WHEELOCK COLLEGE CAMPUS CENTER AND STUDENT RESIDENCE
200 THE RIVERWAY BOSTON MA 02155

Final Report

Architectural Engineering Senior Thesis

Anne-Lynn Cheney

April 7, 2009

Electrical Advisor: Ted Dannerth

Lighting Advisor: Kevin Houser

WHEELOCK
COLLEGE

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

200 THE RIVERWAY, BOSTON, MA 02215

project team

owner	wheelock college
architect	william rawn associates
lighting	hlb lighting design
structural	lemessurier consultants, inc
m/e/p	vanderweil engineering
civil	judith nitsch engineering, inc
g.c.	shawmut design and construction
landscape	richard burck associates
sustainable	the green engineer
food service	foodservice design

statistics

size	60,000 sf
floors	6 above grade, 1 basement
construction	09.27.07 - 12.31.08
delivery method	design-bid-build
cost	$23 million

lighting

predominately linear and compact fluorescent lamping

daylighting is controlled with sun shades

mechanical

one 20,700 cfm ahu in the basement

one 19,000 cfm ahu on the roof

two make-up air units for the kitchens

one fan coil heating/cooling unit per dorm

electrical

combination 480Y/277V and 208Y/120V, 3 phase, 4 wire systems

most loads provided by 208Y/120V transformers

structural

primarily structural steel construction

foundations consist of spread footings, basement and foundation walls, and slabs on grade

5” minimum slab on grade

architecture

curved metal panel and glass facade

roof system is assembled with a drainage mat, fully adhered membrane, board insulation and a vapor barrier on a concrete slab

third floor green roof deck

anne-lynn cheney | lighting/electrical
http://www.engr.psu.edu/ae/thesis/portfolios/2009/akc5002

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EXECUTIVE SUMMARY

The Campus Center and Student Residence building on the Wheelock College campus is a modern addition, providing housing and food services to students attending the school. The 60,000 sf building consists of dorm rooms, a cafeteria, conference room, lounge, offices and multipurpose spaces for the students.

This report specifically focuses on the lighting and electrical system redesign. The lighting redesign considered five spaces: the student lounge, the conference room, the cafeteria serving space, the third floor roof deck, and a typical two-person dorm room. The design criteria was evaluated for each of the spaces, and alternative lighting solutions was proposed. The proposed designs were rendered and calculated based on IESNA and ASHRAE 90.1-2004 codes and recommendations, as well as aesthetic design principals. The final lighting designs were chosen to represent the overall building design and function.

The electrical redesign evaluated the effect of the lighting changes in the five selected spaces to the electrical system. The circuits were re-distributed and new feeder schedules were drawn up for the panelboards. A protection device coordination was also performed to address a single path through the distribution system. Calculations for a short circuit analysis are included. An analysis was also performed based on the benefits of changing from a mixture of 120V and 277V lighting to only 277V lighting throughout the building. An in-depth short circuit analysis, protective device coordination study and arc fault study were also performed with SKM software.

An acoustical breadth study was also performed to evaluate the reverberation levels in the student lounge. An architectural breadth study was conducted to analyze the most appropriate solution for controlling daylight entering the space.

Designing a building involves merging many parts to produce fantastic results. The Campus Center and Student Residence building is Wheelock College's most recent construction, and will be a signature building on the campus for years to come.

GENERAL INFORMATION AND STATISTICS

BUILDING NAME | Wheelock College Campus Center and Student Residence

LOCATION | Wheelock College Campus, 200 The Riverway, Boston, MA 02215

BUILDING OCCUPANT | Wheelock College

OCCUPANCY TYPES | Student Residence, Retail, Offices, Campus Dining Hall

SIZE | 60,000 SF

NUMBER OF STORIES | 6 above grade, 1 below grade

DATES OF CONSTRUCTION | 27 September 2007 - 31 December 2008

ACTUAL COST | $23 million

PROJECT DELIVERY METHOD | Sequential design-bid-build for fast track construction

NATIONAL CODE | the building was designed using IBC 2003

HISTORICAL REQUIREMENTS | the building was constructed on land previously owned by Wheelock College, and has no historical restrictions

PRIMARY PROJECT TEAM

OWNER	Wheelock College (www.wheelock.edu)
ARCHITECT	William Rawn Associates (www.rawnarch.com)
STRUCTURAL	LeMessurier Consultants, Inc (www.lemessurier.com)
M/E/P	Vanderweil Engineering (www.vanderweil.com)
CIVIL	Judith Nitsch Engineering, Inc (www.nitscheng.com)
LANDSCAPE ARCHITECT	Richard Burck Associates (www.richardburck.com)
LIGHTING DESIGNER	HLB Lighting Design (www.hlblighting.com)
SUSTAINABLE CONSULTANT	The Green Engineer (www.greenengineer.com)
FOOD SERVICE	Foodservice Design Group (www.fsdesigngroup.com)
CONSTRUCTION MANAGMENT	Shawmut Design and Construction (www.shawmut.com)

ARCHITECTURE

The Campus Center and Student Residence building is the first major construction on the Wheelock campus in 40 years, so it was designed as a showcase of contemporary architecture. The steel paneled curved façade houses a multi-functional center for Wheelock students and faculty.

The building scope includes a student residence area and campus center. The campus center is located on the ground floor, with the dining area on the second floor, and residences on the upper floors. The campus center includes a lounge, café, campus store, multi-purpose room, conference room and student activities offices. The dining area offers seating for 250. The residences consist of a combination of four bed suites, two bed dorms and single rooms, totaling 108 beds.

BUILDING ENVELOPE

The foundations on this building consist of spread footings, basement and foundation walls, and slabs on grade. The formed concrete will use #6 through #19 bars for reinforcement. The building is constructed using structural steel with a glass and curved metal panel facade.

LIGHTING

The typical lamping used throughout the Campus Center and Student Residence building are linear and compact fluorescent. This type of lamping was used to reduce energy usage and meet the design criteria. Study areas on the first and second floor utilize daylighting, as well as feature a mixture of pendants and downlights when there is less sun. A multi-purpose room boasts large pendants of varying size clustered around the room, with compact fluorescent downlights for more uniform lighting. Wallwashers are common in a variety of places throughout the first and second floors. The suite and dorm rooms are relatively simple, with surface mounted compact fluorescent luminaires for ambient light, and surface mounted halogen downlights for task lights in the closet/dressing areas. Exterior lighting is primarily restricted to path and sign lighting. Uplights along the brick retaining walls lead students to the building.

MECHANICAL

The building uses a variable air volume system, with a 232 ton air-cooled water chiller on the roof. There is one 20,700 CFM air handling unit in the basement which services the basement and first floor. A second 19,000 CFM air handling unit on the roof services the second and third floors. The dorm rooms are individually climate controlled by a fan coil unit. The unit is connected to a dual temperature water pipe so it can be used for heating and cooling. The kitchen make-up air units are located on the roof. The second floor kitchen unit runs at 4,000 CFM, while the basement kitchen unit runs at 6,000 CFM.

ELECTRICAL

The building runs on a 480Y/277V, 3 phase, 4 wire system and is connected to the NSTAR distribution system. Service enters the building on the south side where the primary transformer is located. The transformer supplies a main switchboard which distributes power to the rest of the building. A diesel generator provides emergency power to the building through an automatic transfer switch.

STRUCTURAL

The foundation of the building consists of spread footings, basement and foundation walls. The basement floor is slab on grade, and subsequent floors are 3 ¼" lightweight concrete on 3" – 20 gage minimum galvanized composite steel deck. The framing is primarily steel with glass and metal panel curtain walls. The column arrangement is not regular due to the curved shape of the building. The structural system is moment frame connection.

CONSTRUCTION

The construction of the Wheelock College Campus Center and Student Residence began on September 27, 2007 and was completed on December 31, 2008. The project delivery method is sequential design-bid-build. Since the building is scheduled for fast track completion the subcontractor bids were received as they were required. The budget for the building was $23 million.

FIRE PROTECTION

The building has a sprinkler system designed for all levels. The sprinklers are designed to 250 GMP hose stream for all building spaces. The automatic fire pump is located in the fire room in the basement. It is capable of supplying 750 GMP with 90 head PSI. The majority of the building was designed with 2 hour fire rated material.

TELECOMMUNICATIONS

The telecommunications system in the Wheelock College Campus Center and Student Residence consists of a wireless internet, phone systems and some audio-visual equipment. The main controls and distribution system is located in the main electric room 010 in the basement. The voice and data network extends throughout the building. There are emergency phones next to the two main building entrances on the first floor. All wireless locations are mounted above the ceiling, while other data locations are mounted on the floor, walls and ceiling. The security system is a combination of card reader access into the building, and security cameras. The card access restricts non-residents from entering the dormitory area of the building. The security cameras are located on the main circulation areas, with views of the entrances and staircases.

TRANSPORTATION

The main entrances to the Wheelock College Campus Center and Student Residence are on the east and west sides of the building. Both entrances lead occupants into the main corridor/lounge on the first floor. In the lounge is a main open staircase leading to the second floor. There are fire-rated staircases near both of the entrances. A passenger elevator is located on the west side of the building and is used primarily for students who live in the dorms. A freight elevator is also located on the west side of the building, and can access the basement, first floor and second floor.

LIGHTING DEPTH STUDY

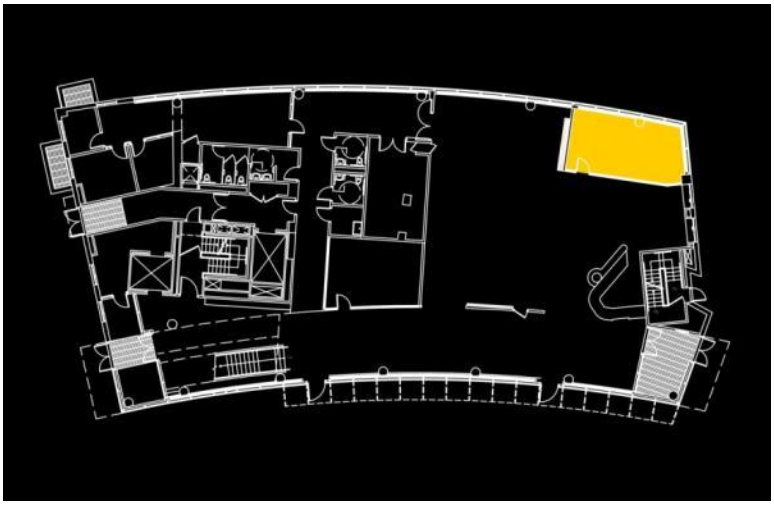
Five spaces were chosen from the Wheelock College Campus Center and Student Residence building for the lighting analysis. Each study takes into consideration the existing architecture and characteristics of the space. Important design criteria is taken from the IESNA Handbook and analyzed. A new lighting design is then proposed and described. Calculations and renderings are used to evaluate the performance of the systems. The equipment is specified throughout the report.

The spaces to be analyzed are the conference room (a work space), student lounge (a circulation space), cafeteria serving space (special purpose space), roof deck (outdoor space) and typical dorm room (a private space).

Information such as luminaire, ballast and lamp specifications, as well as lighting floorplans, may be found in the appendices.

CONFERENCE ROOM

SPACE SUMMARY



The conference room is located on the first floor, in the north-west corner of the building. The space is not quite rectangular, with interestingly angled walls and three walls of modern glazing. The room will be used by student organization and faculty conferences, social events and classes of up to 20 people. The room is approximately 340 square feet, with a ceiling height of 14'-0". The ceiling is a combination of painted drywall and acoustical ceiling tile. The west wall features a LCD television screen for presentations. The furniture in the room is a medium reflectance wooden conference table in the center, surrounded by fabric-covered conference chairs. The exterior walls to the north and east, as well as the interior south wall are glazing with aluminum framing, while the west wall is wood paneling.

Conference Room Surface Materials and Reflectances

Location	Material	Reflectance / Transmittance
Wall	Medium toned wood panels	50%
Ceiling	Acoustical Ceiling Tile	80%
Floor	Carpet	18%
Columns	Paint	65%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

DESIGN CONSIDERATIONS

TASKS: Classroom, Conference room, Social space

TARGET IMPRESSIONS: As a space, the conference room should portray a feeling of sophistication. With an abundance of glass and metal, the space has a very clean, minimalist appearance. The luminaires selected for this space should be discreet and maintain the simple lines of the space.

Aspects to be considered when designing in this space are daylight integration and control, direct glare, light distribution on the task plane, and facial rendering. There are two glass walls to the exterior on the north and east side of the room, so an abundance of daylight is exposed to the space. Controlling the daylight entering the space and integrating it into the lighting system will greatly improve the room's atmosphere. Therefore, a combination shading system should be used to either blackout the daylight or reduce it. Direct glare is also very important to control, both from daylight and from luminaires in the space. Since there will be a lot of desk tasks performed in the space, there should be no glare to distract the occupants and put them in discomfort. Light distribution on the task plane should be evenly distributed and free of shadows, so it is most comfortable for students and faculty to read, write and perform other tasks. Facial rendering is important for presentations and conferences where communication and recognition of facial expressions is significant.

EXISTING LIGHTING

The current lighting design offers flexibility for the various functions of the space. Dimmable compact fluorescent circular downlights provide the basic illuminance for the space. The wood paneled west wall is highlighted with compact fluorescent wallwashers, which may be switched separately from the rest of the room during presentations on the LCD television screen. Linear fluorescent suspended up/downlights make a perimeter on the north and east exterior walls. These fixtures are on a daylight sensor, which reduces the light output during the day when there is a significant amount of daylight entering the space. The space also employs motorized blackout shades on the exterior walls to eliminate daylight entering the room for presentation settings, as well as to give occupants more privacy at night.

Conference Room Existing Luminaire Schedule						
Type	**Mounting**	**Manufacturer**	**Catalogue Number**	**Lamps**	**Volts**	**Description**
F3	Ceiling Recessed	Lightolier	8021CCLW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector.
F4	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent wallwasher with an anodized aluminum parabolic reflector.
F5	Suspended	Lightolier	EG2-1-H-B -L-4'-W	1-F32 T8	120V	Suspended fluorescent up/downlight with 1" deep parabolic louver 2.5"

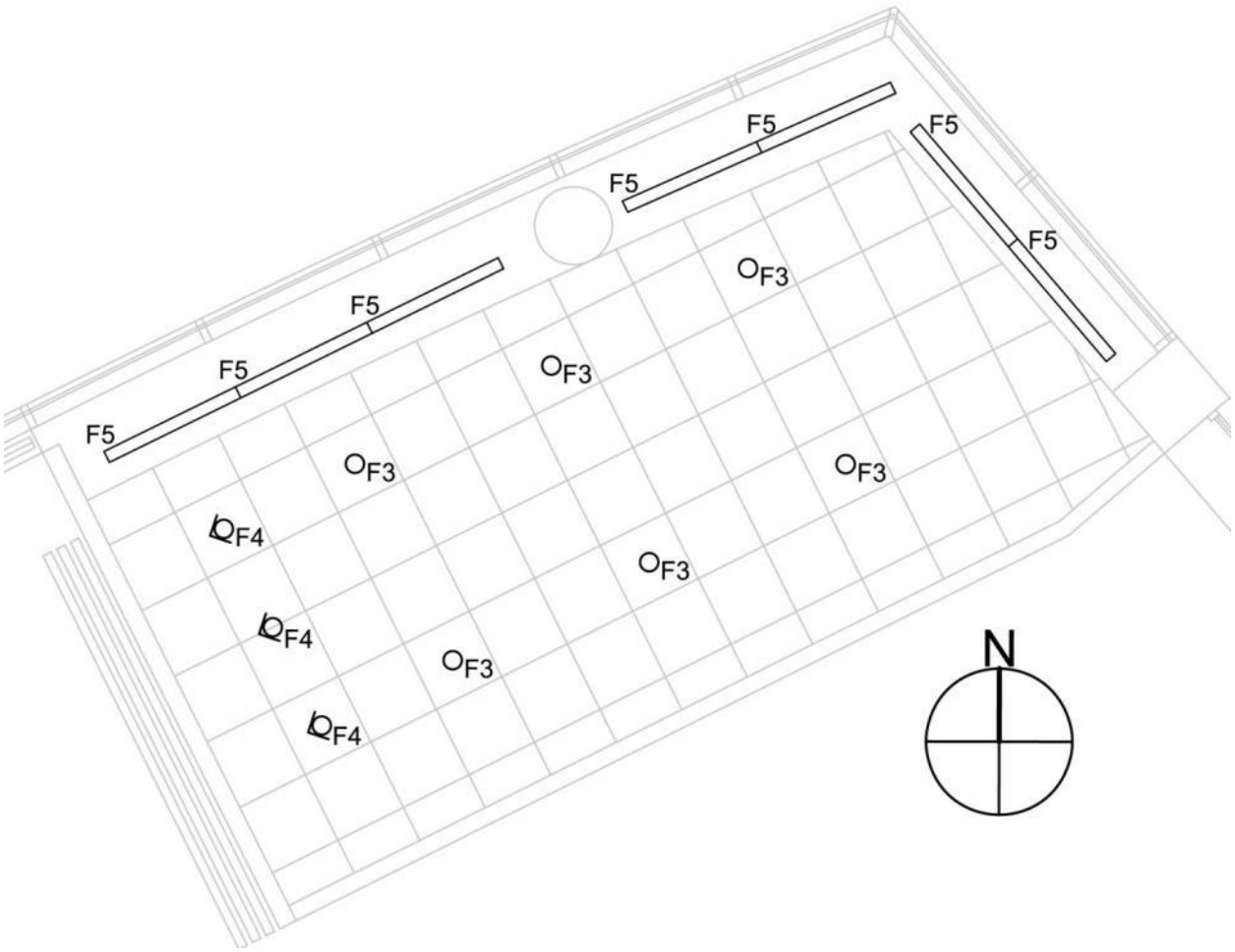
Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 2
- Expected Dirt Depreciation = 12%

Conference Room Existing Light Loss Factors							
Type	**Maintenance Category**	**Distribution**	**BF**	**LDD**	**RSDD**	**LLD**	**Total LLF**
F6	IV	Direct	0.98	0.87	0.98	0.86	0.72
F7	IV	Direct	0.98	0.87	0.98	0.86	0.72
F8	II	Semi-Indirect	0.88	0.93	0.94	0.95	0.73

*all Light Loss Factors in this report are obtained from the IESNA Lighting Handbook

CONFERENCE ROOM EXISTING LAYOUT



Conference Room Existing Illuminance Levels			
Horizontal Calculated	**Horizontal IESNA**	**Vertical Calculated**	**Vertical IESNA**
38.13 fc	30 fc	3.35 fc	5 fc

The existing illuminance level calculations for the conference room are very close to the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels are higher than the recommended levels, but are still satisfactory working conditions. The vertical illuminance levels are just a little bit low from the target levels.

Conference Room Existing Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F3	45	6	270
F4	45	3	135
F5	35	7	245
Space Type			Conference Room
Area (ft^2)			340
Allowable LPD (W/ft^2)			1.3
Allowable Watts			442
Actual LPD (W/ft^2)			1.91
Actual Watts			650

The conference room existing power density calculations are very high compared to the ASHRAE 90.1-2004 code. The LPD for the space is 1.91 W/ft^2, while the target is 1.3 W/ft^2. The new design aims to alter the LPD in the room, reducing it to the code level.

EXISTING EMERGENCY LIGHTING

The emergency lighting in the conference room consists of one F3 compact fluorescent downlight. An emergency generator will provide power to the building when normal grid power fails.

NEW LIGHTING SOLUTION

The space is intended to be minimalist and give the occupants a feeling of sophistication and simplicity. A combination of CFL and linear downlights are a sleek way to add illuminance on the task plane without being obstructive. The Focal Point linear fluorescent luminaires are flush with the surface and seem to create glowing strips in the ceiling. The compact fluorescent downlights add more directional illuminance and enhance the space. Circular compact fluorescent wallwashers allow occupants to add emphasis to the wood paneled wall.

Conference Room New Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F6	Ceiling Recessed	Lightolier	8081 CLW	1-CFTR26W	277V	6" recessed compact fluorescent wallwasher.
F7	Ceiling Recessed	Focal Point	FAV6-FI-1T5HO-1C-277-D-G1-WH-4'	1-F28T5	277V	Recessed fluorescent troffer.
F8	Suspended	Lightolier	8011 CCLW	1-CFTR18W	277V	4" recessed compact fluorescent downlight.

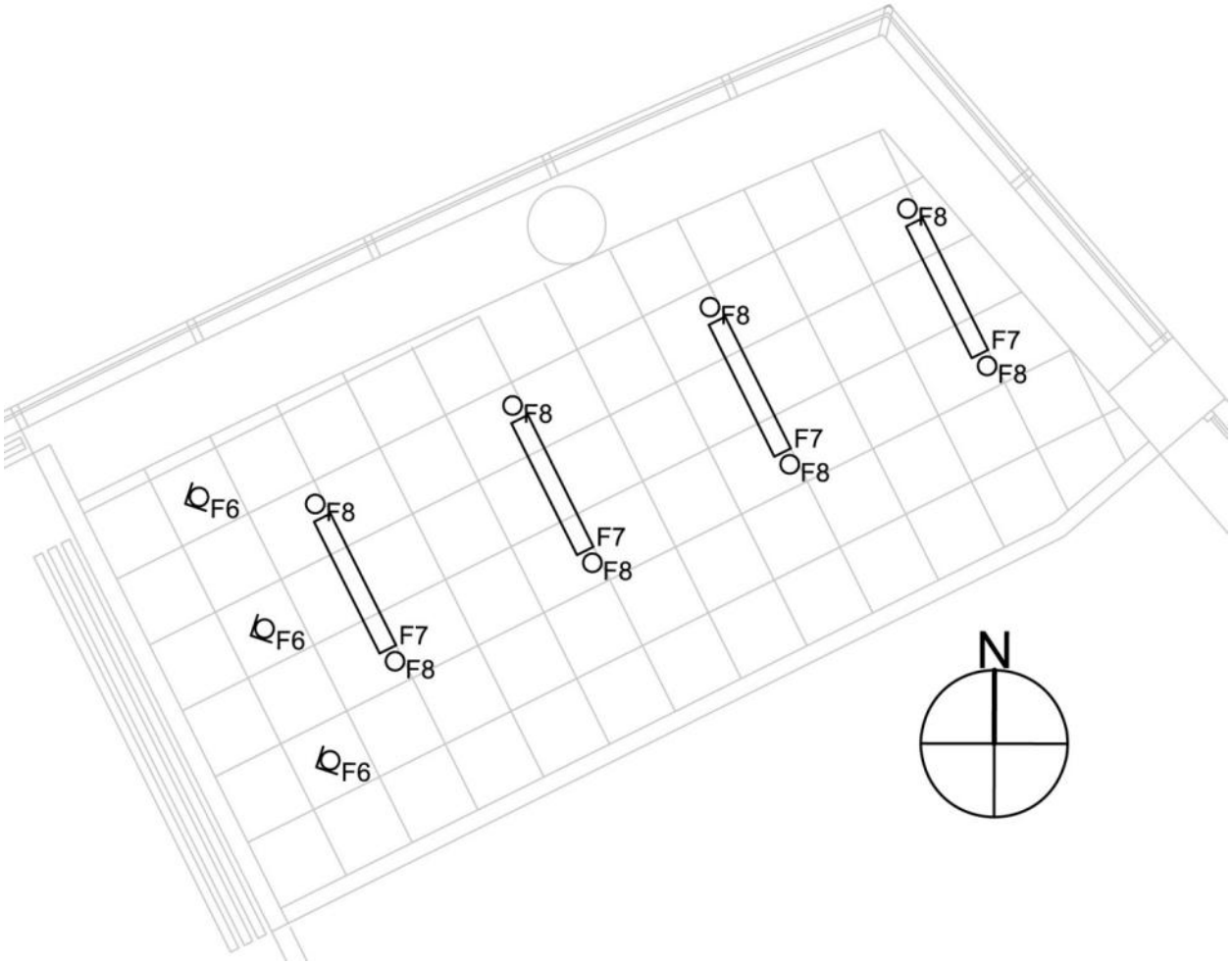
Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 2
- Expected Dirt Depreciation = 12%

Conference Room New Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F6	IV	Direct	0.98	0.88	0.97	0.98	0.82
F7	IV	Direct	1.00	0.88	0.97	0.98	0.84
F8	IV	Direct	0.98	0.88	0.97	0.98	0.82

CONFERENCE ROOM NEW LAYOUT



Conference Room New Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
26.5 fc	30 fc	4.8 fc	5 fc

The new illuminance level calculations are very close to the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels of 26.5 fc fall just a little bit under the target of 30 fc, but are still conducive to a satisfactory work environment. The vertical illuminance levels fall within the acceptable range for the IESNA requirements.

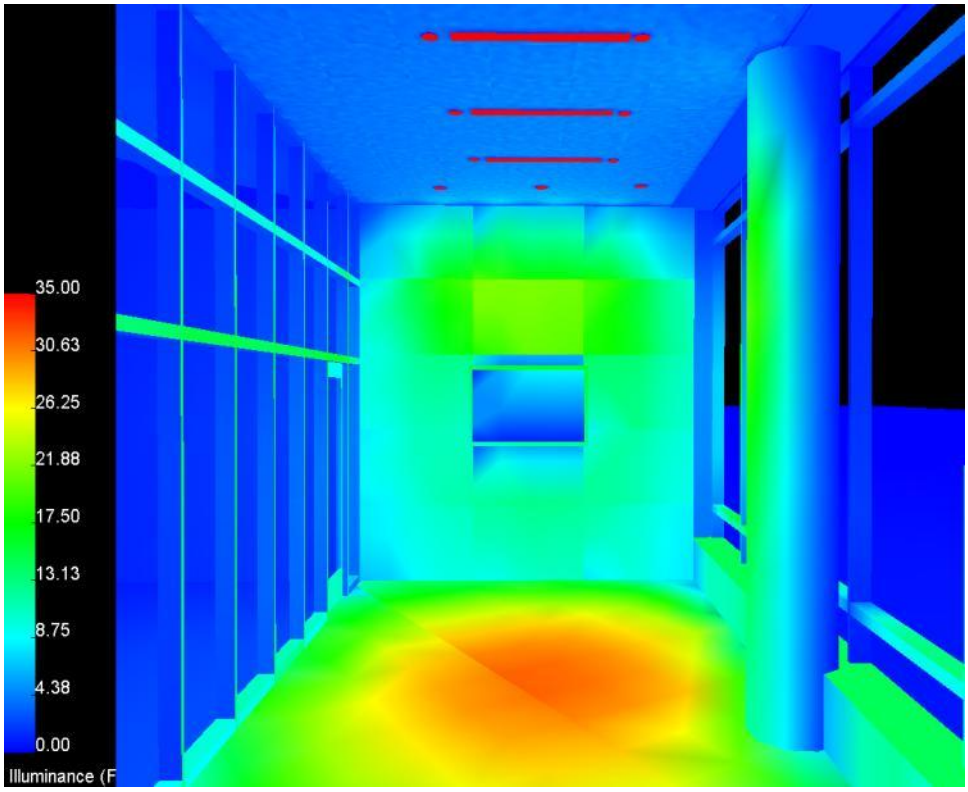
Conference Room New Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F6	28	3	84
F7	61	4	224
F8	20	8	160
Space Type			Conference Room
Area (ft^2)			340
Allowable LPD (W/ft^2)			1.3
Allowable Watts			442
Actual LPD (W/ft^2)			1.43
Actual Watts			488

The new power density calculations are much more on target with the recommended ASHRAE 90.1-2004 code than the existing design. While the new power density calculation of 1.43 W/ft^2 is a significant improvement over the existing power density calculation of 1.91 W/ft^2, it is still a little bit above the target of 1.3 W/ft^2. Although it is above the code, the power density will be made up in other spaces in the building, and the overall power density for the building will remain to code.

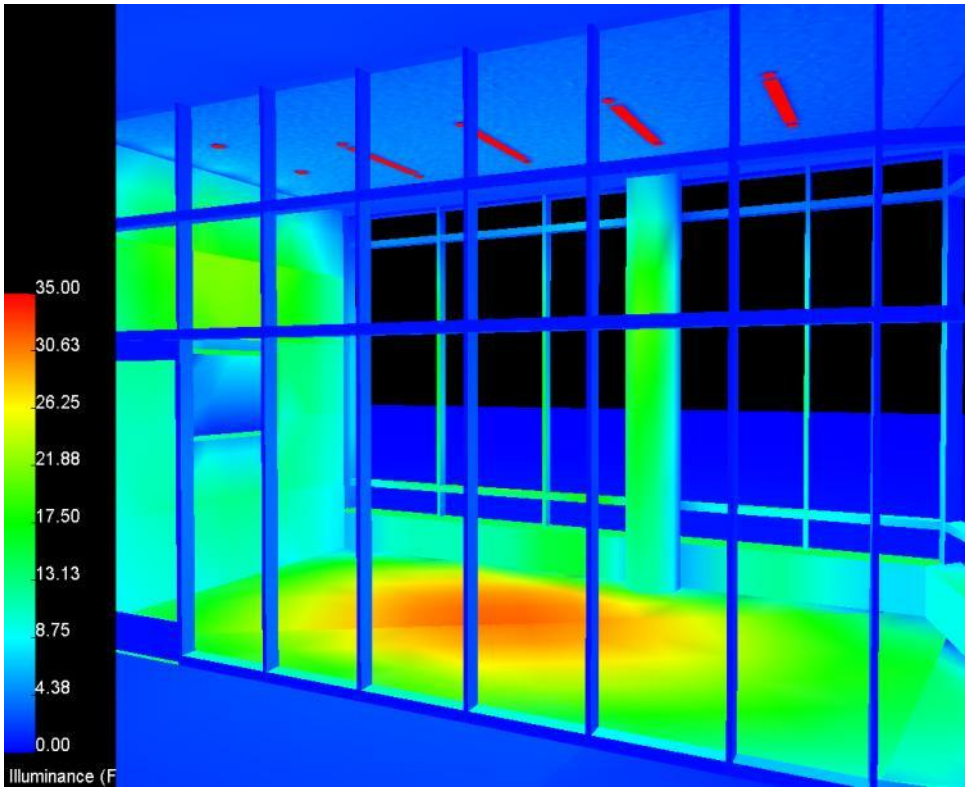
NEW EMERGENCY LIGHTING

The new emergency lighting in the space will consist of one of the F8 linear fluorescent fixtures. An emergency generator will provide power to the building when normal grid power fails. Enlarged plans showing emergency fixtures are available in Appendix G.

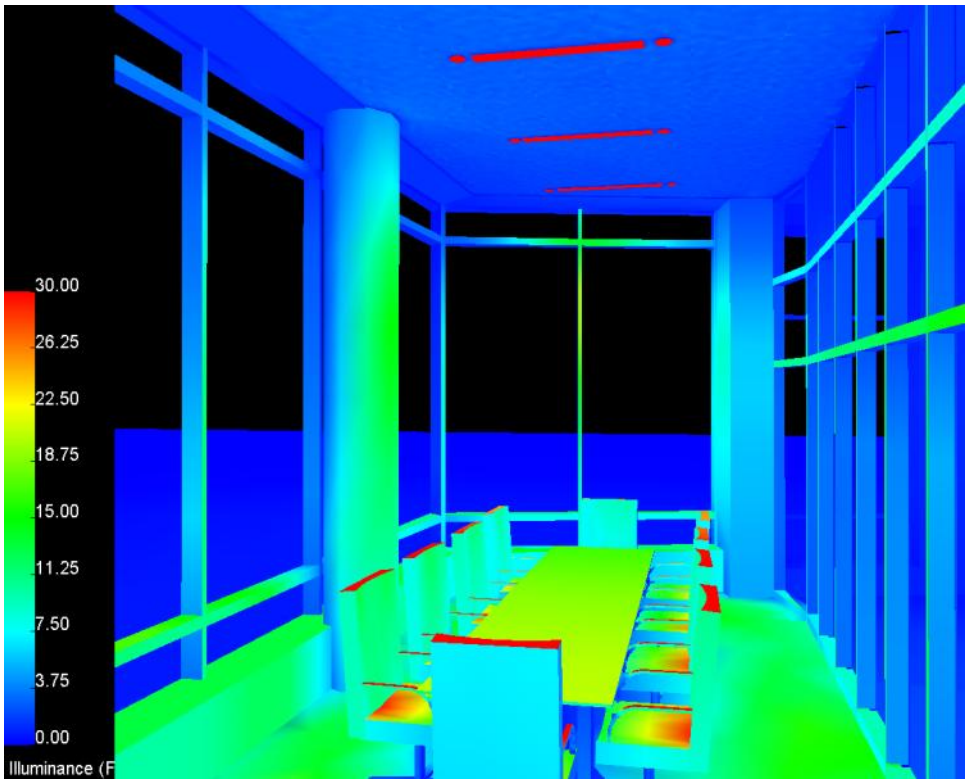
Conference RGB (above) and pseudo color (below) renderings with all fixtures on.



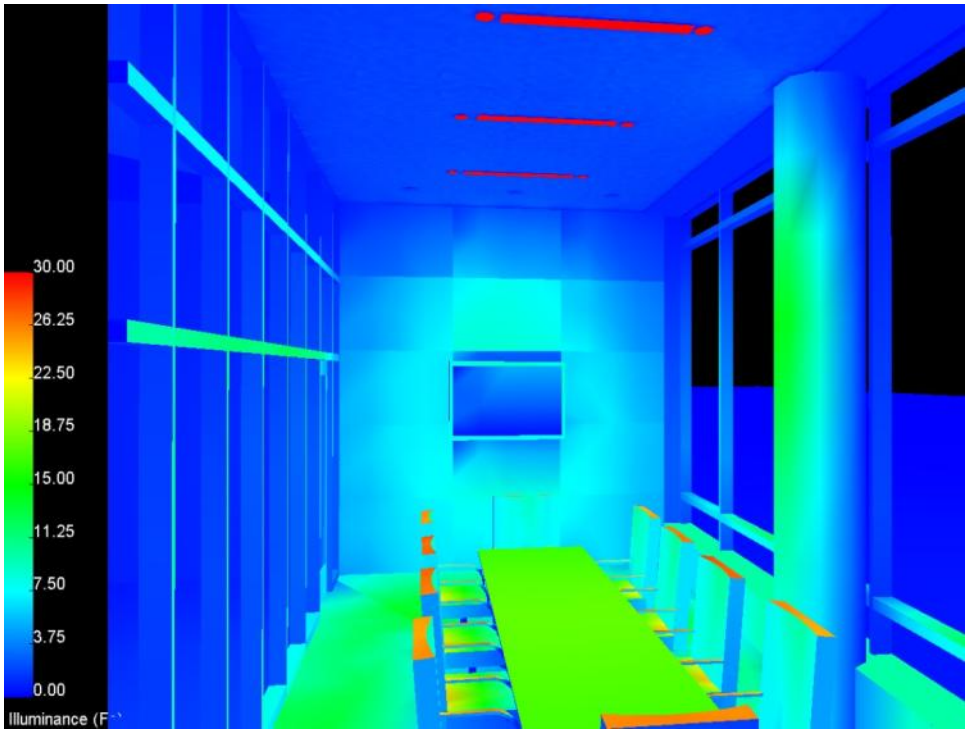
Conference RGB (above) and pseudo color (below) renderings with all fixtures on.



Conference RGB (above) and pseudo color (below) renderings with all fixtures on.



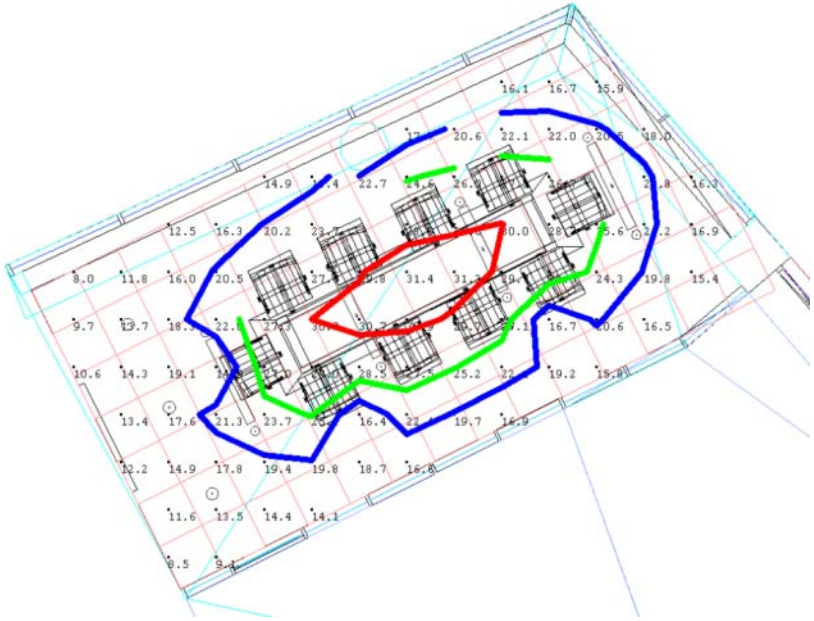
Conference RGB (above) and pseudo color (below) renderings with wallwashers off.



ISOLINE COLOR KEY

Dark Blue	Green	Red	Purple	Light Blue
15 fc	20 fc	25 fc	30 fc	35 fc

All fixtures on (above), wallwashers off (below)



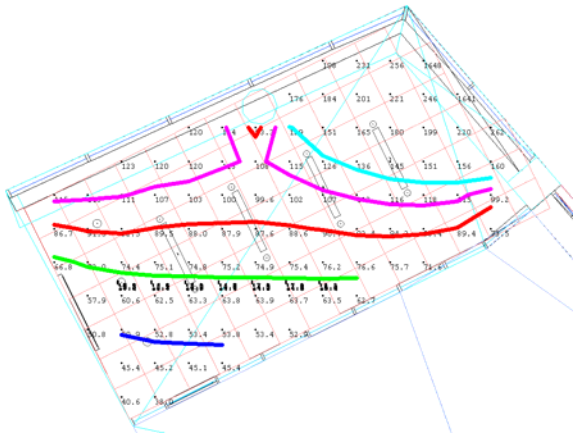
CONFERENCE ROOM DAYLIGHT STUDY

This study evaluates the need for daylight control in the conference room. Daylight level calculations were performed on the space at various times throughout the day. March 20, 2009 was chosen as the day to calculate because it is the spring Equinox, when the tilt of the earth is aligned neither towards or away from the sun. The analysis was performed at 9:00 AM, 12:00 PM and 3:00 PM on a day with a clear sky, and at 12:00 PM on a day with an overcast sky. An analysis was also performed to measure the light levels if the room utilized a translucent shading system. That calculation was performed at 9:00 AM on a day with a clear sky. The existing system uses a motorized blackout shade to prevent daylight from entering the space, but there is no setting to allow some daylight into the space. The new daylight control system will utilize a combination blackout shading and sheer shading system to allow some light to enter the space while controlling the U/V and heat entering the space. A sheer shading system will also be installed on the café windows, to allow for more privacy during classes and meetings. The system will be a Lutron Sivoia QED. Specifications for the shading system may be found in Appendix C.

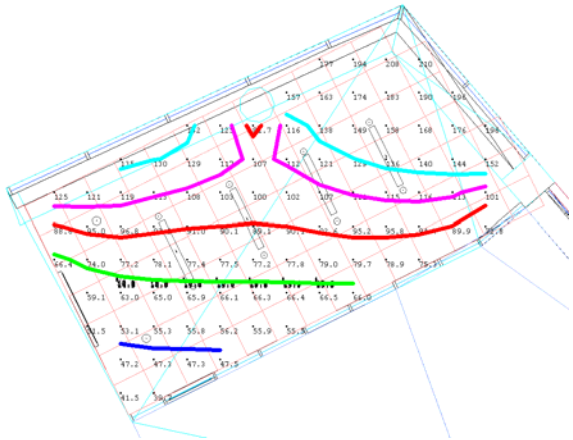
ISOLINE COLOR KEY

Dark Green	Dark Blue	Green	Red	Purple	Light Blue
30 fc	50 fc	70 fc	90 fc	110 fc	130 fc

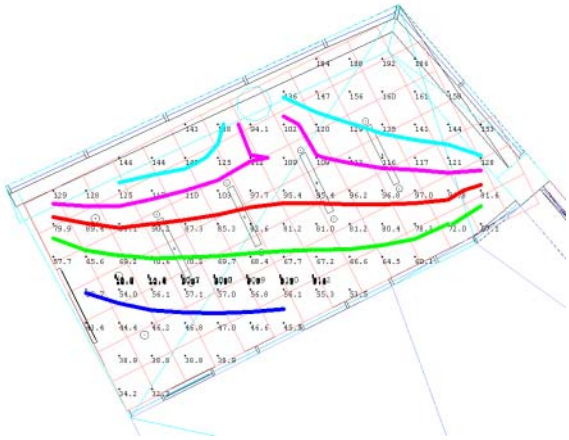
Clear Sky – March 20, 2009, 9:00 AM



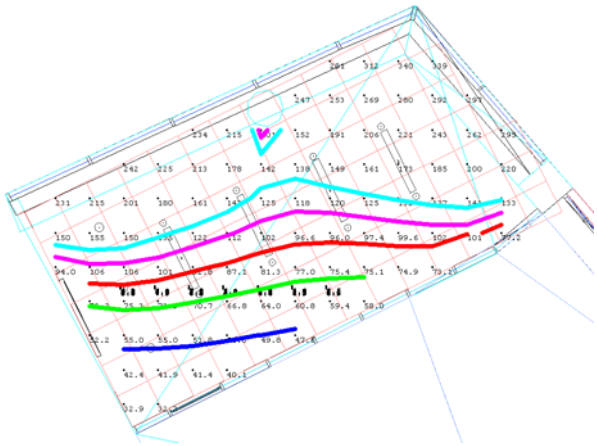
Clear Sky – March 20, 2009, 12:00 PM



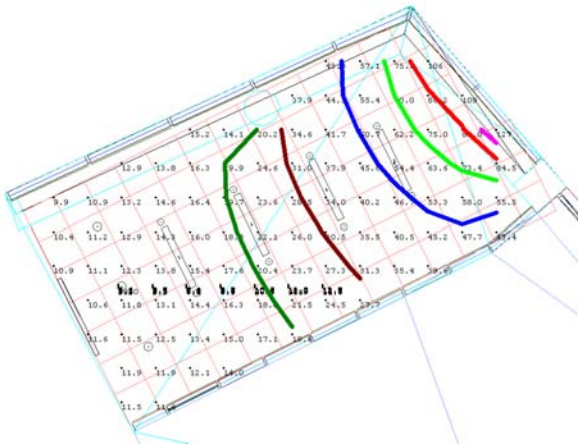
Clear Sky – March 20, 2009, 3:00 PM



Overcast Sky – March 20, 2009, 12:00 PM



Clear Sky – March 20, 2009, 12:00 PM with Shade



STUDENT LOUNGE

SPACE SUMMARY

The student lounge space and main staircase of the building span the curved, south-facing interior on the first floor. The area is a main circulation space in the building, and is open to students to use for studying or relaxing during the daytime as well as in the evening. The exterior south facing wall is floor-to-ceiling glazing, with an exterior sun shade to reduce the amount of direct sunlight in the space during the day. The ceiling height is 14'-0" over the lounge area and 10'0" under the staircase. The ceiling over the lounge is suspended wood panels. The main staircase to the second floor is medium reflectance wood, and the other walls in the space are medium reflectance wood paneling and glazing with aluminum framing. The flooring is a combination of low reflectance slate tile on the high traffic circulation areas and carpet under the seating areas.

Student Lounge Surface Materials and Reflectances

Location	Material	Reflectance / Transmittance
Walls	Medium Toned Wood Panels	50%
Ceiling	Wood Panels	50%
Ceiling	Painted Gypsum Wall Board	80%
Floor	Carpet	20%
Floor	Slate Tiles	30%
Columns	Painted	65%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

DESIGN CRITERIA

TASKS: Lobby, Study area, Circulation space

TARGET IMPRESSION: As a space, the lounge should portray a feeling of sophistication and relaxation. It is the first space occupants and visitors see when they enter the building, and it is visible from the exterior as well. With an abundance of glass, metal and wood, the space has a very clean, minimalist appearance. The luminaires selected for this space should be discreet and maintain the simple lines of the space.

The lighting in this space meets the illuminance criteria recommended by IESNA. While the energy code is not quite met, it is assumed that the lighting designers were considering the whole building method when designing this layout, and made up for energy in other areas of the building. Some considerations to make when designing for this space are to keep in mind daylight integration and control, direct glare, light distribution on the task plane and shadows. Daylight integration is very important due to the floor to ceiling glazing along the south wall. Since so much daylight is exposed to the space, controlling it an integrating it into the lighting system will greatly improve the room's atmosphere. Direct glare is also very important to control, both from daylight and from luminaires. Since students will be studying in the space, there should be no glare to distract them and put them in discomfort. Light distribution on the task plane should be evenly distributed and free of shadows, so it is most comfortable for students to study, read and do homework.

EXISTING LIGHTING

The luminaires over the lounge area are a combination of decorative halogen pendants and recessed compact fluorescent downlights. The halogen pendants add a relaxing, homey feel to the room, while the downlights create non-uniform illuminance on the floor. Underneath the stairs are surface mounted compact fluorescent downlights. LED under-railing lights illuminate the stairs.

Student Lounge Existing Luminaire Schedule						
Type	**Mounting**	**Manufacturer**	**Catalogue Number**	**Lamps**	**Volts**	**Description**
F1	Pendant	DWR	Nelson Pendant Series	1-E26 100W	120V	Translucent plastic is sprayed over a wire frame to allow light through and protect the eye from glare.
F3	Ceiling Recessed	Lightolier	8021CCLW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector.
F4	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 42W	120V	6" Recessed compact fluorescent wallwasher with an anodized aluminum parabolic reflector.
F10	Ceiling Surface	Lightolier	8068WH/CS8226LPU	2-CFQ 26W	120V	9" Surface-mounted compact fluorescent downlight with a parabolic louver.
F11	Wall Recessed	Winona	LED-STEP01-RECT-M-001/HO	LED	12V	Recessed extruded aluminum LED steplight.

Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

Student Lounge Existing Light Loss Factors							
Type	**Maintenance Category**	**Distribution**	**BF**	**LDD**	**RSDD**	**LLD**	**Total LLF**
F1	II	Semi-Indirect	1.0	0.93	0.92	0.76	0.649
F3	IV	Direct	0.98	0.87	0.97	0.86	0.711
F4	IV	Direct	0.98	0.87	0.97	0.86	0.711
F10	IV	Direct	0.98	0.87	0.97	0.86	0.711
F11	VI	Direct	1.0	0.86	0.97	1.0	0.834

STUDENT LOUNGE EXISTING LAYOUT

Student Lounge Existing Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
23.97 fc	10-30 fc	n/a	n/a

The existing illuminance values for the student lounge are on target with the IESNA Lighting Handbook recommendations. The illuminance levels over the seating areas where the students will be studying is higher than the illuminance levels on the walkway, which is appropriate.

Student Lounge Existing Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F1	100	11	1100
F3	45	13	585
F4	45	9	405
F10	45	5	225
F11	7.6/ft	42 ft	319.2
Space Type			Lounge
Area (ft^2)			2243
Allowable LPD (W/ft^2)			1.2
Allowable Watts			2691
Actual LPD (W/ft^2)			1.17
Actual Watts			2634

The existing power density calculations are almost exactly on target with the recommended ASHRAE 90.1-2004 code. The design is actually 0.03 W/ft^2 less than the code requirements, which is 1.2 W/ft^2. Although this is an excellent design, attempts will be made to improve the LPD in the new design.

EXISTING EMERGENCY LIGHTING

The existing emergency lighting in the space is made up of alternating F6 and F10 compact fluorescent downlights. An emergency diesel power generator will provide power to the building when normal grid power fails.

NEW LIGHTING SOLUTION

The new lighting design is intended to emphasize the wood paneled walls, draw people into the space, and be conducive to studying and relaxing. Multiple-lamp fixtures run in an alternating pattern through the length of the space, adding a non-uniform element to the ambient lighting in the space. Linear Fluorescent wallwashers run the length of the wood panel wall in the 14'-0" height of the space. Under the 10'-0" section of ceiling, compact fluorescent wallwashers illuminate the wall. LED steplights lead the way up the main staircase to the second floor.

Student Lounge New Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F1	Ceiling Recessed	Amerlux	CLYR-3-37-MR16-E-BT-277-WT	3-MR16 35W	277 V	5" recessed halogen accent light.
F2	Semi-Recessed	Lightolier	DSL01SA	LED	12 V	Semi-recessed LED step light.
F6	Ceiling Recessed	Lightolier	8021CW/6132BU	1-CFTR 26W	277 V	6" recessed compact fluorescent wallwasher.
F11	Ceiling Recessed	Mark Lighting	SPR-F-1T5HO-277-EB	1-T5HO 28W	277 V	5" recessed fluorescent wallwasher.
F14	Ceiling Surface	Winona Lighting	P1-SS-CFQ26-277V-SS8-SGW-X-STD	1-CFQ 26W	277 V	12" surface-mounted compact fluorescent wallwasher.
F15	Ceiling Surface	Kurt Versen	P602	2-CFQ 26W	277 V	8" surface-mounted compact fluorescent downlight.

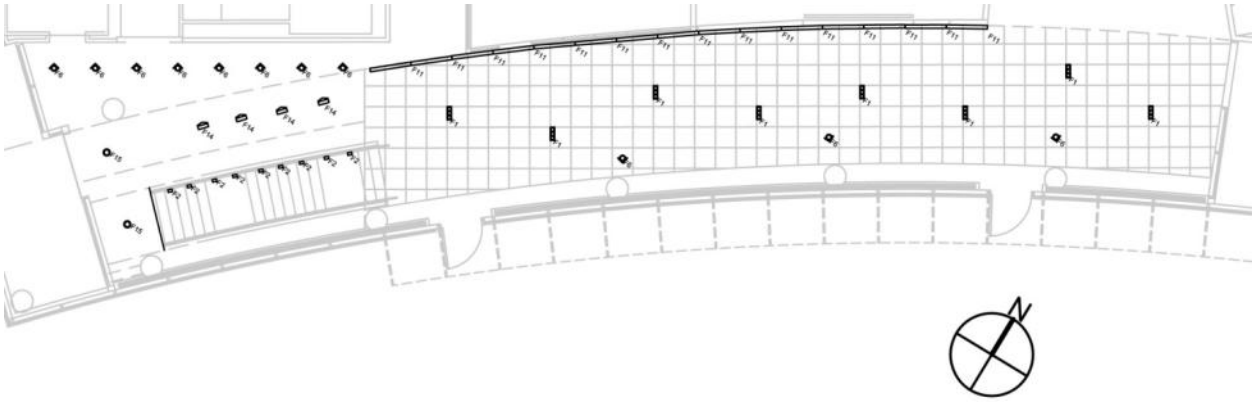
Assumptions:

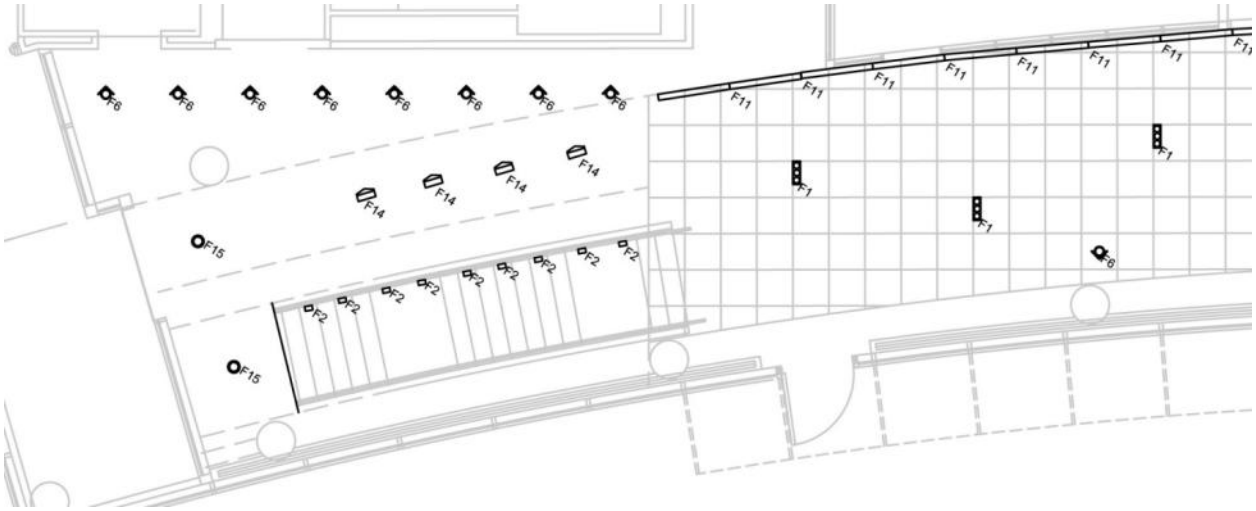
- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

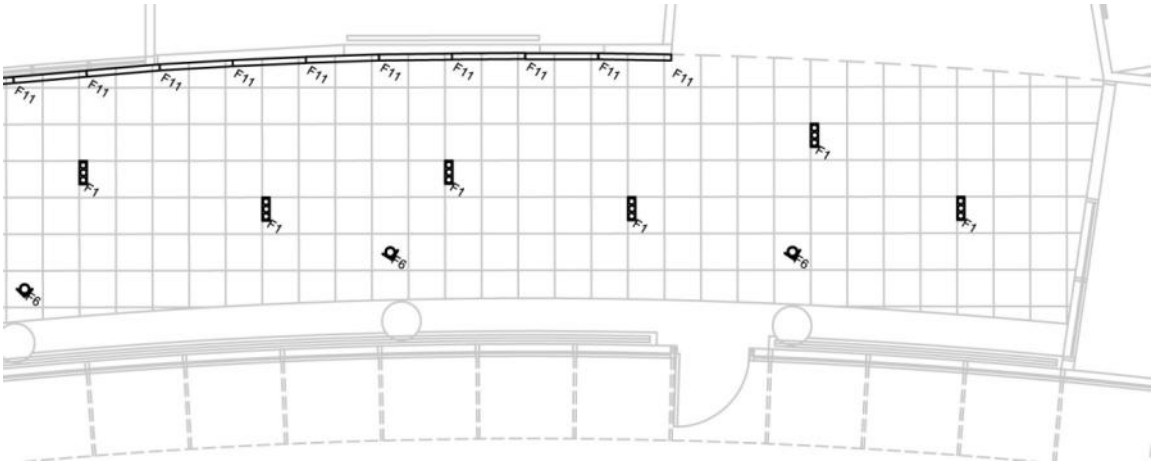
Student Lounge New Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F1	IV	Direct	0.98	0.87	0.97	1.0	0.83
F2	VI	Direct	1.0	0.86	0.97	1.0	0.83
F6	IV	Direct	0.98	0.87	0.97	0.85	0.70
F11	IV	Direct	0.98	0.87	0.97	0.92	0.76
F14	IV	Indirect	0.98	0.87	0.97	0.85	0.70
F15	IV	Direct	0.98	0.87	0.97	0.85	0.70

STUDENT LOUNGE NEW LAYOUT







Student Lounge New Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
25.57 fc	10-30 fc	n/a	n/a

The new illuminance levels in the student lounge are very appropriate considering the IESNA Lighting Handbook recommendations. The lighting is non-uniform in distribution, and maintains an average illuminance level of 25.57 fc, which is acceptable.

Student Lounge New Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F1	120	8	960
F2	4	10	40
F6	28	11	308
F11	32	15	480
F14	28	4	112
F15	54	2	108

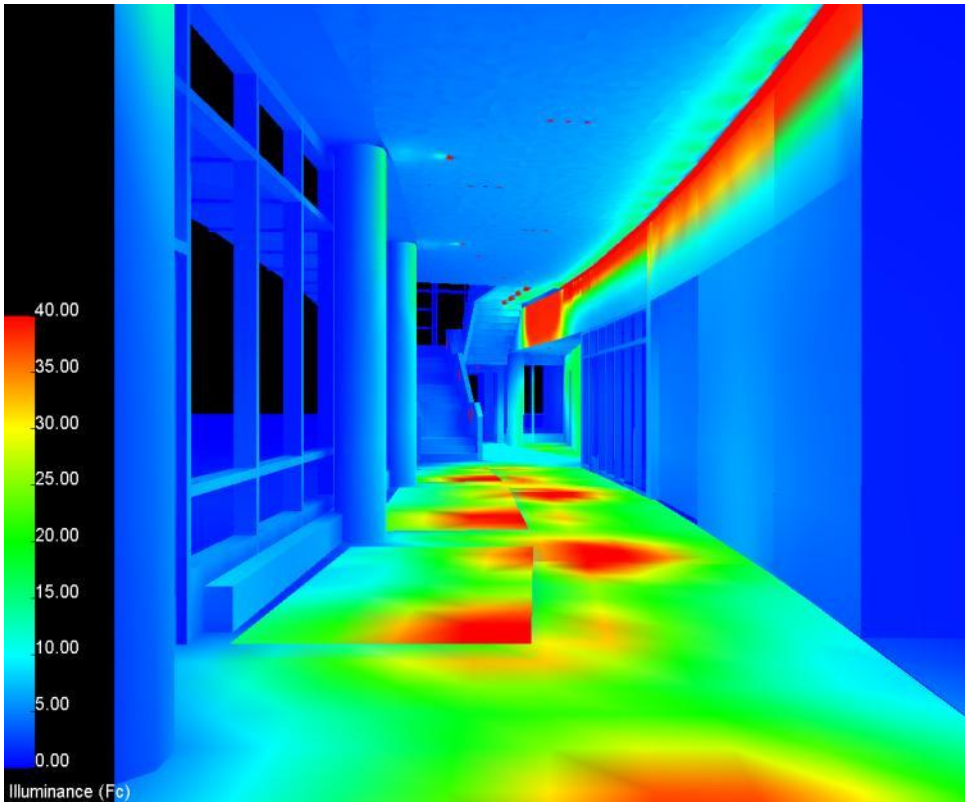
Space Type	Lounge
Area (ft^2)	2243
Allowable LPD (W/ft^2)	1.2
Allowable Watts	2691
Actual LPD (W/ft^2)	0.89
Actual Watts	2012

The new power density calculations rates the actual watts (2012 W) significantly less than the allowable watts (2691 W) according to ASHRAE 90.1-2004. This will help to make up for the conference room calculations, which were slightly higher than the allowable watts.

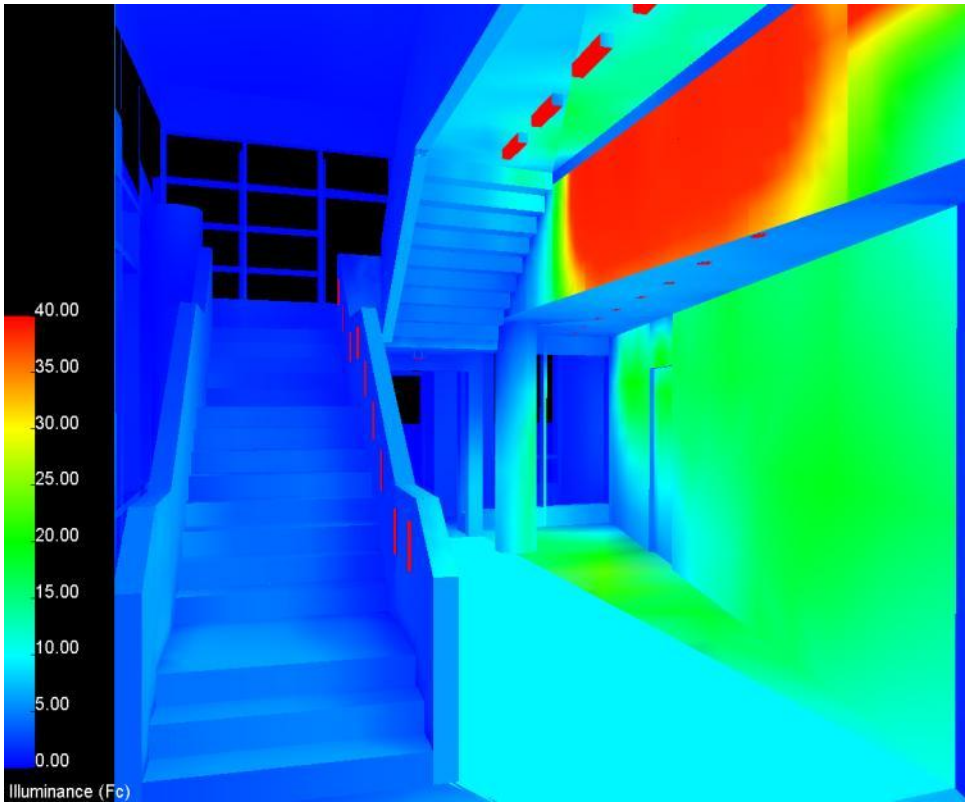
NEW EMERGENCY LIGHTING

The new emergency lighting in the space will consist of a combination of several F6 and F1 fixtures. An emergency generator will provide power to the building when normal grid power fails. Enlarged plans showing emergency fixtures are available in Appendix G.

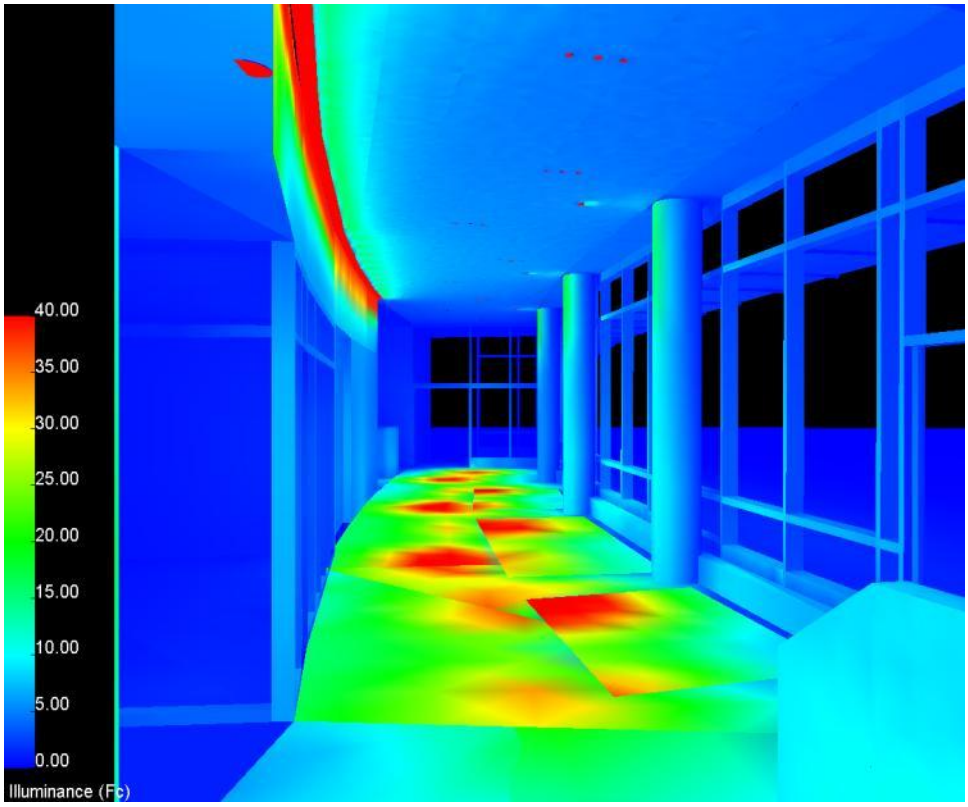
Lounge RGB (above) and Pseudo Color (below) Renderings

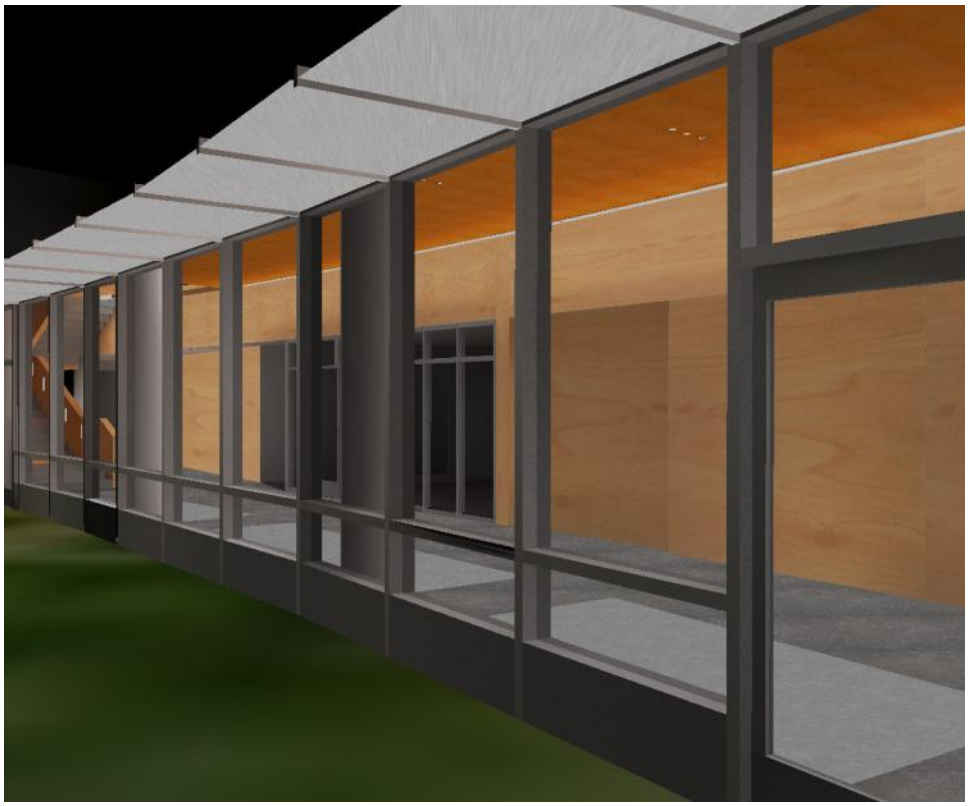


Lounge RGB (above) and Pseudo Color (below) Renderings

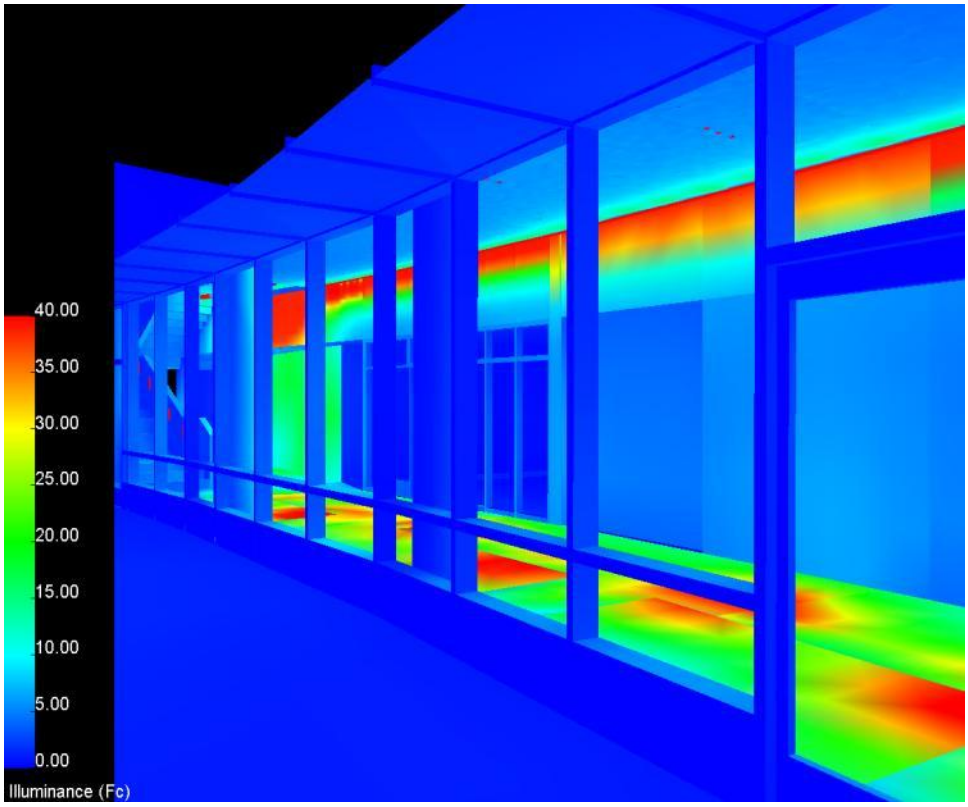


Lounge RGB (above) and Pseudo Color (below) Renderings



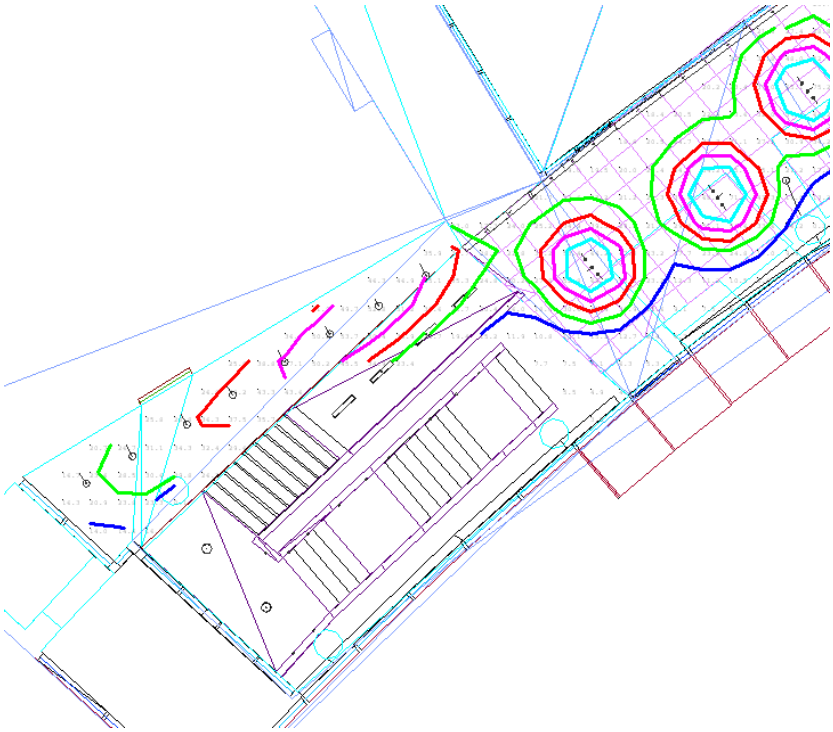


Lounge RGB (above) and Pseudo Color (below) Renderings



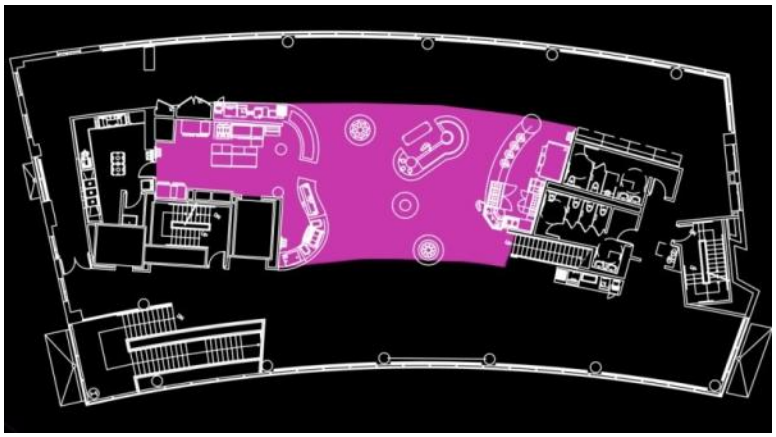
ISOLINE COLOR KEY

Dark Blue	Green	Red	Purple	Light Blue
15 fc	25 fc	35 fc	45 fc	55 fc



CAFETERIA SERVING SPACE

SPACE SUMMARY



The main campus cafeteria serving area is located on the second floor of the Wheelock College Campus Center and Student Residence building. Students will gather here to eat breakfast, lunch and dinner. The space features curved serving bars, round condiment stations, and kitchen and cooking areas. In the center of the space is a specialty bar, with made-to-order items. The space will also have moveable tables and chairs for students to eat. The ceiling height is 8'-0" and is suspended 2x4 acoustical ceiling tile. The north and south sides are open to the hallway, while the east and west walls are painted gypsum wall board.

Cafeteria Serving Surface Materials and Reflectances

Location	Material	Reflectance / Transmittance
Floor	Wood Flooring	50%
Wall/Columns	Painted Gypsum Wall Board	70%
Ceiling	2x4 Acoustical Ceiling Tile	80%
Counter Tops	Black Marble	90%
Counters	Painted Wood	40%
Kitchen Equipment	Stainless Steel	80%

DESIGN CONSIDERATIONS

TASKS: Food preparation, Food serving area

TARGET IMPRESSION: The serving area of the cafeteria needs to be functional and a fun place for students to get food and eat. The atmosphere should be relaxed and youthful.

The architectural design of the space is very open, with counters on the east and west side and in the center of the space. There are also circular condiment stations and movable tables and chairs throughout the space. The flooring is tile, and the walls are painted gypsum wall board. Using neutral color temperature of about 3500 would be comfortable for the occupants. The light should also have a good color rendering index to enhance the colors of the food being served. Direct glare could be a problem in the food preparation areas and serving areas when the kitchen staff is trying to prepare and serve meals. The contrast between the bright glare and the background could potentially be dangerous if the staff cannot see what they are doing when using sharp cutlery. Light distribution throughout the room should be non-uniform to promote relaxation and pleasantness. Emphasis should be placed on the food serving areas. Some peripheral emphasis would also be good design to add to the pleasantness of the space.

EXISTING LIGHTING

The luminaires are a combination of track mounted decorative pendants, and recessed downlights. The T4 halogen pendants illuminate the space over the serving counters, while the compact fluorescent downlights add non-uniform ambient light over the kitchen preparation areas and throughout the space.

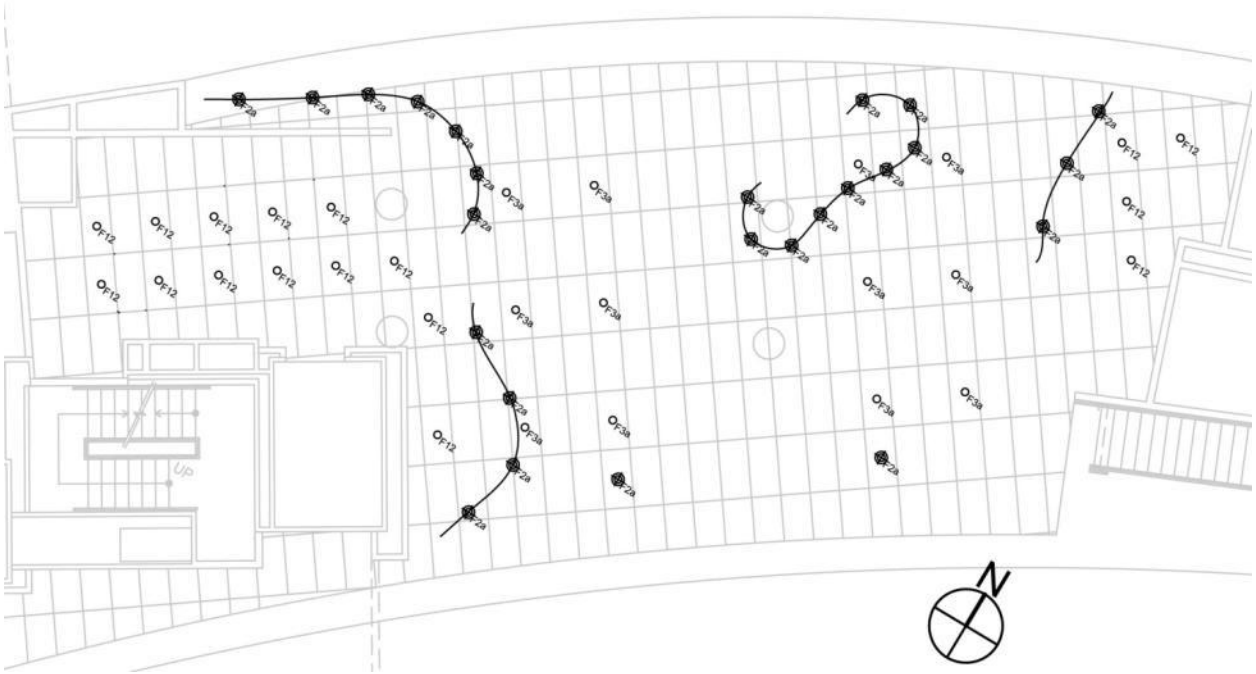
Cafeteria Serving Existing Luminaire Schedule						
Type	**Mounting**	**Manufacturer**	**Catalogue Number**	**Lamps**	**Volts**	**Description**
F2a	Pendant	Wilmette	600-MO-CNG-C	T4 50W Halogen	120V	Monorail mounted halogen pendant.
F3a	Ceiling Recessed	Lightolier	D7A02-8022FCL-S7142BU	1-CFTR 42W	120V	6" Recessed compact fluorescent downlight with an anodized aluminum parabolic reflector and decorative Vetro dropped glass ring.
F12	Ceiling Recessed	Lightolier	8097FWHW/7132BU	1-CFTR 42W	120V	7" Recessed compact fluorescent downlight with anodized aluminum parabolic reflector.

Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

Cafeteria Serving Existing Light Loss Factors							
Type	**Maintenance Category**	**Distribution**	**BF**	**LDD**	**RSDD**	**LLD**	**Total LLF**
F2a	IV	Direct	0.98	0.87	0.97	0.86	0.711
F3a	VI	Direct	1.0	0.86	0.97	1.0	0.834
F12	IV	Direct	0.98	0.87	0.97	0.86	0.711

CAFETERIA EXISTING LAYOUT



Cafeteria Serving Existing Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
12.8 fc	10-30 fc	3.38 fc	3-5 fc

The existing illuminance levels in the cafeteria serving space are similar to the values recommended by the IESNA Lighting Handbook. The horizontal levels on the floor average 9.3 fc, which is very close to the 10 fc recommendation. The illuminance levels on the serving counters average to 18.76 fc, which is lower than the 30 fc recommendation. The lighting in the food preparation area averages 26.8 fc, which is a little bit low, but still acceptable for food preparation. The vertical illuminance levels are acceptable according to the IESNA recommendations.

Cafeteria Serving Existing Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F2a	15	25	375
F3a	45	12	540
F12	45	17	765
Space Type			Cafeteria
Area (ft^2)			2048
Allowable LPD (W/ft^2)			1.4
Allowable Watts			2867
Actual LPD (W/ft^2)			0.82
Actual Watts			1680

The existing power density calculations rates the actual watts (1680 W) significantly less than the allowable watts (2867 W) according to ASHRAE 90.1-2004. Although the power density is rated very low in this space, it is reflected in illuminance values which do not meet the IESNA recommendations.

EXISTING EMERGENCY LIGHTING

The existing emergency lighting in the space consists of a combination of F12 and F3a compact fluorescent downlights. There are five F12 and six F3a emergency fixtures in the space. An emergency generator will provide power to the building when normal grid power fails.

NEW LIGHTING SOLUTION

The space is intended to feel comfortable to occupants, as well as to direct them to the food serving counters, and promote circulation. A uniform spread of compact fluorescent recessed downlights gives the space a general illuminance while remaining sleekly concealed in the low 8'0" ceiling. Pendants hanging over the counters lead students to the food, and add a decorative touch to the space. The linear fluorescent fixtures in the food preparation area allow for a bright, uniformly lit space to properly prepare food. Linear fluorescent wallwashers on the walls behind the counters bring the focus to the peripheral, and give the space a more relaxing feel.

Cafeteria Serving New Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F4	Recessed	Lightolier	8091 CCLW	1-CFTR 26W	277 V	6" recessed compact fluorescent downlight.
F5	Recessed	Focal Point	FLU-24-B-2-T5HO-E-277-G	2-F28T5	277 V	2'x4' recessed indirect with perforated center basket.
F9	Pendant	Delray Lighting	2310-S-18-2-E	1-CFTR 18W	277 V	9" suspended compact fluorescent downlight.
F10	Pendant	Winona Lighting	LED-POPS01-6-ARC-M-001-ND12V-BAL-X-STD	LED	12 V	Suspended LED chandelier.
F11	Ceiling Recessed	Mark Lighting	SPR-F-1T5HO-277-EB	1-T5HO 28W	277 V	5" recessed fluorescent wallwasher.

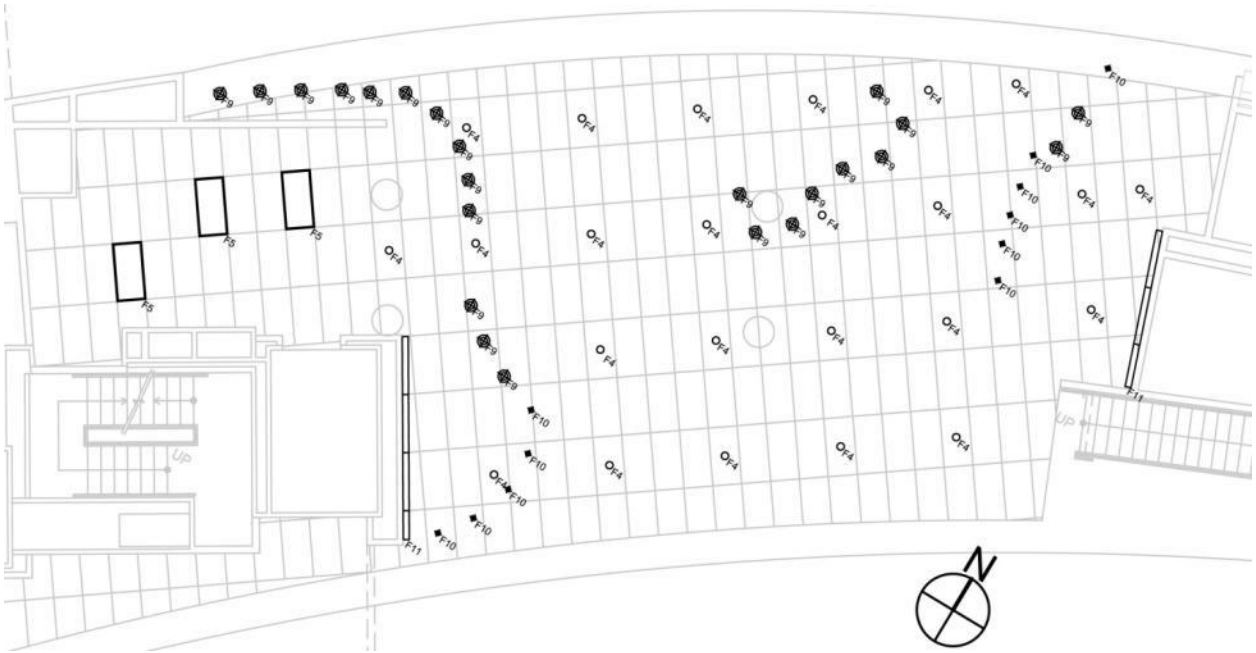
Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

Cafeteria Serving New Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F4	IV	Direct	0.98	0.87	0.96	0.85	0.70
F5	IV	Semi-Direct	0.98	0.87	0.92	0.92	0.72
F9	IV	Direct	0.98	0.87	0.96	0.84	0.67
F10	II	Direct/Indirect	1.0	0.93	0.91	1.0	0.85
F11	IV	Direct	0.98	0.87	0.96	0.92	0.75

CAFETERIA NEW LAYOUT



Cafeteria Serving New Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
17.3 fc	10-30 fc	3.38 fc	3-5 fc

The new illuminance levels for the cafeteria serving space and kitchen are a lot more appropriate than the existing levels. The kitchen area has an average illuminance of 28.6 fc, which is very close to the recommended IESNA levels of 30 fc. The lighting in the serving space is more evenly spaced, so although the distribution is still non-uniform on the ground, there are no spots that fall below 7 fc. The average illuminance on the floor is 11.68 fc, and on the serving counters is 43.7 fc. The vertical illuminance is 3.38, which is in the range of appropriate light levels.

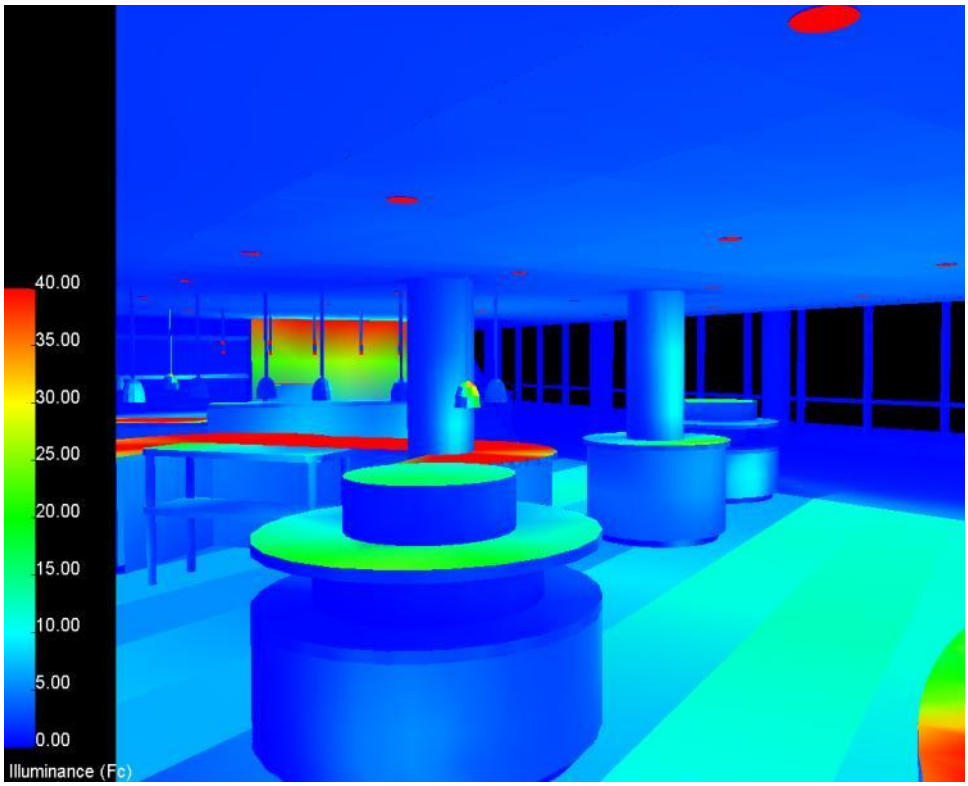
Cafeteria Serving New Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F4	28	23	644
F5	63	3	189
F9	20	21	420
F10	4	11	44
F11	32	7	224
Space Type			Cafeteria
Area (ft^2)			2048
Allowable LPD (W/ft^2)			1.4
Allowable Watts			2867
Actual LPD (W/ft^2)			0.74
Actual Watts			1515

The new power density calculations rates the actual watts (1515 W) significantly less than the allowable watts (2867 W) according to ASHRAE 90.1-2004. This rating is also better than the original LPD calculation by 0.08 W/ft^2.

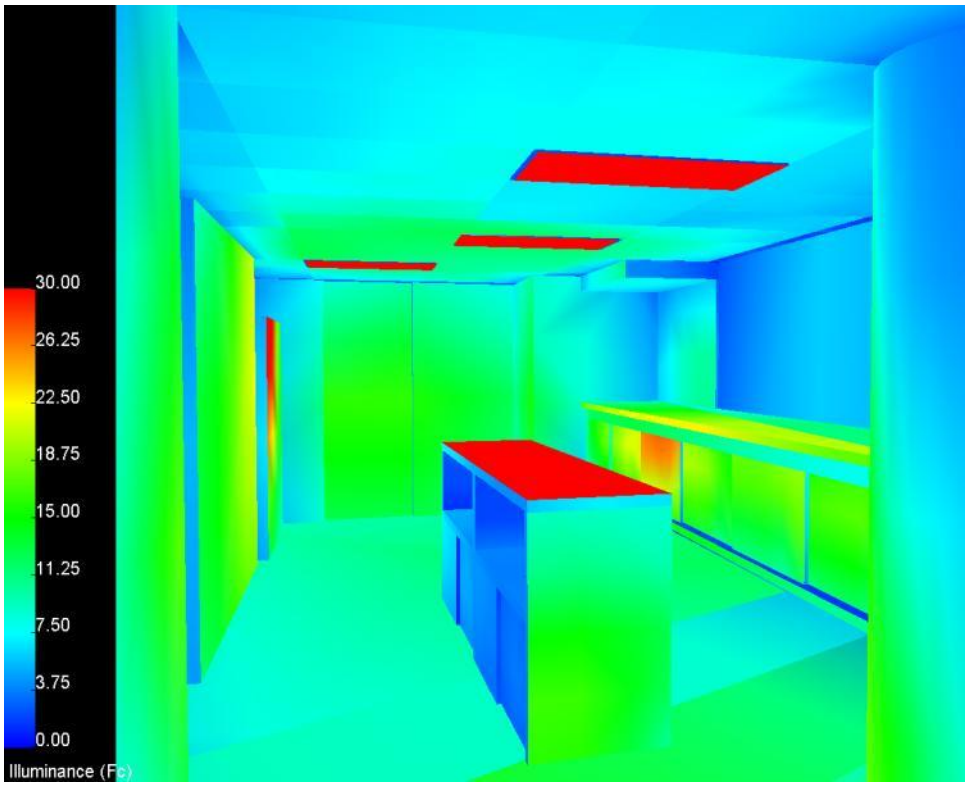
NEW EMERGENCY LIGHTING

The new emergency lighting in the cafeteria serving space consists of several F4 compact fluorescent downlights. An emergency generator will provide power to the building when normal grid power fails. More information about the emergency lighting can be found in Appendix G.

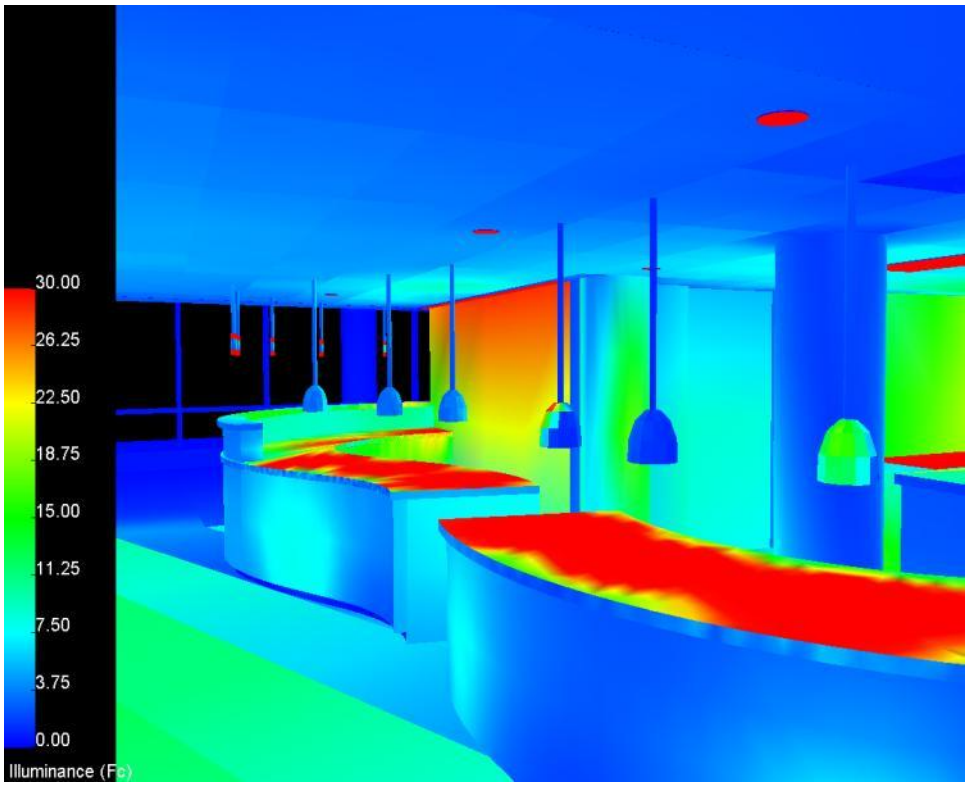
Serving Space RGB (above) and Pseudo Color (below) Renderings



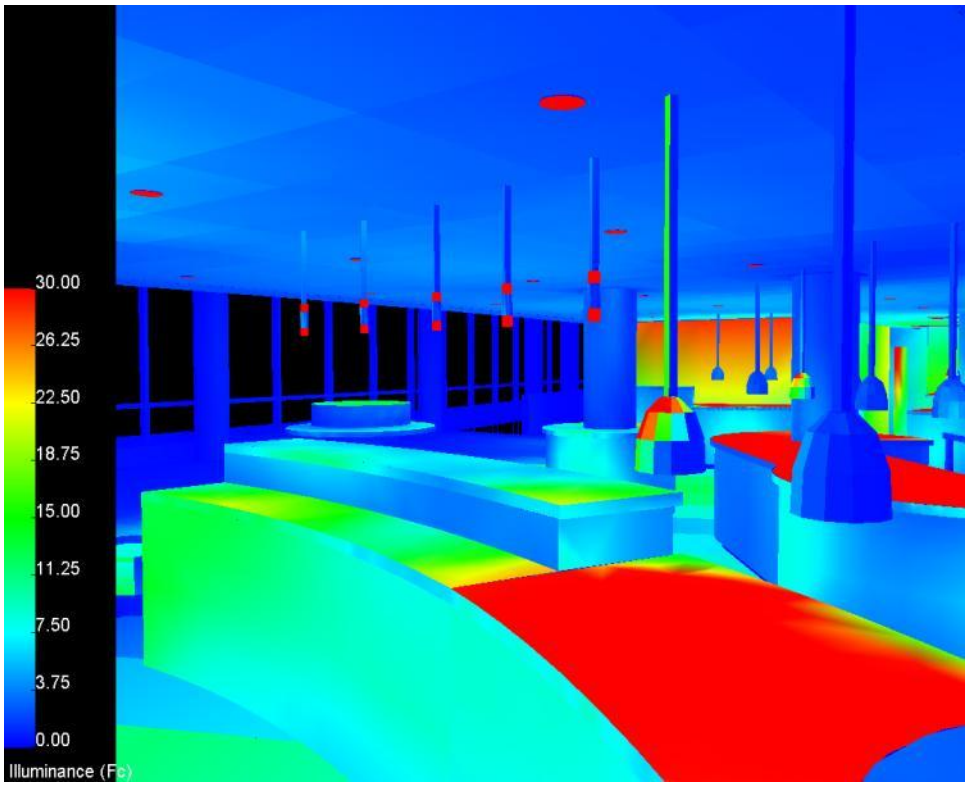
Kitchen RGB (above) and Pseudo Color (below) Renderings



Serving Space RGB (above) and Pseudo Color (below) Renderings

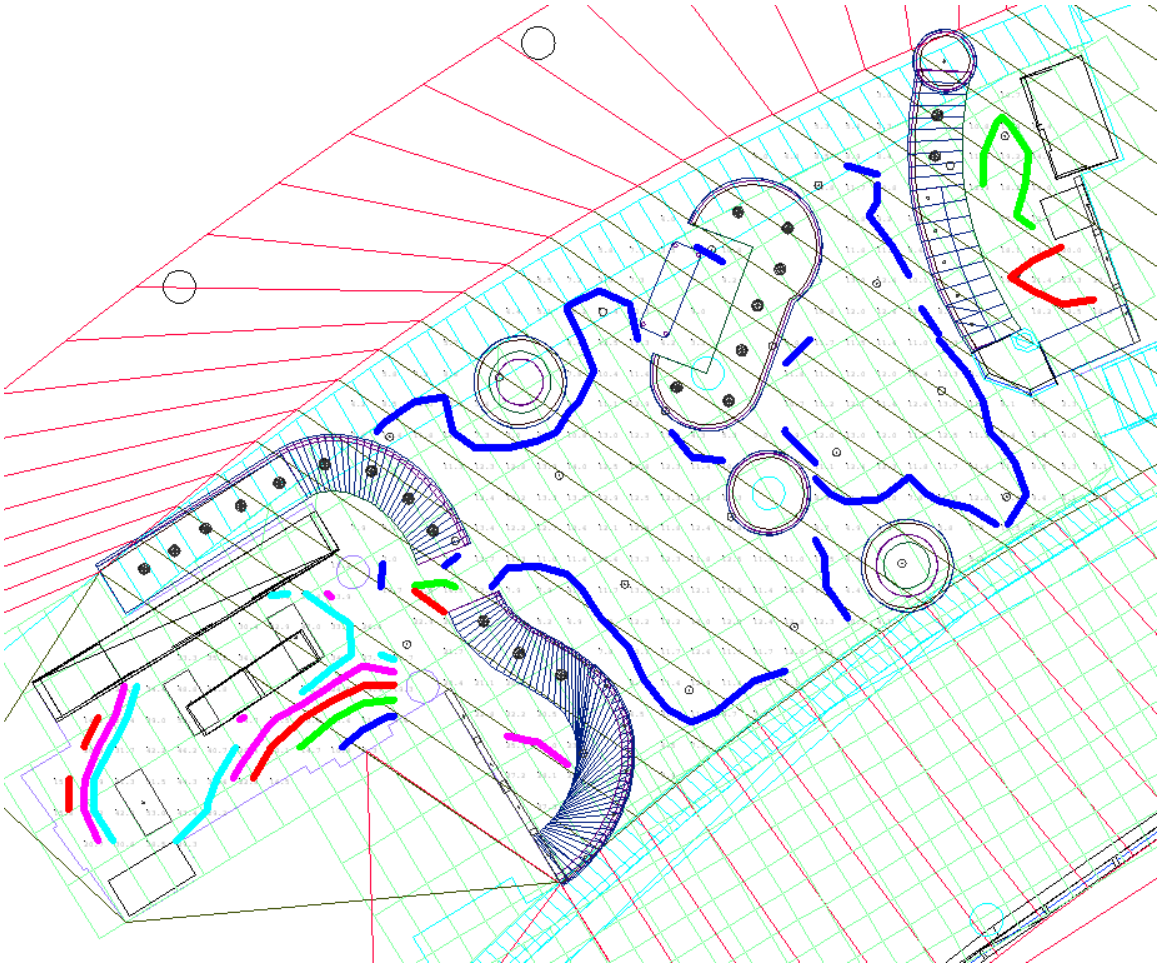


Serving Space RGB (above) and Pseudo Color (below) Renderings



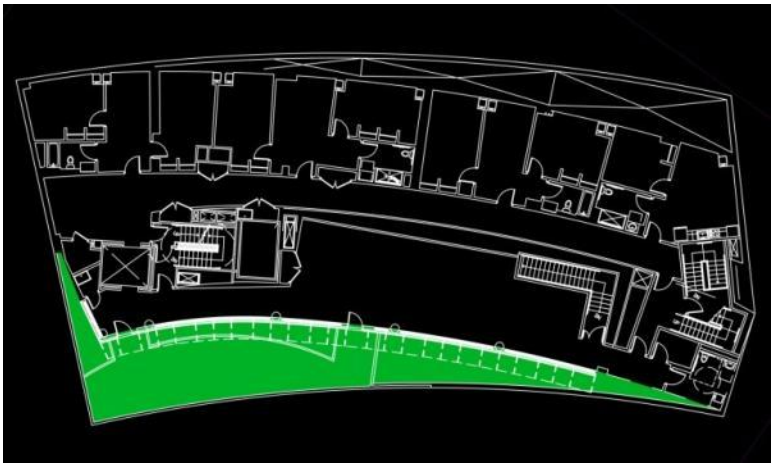
ISOLINE COLOR KEY

Dark Blue	Green	Red	Purple	Light Blue
10 fc	15 fc	20 fc	25 fc	30 fc



ROOF DECK

SPACE SUMMARY



The third floor outdoor deck is located on the south facing side of the building. The deck features vegetation areas, potted plants and a glass railing. The exterior wall is glazing with aluminum framing. Students will be able to use this space for studying and relaxing. The flooring is roof pavers, and the vegetation boxes are concrete unit pavers on a pedestal system with granite coping at the joints which may be used as seating for occupants. There is currently no lighting system in place on the roof deck, but it would be an ideal place to illuminate during the evening for students to sit and relax.

Roof Deck Surface Materials and Reflectances

Location	Material	Reflectance / Transmittance
Floor	Slate Tile	30%
Walls	Stone Walls	30%
Glass Façade	Annealed Float Glass	90%
Mullions	Aluminum	85%

DESIGN CONSIDERATIONS

TASKS: Relaxation, Conversation

TARGET IMPRESSION: The new lighting design for the space is intended to make the space usable and pleasant at night. The roof deck should be a place where students can relax during nice nights, and use as a social gathering area.

The roof deck is adjacent to a glass curtain wall and an interior dining area, so it is important that the color temperature be similar to the indoor space. The assumed color temperature of the interior space is 3500K, so the outdoor deck should be similar. Color rendering is not very important in this space due to the lack of tasks being performed. A CRI of 70 or above would be sufficient. Direct glare from daylight and luminaires should be taken into consideration when designing for the space. For safety reasons some degree of uniformity must be maintained throughout the space. However, to create visual interest and textures of the landscaping of the space, non-uniform lighting should be utilized. Points of interest in the space are the vegetation. Possibly highlighting some of the landscaping would be a good design idea. There is a lot of landscaping in the area, and the plants will be increasing is size yearly, so being aware of projected plant growth in subsequent years is important. The use of shadows in this space may be used to enhance the dimensions of the space and give it more visual interest.

EXISTING LIGHTING

There is currently no lighting system in this space.

NEW LIGHTING

Compact fluorescent path lights lead occupants out onto the deck, and illuminate the floor. The non-uniform patterns created by these path lights will make the space more relaxing and inviting. Landscape lighting draws the eye to the planters and shrubbery. The ground mounted uplights have a dual purpose of illuminating the bushes to add depth and texture, and illuminating the bottoms of the sun shades to create the effect of a ceiling over the space.

Roof Deck New Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F3	In Ground	Winona	CELED-1003-12V-L1-BKS	LED	277V	Surface-mounted LED landscape light.
F13	Wall Surface	Lumiere	1235-RD-M-4LED-120/12-BK	1-CFTR13W	277V	Recessed compact fluorescent step light.

Assumptions:

- Maintenance Category: Dirty
- Cleaning Intervals: 18 Months
- RCR = 5
- Expected Dirt Depreciation = 25%

Roof Deck New Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F3	VI	Direct	1.0	0.72	0.92	1.0	0.66
F13	IV	Direct	0.98	0.69	0.92	0.97	0.59

ROOF DECK NEW LAYOUT

Roof Deck New Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
4.13 fc	3-5 fc	4.52 fc	1-3 fc

The calculated horizontal illuminance levels of 4.13 fc fall within the target range of 3-5 fc specified in the IESNA Lighting Handbook. The horizontal levels fall just a little bit under the target, and are still conducive to a satisfactory work environment. The vertical illuminance levels are slightly above the recommended levels, but are still appropriate for the space.

Roof Deck New Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F3	4	10	40
F13	16	8	120

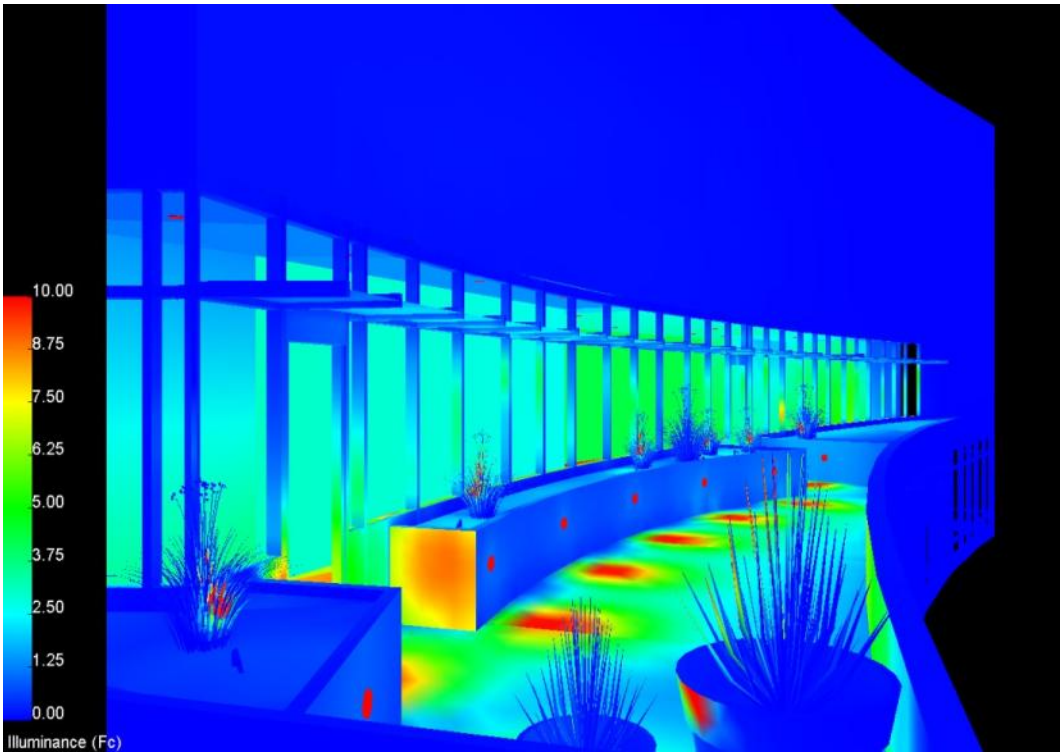
Space Type	Conference Room
Area (ft^2)	750
Allowable LPD (W/ft^2)	0.2
Allowable Watts	150
Actual LPD (W/ft^2)	0.22
Actual Watts	168

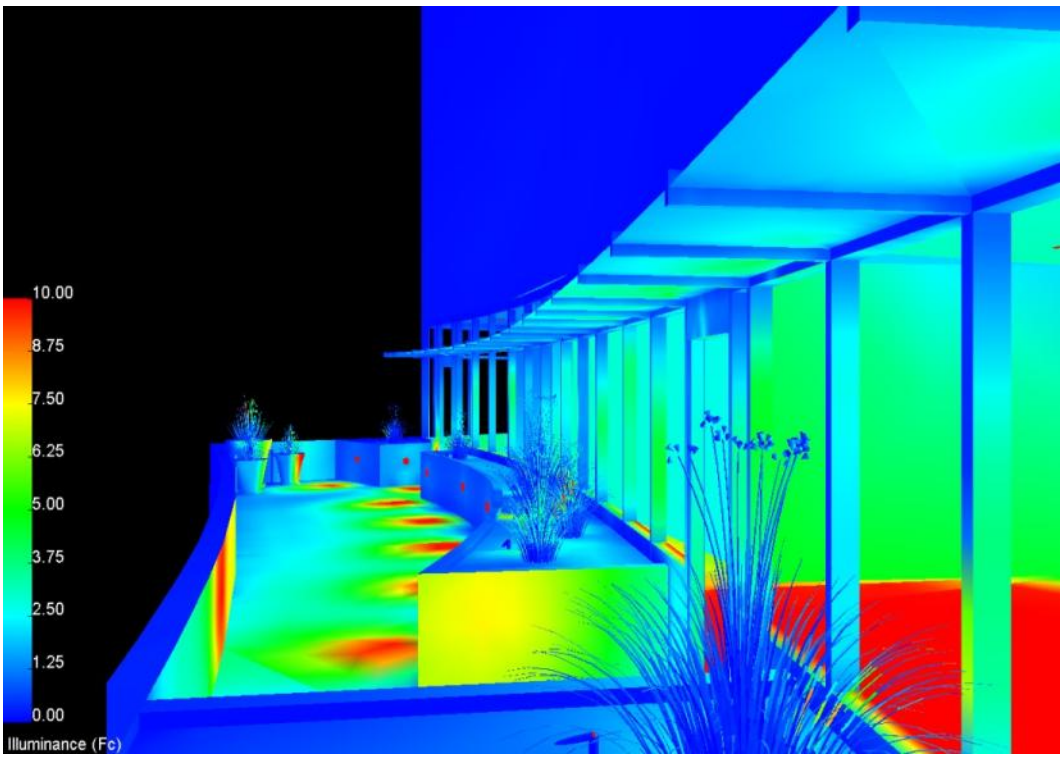
The new power density calculations are very close to the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.02 W/ft^2 higher than the allowable, which will not make a large difference on the total building load.

NEW EMERGENCY LIGHTING

There will be no emergency lighting in the new space.

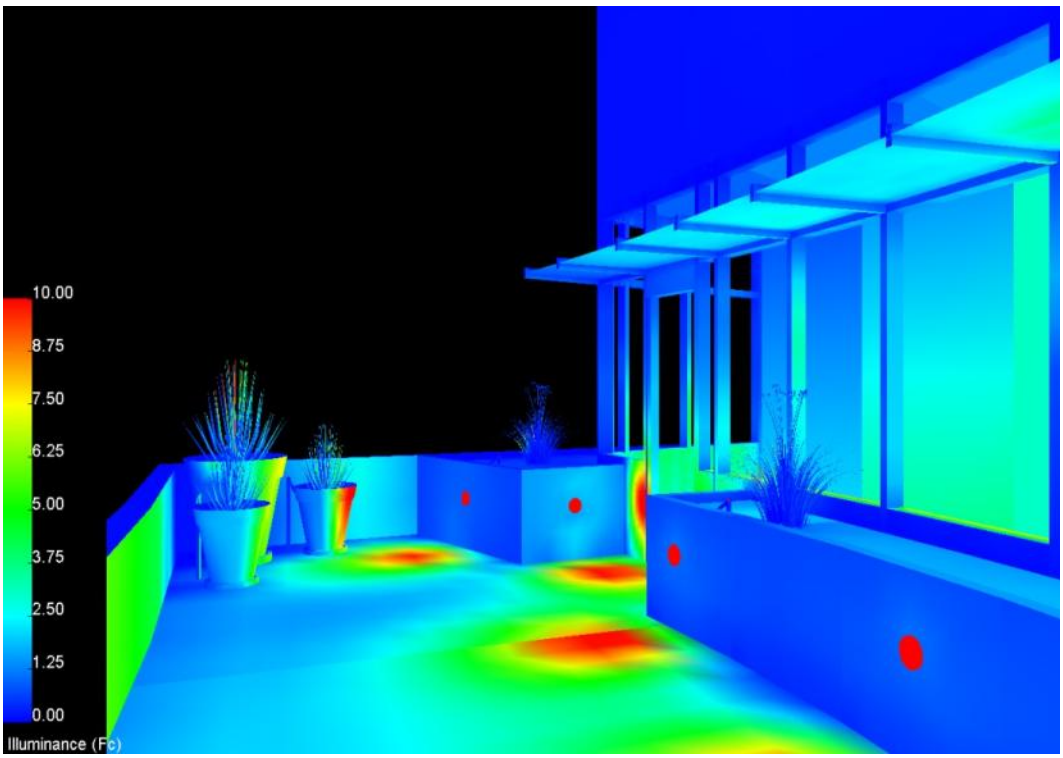
Deck RGB (above) and Pseudo Color (below) Renderings



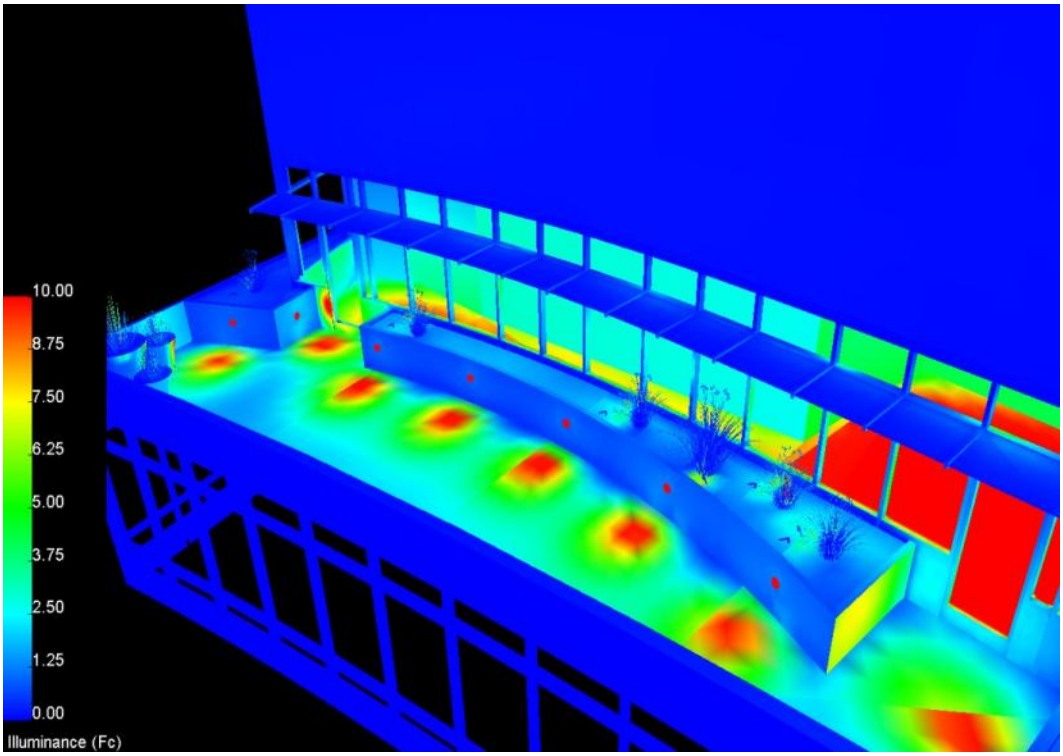


Deck RGB (above) and Pseudo Color (below) Renderings

Deck RGB (above) and Pseudo Color (below) Renderings

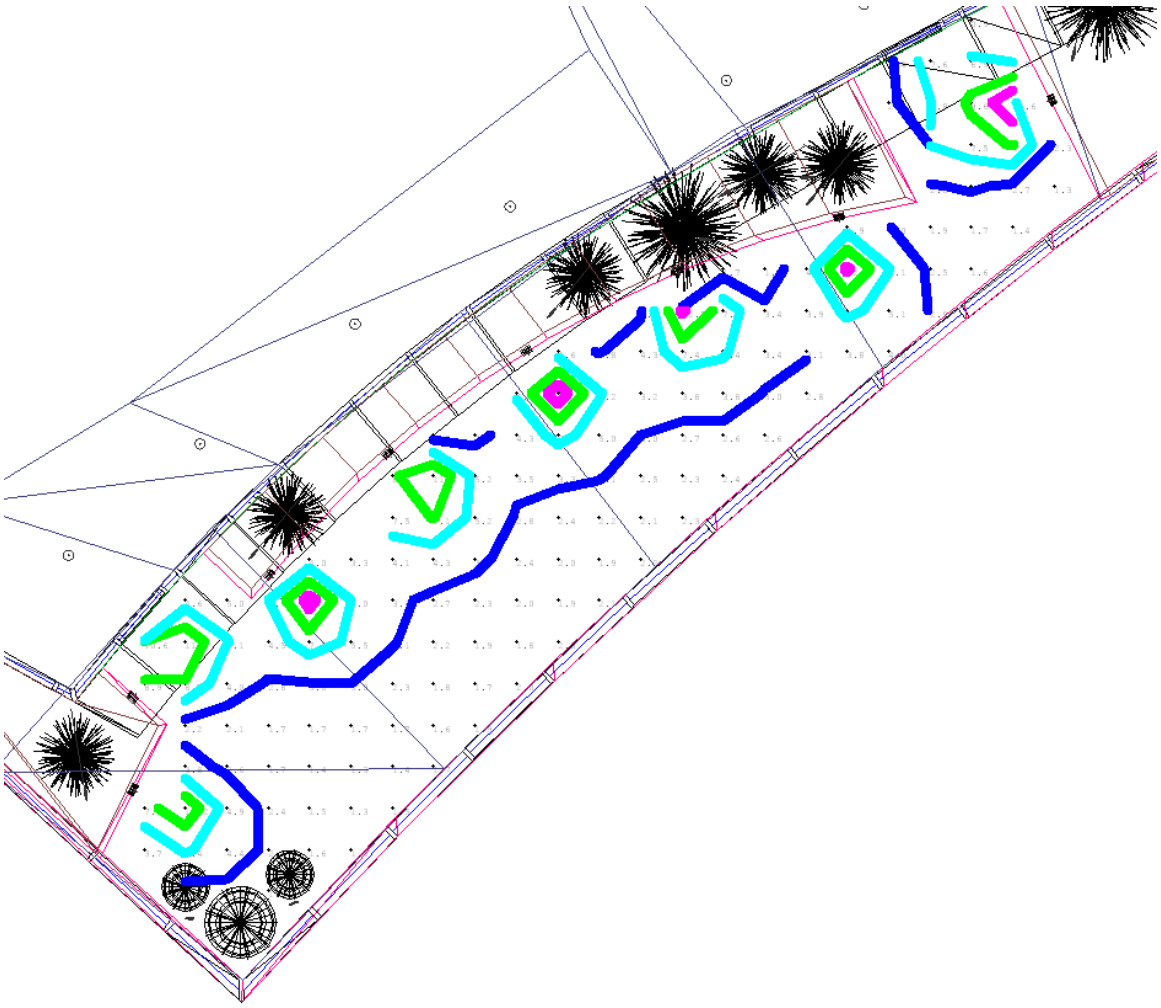


Deck RGB (above) and Pseudo Color (below) Renderings



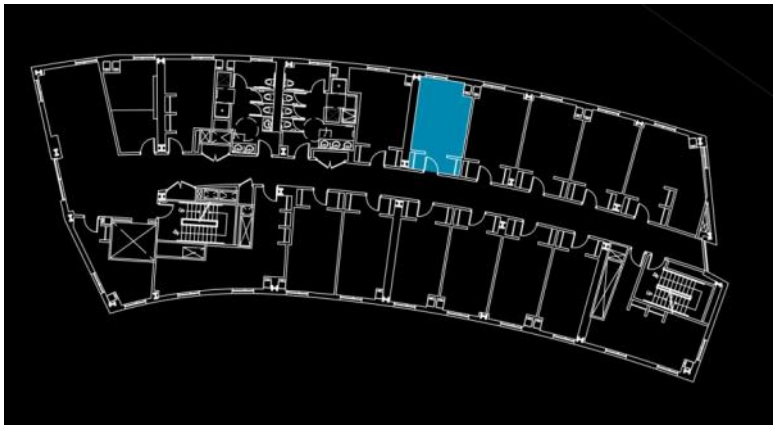
ISOLINE COLOR KEY

Dark Blue	Light Blue	Green	Purple
3 fc	5 fc	7 fc	9 fc



TYPICAL DORM ROOM

SPACE SUMMARY



The typical two-bed student dorm rooms are located on the fourth and fifth floors of the building. The dorm rooms are used as sleeping, studying and living areas for student residents. The rooms feature two beds, two closets and two desks. The rooms are approximately 240 square feet, with 8'-0" ceiling height, but the square footage may vary due to the shape of the building. The walls are gypsum wall board, and the ceilings are suspended gypsum wall board.

Dorm Room Surface Materials and Reflectances

Location	Material	Reflectance / Transmittance
Floor	Carpet	25%
Wall	Painted Gypsum Wall Board	70%
Ceiling	Painted Gypsum Wall Board	70%
Furniture	Medium Toned Wood	50%

DESIGN CONSIDERATIONS

TASKS: Living Space, Reading, Computer use

TARGET IMPRESSIONS: The dorm rooms are meant to be relaxing. The students will call this room "home" for 9 months out of the year, so it needs to reflect a feeling of coziness.

The design allows a lot of room for students to add their unique touch, so the walls and ceiling are plain, painted gypsum wall board. The luminaires should be simple and provide the space with ambient light. A warmer color temperature of 3000K would be good design for this space, to make the room feel cozier and livable. Direct glare in the space is undesirable, since students will be studying, reading and doing homework in the space. For a comfortable work plane, direct glare should be eliminated. Harsh light distributions on surfaces should be avoided, but having a non-uniform lighting scheme would be acceptable. It is important to have uniform light distribution on the desks. Students will be studying and reading there, and non-uniform light levels would distract from the task. The most important surfaces to be lit in the space are the desk area and the closet. The task plane is located on the desk, and it is where students will be doing most of their homework and studying.

EXISTING LIGHTING

The luminaires in the dorm rooms are simple surface mounted fixtures. There are two luminaires in the center of the room for general ambient light, and one over each closet for task lighting.

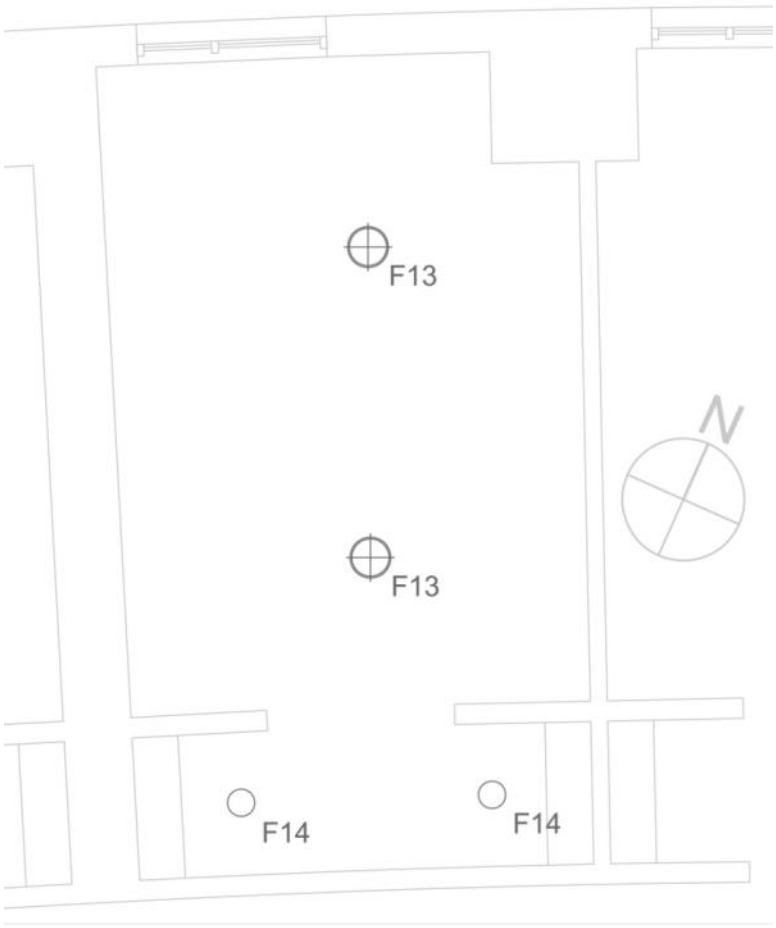
Dorm Existing Luminaire Schedule						
Type	**Mounting**	**Manufacturer**	**Catalogue Number**	**Lamps**	**Volts**	**Description**
F13	Ceiling Surface	Tiella	800FM360LS-CF	2-CFT 13W	120V	11" Surface-mounted compact fluorescent downlight with a frosted glass diffuse white lens.
F14	Ceiling Surface	Tiella	800FM360SS	1-T4 G9 40W	120V	6" Surface-mounted halogen downlight with a frosted glass diffuse white lens.

Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 5
- Expected Dirt Depreciation = 12%

Dorm Existing Light Loss Factors							
Type	**Maintenance Category**	**Distribution**	**BF**	**LDD**	**RSDD**	**LLD**	**Total LLF**
F13	IV	Direct	0.98	0.87	0.97	0.86	0.711
F14	IV	Direct	1.0	0.87	0.97	1.0	0.844

DORM ROOM EXISTING LAYOUT



Dorm Existing Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
7.26 fc	10-30 fc	6.08 fc	3-5 fc

The illuminance level calculations are very different than the target illuminance specified in the IESNA Lighting Handbook. The horizontal levels fall under the target, and are not conducive to a satisfactory work environment, possibly straining students' eyes if they read too long in this environment. The vertical illuminance levels are very close to IESNA requirements.

Dorm Existing Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F13	56	2	112
F14	20	2	40

Space Type	Dorm Room
Area (ft^2)	240
Allowable LPD (W/ft^2)	1.1
Allowable Watts	264
Actual LPD (W/ft^2)	0.63
Actual Watts	152

The existing power density calculations are below the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.47 W/ft^2 lower than the allowable. While the energy savings throughout all the dorm rooms add up, the illuminance levels are too low, and students will be forced to bring their own luminaires which will be using more energy.

EXISTING EMERGENCY LIGHTING

There are no emergency lighting fixtures in the dorm rooms.

DORM ROOM NEW LIGHTING

The new lighting design in the dorms will focus more on peripheral and task emphasis. The main illuminance in the room will come from wall surface up/downlights, located on the walls above the desks. A Kurt Versen ceiling surface mounted compact fluorescent downlight gives the room some extra ambient non-uniform light if its occupants desire. Linear fluorescent strip lights mounted under the shelves in the closet allow for illuminance in the closets.

Dorm New Luminaire Schedule

Type	Mounting	Manufacturer	Catalogue Number	Lamps	Volts	Description
F12	Ceiling Surface	Prudential Lighting	P-T5-STD-1T5-03-BWE-277	1-F28T5	277 V	Surface-mounted fluorescent strip light, rigid housing.
F15	Ceiling Surface	Kurt Versen	P602	2-CFQ26W	277 V	8" surface-mounted compact fluorescent downlight.
F16	Wall Surface	Mark Architectural	DUW-4-1T5-277-EB	1-F28T5	277 V	Wall-mounted fluorescent up/downlight.

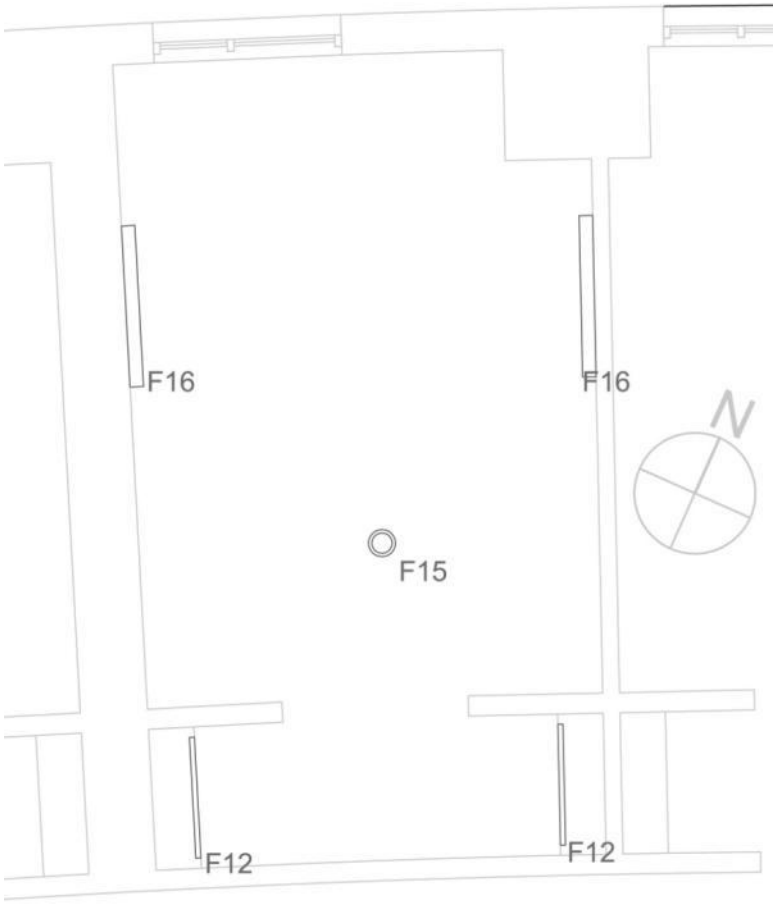
Assumptions:

- Maintenance Category: Clean
- Cleaning Intervals: 12 Months
- RCR = 3
- Expected Dirt Depreciation = 12%

Dorm New Light Loss Factors

Type	Maintenance Category	Distribution	BF	LDD	RSDD	LLD	Total LLF
F12	IV	Direct	0.98	0.87	0.98	0.92	0.79
F15	IV	Direct	0.98	0.87	0.98	0.85	0.71
F16	I	Direct/Indirect	0.98	0.93	0.95	0.92	0.79

DORM ROOM NEW LAYOUT



Dorm New Illuminance Levels			
Horizontal Calculated	Horizontal IESNA	Vertical Calculated	Vertical IESNA
22.0 fc	10-30 fc	6.3 fc	3-5 fc

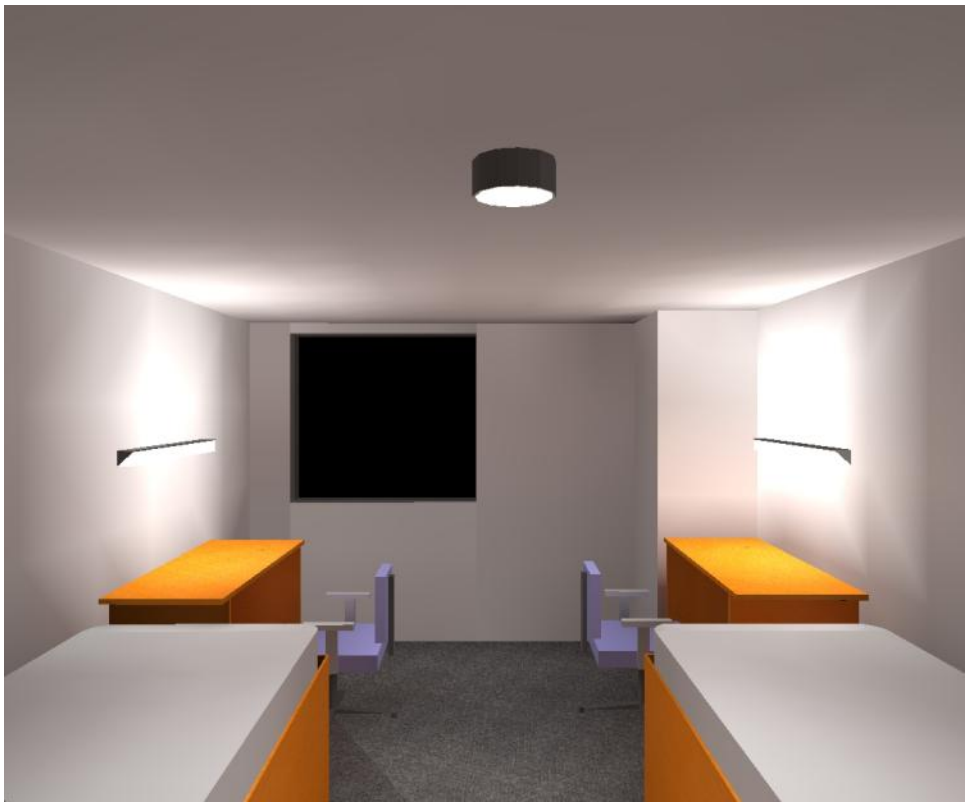
The illuminance level calculations are very close to the target illuminance specified in the IESNA Lighting Handbook. They allow for a non-uniform distribution, with light levels between 7.7 fc and 43.2 fc. The horizontal levels are slightly above the recommended illuminance levels, and are still conducive to a satisfactory work environment.

Dorm New Power Density			
Fixture	**Watts**	**Quantity**	**Total Watts**
F12	32	2	64
F15	54	1	54
F16	63	2	112
Space Type			Dorm Room
Area (ft^2)			240
Allowable LPD (W/ft^2)			1.1
Allowable Watts			264
Actual LPD (W/ft^2)			1.01
Actual Watts			244

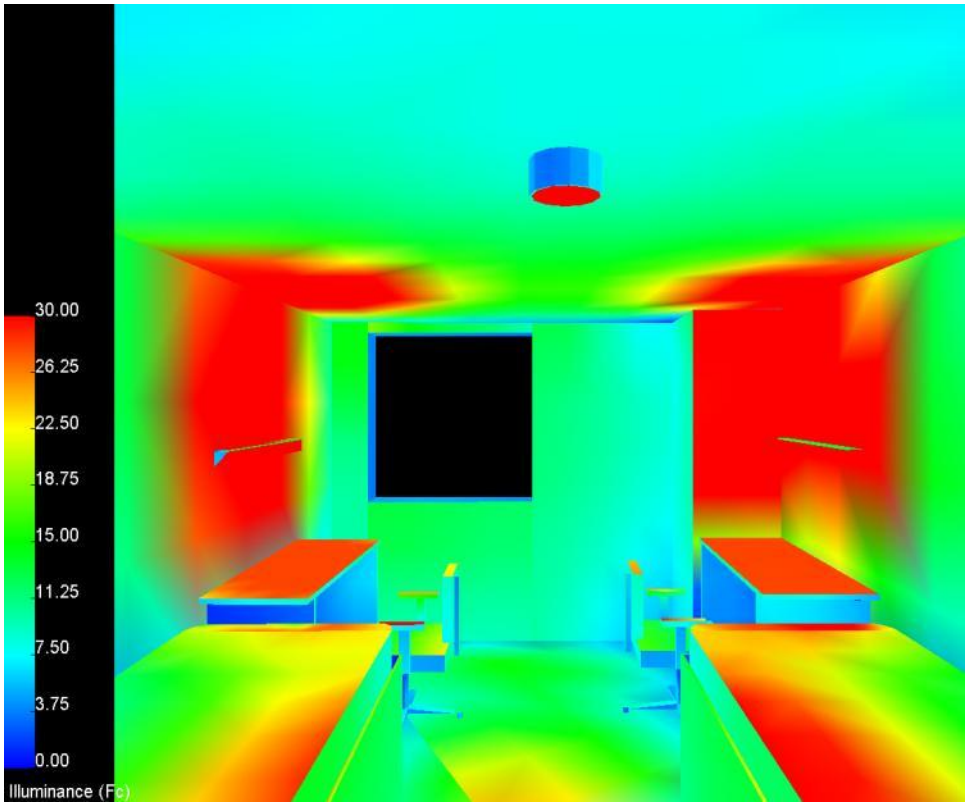
The new power density calculations are still considerably under the recommended ASHRAE 90.1-2004 code. The actual LPD is 0.09 W/ft^2 lower than the allowable. Throughout all 29 dorm rooms in the building, 580 W are saved as opposed to using the maximum allowable watts.

NEW EMERGENCY LIGHTING

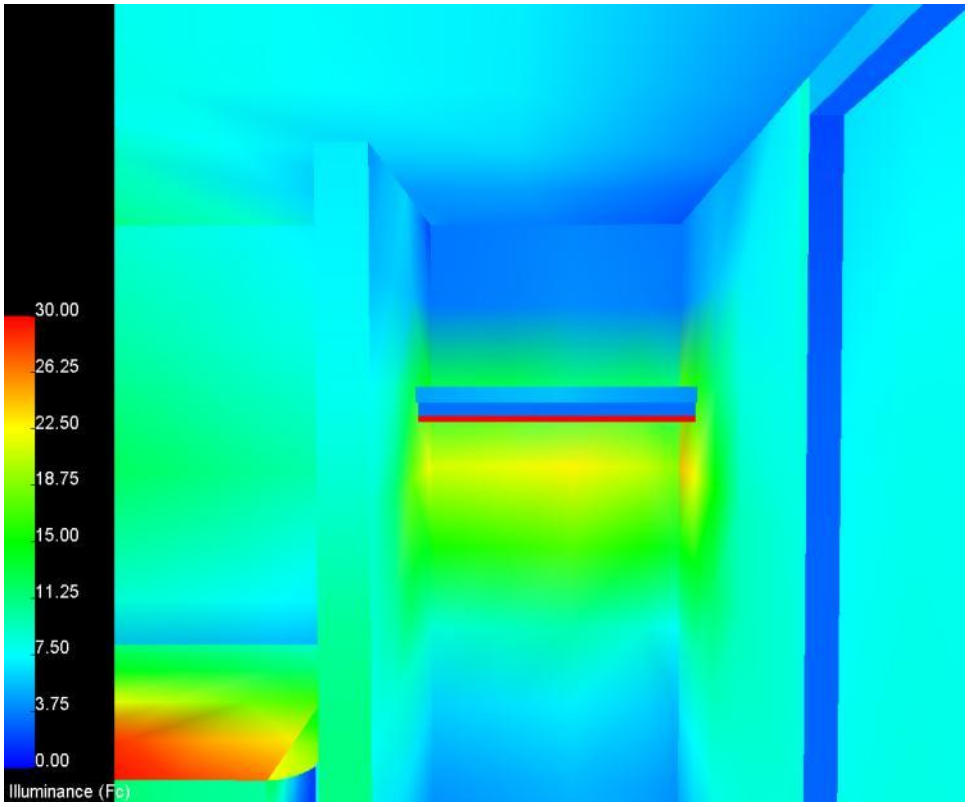
There will be no emergency lighting in the new dorm room design.



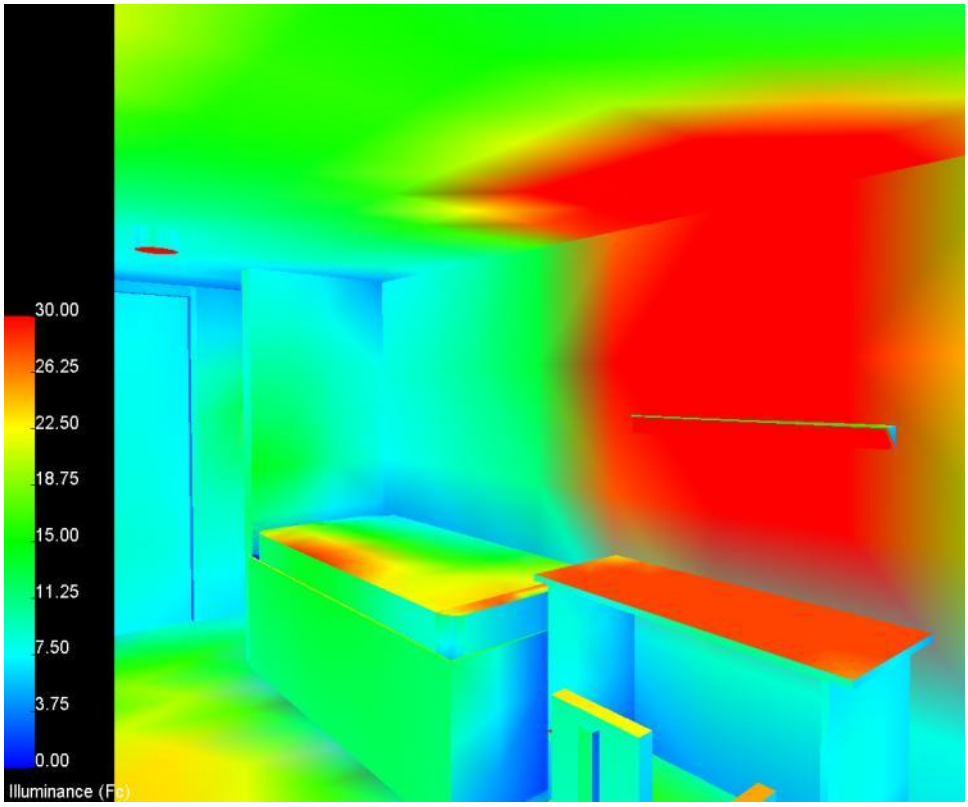
Dorm Room RGB (above) and Pseudo Color (below) Renderings



Dorm Room Closet RGB (above) and Pseudo Color (below) Renderings

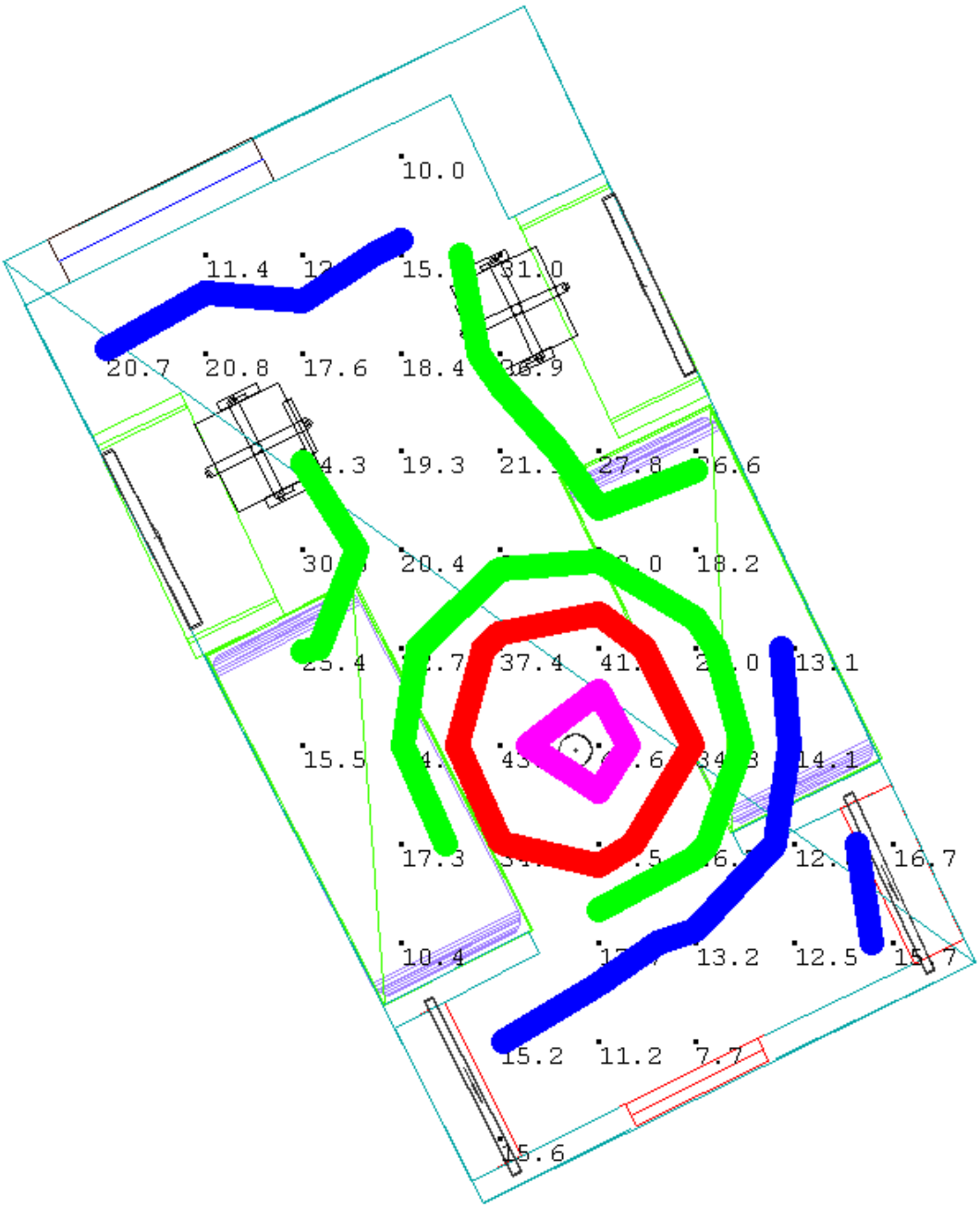


Dorm Room RGB (above) and Pseudo Color (below) Renderings



ISOLINE COLOR KEY

Dark Blue	Green	Red	Purple
15 fc	25 fc	35 fc	45 fc



ELECTRICAL DEPTH STUDY

The first part of the electrical analysis focuses on modifying the electrical system based on the lighting redesigns. The subsequent sections evaluate the effectiveness of the existing system, and propose possible changes to the system.

The spaces which contain altered lighting systems are a conference room (level 1), student lounge (level 1), cafeteria serving space (level 2), roof deck (level 3) and a typical dorm room (level 4).

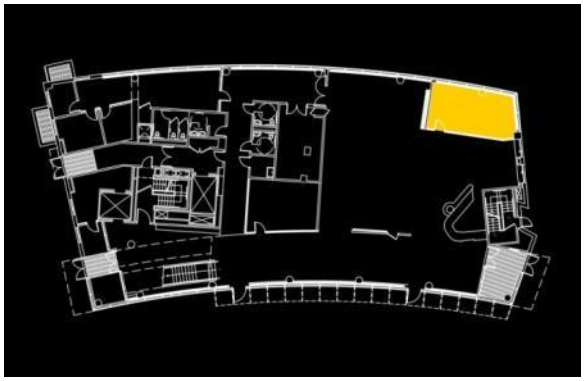
The second electrical analysis calculates fault current potential along a system path. The calculated values are compared against the equipment's rated values. A protective device coordination study will also be performed. The time-current curves of the three overcurrent protection devices along the path are overlaid to determine if they are coordinated.

The third electrical analysis changes the lighting voltages from a combination of 120V and 277V to only 277V. The wire and conduit sizes will be re-evaluated to determine the cost savings available with this change.

The final electrical depth study involves an arc fault study, short circuit analysis and protective device coordination study. The analysis will assess the system from the utility through to each panelboard or motor. The data will be input into the SKM analysis program.

*The panelboard schedules were completed with the information provided. Some panelboards may be incomplete due to lack of information.

CONFERENCE ROOM



The conference room serves the function of meeting space, classroom and social gathering space. The space features three glass walls, two to the exterior on the north and west sides, and one to the café space, to the south of the building. The east facing wall is covered in wood paneling. The ceiling is a combination of acoustical ceiling tile and painted drywall. The flooring is carpet. The conference room is 340 ft^2, with a 14 ft ceiling height. The entrance to the conference room is on the south facing wall, though the café.

ELECTRICAL CHARACTERISTICS

Panelboard LP4B serves the branch circuit in this room. The emergency lighting is served by a branch circuit from panelboard LS42. Panelboard LP4B is located in the basement in room 010 (E-600) and panelboard LS42 on the second floor electrical closet EC-201 (E-600).

Panelboard LP4B has a lower load with the new design. The existing load from the room is 650 W, while the new design utilizes 488 W. The load is divided into two branch circuits, with 427 W going to LP4B-15 and 61 W going to LS42-6.

Conference Room: New Lighting Load Calculations

Fixture	Mounting	W	VA	A	PF	QTY	Total W	Total VA	Total A	Circuits
F6	Recessed	28	60.94	0.22	1.0	3	84	182.82	0.66	LP4B-15
F7	Recessed	63	63.71	0.23	1.0	4	252	254.84	1.84	LP4B-15 LS42-6
F8	Recessed	20	38.78	0.14	1.0	8	160	310.24	0.56	LP4B-15

LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS	225 A		LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1100.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Serving Area	2265.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Lounge	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1529.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4461.0		B PHASE						4276.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11431.0									DEMAND LOAD	10287.9

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1367.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
Spare		0.0		31	*			32		0.0		Spare
Spare		0.0		33		*		34		0.0		Spare
Spare		0.0		35			*	36		0.0		Spare
Spare		0.0		37	*			38		0.0		Spare
Spare		0.0		39		*		40		0.0		Spare
Spare		0.0		41			*	42		0.0		Spare
SUB-TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2687.0
TOTAL CONNECTED LOAD (WATTS)		9326.0									DEMAND LOAD	8393.4

LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS	225 A		LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1100.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Serving Area	2265.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Lounge	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4461.0		B PHASE						4059.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11214.0									DEMAND LOAD	10092.6

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1383.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
					*							
						*						
							*					
					*							
						*						
							*					
SUB-TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2703.0
TOTAL CONNECTED LOAD (WATTS)		9342.0									DEMAND LOAD	8407.8

LOUNGE SPACE

The student lounge space and main staircase of the building span the curved, south-facing wall on the first floor. The area is a main circulation space in the building, and is open to students to use for studying or relaxing during the daytime as well as in the evening. The exterior of the south facing wall is floor-to-ceiling glazing, with exterior sun shades to reduce the amount of direct sunlight in the space during the day. The ceiling height is 14'-0" over the lounge area, 15'0" over the staircase and 8'0" under the staircase.

ELECTRICAL CHARACTERISTICS

The student lounge is currently served by two branch circuits from panelboard LP4B, with emergency lighting coming from panelboard LS42. The panelboard LP4B is located in the basement electrical room 010 (E-600) and panelboard LS42 is located in the second floor electrical closet EC-201 (E-600).

With the existing design, the total load for panelboard LP4B from the lounge space is 1730 W, with 1100 W on branch circuit LP4B-7 and 630 W on branch circuit LP4B-9. The total load for panelboard LS42 is 540 W on branch circuit LS42-6. The new design has a total load of 2012 W, which will be divided into 1420 W on branch circuit LP4B-7 and 536 W on branch circuit LS42-6.

Student Lounge : New Lighting Load Calculations

Fixture	Mounting	W	VA	A	PF	QTY	Total W	Total VA	Total A	Circuits
F1	Recessed	120	102.49	0.39	1.0	8	960	819.92	3.12	LP4B-7 LS42-6
F2	Surface	4	58.17	0.21	1.0	10	40	581.70	2.10	LP4B-7
F6	Recessed	28	60.94	0.22	1.0	11	308	670.76	2.42	LP4B-7 LS42-6
F11	Recessed	32	63.71	0.23	1.0	15	480	955.65	3.45	LP4B-7
F14	Surface	28	60.94	0.22	1.0	4	112	243.76	0.88	LP4B-7
F15	Surface	56	60.94	0.22	1.0	2	112	121.88	0.44	LP4B-7

LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS	225 A		LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1100.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Lounge, Serving A	2265.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4461.0		B PHASE						4059.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11214.0									DEMAND LOAD	10092.6

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1367.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
Spare		0.0		31	*			32		0.0		Spare
Spare		0.0		33		*		34		0.0		Spare
Spare		0.0		35			*	36		0.0		Spare
Spare		0.0		37	*			38		0.0		Spare
Spare		0.0		39		*		40		0.0		Spare
Spare		0.0		41			*	42		0.0		Spare
SUB-TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2687.0
TOTAL CONNECTED LOAD (WATTS)		9326.0									DEMAND LOAD	8393.4

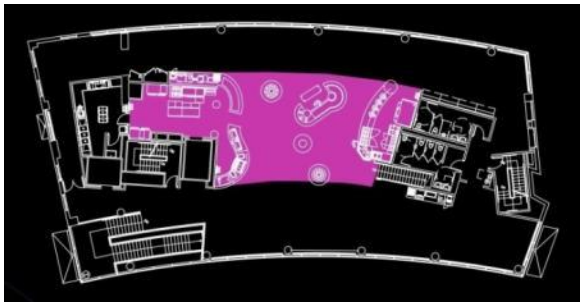
LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1420.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Serving Area	1635.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Lounge	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1529.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4781.0		B PHASE						3646.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11121.0									DEMAND LOAD	10008.9

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1277.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
Spare		0.0		31	*			32		0.0		Spare
Spare		0.0		33		*		34		0.0		Spare
Spare		0.0		35			*	36		0.0		Spare
Spare		0.0		37	*			38		0.0		Spare
Spare		0.0		39		*		40		0.0		Spare
Spare		0.0		41			*	42		0.0		Spare
SUB-TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2597.0
TOTAL CONNECTED LOAD (WATTS)		9236.0									DEMAND LOAD	8312.4

CAFETERIA SERVING SPACE



The main campus cafeteria serving area is located on the second floor of the building. Students will gather here for meals and snacks. The space features curved serving bars, round condiment stations, and kitchen and cooking areas. In the center of the space is a specialty bar, with made-to-order items. The space will also have movable tables and chairs for students to eat. The ceiling height is 8'-0" and is suspended 2x4 acoustical ceiling tile. The north and south sides are open to the hallway, while the east and west walls are painted gypsum wall board.

ELECTRICAL CHARACTERISTICS

The cafeteria serving space is currently served by one branch circuit from panelboard LP4B, with emergency lighting coming served by two branch circuits from panelboard LS42. The panelboard LP4B is located in the basement electrical room 010 (E-600) and panelboard LS42 is located in the second floor electrical closet EC-201 (E-600).

With the existing design, the total load for panelboard LP4B from the cafeteria serving space is 1590 W, with 1095 W on branch circuit LP4B-9, 315 W on branch circuit LS24-3 and 180 W on branch circuit LS24-5. The new design has a total load of 1521 W, which will be divided into 1241 W on branch circuit LP4B-9 and 280 W on branch circuit LS42-3.

Cafeteria Serving Space : New Lighting Load Calculations

Fixture	Mounting	W	VA	A	PF	QTY	Total W	Total VA	Total A	Circuits
F4	Recessed	28	60.94	0.22	1.0	23	644	1401.662	5.06	LP4B-9 LS24-3
F5	Recessed	63	63.71	0.23	1.0	3	189	191.13	0.69	LP4B-9
F9	Pendant	20	38.78	0.14	1.0	21	420	814.38	2.94	LP4B-9
F10	Pendant	4	55.40	0.20	1.0	11	44	609.40	2.20	LP4B-9
F11	Recessed	32	63.71	0.23	1.0	7	224	445.97	1.61	LP4B-9

LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS	225 A		LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1668.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Serving Area, Lou	1635.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	5029.0		B PHASE						3429.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11152.0									DEMAND LOAD	10036.8

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1120.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1050.0		5			*	6		1367.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
SUB-TOTAL	A PHASE	3189.0		B PHASE						3415.0	C PHASE	2507.0
TOTAL CONNECTED LOAD (WATTS)		9111.0									DEMAND LOAD	8199.9

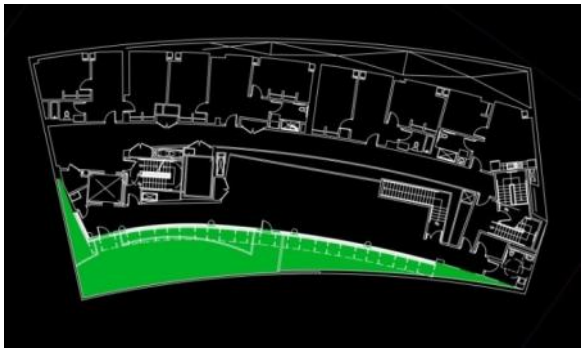
LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1668.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Serving Area, Lou	1781.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	5029.0		B PHASE						3575.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11298.0									DEMAND LOAD	10168.2

LS42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1367.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
Spare		0.0		31	*			32		0.0		Spare
Spare		0.0		33		*		34		0.0		Spare
Spare		0.0		35			*	36		0.0		Spare
Spare		0.0		37	*			38		0.0		Spare
Spare		0.0		39		*		40		0.0		Spare
Spare		0.0		41			*	42		0.0		Spare
SUB-TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2687.0
TOTAL CONNECTED LOAD (WATTS)		9326.0									DEMAND LOAD	8393.4

ROOF DECK



The third floor outdoor deck is located on the south facing side of the building. The deck features vegetation areas, potted plants and 874 ft^2 of patio space. The exterior wall is glazing with aluminum framing. Students will be able to use this space for studying and relaxing. The flooring is roof pavers, and the vegetation boxes are concrete unit pavers on a pedestal system with granite coping at the joints which may be used as seating for occupants. There is currently no lighting system in place on the roof deck, but it would be an ideal place to illuminate during the evening for students to sit and relax.

ELECTRICAL CHARACTERISTICS

The roof deck is currently not served by any panelboard, since there is currently no lighting in that space.

The new lighting design will bring electricity to the roof deck for the first time. The new design has a total load of 168 W. The load will be connected to panelboard LP4B-11, altering the total load on that circuit to 1668 W.

Roof Deck : New Lighting Load Calculations

Fixture	Mounting	W	VA	A	PF	QTY	Total W	Total VA	Total A	Circuits
F3	Surface	4	55.40	0.20	1.0	10	40	554.00	2.00	LP4B-11
F13	Wall Recessed	16	30.47	0.11	1.0	8	128	243.76	0.88	LP4B-11

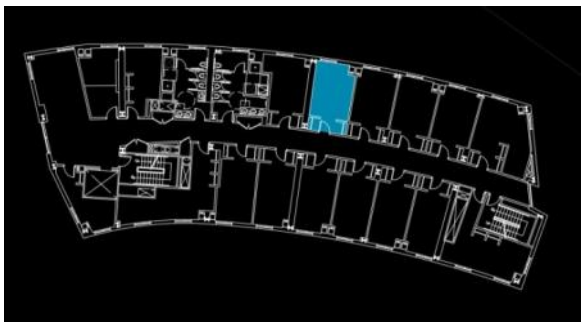
EXISTING PANELBOARD

LP4B												
VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1100.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Lounge, Serving A	2265.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1500.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1529.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4461.0		B PHASE						4276.0	C PHASE	2694.0
TOTAL CONNECTED LOAD (WATTS)		11431.0									DEMAND LOAD	10287.9

REDESIGNED PANELBOARD

LP4B												
VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1100.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Lounge, Serving A	2265.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1668.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1529.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	4461.0		B PHASE						4276.0	C PHASE	2862.0
TOTAL CONNECTED LOAD (WATTS)		11599.0									DEMAND LOAD	10439.1

TYPICAL DORM ROOM



The typical two-bed student dorm rooms are located on the fourth and fifth floors of the building. The dorm rooms are used as sleeping, studying and living areas for student residents. The rooms feature two beds, two closets and two desks. The rooms are approximately 240 square feet, with 8'-0" ceiling height, but the square footage may vary due to the shape of the building. The walls are gypsum wall board, and the ceilings are suspended gypsum wall board. The luminaires in the dorm rooms are simple surface mounted fixtures. There are two luminaires in the center of the room for general ambient light, and one over each closet for task lighting.

ELECTRICAL CHARACTERISTICS

The dorm room lighting on the fourth floor is currently served by RP24, an 84-pole panelboard. The lighting for all of the dorm rooms is divided between branches 56, 58 and 60.

The previous lighting design had 152 W per dorm room. The lighting loads on the branch circuits were 720 W on circuit RP24-56, 816 W on circuit RP24-58 and 988 W on circuit RP24-60. The new design has a load of 240 W per room. The load on the circuits will change to 1014 W on branch circuit RP24-56, 1200 W on RP24-58 and 1440 W on RP24-60.

Dorm Room : New Lighting Load Calculations

Fixture	Mounting	W	VA	A	PF	QTY	Total W	Total VA	Total A	Circuits
F12	Surface	30	66.0	0.55	1.0	2	60	132.0	1.1	RP24-56 RP24-58 RP24-60
F15	Surface	54	60.0	0.50	1.0	1	54	60.0	0.50	RP24-56 RP24-58 RP24-60
F16	Surface	63	66.0	0.55	1.0	2	126	132.0	1.1	RP24-56 RP24-58 RP24-60

EXISTING PANELBOARD

RP24												
VOLTAGE			TAG							TYPE PANEL		
MOUNTING										C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacles	Laundry Room	1500.0	20A 1P	1	*			2	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	3		*		4	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	5			*	6	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	7	*			8	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	9		*		10	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	11			*	12	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	13	*			14	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	15		*		16	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	19	*			20	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	21		*		22	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	23			*	24	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	25	*			26	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	27		*		28	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	29			*	30	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	180.0	20A 1P	31	*			32	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	33		*		34	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	35			*	36	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	37	*			38	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	39		*		40	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
Fan Coil Unit	Dorm Rooms	378.0	20A 1P	43	*			44	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	45		*		46	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	47			*	48	20A 1P	378.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	49	*			50	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	51		*		52	20A 1P	556.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	53			*	54	20A 1P	142.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	55	*			56	20A 1P	720.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	57		*		58	20A 1P	816.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	59			*	60	20A 1P	988.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	13028.0		B PHASE						13426.0	C PHASE	10022.0
TOTAL CONNECTED LOAD (WATTS)		36476.0									DEMAND LOAD	32828.4

REDESIGNED PANELBOARD

RP24												
VOLTAGE			TAG							TYPE PANEL		
MOUNTING										C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacles	Laundry Room	1500.0	20A 1P	1	*			2	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	3		*		4	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	5			*	6	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	7	*			8	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	9		*		10	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	11			*	12	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	13	*			14	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	15		*		16	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	19	*			20	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	21		*		22	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	23			*	24	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	25	*			26	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	27		*		28	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	29			*	30	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	180.0	20A 1P	31	*			32	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	33		*		34	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	35			*	36	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	37	*			38	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	39		*		40	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
Fan Coil Unit	Dorm Rooms	378.0	20A 1P	43	*			44	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	45		*		46	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	47			*	48	20A 1P	378.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	49	*			50	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	51		*		52	20A 1P	556.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	53			*	54	20A 1P	142.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	55	*			56	20A 1P	1014.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	57		*		58	20A 1P	1200.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	59			*	60	20A 1P	1440.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	13028.0		B PHASE						13426.0	C PHASE	10022.0
TOTAL CONNECTED LOAD (WATTS)		36476.0									DEMAND LOAD	32828.4

FEEDER SIZING

LP4B												
VOLTAGE	480Y/277V, 3P, 4W		TAG							TYPE PANEL		
MOUNTING	Surface									C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	0.0		Spare
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	0.0		Spare
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	0.0		Spare
Lighting	Lounge	1420.0	20A/1P	7	*			8	20A/1P	0.0		Spare
Lighting	Lounge, Serving A	1781.0	20A/1P	9		*		10	20A/1P	0.0		Spare
Lighting	Serving Area	1668.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB TOTAL	A PHASE	4781.0		B PHASE						3575.0	C PHASE	2862.0
TOTAL CONNECTED LOAD (WATTS)		11218.0									DEMAND LOAD	10096.2

LP4B Feeder Redesign			
Demand Load	10096.2 W		
Voltage	480/277V		
Design Load	36.4 A	**+25% Spare Capacity**	45.6 A

Circuit Breaker	Conductors	Neutral	Ground	Conduit
50 A	(3) #8 CU THHN	(1) #8 CU THHN	(1) #10 CU	½”

LS42

VOLTAGE			TAG						TYPE PANEL		
MOUNTING									C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS		
SIZE/TYPE MAINS									REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	84.0		1	*			2		1658.0	Basement	Lighting
Lighting	2nd Floor	1155.0		3		*		4		1370.0	Basement	Lighting
Lighting	2nd Floor	1230.0		5			*	6		1293.0	First Floor	Lighting
Lighting	Stairwell	390.0		7	*			8		639.0	First Floor	Lighting
Lighting	Stairwell	280.0		9		*		10		105.0	First Floor	Lighting
Spare		0.0		11			*	12		90.0	First Floor	Lighting
Spare		0.0		13	*			14		418.0	Third Floor	Lighting
Spare		0.0		15		*		16		540.0	Third Floor	Lighting
Spare		0.0		17			*	18		0.0		Spare
Spare		0.0		19	*			20		0.0		Spare
Spare		0.0		21		*		22		0.0		Spare
Spare		0.0		23			*	24		0.0		Spare
Spare		0.0		25	*			26		0.0		Spare
Spare		0.0		27		*		28		0.0		Spare
Spare		0.0		29			*	30		0.0		Spare
Spare		0.0		31	*			32		0.0		Spare
Spare		0.0		33		*		34		0.0		Spare
Spare		0.0		35			*	36		0.0		Spare
Spare		0.0		37	*			38		0.0		Spare
Spare		0.0		39		*		40		0.0		Spare
Spare		0.0		41			*	42		0.0		Spare
SUB TOTAL	A PHASE	3189.0		B PHASE						3450.0	C PHASE	2613.0
TOTAL CONNECTED LOAD (WATTS)		9252.0									DEMAND LOAD	8326.8

LS42 Feeder Redesign				
Demand Load	8326.8 W			
Voltage	480/277V			
Design Load	30.06 A		**+25% Spare Capacity**	37.58 A

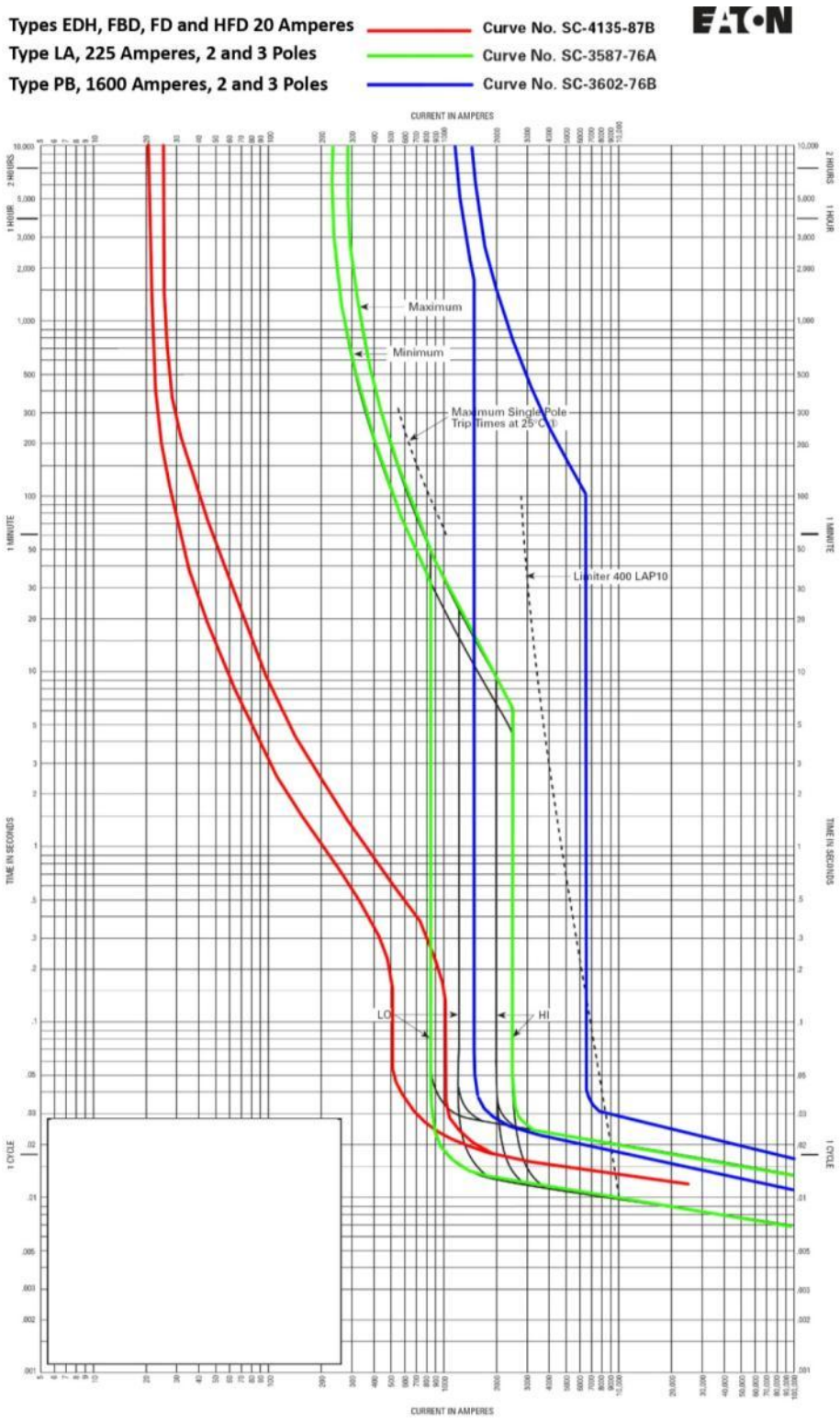
Circuit Breaker	Conductors	Neutral	Ground	Conduit
40 A	(3) #8 CU THHN	(1) #8 CU THHN	(1) #10 CU	½”

RP24

VOLTAGE			TAG							TYPE PANEL		
MOUNTING										C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacles	Laundry Room	1500.0	20A 1P	1	*			2	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	3		*		4	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	5			*	6	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	7	*			8	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	9		*		10	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	11			*	12	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	13	*			14	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Laundry Room	1500.0	20A 1P	15		*		16	20A 1P	1500.0	Laundry Room	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	19	*			20	20A 1P	0.0		Spare
Receptacles	Dorm Rooms	360.0	20A 1P	21		*		22	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	23			*	24	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	25	*			26	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	27		*		28	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	29			*	30	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	180.0	20A 1P	31	*			32	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	33		*		34	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	35			*	36	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	37	*			38	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	39		*		40	20A 1P	180.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
Fan Coil Unit	Dorm Rooms	378.0	20A 1P	43	*			44	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	45		*		46	20A 1P	540.0	Hallway	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	47			*	48	20A 1P	378.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	49	*			50	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	51		*		52	20A 1P	556.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	53			*	54	20A 1P	142.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	55	*			56	20A 1P	720.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	57		*		58	20A 1P	816.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	59			*	60	20A 1P	988.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	13028.0		B PHASE						13426.0	C PHASE	10022.0
TOTAL CONNECTED LOAD (WATTS)		36476.0									DEMAND LOAD	32828.4

RP24 Feeder Redesign				
Demand Load	32828.4 W			
Voltage	208/120V			
Design Load	273.57 A		**+25% Spare Capacity**	341.96 A

Circuit Breaker	Conductors	Neutral	Ground	Conduit
400 A	(6) #2/0 CU THHN	(2) #2/0 CU THHN	(2) #6 CU	1 ¼”


Types EDH, FBD, FD and HFD 20 Amperes
Curve No. SC-4135-87B
Type LA, 225 Amperes, 2 and 3 Poles
Curve No. SC-3587-76A
Type PB, 1600 Amperes, 2 and 3 Poles
Curve No. SC-3602-76B
CURRENT IN AMPERES
TIME IN SECONDS
Maximum
Minimum
Maximum Single-Pole Trip Times at 25°C
Limiter 400 LAP10
LO
HI
2 HOURS
1 HOUR
1 MINUTE
1 CYCLE

FAULT CURRENT ANALYSIS

In an electrical system, the smallest overcurrent device should ideally trip first in order to minimize the area of disruption and power loss. The overcurrent devices will be analyzed through a single electrical path, and compared by overlaying time-current curves.

The Campus Center and Student Residence building uses circuit breakers for their overcurrent protection. The path is as follows:

Utility Transformer > Main Switchboard (MSB) > Distribution Panel (LSDP4) > End Use Panel (LS42)

The results show that the current system in the case analyzed has more than specified by the calculations. Distribution panelboard LSDP4 is rated at 42000 AIC, but the calculations result in a need of 10000 AIC. It is likely that the electrical designers were anticipating the need for more equipment throughout the life of the building.

Results of Fault Analysis			
Point	**Location**	**Available Fault (A)**	**Standard Breaker Rating (A)**
A	Utility Company Secondary	12,648	14,000
B	Switchboard (MSB)	12,400	14,000
C	Distribution Panel (LSDP4)	9,795	10,000
D	End Use Panel (LS42)	7,971	10,000

Fault Current Analysis (Per Unit Method)						
	System Voltage	480				
	Base kVA	10,000				
	Utility Company Available Fault	100,000	∑X	∑R	∑Z	I_{sc} (A)
Utility Primary						
	$X_{(p.u.)}$ = kVA_{base}/Utility S.C. kVA	0.100	0.100	0.000	0.100	120281
	$R_{(p.u.)}$	0.000				
Transformer Secondary						
%Z = 5.0	$X_{(p.u.)}$ = %X*kVA_{base}/100*kVA_{xfmr}	0.813	0.813	0.493	0.951	12648
X/R = 2.89	$R_{(p.u.)}$ = %R*kVA_{base}/100*kVA_{xfmr}	0.493				
%X = 3.05						
%R = 1.85						
kVA = 375						
Switchboard MSB						
Wire = #600	%X = (L/1000)*X_L*(1/Sets), $X_{(p.u.)}$	0.016	0.829	0.504	0.970	12400
Length = 30'	%R = (L/1000)*R*(1/Sets), $R_{(p.u.)}$	0.011				
Sets = 3						
X = 0.037						
R = 0.024						
Panelboard LSDP4						
Wire = #4	%X = (L/1000)*X_L*(1/Sets), $X_{(p.u.)}$	0.055	0.884	0.852	1.228	9795
Length = 25'	%R = (L/1000)*R*(1/Sets), $R_{(p.u.)}$	0.348				
Sets = 1						
X = 0.051						
R = 0.321						
Panelboard LS42						
Wire = #8	%X = (L/1000)*X_L*(1/Sets), $X_{(p.u.)}$	0.026	0.910	1.204	1.509	7971
Length = 10'	%R = (L/1000)*R*(1/Sets), $R_{(p.u.)}$	0.352				
Sets = 1						
X = 0.060						
R = 0.811						

VOLTAGE CHANGE

The third electrical analysis changes the lighting voltages from a combination of 120V and 277V to only 277V. The wire and conduit sizes will be re-evaluated to determine the cost savings available with this change.

The existing lighting in the Wheelock College Campus Center and Student Residence building is a combination of 120 V and 277 V. This study with analyze the benefits of altering the 120 V lighting fixtures to 277 V, to make a completely 277 V system.

The panelboards which will be affected in this redesign are RP23, RP24, RP25 and RP26. Panelboard RP23 serves the receptacle and lighting loads on the third floor, RP24 serves the receptacle and lighting loads on the fourth floor, RP25 serves the receptacle and lighting loads on the fifth floor and RP26 serves the receptacle and lighting loads on the sixth floor. The lighting from panels RP23, RP24, RP25 and RP26 will be re-routed to panelboards LP42 and LP4B. Since the panelboards also serve receptacles, they must be 208/120V.

RP23

VOLTAGE			TAG							TYPE PANEL		
MOUNTING										C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacles	Dorm Rooms	540.0	20A 1P	1	*			2	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	3		*		4	20A 1P	540.0	Dorm Rooms	Receptacles
Hot Water Heater	Dorm Rooms	1500.0	20A 1P	5			*	6	20A 1P	1500.0	Dorm Rooms	Hot Water Heater
Receptacles	Dorm Rooms	540.0	20A 1P	7	*			8	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	9		*		10	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	11			*	12	20A 1P	360.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	13	*			14	20A 1P	360.0	Dorm Rooms	Receptacles
Hot Water Heater	Dorm Rooms	1500.0	20A 1P	15		*		16	20A 1P	1500.0	Dorm Rooms	Refrigerator
Receptacles	Corridor	1080.0	20A 1P	17			*	18	20A 1P	1500.0	Dorm Rooms	Receptacles
Spare		0.0	20A 1P	19	*			20	50A-2P	1500.0	Dorm Rooms	Stove
Spare		0.0	20A 1P	21		*		22	20A 1P	1500.0	Dorm Rooms	Hot Water Heater
Spare		0.0	20A 1P	23			*	24	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	25	*			26	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Spare		0.0	20A 1P	27		*		28	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Lighting	Dorm Rooms	940.0	20A 1P	29			*	30	20A 1P	236.0	Dorm Rooms	Fan Coil Unit
Lighting	Dorm Rooms	900.0	20A 1P	31	*			32	20A 1P	0.0		Spare
Spare		0.0	20A 1P	33		*		34	20A 1P	0.0		Spare
Spare		0.0	20A 1P	35			*	36	20A 1P	0.0		Spare
Spare		0.0	20A 1P	37	*			38	20A 1P	0.0		Spare
Spare		0.0	20A 1P	39		*		40	20A 1P	0.0		Spare
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
Spare		0.0	20A 1P	43	*			44	20A 1P	0.0		Spare
Spare		0.0	20A 1P	45		*		46	20A 1P	0.0		Spare
Spare		0.0	20A 1P	47			*	48	20A 1P	0.0		Spare
Spare		0.0	20A 1P	49	*			50	20A 1P	0.0		Spare
Spare		0.0	20A 1P	51		*		52	20A 1P	0.0		Spare
Spare		0.0	20A 1P	53			*	54	20A 1P	0.0		Spare
Spare		0.0	20A 1P	55	*			56	20A 1P	0.0		Spare
Spare		0.0	20A 1P	57		*		58	20A 1P	0.0		Spare
Spare		0.0	20A 1P	59			*	60	20A 1P	0.0		Spare
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	5094.0		B PHASE						5154.0	C PHASE	7830.0
TOTAL CONNECTED LOAD (WATTS)		18078.0									DEMAND LOAD	16270.2

RP23 Feeder Redesign					
Demand Load	14614.2 W				
Voltage	208/120V				
Design Load	121.8 A		**+25% Spare Capacity**		152.2 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	200 A	(3) #2/0 CU THHN	(1) #2/0 CU THHN	(1) #6 CU	1”
New	200 A	(3) #1/0 CU THHN	(1) #1/0 CU THHN	(1) #6 CU	1”

RP24													
VOLTAGE			TAG							TYPE PANEL			
MOUNTING										C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS			
SIZE/TYPE MAINS										REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Receptacles	Laundry Room	1500.0	20A 1P	1	*			2	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	3		*		4	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	5			*	6	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	7	*			8	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	9		*		10	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	11			*	12	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	13	*			14	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Laundry Room	1500.0	20A 1P	15		*		16	20A 1P	1500.0	Laundry Room	Receptacles	
Receptacles	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	0.0		Spare	
Receptacles	Dorm Rooms	360.0	20A 1P	19	*			20	20A 1P	0.0		Spare	
Receptacles	Dorm Rooms	360.0	20A 1P	21		*		22	20A 1P	540.0	Dorm Rooms	Receptacles	
Receptacles	Dorm Rooms	360.0	20A 1P	23			*	24	20A 1P	360.0	Dorm Rooms	Receptacles	
Receptacles	Dorm Rooms	360.0	20A 1P	25	*			26	20A 1P	360.0	Dorm Rooms	Receptacles	
Receptacles	Dorm Rooms	360.0	20A 1P	27		*		28	20A 1P	360.0	Dorm Rooms	Receptacles	
Receptacles	Dorm Rooms	360.0	20A 1P	29			*	30	20A 1P	360.0	Dorm Rooms	Receptacles	
Receptacles	Dorm Rooms	180.0	20A 1P	31	*			32	20A 1P	360.0	Dorm Rooms	Receptacles	
Spare		0.0	20A 1P	33		*		34	20A 1P	360.0	Dorm Rooms	Receptacles	
Spare		0.0	20A 1P	35			*	36	20A 1P	360.0	Dorm Rooms	Receptacles	
Spare		0.0	20A 1P	37	*			38	20A 1P	180.0	Dorm Rooms	Receptacles	
Spare		0.0	20A 1P	39		*		40	20A 1P	180.0	Dorm Rooms	Receptacles	
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare	
Fan Coil Unit	Dorm Rooms	378.0	20A 1P	43	*			44	20A 1P	540.0	Hallway	Receptacles	
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	45		*		46	20A 1P	540.0	Hallway	Receptacles	
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	47			*	48	20A 1P	378.0	Dorm Rooms	Fan Coil Unit	
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	49	*			50	20A 1P	354.0	Dorm Rooms	Fan Coil Unit	
Spare		0.0	20A 1P	51		*		52	20A 1P	556.0	Dorm Rooms	Fan Coil Unit	
Spare		0.0	20A 1P	53			*	54	20A 1P	142.0	Dorm Rooms	Fan Coil Unit	
Spare		0.0	20A 1P	55	*			56	20A 1P	720.0	Dorm Rooms	Lighting	
Spare		0.0	20A 1P	57		*		58	20A 1P	816.0	Dorm Rooms	Lighting	
Spare		0.0	20A 1P	59			*	60	20A 1P	988.0	Dorm Rooms	Lighting	
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare	
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare	
SUB-TOTAL	A PHASE	13028.0		B PHASE						13426.0	C PHASE	10022.0	
TOTAL CONNECTED LOAD (WATTS)		36476.0									DEMAND LOAD	32828.4	

RP24 Feeder Redesign			
Demand Load	30556.8 W		
Voltage	208/120V		
Design Load	254.64 A	**+25% Spare Capacity**	318.3 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	400 A	(6) #2/0 CU THHN	(2) #2/0 CU THHN	(2) #6 Cu	1 ¼"
New	400 A	(6) #1/0 CU THHN	(2) #2/0 CU THHN	(2) #6 CU	1 ¼"

RP25

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacles	Dorm Rooms	360.0	20A 1P	1	*			2	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	3		*		4	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	5			*	6	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	7	*			8	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	9		*		10	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	11			*	12	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	13	*			14	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	15		*		16	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	180.0	Dorm Rooms	Receptacles
Receptacles	Dorm Rooms	180.0	20A 1P	19	*			20	20A 1P	180.0	Dorm Rooms	Receptacles
Hot Water Heater	Bathroom	1500.0	20A 1P	21		*		22	20A 1P	540.0	Corridor	Receptacles
Hot Water Heater	Bathroom	1500.0	20A 1P	23			*	24	20A 1P	360.0	Corridor	Receptacles
Hot Water Heater	Bathroom	1500.0	20A 1P	25	*			26	20A 1P	378.0	Dorm Rooms	Fan Coil Unit
Hot Water Heater	Bathroom	1500.0	20A 1P	27		*		28	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Hot Water Heater	Bathroom	1500.0	20A 1P	29			*	30	20A 1P	378.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	31	*			32	20A 1P	720.0	Dorm Rooms	Lighting
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	33		*		34	20A 1P	816.0	Dorm Rooms	Lighting
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	35			*	36	20A 1P	988.0	Dorm Rooms	Lighting
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	37	*			38	20A 1P	456.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	39		*		40	20A 1P	0.0		Spare
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
Spare		0.0	20A 1P	43	*			44	20A 1P	0.0		Spare
Spare		0.0	20A 1P	45		*		46	20A 1P	0.0		Spare
Spare		0.0	20A 1P	47			*	48	20A 1P	0.0		Spare
Spare		0.0	20A 1P	49	*			50	20A 1P	0.0		Spare
Spare		0.0	20A 1P	51		*		52	20A 1P	0.0		Spare
Spare		0.0	20A 1P	53			*	54	20A 1P	0.0		Spare
Spare		0.0	20A 1P	55	*			56	20A 1P	0.0		Spare
Spare		0.0	20A 1P	57		*		58	20A 1P	0.0		Spare
Spare		0.0	20A 1P	59			*	60	20A 1P	0.0		Spare
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	6344.0			B PHASE					7224.0	C PHASE	7060.0
TOTAL CONNECTED LOAD (WATTS)		20628.0									DEMAND LOAD	18565.2

RP25 Feeder Redesign

Demand Load	15883.2 W		
Voltage	208/120V		
Design Load	132.36 A	**+25% Spare Capacity**	165.45 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	200 A	(3) #3/0 CU THHN	(1) #3/0 CU THHN	(1) #6 CU	1 ¼”
New	200 A	(3) #2/0 CU THHN	(1) #2/0 CU THHN	(1) #6 CU	1”

RP26

VOLTAGE			TAG							TYPE PANEL		
MOUNTING										C/B MIN	AIC	FEED
SIZE/TYPE BUS			LOCATION							OPTIONS/ACCESSRS		
SIZE/TYPE MAINS										REMARKS		
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Receptacle	Dorm Rooms	360.0	20A 1P	1	*			2	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	3		*		4	20A 1P	360.0	Dorm Rooms	Receptacles
Hot Water Heater	Dorm Rooms	1500.0	20A 1P	5			*	6	20A 1P	180.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	7	*			8	20A 1P	1500.0	Dorm Rooms	Hot Water Heater
Receptacle	Dorm Rooms	360.0	20A 1P	9		*		10	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	11			*	12	20A 1P	540.0	Dorm Rooms	Receptacles
Hot Water Heater	Dorm Rooms	1500.0	20A 1P	13	*			14	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	15		*		16	20A 1P	1500.0	Dorm Rooms	Hot Water Heater
Receptacle	Dorm Rooms	360.0	20A 1P	17			*	18	20A 1P	1500.0	Dorm Rooms	Hot Water Heater
Receptacle	Dorm Rooms	540.0	20A 1P	19	*			20	20A 1P	540.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	21		*		22	20A 1P	360.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	360.0	20A 1P	23			*	24	20A 1P	180.0	Dorm Rooms	Receptacles
Receptacle	Dorm Rooms	540.0	20A 1P	25	*			26	20A 1P	540.0	Corridor	Receptacles
Hot Water Heater	Dorm Rooms	1500.0	20A 1P	27		*		28	20A 1P	360.0	Corridor	Receptacles
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	29			*	30	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	31	*			32	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	236.0	20A 1P	33		*		34	20A 1P	354.0	Dorm Rooms	Fan Coil Unit
Fan Coil Unit	Dorm Rooms	354.0	20A 1P	35			*	36	20A 1P	524.0	Dorm Rooms	Lighting
Fan Coil Unit	Dorm Rooms	118.0	20A 1P	37	*			38	20A 1P	712.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	39		*		40	20A 1P	828.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	41			*	42	20A 1P	724.0	Dorm Rooms	Lighting
Spare		0.0	20A 1P	43	*			44	20A 1P	0.0		Spare
Spare		0.0	20A 1P	45		*		46	20A 1P	0.0		Spare
Spare		0.0	20A 1P	47			*	48	20A 1P	0.0		Spare
Spare		0.0	20A 1P	49	*			50	20A 1P	0.0		Spare
Spare		0.0	20A 1P	51		*		52	20A 1P	0.0		Spare
Spare		0.0	20A 1P	53			*	54	20A 1P	0.0		Spare
Spare		0.0	20A 1P	55	*			56	20A 1P	0.0		Spare
Spare		0.0	20A 1P	57		*		58	20A 1P	0.0		Spare
Spare		0.0	20A 1P	59			*	60	20A 1P	0.0		Spare
Spare		0.0	20A 1P	61	*			62	20A 1P	0.0		Spare
Spare		0.0	20A 1P	63		*		64	20A 1P	0.0		Spare
Spare		0.0	20A 1P	65			*	66	20A 1P	0.0		Spare
Spare		0.0	20A 1P	67	*			68	20A 1P	0.0		Spare
Spare		0.0	20A 1P	69		*		70	20A 1P	0.0		Spare
Spare		0.0	20A 1P	71			*	72	20A 1P	0.0		Spare
Spare		0.0	20A 1P	73	*			74	20A 1P	0.0		Spare
Spare		0.0	20A 1P	75		*		76	20A 1P	0.0		Spare
Spare		0.0	20A 1P	77			*	78	20A 1P	0.0		Spare
Spare		0.0	20A 1P	79	*			80	20A 1P	0.0		Spare
Spare		0.0	20A 1P	81		*		82	20A 1P	0.0		Spare
Spare		0.0	20A 1P	83			*	84	20A 1P	0.0		Spare
SUB-TOTAL	A PHASE	6344.0		B PHASE						7224.0	C PHASE	7060.0
TOTAL CONNECTED LOAD (WATTS)		20628.0									DEMAND LOAD	18565.2

RP26 Feeder Redesign

Demand Load	16056 W		
Voltage	208/120V		
Design Load	133.8 A	**+25% Spare Capacity**	167.3 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	200 A	(3) #3/0 CU THHN	(1) #3/0 CU THHN	(1) #6 CU	1 ½”
New	200 A	(3) #2/0 CU THHN	(1) #2/0 CU THHN	(1) #6 CU	1”

LP4B

VOLTAGE	480Y/277V, 3P, 4W		TAG						TYPE PANEL			
MOUNTING	Surface								C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Lighting	Basement	1596.0	20A/1P	1	*			2	20A/1P	940.0	Dorm Rooms	Lighting
Lighting	Basement	482.0	20A/1P	3		*		4	20A/1P	900.0	Dorm Rooms	Lighting
Lighting	Basement	1194.0	20A/1P	5			*	6	20A/1P	720.0	Dorm Rooms	Lighting
Lighting	Lounge	1420.0	20A/1P	7	*			8	20A/1P	816.0	Dorm Rooms	Lighting
Lighting	Lounge, Serving A	1781.0	20A/1P	9		*		10	20A/1P	988.0	Dorm Rooms	Lighting
Lighting	Serving Area	1668.0	20A/1P	11			*	12	20A/1P	0.0		Spare
Lighting	Serving Area	1765.0	20A/1P	13	*			14	20A/1P	0.0		Spare
Lighting	Conf Room	1312.0	20A/1P	15		*		16	20A/1P	0.0		Spare
Spare		0.0	20A/1P	17			*	18	20A/1P	0.0		Spare
Spare		0.0	20A/1P	19	*			20	20A/1P	0.0		Spare
Spare		0.0	20A/1P	21		*		22	20A/1P	0.0		Spare
Spare		0.0	20A/1P	23			*	24	20A/1P	0.0		Spare
Spare		0.0	20A/1P	25	*			26	20A/1P	0.0		Spare
Spare		0.0	20A/1P	27		*		28	20A/1P	0.0		Spare
Spare		0.0	20A/1P	29			*	30	20A/1P	0.0		Spare
Spare		0.0	20A/1P	31	*			32	20A/1P	0.0		Spare
Spare		0.0	20A/1P	33		*		34	20A/1P	0.0		Spare
Spare		0.0	20A/1P	35			*	36	20A/1P	0.0		Spare
Spare		0.0	20A/1P	37	*			38	20A/1P	0.0		Spare
Spare		0.0	20A/1P	39		*		40	20A/1P	0.0		Spare
Spare		0.0	20A/1P	41			*	42	20A/1P	0.0		Spare
SUB-TOTAL	A PHASE	6537.0		B PHASE						5463.0	C PHASE	3582.0
TOTAL CONNECTED LOAD (WATTS)		15582.0									DEMAND LOAD	14023.8

LP4B Feeder Redesign

Demand Load	14023.8 W		
Voltage	480/277V		
Design Load	50.6 A	**+25% Spare Capacity**	63.3 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	50 A	(3) #8 CU THHN	(1) #8 CU THHN	(1) #10 CU	½”
New	100 A	(3) #4 CU THHN	(1) #4 CU THHN	(1) #10 CU	¾”

LP42

VOLTAGE			TAG						TYPE PANEL			
MOUNTING									C/B MIN	AIC	FEED	
SIZE/TYPE BUS			LOCATION						OPTIONS/ACCESSRS			
SIZE/TYPE MAINS									REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Spare		0.0	20A 1P	1	*			2	20A 1P	553.0	Fourth Floor	Lighting
Spare		0.0	20A 1P	3		*		4	20A 1P	0.0		Spare
Lighting	Third Floor	290.0	20A 1P	5			*	6	20A 1P	328.0	Fifth Floor	Lighting
Lighting	Third Floor	1075.0	20A 1P	7	*			8	20A 1P	0.0		Spare
Lighting	Dorm Rooms	720.0	20A 1P	9		*		10	20A 1P	363.0	Sixth Floor	Lighting
Lighting	Dorm Rooms	816.0	20A 1P	11			*	12	20A 1P	245.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	988.0	20A 1P	13	*			14	20A 1P	450.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	456.0	20A 1P	15		*		16	20A 1P	450.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	524.0	20A 1P	17			*	18	20A 1P	1100.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	712.0	20A 1P	19	*			20	20A 1P	105.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	828.0	20A 1P	21		*		22	20A 1P	245.0	Multi-Purpose	Lighting
Lighting	Dorm Rooms	724.0	20A 1P	23			*	24	20A 1P	0.0		Spare
Spare		0.0	20A 1P	25	*			26	20A 1P	0.0		Spare
Spare		0.0	20A 1P	27		*		28	20A 1P	0.0		Spare
Spare		0.0	20A 1P	29			*	30	20A 1P	0.0		Spare
Spare		0.0	20A 1P	31	*			32	20A 1P	0.0		Spare
Spare		0.0	20A 1P	33		*		34	20A 1P	0.0		Spare
Spare		0.0	20A 1P	35			*	36	20A 1P	0.0		Spare
Spare		0.0	20A 1P	37	*			38	20A 1P	0.0		Spare
Spare		0.0	20A 1P	39		*		40	20A 1P	0.0		Spare
Spare		0.0	20A 1P	41			*	42	20A 1P	0.0		Spare
SUB TOTAL	A PHASE	3883.0		B PHASE						3062.0	C PHASE	4027.0
TOTAL CONNECTED LOAD (WATTS)		10972.0									DEMAND LOAD	9874.8

LP42 Feeder Redesign

Demand Load	9874.8 W		
Voltage	480/277V		
Design Load	35.9 A	**+25% Spare Capacity**	44.6 A

	Circuit Breaker	Conductors	Neutral	Ground	Conduit
Old	30 A	(3) #12 CU THHN	(1) #12 CU THHN	(1) #10 CU	½"
New	60 A	(3) #8 CU THHN	(1) #8 CU THHN	(1) #10 CU	½"

SKM ANALYSIS

ARC FAULT STUDY

The arc fault analysis was performed on the panelboards with SKM software. The study calculated the bus bolted fault (kA), bus arcing fault (kA), protective device bolted fault (kA), protective device arcing fault (kA), arc flash boundary (in) and incident energy (cal/cm^2). From this information, the software generated the Required Protective Clothing Category needed to work on each panel. The results of the study determined the panelboards in the Campus Center and Student Residence building require protective clothing categories 2 and 3. The output for each panelboard is listed in the following charts.

Bus Name	Protective Device	Bus (kV)	Bus Bolted (kA)	Bus Arcing (kA)	Prot Dev Bolted (kA)	Prot Dev Arcing (kA)	Trip/ Delay (sec.)	Breaker Opening (sec.)	Ground
DB4B	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
Generator	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
KC2	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
KCP	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
LS2B	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
LS42	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
LS45	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
LSDP4	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
MP27A	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
MS2	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
MSB	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
MSK	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
OS21	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
OS24	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
OS2BK	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No

Bus Name	Protective Device	Bus kV	Bus Bolted (kA)	Bus Arcing (kA)	Prot Dev Bolted (kA)	Prot Dev Arcing (kA)	Trip/ Delay (sec.)	Breaker Opening (sec.)	Ground
OSDP2B	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
OSDP4	MaxTripTime @2.0s	0.48	2.21	1.80	2.21	1.80	2	0.000	No
RP21	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP22	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP23	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP24	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP25	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP26	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP2B	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP2BA	MaxTripTime @2.0s	0.208	5.04	2.69	5.04	2.69	2	0.000	No
RP2K	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	No
RP2P	MaxTripTime @2.0s	0.208	5.09	2.71	5.09	2.71	2	0.000	Yes

Bus Name	Equip Type	Gap (mm)	Arc Flash (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category	Label #
DB4B	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0001
Generator	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0002
KC2	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0003
KCP	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0004
LS2B	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0005
LS42	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0006
LS45	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0007

Bus Name	Equip Type	Gap (mm)	Arc Flash (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Category	Label #
LSDP4	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0008
MP27A	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0009
MS2	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0010
MSB	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0011
MSK	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0012
OS21	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0013
OS24	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0014
OS2BK	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0015
OSDP2B	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0016
OSDP4	PNL	25	48	18	6.0	Category 2 (*N2) (*N9)	# 0017
RP21	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0018
RP22	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0019
RP23	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0020
RP24	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0021
RP25	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0022
RP26	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0023
RP2B	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0024
RP2BA	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0025
RP2K	PNL	25	68	18	11	Category 3 (*N2) (*N9)	# 0026
RP2P	PNL	25	58	18	8.2	Category 3 (*N2) (*N9)	# 0027

Category 2: Arc-rated FR shirts and pants.

Category 3: Arc-rated FR shirts and pants and arc flash suit.

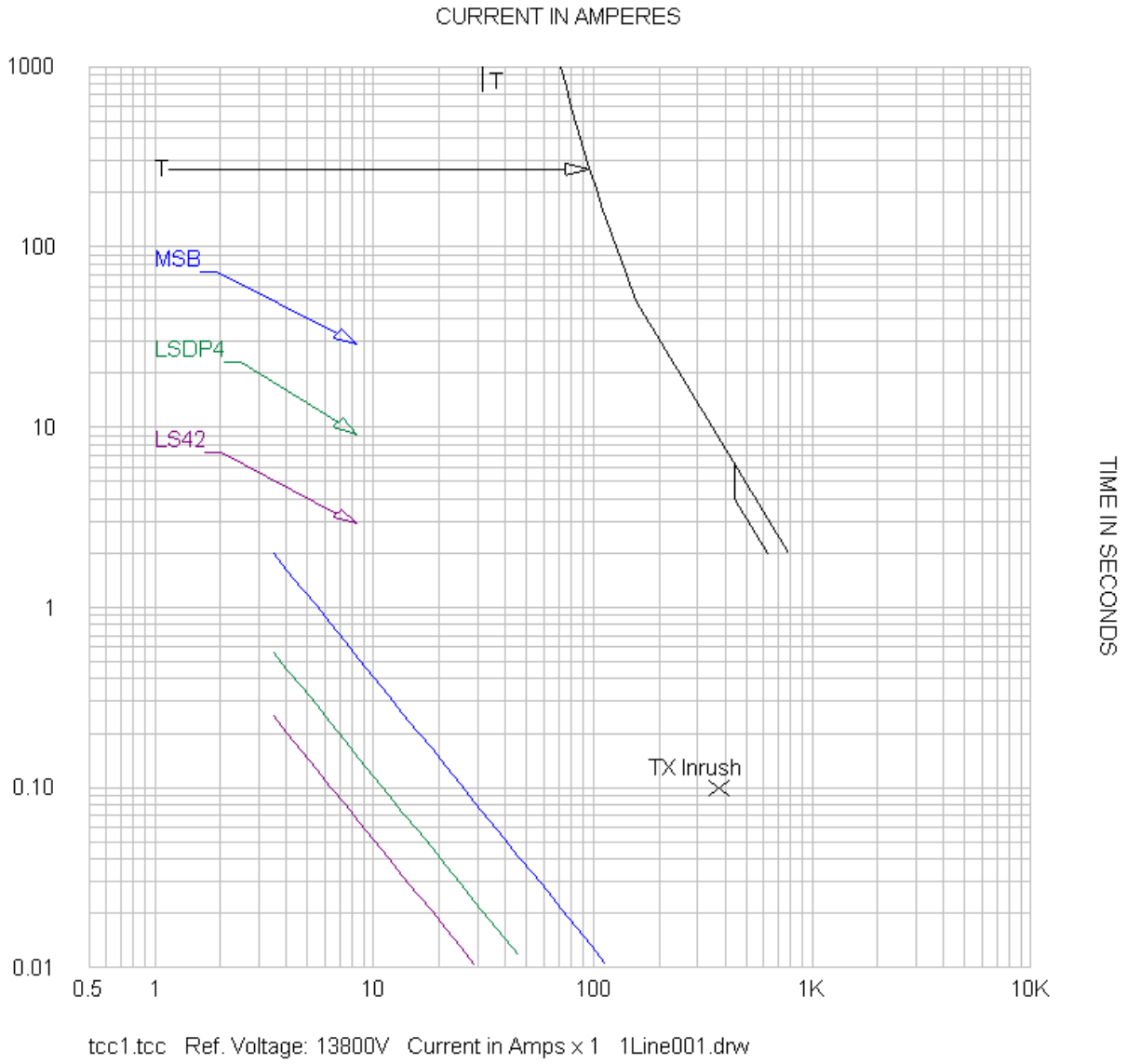
SHORT CIRCUIT ANALYSIS

A short circuit analysis was conducted on the Campus Center and Student Residence electrical system using SKM software. The full results for the analysis can be found in Appendix E. The following table summarizes the results:

Bus Name	Voltage	3 Phase	X/R
DB4B	480	2432.7	11.4
Generator	208	5396.3	8.4
KC2	208	5390.5	8.3
KCP	208	5390.5	8.3
LS2B	208	5388.1	8.3
LS42	480	2335.3	8.3
LS45	480	2335.3	8.3
LSDP4	480	2376.0	9.4
MP27A	480	2459.8	12.8
MS2	208	5629.8	11.8
MSB	480	2461.3	12.9
MSK	208	5484.3	9.4
OS21	208	5396.3	8.4
OS24	208	5396.5	8.4
OS2BK	208	5396.3	8.4
OSDP2B	208	5490.3	9.5
OSDP4	480	2379.1	9.5
RP21	208	5532.7	10.1
RP22	208	5532.7	10.1
RP23	208	5532.7	10.1
RP24	208	5532.7	10.1
RP25	208	5532.7	10.1
RP26	208	5532.7	10.1
RP2B	208	5532.7	10.1
RP2BA	208	5532.7	10.1
RP2K	208	5390.5	8.3
RP2P	208	5577.0	10.8

PROTECTIVE DEVICE COORDINATION STUDY

The chart below is a protective device coordination study run through SKM software. It measures the main transformer, main switchboard, distribution panelboard LSDP4 and lighting panelboard LS42.



ACOUSTICS

A reverberation time analysis was completed for the lounge on the first floor of the building. The lounge is a main circulation space for the building, but also a place for students to study and do homework, so improper acoustics can be detrimental to the atmosphere of the space. After analyzing the spaces alternative materials were chosen and the space was redesigned to maximize the acoustical balance.

ARCHITECTURE

The architectural breadth study is comprised of the south-facing façade on the first floor of the building. The sun shades, which help to control the daylight entering the space, were studied and alternative daylighting solutions were explored.

ACOUSTICS BREADTH

The student lounge in the Wheelock College Campus Center and Student Residence building is meant to be a place for students to be able to relax, do homework and study between classes and in the evening. It is also a main lobby and entrance space to the building, which conflict with the relaxed feeling it is supposed to convey.

The reverberation time, which is a measurement of the amount of time necessary for a sound to decay by 60 dB from its initial strength, is a good way to measure the quietness of a space. There are currently no building code requirements for a lounge space. The book *Architectural Acoustics* recommends a reverberation time between 0.8 and 1.1 seconds.

The formula for reverberation time is a function of the room volume and material absorption (in sabins). The material absorption depends on the amount of a particular material and the material's absorption coefficients (α). Since a material's absorption coefficient varies with the sound frequency, the reverberation time has to be calculated independently at each frequency. The formula for the reverberation time is defined as:

$T = 0.05*(V/a)$

T = reverberation time in seconds

V = volume in ft3

a = room absorption in sabins

MATERIALS AND FINISHES

Surface	Material	Absorption Coefficient

		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor 1	Carpet, heavy, on carpet	0.02	0.06	0.14	0.37	0.60	0.65
Floor 2	Glazed Tiles	0.01	0.01	0.01	0.02	0.02	0.02
Walls	Wood, ¼" thick with airspace behind	0.42	0.21	0.10	0.08	0.06	0.06
Doors	Wood, 1" thick with airspace behind	0.19	0.14	0.09	0.06	0.06	0.05
Ceiling 1	Gypsum board – ½" thick	0.29	0.10	0.10	0.10	0.07	0.02
Ceiling 2	Wood, ¼" thick with airspace behind	0.42	0.21	0.10	0.08	0.06	0.06
Ceiling 3	Acoustical Board, ¾" thick, suspended	0.76	0.93	0.83	0.99	0.99	0.94
Furniture	Fabric well-upholstered seats	0.19	0.37	0.56	0.67	0.61	0.59
Windows	Glass – Heavy	0.18	0.06	0.04	0.03	0.02	0.02
Stairs	Wood	0.15	0.11	0.10	0.07	0.06	0.07
Corridor Opening	Composite (Tile, Wood, ACT)	0.44	0.38	0.35	0.47	0.57	0.57

EXISTING DESIGN REVERBERATION TIMES

Surface	**Surface Area – S**	**Absorption Coefficient**					
		125 Hz	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Floor 1	252 ft^2	5.04	15.12	35.28	93.24	151.20	163.80
Floor 2	2179 ft^2	21.79	21.79	21.79	43.58	43.58	43.58
Walls	946 ft^2	397.32	198.66	94.60	75.68	56.76	56.76
Doors	24 ft^2	4.56	3.36	2.16	1.44	1.44	1.20
Ceiling 1	563 ft^2	163.27	56.30	56.30	56.30	39.41	11.26
Ceiling 2	1868 ft^2	784.56	392.28	186.80	149.44	112.08	112.08
Ceiling 3	0 ft^2	0.00	0.00	0.00	0.00	0.00	0.00
Furniture	756 ft^2	143.64	279.72	423.36	506.52	461.16	446.04
Windows	1680 ft^2	302.40	100.80	67.20	50.40	33.60	33.60
Stairs	506 ft^2	75.90	55.66	50.60	35.42	30.36	35.42
Corridor Opening	402 ft^2	176.88	152.76	140.70	188.94	229.14	229.14
Room Volume V = 34,034 ft^3							
Room Absorption (sabins) a = $\sum S\alpha$		2075.36	1276.45	1078.79	1200.96	1158.73	1132.88
Reverberation Time (seconds) T_{60} = 0.05*(V/a)		0.82	1.33	1.58	1.41	1.47	1.50

ACOUSTICS REDESIGN

After reviewing the reverberation time in the lounge, some alterations were made to the materials in the space. The 10 ft ceiling near the staircase will be switched from painted gypsum wall board to acoustical ceiling tile. The carpet will also be extended throughout the space, covering everything except the main walkway. By making these simple alterations, the reverberation time for the space has been greatly reduced and is much more conducive to speaking and conversations.

REDESIGN REVERBERATION TIMES

Surface	Surface Area – S	Absorption Coefficient					
		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor 1	1451 ft^2	29.02	87.06	203.14	536.87	870.60	943.15
Floor 2	980 ft^2	9.80	9.80	9.80	19.60	19.60	19.60
Walls	946 ft^2	397.32	198.66	94.60	75.68	56.76	56.76
Doors	24 ft^2	4.56	3.36	2.16	1.44	1.44	1.20
Ceiling 1	263 ft^2	76.27	26.30	26.30	26.30	18.41	5.26
Ceiling 2	1868 ft^2	784.56	392.28	186.80	149.44	112.08	112.08
Ceiling 3	300 ft^2	228.00	279.00	249.00	297.00	297.00	282.00
Furniture	756 ft^2	143.64	279.72	423.36	506.52	461.16	446.04
Windows	1680 ft^2	302.40	100.80	67.20	50.40	33.60	33.60
Stairs	506 ft^2	75.90	55.66	50.60	35.42	30.36	35.42
Corridor Opening	402 ft^2	176.88	152.76	140.70	188.94	229.14	229.14
Room Volume V = 34,034 ft^3							
Room Absorption (sabins) a = ∑Sα		2228.35	1585.4	1453.66	1887.61	2130.15	2164.25
Reverberation Time (seconds) T_{60} = 0.05*(V/a)		0.76	1.07	1.17	0.90	0.80	0.79

As apparent in the chart below, the reverberation times in the redesign are much closer to the recommended times than in the existing design. With just a few alterations, the sound quality in the student lounge has been improved dramatically.

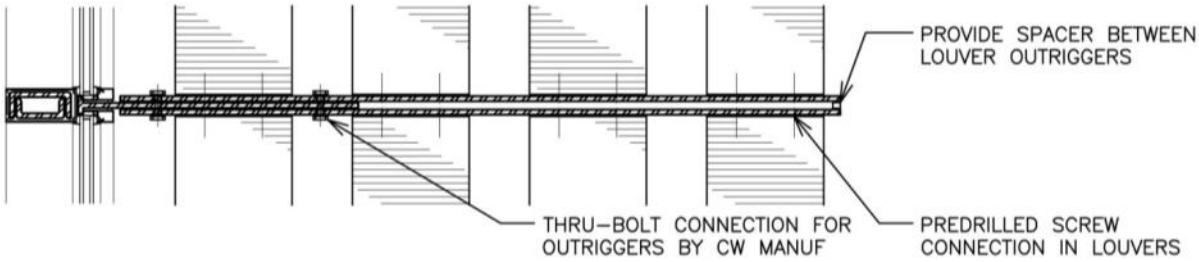
	Reverberation Time (seconds)					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000Hz
Target	0.8 to 1.1	0.8 to 1.1	0.8 to 1.1	0.8 to 1.1	0.8 to 1.1	0.8 to 1.1
Existing Design	0.82	1.33	1.58	1.42	1.47	1.50
Redesign	0.76	1.07	1.17	0.90	0.80	0.79

ARCHITECTURE BREADTH

Natural light is an integral part of building and lighting design. Having light during the day can decrease energy expenses by allowing occupants to turn off electric lights, as well as help to maintain the natural circadian rhythms in our bodies. While it is important to have a building with sufficient daylight, it is also important to have means to control the amount of daylight entering a certain space. During the summer, illuminance from the sun can reach up to 7000 fc, more than 300 times the amount of light needed for most spaces. In addition to an abundance of light, uncontrolled daylight can cause unwanted solar heat gain, damage fabrics and artwork and cause uncomfortable glare for occupants.

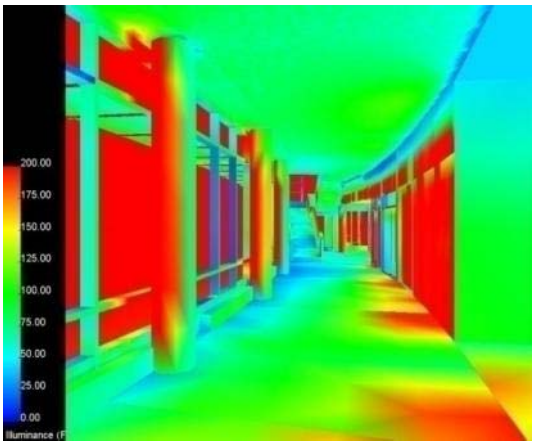
This study evaluates the effectiveness of daylight control in the student lounge. The space was designed with exterior sun shades to reduce the amount of sunlight entering the space during the day, which was modeled and rendered with AGI 32 software. Additional studies were performed with a sheer shading system and a Kalwall system installation. A comparative analysis will be performed on all systems, and each solution will be evaluated based on its effectiveness.

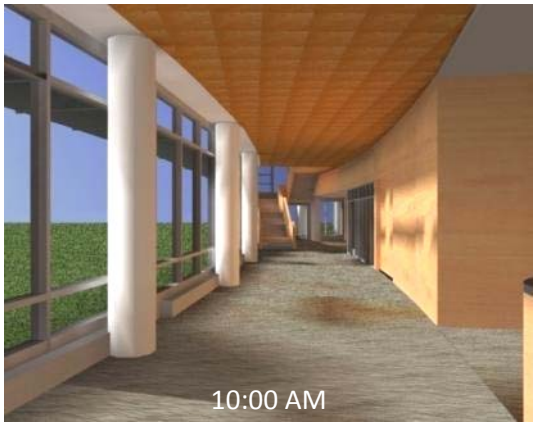
Daylight level calculations were performed on the student lounge at various times throughout the day. December 21, 2009 was chosen as the day to calculate because it is the winter solstice, where the sun is the lowest in the sky and therefore the most likely to cause glare issues for occupants. The analysis for all three solutions was performed at 8:00 AM, 10:00 AM, 12:00 PM, 2:00 PM and 4:00 PM with a clear sky.

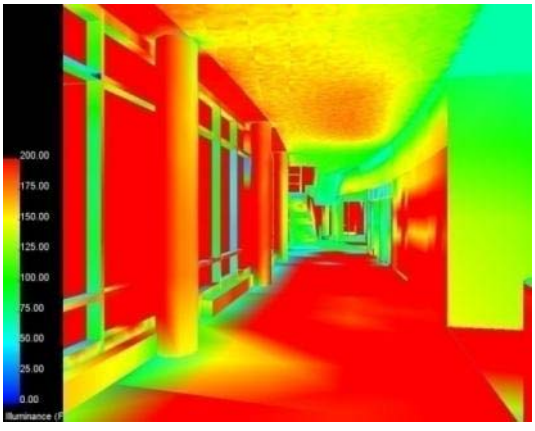


The image above is the plan view of the solar shade connection system.

The sun shades installed on the building extend 4’-6” from the building and are mounted 10’-0” above the ground. They are made of perforated metal strips. The idea of the sun shades are to block out the sun when it is most likely to cause glare during the day. They allow an unobstructed view to the scenery outside while protecting occupants from harsh direct sunlight and glare during the day. The images below are RGB and Pseudo-color renderings to show the amount of illuminance in the space.





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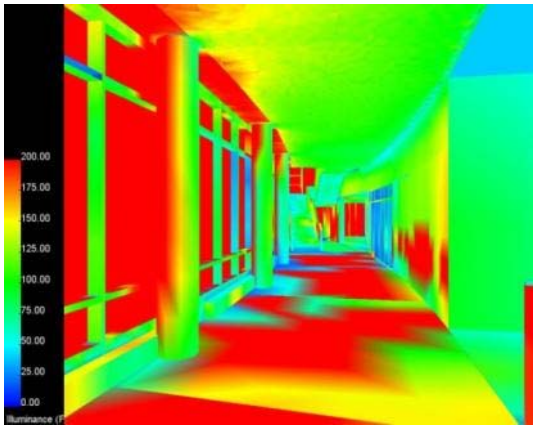
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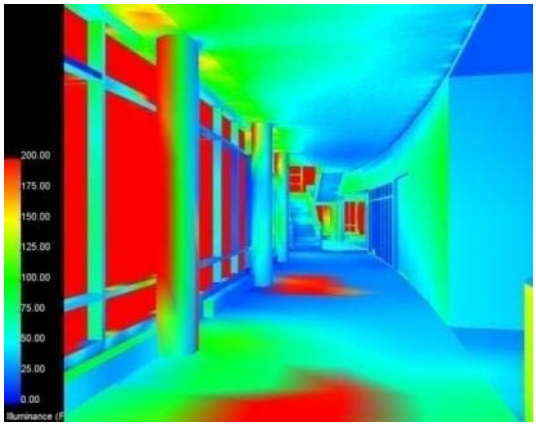
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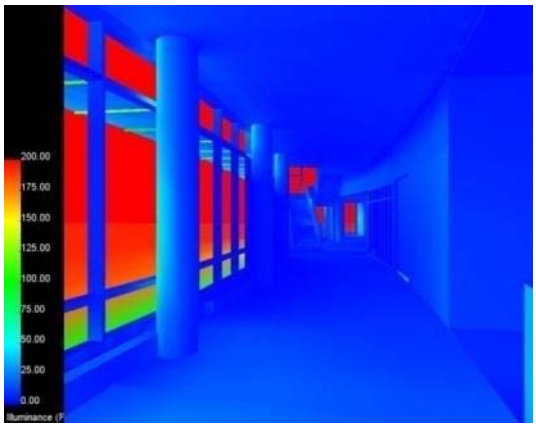
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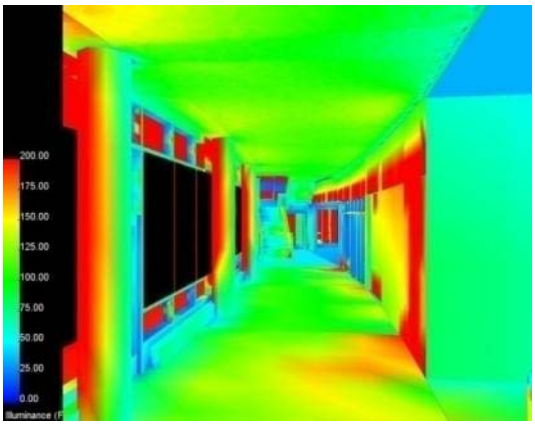
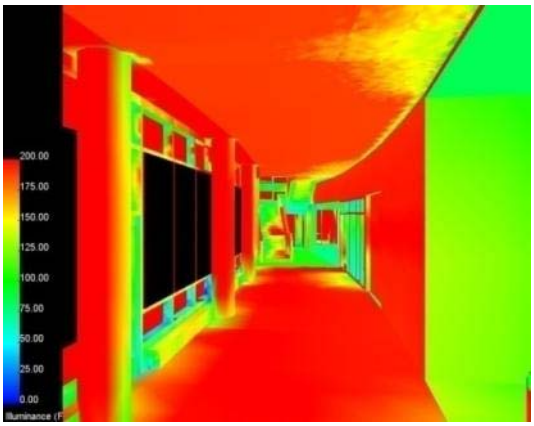
SHEER SHADE ANALYSIS

The above image is a commercial installation of a Lutron sheer shading system.

An alternative solution to the metal sun shades are an interior sheer shading system. A motor controlled sheer shading system offers many benefits, such as blocking harmful UV rays from entering the space. Also, the shades can be retracted on overcast days and when the sun is not shining directly into the space. A clear view to the outside is not necessary due to the parking lot behind the building. The shades are assumed to have a 50% transmittance.



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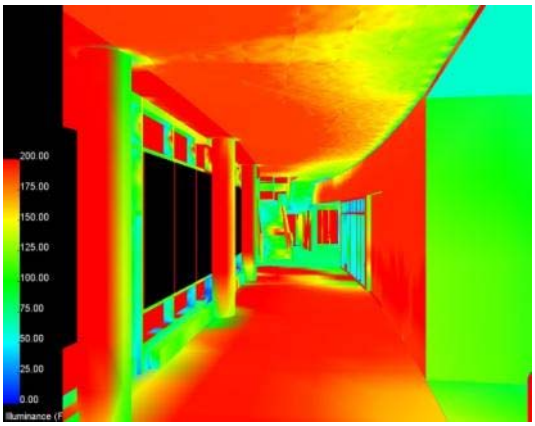
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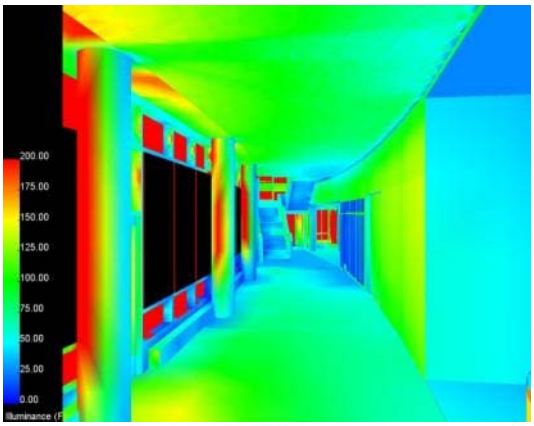
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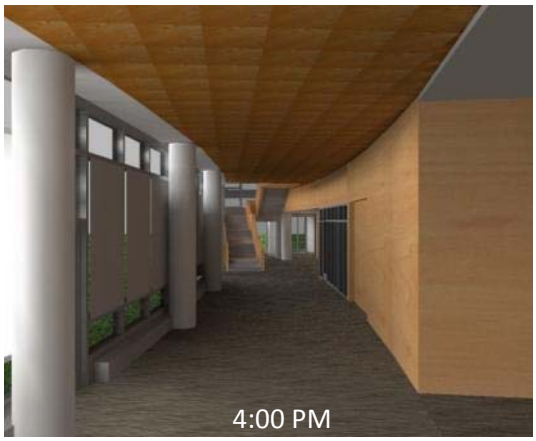
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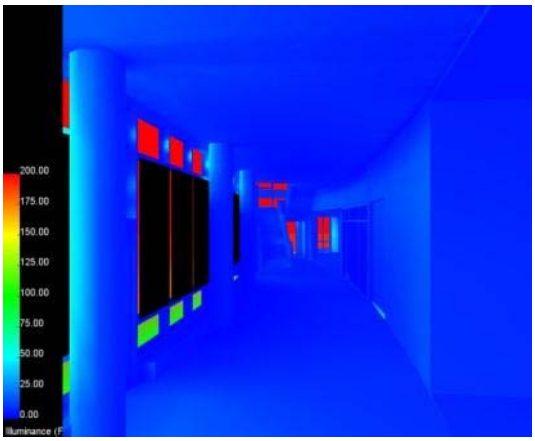
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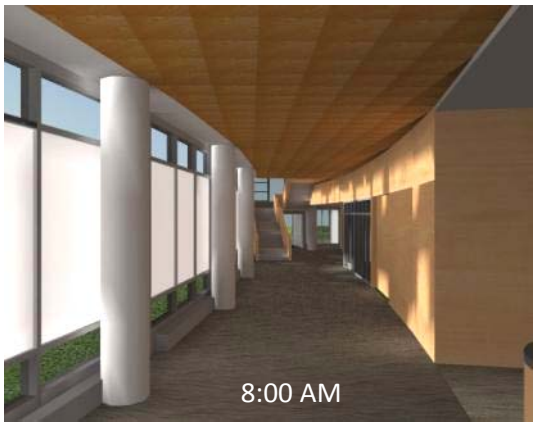
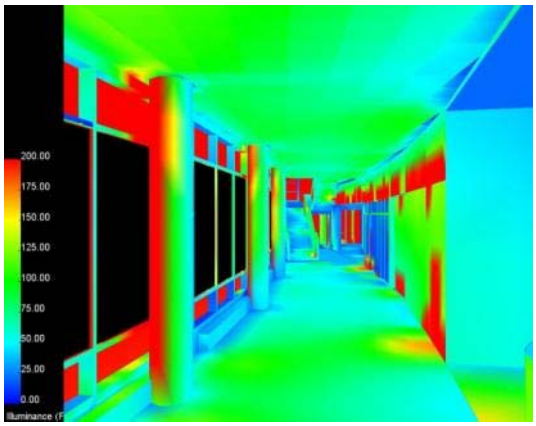
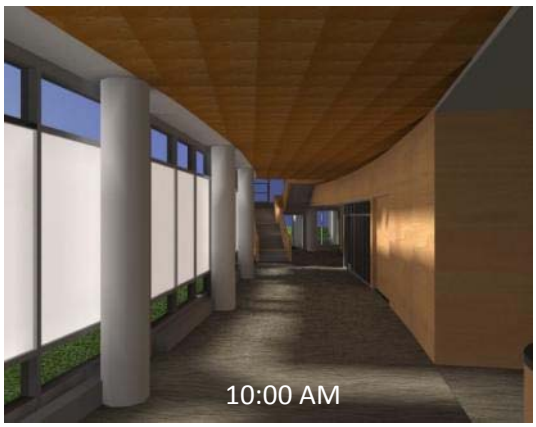
KALWALL SYSTEM ANALYSIS

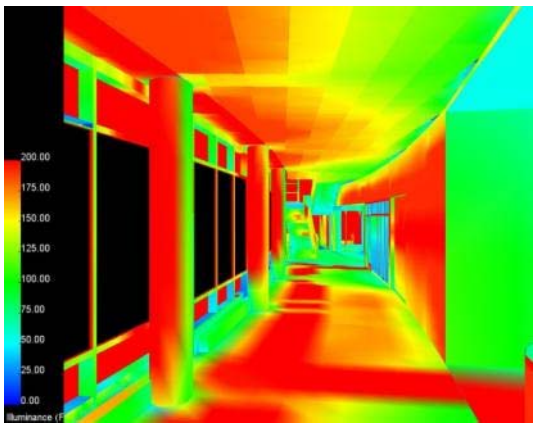
The image above is a Kalwall translucent window installation.

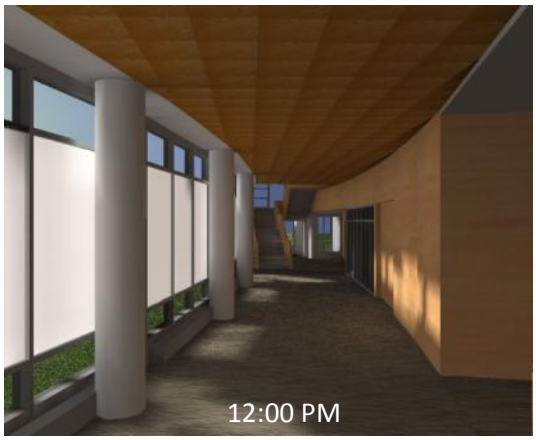
A final study was done evaluating the effectiveness of a Kalwall system replacing the large picture windows in the space. While this system would obstruct the view to the outside, it would allow daylight to enter the space without an uncomfortable glare, while greatly reducing the solar heat gain to the space. A clear view to the outside is not necessary due to the parking lot behind the building. The Kalwall is assumed to have a 30% transmittance.







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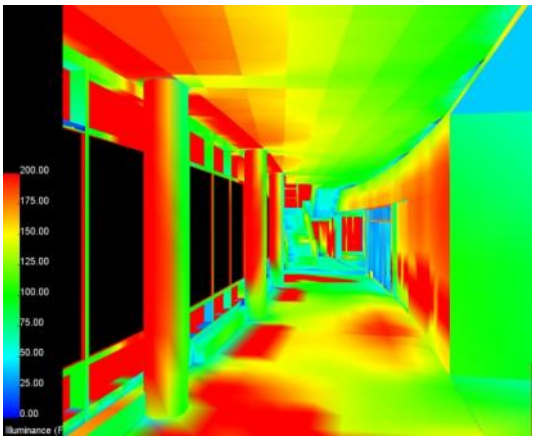
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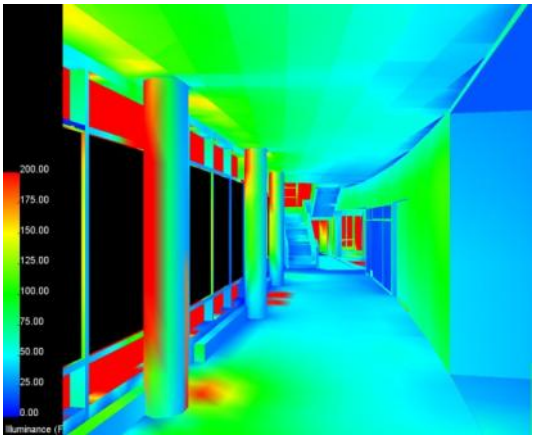
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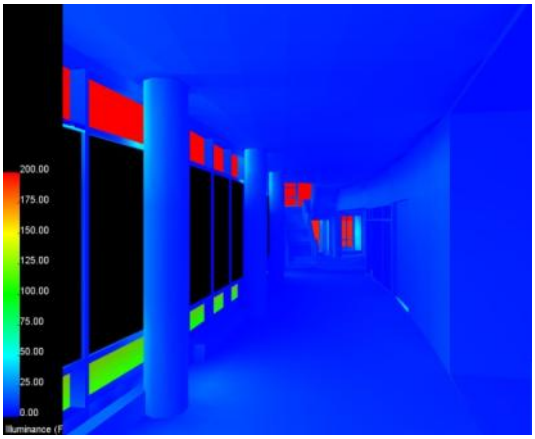
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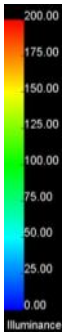
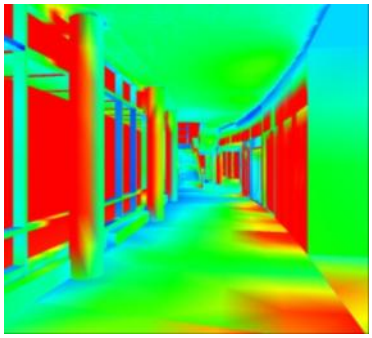
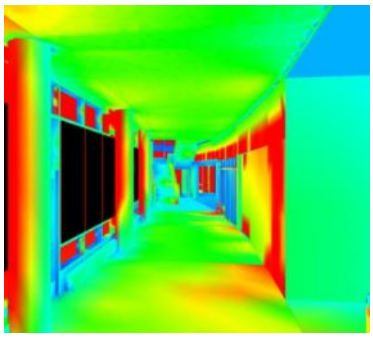
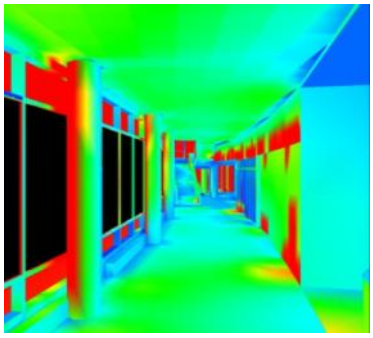
DAYLIGHT EVALUATION

After observing the daylight rendering from each of the daylight integration solutions, it seems that the Kalwall is the best solution. From the renderings, it is apparent that the most direct sunlight enters into the space in the morning. If the three solutions are compared at this time, one can see the most controlled solution is the Kalwall translucent panel installation. In addition to excellent daylight control, Kalwall also has superb insulation properties, and will prevent excessive solar heat gain in the space. More information on the Kalwall system may be found in Appendix D.

	SUN SHADE	SHEER SHADE	KALWALL
			
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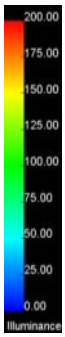	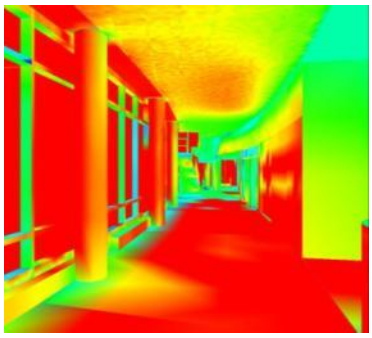	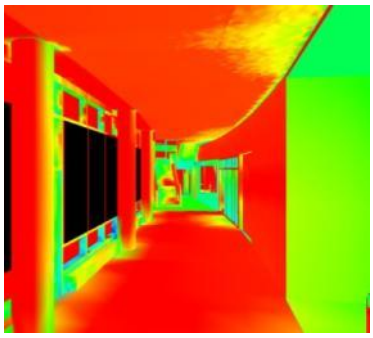	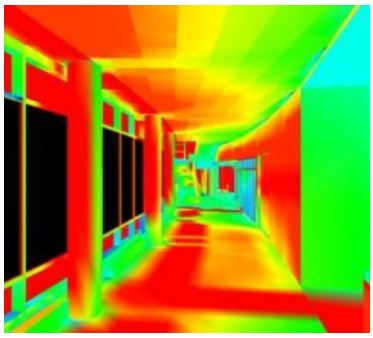
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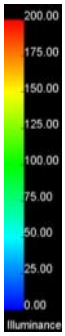	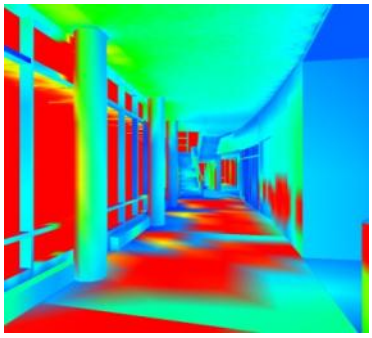	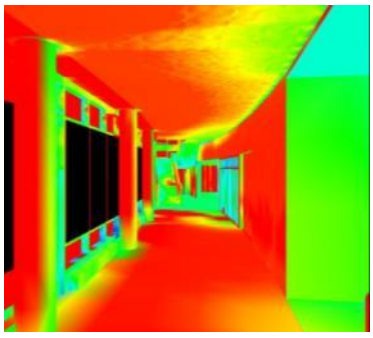	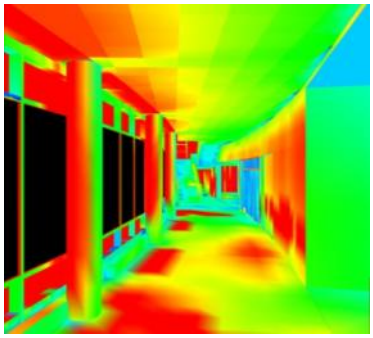
Clear Sky at 12:00 PM			

SUMMARY AND CONCLUSION

This report is meant to illustrate the some of the many paths which may be taken to reach similar design goals in engineering. There may be many solutions to the same problem which are all sufficient to achieve the design goals. There is very rarely an absolute right or wrong design solution in architecture and building design.

Some of the solutions presented in this report, such as the Kalwall solution in the student lounge, would be appropriate. Other designs such as the proposed voltage change were found to be detrimental compared to the existing design. Although the new lighting designs successfully achieve the design goals put forth, the existing designs also achieved those goals through the use of different luminaires and designs.

This project also addresses the complexities of many consultants working together to accomplish a terrific building design while staying within budget and respecting the other building systems. While this report focused on lighting, electrical, acoustical and architectural aspects of the Wheelock College Campus Center and Student Residence building, there are many other breadths which may be considered. Building systems are at their optimum level when the occupants do not notice they are there. When all a building's systems are working in harmony, then it has executed its goals.

ACKNOWLEDGMENTS

For this report, I would like to especially thank the following people and companies for their assistance:

- Wheelock College, for providing the owner's permission and cooperation
- Carrie Hawley and HLB Lighting Design for helping me choose my project and obtain owner permission.
- William Rawn Associates, for providing me the plans necessary for my success
- Vanderweil Engineers for their assistance with the electrical aspects of the building
- Dr. Richard Mistrick, Dr. Kevin Houser, and Ted Dannerth, my Penn State Architectural Engineering consultants
- All of my past professors at Penn State, whose teachings have contributed to the completion of this report
- My family, friends, and Architectural Engineering peers for their support throughout the year

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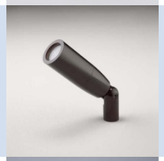
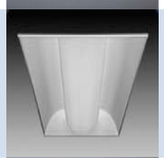
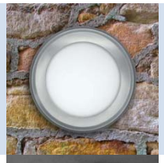
Egan, David M. Architectural Acoustics. New York: McGraw Hill, 1988.

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

Rea, Mark S. The IESNA Lighting Handbook: Reference & Application. New York: Illuminating Engineering Society of North America, 2000.

APPENDIX A:LUMINAIRE SCHEDULE

Tag	Fixture Description	Image	Mounting	Lamp	Watts	Volts	Location	Quantity	Manufacturer	Catalogue Number	Ballast
F1	5" recessed halogen accent light.		Recessed	3-MR16 37 W	120 W	277 V	Lounge	8	Amerlux	CLYR-3-37-MR16-E-BT-277-WT	None
F2	Semi-recessed LED step light.		Wall Mounted	LED	4 W	120 V	Lounge	10	Lightolier	DSL01SA	Integral Transformer
F3	Surface-mounted LED landscape light.		Ground Mounted	LED	4 W	12 V	Third Floor Deck	10	Winona Lighting	CELED-1003-12V-L!-BKS	Integral Transformer
F4	6" recessed compact fluorescent downlight.		Ceiling Recessed	1-CFQ 26W	28 W	277 V	Serving Space	23	Lightolier	8091 CCLW	QTP 2x26CF/UNV BS
F5	2’x4’ recessed indirect with perforated center basket		Ceiling Recessed	2-F28T5	63 W	277 V	Serving Space Kitchen	3	Focal Point	FLU-24-B-2-T5HO-E-277-G	QTP 2x28T5/UNV PSN NL
F6	6" recessed compact fluorescent wallwasher.		Recessed	1-CFQ 26W	28 W	277 V	Conference Room, Lounge	14	Lightolier	8081 CLW	QTP 2x26CF/UNV BS
F7	Recessed fluorescent troffer.		Recessed	1-F28T5	63 W	277 V	Conference Room	8	Focal Point	FAV6-Fl-1T5HO-1C-277-D-G1-WH-4’	QTP 2x28T5/UNV PSN NL
F8	4" recessed compact fluorescent downlight.		Recessed	1-CFQ 18W	20 W	277 V	Conference Room	4	Lightolier	8011 CCLW	QTP 1x18CF/UNV BS

F9	9" suspended compact fluorescent downlight.		Ceiling Suspended	1-CFQ 18W	20 W	277 V	Cafeteria Serving Space	21	Delray Lighting	2310-S-18-2-E	QTP 1x18CF/UNV BS
F10	Suspended LED chandelier.		Ceiling Suspended	LED	4 W	12 V	Cafeteria Serving Space	11	Winona Lighting	LED-POPS01-6-ARC-M-001-ND12V-BAL-X-STD	Integral Transformer
F11	5" recessed fluorescent wallwasher.		Recessed	1-F28T5	32 W	277 V	Cafeteria Serving Space	7	Mark Architectural Lighting	SPR-F-1T5HO-277-EB	QTP 1x28T5/UNV PSN NL
F12	Surface-mounted fluorescent strip light, rigid housing.		Ceiling Surface	1-F28T5	32 W	120 V	Dorm Room	58	Prudential Lighting	P-T5-STD-1T5-03-BWE-277	QTP 1x28T5/UNV PSN NL
F13	Recessed compact fluorescent step light.		Wall Recessed	1-CFQ 13W	16 W	12 V	Roof Deck	8	Cooper - Lumiere	1235-RD-M-4LED-120/12-BK	QTP 1x13CF/UNV
F14	12" surface-mounted compact fluorescent wallwasher.		Ceiling Surface	1-CFQ 26W	28 W	277 V	Lounge	4	Winona Lighting	P1-SS-CFQ26-277V-SS8-SGW-X-STD	QTP 2x26CF/UNV BS
F15	8" surface-mounted compact fluorescent downlight.		Ceiling Surface	2-CFQ 26W	54 W	120 V / 277 V	Lounge, Dorm Room	31	Kurt Versen	P602	QTP 2x26CF/UNV
F16	Wall-mounted fluorescent up/downlight.		Wall Surface	2-F28T5	63 W	120 V	Dorm Room	58	Mark Architectural Lighting	DUW-4-1T5-277-EB	QTP 1x28T5/UNV PSN NL

APPENDIX B:LUMINAIRE SPECIFICATIONS

Type:	F1
Location:	Lounge
Mfr/Catalogue #:	Amerlux - CLYR-3-37-MR16-E-BT-277-WT
Description:	5" Recessed halogen accent light. Spec-grade commercial.
Lamping:	3-MR16 35W
Optics:	Solite beam softening lens
Dimensions:	15.400" length, 5.187" diameter, 6.812" height
Housing:	Steel housing
Electrical:	Integral Electric Ballast
Voltage:	277 Volts
Labels:	CUL, UL. Suitable for Dry, Damp environments.

CYLINDRIX MULTIPLE RECESSED 3 LIGHT

CYLR-3
3LT MR16

APPLICATION:
Accent and display lighting for Retail, Commercial and Hospitality environments

CONSTRUCTION:
Stamped steel mounting frame with integral mounting bars
Thermally protected
Steel ballast housing
Electronic ballast outboard mounted
Steel upper housing and laser cut trim ring
Die-cast lamp housing
Formed aluminum yoke
GU5.3 Bipin socket
Powder coat paint

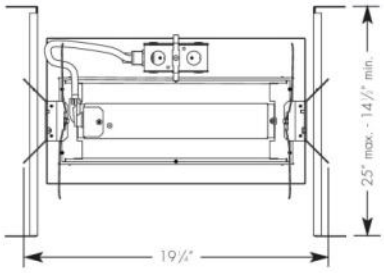
OPTICS:
0-30° x 45° tilt, 360°+ rotation
MR16 12v Bipin base, 37w max
Solite beam softening lens

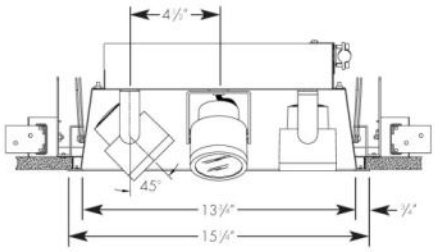
MOUNTING:
For use in T-grid or sheet rock ceilings

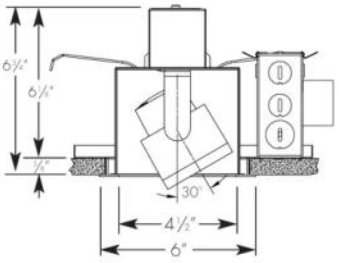
LABELING:
UL and CUL listed
Damp location

PROJECT:

TYPE:







Ceiling Cut Out Dimension: 5⁹⁄₁₆" x 14¹³⁄₁₆"

ecoTECTURAL
Architectural lighting for sustainable design.

AMERLUX
LIGHTING SOLUTIONS
ADAPT. ABILITY.™

ELECTRICAL

Ballast		Lamping 3-37w Input watts	Amps*
Electronic	120v	111	.93
	277V	111	.39

3 MR16, GU5.3 bi-pin base, 37w max

Amerlux reserves the right to change details that do not affect overall function and performance.

ORDERING INFORMATION:

Model	# Lamps	Wattage	Lamp Type	Ballast	Housing/ Head Finish	Voltage	Trim Ring Finish	Options/ Accessories
CYLR	3	37	MR16	E - electronic	WT - white texture BT - black texture ST - silver texture __ - __ (other RAL)	120 277	WT - white texture	HEX - hexcell louver

Example: CYLR-3-37-MR16-E-WT-120-WT

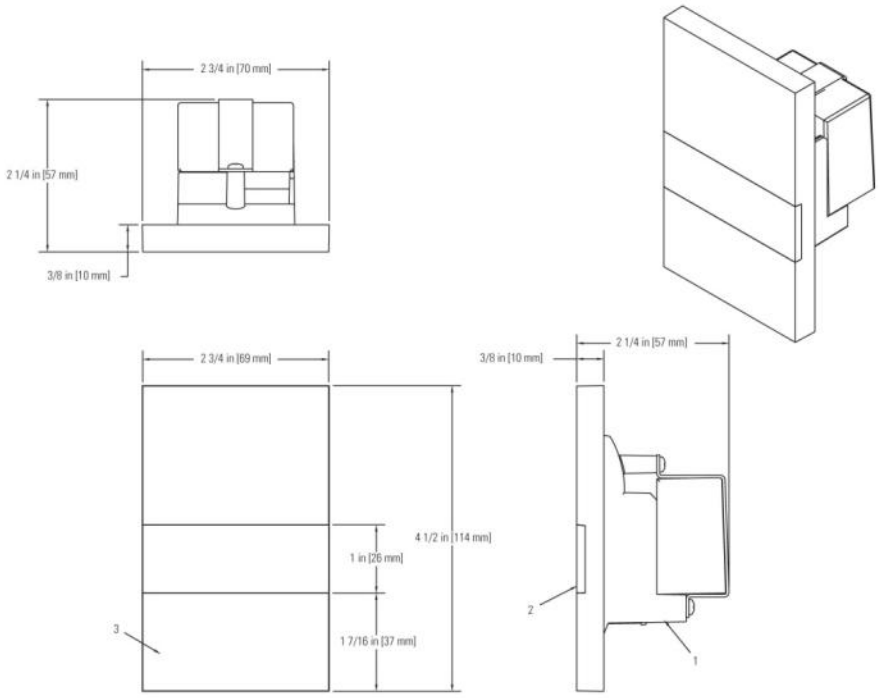
Cat #:

Amerlux, LLC. • 23 Daniel Road East, Fairfield NJ 07004 • T: 973 882 5010 F: 973 882 2605 • www.amerlux.com
LIT-0532 rev 4/08

Type:	F2
Location:	Lounge
Mfr/Catalogue #:	Lightolier - DSL01SA
Description:	Semi-recessed LED step light.
Lamping:	LED
Optics:	Polycarbonate clear lens
Dimensions:	4.500" length, 2.750" width, 2.250" height
Housing:	Die cast aluminum
Electrical:	Integral transformer
Voltage:	12 Volts
Labels:	CUL, UL. Suitable for Dry environments.

LIGHTOLIER® Architectural Decorative **DSL01**

Linear Step LED



Catalog Number	Finish	Lamp	Wattage	Color Temp	Voltage
DSL01W	White	LED	4W	3000K	120-240V
DSL01SA	Satin Aluminum	LED	4W	3000K	120-240V

Note: Order Glass/Diffuser separately.

Features

1. **Heat Sink/Driver Housing:** Die cast aluminum.
2. **Lens:** Injection molded polycarbonate clear, developed for optimum optical output.
3. **Face Plate:** Die cast aluminum.
4. **Switch Box Mounting Plate:** 18ga. C.R.S. zinc plated, for mounting to a 3 1/2" deep switch box. (Not shown)

Electrical

LED: (1) 4W 3000K white LED. Average expected life, under normal operating conditions is 50,000 hours with lumen maintenance of 70% of original light output.

Driver: Class 2 power supply.
Voltage: 120V
Output Wattage: 5 W
Input Current (max.): 100 mA
Frequency: 50/60 Hz
Output Voltage (VDC): 12 V
Constant Current: 500 mA

Finish

Satin aluminum with protective clearcoat.
Matte white powder coat.

Labels

cULus Listed. Suitable for Dry Locations.
Wall mount only.

Job Information **Type:**

Job Name:

Cat. No.:

Lamp(s):

Notes:

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Lightolier is a Philips group brand

PHILIPS

Type:	F3
Location:	Roof Deck
Mfr/Catalogue #:	Winona Lighting - CELED-1003-12V-L!-BKS
Description:	Surface-mounted LED landscape light.
Lamping:	LED
Optics:	Open , tempered glass lens
Dimensions:	1.625" diameter, 1.625" height
Housing:	Aluminum, powder coat paint.
Electrical:	Integral transformer
Voltage:	277 Volts
Labels:	CUL listed Wet Location, UL listed Wet Location. Suitable for Dry, Wet, Damp environments.

Cedar LED — 12V LED

flood & accent

Construction: Body, cap and knuckle machined from 6061 - T6 ALUMINUM. Lens cut from tempered borosilicate glass for superior clarity and strength.

LED Unit: Winscape proprietary unit using one (1) High Output LED and an integral low voltage (10.5V-15.5V) AC LED driver. Available in three (3) beam spreads; 10° Spot, 20° Narrow Flood, and 36° Flood. Available in Warm White (3000K) and Cool White (6500K) color temps.

Finishes: Available in 12 standard TGIC polyester powder coat finishes. Custom powder coat finishes available (contact factory for more information).

Features: Field replaceable lens. Tapered "Sure Lock" knuckle seat for infinite aiming and unparalleled locking ability. Any combination of up to 3 lens accessories/color filter/shielding can be specified in any cap style and are held securely by a removable stainless steel clip ring.

General: This fixture requires a low voltage MAGNETIC transformer to function properly. Magnetic transformer must be purchased separately (see accessories section on our website). Mounting must be specified separately (see accessories section on our website).

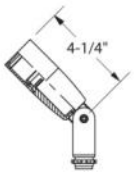
MOUNTING OPTIONS:

GROUND MOUNT | WALL MOUNT | TREE MOUNT | SURFACE MOUNT | MODIFIED STANDARD

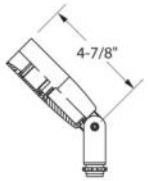
NOTE: See Accessories on our website for mounting options.

c UL — **UL Listed: Wet location** Indoor/Outdoor — **cUL Listed:** Indoor/Outdoor

1. **CELED** — SERIES
   - **CELED** = CEDAR LED
2. LIGHT SOURCE
   - ***Warm White, 3000K, 120 lumen***
   - **1002** = 2.5W/10° SP/WW LED
   - **1003** = 2.5W/20° NFL/WW LED
   - **1004** = 2.5W/36° FL/WW LED
   - ***Cool White, 6500K, 150 lumen***
   - **1005** = 2.5W/10° SP/CW LED
   - **1006** = 2.5W/20° NFL/CW LED
   - **1007** = 2.5W/36° FL/CW LED
3. **12V** — VOLTAGE
   - **12V** = 12 VOLTAGE
4. ACCESSORY LENS
   - **L0** = NONE
   - **L1** = PRISMATIC
   - **L3** = SOFTENING
   - **L4** = WATERSHED™
5. FINISH COLOR
   - **BKS** = BLACK SMOOTH
   - **BKT** = BLACK TEXTURED
   - **BRS** = BRONZE SMOOTH
   - **BRT** = BRONZE TEXTURED
   - **WHS** = WHITE SMOOTH
   - **WHT** = WHITE TEXTURED
   - **SIS** = SILVER SMOOTH
   - **IVS** = IVORY SOMOOTH
   - **CHS** = CHROME SMOOTH
   - **NBS** = NATURAL BRONZE
   - **VET** = VERDE TEXTURED
   - **SAT** = SAND TEXTURED
6. COLOR FILTER
   - **F0** = NONE
   - **FM** = MERCURY VAPOR
   - **FR** = RED
   - **FRD** = RED DICHROIC
   - **FP** = PINK
   - **FA** = AMBER
   - **FG** = GREEN
   - **FGD** = GREEN DICHROIC
   - **FLB** = LIGHT BLUE
   - **FMB** = MEDIUM BLUE
   - **FMBD** = MEDIUM BLUE DICHROIC
7. SHIELDING
   - **SH0** = NONE
   - **SH6** = HONEYCOMB LOUVER
8. CAP STYLE
   - **C1** = SHORT FLUSH
   - **C2** = LENS RECESSED
   - **C3** = 45° CUTOFF
   - **C4** = LONG FLUSH
9. SPECIAL
   - **STD** = STANDARD
   - **MOD** = MODIFIED
   - **350R** = 2 PIECE 350° ROTATION KNUCKLE



CAP C1



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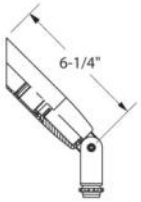
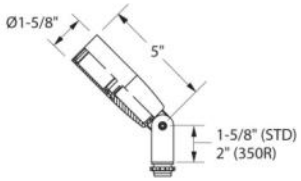


CAP C3



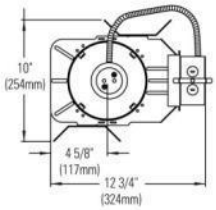
CAP C4

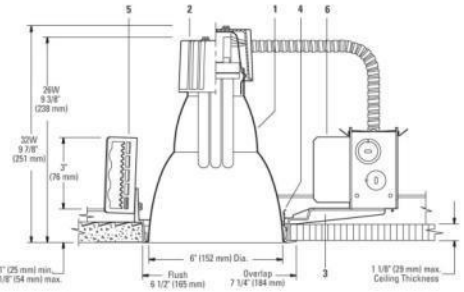
winona lighting
3760 west fourth street • winona, minnesota 55987 • 507 - 454- 5113 • fax: 507 - 454 - 1814
winona lighting on the web • www.winonalighting.com

Type:	F4
Location:	Cafeteria Serving Space
Mfr/Catalogue #:	Lightolier - 8091 CCLW
Description:	6" Recessed compact fluorescent downlight.
Lamping:	1-CFTR 26W
Optics:	Cross baffle
Dimensions:	13.875" length, 11.125" width, 6.000" height
Housing:	Die cast aluminum
Electrical:	Integral electronic 120V/277V ballast
Voltage:	277 Volts
Labels:	IBEW, UL listed Damp Location. Suitable for Damp environments.

LIGHTOLIER® Calculite® CFL Open Downlight 8021

6" Aperture Triple Tube Vertical Lamp





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

Reflector Trim

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

Frame-In Kit

S6132BU	6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)
Standard Dimming Options:	
S6132B ☐	
CU3	Lightolier PowerSpec 3% Dimming (120/277V)
J1LD3	Lutron 5% Dimming (120V)
J2LD3	Lutron 5% Dimming (277V)
JUM7	Mark 7 Dimming (120/277V)
J1MX	Mark 10 Dimming (120V)
J2MX	Mark 10 Dimming (277V)
Other dimming product available, please consult factory	

Remodeler Frame-In Kits

6126BURM	6" aperture, 1 lamp 26W Triple Tube CFL (120/277V) 4-Pin (Amalgam)
6132BURM	6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)

Features

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

Electrical

Note: For ballast electrical data and latest lamp/ballast compatibility refer to **"Ballast"** specification sheet for complete electrical data.
UL Listed for through branch circuit wiring with max of (8) No 12 AWG, 90 degree C supply conductors.

Options and Accessories

Comfort Clear™ Finishes[1]		**Other Finishes**	
Diffuse	**CCD**	White	**WH**
Champagne Bronze	**CCZ**	Specular Clear	**CL**
Multigroove	**MG**		

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

Options and Accessories (continued)

Emergency Ltg. Kit	**FA EM3E***
	FA EM4*
Fuse (Slow Blow)	Add suffix **F**
Existing/Thk. Ceiling	**FA EC6***
Emergency	Add suffix **EM***
Chicago Plenum	Use S6132BULC

*See Spec. Sheets: FAEM, FAEC

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

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

Labels

UL Listed for damp locations.

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

Job Information **Type:**

Job Name:

Cat. No.:

Lamp(s):

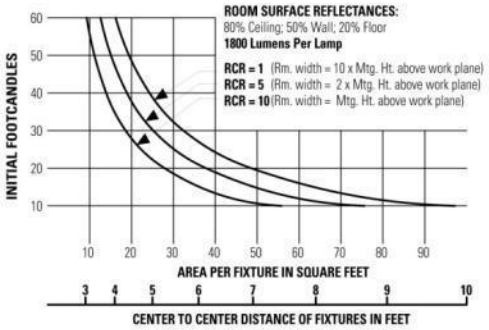
Notes:

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Lightolier is a Philips group brand

PHILIPS

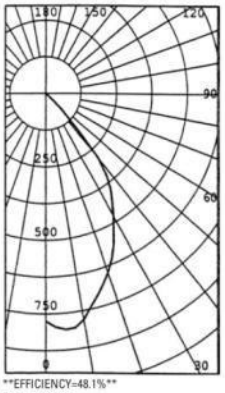
26W
Quick Calculator



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

Spacing Ratio = 1.0

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



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

ZONAL SUMMARY

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

ZONAL LUMENS AND PERCENTAGES

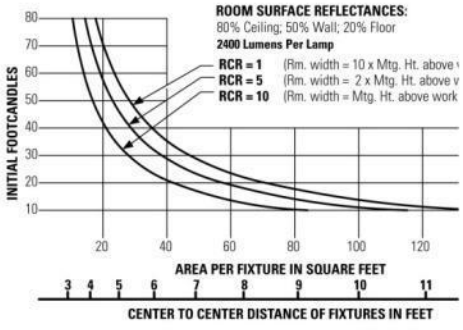
ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	533	29.66	61.66
0-40	778	43.25	89.92
0-60	863	47.98	99.75
0-90	865	48.10	100.00
40-90	87	4.85	10.08
60-90	2	.12	.25
90-180	0	.00	.00
0-180	865	48.10	100.00

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

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

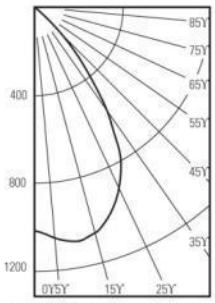
32W
Quick Calculator



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

Spacing Ratio = 1.1

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



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

ZONAL SUMMARY

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

ZONAL LUMENS AND PERCENTAGES

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

Coefficients of Utilization

EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

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

Job Information **Type:**

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Type:	F5
Location:	Cafeteria Serving Space
Mfr/Catalogue #:	Focal Point - FLU-24-B-2-T5HO-E-277-G
Description:	Recessed fluorescent troffer.
Lamping:	2-F28T5
Optics:	Straight louver
Dimensions:	48.000" length, 24.000" width, 5.000" height
Housing:	One piece 20 Ga. steel
Electrical:	Integral electronic ballast
Voltage:	277 Volts
Labels:	CUL, UL. Suitable for Dry environments.

luna® 2x4

FOCAL POINT®

Covered by the following U.S. Patents: D395,727; D397,819.

features

2'x4' recessed indirect with perforated center basket.

Reflector and end caps form seamless one-piece housing.

High reflectance, low gloss Matte White finish controls glare and provides high efficiency.

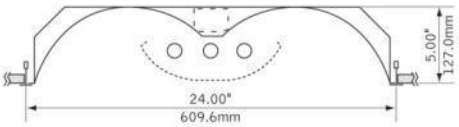
Perforated shield hinges open for quick and easy relamping.

Optional radial blade louver offers a distinct look that highlights interior architecture.

All luminaire combinations may be continuously row mounted.

Luna® provides high angle uniform distribution ideal for general illumination.

dimensional data



lamping options


T8 LAMPS


T5/T5HO LAMPS

shielding options & details

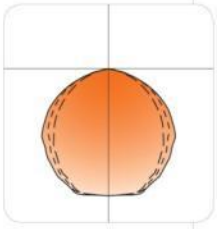

perforated

radial blade louver

july 2008

performance

2–Lamp T8
72% Efficiency
1528 cd @ 10°



Visit focalpointlights.com for complete photometric data.

www.focalpointlights.com | 1.773.247.9494

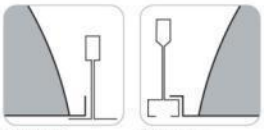
fixture:

project:

mounting information

grid

specify "G" for flat 9/16" and 15/16" tee or "ST" for 9/16" slot tee grid types.

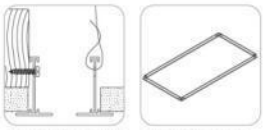


"G" flat tee "ST" slot tee

Luminaires may be installed in T-bar ceiling systems up to 1 11/16" high in T8 lamp configurations.

drywall frame kit

specify "DF" Drywall Frame Kit for drywall ceiling conditions.



Use tie-wire or screws to secure frame kit.

cut out dimensions:

2': Min: 24.125" Max: 24.563"

4': Min: 48.125" Max: 48.563"

specifications

construction

One-piece 20 Ga. steel reflector and housing.

20 Ga. steel ends form finished housing.

Lamps are shielded by detachable 22 Ga. steel perforated lamp shield with acrylic lens insert.

Lamp shield is secured by four spring-pins allowing shield to hinge down for relamping.

Optional radial blade louver: .75"H x 1" frequency fabricated of 20 Ga. steel with acrylic lens insert.

Top access 20 Ga. steel ballast compartment.

Weight: 29 lbs

optic

One-piece 20 Ga. steel reflectors finished in Matte Satin White powder coat.

electrical

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

Optional dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

finish

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

ordering

luminaire series		FLU
Luna	FLU	
nominal size		24
2' x 4'	24	
distribution		B
Bi-Directional	B	
lamp quantity		
Two Lamp	2	
Three Lamp	3	
lamp type		
T8 (1 11/16" maximum grid height)	T8	
T5	T5	
T5HO	T5HO	
ballast		
Electronic Instant Start <20% THD (T8 only)	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
voltage		
120 Volt	120	
277 Volt	277	
347 Volt	347	
mounting		
Grid	G	
Slot Tee	ST	
Surface Mount	SM	
shielding		
Perforated Shield	PS	
Radial Blade Louver	RLP	
factory options		
Air Return	AR	
Chicago Plenum	CP	
Dust Cover	DC	
Drywall Frame Kit (Cut out dimensions: Min:24.25"/Max: 24.563" Min: 48.25"/Max 48.563")	DF	
Emergency Battery Pack*	EM	
Earthquake Clip	EQ	
HLR/GLR Fuse	FU	
Flex Whip*	FW	
Include 3000K Lamp	L830	
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
Separate Circuit*	SC	
Master Satellite*	MS	
Tandem Wiring*	TW	
Lutron™ Sensor Feed* (EcoSystem ballast required)	SF	
finish		WH
Matte Satin White	WH	

* for more information see Reference section.

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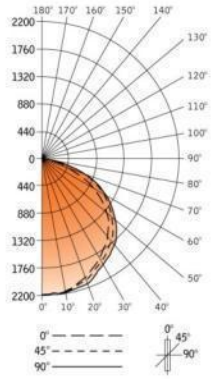
recessed

luna® 2x4

Filename: FLU242T8PS.IES
Catalog #: FLU-24-B-2-T8-E-120-G-PS-WH
Efficiency: 72%
Test #: 11161.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1510	1510	1510	1510	1510	
5°	1503	1503	1505	1511	1510	144
15°	1493	1497	1506	1524	1524	428
25°	1332	1340	1369	1402	1412	635
35°	1132	1150	1198	1257	1273	755
45°	907	941	1023	1094	1122	789
55°	6635	687	781	856	874	691
65°	386	449	531	555	560	498
75°	187	228	221	254	260	245
85°	35	39	45	48	48	47
90°	3	4	4	4	4	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	

Spacing 1.2
Criterion: 1.3

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	1206	20.4	28.5
	0°-40°	1934	33.2	46.4
	0°-60°	3440	58.3	81.3
	0°-90°	4231	71.7	100.0
Total Luminaire	0°-180°	4231	71.7	100.0

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	1825	2059	2258
55°	1575	1937	2168
65°	1300	1788	1885
75°	1028	1215	1429
85°	571	735	784

CO-EFFICIENTS OF UTILIZATION

Floor		80				70			20		50		30		10		00
Ceiling									50								
Wall	70	50	30	10		70	50	10	50	10	50	10	50	10	50	10	00
RCR 0	85	85	85	85		83	83	83	80	80	76	76	73	73			72
1	79	76	73	71		77	74	69	71	67	68	65	66	63			62
2	72	67	63	59		71	66	58	63	57	61	56	59	54			53
3	67	60	54	50		65	58	49	56	49	54	48	53	47			45
4	61	53	47	43		59	52	42	50	42	49	41	47	41			39
5	56	47	41	36		54	46	36	45	36	43	35	42	35			33
6	51	42	36	31		50	41	31	40	31	39	31	38	30			29
7	47	38	32	27		46	37	27	36	27	35	27	34	27			25
8	43	34	28	24		42	33	24	32	23	31	23	31	23			22
9	40	30	24	20		39	30	20	29	20	28	20	27	20			19
10	37	28	22	18		36	27	18	26	18	26	18	25	18			16

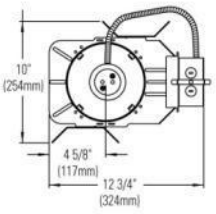
Numbers indicate percentage values of

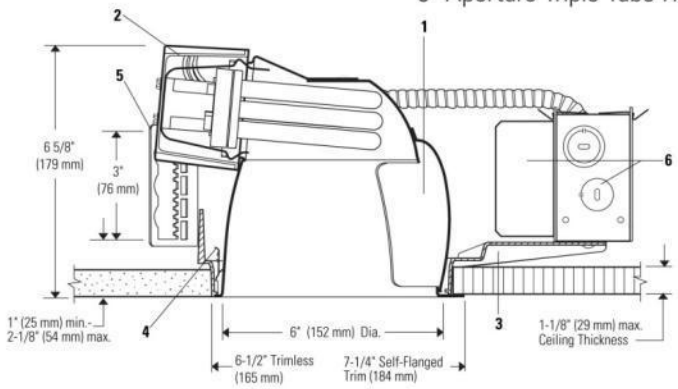
Go to www.focalpointlights.com for additional photometric data.

Type:	F6
Location:	Conference Room, Lounge
Mfr/Catalogue #:	Lightolier - 8081 CLW
Description:	6" Recessed compact fluorescent wallwasher.
Lamping:	1-CFTR 26W
Optics:	Anodized aluminum parabolic reflector
Dimensions:	13.625" length, 11.125" width, 6.625" height
Housing:	Galvanized steel
Electrical:	Integral electronic 120V/277V ballast
Voltage:	277 Volts
Labels:	IBEW, UL listed Damp Location. Suitable for Damp environments.

LIGHTOLIER® Calculite® CFL Open Wall Washer 8081

6" Aperture Triple Tube Horizontal Lamp





Reflector Trim

8081CLW	Clear Iridescence Free, White Flange
8081CLP	Clear Iridescence Free, Polished Flange
8081CL	Clear Iridescence Free, Molded Trim Ring
8081 ☐	Add suffix. See options for other finishes

Frame-In Kit

S6132BU 6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)

Dimming Options:

S6132B ☐

CU3	Lightolier PowerSpec 3% Dimming (120/277V)	**J1LD3**	Lutron 3% Dimming (120V)
J2LD3	Lutron 3% Dimming (277V)	**JUM7**	Mark 7 Dimming (120/277V)
J1MX	Mark 10 Dimming (120V)	**J2MX**	Mark 10 Dimming (277V)

Other dimming product available, please consult factory

Remodeler Frame-In Kits

6126BURM	6" aperture, 1 lamp 26W Triple Tube CFL (120/277V) 4-Pin (Amalgam)
6132BURM	6" aperture, 1 lamp 26/32W Triple Tube CFL (120/277V) 4-Pin (Amalgam)

Features

1. **Downlight Wall Washer Reflector:** 16 ga. Alzak® aluminum, 55° lamp cutoff to lamp and lamp image. Provides vertical surface wall wash and downlighting. Iridescence Free finish. Self-flanged or flangeless with molded white trim ring (field paintable).
2. **Socket Cup:** Effectively dissipates heat and positions lamp holder. Snaps onto reflector neck to assure consistently correct optical alignment without tools.
3. **Mounting Frame:** Galvanized steel for dry or plaster ceilings. Accepts other 6" Triple Tube reflectors (see S6132BU Spec Sheet).
4. **Retaining Springs:** Precision-tooled steel friction springs secure reflector to mounting frame for quick, tool-less installation.
5. **Mounting Brackets:** 16 ga. steel. Adjust from inside of fixture. Use 3/4" or 1 1/2" lathing channel, 1/2" EMT, or optional mounting bars.
6. **Ballast/J-Box:** Electronic 120V-277V. UL listed for through branch circuit wiring with max of (8) No. 12AWG, 90°c supply conductors. Outboard mounted to reduce heat transfer and maintain lamp efficacy and life. Service from below without tools.

Electrical

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

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

Options and Accessories

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

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

Options and Accessories (continued)

Emergency	Add suffix **EM***
Chicago Plenum	Use 6132BULC
Existing/Thk. Ceiling	**FA EC6***
Emergency Ltg. Kit	**FA EM3E***
	FA EM4E*
Fuse (Slow Blow)	Add suffix **F**

*See Spec. Sheets: FAEC, FAEM

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

Labels

UL listed for damp locations.

Job Information **Type:**

Job Name:

Cat. No.:

Lamp(s):

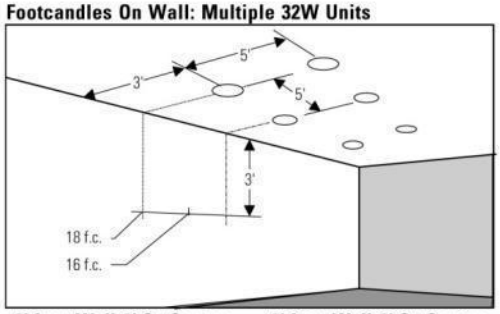
Notes:

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Lightolier is a Philips group brand

PHILIPS

Footcandles On Wall: Multiple 32W Units



EXAMPLE: With multiple clear reflector units located 3' from wall and spaced 5' on center (matching downlights 5' on center), the illumination on the wall 3' down from ceiling will be 18 f.c. beneath units and 16 f.c. between units.

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

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

2' from Wall-2' On Center

Distance From Ceiling in Feet	2'		2'
1	48	46	48
2	68	62	68
3	50	51	50
4	37	37	37
5	27	28	27
6	21	21	21
7	16	16	16
8	13	13	13
9	11	11	11

2' from Wall-3' On Center

Distance From Ceiling in Feet	3'		3'
1	38	26	38
2	42	42	42
3	34	35	34
4	25	26	25
5	20	20	20
6	15	16	15
7	13	13	13
8	11	11	10
9	9	9	9

2' from Wall-4' On Center

Distance From Ceiling in Feet	4'		4'
1	35	14	35
2	37	24	37
3	24	27	24
4	19	20	19
5	15	15	15
6	12	12	12
7	10	10	10
8	8	8	8
9	8	8	8

3' from Wall-3' On Center

Distance From Ceiling in Feet	3'		3'
1	16	15	16
2	25	24	25
3	27	29	17
4	25	26	25
5	21	22	21
6	18	18	18
7	15	15	15
8	13	13	13
9	11	11	11

3' from Wall-4' On Center

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

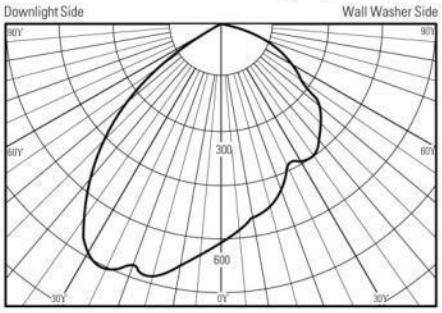
3' from Wall-5' On Center

Distance From Ceiling in Feet	5'		5'
1	12	7	12
2	10	12	10
3	18	16	18
4	15	16	15
5	13	14	13
6	11	11	11
7	9	10	9
8	8	8	8
9	7	7	7

3' from Wall-6' On Center

Distance From Ceiling in Feet	6'		6'
1	12	5	12
2	10	9	10
3	17	11	17
4	13	14	13
5	10	12	10
6	9	10	9
7	8	8	8
8	7	7	7
9	6	6	6

Candlepower Distribution



Down Light Spacing Ration 1.0

Coefficients Of Utilization

ROOM CAVITY RATIO	% EFFECTIVE CEILING CAVITY REFLECTANCE: 80			70			50			30			10			0
	% WALL REFLECTANCE: 50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.69	.68	.66	.68	.66	.65	.65	.64	.63	.63	.62	.61	.61	.60	.59	.58
2	.63	.60	.58	.62	.59	.57	.60	.58	.56	.58	.56	.54	.56	.55	.53	.52
3	.58	.54	.51	.57	.53	.50	.55	.52	.49	.53	.51	.49	.52	.50	.48	.47
4	.53	.48	.45	.52	.48	.45	.50	.47	.44	.49	.46	.44	.48	.45	.43	.42
5	.48	.43	.40	.47	.43	.40	.46	.42	.39	.45	.42	.39	.44	.41	.39	.38
6	.44	.39	.36	.43	.39	.35	.42	.38	.35	.41	.38	.35	.40	.37	.35	.34
7	.40	.35	.32	.39	.35	.31	.38	.34	.31	.37	.34	.31	.37	.33	.31	.30
8	.36	.31	.28	.35	.31	.28	.35	.31	.28	.34	.30	.28	.33	.30	.27	.26
9	.33	.28	.25	.32	.28	.25	.32	.27	.25	.31	.27	.24	.30	.27	.24	.23
10	.30	.25	.22	.29	.25	.22	.29	.25	.22	.28	.24	.22	.28	.24	.21	.20

20% FLOOR CAVITY REFLECTANCE
For 26W units multiply C.U. by 1.0.

Job Information **Type:**

631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710

Lightolier is a Philips group brand

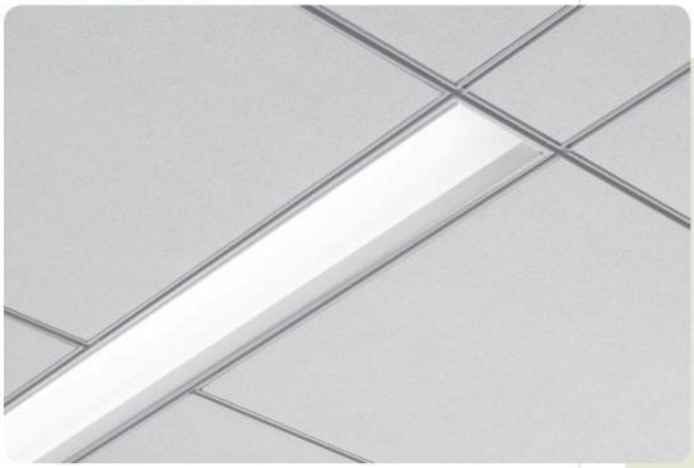
PHILIPS

Type:	F7
Location:	Conference Room
Mfr/Catalogue #:	Focal Point - FAV6-Fl-1T5HO-1C-277-D-G1-WH-4’
Description:	Recessed fluorescent troffer.
Lamping:	1-F28T5
Optics:	Flush lens
Dimensions:	48.000" length, 6.000" width, 5.500" height
Housing:	One piece 20 Ga steel
Electrical:	Integral electronic ballast
Voltage:	277 Volts
Labels:	CUL, UL. Suitable for Dry environments.

USG Logix | Armstrong® TechZone®

avenue® 6

FOCAL POINT®



FEATURES

Avenue® 6 is designed specifically for use with 6" wide USG Logix and Armstrong® TechZone® ceiling systems.

1 and 2 lamp energy efficient fluorescent T5/T5HO.

Shielding options include corrugated or solid regressed trim, flush lens or parabolic louver.

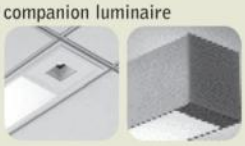
Avenue® 6 provides an integrated lighting solution that compliments the ceiling and entire space while providing comfortable general illumination.

shielding options

solid regress trim | flush lens | parabolic louver

microglow™ lens

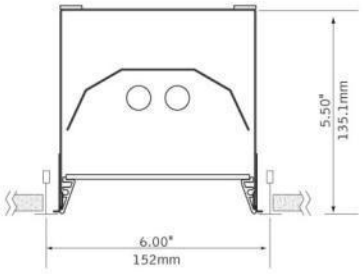
companion luminaire



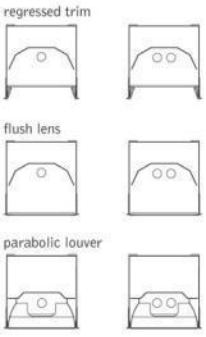
mr16 | favc & favd

april 2008

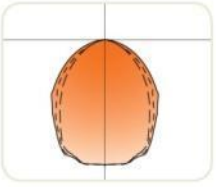
DIMENSIONAL DATA



lamping / shielding options



PERFORMANCE



1–Lamp T5HO
67% Efficiency
1392 cd @ 125°

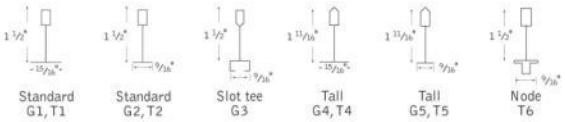
fixture type:

project name:

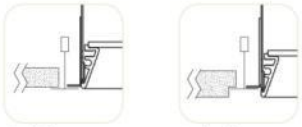
RECESSED

DETAILS

USG Logix® and Armstrong® TechZone® ceiling configurations



Standard G1, T1 | Standard G2, T2 | Slot tee G3 | Tall G4, T4 | Tall G5, T5 | Node T6



lay-in tile G1, G2, G4, G5 | tegular tile G3 & T1, T2, T4, T5, T6

Luminaire always rests at level of tile.

SPECIFICATIONS

construction
One-piece 20 Ga. steel housing
Corrugated and solid regress trim constructed of 6063-T5 extruded aluminum finished in Matte Satin White.
20 Ga. steel, universal flange rail finished in Matte Satin White.

4' unit weight: 15 lbs.
5' unit weight: 22 lbs.

optic
22 Ga. steel reflectors finished in High Reflectance White powder coat.
Acrylic lens diffuser .118" thick, frosted clear.
Parabolic louver: .75"H x 1.5" frequency fabricated of low iridescent, semi-specular premium grade aluminum.
Louver can be specified with matte white finish.

electrical
Luminaires are individually wired for specified circuits.
Thru-wiring not available.
Electronic ballasts are thermally protected and have a Class "P" rating.
Consult factory for dimming specifications and availability.
UL and cUL listed.

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

Armstrong and TechZone are trademarks of AWI Licensing Company.

ORDERING

luminaire series		FAV6
Avenue 6	FAV6	
shielding		_____
Corrugated Regressed Trim Frst.Lns	CR	
Solid Regressed Trim Frosted Lens	SR	
Flush Frosted Lens	FL	
Parabolic Louver	PL	
White Painted Parabolic Louver	PW	
Corrugated Regressed Trim with MicroGlow™ Lens	CRM	
Solid Regressed Trim MicroGlow™ Lens	SRM	
Flush MicroGlow™ Lens	FLM	
lamping		_____
One Lamp T5	1T5	
One Lamp T5HO	1T5HO	
Two Lamp T5	2T5	
Two Lamp T5HO	2T5HO	
circuits		_____
Single Circuit	1C	
Dual Circuit	2C	
voltage		_____
120 Volt	120	
277 Volt	277	
347 Volt (Consult factory for availability)	347	
ballast		_____
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
ceiling configurations (Use only with 6" USG Logix® and Armstrong® TechZone® ceiling systems NOTE: For other ceiling systems consult factory)		_____
Std. 15/16" Lay-in	G1	
Std. 15/16" Tegular	T1	
Std. 9/16" Lay-in	G2	
Std. 9/16" Tegular	T2	
9/16" Slot-tee Tegular	G3	
Tall 15/16" Lay-in	G4	
Tall 15/16" Tegular	T4	
Tall 9/16" Lay-in	G5	
Tall 9/16" Tegular	T5	
Node 9/16" Tegular	T6	
factory options		
Chicago Plenum	CP	_____
Emergency Circuit*	EC	_____
Emergency Battery Pack* (4' Luminaires Only)	EM	
HLR/GLR Fuse	FU	_____
Include 3000K Lamp	L830	_____
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
finish		WH
Matte White Housing & Trim Plate	WH	
luminaire length		_____
4' Nominal Housing	4'	
5' Nominal Housing (Dimming not available with 5' lamps)	5'	

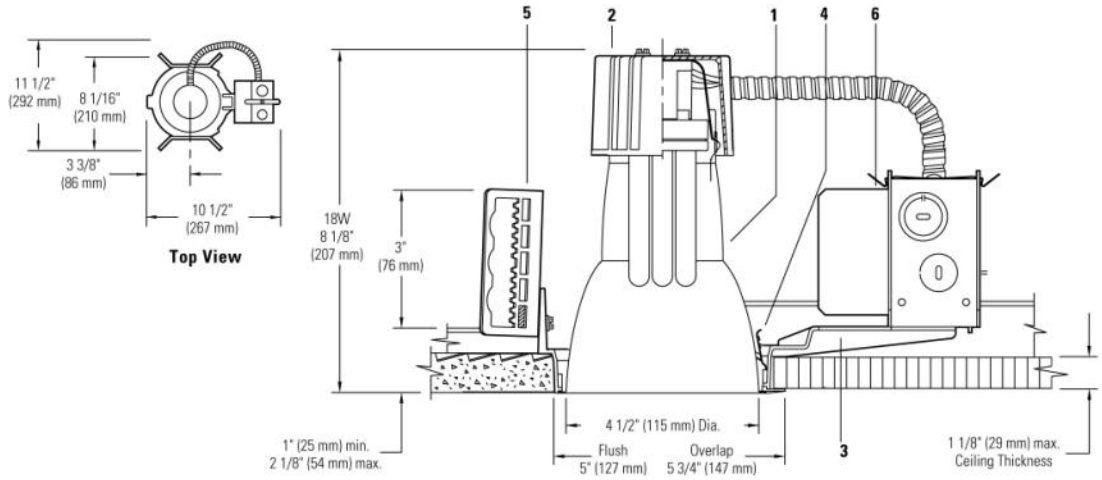
*For more information see the Reference section.

Focal Point L.L.C. 4201 South Pulaski Rd, Chicago, Illinois 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com

Type:	F8
Location:	Conference Room
Mfr/Catalogue #:	Lightolier – 8011 CCLW
Description:	4" Recessed compact fluorescent downlight. Spec-grade commercial
Lamping:	1-CFTR 18W
Optics:	Anodized aluminum parabolic reflector
Dimensions:	11.500" length, 10.500" width, 8.125" height
Housing:	Die cast aluminum
Electrical:	Integral electronic 120V/277V ballast
Voltage:	277 Volts
Labels:	IBEW, UL listed Damp Location. Suitable for Damp environments.

Calculite® Compact Fluorescent Open Downlight **8011**

4 1/2" Aperture Triple Tube Vertical Lamp



Ceiling Cutout: 5 1/16" (129 mm) Dia.

Reflector Trim		Frame-In Kit		Lamp
8011CCLW	Comfort Clear™, White Flange	**4118VU**	Electronic 120V - 277V	**18W Triple Tube**
8011CCLP	Comfort Clear™, Polished Flange			4-Pin (Amalgam)
8011CCL	Comfort Clear™, Molded Trim Ring			
8011 ☐	Add suffix. See options for other finishes.			

Features

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

Electrical

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

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

Options and Accessories

Comfort Clear™ Finishes[1]

Diffuse	**CCD**
Champagne Bronze	**CCZ**

Other Finish

White	**WH**

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

Options and Accessories (continued)

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

*See Spec. Sheet: FAEM

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

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

Labels

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

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

Job Information **Type:**

Job Name:

Cat. No.:

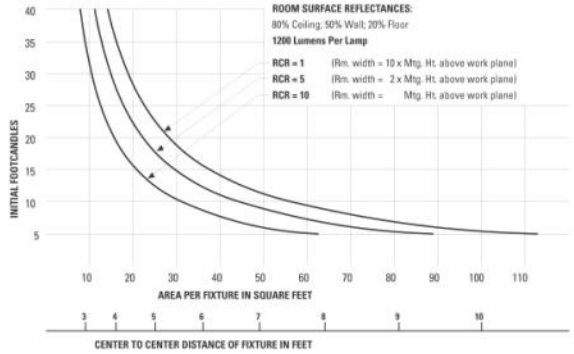
Lamp(s):

Notes:

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

LIGHTOLIER®

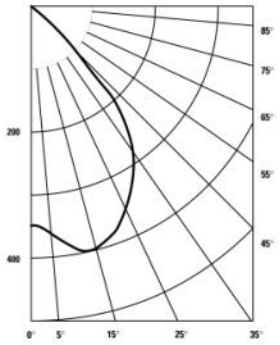
Quick Calculator



This quick calculator chart determines the number and spacing of 1 lt.-18W PL-T units with clear reflector, for any level of illumination.

Spacing Ratio = 1.2

CERTIFIED TEST REPORT NO. 0662FR
COMPUTED BY LSI PROGRAM **TEST-LITE**
CALCULITE RECESSED COMPACT FLUORESCENT OPEN DOWNLIGHT,
4 1/2" DIA. APERTURE CLEAR REFLECTOR
1-18W PLT LAMP. LUMEN RATING = 1200 LMS.



**** Efficiency = 42.38% ****

CANDLEPOWER SUMMARY

ANGLE	MEAN CP	LUMENS
0	350	
5	368	35
10	394	
15	394	110
20	374	
25	343	158
30	305	
35	254	155
40	171	
45	36	48
50	5	
55	1	2
60	0	
65	0	0
70	0	
75	0	0
80	0	
85	0	0
90	0	

ZONAL LUMENS AND PERCENTAGES

ZONE	LUMENS	% LAMP	%LUMINAIRE
0-30	303	25.30	59.81
0-40	458	38.18	90.25
0-60	507	42.30	100.00
0-90	507	42.30	100.00
40-90	49	4.13	9.75
60-90	0	.00	.00
90-180	0	.00	.00
0-180	507	42.30	100.00

Coefficients of Utilization

ZONAL CAVITY METHOD
EFFECTIVE FLOOR CAVITY REFLECTANCE = .20

CC WALL	80			70			50			30			10			
RCR	50	30	10	50	30	10	50	30	10	50	30	10	50	30	10	0
1	.47	.46	.46	.47	.46	.45	.45	.44	.43	.43	.43	.42	.42	.41	.41	.40
2	.44	.43	.42	.44	.42	.41	.42	.41	.40	.41	.40	.39	.40	.39	.39	.38
3	.42	.40	.38	.41	.39	.38	.40	.39	.37	.39	.38	.37	.38	.37	.36	.36
4	.39	.37	.36	.39	.37	.35	.38	.36	.35	.37	.36	.35	.36	.35	.34	.33
5	.37	.34	.33	.36	.34	.33	.36	.34	.32	.35	.33	.32	.34	.33	.32	.31
6	.35	.32	.31	.34	.32	.30	.34	.32	.30	.33	.31	.30	.33	.31	.30	.29
7	.32	.30	.28	.32	.30	.28	.32	.29	.28	.31	.29	.28	.31	.29	.28	.27
8	.30	.28	.26	.30	.28	.26	.30	.27	.26	.29	.27	.26	.29	.27	.26	.25
9	.28	.26	.24	.28	.26	.24	.28	.25	.24	.27	.25	.24	.27	.25	.24	.23
10	.26	.24	.22	.26	.24	.22	.26	.24	.22	.25	.23	.22	.25	.23	.22	.21

Job Information **Type:**

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

LIGHTOLIER®

Type:	F9
Location:	Cafeteria Serving Space
Mfr/Catalogue #:	Delray Lighting - 2310-S-18-2-E
Description:	9" Suspended compact fluorescent downlight. Standard-grade commercial
Lamping:	1-CFTR 18W
Optics:	Frosted glass diffuser
Dimensions:	9.000" diameter, 13.500" height/depth
Housing:	Extruded aluminum
Electrical:	Integral electronic ballast
Voltage:	277 Volts
Labels:	UL listed Damp Location. Suitable for Dry, Damp environments.

ASPECT REFLECTOR WITH OPAL GLASS LUMINAIRE

DELRAY LIGHTING INCORPORATED

2318 & 2328

TYPE: **PROJECT:**

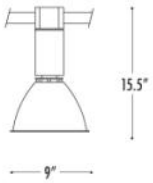
ORDER NUMBER:

2310	S	18	2	E
Model#	**Paint Finish**	**Wattage**	**Voltage**	**Ballast**
	Hammertone **S**ilver **W**hite **CC**–Custom RAL color Specify	**18**, **26** or **75**	**1**–120V **2**–277V	**E**–Electronic Dimming only for items marked ♦. Choose **D1**, **D3**, **D4**, **D5** or **D8**. (See Back Page)
Example:				
2322	W	32	1	E

ARMATURE

Suspends from cable or rod, constructed of extruded aluminum, and is securely fastened to cast wire way top. Ballast fits inside extruded cylinder attached to lamp holder for pulldown access. U.L. listed for damp locations.

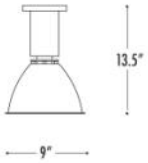
2310 Incandescent
2320 Fluorescent



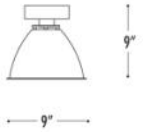
SURFACE MOUNT

Steel canopy mounts to all recessed J-boxes. Ballast fits inside extruded cylinder **2321** or horizontally in flat canopy **2325** . Specify **EM** for emergency battery pack, available on **2321** only. The 650 lumen battery pack adds 9¾" to canopy height, 13¾" with the 1300 lumen unit. U.L. listed for damp locations.

2311 Incandescent
2321 Fluorescent



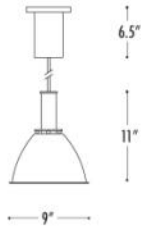
2315 Incandescent
2325♦ Fluorescent



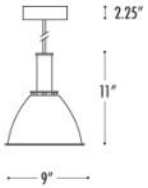
PENDANT MOUNT

Canopies mount to standard J-box. Ballast fits inside extruded cylinder **2322** or horizontally in flat canopy **2327**. Pendant is 6′ standard or can be specified in any length with 12′ max for CFL. Specify **EM** for emergency battery pack, available on **2322** only. The 650 lumen battery pack adds 9¾" to canopy height, 13¾" with the 1300 lumen unit. U.L. listed for damp locations.

2312 Incandescent
2322 Fluorescent



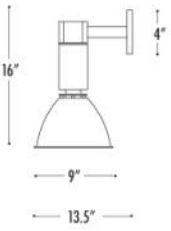
2317 Incandescent
2327♦ Fluorescent



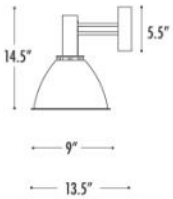
WALL MOUNT

4" square by 3/16" thick aluminum wall plate mounts to 3" mud ring on 2¾" vertical, centered holes. Fixture connects to extruded aluminum arm, which is securely fastened to cast wire way top. Ballast fits inside extruded cylinder **2323** or horizontally in flat canopy **2324** . U.L. listed for damp locations.

2313 Incandescent
2323 Fluorescent



2314 Incandescent
2324♦ Fluorescent



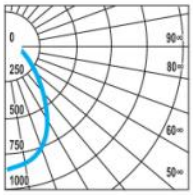
BURBANK,
CALIFORNIA,
91505
WWW.
DELRAY
LIGHTING.
COM

JULY 2008

FLUORESCENT

1-18W PLT

CP DISTRIBUTION



COEFFICIENTS OF UTILIZATION

% CEILING 80	(20% FLOOR)		
% WALL 70		50	30
0	73	62	55
1	70	60	52
2	68	57	51
3	66	55	49
4	64	53	47
5	62	51	45
6	59	49	43
7	57	46	41
8	55	42	39
9	53	41	37
10	51	39	35

NOTES

232218
1-18W triple tube
G24q-3 electronic socket
Total lumens: 1250
Spacing criteria: 1.0

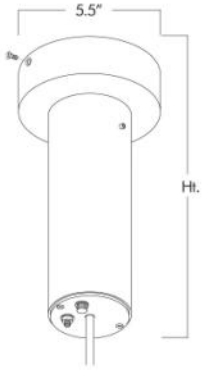
BALLAST INFO

DIMMING

- Dimming only available for items marked ♦ on page 1.
- Voltage *must* be specified.
- Controls lumen output down to ±5%.
- Compatible dimmers required for all ballasts.
- **D1** Lutron Compact SE for 26W lamp.
- **D3** Advance Mark X for 18 or 26W lamp.
- **D4** Lutron Tu-Wire for 26W lamp. 120V *only*.
- **D5** Advance Mark VII for 26W lamp.
- **D8** Lutron Hi-Lume 1% for 26W lamp. Controls lumen output down to ±1%.

EMERGENCY

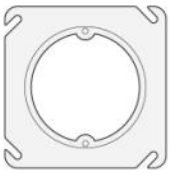
- Voltage *must* be specified.
- **EM** emergency power provides 650 lumens for one lamp for 90 minutes. Ht.=15.25"
- **EM13** emergency power provides 1300 lumens for one lamp for 90 minutes. Ht.=18.75"



WALL MOUNTING

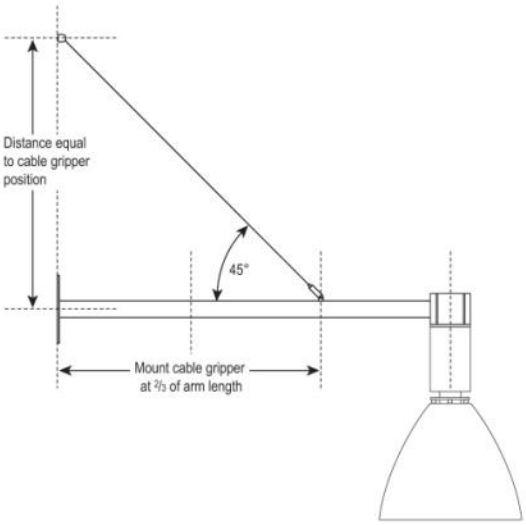
WALL PREPARATION

- For models 2313 and 2323.
- Mount holes must be aligned vertical center, as shown:



2329 ARM EXTENSION

- Specify arm length, up to 36" maximum.
  Example: **2329X** (X=length)
- Aircraft cable, grip locks and mounting hardware included.



JULY 2008

Type:	F10
Location:	Cafeteria Serving Space
Mfr/Catalogue #:	Winona Lighting - LED-POPS01-6-ARC-M-001-ND12V-BAL-X-STD
Description:	Suspended LED chandelier.
Lamping:	LED
Optics:	No optics
Dimensions:	2.000" diameter, 8.000" height/depth
Housing:	Aluminum, powder coat paint
Electrical:	Integral transformer
Voltage:	12 V
Labels:	UL listed Dry Location, UL listed Wet Location. Suitable for Dry, Wet environments.

winonaLED

POPS01 Single Pendant

Type:

Ref #:

Project Name:

Qty:

POPS01 Single Pendant is a surface mounted pendant using one LED. Eight LED colors are available in both normal and high output configurations.

Construction: All aluminum construction with galvanized steel backplate and stainless steel hardware.

Acrylic Diffuser: Twenty standard diffusers, each in three sizes, can be used with this luminaire. Machined solid acrylic diffuser is naturally UV stable. Custom shapes available - consult factory.

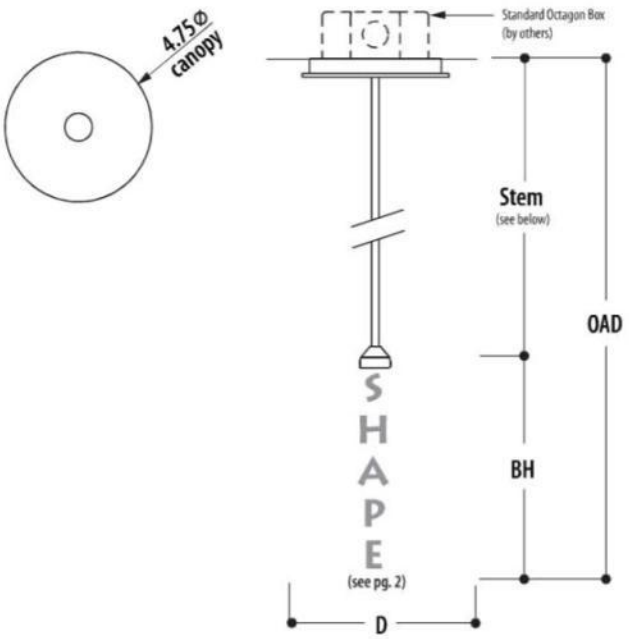
Mounting: Luminaire is mounted to standard 4" octagon junction box (supplied by others) with hidden fasteners.

Integral Driver: Integral non-dimming drivers available for 90-250V AC and 12V AC. Dimmable driver 12V-40V DC only.

Dimming: True 0-100% dimming is available with exclusive LightLink dimming system interface which is compatible with both 0V-10V sink and source-type dimmers.

Power Consumption: Luminaire consumes maximum of 4W depending on LED color.

UL Listed: Dry Location, Wet Location optional



UL LISTED

Note!
This luminaire can use any shape and any size of our standard acrylic diffusers. Refer to SHAPES page for acrylic dimensions to determine Body Height (BH) , Diameter (D), and Overall Drop (OAD).

LED	–	POPS01	–	6	–	ARC	–	M	–	001	–	ND12V	–	BAL	–	X	–	STD
SOURCE		MOUNT		STEM LENGTH		DIFFUSER SHAPE		DIFFUSER SIZE		LED CODE		VOLTAGE		FINISH		OPTIONS		SPECIAL

MOUNT:
POPS01 = SINGLE PENDANT

STEM LENGTH:
3 = 3 INCH
6 = 6 INCH
9 = 9 INCH

DIFFUSER SHAPE:
SPH = SPHERE
CYL = CYLINDER
CAT = CATTAIL
WED = WEDGE
TIK = TIKI
CLA = CLASSICAL
HOU = HOURGLASS
ALA = A-LAMP
CHA = CHARDONNAY
BEE = BEEHIVE
RIB = RIBBED
ARR = ARROW
ARC = ARC
FLU = FLUTE
VAS = VASE
DRO = DROP
SPI = SPIKE
DIS = DISCUS
PUC = PUCK
EDG = EDGE
CUS = CUSTOM (consult factory)

SIZE:
S = SMALL
M = MEDIUM
L = LARGE

CODE	COLOR	OUTPUT
001	WARM WHITE 30K	NORMAL
001/HO	WARM WHITE 30K	HIGH
002	COOL WHITE 62K	NORMAL
002/HO	COOL WHITE 62K	HIGH
003	AMBER	NORMAL
003/HO	AMBER	HIGH
004	BLUE	NORMAL
004/HO	BLUE	HIGH
005	CYAN	NORMAL
005/HO	CYAN	HIGH
006	GREEN	NORMAL
006/HO	GREEN	HIGH
007	RED-ORANGE	NORMAL
007/HO	RED-ORANGE	HIGH
008	RED	NORMAL
008/HO	RED	HIGH

*IES report available for normal & high output. (See website)

VOLTAGE:
Non-Dimming
ND120V = 90V-250VAC
ND12V = 12VAC
Dimming
DM24V = 12V-40VDC*
*LightLink dimming system interface maximum fifty luminaires per LightLink, one LightLink per dimming zone.

FINISH:
BAL = BRUSHED ALUMINUM
BBP = BRUSHED BRASS PAINT
CPF = CUSTOM PAINTED FINISH
LBPS = LIGHT BRONZE PAINT SMOOTH
LSP = LIGHT SILVER PAINT
PGP = PALE GOLD PAINT
SGB = SEMI-GLOSS BLACK
SGW = SEMI-GLOSS WHITE

OPTIONS:
X = NO OPTIONS
WL = WET LOCATION

SPECIAL:
STD = STANDARD
MOD = MODIFIED

MODIFICATIONS:
Please use this space to list any modifications.

Revised: 2/28/08

winona lighting | Winona Lighting | 3760 West Fourth Street | Winona, MN 55987 | 800-328-5291 | www.winonalighting.com

winonaLED

POPS! WIRING

All POPS! models are available with Dimming and Non-Dimming internal drivers. Non-Dimming drivers accept 90V-264V AC (ND120V code) and 11-15V AC (ND12V code). All Dimming drivers require require low voltage DC power supply to operate. Size and model of the power supply will vary according to size of installation and other requirements.

Do not connect line voltage to Dimming drivers! **Do not make live connections!**

NON-DIMMING INSTALLATIONS

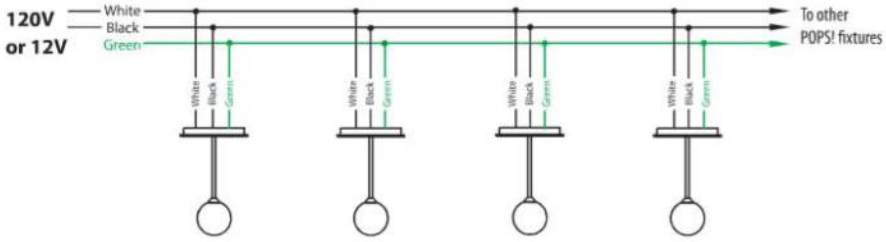
Non-dimming luminaires are supplied with an internal driver with either line voltage (90V-264V AC) or low voltage (12V AC) input. Verify you have the correct driver for your application and power supply before proceeding. Use the following diagram for either type.

Line Voltage Drivers:

1. Connect driver **WHITE** & **BLACK** to **120V** supply
2. Connect chassis **GREEN** wire to supply **GROUND**

Low Voltage Drivers:

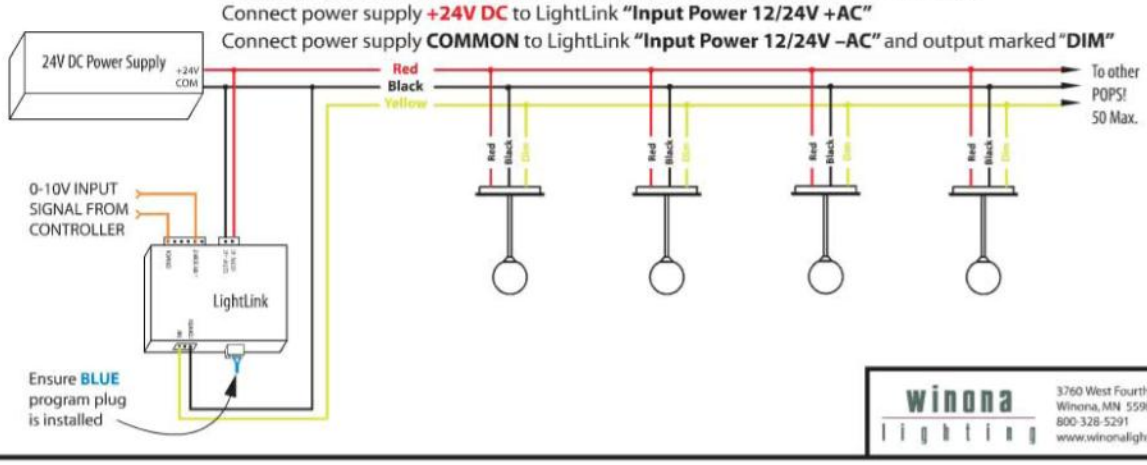
1. Connect driver GREY wires to **12V** supply
2. Connect chassis **GREEN** wire to electrcal box



DIMMING INSTALLATIONS

All dimming installations require the use of the LightLink dimming module which is spliced inline with the control signal output from the dimming control system. The LightLink module will accept any 0-10V dimming signal input (source or sink) from any dimming control system as well as PWM input and analog input from room sensors or other devices. Refer to LightLink documentation for detailed installation and operating instructions. Mount the LightLink module close to and feed it power from the same 24V DC power supply used for the POPS! luminaires. On installations requiring more than one transformer, a LightLink module must be used for each supply. Multiple LightLink modules may be connected to the same power supply. Use minimum of 12 gauge wire for remote power supply installations. **DO NOT MAKE LIVE CONNECTIONS!**

Connect STEP **RED** wire to power supply **+24V DC**
Connect STEP **BLACK** wire to power supply **COMMON**
Connect STEP **YELLOW** wire to LightLink Output marked **"DIM"**
Connect 1 to 10V Dimmer supply Wire to LightLink Control Input marked **"+10V Source"**
Connect 1 to 10V Dimmer common Wire to LightLink Control Input marked **"Common"**
Connect power supply **+24V DC** to LightLink **"Input Power 12/24V +AC"**
Connect power supply **COMMON** to LightLink **"Input Power 12/24V –AC"** and output marked **"DIM"**



winona lighting
3760 West Fourth Street
Winona, MN 55987
800-328-5291
www.winonalighting.com

Type:	F11
Location:	Cafeteria Serving Space, Lounge
Mfr/Catalogue #:	Mark Lighting - SPR-F-1T5HO-277-EB
Description:	5" Recessed fluorescent wallwasher.
Lamping:	1-T5HO 28W
Optics:	Acrylic lens
Dimensions:	Length varies, 5.250" width, 5.750" height
Housing:	Extruded aluminum housing
Electrical:	Integral electronic ballast
Voltage:	277 Volts
Labels:	IBEW, UL.

The SP Series

Product Features

- Shallow profile minimally penetrates ceiling.
- Available in semi-recessed or fully recessed versions.
- Extruded aluminum housing and fascia.
- Staggered lamps are standard.

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The SP Series

Specification Data

Housing: Housing and vertical fascias are extruded aluminum. Internal wiring trays are 20-gauge, cold-rolled steel.

Mounting: Recessed perimeter wall wash in 8-ft., 6-ft., 4-ft., 3-ft. and 2-ft. sections.

Shielding: Extruded matte white acrylic lens snaps into housing.

Corners: 90-degree inside or outside corners.

Housing finish: Standard finish: matte white.

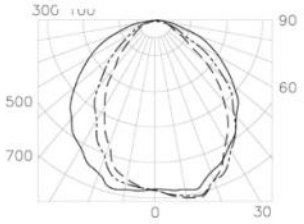
Lamps: Standard 6" stagger (1) or (2) T5, T5HO or (1) T8 (in cross section). Lamps provided by others.

Ballast: Electronic (limited to slim profile case size). Please specify voltage.

Certification: U.L. listed, I.B.E.W. (Local 3) Union made in the USA

Photometrics

Floor	20%								
Ceiling	80%			70%			50%		
Walls	70%	50%	30%	70%	50%	30%	50%	30%	10%
RCR 0	53	53	53	52	52	52	50	50	50
1	50	48	46	49	47	46	45	44	43
2	46	43	40	45	42	40	41	39	37
3	43	39	36	42	38	35	37	34	32
4	39	35	31	38	34	31	33	30	28
5	36	31	28	35	31	27	30	27	24
6	34	28	25	33	28	24	27	24	22
7	31	26	22	30	25	22	24	21	19
8	29	23	19	28	23	19	22	19	17
9	27	21	17	26	20	17	20	17	15
10	25	19	15	24	19	15	18	15	13



Catalog Number:
SP-1T8-EB-SW-120

Report Number:
BALL 13447

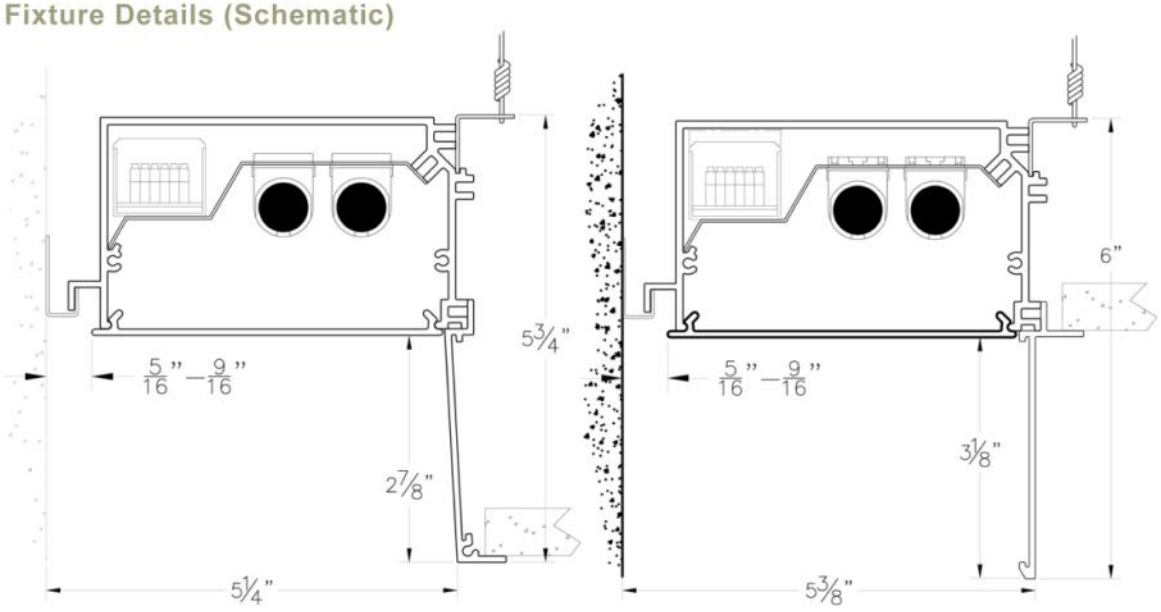
Lamps:
(1) T8 each rated 2950 lumens

Total Efficiency:
44.9%

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The SP Series

Fixture Details (Schematic)



3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The SP Series

Ordering Info

SPR	**Product Family** SPR - The Fully Recessed SP Series SPS - The Semi-Recessed SP Series	Provide wall to wall dimentions.	**Run Length** Provide wall to wall dimentions. - Provide field dimentions when placing order. For patterns, clearly indicate wall locations. Patterns are provided with corners. Upon request, factory will prepare installation drawings for approval.
F	**Ceiling Interface** G - Grid F - Flanged	1T5	**Wattage (consult factory for other lamps)** 1T5 - (1) T5 lamp 2T5 - (2) T5 lamps 1T5HO - (1) T5HO lamp 2T5HO - (2) T5HO lamps 1T8 - (1) T8 lamp
SW	**Lens** SW - Soft White Acrylic	277	**Voltage** 120 - 120V 277 - 277V
EB	**Ballast** EB - Electronic EDB - Electronic Dimming		**Options** EMPK - Emergency Battery Pack

Company Name _____

Project Name _____

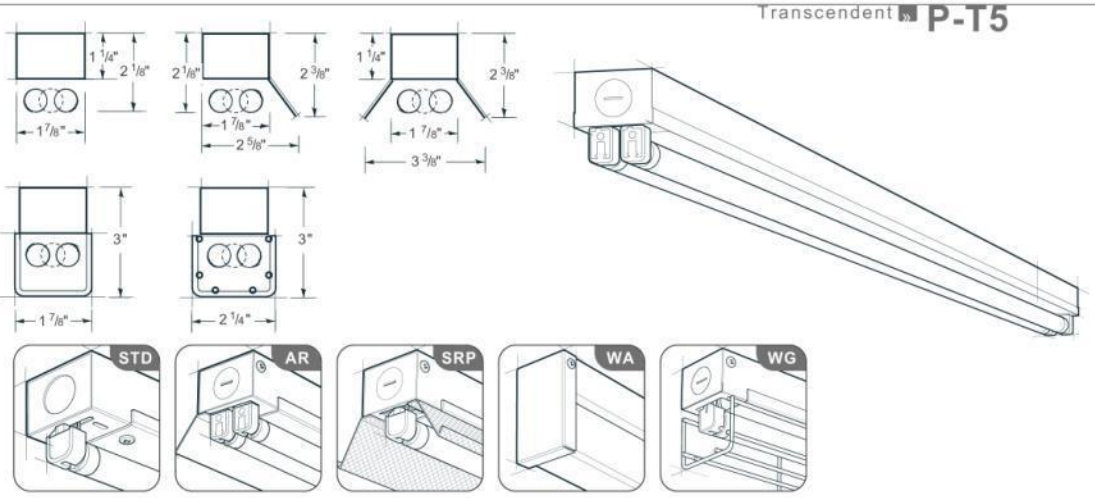
Fixture Type _____

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

Type:	F12
Location:	Dorm Room
Mfr/Catalogue #:	P-T5-STD-1T5-03-BWE-277
Description:	Surface-mounted fluorescent strip light, rigid housing.
Lamping:	1-F28T5
Optics:	No Optics
Dimensions:	36.000” length, 1.875" width, 2.125" height
Housing:	Die-formed steel
Electrical:	Integral electronic ballast
Voltage:	277 V
Labels:	IBEW, UL listed Damp Location. Suitable for Dry, Damp environments.

Type
Job Name
Catalog Number

Transcendent P-T5



ordering

series	body style	lamp rows	nominal length	color/finish	voltage	options
P-T5						
	STD standard	1T5	02'	BWE* white enamel	120	AL
	AR asymmetric reflector	2T5	03'	YGW† gloss white	277	EML*
	ARP asymmetric reflector perforated	1T5HO	04'	Y__ premium color	347*	EMH*
	SR symmetric reflector	2T5HO	06'	CC custom color	*T5HO only	DM
	SRP symmetric reflector perforated		08'	GLV galvanized		B__
	WA* white acrylic diffuser		R__*	*standard †standard on WA body style		FH
	WG wire guard		*row length			*consult factory for fixture lengths < 4'
	*T5 only					

Applications Concealed coves, small offices, retail, healthcare, schools, small profile spaces.

Features A compact T5/HO strip light with integral ballast in 1- or 2-lamp profiles. An optional white acrylic lens produces a sleek 2" x 3" lensed wrap. Options also include perforated or solid, symmetric and asymmetric reflectors, and a rugged, zinc-coated wire guard (natural finish). Dimming ballasts and emergency batteries are also available.

Construction The housing, available in 2-, 3-, 4-, 6- or 8-foot standard lengths, is made of die-formed, 20-gauge steel.

Finish The standard exterior body color is white enamel (BWE) or optional gloss white (YGW) using polyester powder paint. Refer to ordering matrix for optional metal finishes or refer to **Defining Section** for optional paint colors. White acrylic diffuser housing and optional reflectors are painted gloss white (YGW).

Electrical T5/HO fixtures have programmed-start electronic ballasts with less than 10% THD. Fixtures are U.L. Damp labeled (non-emergency) and I.B.E.W. manufactured. Maximum ballast size available: 1 5/8" width x 1 1/4" height.

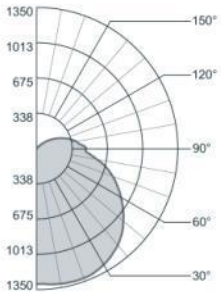
Mounting Fixture is to be surface-mounted.

Options **AL:** aluminum body; **EML:** emergency battery (T5/HO=700 lumens); **EMH:** emergency battery (T5/HO=1200 lumens); **DM:** dimming (consult factory); **B_:** specific ballast, specify manufacturer and catalog number (consult factory); **FH:** fixture fusing (slow blow).

photometric data

P-T5-AR-2T5HO-04-YGW

Report # LSI15308 D=93.6% I=6.4%
Lamp Lumens: 4500 Input Watts: 118



Candlepower Summary

Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Output Lumens
0	1305	1305	1305	1305	1305	
5	1310	1313	1311	1313	1313	64
15	1267	1286	1302	1322	1329	184
25	1181	1219	1262	1311	1322	291
35	1055	1119	1185	1251	1266	368
45	895	979	1061	1151	1172	407
55	704	810	910	1009	1029	401
65	493	610	730	844	874	355
75	265	407	546	682	708	279
85	50	212	346	488	512	184
90	0	127	304	433	483	
95	0	91	264	382	439	131
105	0	36	187	294	350	91
115	0	2	109	194	246	53
125	0	0	40	102	139	24
135	0	0	3	22	49	6
145	0	0	0	0	3	0
155	0	0	0	0	0	0
165	0	0	0	0	0	0
175	0	0	0	0	0	0
180	0	0	0	0	0	

Zonal Lumen Summary

Zone	% Lamp	% Luminaire
0-90	85.21	93.58
90-180	5.84	6.42

Efficiency = 91.1%

Luminance Summary (cd/m²)

Angle	0°	45°	90°
45	15014	14375	14798
55	14559	14122	14358
65	13837	13511	14245
75	12145	13316	14380
85	6805	12230	13650

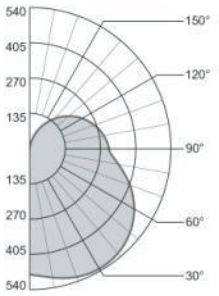
Coefficients of Utilization (%)

Floor	effective floor cavity reflectance = .20									
Ceiling	80				70				50	
Wall	70	50	30	10	70	50	30	10	50	30	10
RCR 0	107	107	107	107	104	104	104	104	98	98	98
1	97	93	89	85	94	90	86	83	85	82	79
2	88	81	74	69	85	78	72	68	74	69	65
3	80	71	63	57	78	69	62	56	65	60	55
4	74	63	54	48	71	61	54	48	58	51	46
5	67	55	47	40	64	54	46	40	51	44	39
6	61	49	41	35	59	48	40	34	45	39	34
7	56	44	36	30	55	43	35	30	41	34	29
8	52	39	31	26	50	38	31	25	37	30	25
9	48	35	27	22	46	34	27	22	33	26	22
10	44	32	24	20	43	31	24	19	30	23	19

photometric data

P-T5-WA-2T5-04-YGW

Report # LSI15304 D=74.4% I=25.6%
Spacing Criteria: Along 1.3; Across 1.6
Lamp Lumens: 2610 Input Watts: 58



Candlepower Summary

Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Output Lumens
0	483	483	483	483	483	
5	481	484	487	491	491	47
15	464	479	495	510	514	140
25	432	461	496	522	530	226
35	386	431	483	519	531	296
45	326	386	455	500	516	340
55	255	329	412	466	484	352
65	175	262	356	417	438	332
75	87	188	289	358	377	282
85	12	120	226	297	318	223
90	0	101	208	280	304	
95	0	92	198	272	298	194
105	0	83	183	251	277	173
115	0	71	163	225	249	144
125	0	59	138	195	213	111
135	0	44	109	155	172	76
145	0	28	78	111	127	45
155	0	14	47	71	81	20
165	0	4	17	30	35	5
175	0	0	1	1	2	0
180	0	0	0	0	0	

Zonal Lumen Summary

Zone	% Lamp	% Luminaire
0-90	42.86	74.40
90-180	14.75	25.60

Efficiency = 57.6%

Luminance Summary (cd/m²)

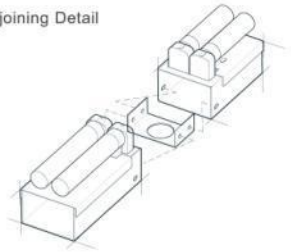
Angle	0°	45°	90°
45	7920	7248	7185
55	7642	7046	7026
65	7121	6797	6846
75	5801	6437	6617
85	2379	6316	6575

Coefficients of Utilization (%)

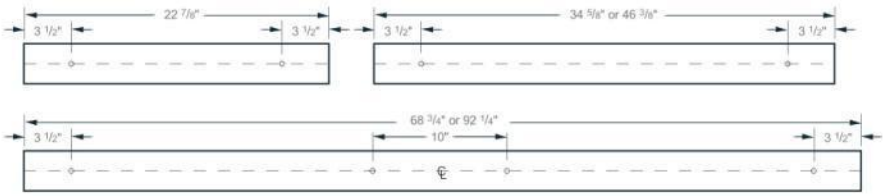
Floor	effective floor cavity reflectance = .20									
Ceiling	80				70				50	
Wall	70	50	30	10	70	50	30	10	50	30	10
RCR 0	65	65	65	65	62	62	62	62	56	56	56
1	58	55	52	49	55	52	49	47	47	45	43
2	52	47	42	39	49	44	40	37	40	37	34
3	47	41	36	32	44	39	34	30	35	31	28
4	43	36	30	26	40	34	29	25	31	26	23
5	39	31	26	22	37	30	25	21	27	23	19
6	36	28	22	19	34	26	21	18	24	20	17
7	33	25	20	16	31	24	19	15	21	17	14
8	30	22	17	14	28	21	16	13	19	15	12
9	28	20	15	12	26	19	14	11	17	13	10
10	26	18	13	10	24	17	13	10	16	12	09

installation

Adjoining Detail



Mounting Locations



In an effort to continually provide the highest quality products, Prudential reserves the right to change design specifications and/or materials, without notice.

0505 Prudential Lighting 1737 E. 22nd St. Los Angeles, CA 90058 phone 213.746.0360 fax 213.741.8590 www.prulite.com

Type:	F13
Location:	Roof Deck
Mfr/Catalogue #:	Cooper – Lumiere - 1235-RD-M-4LED-120/12-BK
Description:	Recessed compact fluorescent step light. Spec-grade residential, Spec-grade commercial
Lamping:	1-CFTR 13W
Optics:	Diffuser
Dimensions:	7.750" diameter, 4.500" width, 7.750" height
Housing:	Aluminum, powder coat paint
Electrical:	Integral electronic ballast
Voltage:	277 Volts
Labels:	CUL listed Wet Location, IBEW, UL listed Wet Location. Suitable for Dry, IC, Wet, Damp environments.

LUMIÈRE®

DESCRIPTION

Rio architectural step lights provide beauty, performance and durability. Transitional styling, low profile design and no visible fasteners provide seamless integration with architectural styles of all kinds. Logical, modular design elements facilitate fast and foolproof installation in all types of wall surfaces including drywall, concrete pour or brick/masonry. All models include IP68 rated outdoor protection, but are also suitable for indoor wall-mounted applications. All models are ADA compliant.

Catalog #		Type
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Back box and painted fascia are die-cast from corrosion-resistant Type 383 aluminum alloy. Back box is painted white. Natural metal fascia is precision-machined from solid brass or stainless steel.

B ... Finish
Back box and fascia are double protected by a chromate conversion undercoating and polyester powdercoat paint finish. Machined, natural finish brass or stainless steel fascia is unpainted to reveal the natural beauty of the material. Brass will patina naturally over time in outdoor environments.

C ... Electrical
Fixture includes integral, electronic ballast, transformer or LED driver mounted to Lumiere's factory-assembled POWER-TRAY(TM) optical/electrical module. The POWER-TRAY(TM) module plugs directly into the back box providing fast, easy installation.

D ... Mounting
Back box is available to ship in advance for rough-in purposes. Back box includes four (4) 3/4" conduit entry ports, concrete pour cover, UP arrow and two level vials to facilitate proper alignment. Fixture also includes the patent pending FASCIAlign(TM) fascia alignment system which provides rotation of the fascia +/- 10 degrees (total of 20 degrees), insuring proper alignment.

E ... Classification / Code Compliance
UL and cUL listed, standard wet label. IP68 rated. Also suitable for indoor recessed wall-mount applications, 4W LED source is IC-rated for direct insulation contact. Manufactured to ISO 9001-2000 Quality Systems Standard. IBEW union made.

F ... Lamp
Lamp for LED source included as standard. Lamps for other sources not included (available from Lumiere as an accessory - order separately).

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

Recessed Housing
Recessed housing is available to ship in advance of complete fixture for rough-in purposes. Specify option -LBB and order separately accompanying recessed housing from below:

1235-BB-C
5" back box and pour cover for concrete pour wall

1235-BB-D
5" back box and pour cover for drywall/frame construction wall

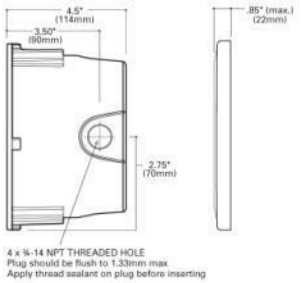
1235-BB-M
5" back box and pour cover for masonry wall

RIO
1235-RD
1235C-RD
1235E-RD
1235L-RD

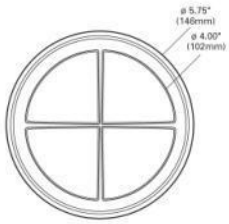
4W (max.) LED
20W (max.) T3 Halogen
Low Voltage

STEP LIGHT

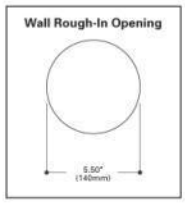
ADA IP68



1235-RD



1235C-RD



1235E-RD

1235L-RD

COOPER Lighting
www.cooperlighting.com

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

ADL060828
08/30/2006 3:22:40 PM

ORDERING INFORMATION

Sample Number: 1235C-RD-M-4LED-120/12-NSS

Model
- **1235-RD**: 5" round, open fascia w/ clear, diffused lens
- **1235C-RD**: 5" round, cross/guard fascia w/ clear, diffused lens
- **1235E-RD**: 5" round, eyelid fascia w/ clear, diffused lens
- **1235L-RD**: 5" round, louvered fascia w/ clear lens

Wall Type
- **C**: Concrete Pour
- **D**: Drywall
- **M**: Masonry

Source [1]

12V Halogen or LED
- **20T3**: 20W / T3 / G4
- **4LED**: 4W / LED (LED lamps included)[2]

Volts

12V Halogen
- **120/12**: 120/12V electronic transformer
- **277/12**: 277/12V electronic transformer

LED
- **120/12**: 120V electronic LED driver

Finish

Painted
- **BK**: black
- **BZ**: bronze
- **CS**: city silver
- **VE**: verde
- **WT**: white

Metal
- **NBR**: brass
- **NSS**: stainless steel

Options
- **LBB**: Housing and Pour Cover Shipped in Advance (select LBB option and order recessed housing separately)

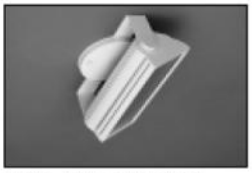
Recessed Housing (order separately)

Select housing from Recessed Housing section on previous page

Notes: 1 Unless noted otherwise, lamps not included.
2 4W LED source is IC-rated for direct insulation contact.

Type:	F14
Location:	Lounge
Mfr/Catalogue #:	Winona Lighting - P1-SS-CFQ26-277V-SS8-SGW-X-STD
Description:	12" surface-mounted compact fluorescent wallwasher.
Lamping:	1-CFQ 26W
Optics:	Anodized aluminum reflector
Dimensions:	12.000" length, 6.375" width, 5.500" height
Housing:	Extruded aluminum
Electrical:	Remote electronic ballast
Voltage:	277 V
Labels:	CUL listed Damp Location, UL listed Damp Location. Suitable for Dry, Damp environments.

Small Ceiling Mount



Profile - P1 (basic): Anodized, extruded aluminum specular reflector with solid aluminum endcaps and stainless steel hardware.

Type - Small profile with smooth or ribbed detail.
Indoor; non-gasketed, captive extruded alum. hinge for lens and baffle options.
Aperture; open aperture is standard for indoor fixtures.

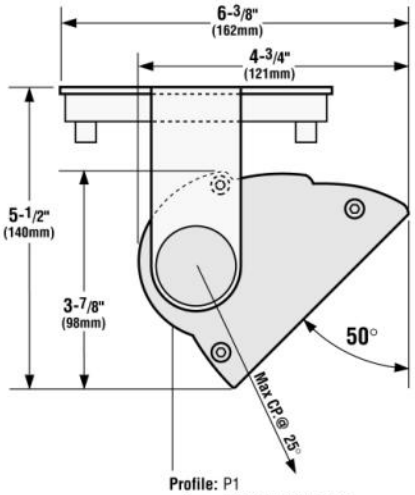
Mounting - Three standard mounts are fully adjustable and lockable. Designed for remote or integral ballast.

Performance - Asymmetric distribution provides a concentration of light on target surface for smooth illumination. Maximum candlepower aimed 25° above nadir has less than 5% spill light within the 0-25° zone and less than 2% spill light within the 90 - 180° zone.

Electrical - Electronic, HPF ballast, lamp protection circuit, Class P and thermally protected. Max distance from ballast to lamp: 15' (CFQ). Provide 90° C supply wire.

Finishes - An electrostatically applied wet paint system utilizes a multi-stage process to provide a durable acrylic enamel finish. Suitable for indoor and outdoor applications.

Options - For complete list and detailed descriptions, refer to Options Section.



Profile: P1
Type: SS, SR, SSW, SRW
Mount: SS8
Length: Refer to chart below
Scale: 3/8" = 1"

INDOOR

HOW TO SPECIFY

P1 – SS – CFQ26 – 277V – SS8 – SGW – X – STD

PROFILE

P1 (basic)

TYPE

Indoor Locations: (damp label)
SS: Small Smooth
SR: Small Ribbed

Outdoor Locations: Wet label (not available for CFQ lamp)

LAMPING - VOLTAGE

120V or 277V

Code	Description	Length	Weight
	Compact Fluorescent		
CFQ26	(1)CFQ26W/G24q	12"	6 lbs.
	Linear Fluorescent		
	- For single linear or continuous row applications see **Surface Linear Tab.**		

MOUNTING

Remote Ballast
SS8: Simple Yoke
SD8: Deco Yoke
SK8: Knuckle

Integral Ballast
SS9: Simple Yoke
SS10: Simple Yoke
SS12: Simple Yoke

FINISH

SGW: Semi-Gloss White
SGB: Semi-Gloss Black
ALP: Aluminum Paint (matte finish)
LGP: Light Gold Iridescent (gloss finish)
PBP: Pale Bronze Paint (gloss finish)
CPF: (MOD) Custom Painted Finish

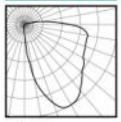
OPTIONS

X: No Options
SV: (P1 only) Short Visor
PB: Parabolic Blade Baffle (internal mount)
EM: (remote) Emergency Battery
SO: (MOD) Special Option

CLASS

STD: Indicate only when specifying a standard.
MOD: Indicate when specifying any modification.

PHOTOMETRY



CFQ26W
Refer to Technical Section for detailed Photometry Reports.
Report #9133

Winona Lighting • 3760 West Fourth Street • P.O. Box 1205 • Winona, MN 55987-7205
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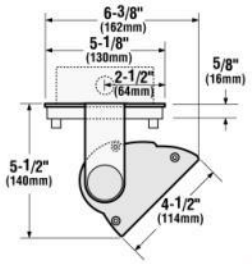
Fluorescent Small Ceiling Mount

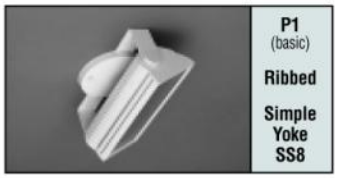
winona lighting

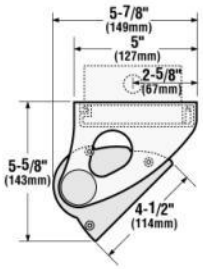
WINDIRECT™

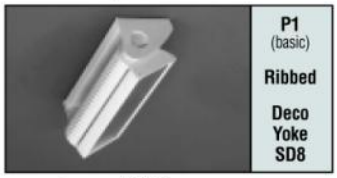
MOUNTING STYLES*

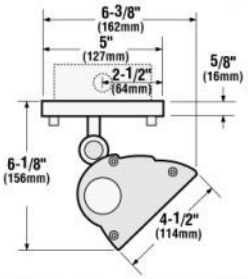
Remote Ballast



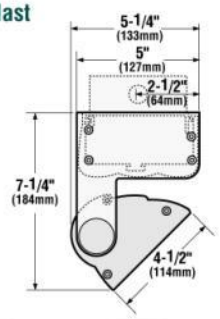


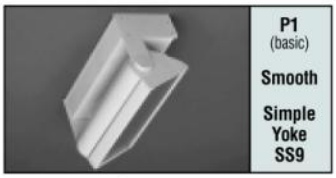


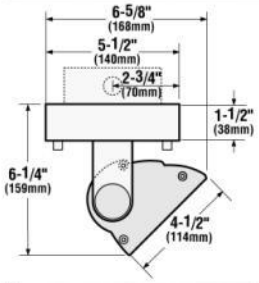


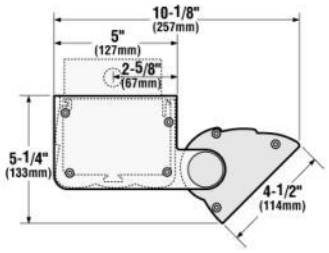


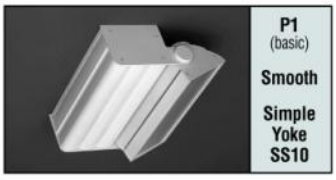
Integral Ballast











* P1 profile can be combined with any mounting style

PAGE:SC.6

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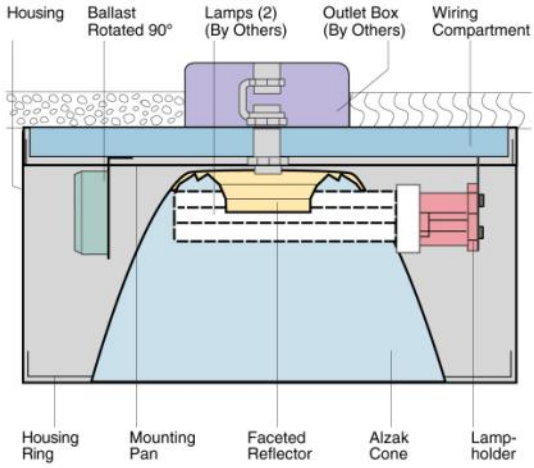
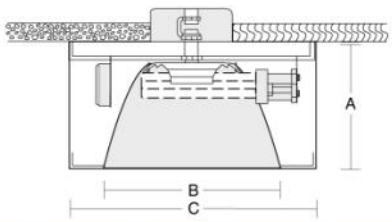
Type:	F15
Location:	Lounge, Dorm Rooms
Mfr/Catalogue #:	Kurt Versen - P602
Description:	8" Surface-mounted compact fluorescent downlight.
Lamping:	2-CFQ 26W
Optics:	Anodized aluminum parabolic reflector
Dimensions:	13.000" diameter, 6.000" height
Housing:	One piece 20 Ga steel
Electrical:	Integral electronic ballast
Voltage:	277 V
Labels:	CUL, IBEW, UL. Suitable for Dry environments.



Dimensions and Lamps



Number	A Depth	B Aperture	C Diameter	Lamps*
P602	6" 152mm	8⅜" 213mm	13" 330mm	Two 26W Quad Tube

*For 18W lamps, add 18W to catalog number.

P602 DISCONTINUED

See P639CB, Page P43

Surface Mount Cylinder
Two 26W Quad Tube lamps
8⅜" Conoid Aperture

Optics and Applications
The optical system features a two reflector system. The primary reflector is longitudinally formed and faceted. The parabolic shielding cone offers unparalleled brightness control from normal viewing angles. The pattern is slightly asymmetrical depending upon measurement perpendicular or parallel to the lamps. Use in corridors, transit areas, open spaces, foyers, restrooms, etc.

Finish
A specular clear Alzak cone is standard. Optional colors and Softglow® finishes are available. Interior finish is matte black, the cylindrical housing exterior is satin brushed, then painted matte white baked enamel.

Ballast
Fully electronic, microprocessor controlled with variable starting current for inrush protection to assure rated lamp life. Input voltage range from 120V through 277V. Power factor .98, starting temperature 0°F (-18°C), THD < 10%. Pre-heat start < 1.0 second. End of lamp life protection. Rated for > 50,000 starts.

General
Fixtures are UL and C-UL listed for thermal and electrical safety. Union made IBEW. Luminaire Efficiency Rating (LER) data is in the photometric directory located in Section Z.

Accessories

G	Gold cone.	WT	White trim flange.
H	Mocha cone.	WHT	White complete trim.
P	Graphite cone.	BA	Brushed aluminum.
T	Titanium cone.	CC	Custom color.
W	Wheat cone.	P5	Pendant adaptor, 21" length.
Y	Pewter cone.	ES	Extra stem length, specify length.
Z	Bronze cone.		

S Softglow® finishes: add S before color letters. e.g. SW for Softglow® wheat cone, SC for Softglow® clear cone.
V347 347 volt ballast.
DM Dimming ballast, contact the factory.
EM Emergency power. Includes battery pack, charger light, test switch and single lamp operation for 90 minutes. Components are remote from fixture. Specify volts.

Matching Units

Recessed downlights	Pages P5, P6
Recessed wall washers	Page P33

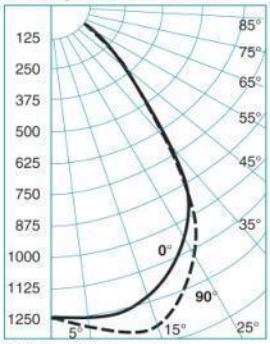
P42 P602

Performance Datachart

Single Unit Initial Footcandles, 30" Work Plane							Ceiling to Floor	Multiple Units Initial Footcandles, 30" Work Plane			
P602 Two 26W Quad Tube lamps								Ceiling 80% Walls 50% Floor 20%			
Nadir	20°		30°		40°			Spacing is Maximum Over Work Plane			
FC	FC	Diam	FC	Diam	FC	Diam		Spacing	RCR 1	RCR 3	RCR 8
42	33	4'	24	6'	9	9'	8'	7'	46	38	25
30	24	5'	17	8'	6	11'	9'	8'	33	27	18
22	18	5'	13	9'	5	13'	10'	9'	25	21	14
14	11	7'	8	11'	3	16'	12'	12'	15	13	9
10	8	8'	6	13'	2	19'	14'	14'	10	9	6

See notes 4, 5 and 6.

Candlepower Distribution



P602 Two 26W Quad Tube lamps
Eff. 56% S/M 0° 1.2 S/M 90° 1.3

Candelas

	0°	90°
o	3600*	3600*
0	1257	1257
5	1259	1281
10	1263	1307
15	1189	1336
20	1182	1283
25	1135	1237
30	1116	1163
35	931	955
40	592	618
45	383	392
50	233	280
55	96	113
60	33	38
65	11	10
70	4	3
75	0	0
80	0	0
85	0	0
90	0	0

° Vertical Angles
* Initial Lamp Lumens

Coefficients of Utilization

Ceiling	80%				70%		50%		30%		0
Wall %	70	50	30	10	50	10	50	10	50	10	0
RCR	Zonal Cavity Method - Floor Reflectance 20%										
1	.63	.61	.59	.58	.60	.57	.57	.55	.55	.53	.51
2	.59	.56	.53	.51	.55	.50	.53	.49	.51	.48	.46
3	.55	.51	.48	.45	.50	.45	.49	.44	.47	.43	.42
4	.52	.47	.43	.40	.46	.40	.45	.39	.43	.39	.38
5	.48	.43	.39	.36	.42	.36	.41	.36	.40	.35	.34
6	.45	.39	.35	.33	.39	.33	.38	.32	.37	.32	.31
7	.42	.36	.32	.30	.36	.30	.35	.29	.34	.29	.28
8	.40	.34	.30	.27	.33	.27	.33	.27	.32	.27	.26
9	.37	.31	.27	.25	.31	.25	.30	.25	.30	.25	.24
10	.35	.29	.25	.23	.29	.23	.28	.23	.28	.23	.22

P602 Two 26W Quad Tube lamps

Brightness

Number	Lamps	Plane	85°	75°	65°	55°	45°
P602	Two 26W Quad Tube	0°	10	39	436	9572	12283
		90°	11	33	75	10409	12931

Data in footlamberts. Photometer readings, Maximum Brightness Method. See note 7.

Corridor Footcandles

P602 Two 26W Quad Tube lamps												
Ceiling Height	Reflectances: Ceiling 80% Walls 50% Floor 20%											
	8' Centers					12' Centers						
	C/L	2'	4'	6'	C/L	C/L	2'	4'	6'	8'	10'	C/L
8'	31	34	35	34	31	25	25	201	17	20	25	25
9'	28	31	31	21	28	21	25	19	19	19	21	21
10'	26	27	28	27	26	18	18	18	18	18	18	18

Initial footcandles. Readings on the floor. 5' corridor width.

Notes

1 Data on all charts calculated with a clear specular cone finish.

2 Specular cone multipliers: Wheat x .88, Pewter x .82, Mocha x .85, Graphite x .81, Titanium x .81, Bronze x .75.

3 Softglow® cone multipliers: Clear x .93, Wheat x .87, Pewter x .78, Mocha x .77, Graphite x .75, Titanium x .75, Bronze x .69.

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

5 Datachart spacing is rounded off to the nearest foot.

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

7 Brightness data from the Average Luminance Method are inaccurate for small aperture downlights. They are theoretical calculations derived for large surfaces such as troffers. For a complete discussion refer to section Z brochure Z1.

8 For 18W lamps, multiply all data by .70 or contact the factory for precise data.

Kurt Versen Company, Westwood, New Jersey

Type:	F16
Location:	Dorm Rooms
Mfr/Catalogue #:	Focal Point - DUW-4-T5HO-277-EB
Description:	Wall-mounted fluorescent up/downlight.
Lamping:	1-T5HO
Optics:	Opal acrylic diffuser
Dimensions:	48.000” length, 4.000" width, 4.000" height/depth
Housing:	Steel, powder coat paint
Electrical:	Integral electronic ballast
Voltage:	277 V
Labels:	IBEW, UL. Suitable for Dry environments.

The Duet Series

Product Features

- Baffles are an integral part of the fixture housing provided in either "up" (internal) or "down" (external) configurations.
- Compact 4" X 4" profile conforms with A.D.A. (Americans with Disabilities Act) requirements.
- Available with one-lamp or two-lamp T8 or T5 configurations.

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The Duet Series

Specification Data

Housing: Die-formed, 20-gauge, cold-rolled steel. Ballast compartments provided with 7/8" diameter KOs at either end of housing for through wiring.

Mounting: Wall wash 4" X 4" X 2-ft., 4-ft. or 8-ft. long. All units are intermediate units and are provided with field attachable finishing end caps to terminate runs.

Reflector: Die-formed, cold-rolled steel with 89% reflectance white finish.

Shielding: 3/8" high blades at 3/4" on center. Blades are an integral part of the fixture housing and can be provided in a "down" position (visible below fixture housing) or in an "up" position (concealed within the housing). Indirect component is provided with an acrylic prismatic lens. Housing/baffle combination lifts from wall plate for easy relamping and maintenence.

Finish: Baked white enamel.

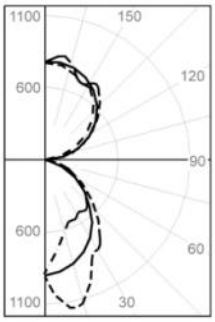
Lamps (in cross section): (1) or (2) T5, T5HO or T8 lamps. (Lamps by others.)

Ballast: Electronic. Please specify voltage.

Certification: U.L. listed, I.B.E.W. (Local 3) Union made in the U.S.A.

Photometrics

Floor	20%										
Ceiling	80%				70%				50%		
Walls	70%	50%	30%	10%	70%	50%	30%	10%	50%	30%	10%
0	.76	.76	.76	.76	.70	.70	.70	.70	.58	.58	.58
1	.70	.67	.64	.61	.64	.61	.59	.57	.51	.50	.48
2	.63	.58	.54	.51	.58	.54	.50	.47	.45	.43	.40
3	.58	.51	.46	.42	.53	.48	.43	.40	.40	.37	.34
4	.53	.46	.40	.36	.49	.42	.37	.34	.36	.32	.29
5	.49	.41	.35	.31	.45	.38	.33	.29	.32	.28	.25
6	.45	.37	.31	.27	.41	.34	.29	.25	.29	.25	.22
7	.42	.33	.28	.24	.38	.31	.26	.22	.26	.22	.20
8	.39	.30	.25	.21	.36	.28	.23	.20	.24	.20	.17
9	.36	.28	.22	.19	.33	.26	.21	.18	.22	.18	.16
10	.34	.25	.20	.17	.31	.24	.19	.16	.20	.17	.14



Catalog Number:
DUW-4-2T8-EB-LU

Report Number:
ITLL49302

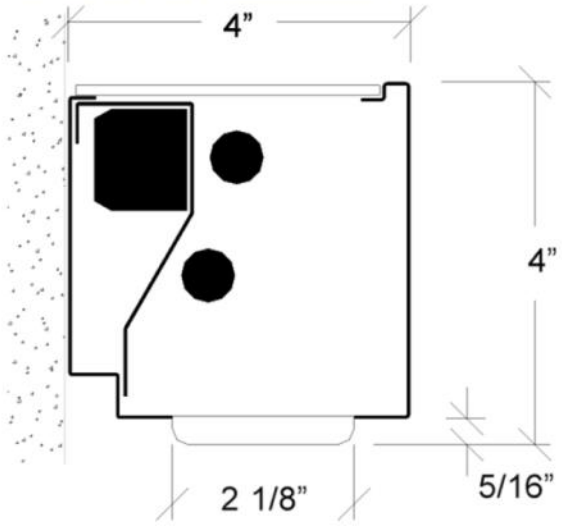
Lamps:
(2) T8 each rated 2950 lumens

Total Efficiency:
71.4%

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The Duet Series

Fixture Details (Schematic)



3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

The Duet Series

Ordering Info

Product Family
DUW - Duet, Wall

Length
2 - 2 ft. nominal
4 - 4 ft. nominal
8 - 8 ft. nominal

Wattage (consult factory for other lamps)
1T5 - (1) T5 lamp
2T5 - (2) T5 lamps
1T5HO - (1) T5HO lamp
2T5HO - (2) T5HO lamps
1T8 - (1) T8 lamp
2T8 - (2) T8 lamps

Shielding
LU - Louver Up
LD - Louver down

Voltage
277 - 277V
120 - 120V

Ballast
EB - Electronic
EDB - Electronic dimming

Options
EMPK - Emergency Bettery Pack
SW - Soft white overlay ("LD" only)

Company Name _____
Project Name _____
Fixture Type _____

3 Kilmer Road Edison, New Jersey 08817 telephone 732.985.2600 facsimile 732.985.8441
www.marklighting.com

Ballast for Fixtures F4, F6, F14

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* PROStart® COMPACT FLUORESCENT - UNIVERSAL VOLTAGE DUAL ENTRY[5,6]										
NORMAL BALLAST FACTOR										
51818 ○	QTP 1/2x13CF/UNV	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51850 ○	*QTP 1/2x13CF/UNV-KIT ▲*			13W DD/E,T/E	900	2	1.00	1800	29	62
51823 ○	QTP 1/2x18CF/UNV	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51851 ○	*QTP 1/2x18CF/UNV-KIT ▲*			18W DD/E,T/E	1200	2	1.00	2400	38	63
51833 ○	QTP 2x26CF/UNV	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51852 ○	*QTP 2x26CF/UNV-KIT ▲*			26W DD/E,T/E	1800	2	1.00	3600	54	67
51898	QTP 2x26CF/UNV PEM			32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51843	QTP 2x26/32/42CF/UNV M	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51853 ○	*QTP 2x26/32/42CF/UNV M-KIT ▲*		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51863	QTP 2x26/32/42CF/UNV M PEM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
				57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
Also operates: see Ballast Technology & Specification Guide for additional lamp types.										
▲CF Kits include a ballast, screws, wire, mounting bracket, an instruction sheet and a wire removal tool.										
NORMAL BALLAST FACTOR - QTP CF models above replace gray shaded models below										
51718	QTP 1/2x13CF/UNV BS	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51748	QTP 1/2x13CF/UNV TS			13W DD/E,T/E	900	2	1.00	1800	29	62
51723	QTP 1/2x18CF/UNV BS	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51753	QTP 1/2x18CF/UNV TS			18W DD/E,T/E	1200	2	1.00	2400	38	63
51733	QTP 2x26CF/UNV BS	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51763	QTP 2x26CF/UNV TS			26W DD/E,T/E	1800	2	1.00	3600	54	67
				32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51738	QTP 1/2xCF/UNV BM	120-277	0.57/0.25	26W DD/E,T/E	1800	1	1.02	1830	28	65
51798	QTP 1/2xCF/UNV PM			26W DD/E,T/E	1800	2	1.02	3670	57	64
51768	QTP 1/2xCF/UNV TM			32W DT/E	2400	1	0.97	2330	36	65
				42W DT/E	3200	1	1.00	3200	46	70
51743	QTP 2x26/32/42CF/UNV BM	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51803	QTP 2x26/32/42CF/UNV PM		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51773	QTP 2x26/32/42CF/UNV TM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
	Also operates one 57W or 70W CFL lamps			57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-5% Dimming Range - <10% THD										
50705	QTP 1x32T8/UNV DIM-TC	120-277	0.27/0.12	F032XP	3000	1	0.88 0.05	2640 150	30 8	88
50707	QTP 2x32T8/UNV DIM-TC	120-277	0.54/0.24	F032XP	3000	2	0.88 0.05	5280 300	60/58 15	88/91
50714	QTP 3x32T8/UNV DIM-TCL	120-277	0.73/0.30	F032XP	3000	3	0.88 0.05	7920 450	87/84 20	91/94
50716	QTP 4x32T8/UNV DIM-TCL	120-277	0.96/0.40	F032XP	3000	4	0.88 0.05	10560 600	114/110 27	92/96
POWERSENSE™ QTP models above also operate these lamps: F025, F017 & FB032. POWERSENSE T8 replaces former Helios T8 dimming products.										
QUICKTRONIC® *HIGH EFFICIENCY* HELIOS™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
High Ballast Factor - "PLUS" High Light Output System - For 277V, 0-10Vdc Control Applications Only										
50718 ○	QTP 4x32T8/277 DIM PLUS-TCL	277	0.53	F032XP	3000	4	1.20 0.05	14400 600	145 28	99
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 28 T5 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-1% Dimming Range - <10% THD										
50726 ○	QTP 2x28T5/UNV DIM-TCL	120-277	0.53/0.23	FP28	2900	2	1.00 0.01	5800 58	63/62 10	92/94
POWERSENSE™ QTP model above also operate these lamps: FP35, FP21 & FP14										
QUICKTRONIC® *PROFESSIONAL* HELIOS™ 54 T5 HO DIMMING SYSTEMS[3] - A list of controllers is available from OSRAM SYLVANIA										
(0-10Vdc control) - 100-1% Dimming Range - <10% THD										
49671	QT1x54/120PHO-DIM	120	0.54	FP54T5HO	5000	1	1.00 0.01	5000 50	62 8	81
49672	QT1x54/277PHO-DIM	277	0.23	FP54T5HO	5000	1	1.00 0.01	5000 50	61 8	82
49673	QT2x54/120PHO-DIM	120	1.07	FP54T5HO	5000	2	1.00 0.01	10000 100	120 18	83
49674	QT2x54/277PHO-DIM	277	0.45	FP54T5HO	5000	2	1.00 0.01	10000 100	117 18	85
HELIOS™ QT models above also operate these lamps: FT55DL & FPC55										

Ballast for Fixtures F5, F7

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
***NORMAL BALLAST FACTOR*[3]**										
49111 *(49110)*◆	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.47/0.20	FP24T5HO	2000	2 1	1.00 1.00	4000 2000	55/54 29	73/74 70
49111 *(49110)*◆	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.76/0.32	FP39T5HO	3500	2 1	1.00 1.00	7000 3500	85/83 42	82/84 83
49131 *(49130)*◆	QTP 2x54T5HO/UNV PSN NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
49151 *(49150)*◆	QTP 1x80T5HO/UNV PSN NL	120-277	0.74/0.32	FP80T5HO FT80T5DL	6000 7000	1 1	1.00 1.00	7000 6000	90 90	78 67
◆ *(Item Number) = Item Number/NAED in parentheses are models with leads/wires. See Ballast Technology & Specification Guide for additional lamp types and full specifications.*										
QUICKTRONIC® *PROFESSIONAL* T5 PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
***NORMAL BALLAST FACTOR*[3]**										
49181 *(49180)*◆	QTP 2x28T5/UNV PSN NL	120-277	0.55/0.23	FP28T5	2900	2 1	1.00 1.00	5800 2900	65/63 32	89/92 90
PROStart® QTP PSN models above also operate these lamps: FP14, FP21 & FP35 ◆ *(Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® UNIVERSAL VOLTAGE HIGH AMBIENT TEMP. SYSTEMS										
***FIXED OUTPUT*[3]**										
49136 *(49135)*◆	QTP 2x54T5HO/UNV PSN HT NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
***SWITCHABLE MODEL*[3]**										
49161 *(49160)*◆	QTP 4x54T5HO/UNV PSN HTW NL	120-277	2.00/0.85	FP54T5HO	5000	4 3 2 1	1.00 1.00 1.00 1.00	20000 15000 10000 5000	241/236 182/178 121/118 61	83/85 83/85 83/85 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 ◆ *(Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® 347- 480V HIGH AMBIENT TEMP. SYSTEMS										
***NORMAL BALLAST FACTOR*[3]**										
49146 *(49145)*◆	QTP 2x54T5HO/347-480 PSN HT NL	347-480	0.35/0.25	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/120 61	83 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 ◆ *(Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *HIGH EFFICIENCY* INSTANT START DL40 UNIVERSAL VOLTAGE SYSTEMS[4]										
49428 ✪	QHE 1x40DL/UNV ISN-SC	120-277	0.30/0.13 0.27/0.12	FT40T5 FT40DL/28W/SS/IS	3150 2800	1 1	0.90 1.07	2835 2995	35 32	81 94
49429	QHE 2x40DL/UNV ISN-SC	120-277	0.56/0.26 0.54/0.24	FT40T5 FT40DL/28W/SS/IS	3150 2800	2 2	0.90 1.07	5670 5990	68/67 64/63	83/84 94/95
49430	QHE 3x40DL/UNV ISN-SC	120-277	0.84/0.36 0.79/0.35	FT40T5 FT40DL/28W/SS/IS	3150 2800	3 3	0.90 1.07	8505 8990	100/99 95/94	85/86 95/96
[4] *Ballast factor based upon 225mA nominal lamp current for FT40DL lamp and 190mA nominal lamp current for FT40DL/28W/SS/IS lamp.*										
QUICKTRONIC® *PROFESSIONAL* PROStart® DL40										
NORMAL BALLAST FACTOR										
50320	QTP 1x40TT5/120 PSN-F *Formerly: M1-PN-TT5/40-F-120*	120	0.32	FT40T5	3150	1	0.88	2770	38	73
50330	QTP 1x40TT5/277 PSN-F *Formerly: M1-PN-TT5/40-F-277*	277	0.13	FT40T5	3150	1	0.88	2770	37	75
50340	QTP 2x40TT5/120 PSN-F *Formerly: M2-PN-TT5/40-F-120*	120	0.63	FT40T5	3150	2	0.88	5545	76	73
50350	QTP 2x40TT5/277 PSN-F *Formerly: M2-PN-TT5/40-F-277*	277	0.27	FT40T5	3150	2	0.88	5545	73	76
50360	QTP 3x40TT5/120 PSN-B *Formerly: M3-PN-TT5/40-B-120*	120	0.92	FT40T5	3150	3	0.88	8315	110	76
50370	QTP 3x40TT5/277 PSN-B *Formerly: M3-PN-TT5/40-B-277*	277	0.39	FT40T5	3150	3	0.88	8315	108	77

3: Rated lamp lumens and performance data based on PENTRON® HO lamps. Rated lumens at 35°C lamp ambient temperature

Ballast for Fixtures F8, F9

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* PROStart® COMPACT FLUORESCENT - UNIVERSAL VOLTAGE DUAL ENTRY[5,6]										
NORMAL BALLAST FACTOR										
51818 ○	QTP 1/2x13CF/UNV	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51850 ○	*QTP 1/2x13CF/UNV-KIT* ▲			13W DD/E,T/E	900	2	1.00	1800	29	62
51823 ○	QTP 1/2x18CF/UNV	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51851 ○	*QTP 1/2x18CF/UNV-KIT* ▲			18W DD/E,T/E	1200	2	1.00	2400	38	63
51833 ○	QTP 2x26CF/UNV	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51852 ○	*QTP 2x26CF/UNV-KIT* ▲			26W DD/E,T/E	1800	2	1.00	3600	54	67
51898	QTP 2x26CF/UNV PEM			32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51843	QTP 2x26/32/42CF/UNV M	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51853 ○	*QTP 2x26/32/42CF/UNV M-KIT* ▲		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51863	QTP 2x26/32/42CF/UNV M PEM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
				57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
Also operates: see Ballast Technology & Specification Guide for additional lamp types.							▲CF Kits include a ballast, screws, wire, mounting bracket, an instruction sheet and a wire removal tool.			
NORMAL BALLAST FACTOR* - *QTP CF models above replace gray shaded models below										
51718	QTP 1/2x13CF/UNV BS	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51748	QTP 1/2x13CF/UNV TS			13W DD/E,T/E	900	2	1.00	1800	29	62
51723	QTP 1/2x18CF/UNV BS	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51753	QTP 1/2x18CF/UNV TS			18W DD/E,T/E	1200	2	1.00	2400	38	63
51733	QTP 2x26CF/UNV BS	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51763	QTP 2x26CF/UNV TS			26W DD/E,T/E	1800	2	1.00	3600	54	67
				32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51738	QTP 1/2xCF/UNV BM	120-277	0.57/0.25	26W DD/E,T/E	1800	1	1.02	1830	28	65
51798	QTP 1/2xCF/UNV PM			26W DD/E,T/E	1800	2	1.02	3670	57	64
51768	QTP 1/2xCF/UNV TM			32W DT/E	2400	1	0.97	2330	36	65
				42W DT/E	3200	1	1.00	3200	46	70
51743	QTP 2x26/32/42CF/UNV BM	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51803	QTP 2x26/32/42CF/UNV PM		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51773	QTP 2x26/32/42CF/UNV TM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
	Also operates one 57W or 70W CFL lamps			57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-5% Dimming Range - <10% THD										
50705	QTP 1x32T8/UNV DIM-TC	120-277	0.27/0.12	FO32XP	3000	1	0.88 0.05	2640 150	30 8	88
50707	QTP 2x32T8/UNV DIM-TC	120-277	0.54/0.24	FO32XP	3000	2	0.88 0.05	5280 300	60/58 15	88/91
50714	QTP 3x32T8/UNV DIM-TCL	120-277	0.73/0.30	FO32XP	3000	3	0.88 0.05	7920 450	87/84 20	91/94
50716	QTP 4x32T8/UNV DIM-TCL	120-277	0.96/0.40	FO32XP	3000	4	0.88 0.05	10560 600	114/110 27	92/96
POWERSENSE™ QTP models above also operate these lamps: FO25, FO17 & FB032. POWERSENSE T8 replaces former Helios T8 dimming products.										
QUICKTRONIC® *HIGH EFFICIENCY* HELIOS™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
High Ballast Factor - "PLUS" High Light Output System* - *For 277V, 0-10Vdc Control Applications Only										
50718 ○	QTP 4x32T8/277 DIM PLUS-TCL	277	0.53	FO32XP	3000	4	1.20 0.05	14400 600	145 28	99
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 28 T5 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-1% Dimming Range - <10% THD										
50726 ○	QTP 2x28T5/UNV DIM-TCL	120-277	0.53/0.23	FP28	2900	2	1.00 0.01	5800 58	63/62 10	92/94
POWERSENSE™ QTP model above also operate these lamps: FP35, FP21 & FP14										
QUICKTRONIC® *PROFESSIONAL* HELIOS™ 54 T5 HO DIMMING SYSTEMS[3] - A list of controllers is available from OSRAM SYLVANIA										
(0-10Vdc control) - 100-1% Dimming Range - <10% THD										
49671	QT1x54/120PHO-DIM	120	0.54	FP54T5HO	5000	1	1.00 0.01	5000 50	62 8	81
49672	QT1x54/277PHO-DIM	277	0.23	FP54T5HO	5000	1	1.00 0.01	5000 50	61 8	82
49673	QT2x54/120PHO-DIM	120	1.07	FP54T5HO	5000	2	1.00 0.01	10000 100	120 18	83
49674	QT2x54/277PHO-DIM	277	0.45	FP54T5HO	5000	2	1.00 0.01	10000 100	117 18	85
HELIOS™ QT models above also operate these lamps: FT55DL & FPC55										

Ballast for Fixtures F11

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49111 *(49110)♦*	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.47/0.20	FP24T5HO	2000	2 1	1.00 1.00	4000 2000	55/54 29	73/74 70
49111 *(49110)♦*	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.76/0.32	FP39T5HO	3500	2 1	1.00 1.00	7000 3500	85/83 42	82/84 83
49131 *(49130)♦*	QTP 2x54T5HO/UNV PSN NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
49151 *(49150)♦*	QTP 1x80T5HO/UNV PSN NL	120-277	0.74/0.32	FP80T5HO FT80T5DL	6000 7000	1 1	1.00 1.00	7000 6000	90 90	78 67
♦ (Item Number) = Item Number/NAED in parentheses are models with leads/wires. See Ballast Technology & Specification Guide for additional lamp types and full specifications.										
QUICKTRONIC® *PROFESSIONAL* T5 PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49181 *(49180)♦*	QTP 2x28T5/UNV PSN NL	120-277	0.55/0.23	FP28T5	2900	2 1	1.00 1.00	5800 2900	65/63 32	89/92 90
PROStart® QTP PSN models above also operate these lamps: FP14, FP21 & FP35 *♦ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® UNIVERSAL VOLTAGE HIGH AMBIENT TEMP. SYSTEMS										
FIXED OUTPUT[3]										
49136 *(49135)♦*	QTP 2x54T5HO/UNV PSN HT NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
SWITCHABLE MODEL[3]										
49161 *(49160)♦*	QTP 4x54T5HO/UNV PSN HTW NL	120-277	2.00/0.85	FP54T5HO	5000	4 3 2 1	1.00 1.00 1.00 1.00	20000 15000 10000 5000	241/236 182/178 121/118 61	83/85 83/85 83/85 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *♦ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® 347- 480V HIGH AMBIENT TEMP. SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49146 *(49145)♦*	QTP 2x54T5HO/347-480 PSN HT NL	347-480	0.35/0.25	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/120 61	83 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *♦ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *HIGH EFFICIENCY* INSTANT START DL40 UNIVERSAL VOLTAGE SYSTEMS[4]										
49428 ✪	QHE 1x40DL/UNV ISN-SC	120-277	0.30/0.13 0.27/0.12	FT40T5 FT40DL/28W/SS/IS	3150 2800	1 1	0.90 1.07	2835 2995	35 32	81 94
49429	QHE 2x40DL/UNV ISN-SC	120-277	0.56/0.26 0.54/0.24	FT40T5 FT40DL/28W/SS/IS	3150 2800	2 2	0.90 1.07	5670 5990	68/67 64/63	83/84 94/95
49430	QHE 3x40DL/UNV ISN-SC	120-277	0.84/0.36 0.79/0.35	FT40T5 FT40DL/28W/SS/IS	3150 2800	3 3	0.90 1.07	8505 8990	100/99 95/94	85/86 95/96
[4] Ballast factor based upon 225mA nominal lamp current for FT40DL lamp and 190mA nominal lamp current for FT40DL/28W/SS/IS lamp.										
QUICKTRONIC® *PROFESSIONAL* PROStart® DL40										
NORMAL BALLAST FACTOR										
50320	QTP 1x40TT5/120 PSN-F *Formerly: M1-PN-TT5/40-F-120*	120	0.32	FT40T5	3150	1	0.88	2770	38	73
50330	QTP 1x40TT5/277 PSN-F *Formerly: M1-PN-TT5/40-F-277*	277	0.13	FT40T5	3150	1	0.88	2770	37	75
50340	QTP 2x40TT5/120 PSN-F *Formerly: M2-PN-TT5/40-F-120*	120	0.63	FT40T5	3150	2	0.88	5545	76	73
50350	QTP 2x40TT5/277 PSN-F *Formerly: M2-PN-TT5/40-F-277*	277	0.27	FT40T5	3150	2	0.88	5545	73	76
50360	QTP 3x40TT5/120 PSN-B *Formerly: M3-PN-TT5/40-B-120*	120	0.92	FT40T5	3150	3	0.88	8315	110	76
50370	QTP 3x40TT5/277 PSN-B *Formerly: M3-PN-TT5/40-B-277*	277	0.39	FT40T5	3150	3	0.88	8315	108	77

Ballast for Fixture F12

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49111 *(49110)◆*	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.47/0.20	FP24T5HO	2000	2 1	1.00 1.00	4000 2000	55/54 29	73/74 70
49111 *(49110)◆*	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.76/0.32	FP39T5HO	3500	2 1	1.00 1.00	7000 3500	85/83 42	82/84 83
49131 *(49130)◆*	QTP 2x54T5HO/UNV PSN NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
49151 *(49150)◆*	QTP 1x80T5HO/UNV PSN NL	120-277	0.74/0.32	FP80T5HO FT80T5DL	6000 7000	1 1	1.00 1.00	7000 6000	90 90	78 67
◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires. See Ballast Technology & Specification Guide for additional lamp types and full specifications.										
QUICKTRONIC® *PROFESSIONAL* T5 PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49181 *(49180)◆*	QTP 2x28T5/UNV PSN NL	120-277	0.55/0.23	FP28T5	2900	2 1	1.00 1.00	5800 2900	65/63 32	89/92 90
PROStart® QTP PSN models above also operate these lamps: FP14, FP21 & FP35 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® UNIVERSAL VOLTAGE HIGH AMBIENT TEMP. SYSTEMS										
FIXED OUTPUT[3]										
49136 *(49135)◆*	QTP 2x54T5HO/UNV PSN HT NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
SWITCHABLE MODEL[3]										
49161 *(49160)◆*	QTP 4x54T5HO/UNV PSN HTW NL	120-277	2.00/0.85	FP54T5HO	5000	4 3 2 1	1.00 1.00 1.00 1.00	20000 15000 10000 5000	241/236 182/178 121/118 61	83/85 83/85 83/85 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® 347- 480V HIGH AMBIENT TEMP. SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49146 *(49145)◆*	QTP 2x54T5HO/347-480 PSN HT NL	347-480	0.35/0.25	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/120 61	83 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *HIGH EFFICIENCY* INSTANT START DL40 UNIVERSAL VOLTAGE SYSTEMS[4]										
49428 ✪	QHE 1x40DL/UNV ISN-SC	120-277	0.30/0.13 0.27/0.12	FT40T5 FT40DL/28W/SS/IS	3150 2800	1 1	0.90 1.07	2835 2995	35 32	81 94
49429	QHE 2x40DL/UNV ISN-SC	120-277	0.56/0.26 0.54/0.24	FT40T5 FT40DL/28W/SS/IS	3150 2800	2 2	0.90 1.07	5670 5990	68/67 64/63	83/84 94/95
49430	QHE 3x40DL/UNV ISN-SC	120-277	0.84/0.36 0.79/0.35	FT40T5 FT40DL/28W/SS/IS	3150 2800	3 3	0.90 1.07	8505 8990	100/99 95/94	85/86 95/96
[4] Ballast factor based upon 225mA nominal lamp current for FT40DL lamp and 190mA nominal lamp current for FT40DL/28W/SS/IS lamp.										
QUICKTRONIC® *PROFESSIONAL* PROStart® DL40										
NORMAL BALLAST FACTOR										
50320	QTP 1x40TT5/120 PSN-F *Formerly: M1-PN-TT5/40-F-120*	120	0.32	FT40T5	3150	1	0.88	2770	38	73
50330	QTP 1x40TT5/277 PSN-F *Formerly: M1-PN-TT5/40-F-277*	277	0.13	FT40T5	3150	1	0.88	2770	37	75
50340	QTP 2x40TT5/120 PSN-F *Formerly: M2-PN-TT5/40-F-120*	120	0.63	FT40T5	3150	2	0.88	5545	76	73
50350	QTP 2x40TT5/277 PSN-F *Formerly: M2-PN-TT5/40-F-277*	277	0.27	FT40T5	3150	2	0.88	5545	73	76
50360	QTP 3x40TT5/120 PSN-B *Formerly: M3-PN-TT5/40-B-120*	120	0.92	FT40T5	3150	3	0.88	8315	110	76
50370	QTP 3x40TT5/277 PSN-B *Formerly: M3-PN-TT5/40-B-277*	277	0.39	FT40T5	3150	3	0.88	8315	108	77

3: Rated lamp lumens and performance data based on PENTRON® HO lamps. Rated lumens at 35°C lamp ambient temperature

Ballast for Fixture F13

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* PROStart® COMPACT FLUORESCENT - UNIVERSAL VOLTAGE DUAL ENTRY[5,6]										
NORMAL BALLAST FACTOR										
51818 ○	QTP 1/2x13CF/UNV	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51850 ○	*QTP 1/2x13CF/UNV-KIT* ▲			13W DD/E,T/E	900	2	1.00	1800	29	62
51823 ○	QTP 1/2x18CF/UNV	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51851 ○	*QTP 1/2x18CF/UNV-KIT* ▲			18W DD/E,T/E	1200	2	1.00	2400	38	63
51833 ○	QTP 2x26CF/UNV	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51852 ○	*QTP 2x26CF/UNV-KIT* ▲			26W DD/E,T/E	1800	2	1.00	3600	54	67
51898	QTP 2x26CF/UNV PEM			32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51843	QTP 2x26/32/42CF/UNV M	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51853 ○	*QTP 2x26/32/42CF/UNV M-KIT* ▲		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51863	QTP 2x26/32/42CF/UNV M PEM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
				57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
Also operates: see Ballast Technology & Specification Guide for additional lamp types.								▲CF Kits include a ballast, screws, wire, mounting bracket, an instruction sheet and a wire removal tool.		
NORMAL BALLAST FACTOR* - *QTP CF models above replace gray shaded models below										
51718	QTP 1/2x13CF/UNV BS	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51748	QTP 1/2x13CF/UNV TS			13W DD/E,T/E	900	2	1.00	1800	29	62
51723	QTP 1/2x18CF/UNV BS	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51753	QTP 1/2x18CF/UNV TS			18W DD/E,T/E	1200	2	1.00	2400	38	63
51733	QTP 2x26CF/UNV BS	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51763	QTP 2x26CF/UNV TS			26W DD/E,T/E	1800	2	1.00	3600	54	67
				32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51738	QTP 1/2xCF/UNV BM	120-277	0.57/0.25	26W DD/E,T/E	1800	1	1.02	1830	28	65
51798	QTP 1/2xCF/UNV PM			26W DD/E,T/E	1800	2	1.02	3670	57	64
51768	QTP 1/2xCF/UNV TM			32W DT/E	2400	1	0.97	2330	36	65
				42W DT/E	3200	1	1.00	3200	46	70
51743	QTP 2x26/32/42CF/UNV BM	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51803	QTP 2x26/32/42CF/UNV PM		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51773	QTP 2x26/32/42CF/UNV TM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
	Also operates one 57W or 70W CFL lamps			57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-5% Dimming Range - <10% THD										
50705	QTP 1x32T8/UNV DIM-TC	120-277	0.27/0.12	F032XP	3000	1	0.88 0.05	2640 150	30 8	88
50707	QTP 2x32T8/UNV DIM-TC	120-277	0.54/0.24	F032XP	3000	2	0.88 0.05	5280 300	60/58 15	88/91
50714	QTP 3x32T8/UNV DIM-TCL	120-277	0.73/0.30	F032XP	3000	3	0.88 0.05	7920 450	87/84 20	91/94
50716	QTP 4x32T8/UNV DIM-TCL	120-277	0.96/0.40	F032XP	3000	4	0.88 0.05	10560 600	114/110 27	92/96
POWERSENSE™ QTP models above also operate these lamps: F025, F017 & FB032. POWERSENSE T8 replaces former Helios T8 dimming products.										
QUICKTRONIC® *HIGH EFFICIENCY* HELIOS™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
High Ballast Factor - "PLUS" High Light Output System* - *For 277V, 0-10Vdc Control Applications Only										
50718 ○	QTP 4x32T8/277 DIM PLUS-TCL	277	0.53	F032XP	3000	4	1.20 0.05	14400 600	145 28	99
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 28 T5 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-1% Dimming Range - <10% THD										
50726 ○	QTP 2x28T5/UNV DIM-TCL	120-277	0.53/0.23	FP28	2900	2	1.00 0.01	5800 58	63/62 10	92/94
POWERSENSE™ QTP model above also operate these lamps: FP35, FP21 & FP14										
QUICKTRONIC® *PROFESSIONAL* HELIOS™ 54 T5 HO DIMMING SYSTEMS[3] - A list of controllers is available from OSRAM SYLVANIA										
(0-10Vdc control) - 100-1% Dimming Range - <10% THD										
49671	QT1x54/120PHO-DIM	120	0.54	FP54T5HO	5000	1	1.00 0.01	5000 50	62 8	81
49672	QT1x54/277PHO-DIM	277	0.23	FP54T5HO	5000	1	1.00 0.01	5000 50	61 8	82
49673	QT2x54/120PHO-DIM	120	1.07	FP54T5HO	5000	2	1.00 0.01	10000 100	120 18	83
49674	QT2x54/277PHO-DIM	277	0.45	FP54T5HO	5000	2	1.00 0.01	10000 100	117 18	85
HELIOS™ QT models above also operate these lamps: FT55DL & FPC55										

Ballast for Fixture F15

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* PROStart® COMPACT FLUORESCENT - UNIVERSAL VOLTAGE DUAL ENTRY[5,6]										
NORMAL BALLAST FACTOR										
51818 ○	QTP 1/2x13CF/UNV	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51850 ○	*QTP 1/2x13CF/UNV-KIT* ▲			13W DD/E,T/E	900	2	1.00	1800	29	62
51823 ○	QTP 1/2x18CF/UNV	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51851 ○	*QTP 1/2x18CF/UNV-KIT* ▲			18W DD/E,T/E	1200	2	1.00	2400	38	63
51833 ○	QTP 2x26CF/UNV	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51852 ○	*QTP 2x26CF/UNV-KIT* ▲			26W DD/E,T/E	1800	2	1.00	3600	54	67
51898	QTP 2x26CF/UNV PEM			32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51843	QTP 2x26/32/42CF/UNV M	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51853 ○	*QTP 2x26/32/42CF/UNV M-KIT* ▲		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51863	QTP 2x26/32/42CF/UNV M PEM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
				57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
Also operates: see Ballast Technology & Specification Guide for additional lamp types.								▲CF Kits include a ballast, screws, wire, mounting bracket, an instruction sheet and a wire removal tool.		
NORMAL BALLAST FACTOR - *QTP CF models above replace gray shaded models below*										
51718	QTP 1/2x13CF/UNV BS	120-277	0.25/0.11	13W DD/E,T/E	900	1	1.00	900	16	56
51748	QTP 1/2x13CF/UNV TS			13W DD/E,T/E	900	2	1.00	1800	29	62
51723	QTP 1/2x18CF/UNV BS	120-277	0.32/0.14	18W DD/E,T/E	1200	1	1.00	1200	20	60
51753	QTP 1/2x18CF/UNV TS			18W DD/E,T/E	1200	2	1.00	2400	38	63
51733	QTP 2x26CF/UNV BS	120-277	0.50/0.22	26W DD/E,T/E	1800	1	1.00	1800	28	64
51763	QTP 2x26CF/UNV TS			26W DD/E,T/E	1800	2	1.00	3600	54	67
				32W DT/E	2400	1	0.98	2350	35	67
				42W DT/E	3200	1	1.00	3200	45	71
51738	QTP 1/2xCF/UNV BM	120-277	0.57/0.25	26W DD/E,T/E	1800	1	1.02	1830	28	65
51798	QTP 1/2xCF/UNV PM			26W DD/E,T/E	1800	2	1.02	3670	57	64
51768	QTP 1/2xCF/UNV TM			32W DT/E	2400	1	0.97	2330	36	65
				42W DT/E	3200	1	1.00	3200	46	70
51743	QTP 2x26/32/42CF/UNV BM	120-277	0.90/0.40	26W DT/E	1800	2	1.02	3670	54	68
51803	QTP 2x26/32/42CF/UNV PM		0.53/0.23	32W DT/E	2400	2	0.96	4600	69	67
51773	QTP 2x26/32/42CF/UNV TM		0.57/0.25	42W DT/E	3200	2	0.95	6080	94	65
	Also operates one 57W or 70W CFL lamps			57W DT/E	4300	1	1.00	4300	62	69
				70W DT/E	5200	1	0.92	4780	71	67
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-5% Dimming Range - <10% THD										
50705	QTP 1x32T8/UNV DIM-TC	120-277	0.27/0.12	FO32XP	3000	1	0.88 0.05	2640 150	30 8	88
50707	QTP 2x32T8/UNV DIM-TC	120-277	0.54/0.24	FO32XP	3000	2	0.88 0.05	5280 300	60/58 15	88/91
50714	QTP 3x32T8/UNV DIM-TCL	120-277	0.73/0.30	FO32XP	3000	3	0.88 0.05	7920 450	87/84 20	91/94
50716	QTP 4x32T8/UNV DIM-TCL	120-277	0.96/0.40	FO32XP	3000	4	0.88 0.05	10560 600	114/110 27	92/96
POWERSENSE™ QTP models above also operate these lamps: FO25, FO17 & FB032. POWERSENSE T8 replaces former Helios T8 dimming products.										
QUICKTRONIC® *HIGH EFFICIENCY* HELIOS™ 32 T8 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
High Ballast Factor - "PLUS" High Light Output System - *For 277V, 0-10Vdc Control Applications Only*										
50718 ○	QTP 4x32T8/277 DIM PLUS-TCL	277	0.53	FO32XP	3000	4	1.20 0.05	14400 600	145 28	99
QUICKTRONIC® *HIGH EFFICIENCY* POWERSENSE™ 28 T5 DIMMING SYSTEMS - A list of controllers is available from OSRAM SYLVANIA										
Power-line control (2-wire) or 0-10Vdc control (4-wire) - 100-1% Dimming Range - <10% THD										
50726 ○	QTP 2x28T5/UNV DIM-TCL	120-277	0.53/0.23	FP28	2900	2	1.00 0.01	5800 58	63/62 10	92/94
POWERSENSE™ QTP model above also operate these lamps: FP35, FP21 & FP14										
QUICKTRONIC® *PROFESSIONAL* HELIOS™ 54 T5 HO DIMMING SYSTEMS[3] - A list of controllers is available from OSRAM SYLVANIA										
(0-10Vdc control) - 100-1% Dimming Range - <10% THD										
49671	QT1x54/120PHO-DIM	120	0.54	FP54T5HO	5000	1	1.00 0.01	5000 50	62 8	81
49672	QT1x54/277PHO-DIM	277	0.23	FP54T5HO	5000	1	1.00 0.01	5000 50	61 8	82
49673	QT2x54/120PHO-DIM	120	1.07	FP54T5HO	5000	2	1.00 0.01	10000 100	120 18	83
49674	QT2x54/277PHO-DIM	277	0.45	FP54T5HO	5000	2	1.00 0.01	10000 100	117 18	85
HELIOS™ QT models above also operate these lamps: FT55DL & FPC55										

Ballast for F16

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49111 *(49110)*◆	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.47/0.20	FP24T5HO	2000	2 1	1.00 1.00	4000 2000	55/54 29	73/74 70
49111 *(49110)*◆	QTP 2x39-24T5HO/UNV PSN NL	120-277	0.76/0.32	FP39T5HO	3500	2 1	1.00 1.00	7000 3500	85/83 42	82/84 83
49131 *(49130)*◆	QTP 2x54T5HO/UNV PSN NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
49151 *(49150)*◆	QTP 1x80T5HO/UNV PSN NL	120-277	0.74/0.32	FP80T5HO FT80T5DL	6000 7000	1 1	1.00 1.00	7000 6000	90 90	78 67
◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires. See Ballast Technology & Specification Guide for additional lamp types and full specifications.										
QUICKTRONIC® *PROFESSIONAL* T5 PROStart® PSN UNIVERSAL VOLTAGE SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49181 *(49180)*◆	QTP 2x28T5/UNV PSN NL	120-277	0.55/0.23	FP28T5	2900	2 1	1.00 1.00	5800 2900	65/63 32	89/92 90
PROStart® QTP PSN models above also operate these lamps: FP14, FP21 & FP35 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® UNIVERSAL VOLTAGE HIGH AMBIENT TEMP. SYSTEMS										
FIXED OUTPUT[3]										
49136 *(49135)*◆	QTP 2x54T5HO/UNV PSN HT NL	120-277	1.00/0.43	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/118 61	83/85 82
SWITCHABLE MODEL[3]										
49161 *(49160)*◆	QTP 4x54T5HO/UNV PSN HTW NL	120-277	2.00/0.85	FP54T5HO	5000	4 3 2 1	1.00 1.00 1.00 1.00	20000 15000 10000 5000	241/236 182/178 121/118 61	83/85 83/85 83/85 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *PROFESSIONAL* T5HO PROStart® 347- 480V HIGH AMBIENT TEMP. SYSTEMS										
NORMAL BALLAST FACTOR[3]										
49146 *(49145)*◆	QTP 2x54T5HO/347-480 PSN HT NL	347-480	0.35/0.25	FP54T5HO	5000	2 1	1.00 1.00	10000 5000	121/120 61	83 82
PROStart® QTP PSN models above also operate these lamps: FT55DL, FPC55, L58 *◆ (Item Number) = Item Number/NAED in parentheses are models with leads/wires.*										
QUICKTRONIC® *HIGH EFFICIENCY* INSTANT START DL40 UNIVERSAL VOLTAGE SYSTEMS[4]										
49428 ✪	QHE 1x40DL/UNV ISN-SC	120-277	0.30/0.13 0.27/0.12	FT40T5 FT40DL/28W/SS/IS	3150 2800	1 1	0.90 1.07	2835 2995	35 32	81 94
49429	QHE 2x40DL/UNV ISN-SC	120-277	0.56/0.26 0.54/0.24	FT40T5 FT40DL/28W/SS/IS	3150 2800	2 2	0.90 1.07	5670 5990	68/67 64/63	83/84 94/95
49430	QHE 3x40DL/UNV ISN-SC	120-277	0.84/0.36 0.79/0.35	FT40T5 FT40DL/28W/SS/IS	3150 2800	3 3	0.90 1.07	8505 8990	100/99 95/94	85/86 95/96
[4] Ballast factor based upon 225mA nominal lamp current for FT40DL lamp and 190mA nominal lamp current for FT40DL/28W/SS/IS lamp.										
QUICKTRONIC® *PROFESSIONAL* PROStart® DL40										
NORMAL BALLAST FACTOR										
50320	QTP 1x40TT5/120 PSN-F *Formerly: M1-PN-TT5/40-F-120*	120	0.32	FT40T5	3150	1	0.88	2770	38	73
50330	QTP 1x40TT5/277 PSN-F *Formerly: M1-PN-TT5/40-F-277*	277	0.13	FT40T5	3150	1	0.88	2770	37	75
50340	QTP 2x40TT5/120 PSN-F *Formerly: M2-PN-TT5/40-F-120*	120	0.63	FT40T5	3150	2	0.88	5545	76	73
50350	QTP 2x40TT5/277 PSN-F *Formerly: M2-PN-TT5/40-F-277*	277	0.27	FT40T5	3150	2	0.88	5545	73	76
50360	QTP 3x40TT5/120 PSN-B *Formerly: M3-PN-TT5/40-B-120*	120	0.92	FT40T5	3150	3	0.88	8315	110	76
50370	QTP 3x40TT5/277 PSN-B *Formerly: M3-PN-TT5/40-B-277*	277	0.39	FT40T5	3150	3	0.88	8315	108	77

3: Rated lamp lumens and performance data based on PENTRON® HO lamps. Rated lumens at 35°C lamp ambient temperature

Lamp for Fixture F1

TRU-AIM IR® MR16 LAMPS

UV Filter capsule with axial filament in covered constant color, hard coated dichroic reflector and infrared reflective coating on the lamp capsule.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Beam Type	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	CBCP	Beam Angle	MOL (in)
20	MR16	GU5.3 Bipin	58531	47,62,66, 91,93	20MR16/IR/SP10/C	12	20	SP	C,AXIAL	5000	3000	6000	10	1.75
			58532	47,62,66, 91,93	20MR16/IR/NFL25/C	12	20	NFL	C,AXIAL	5000	3000	2300	25	1.75
			58533	47,62,66, 91,93	20MR16/IR/FL35/C	12	20	FL	C,AXIAL	5000	3000	1000	35	1.75
			58838	47,62,66, 91,93	20MR16/IR/WFL60/C	12	20	WFL	C, AXIAL	5000	3000	450	60	1.75
37	MR16	GU5.3 Bipin	58641	37,47,62, 92,93	37MR16/IR/SP10/C	12	20	SP	C, AXIAL	5000	3000	12500	10	1.75
			58634	37,47,62, 92,93	37MR16/IR/NFL25/C	12	20	NFL	C, AXIAL	5000	3000	4400	25	1.75
			58633	37,47,62, 92,93	37MR16/IR/FL35/C	12	20	FL	C, AXIAL	5000	3000	2200	35	1.75
			58837	47,62,66, 92,93	37MR16/IR/WFL60/C	12	20	WFL	C, AXIAL	5000	3000	1100	60	1.75
50	MR16	GU5.3 Bipin	54175	37,47,62, 92,93	50MR16/IR/SP10/C	12	20	SP	C, AXIAL	5000	3000	15000	10	1.75
			54174	37,47,62, 92,93	50MR16/IR/NFL25/C	12	20	NFL	C, AXIAL	5000	3000	5700	25	1.75
			54173	37,47,62, 92,93	50MR16/IR/FL35/C	12	20	FL	C, AXIAL	5000	3000	2850	35	1.75
			54237	47,62,66, 92,93	50MR16/IR/WFL60/C	12	20	WFL	C, AXIAL	5000	3000	1430	60	1.75

TRU-AIM TITAN® MR16 LAMPS

UV Filter capsule with axial filament in covered constant color, hard coated dichroic reflector.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Beam Type	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	CBCP	Beam Angle	MOL (in)
20	MR16	GU5.3 Bipin	58300	62,65,91, 145	20MR16/T/SP10/C(ESX)	12	20	SP	C, AXIAL	4000	3000	5000	10	1.75
			58301	62,65,91, 93,145	20MR16/T/FL35/C(BAB)	12	20	FL	C, AXIAL	4000	3000	780	35	1.75
			58302	62,65,91, 93,145	20MR16/T/WFL60/C	12	20	WFL	C, AXIAL	4000	3000	350	60	1.75
35	MR16	GU5.3 Bipin	58303	62,65,91, 93,145	35MR16/T/SP10/C(FRB)	12	20	SP	C, AXIAL	4000	3000	9100	10	1.75
			58304	62,65,91, 93,145	35MR16/T/NFL25/C	12	20	NFL	C, AXIAL	4000	3000	3100	25	1.75
			58305	62,65,91, 93,145	35MR16/T/FL35/C(FMW)	12	20	FL	C, AXIAL	4000	3000	1500	35	1.75
			58306	62,65,91, 93,145	35MR16/T/WFL60/C	12	20	WFL	C, AXIAL	4000	3000	700	60	1.75
50	MR16	GU5.3 Bipin	58307	62,65,91, 93,145	50MR16/T/SP10/C(EXT)	12	20	SP	C, AXIAL	4000	3000	11500	10	1.75
			58308	62,65,91, 93,145	50MR16/T/NFL25/C(EXZ)	12	20	NFL	C, AXIAL	4000	3000	4400	25	1.75
			58309	62,65,91, 93,145	50MR16/T/FL35/C(EXN)	12	20	FL	C, AXIAL	4000	3000	2200	35	1.75

Lamp for Fixtures F4, F6, F14

DULUX® D/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast. Lamps have End-of-lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	D (T4)	5.2	131	G24Q-1	20682	**CF13DD/E/827/ECO**	CFQ13W/G24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20721	**CF13DD/E/830/ECO**	CFQ13W/G24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20671	**CF13DD/E/835/ECO**	CFQ13W/G24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20667	**CF13DD/E/841/ECO**	CFQ13W/G24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	D (T4)	5.8	147	G24Q-2	20683	**CF18DD/E/827/ECO**	CFQ18W/G24Q/827	50	12000	2700	82	1150	989	1,2,5,6, 7,12,20
					20724	**CF18DD/E/830/ECO**	CFQ18W/G24Q/830	50	12000	3000	82	1150	989	1,2,5,6, 7,12,20
					20672	**CF18DD/E/835/ECO**	CFQ18W/G24Q/835	50	12000	3500	82	1150	989	1,2,5,6, 7,12,20
					20668	**CF18DD/E/841/ECO**	CFQ18W/G24Q/841	50	12000	4100	82	1150	989	1,2,5,6, 7,12,20
26	D (T4)	6.5	166	G24Q-3	20684	**CF26DD/E/827/ECO**	CFQ26W/G24Q/827	50	12000	2700	82	1710	1470	1,2,5,6, 7,12,20
					20722	**CF26DD/E/830/ECO**	CFQ26W/G24Q/830	50	12000	3000	82	1710	1470	1,2,5,6, 7,12,20
					20673	**CF26DD/E/835/ECO**	CFQ26W/G24Q/835	50	12000	3500	82	1710	1470	1,2,5,6, 7,12,20
					20669	**CF26DD/E/841/ECO**	CFQ26W/G24Q/841	50	12000	4100	82	1710	1470	1,2,5,6, 7,12,20

DULUX T PREHEAT 2-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

With starter in Lamp Base for Magnetic Ballast

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
18	T (T4)	4.8	123	GX24D-2	20756	**CF18DT/827/ECO**	CFTR18W/GX24D/827	50	12000	2700	82	1200	1032	1,4,6,11, 12,20,22
26	T (T4)	5.4	138	GX24D-3	20752	**CF26DT/827/ECO**	CFTR26W/GX24D/827	50	12000	2700	82	1800	1548	1,4,6,11, 12,20,22

DULUX T/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

For dimming and electronic ballast. Lamps have End-of-Lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T (T4)	4.2	106	GX24Q-1	20891	**CF13DT/E/827/ECO**	CFTR13W/GX24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20892	**CF13DT/E/830/ECO**	CFTR13W/GX24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20893	**CF13DT/E/835/ECO**	CFTR13W/GX24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20894	**CF13DT/E/841/ECO**	CFTR13W/GX24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	T (T4)	4.6	116	GX24Q-2	20760	**CF18DT/E/827/ECO**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,5,6, 7,12,20

Lamp for Fixtures F5, F7, F11, F12, F16

PENTRON® T5 FLUORESCENT LAMPS

PENTRON® T5 lamps are designed to operate on dedicated electronic programmed rapid start (also know as programmed start) ballasts only. These lamps are globally standardized and are designed to operate with their peak light output at 35°C (95°F) ambient temperature. For comparison purposes and to accommodate existing lamp measurement standards, ratings are given at both 25°C (77°F) and 35°C (95°F). The new lamp dimensions allow for innovative fixture designs and improved fixture performance

PENTRON® High Performance T5 Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F (@35°C/95°F)	Mean @25°C/77°F (@35°C/95°F)	Symbols & Footnotes
28	T5	48	45.8	Mini Bipin	20868	**FP28/830/ECO**	40	20000	3000	85	2600 2900	2418 2697	CRI 31,33,38,48, 74,76
					20901	**FP28/835/ECO**	40	20000	3500	85	2600 2900	2418 2697	CRI 31,33,38,48, 74,76
					20902	**FP28/841/ECO**	40	20000	4100	85	2600 2900	2418 2697	CRI 31,33,38,48, 74,76
					22203	**FP28/850/ECO**	40	20000	5000	85	2545 2840	2367 2641	CRI 31,33,38,48, 74,76
					20990	**FP28/865/ECO**	40	20000	6500	85	2400 2750	2232 2558	CRI 31,33,38,48, 74,76
					20977	**FP28RED 40/CS 1/SKU**	40	20000			2100		15,31,33,38,48,74
					20978	**FP28GREEN 40/CS 1/SKU**	40	20000			3500		15,31,33,38,48,74
					20986	**FP28BLUE 40/CS 1/SKU**	40	20000			700		15,31,33,38,48,74
14	T5	24	22.2	Mini Bipin	20907	**FP14/830/ECO**	40	20000	3000	85	1200 1350	1116 1256	CRI 31,33,38,48, 74,76
					20908	**FP14/835/ECO**	40	20000	3500	85	1200 1350	1116 1256	CRI 31,33,38,48, 74,76
					20914	**FP14/841/ECO**	40	20000	4100	85	1200 1350	1116 1256	CRI 31,33,38,48, 74,76
					20988	**FP14/865/ECO**	40	20000	6500	85	1100 1300	1045 1209	CRI 31,33,38,48, 74,76
21	T5	36	34	Mini Bipin	20919	**FP21/830/ECO**	40	20000	3000	85	1900 2100	1767 1953	CRI 31,33,38,48, 74,76
					20921	**FP21/835/ECO**	40	20000	3500	85	1900 2100	1767 1953	CRI 31,33,38,48, 74,76
					20924	**FP21/841/ECO**	40	20000	4100	85	1900 2100	1767 1953	CRI 31,33,38,48, 74,76
					20989	**FP21/865/ECO**	40	20000	6500	85	1750 2000	1662 1860	CRI 31,33,38,48, 74,76
35	T5	60	57.6	Mini Bipin	20925	**FP35/830/ECO**	40	20000	3000	85	3300 3650	3069 3394	CRI 31,33,38,48, 74,76
					20926	**FP35/835/ECO**	40	20000	3500	85	3300 3650	3069 3394	CRI 31,33,38,48, 74,76
					20927	**FP35/841/ECO**	40	20000	4100	85	3300 3650	3069 3394	CRI 31,33,38,48, 74,76

PENTRON® PREMIER™ High Performance T5 Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F (@35°C/95°F)	Mean @25°C/77°F (@35°C/95°F)	Symbols & Footnotes
28	T5	48	45.8	Mini Bipin	20948	**FP28/830PM/ECO**	40	20000	3000	85	2730 3050	2594 2898	CRI 31,33,38,48, 74,76
					20943	**FP28/835PM/ECO**	40	20000	3500	85	2730 3050	2594 2898	CRI 31,33,38,48, 74,76
					20944	**FP28/841PM/ECO**	40	20000	4100	85	2730 3050	2594 2898	CRI 31,33,38,48, 74,76

Lamp for Fixtures F8, F9

DULUX® D/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast. Lamps have End-of-lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	D (T4)	5.2	131	G24Q-1	20682	**CF13DD/E/827/ECO**	CFQ13W/G24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20721	**CF13DD/E/830/ECO**	CFQ13W/G24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20671	**CF13DD/E/835/ECO**	CFQ13W/G24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20667	**CF13DD/E/841/ECO**	CFQ13W/G24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	D (T4)	5.8	147	G24Q-2	20683	**CF18DD/E/827/ECO**	CFQ18W/G24Q/827	50	12000	2700	82	1150	989	1,2,5,6, 7,12,20
					20724	**CF18DD/E/830/ECO**	CFQ18W/G24Q/830	50	12000	3000	82	1150	989	1,2,5,6, 7,12,20
					20672	**CF18DD/E/835/ECO**	CFQ18W/G24Q/835	50	12000	3500	82	1150	989	1,2,5,6, 7,12,20
					20668	**CF18DD/E/841/ECO**	CFQ18W/G24Q/841	50	12000	4100	82	1150	989	1,2,5,6, 7,12,20
26	D (T4)	6.5	166	G24Q-3	20684	**CF26DD/E/827/ECO**	CFQ26W/G24Q/827	50	12000	2700	82	1710	1470	1,2,5,6, 7,12,20
					20722	**CF26DD/E/830/ECO**	CFQ26W/G24Q/830	50	12000	3000	82	1710	1470	1,2,5,6, 7,12,20
					20673	**CF26DD/E/835/ECO**	CFQ26W/G24Q/835	50	12000	3500	82	1710	1470	1,2,5,6, 7,12,20
					20669	**CF26DD/E/841/ECO**	CFQ26W/G24Q/841	50	12000	4100	82	1710	1470	1,2,5,6, 7,12,20

DULUX T PREHEAT 2-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

With starter in Lamp Base for Magnetic Ballast

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
18	T (T4)	4.8	123	GX24D-2	20756	**CF18DT/827/ECO**	CFTR18W/GX24D/827	50	12000	2700	82	1200	1032	1,4,6,11, 12,20,22
26	T (T4)	5.4	138	GX24D-3	20752	**CF26DT/827/ECO**	CFTR26W/GX24D/827	50	12000	2700	82	1800	1548	1,4,6,11, 12,20,22

DULUX T/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

For dimming and electronic ballast. Lamps have End-of-Lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T (T4)	4.2	106	GX24Q-1	20891	**CF13DT/E/827/ECO**	CFTR13W/GX24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20892	**CF13DT/E/830/ECO**	CFTR13W/GX24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20893	**CF13DT/E/835/ECO**	CFTR13W/GX24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20894	**CF13DT/E/841/ECO**	CFTR13W/GX24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	T (T4)	4.6	116	GX24Q-2	20760	**CF18DT/E/827/ECO**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,5,6, 7,12,20

Lamp for Fixtures F13

DULUX® D/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast. Lamps have End-of-lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	D (T4)	5.2	131	G24Q-1	20682	**CF13DD/E/827/ECO**	CFQ13W/G24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20721	**CF13DD/E/830/ECO**	CFQ13W/G24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20671	**CF13DD/E/835/ECO**	CFQ13W/G24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20667	**CF13DD/E/841/ECO**	CFQ13W/G24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	D (T4)	5.8	147	G24Q-2	20683	**CF18DD/E/827/ECO**	CFQ18W/G24Q/827	50	12000	2700	82	1150	989	1,2,5,6, 7,12,20
					20724	**CF18DD/E/830/ECO**	CFQ18W/G24Q/830	50	12000	3000	82	1150	989	1,2,5,6, 7,12,20
					20672	**CF18DD/E/835/ECO**	CFQ18W/G24Q/835	50	12000	3500	82	1150	989	1,2,5,6, 7,12,20
					20668	**CF18DD/E/841/ECO**	CFQ18W/G24Q/841	50	12000	4100	82	1150	989	1,2,5,6, 7,12,20
26	D (T4)	6.5	166	G24Q-3	20684	**CF26DD/E/827/ECO**	CFQ26W/G24Q/827	50	12000	2700	82	1710	1470	1,2,5,6, 7,12,20
					20722	**CF26DD/E/830/ECO**	CFQ26W/G24Q/830	50	12000	3000	82	1710	1470	1,2,5,6, 7,12,20
					20673	**CF26DD/E/835/ECO**	CFQ26W/G24Q/835	50	12000	3500	82	1710	1470	1,2,5,6, 7,12,20
					20669	**CF26DD/E/841/ECO**	CFQ26W/G24Q/841	50	12000	4100	82	1710	1470	1,2,5,6, 7,12,20

DULUX T PREHEAT 2-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

With starter in Lamp Base for Magnetic Ballast

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
18	T (T4)	4.8	123	GX24D-2	20756	**CF18DT/827/ECO**	CFTR18W/GX24D/827	50	12000	2700	82	1200	1032	1,4,6,11, 12,20,22
26	T (T4)	5.4	138	GX24D-3	20752	**CF26DT/827/ECO**	CFTR26W/GX24D/827	50	12000	2700	82	1800	1548	1,4,6,11, 12,20,22

DULUX T/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

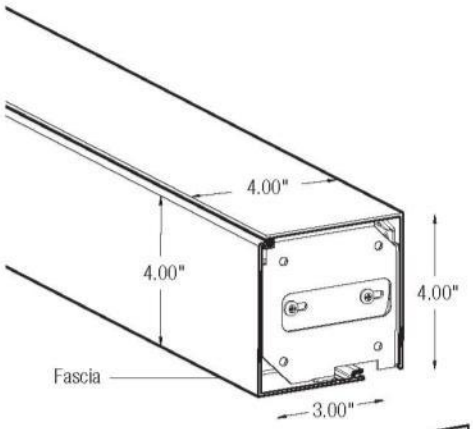
For dimming and electronic ballast. Lamps have End-of-Lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T (T4)	4.2	106	GX24Q-1	20891	**CF13DT/E/827/ECO**	CFTR13W/GX24Q/827	50	12000	2700	82	900	774	1,2,5,6, 7,12,20
					20892	**CF13DT/E/830/ECO**	CFTR13W/GX24Q/830	50	12000	3000	82	900	774	1,2,5,6, 7,12,20
					20893	**CF13DT/E/835/ECO**	CFTR13W/GX24Q/835	50	12000	3500	82	900	774	1,2,5,6, 7,12,20
					20894	**CF13DT/E/841/ECO**	CFTR13W/GX24Q/841	50	12000	4100	82	900	774	1,2,5,6, 7,12,20
18	T (T4)	4.6	116	GX24Q-2	20760	**CF18DT/E/827/ECO**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,5,6, 7,12,20

4" Fascia and Top-Back Cover

The 4" Fascia and Top-Back Cover system provides a top treatment to enclose either manual or motorized rollershade mechanisms. The Top-Back Cover blocks light that could enter the room over the top of the rollershade, while concealing the rollershade mechanism from viewers outside of the treated window.

The Fascia engages smoothly with the Top-Back Cover to complete the light seal and conceal the rollershade system from viewers inside the room being treated. When used in conjunction with side channels and sill angle, Fascia and Top-Back Cover provides one of the basic elements of a complete light blocking rollershade system.



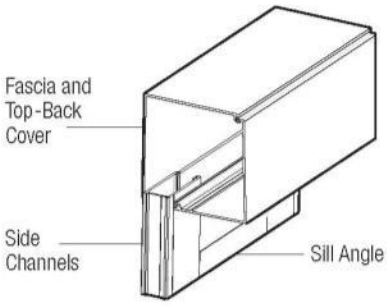
Fascia Endcap
Endcaps are available to finish outside mount applications

Specifications

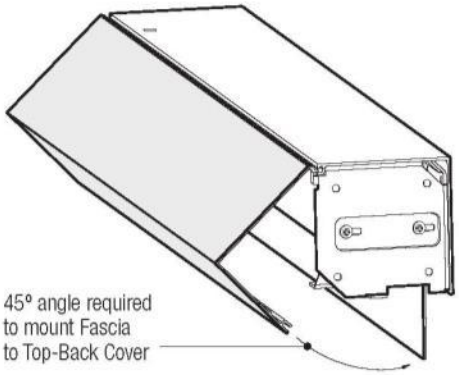
Material	0.075" Extruded Aluminum
Color	White, Bronze, and Anodized Custom colors are available and may result in additional lead time and cost
Length	Available in custom lengths up to 150"

Mounting

When designing trim around the Fascia system note that a 45° angle is required to mount the Fascia on the brackets and Top-Back Cover. For systems with ends that are either partially or completely exposed, end caps are available to create a finished appearance.



Blackout System Components



Attach Fascia

LUTRON. SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Worldwide Technical and Sales Assistance

Lutron Shading Solutions by VIMCO
11520 Sun Shade Lane
Ashland, VA 23005

www.lutron.com
www.vimco.com
customer service: 1.800.446.1503
fax: 1.804.752.3366
24/7 tech support: 1.800.523.9466
email: shadinginfo@lutron.com

Limited Warranty

Lutron Shading Solutions by VIMCO offers an 8-year limited warranty for our shading systems. Please contact customer service or visit our website for a complete warranty statement.

Lutron Shading Solutions by VIMCO reserves the right to make improvements or changes to these products without prior notice. Although every attempt is made to ensure that this information is accurate and up to date, please check with Lutron Shading Solutions by VIMCO to confirm product availability, latest specifications, and suitability for your application.

These products may be covered by one or more of the following US patents: 4,803,380; 4,835,343; 4,924,349; 5,180,886; 5,671,387; 5,848,634; 6,100,659; 6,313,588; 6,346,781; 6,497,267; D310,349; D370,663; D391,924; D422,567; D436,930; D453,742; D456,783; D461,782; D462,332; D465,460; D465,770; D466,090; D466,091; D466,484; D475,024; D475,025; and corresponding foreign patents. US and foreign patents pending.

Job Name:	Model Numbers:	
Job Number:		

Sivoia QED | roller 20

The *Sivoia QED* roller 20 shade utilizes the ultra-quiet, precision controlled Electronic Drive Unit (EDU). The *Sivoia QED* EDU is housed inside the roller shade assembly and controls the movement of the shade, keeps track of the shade's position, and adjusts the shade to the user's desired preset positions.

Sivoia QED roller 20 shade

Features

- Smooth, ultra-quiet operation
- Shades start, move and stop with precision
- Offers programmable stop points. The EDU tracks the position of the shade and is able to adjust it to predetermined locations at the touch of a button
- Provides maximum window coverage with small, symmetrical light gaps, 0.75 in (19 mm) between the shade fabric and the mounting bracket
- Easy-to-read and easy-to-use controls
- Optional infrared (IR) system provides easy, convenient control from anywhere in the room
- Integrates with Lutron lighting control systems and other AV equipment
- Does not require group controllers or relay systems to create shade groups and sub-groups
- The EDU requires only low-voltage wiring
- Power failure memory for the lifetime of the product
- 8 year limited warranty

Specifications

Power

- Requires 24 V~, 50 VA
- One transformer is required per EDU
- Power must be provided by a Lutron approved NEC Class 2 power source
- One EDU can power one accessory control (keypads and accessories)

System Capacity

- System allows for a total of 96 devices, including any type of *Sivoia QED* EDU, keypads, Contact Closure Input (CCI) or other interfaces
- If the number of keypads and interfaces in an installation exceeds the number of EDUs, external keypad power supplies are required
- Typical maximum shade size is 20 ft^2 (1.86 m^2)
- Maximum shade size is determined from shade width, fabric type, fabric weight, hembar type etc. (refer to Lutron Shade Configuration Tool (SCT) for your application)

Performance

- Ultra-quiet operation (will not exceed 44dBA measured 3 ft (1 m) from the EDU)
- System allows for symmetrical light gaps as small as 0.75 in (19 mm) on each side
- Each EDU stores programmable presets including open, closed, and any other position
- Presets can be recalled from keypads, CCI's, IR receivers, and other lighting control system interfaces
- Presets can be set with a 5 second button push and hold from the keypads, CCI's, or hand-held remote controls
- Keypad adjustment of presets can be disabled with the "lock out" function on the keypad
- Open and close limits are programmable from the EDU, wall-mounted keypads, and hand-held remote controls
- All system components are Electro Static Discharge (ESD) protected

Grouping

- Keypads and CCIs can control any EDU or group of EDUs without a separate group controller
- System groups and subgroups can be configured at the point of control without rewiring and without access to the EDU
- System may contain multiple EDU types
- Keypads and interfaces within the system are able to operate any group or subgroup of EDUs

Integration

- EDUs seamlessly integrate with Lutron lighting control systems including, GRAFIK Eye®, RadioRA®, HomeWorks®, and RadioTouch®
- Contact closure available to integrate with A/V equipment such as time clocks and security systems.

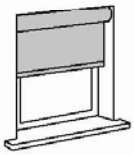
Controls

- Keypads and CCIs are low-voltage and receive their power from the EDUs
- All system devices must be connected through a common communication link
- IR controls available. IR receivers can be wired directly to EDU. There are also *Sivoia QED* keypads and CCIs with built in IR receivers

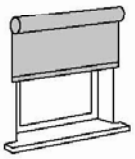
Sivoia QED roller 20™ shade options

Mounting options

Depending on window dimensions, brackets can be mounted inside the window frame, outside the window frame, to the ceiling, or in a pocket.



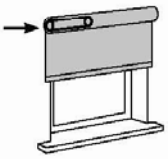
Inside mount



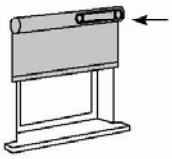
Outside mount

Drive side options

EDU can be mounted on the left or right of the shade:

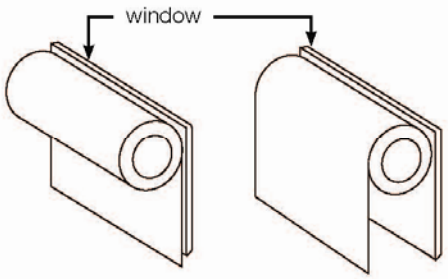


Left drive side



Right drive side

Fabric drop options

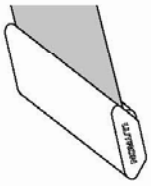


Regular roll

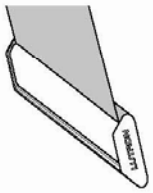
Reverse roll

Architectural bottom bar options

The bottom bar comes in two varieties:



Exposed bottom bar
Available in: white, bronze, anodized, and custom color. Welded bottom bars also available.



Half-wrap bottom bar (reverse view shown)

Fabric options

Sivoia QED roller shades are available in a wide variety of fabric types including:
Sheer Filter sun light, UV protection, view
Privacy Minimal translucence, UV protection
Blackout Total darkness, maximum UV protection, no view

For complete fabric selection, visit www.lutron.com

APPENDIX D : KALWALL SPEC

2007 MASTER FORMAT™ SECTION 08 45 23

INSULATED TRANSLUCENT FIBERGLASS SANDWICH PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the insulated translucent sandwich panel system as shown and specified. Work includes providing and installing:

1. Flat (curved) factory prefabricated structural insulated translucent sandwich panels.

2. Aluminum installation system.

3. Aluminum sill flashing.

1.2 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.

B. Submit shop drawings. Include elevations, details, dimensions and attachments to other work.

C. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.

a. Sandwich panels: 14" x 28" units

b. Factory finished aluminum: 5" long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product test reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:

a. Flame Spread and Smoke Developed (UL 723) – Submit UL Card

b. Burn Extent (ASTM D-635)

c. Color Difference (ASTM D-2244)

d. Abrasion/Erosion Resistance (ASTM D-4060)

e. Impact Strength (UL 972)

f. Bond Tensile Strength (ASTM C-297 after aging by ASTM D-1037)

g. Bond Shear Strength (ASTM D-1002)

h. Beam Bending Strength (ASTM E-72)

i. Insulation U-Factor (NFRC-100)

j. NFRC System Certification

k. Condensation Resistance Factor (AAMA 1503)

l. Class 1 Fire Approval (FM 4881) (Optional)

m. Blast Analysis and Testing of Translucent Sandwich Panels Demonstrating Equivalent Performance to 1/4" Laminated Glass per DoD UFC 4-010-01 (Optional)

F. Submit current documentation indicating regular, independent quality control monitoring under a nationally recognized building code review and listing program.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten (10) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been in successful use for ten (10) years or longer.

2. Panel system must be listed by the International Code Council – Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an approved agency.

3. Quality control inspections and required testing shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with “Acceptance Criteria for Sandwich Panels” as regulated by the ICC-ES.

B. Installer’s Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

C. Performance Requirements: The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 DELIVERY STORAGE AND HANDLING

A. Deliver panel system, components and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge, several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.5 WARRANTY

A. Submit manufacturer's and installer's written warranty agreeing to repair or replace panel system work which fails in materials or workmanship within one (1) year of the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering and defects in accessories, insulated translucent sandwich panels and other components of the work. (Contact local representative for extended warranty periods.)

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Kalwall Corporation, tel: (800) 258-9777 – fax: (603) 627-7905 – email: info@kalwall.com

2.2 PANEL COMPONENTS

A. Face Sheets

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.

a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.

2. Flammability of interior face sheets:

a. Flamespread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flamespread rating no greater than 50 (20) and smoke developed no greater than 250 (200) when tested in accordance with UL 723.

b. Burn extent by ASTM D-635 shall be no greater than 1”.

c. Face sheets shall not deform, deflect or drip when subjected to fire or flame.

d. Face sheets shall not delaminate when exposed to 200°F for 30 minutes per IBC and NBC (300°F for 25 minutes per UBC and SBC).

3. Weatherability of exterior face sheets:

a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3.0 CIE Units DELTA E by ASTM D-2244 after 5 years outdoor South Florida weathering at 5 degrees facing south, determined by the average of at least three (3) white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.

b. Erosion barrier: Exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide long-term resistance to reinforcing fiber exposure. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D-4060 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles. Sacrificial surface films or coatings are not acceptable erosion barriers.

4. Appearance:

a. Exterior face sheets: Smooth, 0.070" thick and _____ in color.

b. Interior face sheets: Smooth, 0.045" thick and _____ in color.

c. Face sheets shall not vary more than +/- 10% in thickness and be uniform in color.

5. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 (230) ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

B. Grid Core

1. Thermally broken (aluminum) I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I- beam shall be no less than 7/16". The I-beam grid shall be machined to tolerances of not greater than +/- .002".

2. Thermal break: Minimum 1".

C. Laminate Adhesive

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives."

2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.

3. Minimum shear strength of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:

a. 50% Relative Humidity at 73° F: 540 PSI

b. 182° F: 100 PSI

c. Accelerated Aging by ASTM D-1037 at room temperature: 800 PSI

d. Accelerated Aging by ASTM D-1037 at 182° F: 250 PSI

e. 500 Hour Oxygen Bomb by ASTM D-572: 1400 PSI

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken (aluminum) I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat sharp edge.

1. Thickness: 2-3/4”

2. Light transmission: _____.

3. Solar heat gain coefficient: _____.

4. U-factor by NFRC certified laboratory:(0.23, 0.14, 0.10, 0.05) thermally broken [OR (0.53, 0.29, 0.22, 0.18) aluminum I-beam].

a. Complete insulated panel system shall have NFRC certified U-factor of _____.

5. Grid pattern: Nominal 12” x 24” (8” x 20”, 12” x 12”, other) shoji (reverse shoji, square, staggered)..

B. Panels shall deflect no more than 1.9” at 30 psf in 10’-0” span without a supporting frame by ASTM E-72.

C. Panels shall withstand 1200ºF fire for minimum one (1) hour without collapse or exterior flaming.

D. Thermally broken panels:

1. Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.

2. Minimum CRF of 90 at center of grid cell.

E. (OPTIONAL) Panel system shall be a Factory Mutual (FM) tested and approved Class 1 wall system in accordance with FM 4881.

F. (OPTIONAL) Panels shall demonstrate performance equivalent to 1/4" laminated glass under blast loading as specified in DoD UFC 4-010-01.

2.4 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Closure system: Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.

1. (Optional) Thermally broken perimeter system shall have a urethane bridge.

2. (Optional) Perimeter system shall be factory prefabricated “Superbreak” as shown on drawings.

3. (Optional) Curved closure system may be roll formed.

B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

D. Finish: Exposed aluminum to be manufacturer's factory applied finish that meets the performance requirements of AAMA 2604. (Mill)

1. Color _____ (selected from manufacturer's standard colors).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, supporting structure and installation conditions. Do not proceed with panel erection until unsatisfactory conditions have been corrected.

3.2 PRERARATION

A. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

3.2 PREPARATION (continued)

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

A. Install the panel system in accordance with the manufacturer's installation recommendations and approved shop drawings.

1. Anchor component parts securely in place by permanent mechanical attachment system.

2. Accommodate thermal and mechanical movements.

3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's installation instructions.

3.4 CLEANING

A. Clean the panel system inside and outside, immediately after installation, according to manufacturer's written recommendations.

END OF SECTION 08 45 23

APPENDIX E: SHORT CIRCUIT ANALYSIS

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ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
SKM DISCLAIMS ANY RESPONSIBILITY AND LIABILITY RESULTING
FROM THE USE AND INTERPRETATION OF THIS SOFTWARE.

SKM POWER*TOOLS FOR WINDOWS
SHORT CIRCUIT ANALYSIS REPORT

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ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

SWING GENERATORS

SOURCE NAME	VOLTAGE	ANGLE
NSTAR	1.00	0.00

PQ MACHINES

SOURCE	kW	kVAR
Emergency Gene	300.	375.

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************* P R E - F A U L T V O L T A G E P R O F I L E **************

BUS# NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
BUS-0001	13800.00	1.1930	8.
BUS-0007	480.00	1.2549	8.
BUS-0009	480.00	1.2549	8.
BUS-0020	480.00	1.2541	8.
BUS-0021	480.00	1.2541	8.
BUS-0022	480.00	1.2544	8.
BUS-0023	208.00	1.2544	8.
BUS-0030	480.00	1.2544	8.
BUS-0031	480.00	1.2544	8.
BUS-0037	480.00	1.2543	8.
BUS-0047	480.00	0.0000	0.

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BUS-0048	480.00	0.0000	0.
BUS-0052	480.00	1.2543	8.
BUS-0053	480.00	1.2543	8.
BUS-0054	480.00	1.2543	8.
BUS-0055	480.00	1.2543	8.
BUS-0056	480.00	1.2543	8.
BUS-0057	480.00	1.2543	8.
BUS-0058	480.00	1.2543	8.
BUS-0059	480.00	1.2543	8.
BUS-0060	480.00	1.2543	8.
BUS-0061	480.00	1.2543	8.
BUS-0062	480.00	1.2543	8.
BUS-0063	480.00	1.2543	8.
BUS-0064	480.00	1.2543	8.
BUS-0065	480.00	1.2543	8.
BUS-0066	480.00	1.2545	8.
BUS-0068	480.00	1.2549	8.
BUS-0069	480.00	0.0000	0.
DB4B	480.00	1.2541	8.
Generator	208.00	1.2556	8.
KC2	208.00	1.2544	8.
KCP	208.00	1.2544	8.
LS2B	208.00	1.2549	8.
LS42	480.00	1.2547	8.
LS45	480.00	1.2547	8.
LSDP4	480.00	1.2547	8.
MP27A	480.00	1.2543	8.
MS2	208.00	1.2543	8.
MSB	480.00	1.2541	8.
MSK	208.00	1.2544	8.
OS21	208.00	1.2556	8.
OS24	208.00	1.2556	8.
OS2BK	208.00	1.2556	8.

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************* P R E - F A U L T V O L T A G E P R O F I L E **************

BUS# NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
OSDP2B	208.00	1.2556	8.
OSDP4	480.00	1.2556	8.
RP21	208.00	1.2543	8.
RP22	208.00	1.2543	8.
RP23	208.00	1.2543	8.
RP24	208.00	1.2543	8.
RP25	208.00	1.2543	8.
RP26	208.00	1.2543	8.
RP2B	208.00	1.2543	8.
RP2BA	208.00	1.2543	8.
RP2K	208.00	1.2544	8.
RP2P	208.00	1.2545	-22.

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***************** F A U L T A N A L Y S I S R E P O R T ****************

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```
                FAULT TYPE: 3PH
                MODEL INDUCTION MOTOR CONTRIBUTION: YES
                MODEL TRANSFORMER TAPS: YES
                MODEL TRANSFORMER PHASE SHIFT: YES
 ================================================================

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  DB4B            VOLTAGE BASE LL:                 480.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:   2432.7 /  -77. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:    5.399 +j  61.774 (PU)
                  THEVENIN IMPEDANCE X/R RATIO:    11.442

                   ASYM     RMS    INTERRUPTING AMPS
                  1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
                      3571.0       2689.6       2521.2       2442.7       2433.0

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                  0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                  INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                   2432.7 / -76.8       2432.7 / 163.2       2432.7 /  43.2

  DB4B            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                            ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSB                 480.0  0.0239 / -32.  0.0239 /-152.  0.0239 /  88.
    DB4B              ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================

                                FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-      -PHASE B-

-PHASE C-
 AHU-1          DB4B                          480.   187.3/ -76.   187.3/ 164.
187.3/  44.
 AHU-1a         DB4B                          480.   187.3/ -76.   187.3/ 164.
187.3/  44.
 BP             DB4B                          480.    25.1/ -76.    25.1/ 164.
25.1/  44.
 MSB            DB4B          Wire 4          480.  2033.1/ -77.  2033.1/ 163.
2033.1/  43.

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  Generator       VOLTAGE BASE LL:                 208.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:   5396.3 /  -75. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:    7.617 +j  64.134 (PU)
                                  Page 3
```

```
                  THEVENIN IMPEDANCE X/R RATIO:     8.420

                   ASYM     RMS    INTERRUPTING AMPS
                  1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
                      7532.3       5662.5       5457.3       5399.4       5396.3

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                  0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                  INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                   5396.3 / -75.0       5396.3 / 165.0       5396.3 /  45.0

  Generator       ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                            ---PHASE A---      ---PHASE B---      ---PHASE C---
    OSDP2B              208.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
    Generator         ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
==============

                                FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-      -PHASE B-

-PHASE C-
 OSDP2B         Generator      Wire 54          208.  5396.3/ -75.  5396.3/ 165.
5396.3/  45.

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  KC2             VOLTAGE BASE LL:                 208.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:   5390.5 /  -75. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:    7.718 +j  64.129 (PU)
                  THEVENIN IMPEDANCE X/R RATIO:     8.309

                   ASYM     RMS    INTERRUPTING AMPS
                  1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
                      7506.0       5646.3       5447.9       5393.3       5390.6

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                  0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                  INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =      0.5 CYCLES
                  ---PHASE A---        ---PHASE B---        ---PHASE C---
                   5390.5 / -74.9       5390.5 / 165.1       5390.5 /  45.1

  KC2             ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                            ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSK                 208.0  0.0274 / -30.  0.0274 /-150.  0.0274 /  90.
    KC2               ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
==============

                                  Page 4
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                                    SC
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MSK              KC2           Wire 42          208.  5390.5/ -75.  5390.5/ 165.
5390.5/  45.

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  KCP            VOLTAGE BASE LL:                208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5390.5 /  -75. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    7.718 +j  64.129 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     8.309

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7506.0      5646.3      5447.9      5393.3      5390.6

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5390.5 / -74.9     5390.5 / 165.1      5390.5 /  45.1

  KCP            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSK              208.0  0.0274 / -30.  0.0274 /-150.  0.0274 /  90.
    KCP            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MSK              KCP           Wire 41          208.  5390.5/ -75.  5390.5/ 165.
5390.5/  45.

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  LS2B           VOLTAGE BASE LL:                208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5388.1 /  -75. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    7.727 +j  64.184 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     8.307

                  ASYM    RMS   INTERRUPTING AMPS
                                    Page 5
```

```
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7502.3      5643.6      5445.4      5390.9      5388.1

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5388.1 / -74.9     5388.1 / 165.1      5388.1 /  45.1

  LS2B           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    BUS-0068         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    LS2B           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0068       LS2B          T2               208.  5388.1/ -75.  5388.1/ 165.
5388.1/  45.

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  LS42           VOLTAGE BASE LL:                480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2335.3 /  -75. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    7.724 +j  64.158 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     8.307

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    3251.7      2446.0      2360.2      2336.5      2335.3

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2335.3 / -74.9     2335.3 / 165.1      2335.3 /  45.1

  LS42           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    LSDP4            480.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
    LS42           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
                                    Page 6
```

```
 LSDP4          LS42          Wire 44          480.  2335.3/ -75.  2335.3/ 165.
2335.3/  45.

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  LS45          VOLTAGE BASE LL:                 480.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   2335.3 /  -75. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    7.724 +j  64.158 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     8.307

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   3251.7      2446.0      2360.2      2336.5      2335.3

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 2335.3 / -74.9      2335.3 / 165.1      2335.3 /  45.1

  LS45          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    LSDP4            480.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
    LS45           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 LSDP4          LS45          Wire 45          480.  2335.3/ -75.  2335.3/ 165.
2335.3/  45.

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  LSDP4         VOLTAGE BASE LL:                 480.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   2376.0 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.724 +j  63.158 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     9.393

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   3380.7      2534.4      2418.6      2379.0      2376.1

                                Page 7
```

```
                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 2376.0 / -75.7      2376.0 / 164.3      2376.0 /  44.3

  LSDP4         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    BUS-0031         480.0  0.0279 / -31.  0.0279 /-151.  0.0279 /  89.
    LS45             480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    LS42             480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    BUS-0068         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    LSDP4          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0031       LSDP4         Wire 9           480.  2376.0/ -76.  2376.0/ 164.
2376.0/  44.
 LSDP4          LS45          Wire 45          480.     0.0/   0.     0.0/   0.
0.0/   0.
 LSDP4          LS42          Wire 44          480.     0.0/   0.     0.0/   0.
0.0/   0.
 LSDP4          BUS-0068      Wire 43          480.     0.0/   0.     0.0/   0.
0.0/   0.

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  MP27A         VOLTAGE BASE LL:                 480.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   2459.8 /  -77. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    4.769 +j  61.146 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    12.821

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   3669.3      2784.8      2586.6      2478.1      2460.8

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 2459.8 / -77.3      2459.8 / 162.7      2459.8 /  42.7

  MP27A         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
                                Page 8
```

```
    MSB             480.0  0.0078 / -33.  0.0078 /-153.  0.0078 /  87.
    BUS-0052        480.0  0.0003 / -31.  0.0003 /-151.  0.0003 /  89.
    BUS-0053        480.0  0.0003 / -31.  0.0003 /-151.  0.0003 /  89.
    BUS-0054        480.0  0.0001 / -31.  0.0001 /-151.  0.0001 /  89.
    BUS-0055        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0056        480.0  0.0013 / -31.  0.0013 /-151.  0.0013 /  89.
    BUS-0057        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0058        480.0  0.0007 / -31.  0.0007 /-151.  0.0007 /  89.
    BUS-0059        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0060        480.0  0.0007 / -31.  0.0007 /-151.  0.0007 /  89.
    BUS-0061        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0062        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0063        480.0  0.0005 / -31.  0.0005 /-151.  0.0005 /  89.
    BUS-0064        480.0  0.0018 / -31.  0.0018 /-151.  0.0018 /  89.
    BUS-0065        480.0  0.0018 / -31.  0.0018 /-151.  0.0018 /  89.
    BUS-0066        480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
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    MP27A          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                 BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 CP-2            MP27A                          480.     4.2/ -76.     4.2/ 164.
4.2/  44.
 CP-1            MP27A                          480.     4.2/ -76.     4.2/ 164.
4.2/  44.
 AHU-2B          MP27A                          480.   149.8/ -76.   149.8/ 164.
149.8/  44.
 AHU-2A          MP27A                          480.   149.8/ -76.   149.8/ 164.
149.8/  44.
 MSB             MP27A          Wire 2          480.  1320.8/ -78.  1320.8/ 162.
1320.8/  42.
 MP27A           BUS-0052       Wire 27         480.    25.1/ 104.    25.1/ -16.
25.1/-136.
 MP27A           BUS-0053       Wire 28         480.    25.1/ 104.    25.1/ -16.
25.1/-136.
 MP27A           BUS-0054       Wire 26         480.     6.3/ 104.     6.3/ -16.
6.3/-136.
 MP27A           BUS-0055       Wire 25         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0056       Wire 24         480.   112.3/ 104.   112.3/ -16.
112.3/-136.
 MP27A           BUS-0057       Wire 23         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0058       Wire 22         480.    56.2/ 104.    56.2/ -16.
56.2/-136.
 MP27A           BUS-0059       Wire 21         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0060       Wire 20         480.    56.2/ 104.    56.2/ -16.
56.2/-136.
 MP27A           BUS-0061       Wire 19         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0062       Wire 18         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0063       Wire 17         480.    41.9/ 104.    41.9/ -16.
41.9/-136.
 MP27A           BUS-0064       Wire 16         480.   149.7/ 104.   149.7/ -16.
149.7/-136.
 MP27A           BUS-0065       Wire 15         480.   149.7/ 104.   149.7/ -16.
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149.7/-136.
 MP27A           BUS-0066       Wire 31         480.     0.0/   0.     0.0/   0.
0.0/   0.

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  MS2            VOLTAGE BASE LL:                208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5629.8 /  -77. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    5.220 +j  61.619 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:    11.804

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     8301.9      6263.8      5856.2      5657.2      5631.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5629.8 / -76.9     5629.8 / 163.1      5629.8 /  43.1

  MS2            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                  ---PHASE A---     ---PHASE B---     ---PHASE C---
    BUS-0037          480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP21              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP22              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP23              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP24              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP25              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP26              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP2B              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP2BA             208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    MS2            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                 BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0037        MS2            T8              480.  2439.6/ -77.  2439.6/ 163.
2439.6/  43.
 MS2             RP21           Wire 47         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP22           Wire 48         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP23           Wire 49         208.     0.0/   0.     0.0/   0.
0.0/   0.
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    MS2          ================  FIRST BUS FROSYSTEM BRANCH FLOWS ( AMPS )
==============

 MS2             RP24            Wire 50          208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP25            Wire 51          208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP26            Wire 52          208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP2B            Wire 46          208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP2BA           Wire 53          208.     0.0/   0.     0.0/   0.
0.0/   0.

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  MSB            VOLTAGE BASE LL:                 480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2461.3 /  -77. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    4.719 +j  61.107 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:    12.949

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     3676.4      2792.4      2591.7      2480.4      2462.3

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2461.3 / -77.4     2461.3 / 162.6      2461.3 /  42.6

  MSB            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0001       13800.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    MP27A            480.0  0.0067 / -31.  0.0067 /-151.  0.0067 /  89.
    BUS-0007         480.0  0.0008 / -31.  0.0008 /-151.  0.0008 /  89.
    DB4B             480.0  0.0047 / -31.  0.0047 /-151.  0.0047 /  89.
    BUS-0020         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    BUS-0021         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    BUS-0022         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    BUS-0030         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    BUS-0037         480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    MSB            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0001        MSB             T              13800.    31.4/ -80.    31.4/ 160.
31.4/  40.
 MSB             MP27A           Wire 2           480.  1135.0/ 104.  1135.0/ -16.
                                    Page 11
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1135.0/-136.
 MSB             BUS-0007        Wire 11          480.    71.3/ 104.    71.3/ -16.
71.3/-136.
 MSB             DB4B            Wire 4           480.   398.5/ 104.   398.5/ -16.
398.5/-136.
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    MSB          ================  FIRST BUS FROSYSTEM BRANCH FLOWS ( AMPS )
==============

 MSB             BUS-0020        Wire 6           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB             BUS-0021        Wire 7           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB             BUS-0022        Wire 8           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB             BUS-0030        Wire 12          480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB             BUS-0037        Wire 10          480.     0.0/   0.     0.0/   0.
0.0/   0.

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  MSK            VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5484.3 /  -76. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    6.720 +j  63.131 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     9.395

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     7803.7      5850.0      5582.6      5491.2      5484.5

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5484.3 / -75.7     5484.3 / 164.3      5484.3 /  44.3

  MSK            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0023         208.0  0.0279 / -31.  0.0279 /-151.  0.0279 /  89.
    RP2K             208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    KCP              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    KC2              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    MSK            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                    Page 12
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                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0023       MSK             Wire 8A          208.  5484.3/ -76.  5484.3/ 164.
5484.3/  44.
 MSK            RP2K            Wire 40          208.     0.0/   0.     0.0/   0.
0.0/    0.
 MSK            KCP             Wire 41          208.     0.0/   0.     0.0/   0.
0.0/    0.
 MSK            KC2             Wire 42          208.     0.0/   0.     0.0/   0.
0.0/    0.

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  OS21          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5396.3 /  -75. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    7.617 +j  64.134 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     8.420

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7532.3      5662.5      5457.3      5399.4      5396.3

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5396.3 / -75.0     5396.3 / 165.0      5396.3 /  45.0

  OS21          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    OSDP2B          208.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
    OS21          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
===============
                               FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                              BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP2B         OS21            Wire 55          208.  5396.3/ -75.  5396.3/ 165.
5396.3/  45.

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  OS24          VOLTAGE BASE LL:                208.0 (VOLTS)
                                    Page 13
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```
                INI. SYM. RMS FAULT CURRENT:   5396.5 /  -75. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    7.615 +j  64.132 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     8.422

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7532.9      5662.9      5457.6      5399.6      5396.6

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5396.5 / -75.0     5396.5 / 165.0      5396.5 /  45.0

  DS24          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    OSDP2B          208.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
    OS24          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
===============
                               FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                              BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP2B         DS24            Wire 56          208.  5396.5/ -75.  5396.5/ 165.
5396.5/  45.

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  DS2BK         VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5396.3 /  -75. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    7.617 +j  64.134 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     8.420

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7532.3      5662.5      5457.3      5399.4      5396.3

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5396.3 / -75.0     5396.3 / 165.0      5396.3 /  45.0

  DS2BK         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    OSDP2B          208.0  0.0275 / -30.  0.0275 /-150.  0.0275 /  90.
                                    Page 14
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    OS2BK          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP2B         OS2BK          Wire 36          208.  5396.3/ -75.  5396.3/ 165.
5396.3/  45.

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  OSDP2B         VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5490.3 /  -76. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    6.616 +j  63.133 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     9.542

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     7832.7      5871.3      5595.0      5497.9      5490.5

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =      0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =      0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5490.3 / -75.8      5490.3 / 164.2      5490.3 /  44.2

  OSDP2B         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    OSDP4             480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    Generator         208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    OS2BK             208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    OS21              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    OS24              208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    OSDP2B         ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP4          OSDP2B         T5               480.  2379.1/ -76.  2379.1/ 164.
2379.1/  44.
 OSDP2B         Generator      Wire 54          208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS2BK          Wire 36          208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS21           Wire 55          208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS24           Wire 56          208.     0.0/   0.     0.0/   0.
0.0/   0.

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  OSDP4          VOLTAGE BASE LL:                 480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2379.1 /  -76. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    6.616 +j  63.133 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     9.543

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     3394.2      2544.3      2424.5      2382.4      2379.2

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =      0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =      0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2379.1 / -75.8      2379.1 / 164.2      2379.1 /  44.2

  OSDP4          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0009          480.0  0.0271 / -31.  0.0271 /-151.  0.0271 /  89.
    OSDP2B            208.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    OSDP4          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 JP-1           OSDP4                            480.    12.6/ -76.    12.6/ 164.
12.6/  44.
 SE-1           OSDP4                            480.    41.9/ -76.    41.9/ 164.
41.9/  44.
 SP-1           OSDP4                            480.    16.8/ -76.    16.8/ 164.
16.8/  44.
 BUS-0009       OSDP4          Wire 11A          480.  2307.9/ -76.  2307.9/ 164.
2307.9/  44.
 OSDP4          OSDP2B         T5                480.     0.0/   0.     0.0/   0.
0.0/   0.

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  RP21           VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5532.7 /  -76. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:    6.219 +j  62.618 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:    10.069

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                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7963.3      5971.3      5662.1      5543.5      5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5532.7 / -76.1      5532.7 / 163.9      5532.7 /  43.9

  RP21          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2              208.0  0.0281 / -31.  0.0281 /-151.  0.0281 /  89.
    RP21           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP21          Wire 47          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP22          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5532.7 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.069

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7963.3      5971.3      5662.1      5543.5      5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5532.7 / -76.1      5532.7 / 163.9      5532.7 /  43.9

  RP22          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2              208.0  0.0281 / -31.  0.0281 /-151.  0.0281 /  89.
    RP22           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
                                      Page 17
```

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-PHASE C-
 MS2            RP22          Wire 48          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP23          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5532.7 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.069

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7963.3      5971.3      5662.1      5543.5      5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5532.7 / -76.1      5532.7 / 163.9      5532.7 /  43.9

  RP23          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2              208.0  0.0281 / -31.  0.0281 /-151.  0.0281 /  89.
    RP23           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP23          Wire 49          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP24          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5532.7 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.069

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7963.3      5971.3      5662.1      5543.5      5532.9
                                      Page 18
```

```
                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                0.0000 /    0.0    0.0000 /    0.0    0.0000 /    0.0

                INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                 5532.7 / -76.1    5532.7 / 163.9     5532.7 /  43.9

  RP24          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MS2              208.0  0.0281 / -31.   0.0281 /-151.   0.0281 /  89.
    RP24          ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                               BRANCH NAME    VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP24           Wire 50          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP25          VOLTAGE BASE LL:                    208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:    5532.7 /  -76.  ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:     6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     10.069

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    7963.3       5971.3      5662.1       5543.5       5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                0.0000 /    0.0    0.0000 /    0.0    0.0000 /    0.0

                INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                 5532.7 / -76.1    5532.7 / 163.9     5532.7 /  43.9

  RP25          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MS2              208.0  0.0281 / -31.   0.0281 /-151.   0.0281 /  89.
    RP25          ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                               BRANCH NAME    VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP25           Wire 51          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.
                                      Page 19
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  RP26          VOLTAGE BASE LL:                    208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:    5532.7 /  -76.  ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:     6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     10.069

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    7963.3       5971.3      5662.1       5543.5       5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                0.0000 /    0.0    0.0000 /    0.0    0.0000 /    0.0

                INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---      ---PHASE B---      ---PHASE C---
                 5532.7 / -76.1    5532.7 / 163.9     5532.7 /  43.9

  RP26          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MS2              208.0  0.0281 / -31.   0.0281 /-151.   0.0281 /  89.
    RP26          ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                               BRANCH NAME    VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP26           Wire 52          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP28          VOLTAGE BASE LL:                    208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:    5532.7 /  -76.  ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:     6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     10.069

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    7963.3       5971.3      5662.1       5543.5       5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                                    Page 20
```

```
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                 5532.7 / -76.1       5532.7 / 163.9       5532.7 /  43.9

  RP2B          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MS2             208.0  0.0281 / -31.  0.0281 /-151.  0.0281 /  89.
    RP2B          ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
 MS2            RP2B            Wire 46          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP2BA         VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5532.7 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.219 +j  62.618 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.069

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   7963.3      5971.3      5662.1      5543.5      5532.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                 5532.7 / -76.1       5532.7 / 163.9       5532.7 /  43.9

  RP2BA         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MS2             208.0  0.0281 / -31.  0.0281 /-151.  0.0281 /  89.
    RP2BA         ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
 MS2            RP2BA           Wire 53          208.  5532.7/ -76.  5532.7/ 164.
5532.7/  44.

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  RP2K          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5390.5 /  -75. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    7.718 +j  64.129 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     8.309

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   7506.0      5646.3      5447.9      5393.3      5390.6

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                 5390.5 / -74.9       5390.5 / 165.1       5390.5 /  45.1

  RP2K          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSK             208.0  0.0274 / -30.  0.0274 /-150.  0.0274 /  90.
    RP2K          ================ INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                                 FIRST BUS FROM FAULT    AT TIME =      0.5 CYCLES
                                BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
 MSK            RP2K            Wire 40          208.  5390.5/ -75.  5390.5/ 165.
5390.5/  45.

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  RP2P          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5577.0 / -106. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    5.771 +j  62.172 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.773

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   8112.9      6094.0      5743.0      5593.3      5577.5

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =      0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0      0.0000 /    0.0      0.0000 /    0.0

                                    Page 22
```

```
                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                 5577.0 /-106.5      5577.0 / 133.5       5577.0 /  13.5

  RP2P          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    BUS-0066        480.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
    RP2P          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                              FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0066       RP2P          T3              480.  2366.8/ -79.  2366.8/ 161.
2366.8/  41.

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 ***************** F A U L T    A N A L Y S I S    R E P O R T ****************

                FAULT TYPE: SLG
                MODEL INDUCTION MOTOR CONTRIBUTION: YES
                MODEL TRANSFORMER TAPS: YES
                MODEL TRANSFORMER PHASE SHIFT: YES
 ================================================================

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  DB4B          VOLTAGE BASE LL:                 480.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:      0.0 /  -37. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     1.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   5.399 +j  61.774 (PU)
                                              Z2:   5.399 +j  61.774 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0     2.1722 / -141.8      2.1722 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

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```

```
  DB4B          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSB             480.0  0.0000 /   0.  2.1722 /-142.  2.1722 / 158.
    DB4B          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                              FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 AHU-1          DB4B                          480.     0.0/ -36.     0.0/   0.
0.0/   0.
 AHU-1a         DB4B                          480.     0.0/ -36.     0.0/   0.
0.0/   0.
 BP             DB4B                          480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            DB4B          Wire 4          480.     0.0/ -37.     0.0/   0.
0.0/   0.

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  Generator     VOLTAGE BASE LL:                 208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.617 +j  64.134 (PU)
                                              Z2:   7.617 +j  64.134 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                0.0000 /    0.0     2.1748 / -141.8      2.1748 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---        ---PHASE B---        ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  Generator     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    DSDP2B          208.0  0.0000 /   0.  2.1748 /-142.  2.1748 / 158.
    Generator     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                              FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP2B         Generator     Wire 54          208.     0.0/   8.     0.0/   0.
0.0/   0.

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  KC2             VOLTAGE BASE LL:                  208.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                  THEVENIN IMPEDANCE X/R RATIO:     0.000
                  SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.718 +j  64.129 (PU)
                                                Z2:   7.718 +j  64.129 (PU)
                                                Z0: INFINITE

                   ASYM     RMS   INTERRUPTING AMPS
                  1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                        0.0         0.0         0.0         0.0         0.0

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                  0.0000 /    0.0     2.1727 / -141.8     2.1727 /  158.2

                  INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                      0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  KC2             ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                            ---PHASE A---       ---PHASE B---       ---PHASE C---
    MSK                 208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    KC2               ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MSK          KC2              Wire 42          208.     0.0/   8.     0.0/   0.
0.0/   0.

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  KCP             VOLTAGE BASE LL:                  208.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                  THEVENIN IMPEDANCE X/R RATIO:     0.000
                  SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.718 +j  64.129 (PU)
                                                Z2:   7.718 +j  64.129 (PU)
                                                Z0: INFINITE

                   ASYM     RMS   INTERRUPTING AMPS
                  1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                                      Page 25
```

```
                        0.0         0.0         0.0         0.0         0.0

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                  0.0000 /    0.0     2.1727 / -141.8     2.1727 /  158.2

                  INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                      0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  KCP             ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                            ---PHASE A---       ---PHASE B---       ---PHASE C---
    MSK                 208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    KCP               ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MSK          KCP              Wire 41          208.     0.0/   8.     0.0/   0.
0.0/   0.

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  LS2B            VOLTAGE BASE LL:                  208.0 (VOLTS)
                  INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                  THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                  THEVENIN IMPEDANCE X/R RATIO:     0.000
                  SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.727 +j  64.184 (PU)
                                                Z2:   7.727 +j  64.184 (PU)
                                                Z0: INFINITE

                   ASYM     RMS   INTERRUPTING AMPS
                  1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                        0.0         0.0         0.0         0.0         0.0

                  INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                  0.0000 /    0.0     2.1736 / -141.8     2.1736 /  158.2

                  INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                  ---PHASE A---       ---PHASE B---       ---PHASE C---
                      0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  LS2B            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
                      FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                            ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0068            480.0  1.2549 /   8.  1.2549 /-112.  1.2549 / 128.
    LS2B              ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                      Page 26
```

```
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0068        LS28           T2              208.     0.0/   0.     0.0/   0.
0.0/   0.

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  LS42           VOLTAGE BASE LL:                480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:     0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:    1.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.724 +j  64.158 (PU)
                                               Z2:   7.724 +j  64.158 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1731 / -141.8     2.1731 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  LS42           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    LSDP4             480.0  0.0000 /   0.  2.1731 /-142.  2.1731 / 158.
    LS42            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 LSDP4           LS42           Wire 44         480.     0.0/ -37.     0.0/   0.
0.0/   0.

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  LS45           VOLTAGE BASE LL:                480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:     0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:    1.000
                                  Page 27
```

```
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.724 +j  64.158 (PU)
                                               Z2:   7.724 +j  64.158 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1731 / -141.8     2.1731 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  LS45           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---       ---PHASE B---       ---PHASE C---
    LSDP4             480.0  0.0000 /   0.  2.1731 /-142.  2.1731 / 158.
    LS45            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 LSDP4           LS45           Wire 45         480.     0.0/ -37.     0.0/   0.
0.0/   0.

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  LSDP4          VOLTAGE BASE LL:                480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:     0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:    1.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.724 +j  63.158 (PU)
                                               Z2:   6.724 +j  63.158 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1731 / -141.8     2.1731 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  LSDP4          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                                  Page 28
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```
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                         ---PHASE A---      ---PHASE B---      ---PHASE C---
    BUS-0031          480.0  0.0003 /-172.  2.1729 /-142.  2.1729 / 158.
    LS45              480.0  0.0000 /   0.  2.1731 /-142.  2.1731 / 158.
    LS42              480.0  0.0000 /   0.  2.1731 /-142.  2.1731 / 158.
    BUS-0068          480.0  0.0003 /   8.  2.1733 /-142.  2.1734 / 158.
    LSDP4          ============== INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                     BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0031       LSDP4          Wire 9           480.     0.0/ -37.     0.0/   0.
0.0/   0.
 LSDP4          LS45           Wire 45          480.     0.0/   0.     0.0/   0.
0.0/   0.
 LSDP4          LS42           Wire 44          480.     0.0/   0.     0.0/   0.
0.0/   0.
 LSDP4          BUS-0068       Wire 43          480.     0.0/   0.     0.0/   0.
0.0/   0.

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  MP27A          VOLTAGE BASE LL:                  480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:      0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     1.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   4.769 +j  61.146 (PU)
                                               Z2:   4.769 +j  61.146 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                       AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1724 / -141.8     2.1725 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                       AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                     0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  MP27A          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
    MSB               480.0  0.0001 /-172.  2.1723 /-142.  2.1723 / 158.
    BUS-0052          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0053          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0054          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0055          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0056          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0057          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0058          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
                                  Page 29
```

```
    BUS-0059          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0060          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0061          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0062          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0063          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0064          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0065          480.0  0.0000 /   0.  2.1724 /-142.  2.1725 / 158.
    BUS-0066          480.0  0.0003 /   8.  2.1727 /-142.  2.1727 / 158.
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    MP27A          ============== INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                     BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 CP-2           MP27A                            480.     0.0/   0.     0.0/   0.
0.0/   0.
 CP-1           MP27A                            480.     0.0/   0.     0.0/   0.
0.0/   0.
 AHU-2B         MP27A                            480.     0.0/   0.     0.0/   0.
0.0/   0.
 AHU-2A         MP27A                            480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            MP27A          Wire 2            480.     0.0/ -37.     0.0/ 142.
0.0/ 142.
 MP27A          BUS-0052       Wire 27           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0053       Wire 28           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0054       Wire 26           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0055       Wire 25           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0056       Wire 24           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0057       Wire 23           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0058       Wire 22           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0059       Wire 21           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0060       Wire 20           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0061       Wire 19           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0062       Wire 18           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0063       Wire 17           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0064       Wire 16           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0065       Wire 15           480.     0.0/   0.     0.0/   0.
0.0/   0.
 MP27A          BUS-0066       Wire 31           480.     0.0/   0.     0.0/   0.
0.0/   0.

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                                  Page 30
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 MS2             VOLTAGE BASE LL:                  208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:       0.0 /    8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   5.220 +j  61.619 (PU)
                                               Z2:   5.220 +j  61.619 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                     0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 MS2             ==== INI. SYM. RMS SYSTEN BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0037          480.0  1.2543 /   8.  1.2543 /-112.  1.2543 / 128.
    RP21              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP22              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP23              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP24              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP25              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP26              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP2B              208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP2BA             208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    MS2            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                    BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0037        MS2                T8              480.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP21               Wire 47         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP22               Wire 48         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP23               Wire 49         208.     0.0/   0.     0.0/   0.
0.0/   0.
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    MS2          ================  FIRST BUS FROSYSTEM BRANCH FLOWS ( AMPS )
==============

 MS2             RP24               Wire 50         208.     0.0/   0.     0.0/   0.
0.0/   0.
                                    Page 31
```

```
 MSZ             RP25               Wire 51         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP26               Wire 52         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP2B               Wire 46         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MS2             RP2BA              Wire 53         208.     0.0/   0.     0.0/   0.
0.0/   0.

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 MSB             VOLTAGE BASE LL:                  480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:       0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     1.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   4.719 +j  61.107 (PU)
                                               Z2:   4.719 +j  61.107 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1722 / -141.8     2.1722 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                     0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 MSB             ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0001       13800.0  1.1930 /   8.  1.1930 /-112.  1.1930 / 128.
    MP27A            480.0  0.0001 /   8.  2.1723 /-142.  2.1723 / 158.
    BUS-0007         480.0  0.0007 /   8.  2.1729 /-142.  2.1729 / 158.
    DB4B             480.0  0.0000 /   0.  2.1722 /-142.  2.1722 / 158.
    BUS-0020         480.0  0.0000 /   0.  2.1722 /-142.  2.1722 / 158.
    BUS-0021         480.0  0.0000 /   0.  2.1722 /-142.  2.1722 / 158.
    BUS-0022         480.0  0.0003 /   8.  2.1724 /-142.  2.1725 / 158.
    BUS-0030         480.0  0.0003 /   8.  2.1724 /-142.  2.1725 / 158.
    BUS-0037         480.0  0.0001 /   8.  2.1723 /-142.  2.1723 / 158.
    MSB            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                    BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0001        MSB                T              13800.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB             MP27A              Wire 2           480.     0.0/ 144.     0.0/ 142.
0.0/ 142.
 MSB             BUS-0007           Wire 11          480.     0.0/   0.     0.0/   0.
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```

```
0.0/   0.
 MSB            DB4B          Wire 4          480.     0.0/ 144.     0.0/   0.
0.0/   0.
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    MSB           ===============  FIRST BUS FROSYSTEM BRANCH FLOWS ( AMPS )
===============

 MSB            BUS-0020      Wire 6          480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            BUS-0021      Wire 7          480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            BUS-0022      Wire 8          480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            BUS-0030      Wire 12         480.     0.0/   0.     0.0/   0.
0.0/   0.
 MSB            BUS-0037      Wire 10         480.     0.0/   0.     0.0/   0.
0.0/   0.

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  MSK            VOLTAGE BASE LL:                208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:     0.0 /    8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:    0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.720 +j  63.131 (PU)
                                               Z2:   6.720 +j  63.131 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1727 / -141.8     2.1727 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                     0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  MSK            ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
    BUS-0023          208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    RP2K              208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    KCP               208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    KC2               208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    MSK             ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

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```
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0023       MSK            Wire 8A         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MSK            RP2K           Wire 40         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MSK            KCP            Wire 41         208.     0.0/   0.     0.0/   0.
0.0/   0.
 MSK            KC2            Wire 42         208.     0.0/   0.     0.0/   0.
0.0/   0.

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  DS21           VOLTAGE BASE LL:                208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:     0.0 /    8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:    0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.617 +j  64.134 (PU)
                                               Z2:   7.617 +j  64.134 (PU)
                                               Z0: INFINITE

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1748 / -141.8     2.1748 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                          AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                     0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  DS21           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
    OSDP2B            208.0  0.0000 /   0.  2.1748 /-142.  2.1748 / 158.
    OS21            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 OSDP2B         DS21           Wire 55         208.     0.0/   8.     0.0/   0.
0.0/   0.

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 OS24           VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:        0.0 /     8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   INFINITE
                THEVENIN IMPEDANCE X/R RATIO:       0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:    7.615 +j  64.132 (PU)
                                              Z2:    7.615 +j  64.132 (PU)
                                              Z0:  INFINITE

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    0.0          0.0         0.0          0.0          0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /     0.0    2.1748 / -141.8     2.1748 /  158.2

                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /    0.0        0.0 /    0.0        0.0 /    0.0

 OS24           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   OSDP2B            208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OS24            =============== INI.     RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                              FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                              BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
 OSDP2B         OS24           Wire 56           208.      0.0/    8.      0.0/    0.
0.0/    0.

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 OS2BK          VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:        0.0 /     8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   INFINITE
                THEVENIN IMPEDANCE X/R RATIO:       0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:    7.617 +j  64.134 (PU)
                                              Z2:    7.617 +j  64.134 (PU)
                                              Z0:  INFINITE

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    0.0          0.0         0.0          0.0          0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /     0.0    2.1748 / -141.8     2.1748 /  158.2
                                          Page 35
```

```
                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /    0.0        0.0 /    0.0        0.0 /    0.0

 OS2BK          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   OSDP2B            208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OS2BK           =============== INI.     RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                              FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                              BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
 OSDP2B         OS2BK          Wire 36           208.      0.0/    8.      0.0/    0.
0.0/    0.

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 OSDP2B         VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:        0.0 /     8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   INFINITE
                THEVENIN IMPEDANCE X/R RATIO:       0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:    6.616 +j  63.133 (PU)
                                              Z2:    6.616 +j  63.133 (PU)
                                              Z0:  INFINITE

                 ASYM     RMS    INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES     5 CYCLES     8 CYCLES
                    0.0          0.0         0.0          0.0          0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /     0.0    2.1748 / -141.8     2.1748 /  158.2

                INI.     RMS    FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =      0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /    0.0        0.0 /    0.0        0.0 /    0.0

 OSDP2B         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   OSDP4             480.0  1.2556 /    8.  1.2556 /-112.  1.2556 / 128.
   Generator         208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OS2BK             208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OS21              208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OS24              208.0  0.0000 /    0.  2.1748 /-142.  2.1748 / 158.
   OSDP2B          =============== INI.     RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                              FIRST BUS FROM FAULT     AT TIME =      0.5 CYCLES
                              BRANCH NAME    VBASE LL  -PHASE A-      -PHASE B-
-PHASE C-
                                     Page 36
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 OSDP4          OSDP2B         T5              480.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         Generator      Wire 54         208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS2BK          Wire 36         208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS21           Wire 55         208.     0.0/   0.     0.0/   0.
0.0/   0.
 OSDP2B         OS24           Wire 56         208.     0.0/   0.     0.0/   0.
0.0/   0.

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  OSDP4          VOLTAGE BASE LL:                 480.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:      0.0 /  -37. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     1.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.616 +j  63.133 (PU)
                                               Z2:   6.616 +j  63.133 (PU)
                                               Z0: INFINITE

                  ASYM     RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1748 / -141.8     2.1748 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  OSDP4          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0009          480.0  0.0007 /-172.  2.1741 /-142.  2.1741 / 158.
    OSDP2B            208.0  1.2556 /   8.  1.2556 /-112.  1.2556 / 128.
    OSDP4           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 JP-1           OSDP4                          480.     0.0/   0.     0.0/   0.
0.0/   0.
 SE-1           OSDP4                          480.     0.0/   0.     0.0/   0.
0.0/   0.
 SP-1           OSDP4                          480.     0.0/   0.     0.0/   0.
0.0/   0.
 BUS-0009       OSDP4          Wire 11A        480.     0.0/ -36.     0.0/   0.
0.0/   0.
 OSDP4          OSDP2B         T5              480.     0.0/   0.     0.0/   0.
0.0/   0.
                                      Page 37
```

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  RP21           VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                               Z2:   6.219 +j  62.618 (PU)
                                               Z0: INFINITE

                  ASYM     RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                       0.0         0.0         0.0         0.0         0.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  RP21           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2             208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP21          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP21           Wire 47         208.     0.0/   8.     0.0/   0.
0.0/   0.

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  RP22           VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:     0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                               Z2:   6.219 +j  62.618 (PU)
                                               Z0: INFINITE
                                      Page 38
```

```
           ASYM     RMS    INTERRUPTING AMPS
           1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
              0.0           0.0          0.0          0.0          0.0

           INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
           0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

           INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
               0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 RP22      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                     ---PHASE A---     ---PHASE B---      ---PHASE C---
   MS2          208.0  0.0000 /    0.  2.1725 /-142.  2.1725 / 158.
   RP22          =============== INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                         FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP22          Wire 48          208.     0.0/    8.     0.0/    0.
0.0/    0.

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 RP23            VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:       0.0 /     8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:      0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:    6.219 +j   62.618 (PU)
                                               Z2:    6.219 +j   62.618 (PU)
                                               Z0:  INFINITE

           ASYM     RMS    INTERRUPTING AMPS
           1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
              0.0           0.0          0.0          0.0          0.0

           INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
           0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

           INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
               0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 RP23      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                     ---PHASE A---     ---PHASE B---      ---PHASE C---
   MS2          208.0  0.0000 /    0.  2.1725 /-142.  2.1725 / 158.
   RP23          =============== INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
                                 Page 39
```

```
                         FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP23          Wire 49          208.     0.0/    8.     0.0/    0.
0.0/    0.

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 RP24            VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:       0.0 /     8. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                 THEVENIN IMPEDANCE X/R RATIO:      0.000
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:    6.219 +j   62.618 (PU)
                                               Z2:    6.219 +j   62.618 (PU)
                                               Z0:  INFINITE

           ASYM     RMS    INTERRUPTING AMPS
           1/2 CYCLES     2 CYCLES     3 CYCLES     5 CYCLES     8 CYCLES
              0.0           0.0          0.0          0.0          0.0

           INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
           0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

           INI.    RMS    FAULTED CURRENT ( AMPS / DEG )
                   AT TIME =      0.5 CYCLES
           ---PHASE A---       ---PHASE B---       ---PHASE C---
               0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 RP24      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) ======
               FIRST BUS FROM FAULT     AT TIME =     0.5 CYCLES
                     ---PHASE A---     ---PHASE B---      ---PHASE C---
   MS2          208.0  0.0000 /    0.  2.1725 /-142.  2.1725 / 158.
   RP24          =============== INI.    RMS    SYSTEM BRANCH FLOWS ( AMPS )
================
                         FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                        BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP24          Wire 50          208.     0.0/    8.     0.0/    0.
0.0/    0.

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 RP25            VOLTAGE BASE LL:                 208.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:       0.0 /     8. ( AMPS/DEG )
                                 Page 40
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```
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                              Z2:   6.219 +j  62.618 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  RP25          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2             208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP25          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP25           Wire 51          208.     0.0/   8.     0.0/   0.
0.0/   0.

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  RP25          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                              Z2:   6.219 +j  62.618 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0
                                  Page 41

  RP26          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2             208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP26          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP26           Wire 52          208.     0.0/   8.     0.0/   0.
0.0/   0.

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  RP2B          VOLTAGE BASE LL:                208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:      0.0 /    8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                              Z2:   6.219 +j  62.618 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

  RP2B          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2             208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP2B          ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
==============
                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2            RP2B           Wire 46          208.     0.0/   8.     0.0/   0.
0.0/   0.

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```
 RP2BA          VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:       0.0 /    8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:      0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.219 +j  62.618 (PU)
                                              Z2:   6.219 +j  62.618 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     2.1725 / -141.8     2.1725 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 RP2BA          ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                       ---PHASE A---       ---PHASE B---       ---PHASE C---
    MS2               208.0  0.0000 /   0.  2.1725 /-142.  2.1725 / 158.
    RP2BA           ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MS2          RP2BA          Wire 53          208.     0.0/   8.     0.0/   0.
0.0/   0.

------------------------------------------------------------------------------
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 RP2K           VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:       0.0 /    8. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:      0.000
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   7.718 +j  64.129 (PU)
                                              Z2:   7.718 +j  64.129 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      0.0         0.0         0.0         0.0         0.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                                  Page 43
```

```
                0.0000 /    0.0     2.1727 / -141.8     2.1727 /  158.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                    0.0 /   0.0         0.0 /   0.0         0.0 /   0.0

 RP2K           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                       ---PHASE A---       ---PHASE B---       ---PHASE C---
    MSK               208.0  0.0000 /   0.  2.1727 /-142.  2.1727 / 158.
    RP2K            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 MSK          RP2K           Wire 40          208.     0.0/   8.     0.0/   0.
0.0/   0.

------------------------------------------------------------------------------
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 RP2P           VOLTAGE BASE LL:                  208.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   8365.5 / -106. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   11.543 +j 124.343 (PU)
                THEVENIN IMPEDANCE X/R RATIO:    10.773
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   5.771 +j  62.172 (PU)
                                              Z2:   5.771 +j  62.172 (PU)
                                              Z0:   0.000 +j   0.000 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   12169.3      9141.0      8614.5      8390.0      8366.3

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0865 / -111.8     1.0865 /   68.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                8365.5 /-106.5        0.0 /   0.0         0.0 /   0.0

 RP2P           ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                       ---PHASE A---       ---PHASE B---       ---PHASE C---
    BUS-0066        480.0  0.6273 /   68.  1.2545 /-112.  0.6273 /   68.
    RP2P            ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS )
================

                                 FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                                BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-
-PHASE C-
 BUS-0066     RP2P           T3               480.  2107.7/-106.     0.0/   0.
2107.7/  74.

                                  Page 44
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****************** F A U L T   A N A L Y S I S   S U M M A R Y ******************

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
DB4B	480.	2432.7	11.4	0.02	1.0
Generator	208.	5396.3	8.4	0.00	0.0
KC2	208.	5390.5	8.3	0.00	0.0
KCP	208.	5390.5	8.3	0.00	0.0
LS2B	208.	5388.1	8.3	0.00	0.0
LS42	480.	2335.3	8.3	0.02	1.0
LS45	480.	2335.3	8.3	0.02	1.0
LSDP4	480.	2376.0	9.4	0.02	1.0
MP27A	480.	2459.8	12.8	0.02	1.0
MS2	208.	5629.8	11.8	0.00	0.0
MSB	480.	2461.3	12.9	0.02	1.0
MSK	208.	5484.3	9.4	0.00	0.0
OS21	208.	5396.3	8.4	0.00	0.0
OS24	208.	5396.5	8.4	0.00	0.0
OS2BK	208.	5396.3	8.4	0.00	0.0
OSDP2B	208.	5490.3	9.5	0.00	0.0
OSDP4	480.	2379.1	9.5	0.02	1.0
RP21	208.	5532.7	10.1	0.00	0.0
RP22	208.	5532.7	10.1	0.00	0.0
RP23	208.	5532.7	10.1	0.00	0.0
RP24	208.	5532.7	10.1	0.00	0.0
RP25	208.	5532.7	10.1	0.00	0.0
RP26	208.	5532.7	10.1	0.00	0.0
RP2B	208.	5532.7	10.1	0.00	0.0
RP2BA	208.	5532.7	10.1	0.00	0.0
RP2K	208.	5390.5	8.3	0.00	0.0
RP2P	208.	5577.0	10.8	8365.51	10.8

*********************** FAULT ANALYSIS REPORT COMPLETED ***********************

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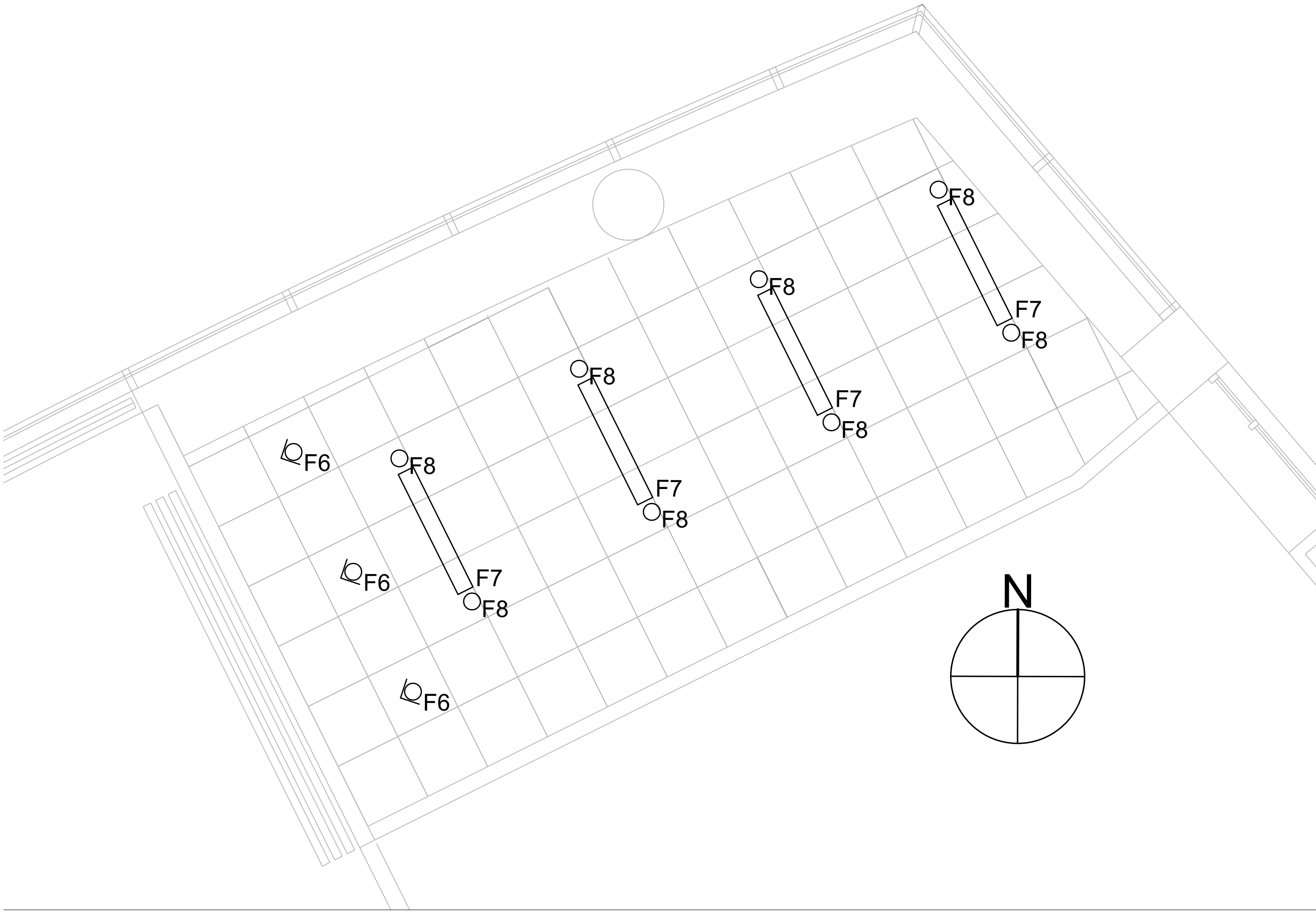


WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

CONFERENCE ROOM LIGHTING PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{8}$" = 1'-0"

A-101

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

STUDENT LOUNGE LIGHTING PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{1}{8}$" = 1'-0"

A-102

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

CAFETERIA SERVING SPACE LIGHTING PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{16}$" = 1'-0"

A-103

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

ROOF DECK LIGHTING PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{16}$" = 1'-0"

A-104

F16

F16

N

F15

F12

F12

WHEELOCK COLLEGE

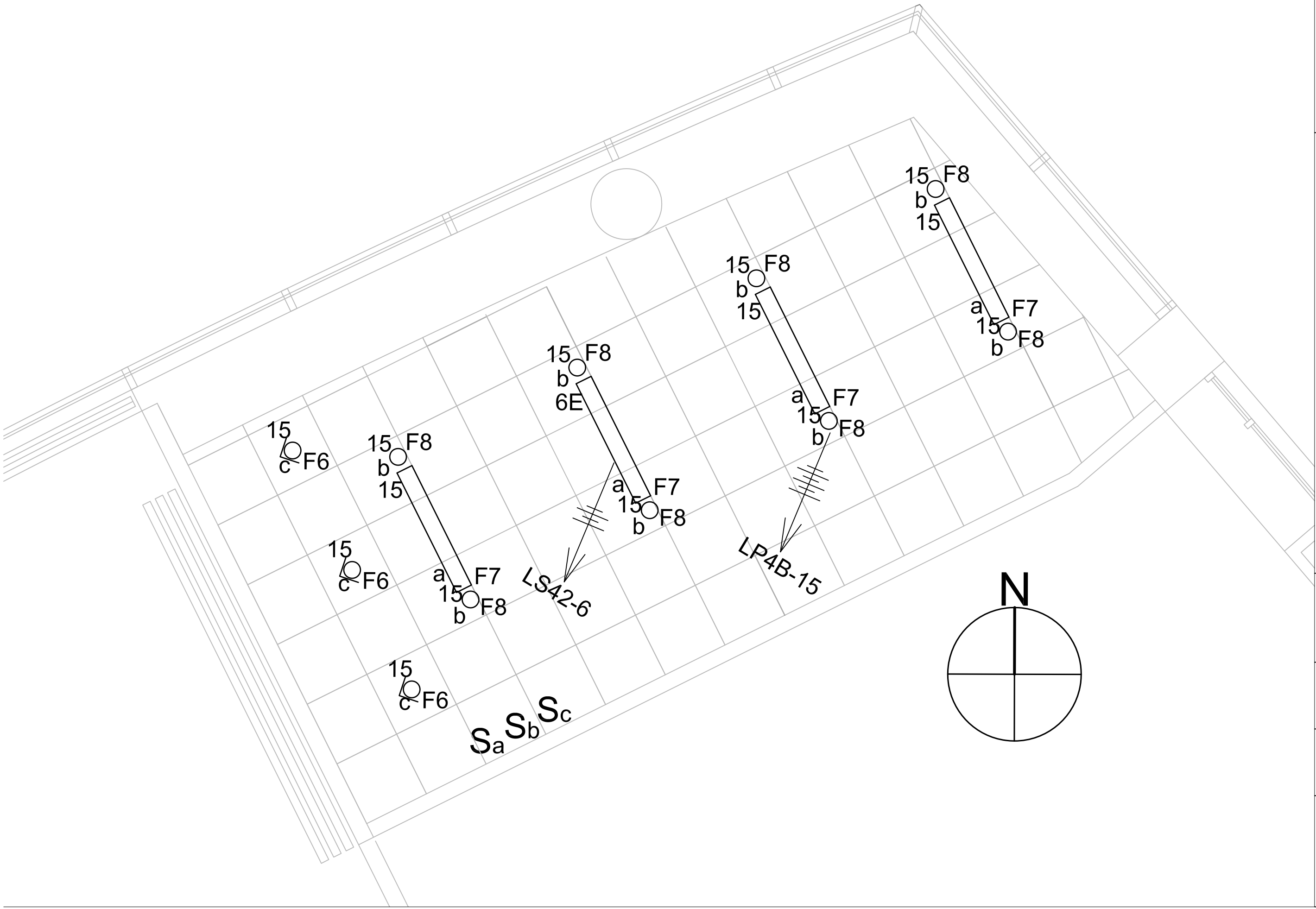
CAMPUS CENTER AND STUDENT RESIDENCE

DORM ROOM LIGHTING PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{8}$" = 1'-0"

A-105



WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

CONFERENCE ROOM ELECTRICAL PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{8}$" = 1'-0"

E-101

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

STUDENT LOUNGE ELECTRICAL PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{1}{8}$" = 1'-0"

E-102

WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

CAFETERIA SERVING SPACE ELECTRICAL PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{16}$" = 1'-0"

E-103

WHEELOCK COLLEGE

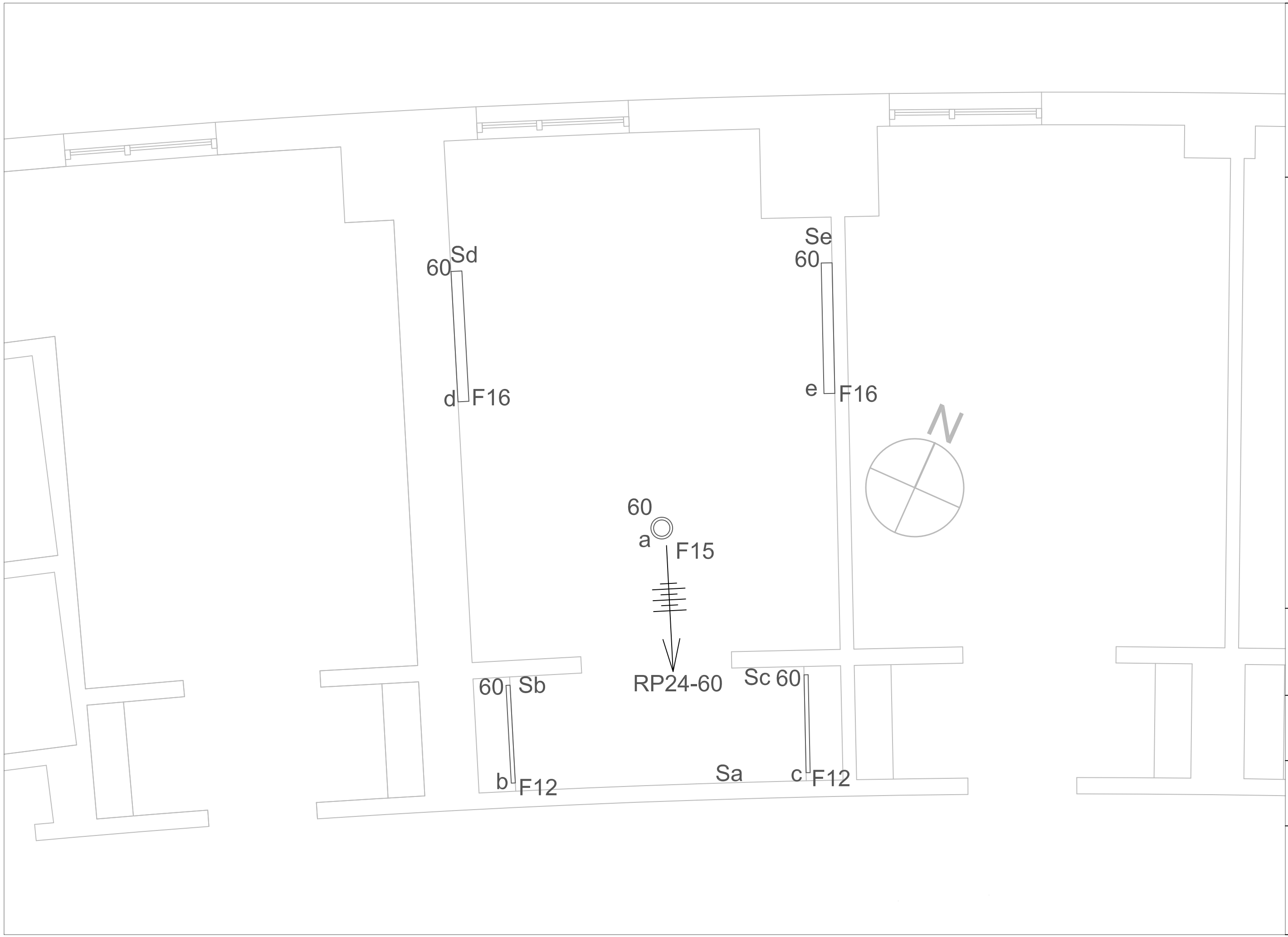
CAMPUS CENTER AND STUDENT RESIDENCE

ROOF DECK ELECTRICAL PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{16}$" = 1'-0"

E-104



WHEELOCK COLLEGE

CAMPUS CENTER AND STUDENT RESIDENCE

DORM ROOM ELECTRICAL PLAN

DRAWN BY: AC
DATE: 04/07/09

SCALE: $\frac{3}{8}$" = 1'-0"

E-105