

Lamps

- Incandescent
- Halogen
- Fluorescent
- Compact Fluorescent-Integrated
- Compact Fluorescent-NonIntegrated
- High Intensity Discharge
- QL Induction Lighting

Special Lighting

Lighting Solutions

Breakthrough Products

Innovation Award

TradeLink℠

Lighting Application Center

Browse Literature

Last update: March 29, 2005 Back | PDF preview | Print pr

Deco 60W Cand 130V B10 1/2 CL 1CT

General + Images +

PRODUCT DATA

Product Number	140020
Full product name	Deco 60W Cand 130V B10 1/2 CL 1CT
Ordering Code	60B10-1/2/CL 130V
Pack type	1 Lamp in a Folding Carton
Pieces per pack	1
Packs per case	25
Pack UPC	046677140021
EAN2US	-
Case Bar Code	50046677140026
Successor Product number	-
Wattage[W]	60W
Base	Cand [Candelabra]
Voltage[V]	130V
Bulb	B-10 1/2 [Diameter: 1.3125 inch]
Bulb Finish	CL [Clear]
Packing Type	1CT [1 Lamp in a Folding Carton]
Base Information	Brass[Brass Base]
Filament Shape	C-7A[Ring]
Operating Position	Base Down +/- 90D[Base Down +/- 90
Packing Configuration	25

Atmosphere	Gas
Rated Avg. Life[hr]	2000
Initial Lumens[Lm]	550
Max Overall Length (MOL) - C[in]	4.187
Diameter D[in]	1.313

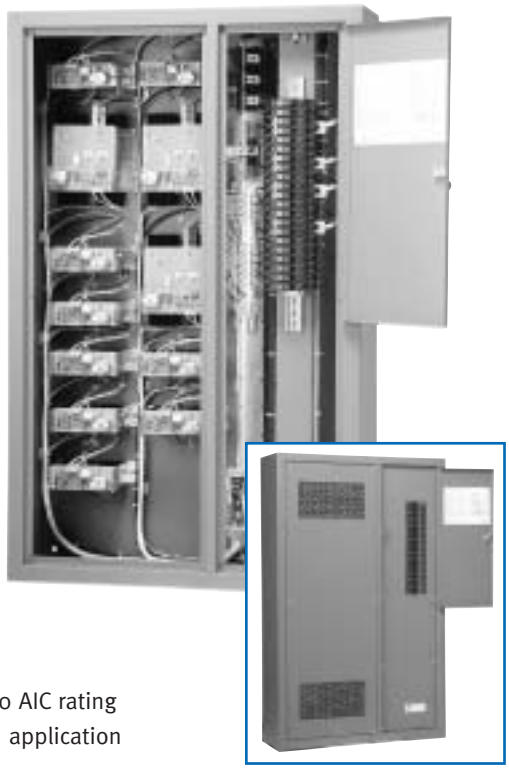
Version 10b.2.1.0 WEB03

©2004-2005 Koninklijke Philips Electronics N.V. All rights reserved. Privacy policy Philips. Access to and use of this Web Site is subject to these Terms of use.

STANDARD AND CUSTOM DIMMER CABINETS

ALM Dimmer Cabinets are the heart of the comprehensive ALM dimming system. They are built using manufacturing expertise that only comes with many years of experience and training.

Choose from a wide range of standard sizes (see standard cabinet tab) or allow ALM engineering to design a custom cabinet and overall dimming system.



FEATURES:

- Quick access to all contractor-wiring terminals
- Square D circuit breakers with a standard 10,000 AIC rating
- Primary and branch breakers as required by the application
- Convection cooled - no fan noise
- Solid copper neutral buss bar
- Clear and concise wiring diagrams and dimmer schedule
- Material code 14 ga. steel
- Textured medium gray finish
- Easy dimmer removal
- Easy and positive dimmer by-pass

AVAILABLE CUSTOM OPTIONS:

- Recessed, freestanding or wall-mounted
- Cooling fans
- 120V/208V, 120V/240V, 277V/480V
- Main breakers
- Built in 277 sections
- Emergency transfer section
- Fully wired spare circuitry with breaker awaiting future dimmer replacement
- A wide variety of dimmer sizes available
- Fluorescent dimming modules
- Non dimmable modules
- Locking door cover
- Nearly any shape or size the application requires

NOTES:

1. Adequate ventilation is necessary to insure a maximum temperature of 40˚C
2. All systems are shipped in dimmer by-pass

Questions? Please call us toll-free 888-446-9137 or fax 847-860-0959 or visit www.almsys.com
Note: Autocad 2000 drawings available upon request

ALM
ARCHITECTURAL
LIGHTING
MANAGEMENT

[Dimming Cabinets]

DIMMER CABINET COMPONENT WORK SHEET

Series	Voltage / Phasing	PN				Mounting	Options
APLS	V1 = 120/208V - 3PH/4W	P/N	L	W	H	SF = Surface Mount	
	V2 = 120/240V - 1PH/3W	C4	30"	24"	8"	FL = Flush Mount	
	V3 = 277/480V- 3PH/4W	C8	30"	30"	8"	FM = Floor Mount	
		C12	40"	30"	8"		
		C24	72"	30"	8"		
		C36	72"	40"	8"		
		C48	72"	48"	8"		

Available System Options for Custom Cabinets:

P/N	Description	Notes
CS	Control Station Mounted On Dimmer Cabinet Door	Specify locking Cover
RC	Room Combiner	Specify number of rooms
AV	Audio/Visual interface	Up to 8 peripheral functions
WT	Wireless Transmitter / Receiver	Specify number of transmitters
EM	Emergency Transfer System	Specify number of circuits
MB	Main Breaker	Specify Amperage
ND20/120	20 amp Non-dim Relay 120volt	
ND20/277	20 amp Non-dim Relay 277volt	

Notes: Please designate the unit quantity and type of dimming modules
For Fluorescent dimming, please add 2" to cabinet depth.

When ordering, please include all part descriptions. For example: APLS-V1-2-C8-FL = 120/208V, 3PH/4W, C8 cabinet Analog system with 6 ABIU 2.KW dimmers and 2 - 120V non-dim modules with flush mounting.

Also available: Total Custom Cabinets and Dimming Systems.

ALM
ARCHITECTURAL
LIGHTING
MANAGEMENT

Questions? Please call us toll-free 888-446-9137 or fax 847-860-0959 or visit www.almsys.com
Note: Autocad 2000 drawings available upon request

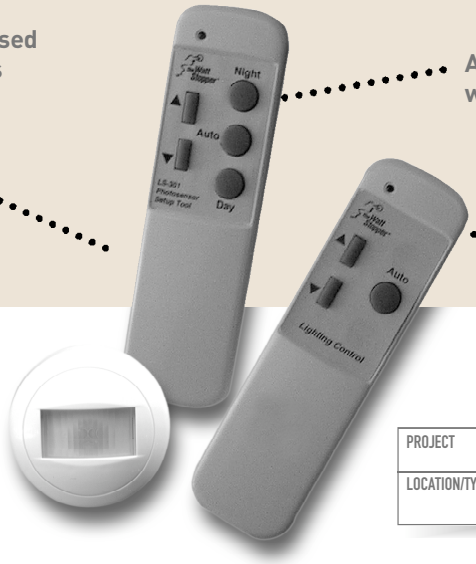
LS-301 Dimming Photosensor

Automatic dimming based on ambient light levels

All setup performed remotely with handheld

Controls standard 0-10 VDC electronic dimming ballasts

Optional occupant adjustment via handheld remote



Single zone control

Closed loop daylighting control

PROJECT

LOCATION/TYPE

Product Overview

Description

The LightSaver LS-301 is a ceiling mount, low voltage indoor photosensor that works with standard, 0-10 VDC electronic dimming ballasts to dim lighting as daylight increases.

Operation

The LS-301 mounts on a ceiling and utilizes a spectral filtering system to measure daylight and electric light levels. A closed loop daylighting system, the LS-301 measures the total light level from daylight and electric light in the controlled area to adjust electric lighting levels. As the daylight contribution increases, the lights dim down. The photosensor utilizes sliding setpoint control, which responds to the different spatial distribution qualities of electric light and daylight. The LS-301 calculates the required light level for current daylight contribution based on two setpoints. One represents the target level when no daylight is present (night setpoint) and the other when significant daylight is present (day setpoint).

Adjustment via Handheld Remote Control

All LS-301 adjustments are made with one of two handheld remotes. The LSR-301-S provides five buttons for initial set-up, which is easily completed by first raising or lowering electric light levels to desired levels, then programming this target level into the photosensor. The LSR-301-P provides three buttons for occupants to adjust light levels. With this optional tool, users can increase target light levels by up to 25% or reduce them to the lamp/ballast minimum level. Pressing the "Auto" button returns the control to programmed levels.

Applications

The LS-301 is designed to blend into its surroundings when installed in any environment. It provides one zone of daylighting control in a private office or classroom. In these applications, the LS-301 can be combined with an occupancy sensor. Often, it is possible for the LS-301 to share a single power pack with occupancy sensor(s).

Features

- Provides precise control of lighting to maintain desired light level
- Extremely linear photocell response with greater than 1% accuracy
- Designed to measure light as the human eye perceives it, eliminating "overreporting" illumination levels provided by daylight
- Separate handheld remote controls for setup and occupant adjustment to prevent tampering
- Boosts energy savings by reducing maximum lamp output, often resulting in a 20% reduction or more compared with lights at full output
- Achieves lumen maintenance by holding target light level as lamp output decreases over time

WattStopper
legrand
www.wattstopper.com
800.879.8585

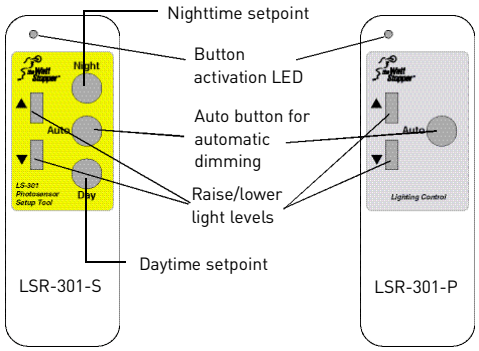
LS-301 Technical Information

Specifications

- Full range dimming: .2 VDC (minimum) to 10 VDC (100% lighting) output voltage
- Current consumption: 30 mA @ 24 VDC
- In typical applications, setpoints are adjustable from 20-60 footcandles (210-640 lux)
- Controls up to 50 standard dimming ballasts in one zone
- Sensor leads: gray and violet to ballast, red and black to 24 VDC
- Dimensions: 2.35" diam. x 0.875" depth (60mm x 22mm), threaded piece extends 1.25" (31.8mm) from back, fits .5" knockout
- 5 year warranty

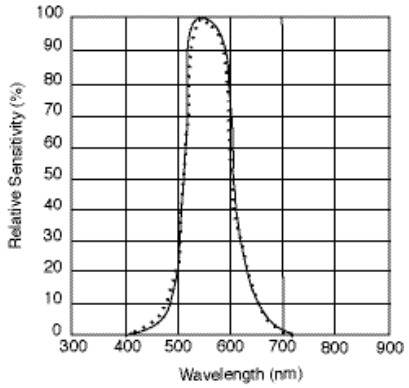
Product Controls

Remote Controls



Remote handheld (above left) enables easy set-up while optional occupant remote provides adjustability for individual lighting preferences.

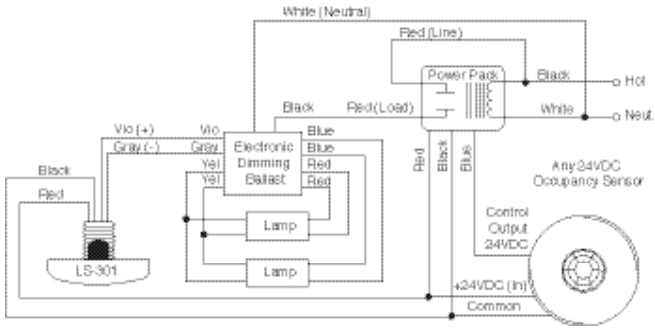
Spectral Response Curve



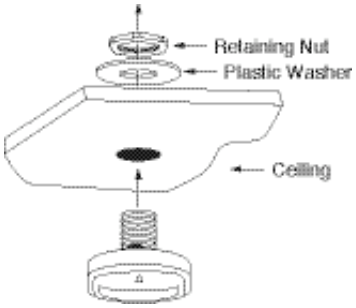
The spectral response of the LS-301 photocell closely matches the sensitivity of the human eye.

Wiring & Installation

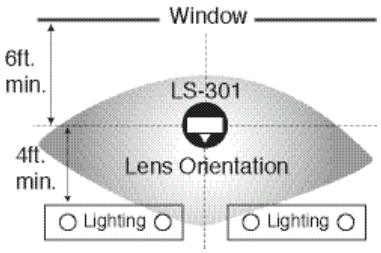
Wiring



Mounting and Installation



Coverage



Placement Guidelines

- Mount photocell between 6 and 12 feet (1.8m - 3.7m) from window.
- Do not mount directly above direct/indirect pendant fixtures. Mount at least 4 feet (1.2m) from pendant fixtures.

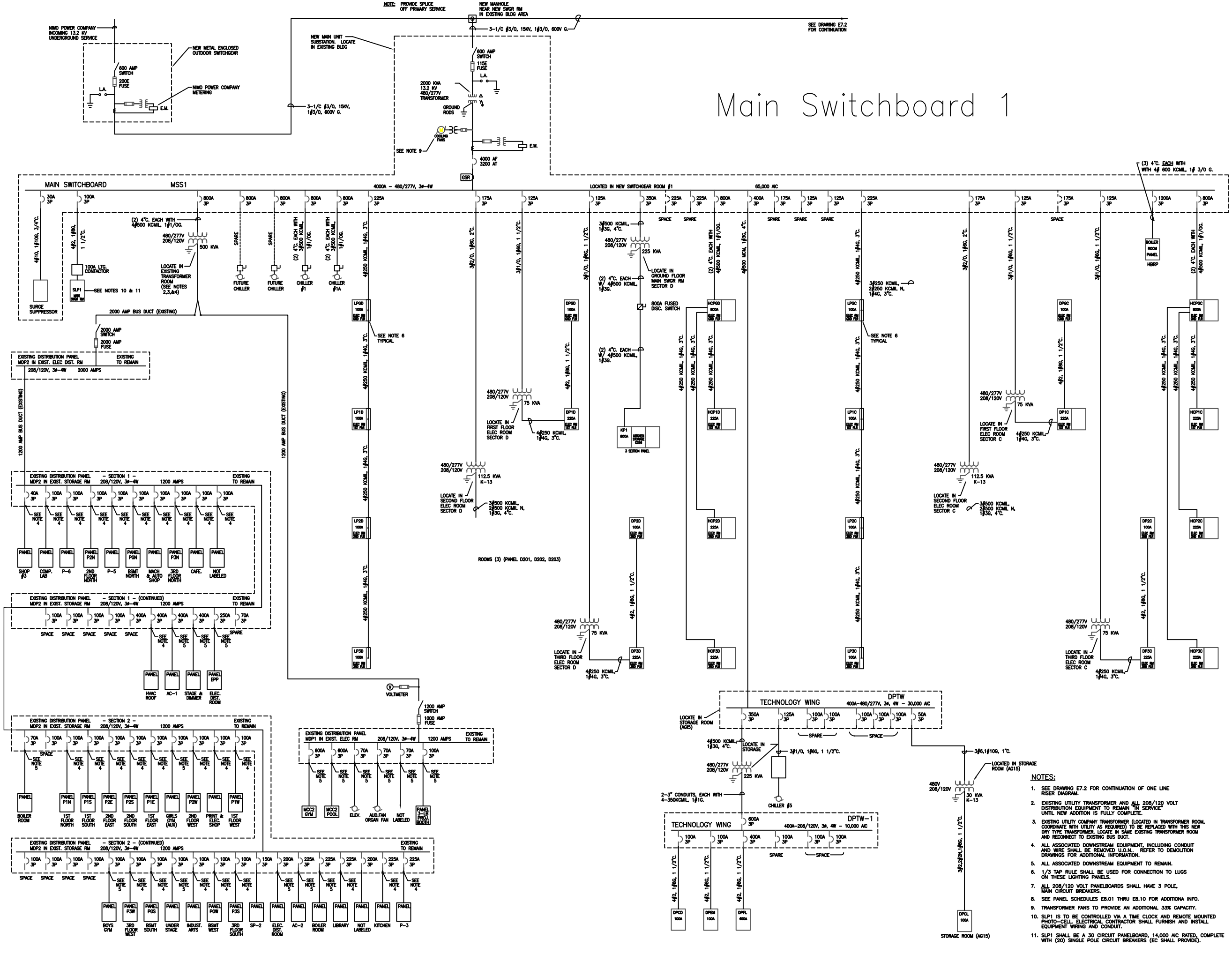
Ordering Information

Catalog No.	Description	Output Voltage
LS-301	Dimming Photosensor	.2 VDC (min.) to 10 VDC (max.)
LSR-301-S	Setup Remote Control (2 AAA batteries included)	
LSR-301-P	Occupant Remote Control (2 AAA batteries included)	

Watt Stopper/Legrand®
Pub. No. 17503

Appendix B - Electrical

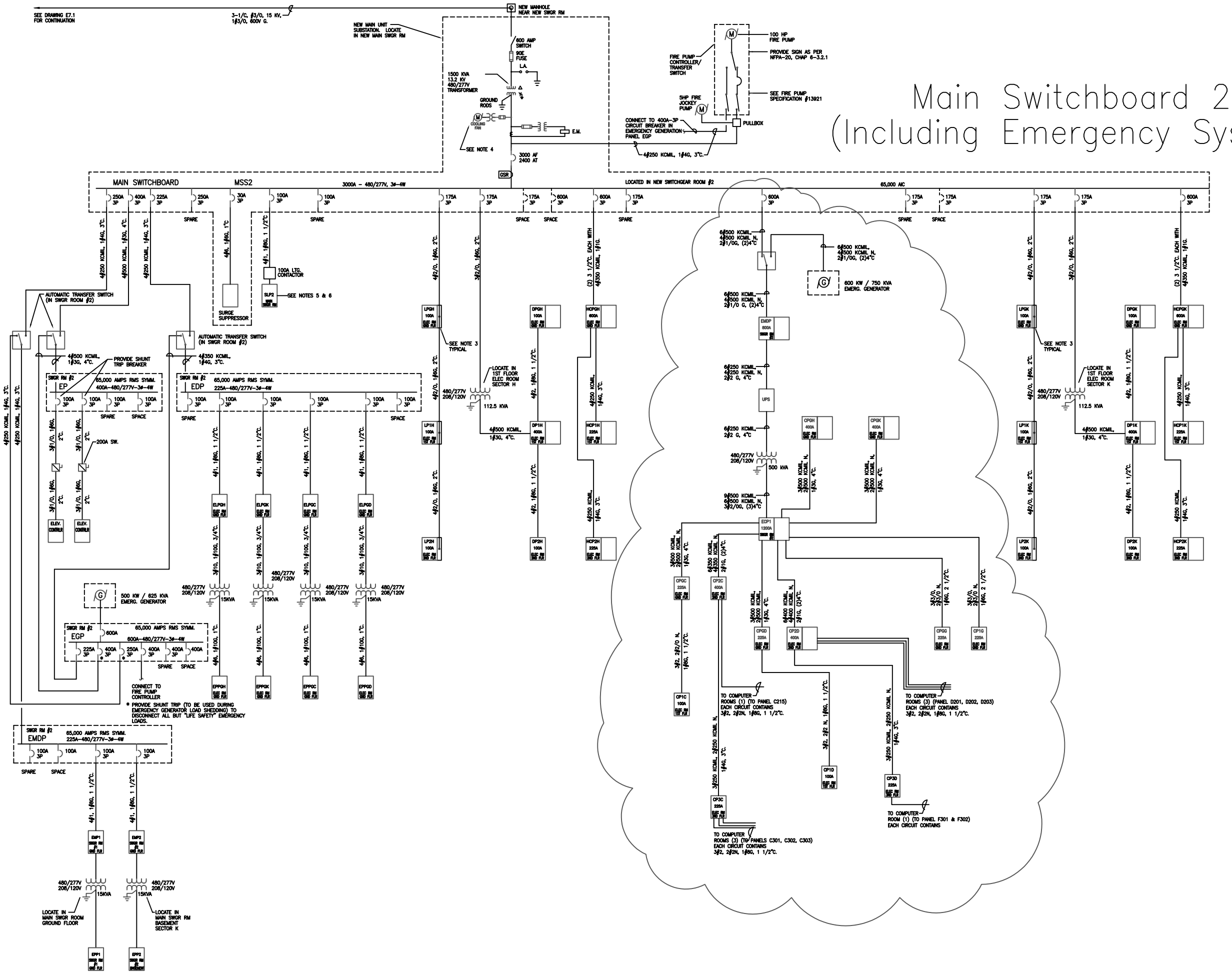
Main Switchboard 1



NOTES:

1. SEE DRAWING E7.2 FOR CONTINUATION OF ONE LINE RISER DIAGRAM.
2. EXISTING UTILITY TRANSFORMER AND ALL 208/120 VOLT DISTRIBUTION EQUIPMENT TO REMAIN "IN SERVICE" UNTIL NEW ADDITION IS FULLY COMPLETE.
3. EXISTING UTILITY COMPANY TRANSFORMER (LOCATED IN TRANSFORMER ROOM, COORDINATE WITH UTILITY AS REQUIRED) TO BE REPLACED WITH THIS NEW DRY TYPE TRANSFORMER. LOCATE IN SAME EXISTING TRANSFORMER ROOM AND RECONNECT TO EXISTING BUS DUCT.
4. ALL ASSOCIATED DOWNSTREAM EQUIPMENT, INCLUDING CONDUIT AND WIRE SHALL BE REMOVED U.O.N.. REFER TO DEMOLITION DRAWINGS FOR ADDITIONAL INFORMATION.
5. ALL ASSOCIATED DOWNSTREAM EQUIPMENT TO REMAIN.
6. 1/3 TAP RULE SHALL BE USED FOR CONNECTION TO LUGS ON THESE LIGHTING PANELS.
7. ALL 208/120 VOLT PANELBOARDS SHALL HAVE 3 POLE, MAIN CIRCUIT BREAKERS.
8. SEE PANEL SCHEDULES E8.01 THRU E8.10 FOR ADDITIONA INFO.
9. TRANSFORMER FANS TO PROVIDE AN ADDITIONAL 33% CAPACITY.
10. SLP1 IS TO BE CONTROLLED VIA A TIME CLOCK AND REMOTE MOUNTED PHOTO-CELL. ELECTRICAL CONTRACTOR SHALL FURNISH AND INSTALL EQUIPMENT WIRING AND CONDUIT.
11. SLP1 SHALL BE A 30 CIRCUIT PANELBOARD, 14,000 AIC RATED, COMPLETE WITH (20) SINGLE POLE CIRCUIT BREAKERS (EC SHALL PROVIDE).

Main Switchboard 2 (Including Emergency System)



Diesel Generator Set
Model DFGB 60 Hz

600 kW, 750 kVA Standby
545 kW, 681 kVA Prime

Description

The Cummins Power Generation DF-series commercial generator set is a fully integrated power generation system providing optimum performance, reliability, and versatility for stationary standby or prime power applications.

A primary feature of the DF GenSet is strong motor-starting capability and fast recovery from transient load changes. The torque-matched system includes a heavy-duty Cummins 4-cycle diesel engine, an AC alternator with high motor-starting kVA capacity, and an electronic voltage regulator with three-phase sensing for precise regulation under steady-state or transient loads. The DF GenSet accepts 100% of the nameplate standby rating in one step, in compliance with NFPA110 requirements.

The standard PowerCommand® digital electronic control is an integrated system that combines engine and alternator controls for high reliability and optimum GenSet performance.

Optional coolant heaters improve starting in extreme operating conditions. A wide range of options, accessories, and services are available, allowing configuration to your specific power generation needs.

Every production unit is factory tested at rated load and power factor. This testing includes demonstration of rated power and single-step rated load pickup. Cummins Power Generation manufacturing facilities are registered to ISO9001 quality standards emphasizing our commitment to high quality in the design, manufacture, and support of our products. The generator set is CSA certified and is available as UL 2200 Listed. The PowerCommand control is UL 508 Listed.

All Cummins Power Generation systems are backed by a comprehensive warranty program and supported by a worldwide network of 170 distributors and service branches to assist you with warranty, service, parts, and planned maintenance support.

Features

UL Listed Generator Set - The complete generator set assembly is available Listed to UL 2200.

Cummins Heavy-Duty Engine - Rugged 4-cycle industrial diesel delivers reliable power, low emissions, and fast response to load changes.

Permanent Magnet Generator (PMG) - Offers enhanced motor starting and fault clearing short circuit capability.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings; low waveform distortion with non-linear loads, fault clearing short-circuit capability, and class H insulation.

Control System - The PowerCommand electronic control is standard equipment and provides total genset system integration, including automatic remote starting/stopping, precise frequency and voltage regulation, alarm and status message display, AmpSentry™ protection, output metering, auto-shutdown at fault detection, and NFPA 110 compliance. PowerCommand control is listed to UL508.

Cooling System - Provides reliable running at rated power in ambient temperatures through 50°C.

Structural Steel Skid Base - Robust skid base supports the engine, alternator, and radiator.

E-Coat Finish - Dual electro-deposition paint system provides high resistance to scratches, corrosion, or fading.

Certifications - Generator sets are designed, manufactured, tested, and certified to relevant UL, NFPA, ISO, IEC, and CSA standards.

Warranty and Service - Backed by a comprehensive warranty and world wide distributor network.

© 2004 Cummins Power Generation

Generator Set

The general specifications provide representative configuration details. Consult the outline drawing for installation design.

Specifications – General

See outline drawing 500-3477 installation design specifications.

Unit Width, in (mm)	72.1 (1830)
Unit Height, in (mm)	88.2 (2242)
Unit Length, in (mm)	169.5 (4305)
Unit Dry Weight, lb (kg)	13600 (6169)
Unit Wet Weight, lb (kg)	14160 (6423)
Rated Speed, rpm	1800
Voltage Regulation, No Load to Full Load	±0.5%
Random Voltage Variation	±0.5%
Frequency Regulation	Isochronous
Random Frequency Variation	±0.25%
Radio Frequency Interference	IEC 801.2, Level 4 Electrostatic Discharge IEC 801.3, Level 3 Radiated Susceptibility IEC 801.4, Level 4 Electrical Fast Transients IEC 801.5, Level 5 Voltage Surge Immunity MIL STD 461C, Part 9 Radiated Emissions (EMI)

Cooling	**Standby**	**Prime**
Fan Load, HP (kW)	30.0 (22.4)	30.0 (22.4)
Coolant Capacity with radiator, US Gal (L)	44.0 (166.5)	44.0 (166.5)
Coolant Flow Rate, Gal/min (L/min)	236.0 (893.3)	236.0 (893.3)
Heat Rejection To Coolant, Btu/min (MJ/min)	26065.0 (27.6)	20985.0 (22.2)
Heat Radiated To Room, Btu/min (MJ/min)	7790.0 (8.3)	6920.0 (7.3)
Maximum Coolant Friction Head, psi (kPa)	10.0 (68.9)	10.0 (68.9)
Maximum Coolant Static Head, ft (m)	60.0 (18.3)	60.0 (18.3)

Air		
Combustion Air, scfm (m^3/min)	2280.0 (64.5)	2065.0 (58.4)
Alternator Cooling Air, scfm (m^3/min)	4156.0 (117.6)	4156.0 (117.6)
Radiator Cooling Air, scfm (m^3/min)	42000.0 (1188.6)	42000.0 (1188.6)
Max. Static Restriction, in H_2O (Pa)	0.25 (62.25)	0.25 (62.25)

Rating Definitions

Standby Rating based on: Applicable for supplying emergency power for the duration of normal power interruption. No sustained overload capability is available for this rating. (Equivalent to Fuel Stop Power in accordance with ISO3046, AS2789, DIN6271 and BS5514). Nominally rated.

Prime (Unlimited Running Time) Rating based on: Applicable for supplying power in lieu of commercially purchased power. Prime power is the maximum power available at a variable load for an unlimited number of hours. A 10% overload capability is available for limited time. (Equivalent to Prime Power in accordance with ISO8528 and Overload Power in accordance with ISO3046, AS2789, DIN6271, and BS5514). This rating is not applicable to all generator set models.

Base Load (Continuous) Rating based on: Applicable for supplying power continuously to a constant load up to the full output rating for unlimited hours. No sustained overload capability is available for this rating. Consult authorized distributor for rating. (Equivalent to Continuous Power in accordance with ISO8528, ISO3046, AS2789, DIN6271, and BS5514). This rating is not applicable to all generator set models.

Site Derating Factors

Rated power available up to 4600 ft (1403 m) at ambient temperatures up to 104°F (40°C). Above 4600 ft (1403 m), derate at 4% per 1000 ft (305 m) and 1% per 10°F (2% per 11°C) above 104°F (40°C).

Engine

Cummins heavy duty diesel engines use advanced combustion technology for reliable and stable power, low emissions, and fast response to sudden load changes.

Electronic governing provides precise speed regulation, especially useful for applications requiring constant (isochronous) frequency regulation such as Uninterruptible Power Supply (UPS) systems, non-linear loads, or sensitive electronic loads. Optional coolant heaters are recommended for all emergency standby installations or for any application requiring fast load acceptance after start-up.

Specifications – Engine

Base Engine	Cummins Model VTA28-G5, Turbocharged and Aftercooled, diesel-fueled
Displacement in^3 (L)	1710.0 (28.0)
Overspeed Limit, rpm	2100 ±50
Regenerative Power, kW	105.00
Cylinder Block Configuration	Cast iron with replaceable wet cylinder liners, 40°V 12 cylinder
Battery Capacity	660 amps minimum at ambient temperature of 32°F (0°C)
Battery Charging Alternator	55 amps
Starting Voltage	24-volt, negative ground
Lube Oil Filter Types	Three spin-on, full flow
Standard Cooling System	122°F (50°C) ambient radiator

Power Output	**Standby**	**Prime**
Gross Engine Power Output, bhp (kWm)	900.0 (671.4)	815.0 (608.0)
BMEP at Rated Load, psi (kPa)	226.0 (1558.2)	206.0 (1420.3)
Bore, in. (mm)	5.50 (139.7)	5.50 (139.7)
Stroke, in. (mm)	6.00 (152.4)	6.00 (152.4)
Piston Speed, ft/min (m/s)	1800.0 (9.1)	1800.0 (9.1)
Compression Ratio	13.1:1	13.1:1
Lube Oil Capacity, qt. (L)	89.0 (84.2)	89.0 (84.2)
Fuel Flow		
Fuel Flow at Rated Load, US Gal/hr (L/hr)	89.0 (336.9)	89.0 (336.9)
Maximum Inlet Restriction, in. Hg (mm Hg)	4.0 (101.6)	4.0 (101.6)
Maximum Return Restriction, in. Hg (mm Hg)	6.5 (165.1)	6.5 (165.1)
Air Cleaner		
Maximum Air Cleaner Restriction, in. H_2O (kPa)	25.0 (6.2)	25.0 (6.2)
Exhaust		
Exhaust Flow at Rated Load, cfm (m^3/min)	5040.0 (142.6)	4635.0 (131.2)
Exhaust Temperature, °F (°C)	935.0 (501.7)	885.0 (473.9)
Max Back Pressure, in. H_2O (kPa)	41.0 (10.2)	41.0 (10.2)

Fuel System	Direct injection, number 2 diesel fuel; fuel filter; automatic electric fuel shutoff.

Fuel Consumption		**Standby**				**Prime**			
60 Hz Ratings, kW (kVA)		**600 (750)**				**545 (681)**			
	Load	1/4	1/2	3/4	Full	1/4	1/2	3/4	Full
	US Gal/hr	14.7	24.3	34.1	44.2	13.9	22.6	31.2	40.3
	L/hr	56	92	129	167	53	86	118	153

Liebert Series 610 Specifications

UPS RATING kVA	kW	LOAD POWER FACTOR	AC INPUT/ OUTPUT VOLTAGE	%EFFICIENCY AT VARIOUS LOADS[1] 50%	75%	100%	NOMINAL BATTERY REQUIREMENTS (CELLS)	MAXIMUM HEAT DISSIPATION (BTU/HR) FULL LOAD	DIMENSIONS WxDxH[2] (INCHES) TOP ENTRY ONLY	TOP & BOTTOM ENTRY	APPROXIMATE WEIGHT[2] SMS	MMU
65	52	0.8	208/208	92.0%	92.0%	92.0%	240	15,450	N/A	34x32x68	1,900	1,870
65	52	0.8	480/208	92.5%	93.0%	93.0%	240	13,350	N/A	34x32x68	1,700	1,670
65	52	0.8	480/480	92.5%	93.5%	93.5%	240	12,350	N/A	34x32x68	1,500	1,470
65	52	0.8	600/208	92.0%	92.5%	92.5%	240	14,400	N/A	34x32x68	1,800	1,770
65	52	0.8	600/600	92.5%	93.0%	93.0%	240	13,350	N/A	34x32x68	1,600	1,570
80	64	0.8	208/208	92.0%	92.0%	92.0%	240	19,000	N/A	34x32x68	2,100	2,070
80	64	0.8	480/208	92.5%	93.0%	93.0%	240	16,450	N/A	34x32x68	1,950	1,920
80	64	0.8	480/480	92.5%	93.5%	93.5%	240	15,200	N/A	34x32x68	1,700	1,670
80	64	0.8	600/208	92.0%	92.5%	92.5%	240	17,700	N/A	34x32x68	2,050	2,020
80	64	0.8	600/600	92.5%	93.0%	93.0%	240	16,450	N/A	34x32x68	1,800	1,770
100	80	0.8	208/208	92.0%	92.0%	92.0%	240	23,750	48x33x78	56x33x78	3,100	3,065
100	80	0.8	480/208	92.5%	93.0%	93.0%	240	20,550	48x33x78	56x33x78	2,800	2,765
100	80	0.8	480/480	92.5%	93.5%	93.5%	240	19,000	48x33x78	56x33x78	2,500	2,465
100	80	0.8	600/208	92.0%	92.5%	92.5%	240	22,150	48x33x78	56x33x78	2,950	2,915
100	80	0.8	600/600	92.5%	93.0%	93.0%	240	20,550	48x33x78	56x33x78	2,650	2,615
125	100	0.8	208/208	92.0%	92.0%	92.0%	240	29,700	48x33x78	56x33x78	3,250	3,215
125	100	0.8	480/208	92.5%	93.0%	93.0%	240	25,700	48x33x78	56x33x78	2,900	2,865
125	100	0.8	480/480	92.5%	93.5%	93.5%	240	23,750	48x33x78	56x33x78	2,600	2,565
125	100	0.8	600/208	92.0%	92.5%	92.5%	240	27,650	48x33x78	56x33x78	3,100	3,065
125	100	0.8	600/600	92.5%	93.0%	93.0%	240	25,700	48x33x78	56x33x78	2,800	2,765
150	120	0.8	208/208	93.0%	92.5%	92.5%	240	33,200	N/A	56x33x78	3,320	3,270
150	120	0.8	480/208	93.0%	93.5%	93.5%	240	28,450	N/A	56x33x78	3,050	3,000
150	120	0.8	480/480	93.0%	94.0%	94.0%	240	26,150	48x33x78	56x33x78	2,850	2,800
150	120	0.8	600/208	92.5%	93.0%	93.0%	240	30,850	N/A	56x33x78	3,270	3,220
150	120	0.8	600/600	93.0%	93.5%	93.5%	240	28,450	48x33x78	56x33x78	3,120	3,070
225	180	0.8	208/208	93.0%	92.5%	92.5%	240	49,800	N/A	56x33x78	3,870	3,820
225	180	0.8	480/208	93.0%	93.5%	93.5%	240	42,700	N/A	56x33x78	3,475	3,425
225	180	0.8	480/480	93.0%	94.0%	94.0%	240	39,200	48x33x78	56x33x78	3,190	3,140
225	180	0.8	600/208	92.5%	93.0%	93.0%	240	46,250	N/A	56x33x78	3,660	3,610
225	180	0.8	600/600	93.0%	93.5%	93.5%	240	42,700	48x33x78	56x33x78	3,460	3,410
300	240	0.8	208/208	93.0%	92.5%	92.5%	240	66,400	N/A	72x35x78	5,400	5,350
300	240	0.8	480/208	93.0%	93.5%	93.5%	240	56,950	N/A	72x35x78	4,450	4,400
300	240	0.8	480/480	93.0%	94.0%	94.0%	240	52,300	N/A	72x35x78	4,200	4,150
300	240	0.8	600/208	92.5%	93.0%	93.0%	240	61,650	N/A	72x35x78	5,050	5,000
300	240	0.8	600/600	93.0%	93.5%	93.5%	240	56,950	N/A	72x35x78	4,600	4,550
300	270	0.9	480/480	93.5%	94.0%	94.0%	240	58,820	N/A	72x35x78	4,200	4,150
400	320	0.8	208/208	92.5%	92.0%	92.0%	240	94,950	N/A	96x35x78	8,400	8,350
400	320	0.8	480/208	93.0%	93.5%	93.5%	240	75,950	N/A	72x35x78	5,150	5,100
400	320	0.8	480/480	93.0%	94.0%	94.0%	240	69,700	N/A	72x35x78	4,900	4,850
400	320	0.8	600/208	92.5%	93.0%	93.0%	240	82,200	N/A	72x35x78	5,900	6,050
400	320	0.8	600/600	93.0%	93.5%	93.5%	240	75,950	N/A	72x35x78	5,400	5,350
450	360	0.8	480/480	93.0%	94.0%	94.0%	240	78,450	N/A	72x35x78	5,100	5,050
500 (6P)	400	0.8	480/480	93.0%	94.0%	94.0%	240	87,150	N/A	72x39x78	5,775	5,710
500 (12P)	400	0.8	480/480	91.5%	92.0%	92.0%	240	110,700	N/A	96x39x78	8,775	8,710
500 (6P)	400	0.8	600/600	93.0%	93.5%	93.5%	240	94,900	N/A	72x39x78	6,175	6,110
500 (12P)	400	0.8	600/600	91.5%	92.0%	92.0%	240	118,700	N/A	96x39x78	8,775	8,710
500 (6P)	450	0.9	480/480	93.0%	94.0%	94.0%	240	98,050	N/A	72x39x78	5,795	5,730
500 (12P)	450	0.9	480/480	91.5%	92.0%	92.0%	240	124,500	N/A	96x39x78	9,095	9,030
500 (6P)	450	0.9	600/600	93.0%	93.5%	93.5%	240	106,750	N/A	72x39x78	6,195	6,13
500 (12P)	450	0.9	600/600	91.5%	92.0%	92.0%	240	133,550	N/A	96x39x78	9,095	9,030
625 (6P)	500	0.8	480/480	93.5%	94.5%	94.5%	240	99,300	N/A	108x39x78	7,500	7,405
625 (12P)	500	0.8	480/480	93.0%	93.5%	93.5%	240	118,650	N/A	120x39x78	10,580	10,485
625 (6P)	500	0.8	600/600	93.5%	94.0%	94.0%	240	108,950	N/A	108x39x78	7,900	7,805
625 (12P)	500	0.8	600/600	92.5%	93.0%	93.0%	240	128,450	N/A	120x39x78	10,580	10,485
750 (6P)	600	0.8	480/480	93.5%	94.5%	94.5%	240	119,200	N/A	108x39x78	8,100	8,005
750 (12P)	600	0.8	480/480	93.0%	93.5%	93.5%	240	142,350	N/A	120x39x78	11,580	11,485
750 (6P)	600	0.8	600/600	93.5%	94.0%	94.0%	240	130,700	N/A	108x39x78	8,500	8,405
750 (12P)	600	0.8	600/600	92.5%	93.0%	93.0%	240	154,135	N/A	120x39x78	11,580	11,485
750 (12P)	675	0.9	480/480	93.0%	93.5%	93.5%	240	160,150	N/A	120x39x78	11,880	11,785
750 (12P)	675	0.9	600/600	92.5%	93.0%	93.0%	240	173,400	N/A	120x39x78	11,880	11,785
1000(12P)[3]	900	0.9	480/480	92.5%	93.0%	93.0%	240	231, 200	N/A	177x44x82	16,700	16,555
1000 (12P)	900	0.9	600/600	92.5%	93.0%	93.0%	240	231,203	N/A	177x44x82	16,700	16,555

1 Efficiency measured at rated load power factor and non-linear load without input filter. Input filter loss is less than 0.5%.

2 Dimensions and weights do not include System Control Cabinet furnished with Multi-Module Systems. Weights are for the standard configurations; top-entry models will be 200 pounds less.

3 1000 kVA unit is SCR-based inverter. See also separate 1000 kVA Series 610 brochure.

Specifications

See separate brochure for 1000 kVA

Input

- Voltage: 480, 208 or 600 VAC, 3-phase, 3-wire plus ground
- Voltage Range: +10, -15% (no battery discharge down to -20%)
- Power Factor: 0.92 lagging with input filter (0.85 without)
- Frequency Range: 60 Hz, ±5%
- Current Distortion: 7% reflected THD at full load with input filter. 4% reflected THD at full load with optional 12-pulse rectifier and input filter (for 500-750 kVA)
- Subcycle Magnetizing Inrush: 2-3 times normal full load current; 5-8 times normal for units with optional input isolation transformer or 12-pulse rectifier
- Configurable walk-in of 20% to 100% over 15 seconds

Output and Bypass

- Voltage: 480, 208 or 600 VAC, 3-phase, 3-wire or 4-wire plus ground
- Voltage Adjustment: ±5%
- Voltage Regulation: ±0.5% for balanced load; ±2% for 50% unbalanced load
- Dynamic Regulation: ±5% deviation for 100% load step. ±4% deviation for 50% load step. ±1% for loss or return of AC input. Manual return of load to UPS: ±4%
- Transient Response Time: Recover to ±1% of steady state within 16 milliseconds (1 cycle) with connected battery
- Voltage Distortion: For linear loads, less than 4% THD. Maximum of 2% RMS for any single harmonic. Less than 5% THD for 100% nonlinear loads without kVA/kW derating
- Phasing Balance: 120° ±1° for balanced load. 120° ±3° for 50% unbalanced load
- Frequency Regulation: ±0.1%
- Load Power Factor Range: Unity to rated lagging load factor without derating
- Overload: 125% of full load for ten minutes. 150% for 30 seconds. 104% continuous
- Fault-Clearing Current: Up to 1,000% for 16 milliseconds. Up to 500% for 40 milliseconds

Environmental

- Operating Temperature: 0° to 40°C without derating
- Non-Operating Temperature: -20°C to 70°C
- Humidity: 0-95% relative humidity without condensation
- Operating Altitude: Up to 4,000 feet (1200 meters) without derating
- Non-Operating Altitude: Up to 15,000 meters
- Audible noise 65-72 dBA typical, depending on kVA rating; measured 5 ft. from the unit

Physical

- ETL listed to UL 1778 UPS standard and CSA certified. Meets requirements for safe high-performance UPS operation

Standard Features

- Easy-to -read backlit LCD monitor/ control display panel
- Self-diagnostics
- Output isolation transformer
- 2-stage battery charge current limit
- 2-stage input AC current limit
- Internal wrap-around bypass
- Automatic and programmable retransfer
- Automatic line-drop compensation
- Battery overdischarge protection
- Battery-time-remaining display and battery statistics
- Automatic equalize charge timer
- Emergency Power Off (EPO)
- Front access for service and maintenance

Options and Accessories

- Input filter/power factor correction
- 12-pulse rectifier input (for 500-750 kVA)
- Load Bus Sync™ (for dual load bus systems)
- Power-Tie®Dual-Bus System
- Input isolation transformer
- Bypass isolation transformer
- Maintenance bypass cabinet, matching or panelboard
- Power distribution unit (single or dual input)
- Standard and custom switchgear packages
- Valve-regulated lead-acid battery packs
- Flooded rack-mounted battery systems
- SNMP capabilities
- Remote monitor panel
- Communications interfaces
- Alarm status contacts
- Customer alarm inputs

Transformers for Non-Linear Loads
Standard NL Model and Premium NLP Model

Application

Type NL and NLP are dry type transformers intended to feed applications such as computers, copiers, printers, FAX machines, video display terminals and other equipment having switching-mode power supplies. These transformers are specially built to handle high harmonics associated with such loads. Type NLP is designed particularly for more severe non-linear applications and has reduced sound levels three decibels below NEMA standards.

Features

Features for typical non-linear load service include:

- Three-phase, dry type transformers, 480 Delta – 208Y/120
- Electrostatic shield
- Class 220 installation
- Reduced core flux to compensate for harmonic voltage distortion
- 200% neutral with double size neutral terminal for additional customer neutral cables
- Additional coil capacity to compensate for higher non-linear load loss
- Temperature rise of 115°C
- Heavy-gauge ventilated indoor enclosures (weather shields available)
- UL Listed

Type NL Transformers for typical non-linear load service and Type NLP Transformers for more severe non-linear load service.

Three Phase Standard NL Model 60 Hz

kVA	Catalog Number	Full Capacity Taps	Deg. C. Temp. Rise	Wt. (lbs)	Encl. ■	Wiring ♦
480 Volts Delta Primary 208Y/120 Volts Secondary 60 Hz			**Aluminum Wound UL K-4 Rated**			
15	**15T3HFISNL**	6—2.5%2+4-	115	240	17D	10
30	**30T3HFISNL**	6—2.5%2+4-	115	300	18D	10
45	**45T3HFISNL**	6—2.5%2+4-	115	500	19D	10
75	**75T3HFISNL**	6—2.5%2+4-	115	725	21D	10
112.5	**112T3HFISNL**	6—2.5%2+4-	115	950	22D	10
150	**150T3HFISNL**	6—2.5%2+4-	115	1290	24D	10
225	225T3HFISNL	6—2.5%2+4-	115	1900	25D	10
300	300T68HFISNL	4—2.5%2+2-	115	2100	25D	11
500	500T90HFISNL	4—3.5%2+2-	115	3600	29D	11
480 Volts Delta Primary 208Y/120 Volts Secondary 60 Hz			**Copper Wound UL K-4 Rated**			
15	15T3HFISCUNL	6—2.5%2+4-	115	330	18D	10
30	**30T3HFISCUNL**	6—2.5%2+4-	115	380	18D	10
45	**45T3HFISCUNL**	6—2.5%2+4-	115	475	18D	10
75	**75T3HFISCUNL**	6—2.5%2+4-	115	865	21D	10
112.5	112T3HFISCUNL	6—2.5%2+4-	115	1090	22D	10
150	150T3HFISCUNL	6—2.5%2+4-	115	1450	24D	10
225	225T3HFISCUNL	6—2.5%2+4-	115	2065	25D	10
300	300T68HFISCUNL	4—2.5%2+2-	115	2200	25D	11
500	500T90HFISCUNL	4—3.5%2+2-	115	4300	29D	11

Note: Boldface Catalog Numbers indicate in-stock transformers.
■ For enclosure styles see **Dimensions Table** Page 27.
♦ See **Wiring Diagrams** Page 41.

Three Phase Premium NLP Model

kVA	Catalog Number	Full Capacity Taps	Deg. C. Temp. Rise	Wt. (lbs)	Encl. ■	Wiring ♦
480 Volts Delta Primary 208Y/120 Volts Secondary 60 Hz			**Aluminum Wound UL K-13 Rated**			
15	**15T3HFISNLP**	6—2.5%2+4-	115	245	17D	10
30	**30T3HFISNLP**	6—2.5%2+4-	115	350	18D	10
45	**45T3HFISNLP**	6—2.5%2+4-	115	600	19D	10
75	**75T3HFISNLP**	6—2.5%2+4-	115	780	22D	10
112.5	**112T3HFISNLP**	6—2.5%2+4-	115	1025	22D	10
150	**150T3HFISNLP**	6—2.5%2+4-	115	1390	25D	10
225	**225T3HFISNLP**	6—2.5%2+4-	115	2010	25D	10
300	300T68HFI8NLP	4—2.5%2+2-	115	2100	30D	11
500	500T90HFISNLP	4—3.5%2+2-	115	3600	32F	11
480 Volts Delta Primary 208Y/120 Volts Secondary 60 Hz			**Copper Wound UL K-13 Rated**			
15	15T3HFISCUNLP	6—2.5%2+4-	115	330	18D	10
30	**30T3HFISCUNLP**	6—2.5%2+4-	115	380	18D	10
45	**45T3HFISCUNLP**	6—2.5%2+4-	115	600	19D	10
75	**75T3HFISCUNLP**	6—2.5%2+4-	115	865	22D	10
112.5	**112T3HFISCUNLP**	6—2.5%2+4-	115	1250	22D	10
150	150T3HFISCUNLP	6—2.5%2+4-	115	1955	25D	10
225	225T3HFISCUNLP	6—2.5%2+4-	115	2450	25D	10
300	300T68HFISCUNLP	4—2.5%2+2-	115	2400	30D	11
500	500T90HFISCUNLP	4—3.5%2+2-	115	5000	33F	11

Static Transfer Switch: SBR Series 100–800 Amp

SEAMLESS POWER TRANSFERS FOR CRITICAL LOADS

Fully Automatic, Transparent Dual-Source Switching

PDI's SBR Series Static Automatic Transfer Switch supplies your critical loads with a choice between two available sources of electrical power. The SBR continually monitors power quality and will automatically transfer to an alternate source without interruption of power to even your most sensitive critical loads. With a sense and transfer time of less than 4ms, the SBR represents the highest performance power switching solution available for the most critical applications.

A key element in any critical power distribution system, the SBR improves the overall reliability and availability of your facility by:

- Providing instantaneous access to redundant sources of power
- Enabling on-line maintenance of upstream equipment
- Utilizing a solid state transfer mechanism with no mechanical parts to maintain
- Preventing cross connection of sources during transfer and eliminating the possibility of cross current between sources

Design Quality

Our systems design and integration experience is packaged in every product we sell.

Front Access: Draw-out sub-assemblies enable front-only access for system installation and maintenance; minimizing floor space requirements.

Fiber Optics: Fiber optic internal control connections are utilized throughout the SBR to eliminate potential EMI/RFI problems and increase system reliability.

Superior Switching Logic: The SBR's Digital Signal Processing logic detects the type of power failure (single or three phase) and automatically applies the appropriate transfer sequence to ensure transfer times of ¼ cycle or less. This process of utilizing simultaneous or sequential transfer is unique in the industry.

SBR with draw-out sub-assemblies

True System Redundancy

Component Redundancy: redundant power supplies, control power circuits and sensors

Logic Redundancy: redundant voltage detection systems, voltage sensing/sampling systems and independent redundant logic for both static mode and optional auto bypass mode

System Redundancy: redundant static transfer mode power path, bypass power path and optional dual isolation switches

The PDI Difference

Packaging Flexibility: Configurable as part of PDI's PowerPak PDU Series of complete Redundant Power Distribution Systems.

Rigorous Product Testing: Fully rated switching elements tested to 6000 operations at 150% load and 50 operations at 600% load. The SBR will keep you powered when others drop out.

PDI Service and Support: Unmatched customer service and support. We will work with you to design the best system for your application, we provide complete installation service and we stay with you through the life of your system.

PDI

creating the perfect wave

Static Transfer Switch: SBR Series

STANDARD SPECIFICATIONS

Ratings

- Current: 100 - 800 Amps
- Voltage: 208, 480 or 600V
- Frequency: 50 or 60Hz
- 3-Phase, 3 Wire Plus Ground
- Short Circuit Withstand: 22kA @ 480 & 600V
  (available up to 65kA)

Features

- Sense and Transfer Time: *maximum ¼ cycle*
- True RMS Metering & Alarm System
- User Friendly Operator Controls, Mimic Bus and Status Indicators
- Front-only Access for Installation, Operation and Maintenance
- Five Switch Configuration:
  Two input, two bypass and one output isolation switch
- Operating Efficiency: > 99%
- Listed and Certified to UL 1008

Enclosure

- NEMA 1

Operating Conditions

- Operating Temperature: Ambient 0°C to 50°C
- Audible Noise: < 50 dBA @ 1meter

SBR Series Dimensions

The smallest, completely front accessible package available, the SBR does not require rear or side access for either installation or maintenance.

	Width	Depth	Height
5 switch, 100–800A	30.5”	32”	72”
6 switch < 600A	30.5”	32”	72”
6 switch ≥ 600A	45”	32”	72”

SBR Series Options

Auto Bypass

The Auto Bypass option automatically transfers from static mode to the wraparound bypass circuit without interruption of power to the load.

Redundant Output Isolation Switch

(Six switch design)

An additional plug-in type Output Switch provides a second output power path to your load and allows you to maintain or repair your preferred output without interruption of service.

System Circuit Breakers

Circuit breakers are offered in place of the standard multi-case switches.

Redundant Power Distribution System

The SBR can be close coupled to our PowerPak PDUs to create the PowerPak SS, an integrated static switching, power conditioning and distribution system. The PowerPak SS can be configured for primary or secondary switching and extends your redundant power path all the way to the load.

RCS Series, 1000–4000A

Featuring the same design, sensing and performance of the SBR Series, the RCS Series is packaged and rated to handle larger loads. The RCS Series products are flexible in their packaging and can be customized to fit effectively within your upstream power distribution system.

For Additional Information, Please Contact:
Wilson Engineered Systems, Inc.
11497 Columbia Park Drive West, Suite #2
Jacksonville, FL 32258
Phn: (904) 880-0118
Fax: (904) 880-0494
www.wilsonengineered.com

PDI

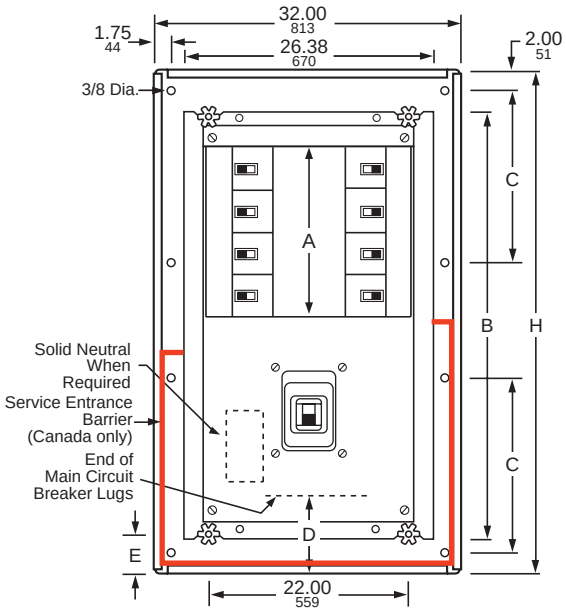
creating the perfect wave

Power Distribution, Inc.
4200 Oakleys Ct.
Richmond, VA 23223
Phone: (804) 737-9880
Toll Free: (800) 225-4838
Fax: (804) 737-1703
Web: http://www.pdicorp.com

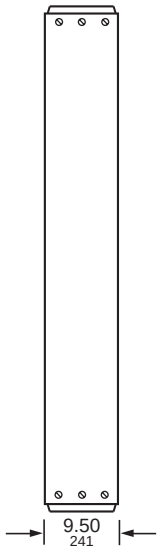
©PDI SBRSALES, 3/99 Product specifications subject to change without notice.

I-Line® Circuit Breaker Panelboards
Dimensions

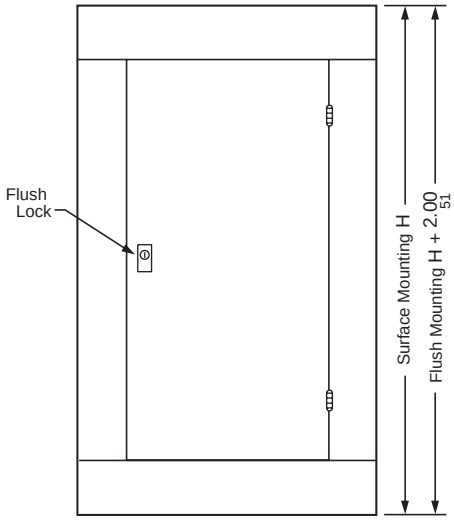
Type HCM—800 A Maximum Main Circuit Breaker



Typical Box with Interior

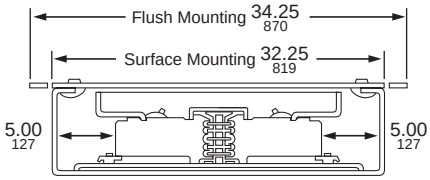


Typical Box Side View

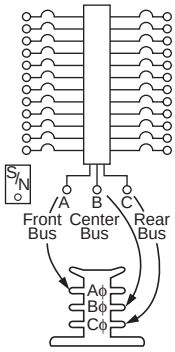


Typical 4-Piece Trim with Optional Door

Typical Endwall

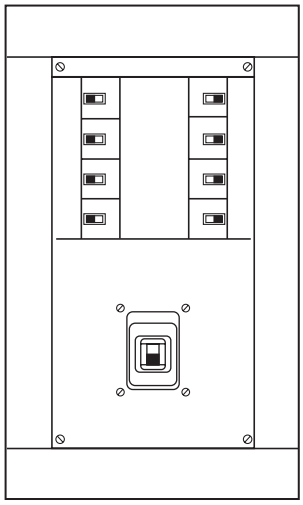


Typical Mounting of FY, FA, FH, FC, FK, FI, HD, HG, HJ, HL, JD, JG, JJ, JL, KA, KH, QB, QD, QG, QJ, or QO Circuit Breakers



Typical Wiring Diagram

Branch connection phasing is determined by circuit breaker selection.



Typical 4-Piece Trim without Optional Door

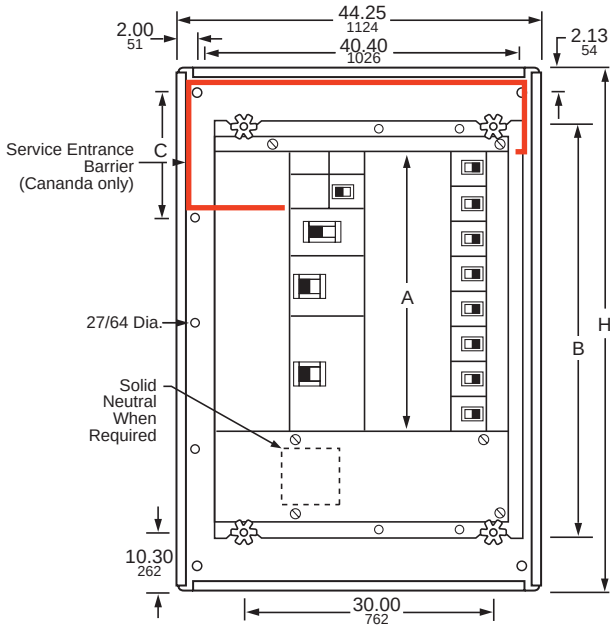
Dual Dimensions: INCHES
Millimeters

Main Circuit Breaker Ampere Rating	Catalog Number				H		A		B		C		D		E	
	Interior	Box	4-Piece Trim without Door ‡	4-Piece Trim with Door ‡ ◆	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
600	HCM1873-6MP	HC3273DB9	HCM73T( )	HCM73T( )D	**73.00**	1854	**18.00**	457	**48.00**	1219	**22.90**	582	**18.68**	474	**12.80**	325
	HCM3691-6MP	HC3291DB9	HCM91T( )	HCM91T( )D	**91.00**	2311	**36.00**	914	**66.00**	1676	**28.90**	734	**18.68**	474	**12.80**	325
800	HCM1873-8MP	HC3273DB9	HCM73T( )	HCM73T( )D	**73.00**	1854	**18.00**	457	**48.00**	1219	**22.90**	582	**18.68**	474	**12.80**	325
	HCM3691-8MP	HC3291DB9	HCM91T( )	HCM91T( )D	**91.00**	2311	**36.00**	914	**66.00**	1676	**28.90**	734	**18.68**	474	**12.80**	325

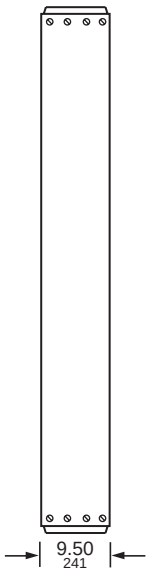
‡ Replace parentheses with “F” for flush or “S” for surface.
◆ Two flush locks are supplied.

© 1998–2005 Schneider Electric All Rights Reserved

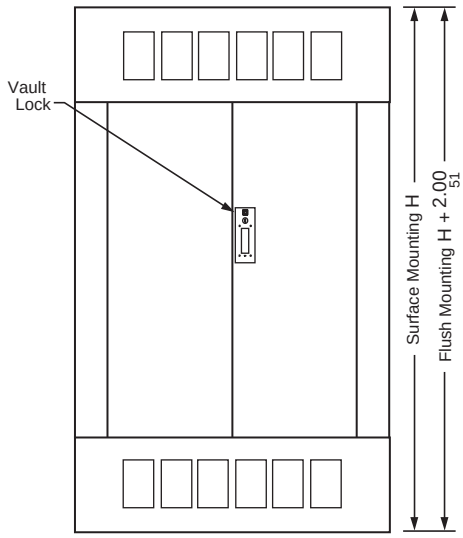
Type HCR-U—1200 A Main Lugs or Main Circuit Breaker



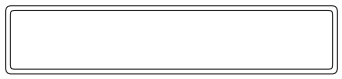
Typical Box with Interior



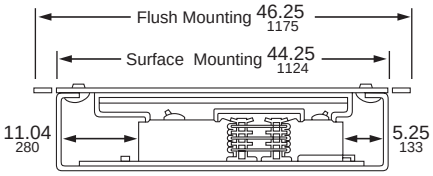
Typical Box Side View



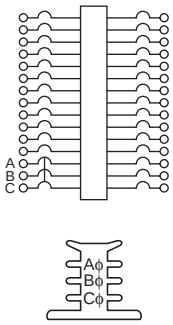
Typical 4-Piece Trim with Optional Door



Typical Endwall



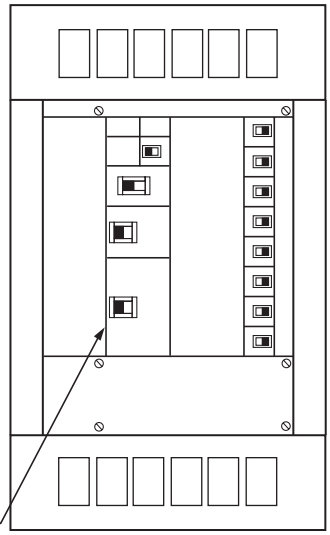
Typical Mounting of FY, FA, FH, FC, FK, FI, HD, HG, HJ, HL, JD, JG, JJ, JL, KA, KH, KC, KI, LA, LH, LC, LI, LX, LE, LXI MA, MH, MG, MJ, PG, PJ, PK, PL, QB, QD, QG, QJ, or QO RG, RJ, RK, and RL Circuit Breakers



Typical Wiring Diagram

Branch connection phasing is determined by circuit breaker selection.

Back-fed PG, PJ, PL, RG RJ, and RL Main Circuit Breaker or Main Lugs Kit S33930 (see *Note:*)



Typical 4-Piece Trim without Optional Door

Dual Dimensions: INCHES
Millimeters

Main Lugs or Main Circuit Breaker Ampere Rating	Catalog Number				H		A		B		C	
	Interior	Box	4-Piece Trim without Door ‡	4-Piece Trim with Door ‡	in.	mm	in.	mm	in.	mm	in.	mm
1200	HCR5486-12U	HC4486DB	HCR86T( )	HCR86T( )D	**86.00**	2184	**54.00**	1372	**65.10**	1654	**18.00**	457

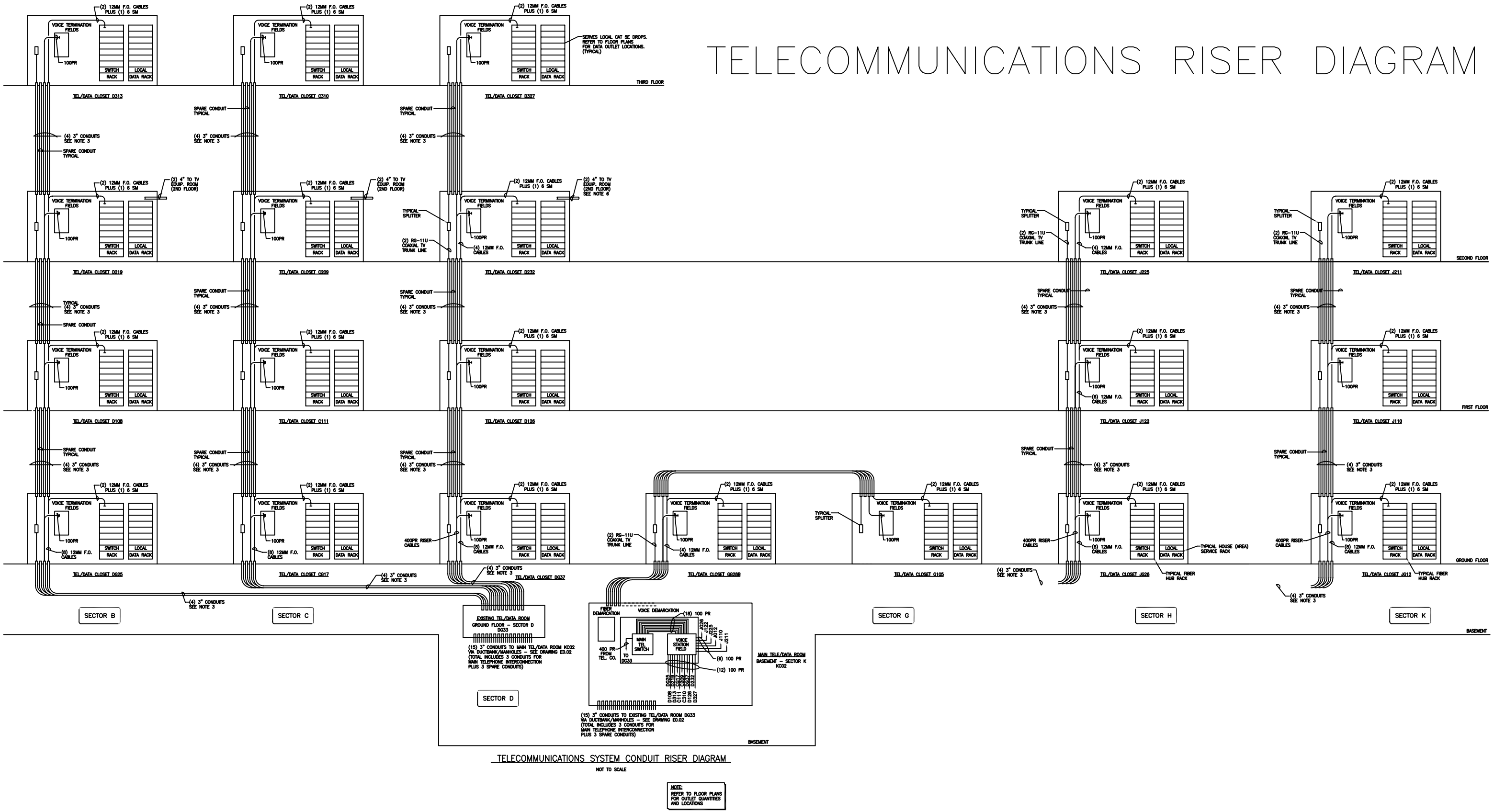
‡ Replace parentheses with “F” for flush or “S” for surface.

NOTE: The back-fed RG, RJ, and RL Main Circuit Breaker or Main Lugs Kit takes up 15 in. (381 mm) of mounting space, leaving 93 in. (2362 mm) of branch circuit breaker mounting space. The back-fed PG, PJ, PL Main Circuit Breaker takes up 9 in. (229 mm) of mounting spaces, leaving 99 in. (2515 mm) of branch circuit breaker mounting space.

© 1998–2005 Schneider Electric All Rights Reserved

Appendix C - Telecommunications

TELECOMMUNICATIONS RISER DIAGRAM



TELECOMMUNICATIONS SYSTEM CONDUIT RISER DIAGRAM

NOT TO SCALE

NOTE:
REFER TO FLOOR PLANS FOR OUTLET QUANTITIES AND LOCATIONS