ARCHITECTURAL ENGINEERING THESIS SUMMARY REPORT

Spring 2009
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# UCI Natural Science Unit II

Grant W Kightlinger

L / E Option

Electrical Advisor: Prof. Ted Dannerth

Lighting Advisor: Dr. Kevin Houser

Pennsylvania State University

Architectural Engineering Senior Thesis

# UCI natural sciences unit two

irvine, california

grant w kightlinger
lighting/electrical

http://www.engr.psu.edu/ae/thesis/portfolios/2009/gwk124

## info

project area: 146,075 ft²
height: 5 stories
total cost: $45M
construction time: 17 mar 2005 – 01 sep 2008
delivery method: modified design / build

## team

owner: the university of california irvine
architect of record: carrier-johnson
design architect: zimmer-gunsul-frasca architects
general contractor: hensel phelps construction co.
structural: bfl owen & assoc.
civil: boyle engineering
mechanical: ma engineers
electrical: konsortum 1
landscape: ima design

## arch

The academic building is composed of a four-story laboratory wing and a five-story office wing which form the shape of an “L”, with a two-story entrance lobby located between the two. A small outdoor courtyard is sheltered on two sides by the wings of the building. The fifth floor features a terrace with access to the main stair. Concrete shear walls and red granite panels make up the building façade. The roof is reinforced modified bitumen with copper and steel accents.

## struc

18” thick concrete shear walls form the bulk of the façade. The building foundation consists of reinforced piles below a 6” slab-on-grade. 10” thick two-way slabs are typical on upper floors. The structure employs a reinforced concrete framing system with 8” drop panels.

## ltg/ elec

A 12kV service connected to UCI’s underground distribution network provides normal power to the building. A 2500kVA pad-mounted transformer feeds the 480/277V three-phase system. A 1250 kW diesel generator provides emergency backup power. 2’ x 4’ linear fluorescent fixtures are typical throughout office and lab areas. Recessed compact fluorescent downlights are used in public and circulation areas.

## mech

Three air handling units located in the mechanical room on the first floor supply conditioned air to the spaces and have a combined 160,000 cfm capacity. Constant air volume and variable air volume terminal units with reheat coils are used within the branch duct system.

## CONTENTS

## EXECUTIVE SUMMARY

Natural Science Unit II is a notable new building on the campus of The University of California Irvine. This report presents a summary of work completed in the spring semester of 2009, and is the culmination of a year-long study of various systems within the building and their interaction with one another. The primary focus of this report is the lighting and electrical systems within Natural Sciences Unit II.

The lighting depth section presents a redesign of the architectural lighting for four student-selected spaces: the building's north façade and entry plaza, the main entry lobby, the main conference room, and a third floor open office space. New designs have been conceived based on several technical and aesthetic criteria relating to the use and architectural style of the facility. Calculations and renderings have been performed to confirm the effectiveness of the proposed redesigns for each of the four spaces. Unique design concepts and developments are also discussed in each section. Proposed solutions are generally responsive to design goals and are successful in meeting the design criteria set forth.

In addition to the lighting redesign, an electrical systems redesign was also performed to accommodate changes in the building illumination systems. Panelboards and feeders for each room were sized according to the redesigned load, and circuiting and control diagrams are presented. A protective device coordination and short circuit analysis have also been performed for a path through the electrical distribution system. Additional depth studies in the electrical section include a feasibility analysis of the installation of a photovoltaic array on the roof of the building, and a study of the possible financial and performance implications of changing the building's feeder material from copper to aluminum. Both of these solutions represent a significant opportunity for fiscal savings by the university.

As energy efficiency is a major concern in most modern institutional projects, a daylighting study has been performed for the open office space on the third floor. Daylight conditions throughout the year have been evaluated an appropriate photosensor-based system has been designed for the space to allow wiser use of energy and materials.
Two additional topics outside the lighting and electrical focus have been studied and are also presented here. First, a mechanical study evaluating the heat loss through a large expanse of glass in the main lobby has been performed, and suggestions for improving the building's glazing system are given. An acoustical study of the lobby space was also completed through the discussion of architectural modifications, building materials, and reverberation times and was found to be acceptable.

Through the simultaneous evaluation of all these topics, this report provides insight into the unique building systems and integration issues concerning UCI Natural Science Unit II.

# BUILDING STATISTICS

## General

**Project Name:** University of California Irvine Natural Sciences Unit II
**Location:** Irvine, California, USA
**Building Occupant:** The University of California Irvine, Physical and Biological Science Departments
**Size:** 146,075 Square Feet
**Number of Stories:** Five levels above grade
**Dates of Construction:** March 2005 – September 2008
**Total Building Cost:** $45.5M
**Delivery Method:** Modified Design Build
**Major National Codes:** 2001 California Building Code (UBC with amendments)

## Project Team

**Owner:** The University of California Irvine
**Architect of Record:** Carrier-Johnson Architects
**Design Architect:** Zimmer-Gunsul-Frasca Architects
**General Contractor:** Hensel Phelps Construction Co.
**Structural Engineer:** BFL Owen & Associates
**Civil Engineer:** Boyle Engineering
**Mechanical Engineer:** MA Engineers
**Electrical Engineer:** Konsortum 1
**Landscape Architect:** IMA+ Design

## Architecture

The building includes a four-story laboratory and classroom wing and a five-story office wing which form the shape of an "L", with a two-story entrance lobby located between the two. The facility is shared by the Schools of Biological and Physical Sciences, each predominantly occupying two floors of the structure. A small outdoor courtyard is sheltered on two sides by the wings of the building. The fifth floor features a balcony with access to the main stair. The architecture is modern and consistent with existing surrounding buildings and the master plan of the campus.

## Construction

A modified design-build scheme was used for this construction. DD-level 'bridging' plans and specifications were prepared, and then were bid on and completed by the design-build team. Construction was completed for the project on September 1, 2008.

**Building Envelope**

The exterior façade is composed of 18" concrete shear walls with interior furring and insulation. Architectural red granite panels are attached at the base of the building. The doors and windows feature dual-pane, low-e glazing for energy conservation. Ceramic tiles are used in some areas as exterior accents. Stainless steel and copper accents are also used on the main stair tower. The roof is constructed of reinforced modified bitumen built up over rigid foam insulation.

**Construction**

A modified design-build scheme was used for this construction. DD-level 'bridging' plans and specifications were prepared, and then were bid on and completed by the design-build team. Construction was completed for the project on September 1, 2008.

**Electrical**

Natural Science Unit 2 is connected to the University of California Irvine utility distribution system. The building's electrical distribution system is radial with a service entrance in the electrical room at the southeast corner of the main building. A 2500 KVA, 3Ø, 4W, pad-mounted transformer reduces the campus supply voltage from 12kV to 480/277V. A 4000A main switchboard distributes power to subsequent panel boards throughout the building. Emergency backup power is provided by a 1250 KW, 480/277V diesel generator located in the high energy lab building. The emergency power system feeds life safety and lab critical distribution panels for the building.

**Lighting**

The lighting system in the building is generally modern and designed to reduce power consumption. Lobbies and public areas feature recessed compact fluorescent downlights and some cove lighting while laboratories and offices predominantly use recessed 2' by 4' linear fluorescent fixtures. Conference rooms on each floor utilize both compact and linear fluorescent sources in a multi-scene control system. The main atrium space includes two decorative metal halide pendants on the second and fourth floors. The building orientation allows daylighting to be a significant source of light in many spaces, further reducing energy use during the day.

**Mechanical**

Three air handling units located in the mechanical room on the first floor supply conditioned air to the spaces and have a combined 160,000 cfm capacity. Constant air volume and variable air volume terminal units with reheat coils are used within the branch duct system.

**Structural**

Natural Science Unit 2 uses a reinforced concrete pile foundation system. The first floor of the building is slab-on-grade of varying thickness. 10" thick two-way slabs are typical on all upper floors. 20" square concrete columns with 8" thick drop panels are located in the office and laboratory wings while the main lobby uses 20" circular columns.

**Fire Protection**

The fire detection and suppression system features a central control center with interface panel. Fire sprinkler flow and tamper switches, elevator status, smoke fire dampers and relays can be monitored and controlled through the interface panel. Visible and audible cues are used to alert occupants in an emergency. The entire fire system is backed up by a dedicated battery system.

**Transportation**

Two elevators and three stairwells allow vertical circulation through the main building. The main entry stair is outdoor with access to the lobby at the northwest corner of the building and the terrace on the fifth floor

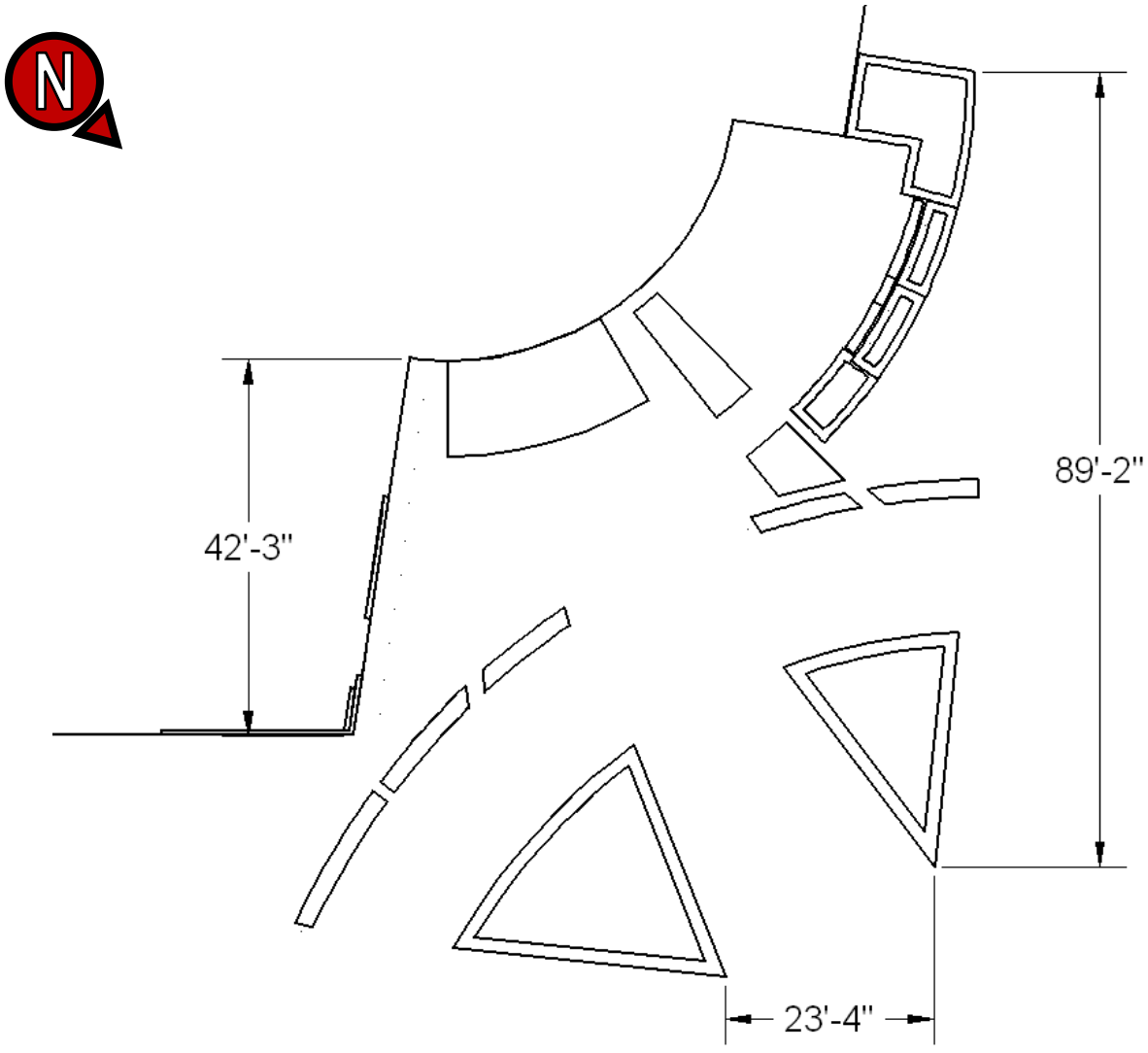
**Communications**

The building's main distribution frame in the first floor data room is connected to the campus utility tunnel system through underground conduit. Vertically stacked data rooms are located on each floor and act as access points for wiring and conduit. Combination voice/data outlets are located throughout the building. Audiovisual systems are installed in the conference rooms on each floor. A projector is mounted on the ceiling with data input terminals near the south wall of each room. An automatic projection screen is operated by a switch on the south wall.

## LIGHTING – NORTH FAÇADE AND PLAZA

The main entry to UCI Natural Science Unit II is marked by a four-story glass curtain wall, an outdoor stair feature and a 5875 square foot landscaped plaza. Trees are located within planters in the center of the plaza, and paving patterns highlight the radial center point within the lobby. The scope of the proposed lighting redesign includes the inner plaza area, the curtain wall, the adjacent office wall, and stair wall at the west side of the plaza. Stairway lighting is not in scope.

### Dimensions




Partial Site Plan
Scale: NTS

## Materials

### Paving

| | |
|---|---|
| Color: | Slate Grey |
| Reflectance: | 0.20 |

### Stair Wall / Lower Office Wall

| | |
|---|---|
| Material: | Red Granite Panels |
| Reflectance: | 0.40 |

### Upper Wall

| | |
|---|---|
| Material: | Exposed Architectural Concrete |
| Reflectance: | 0.50 |

### Glazing

| | |
|---|---|
| Material: | Heat Mirror 66 – Clear |
| Transmittance: | 0.56 |
| Shading Coefficient: | 0.44 |

**Design Concept Development**

The north façade and plaza lighting is intended to lead pedestrians into the main entry of the building and to echo the architectural aesthetic of the interior. A strong sense of motion is created by linear elements which converge within the lobby. A transparent connection between the lobby and plaza lighting through the curtain wall bring them together to create one unified space. The cutout section of the stair wall has been accentuated by keeping the exterior wash at a low light level, creating a focal point of the motion of pedestrians up and down the stairway. This also acts to prevent any confusion caused by the stairway being exterior and not within the lobby itself.

The plaza – lobby interaction is the most obvious example of the use of color differences which is echoed throughout the project. A colored LED cove in the interior lobby and blue wall surfaces provide a stark contrast to the warm, earth-tone façade of the building. This difference has been embraced and accentuated in order to create a cool, technological and clean impression of the interior.

The design themes have remained generally the same throughout the project, but the façade lighting was toned down from the first schematic presentation in order to increase transparency into the lobby space. The interior lighting in the lobby (especially near the curtain wall) acts also to create an exterior impression, and great care has been taken to coordinate the two spaces visually. Luminaire maintenance issues also had to be considered here due to the height of the building façade.

Lobby Schematic Design

## Design Objectives / Considerations

### Appearance of Space and Luminaires

The building façade must maintain its modern, curvilinear feel. Fixture choices should echo these styles, and also highlight the features on the building itself. The plaza area may be allowed to feel more free-flowing or disorganized than the building itself, to compliment the soft, organic forms of the landscaping.

### Psychological Impressions

The façade and plaza of the natural sciences building are the first to be experienced by visitors to the building, and they should produce a welcoming and comfortable atmosphere. In keeping with the themes of dynamic activity in the lobby area, the vertical stair is a symbolically important feature. A strong flow between the plaza and the lobby should be created. Transparency and visual clues should lead visitors into the lobby space or up the stairs without confusion.

### Glare

In-grade uplights might create a glare problem if their output is too intense. Also, care must be taken to avoid reflections of site fixtures in the curtain wall from producing glare.

### Light Distribution on Surfaces

Uniformity is favored for the architectural style of the building, but some non-uniformity is desired in the plaza to highlight organic forms.

### Light Distribution on Task Plane

Pathways should be uniformly illuminated for safety.

### Points of Interest

The main vertical stair wall, lobby levels within the building, vegetation in the plaza, and paving materials/textures are all focal points in this area.

### Control/Daylight Integration

A time clock system is to be installed to ensure that site fixtures are turned off when the building is closed, and/or when there is sufficient daylight.

## Technical Objectives

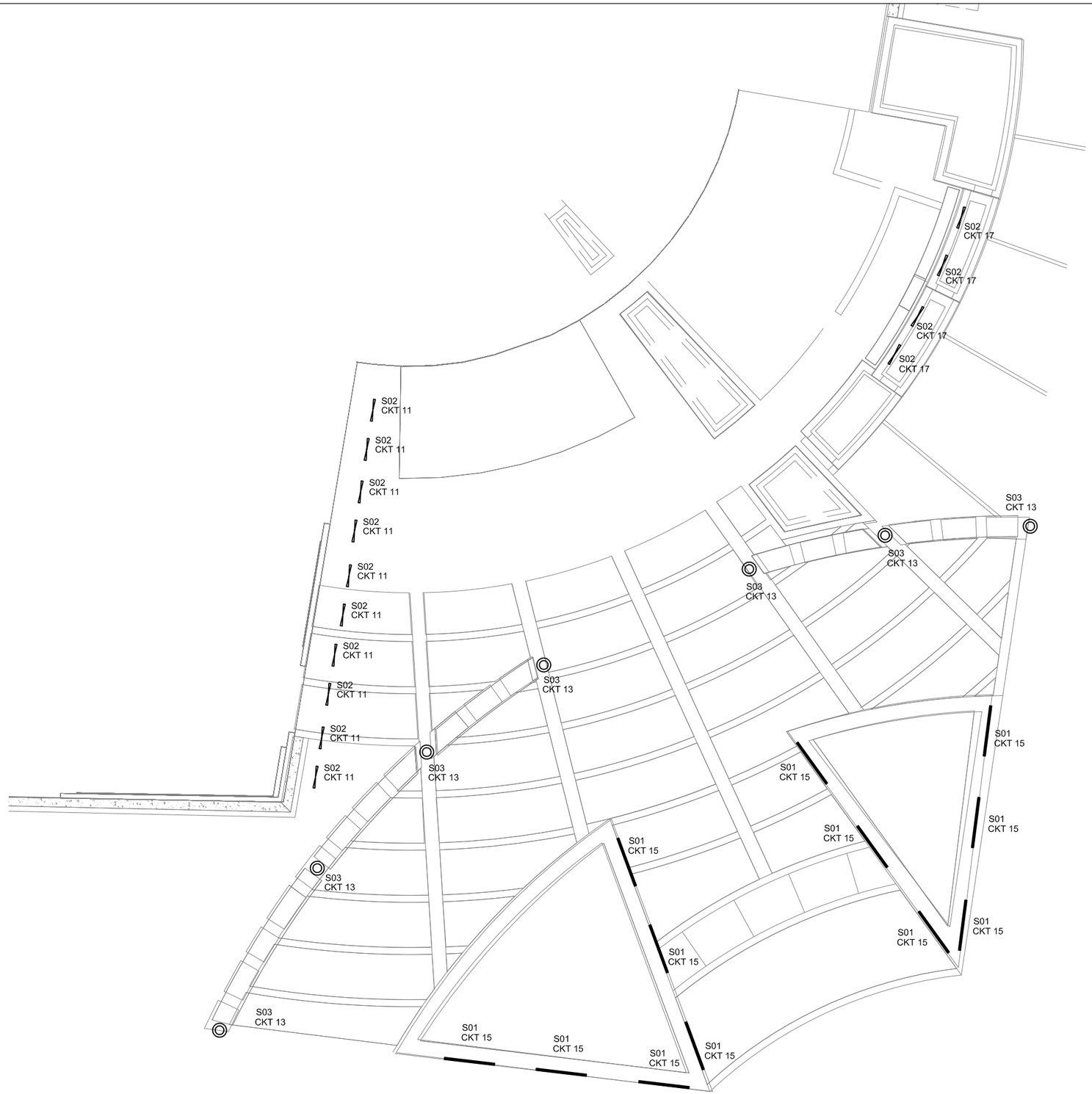
| DESCRIPTION | GOAL | RESULT | MET? |
|---|---|---|---|
| **Horizontal Illuminance** | Floor: **1** fc | **1.64** fc Avg. | **YES** |
| **Power Density** (ASHRAE 90.1) | See Below | | **YES** |

## Power Allowances

| AREA | QUOTA | MULTIPLIER | ALLOWED WATTS | DESIGNED WATTS |
|---|---|---|---|---|
| **PLAZA** | 0.2 W/ft² | 5875 ft² | 1175 W | 784 W |
| **ENTRY** | 30 W/ft of Door Width | 6 ft | 180 W | 0 W |
| **ATTACHED CANOPY** | 1.25 W/ft² | 233 ft² | 291 W | 0 W |
| **ILLUMINATED WALL (STAIR)** | 0.2 W/ft² | 1015 ft² | 203 W | 104 W |
| **ILLUMINATED WALL (OFFICE)** | 0.2 W/ft² | 2858 ft² | 572 W | 260 W |
| | | **TOTAL** | **2421** W | **1148** W |

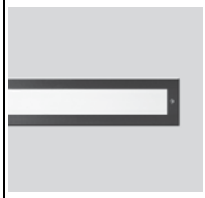
## Power Density Calculation

| FIXTURE | QUANTITY | WATTS | TOTAL WATTS |
|---|---|---|---|
| **S01** | 12 | 38.5 | 462 |
| **S02** | 14 | 26 | 364 |
| **S03** | 7 | 46 | 322 |
| | | **TOTAL Watts** | 1148 |
| | | **Area (SF)** | 5875 |
| | | **Power Density (W/SF)** | **0.195** |

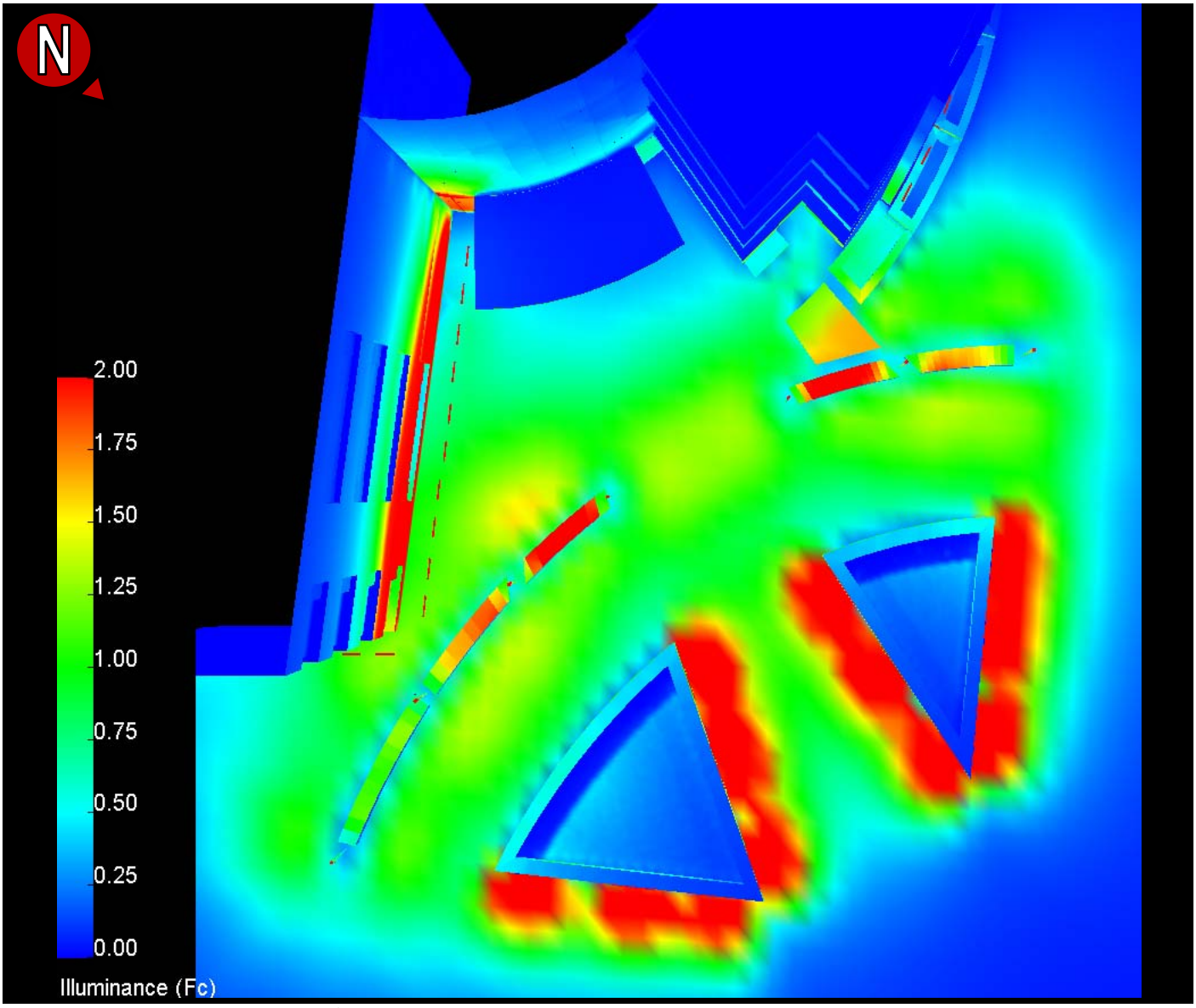



| | | | | | |
|---|---|---|---|---|---|
| | UCI Nat. Sci. Unit II<br>Irvine, California | Lighting Consultant:<br>Dr. Kevin Houser | Grant Kightlinger<br>L/E Option | Penn State University<br>AE Senior Thesis | PLAZA LIGHTING PLAN<br>3/32" = 1'-0" |

**Partial Fixture Schedule**

| TYPE | IMAGE | MANUF. | DESCRIPTION |
|---|---|---|---|
| **OUTDOOR / SITE FIXTURES** | | | |
| **S01** |  | BEGA | RECESSED LINEAR WALL FIXTURE. STAINLESS STEEL FINISH. RATED FOR WET LOCATION. |
| **S02** |  | BEGA | IN-GRADE RECESSED FLODLIGHT. LINEAR FLUORESCENT. DRIVE OVER. RATED FOR WET LOCATION. STAINLESS STEEL FINISH. |
| **S03** |  | BEGA | LINEAR STAINLESS STEEL POLE-MOUNTED SITE FIXTURE. RATED FOR WET LOCATION. |

**Pseudocolor Renderings**

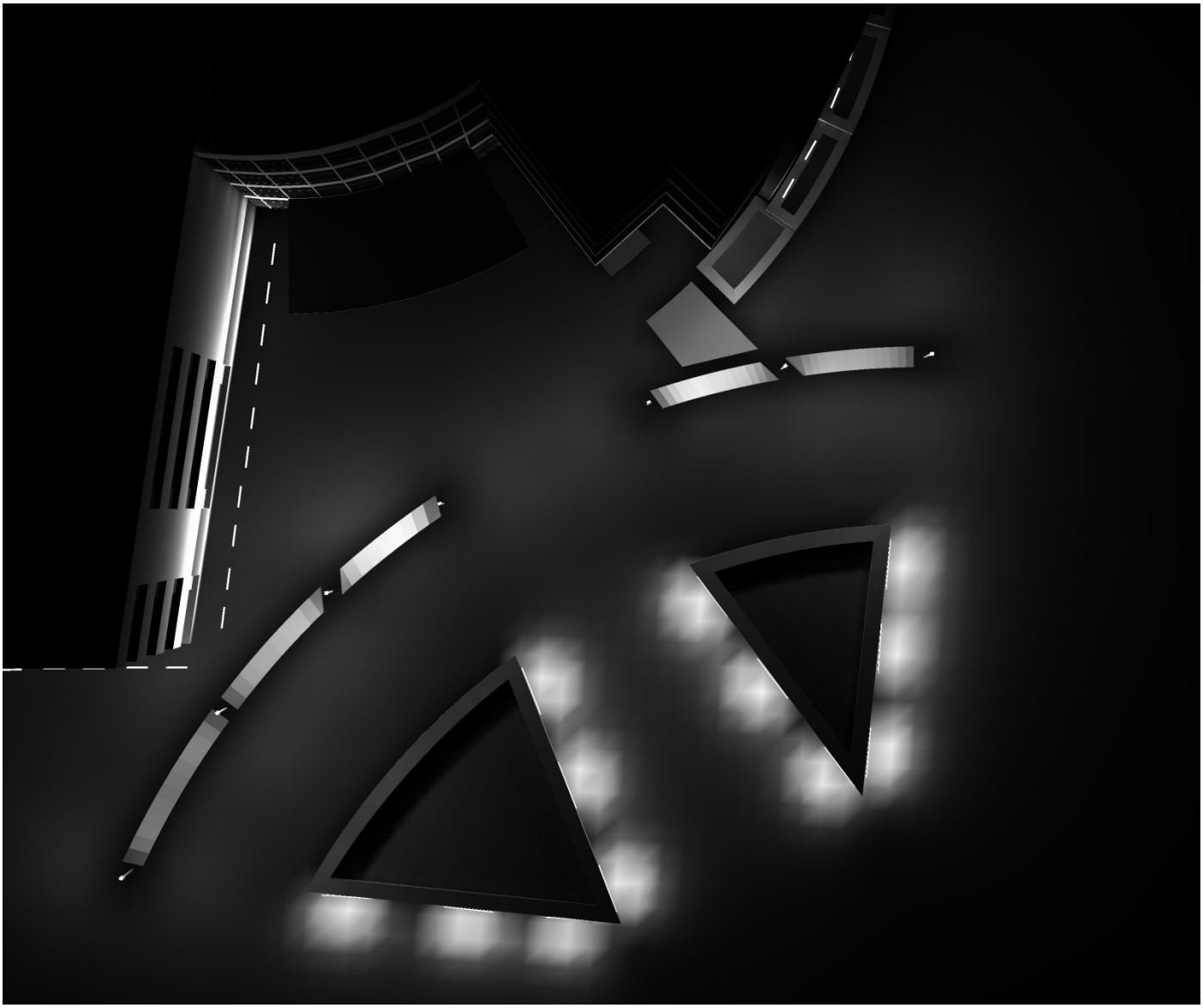



*NOTE: Tree lighting is not included in this calculation.

**Statistics**

| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| Plaza | 0'-0" AFF | fc | 1.21 | 6.00 | 0.20 | 6.05 | 30.00 |

**Renderings**



Plaza from Above

Plaza and Façade from Street

**Light Loss Factors**

| FIXTURE | MAINT. CAT. | DISTR. | LLD | LDD | RSDD | BF | TOTAL LLF |
|---|---|---|---|---|---|---|---|
| **S01** | VI | DIRECT | 0.95 | 0.80 | 0.94 | 1.00 | **0.71** |
| **S02** | VI | DIRECT | 0.95 | 0.80 | 0.94 | 1.00 | **0.71** |
| **S03** | VI | DIRECT/INDIRECT | 0.90 | 0.80 | 0.87 | 1.22 | **0.76** |

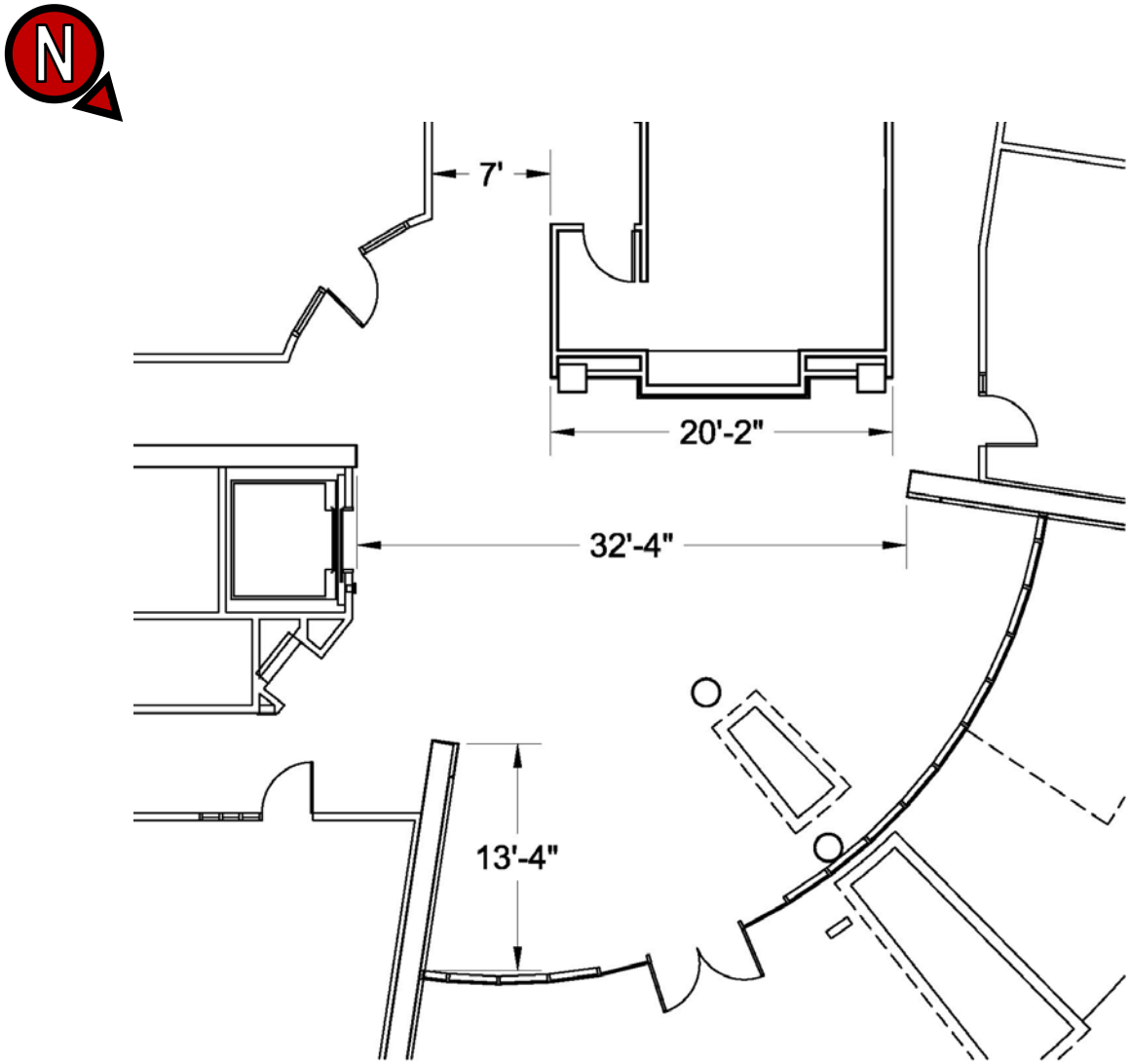
* Assumptions:

1. Medium Environment, 12-month cleaning cycle.
2. 35°C lamp data used in calculations.

## LIGHTING – LOBBY

The lobby space adjacent to the north façade is the main entry point for the building. The lobby measures approximately 1230 square feet per floor and features a large curved glass curtain wall to the north. This space is the primary access to classrooms and circulation. Above the main doorway, a double height atrium space connects the first and second floor lobbies. The main conference room is directly adjacent to the lobby on the first floor, and each level provides access to the main outdoor stair of the building.

### Dimensions




Partial First Floor Plan
Scale: NTS

## Materials

### Floor

| | |
|---|---|
| Material: | Carpet / Stone |
| Color: | Dark Blue, Tan / Gray |
| Reflectance: | 0.20, 0.20 |

### Walls

| | |
|---|---|
| Material: | Painted Gypsum / Concrete |
| Color: | Shell White, Dark Blue, Gray |
| Reflectance: | 0.80, 0.20, 0.30 / 0.3 |

### Whiteboard Wall

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

### Ceiling

| | |
|---|---|
| Material: | Painted Gypsum |
| Color: | Shell White |
| Reflectance: | 0.85 |

### Doors

| | |
|---|---|
| Material: | Wood - White Maple / Painted Steel |
| Reflectance: | 0.60 / 0.2 |

### Glazing (Exterior)

| | |
|---|---|
| Material: | Heat Mirror 66 – Clear |
| Transmittance: | 0.56 |
| Shading Coefficient: | 0.44 |

### Glazing (Interior)

| | |
|---|---|
| Material: | Translucent Tempered Glass |
| Transmittance: | 0.40 |

### Wooden Wall

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

**Design Concept Development**

The lobby acts as the focal point the building and is intended to convey radial and vertical motion, especially from the center point of the space. A strong association with the exterior plaza to the north reinforces a theme of transparency in the building. Lighting highlights the central focus of the space and also leads occupants to key points of circulation such as hallways, doors and elevators. Lighting elements are intended to be viewed both from the interior and the exterior of the building. Vertical pendants located in the two-story atrium area serve as focal points from both sides, and also act to bring the eye up into the atrium space.

Since the first schematic design submission, the lobby (and the rest of the spaces) have come to use more regular and evenly spaced luminaire organization in order to avoid visual confusion and clutter. Radial linear elements have remained the key points of the visual impression in this space. An RGB LED cove has been installed where there was previously a fluorescent cove. This feature would act as a unique identifier for the building, and allows the university to signify special events within the building at night. The default setting for the cove would be blue in order to accentuate the previously mentioned color difference between interior and exterior.

Lobby Schematic Design Submission

## Design Objectives / Considerations

### Focal Points

The central point of the lobby should be defined. Views of campus from inside should act as additional focal points, especially on the higher floors. Elevators and stairs should be easily identifiable for ease of circulation. The large wooden feature wall on each floor should be highlighted without causing shadows on readable objects mounted on the wall.

### Appearance of Space and Luminaires

Clearly the appearance of the lobby/atrium space is critical. This north entry will likely experience the most traffic, as it faces central campus. Night is a critical time when the lobby will be most visible from outside, therefore, light should be used to highlight activity within the lobby and to also produce a welcoming glow from within.

### Psychological Impressions

The architecture seems to designate this particular space as the hub of activity for the building, as well as for its adjacent buildings. Thus, a dynamic mood should be reinforced. Radial linear patterns act to support this theme.

### Glare

Solar glare should not present a significant problem due to the curtain wall's northerly orientation. Fixture glare should be carefully considered, especially in the double-height atrium space. Any possible viewing angle of the luminaire needs to be considered.

### Light Distribution on Surfaces

Walls should be well lit to create a night presence through the curtain wall. General non-uniformity can help to accent visual foci and create a deeper appearance. Local uniformity, however, is still important in maintaining the clean, strong image defined by the existing architecture.

### Facial Rendering

As a social space, multi-source ambient light should be used to soften shadows and assume idea facial rendering.

### Color

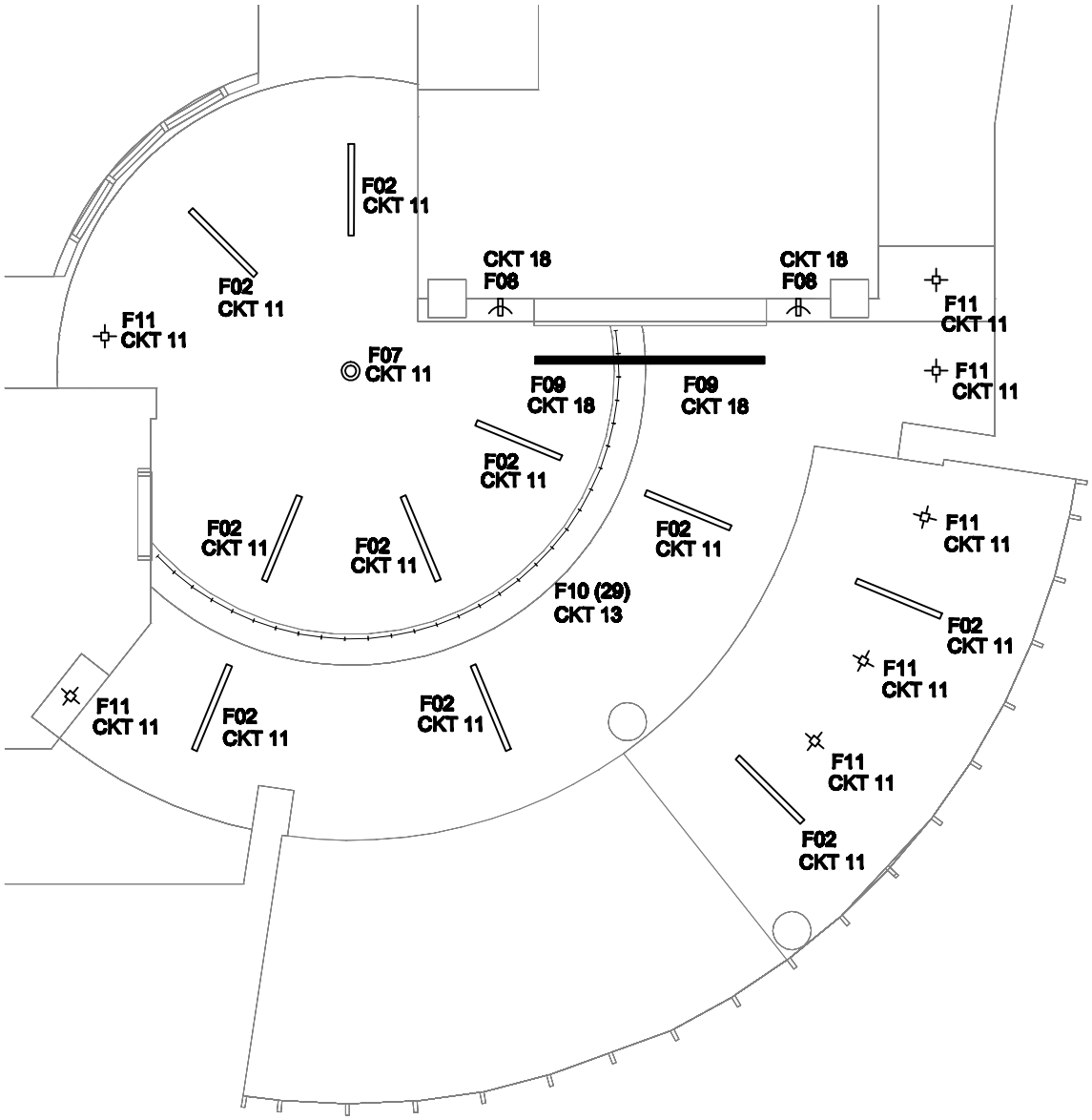
As with the rest of the building, a higher color temperature can help to convey the technology and modernity of the building. Color rendering is also important in this space due to the rich colors of finishes.

**Technical Objectives**

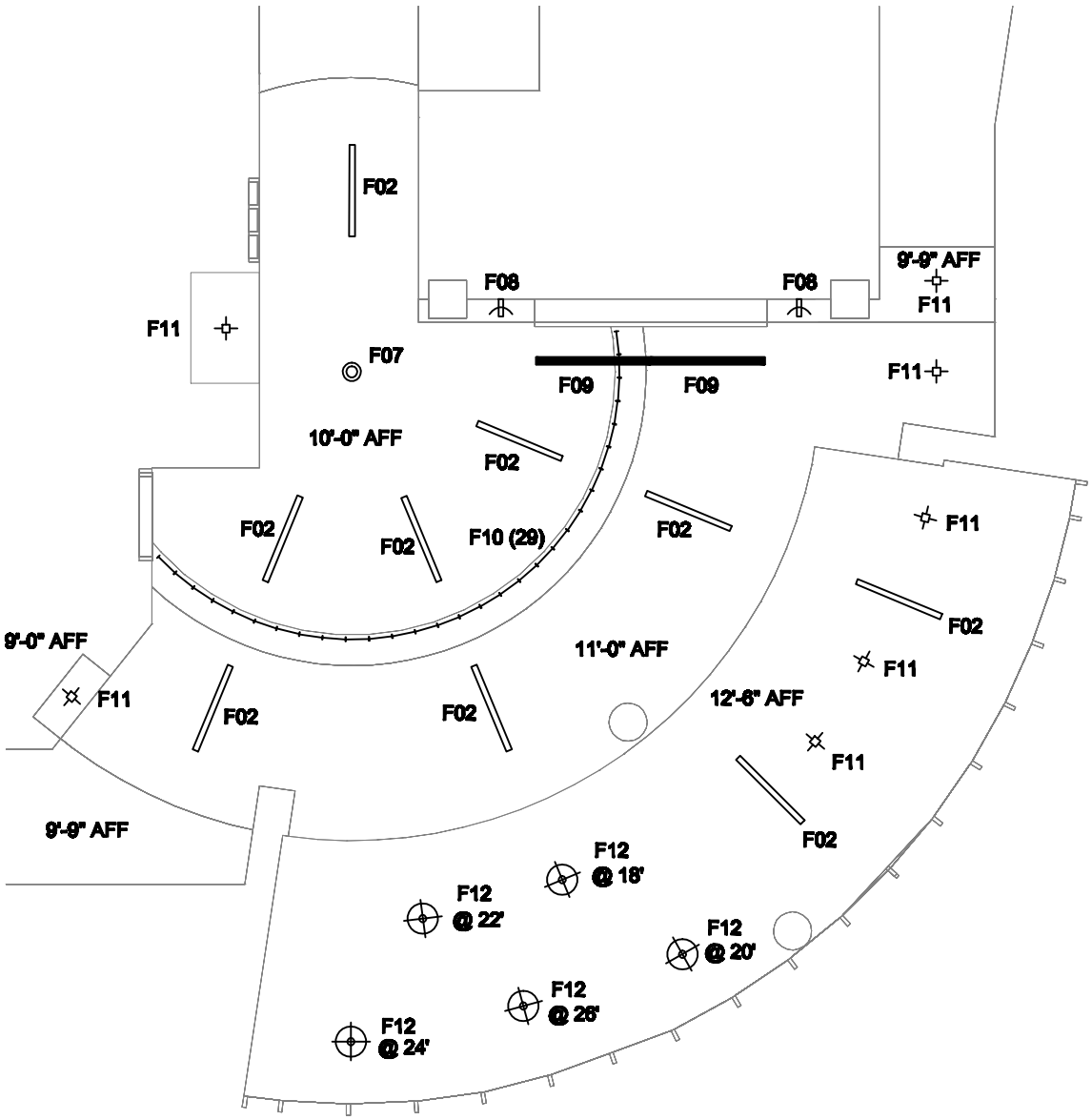
| DESCRIPTION | GOAL | RESULT | MET? |
|---|---|---|---|
| **Horizontal Illuminance** | Floor: **10** fc | **10.1, 9.8** fc Avg. | **YES** |
| **Power Density** (ASHRAE 90.1) | **1.3** W/SF (Space Method) | **0.79** W/SF | **YES** |

**Power Density Calculation (Total First and Second Floors)**

| FIXTURE | QUANTITY | WATTS | TOTAL WATTS |
|---|---|---|---|
| **F02** | 20 | 32 | 640 |
| **F07** | 2 | 20 | 40 |
| **F08** | 4 | 32 | 128 |
| **F09** | 4 | 38 | 152 |
| **F10** | 60 | 3 | 180 |
| **F11** | 14 | 35 | 490 |
| **F12** | 5 | 64 | 320 |
| | | **TOTAL Watts** | 1950 |
| | | **Area (SF)** | 1230 x 2 = 2460 |
| | | **Power Density (W/SF)** | **0.79** |

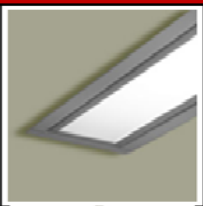
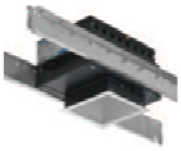



| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Lighting Consultant:<br>Dr. Kevin Houser | Grant Kightlinger<br>L/E Option | Penn State University<br>AE Senior Thesis | 1F LOBBY LIGHTING RCP<br>1/8" = 1'-0" |

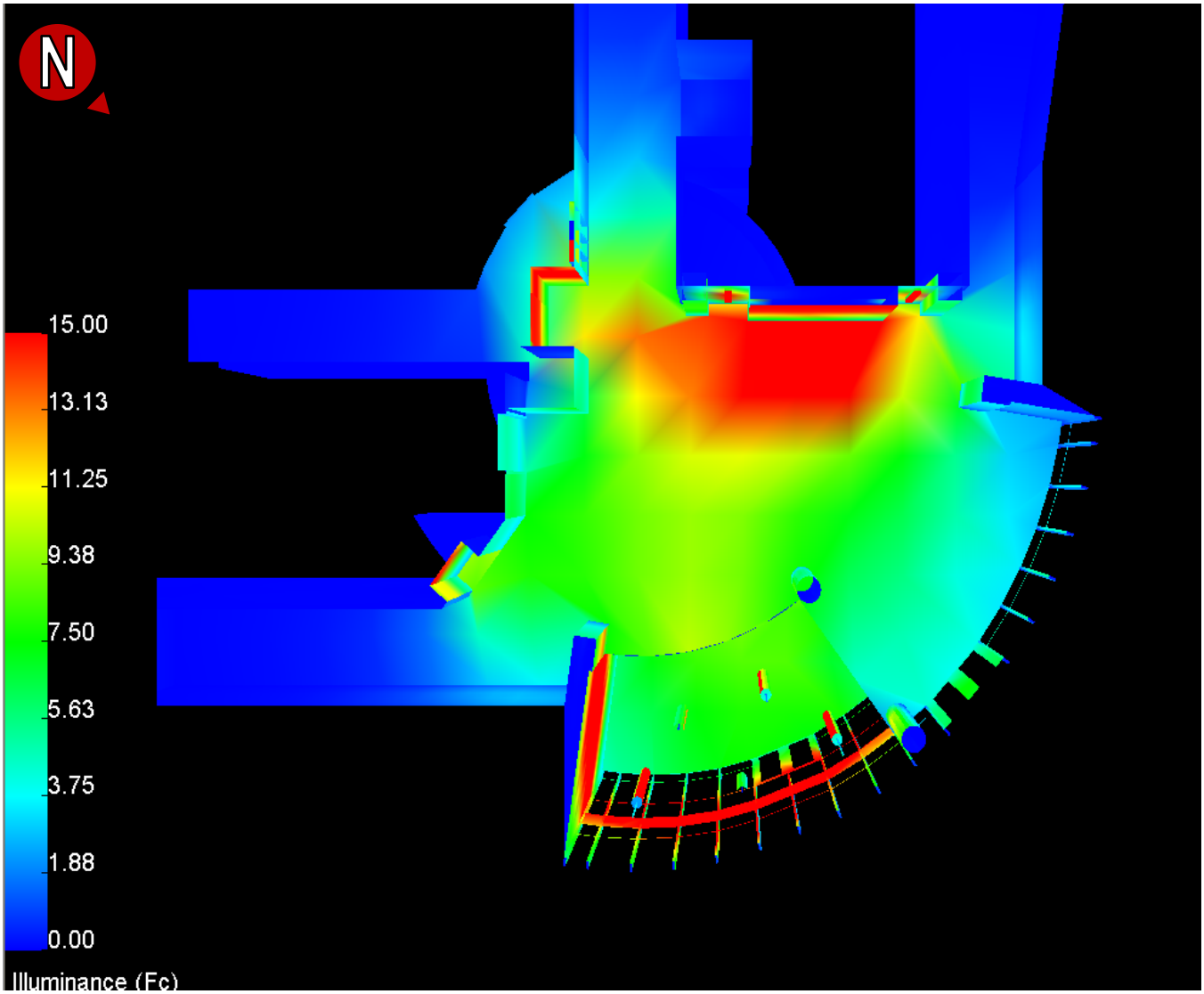



| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Lighting Consultant:<br>Dr. Kevin Houser | Grant Kightlinger<br>L/E Option | Penn State University<br>AE Senior Thesis | 2F LOBBY LIGHTING RCP<br>1/8" = 1'-0" |

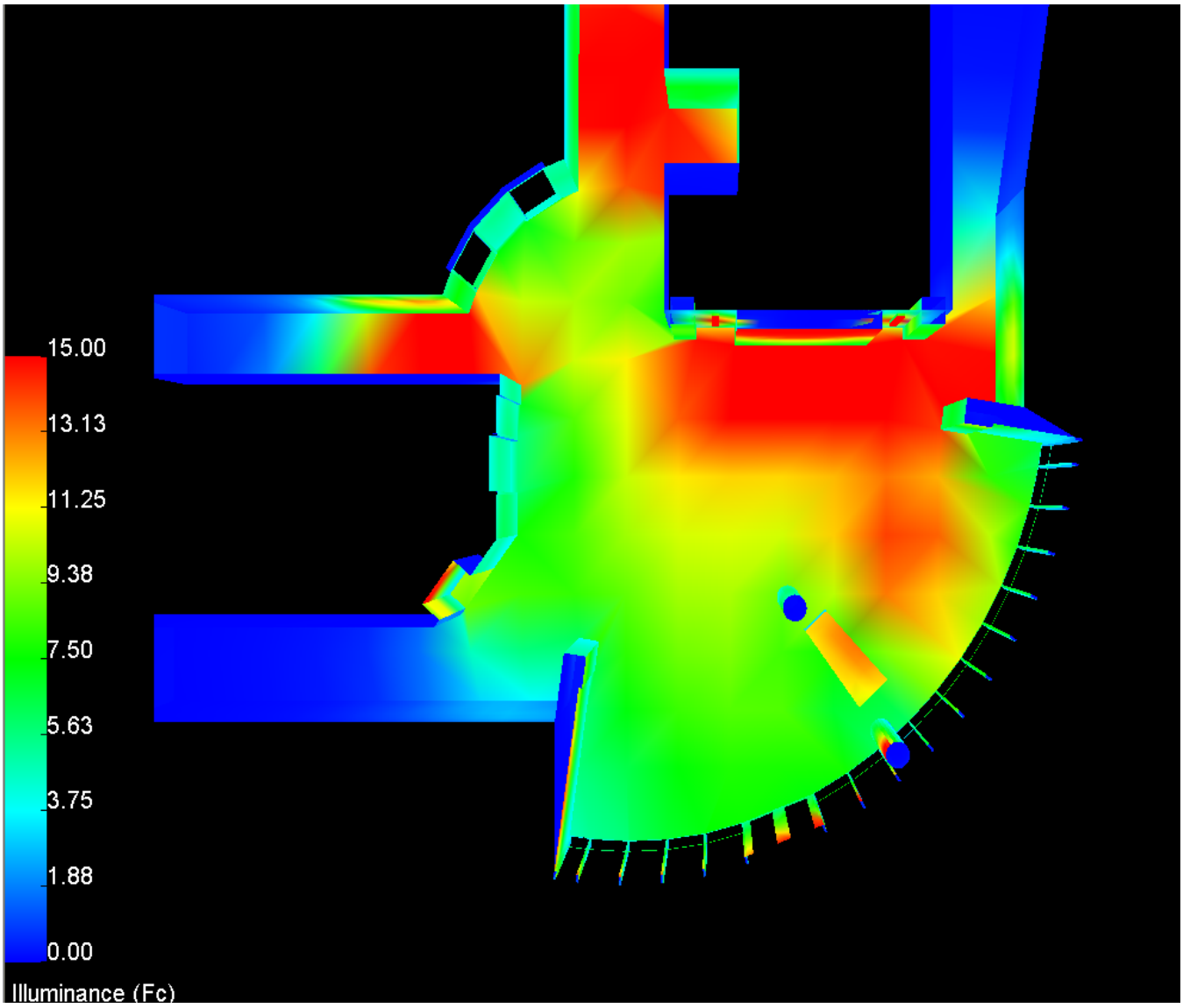
**Partial Fixture Schedule**

| TYPE | IMAGE | MANUF. | DESCRIPTION |
|---|---|---|---|
| **INDOOR FIXTURES** | | | |
| **F02** |  | FOCAL POINT | "AVENUE B" - RECESSED SLOT FIXTURE. DIFFUSE FLUSH LENS, SINGLE CIRCUIT, DRYWALL FLANGE, MATTE WHITE HOUSING. STEEL CONSTRUCTION. |
| **F07** |  | LOUIS POULSEN | "BALLERUP" |
| **F08** |  | LIGHTOLIER | "SOLI" WALL-MOUNTED DECORATIVE T5 FIXTURE. METALLIC ALUMINUM FINISH, SEE DIFFUSER SPECIFICATION BELOW (ORDER SEPERATELY). ADA COMPLIANT |
| **F09** |  | ELLIPTIPAR | "STYLE 102" WALL CANTILEVER-MOUNTED WALL WASH LUMINAIRE. BRIGHT ALUMINUM FLUTED HOUSING WITH SILVER END PLATES, 18" CANTILEVEL ARM. 5' LENGTH. |
| **F10** |  | COLOR KINETICS | "iCOLOR COVE QLX" COVE-MOUNTED RGB COLOR-CHANGING COVE FIXTURE. 120 DEGREE CANDLEPOWER DISTRIBUTION, ADJUSTABLE POSITION MOUNTING BRACKET. |
| **F11** |  | PHILIPS | "OMEGA REVELATION" 4-INCH SQUARE CFL DOWNLIGHT. CLEAR SPECULAR REFLECTOR. |
| **F12** |  | SCHMITZ | "TOOL" PENDANT FIXTURE. NO DOWNLIGHT. RIBBED ACRYLIC TUBE, SATIN NICKEL FINISH. ADJUSTABLE SUSPENSION CABLE. |

**Pseudocolor Renderings**




First Floor Lobby



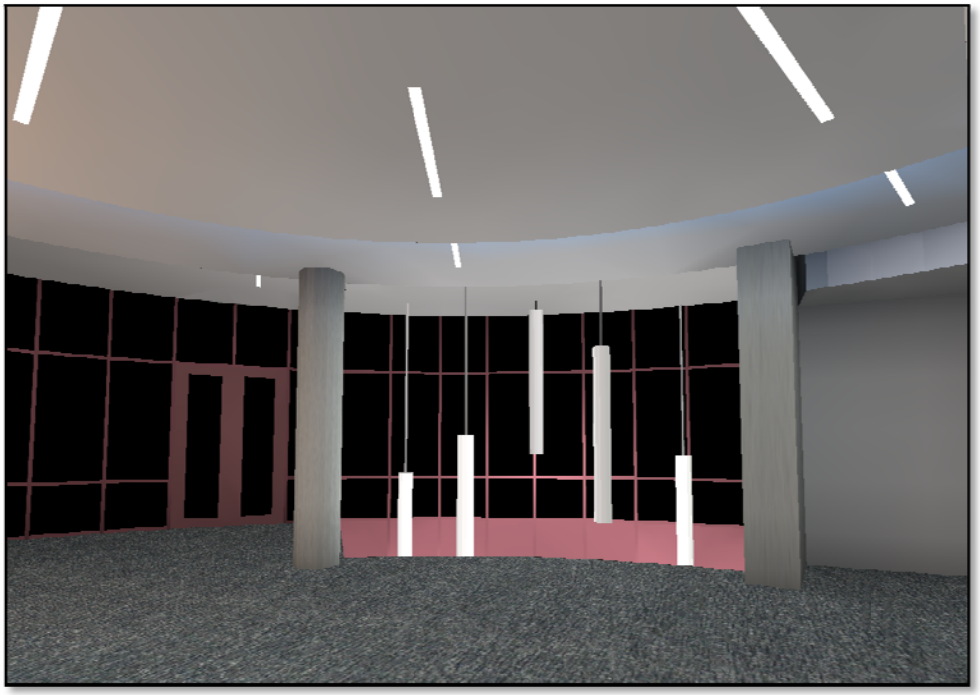

Second Floor Lobby

**Statistics**

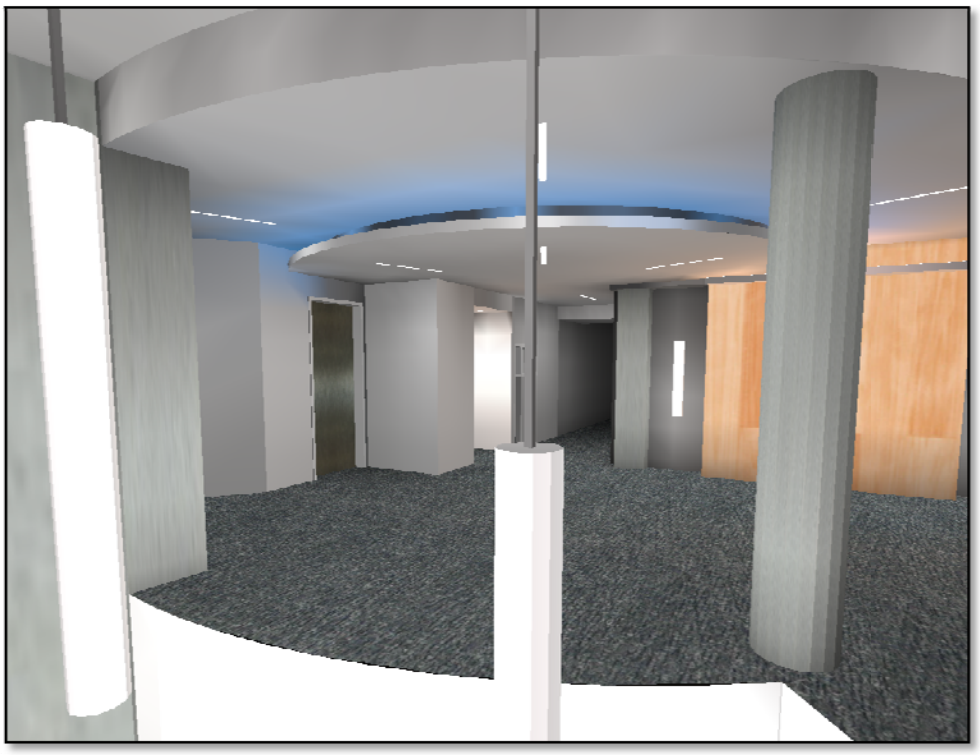
| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| First Floor | 0'-0" AFF | fc | 10.1 | 29.0 | 3.4 | 3.0 | 8.5 |
| Second Floor | 0'-0" AFF | fc | 9.8 | 27.6 | 3.3 | 3.0 | 8.4 |

**Renderings**

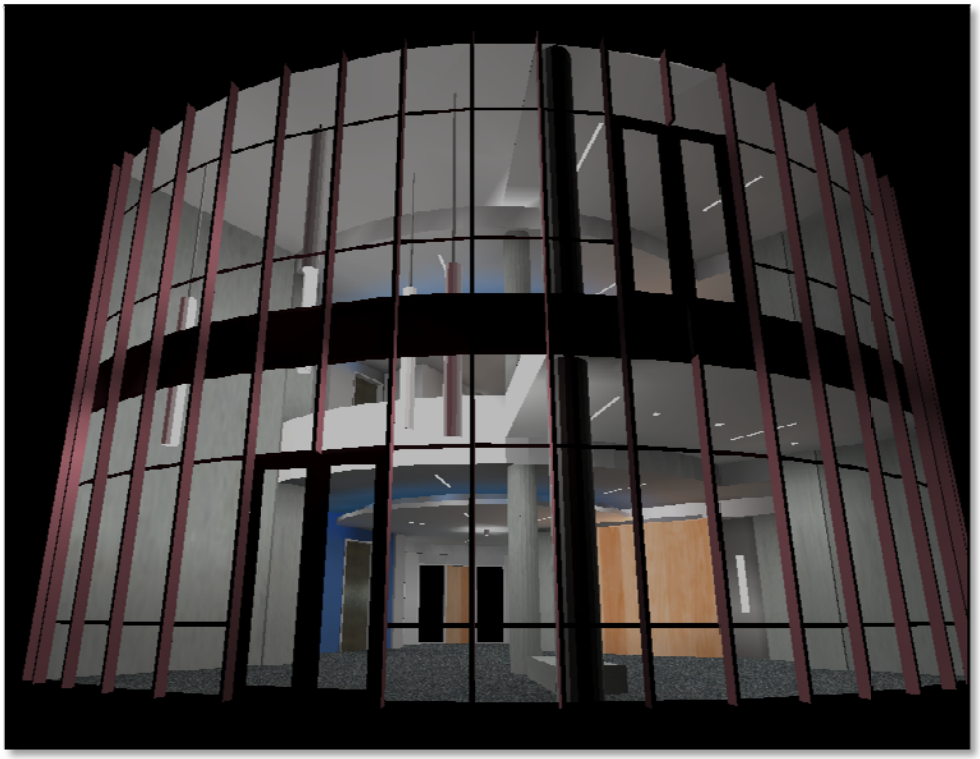
1st Floor from Main Doorway



2nd Floor from Center



2nd Floor from Atrium



View from North Plaza

**Light Loss Factors**

| FIXTURE | MAINT. CAT. | DISTR. | LLD | LDD | RSDD | BF | TOTAL LLF |
|---|---|---|---|---|---|---|---|
| **F02** | V | DIRECT | 0.93 | 0.87 | 0.96 | 1.00 | 0.78 |
| **F07** | IV | DIRECT | 0.85 | 0.89 | 0.96 | 1.00 | 0.73 |
| **F08** | II | DIRECT/INDIRECT | 0.93 | 0.87 | 0.93 | 1.00 | 0.75 |
| **F09** | IV | DIRECT | 0.96 | 0.89 | 0.96 | 1.00 | 0.82 |
| **F10** | VI | DIRECT | 0.85 | 0.85 | 0.96 | - | 0.70 |
| **F11** | IV | DIRECT | 0.85 | 0.89 | 0.96 | 1.00 | 0.73 |
| **F12** | II | DIRECT | 0.93 | 0.87 | 0.96 | 1.00 | 0.77 |

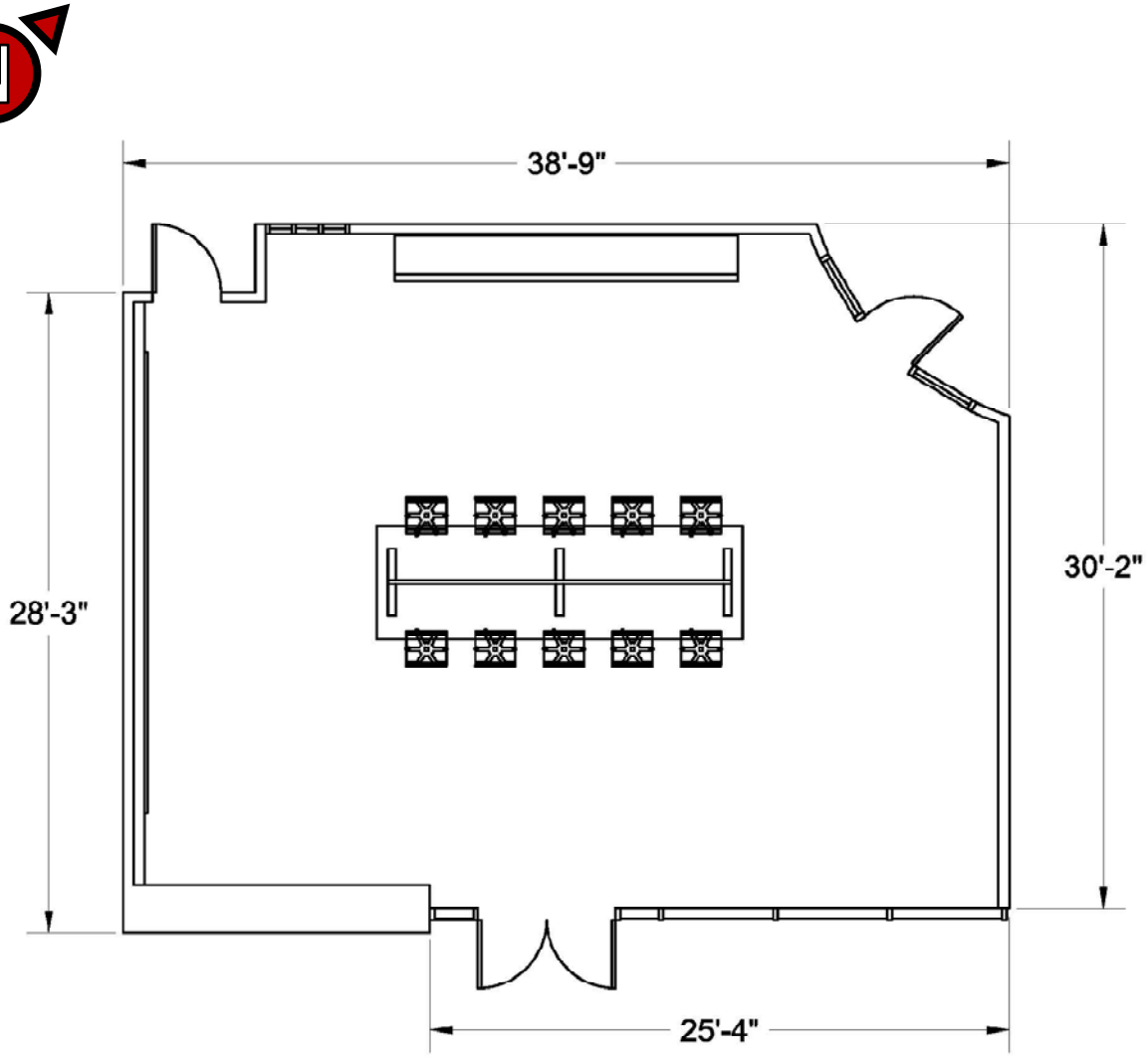
* Assumptions:

1. Clean Environment, 12-month cleaning cycle.
2. 35°C lamp data used in calculations.

## LIGHTING – CONFERENCE ROOM

The large conference room on the first floor of the building is a multi-purpose space and serves as a location for face-to-face meetings, whiteboard lectures, A/V presentations and social gatherings. It measures approximately 1050 square feet. The room can be accessed through a main door connecting to the lobby to the north, and also through a secondary interior door to the west. Windows and doors on the southeast side of the room open to an outdoor patio space. On the southwest wall, a whiteboard is framed by a white maple wall. A credenza runs along the wall between the two interior entries, and a large conference table sits in the center of the room.

**Dimensions**




Partial First Floor Plan
Scale: NTS

## Materials

### Floor

| | |
|---|---|
| Material: | Carpet |
| Color: | Medium Brown |
| Reflectance: | 0.20 |

### Walls

| | |
|---|---|
| Material: | Painted Gypsum |
| Color: | Semi-Gloss White, Semi-Gloss Blue |
| Reflectance: | 0.6, 0.3 |

### Whiteboard Wall

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

### Ceiling (Upper)

| | |
|---|---|
| Material: | Acoustic Ceiling Tile - 2’ x 2’ Suspended Grid |
| Color: | White |
| Reflectance: | 0.89 |

### Ceiling (Lower)

| | |
|---|---|
| Material: | Painted Gypsum |
| Color: | 501 “Shell White” |
| Reflectance: | 0.65 |

### Doors (Interior)

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

### Glazing (Exterior)

| | |
|---|---|
| Material: | Heat Mirror 66 – Clear |
| Transmittance: | 0.56 |
| Shading Coefficient: | 0.44 |

### Glazing (Interior)

| | |
|---|---|
| Material: | Translucent Tempered Glass |
| Transmittance: | 0.40 |

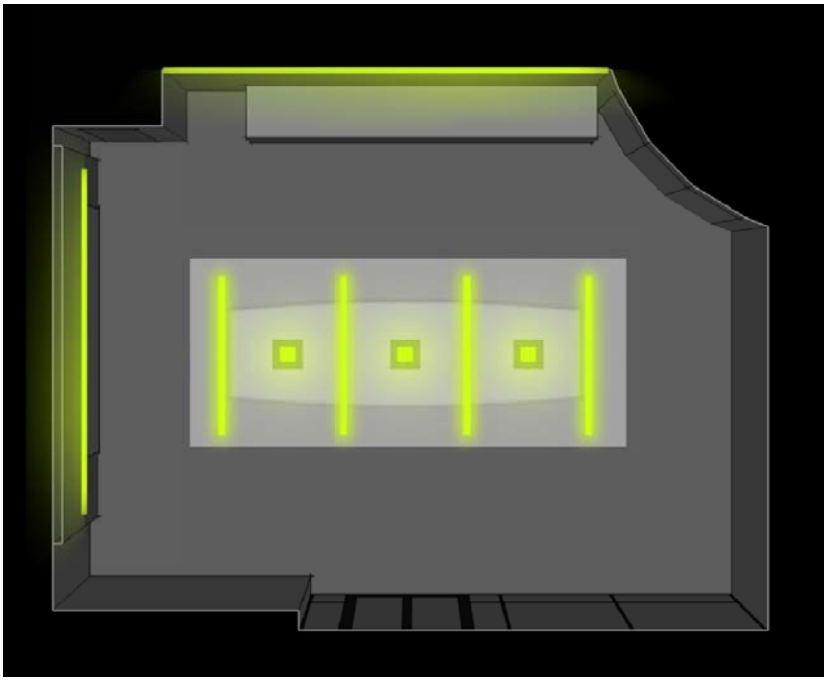
### Table/Credenza

| | |
|---|---|
| Material: | Wood - White Maple |

**Design Concept Development**

This space is unique in that it has direct pedestrian access to a landscaped patio to the south. The transparency between these two spaces is of great importance for the lighting redesign. Within the room itself, flexibility of use is an important consideration. The lighting design is elegant and customizable to accommodate audio/visual presentations, group meetings, lectures, and casual entertaining situations without being too complex for user operation. The clean, linear fixtures in this room reinforce the linear motion theme which is echoed throughout the building and the simple, modern architectural style. Cool color temperature sources and colored surfaces are in contrast to the warmer color theme used in the exterior spaces.

The lighting in the conference room has gone through a few changes over the course of the project. The north wall is highlighted for visual interest and for the display of artwork. The surface behind the credenza has been fitted with a decorative texture which is then grazed from the top of the wall. This provides a focal point for the interior and exterior of the space. The general concept of the central fixture has been maintained, but has been simplified and suspended for a more ambient lighting solution, which is crucial for good facial rendering in the space.



Conference Room Schematic Design

## Design Objectives / Considerations

### Desired Perceptions

Conceptually, the conference room should be an extension of the patio and vice versa, particularly at night—allowing occupants to appreciate and explore the outdoor space. A transparent feeling should be achieved whenever possible. Visual clutter is to be avoided in this space, allowing the occupants to focus on the meeting or presentation at hand. Peripheral emphasis is used to encourage relaxation, especially in the social mode.

### Focal Points

The accessible patio is a major focal point of the space as mentioned above. Within the room itself, other focal emphases vary by mode and include: facial rendering for meetings, the whiteboard/projection screen, the textured credenza wall, and the accented art and/or articles posted on the rear wall.

### Light Distribution on Task Plane

The several modes of use of the space each require different task plane illuminances. In general, the conference table should have a very uniform distribution, allowing occupants to perform necessary visual tasks regardless of seating location. Uniform light also helps to reinforce the clean, modern feel of the space.

### Facial Rendering

Facial rendering in the meeting mode is extremely important, and sufficient vertical illuminance at the table is critical. Ambient light is maximized to help soften shadows and provide a more favorable facial image.

### Color

Color rendering is somewhat important in social modes to provide favorable rendering of faces and possibly food or other displays. Cool (high CCT) sources are selected to fit with the technological, modern style of the building.

### Facial Rendering

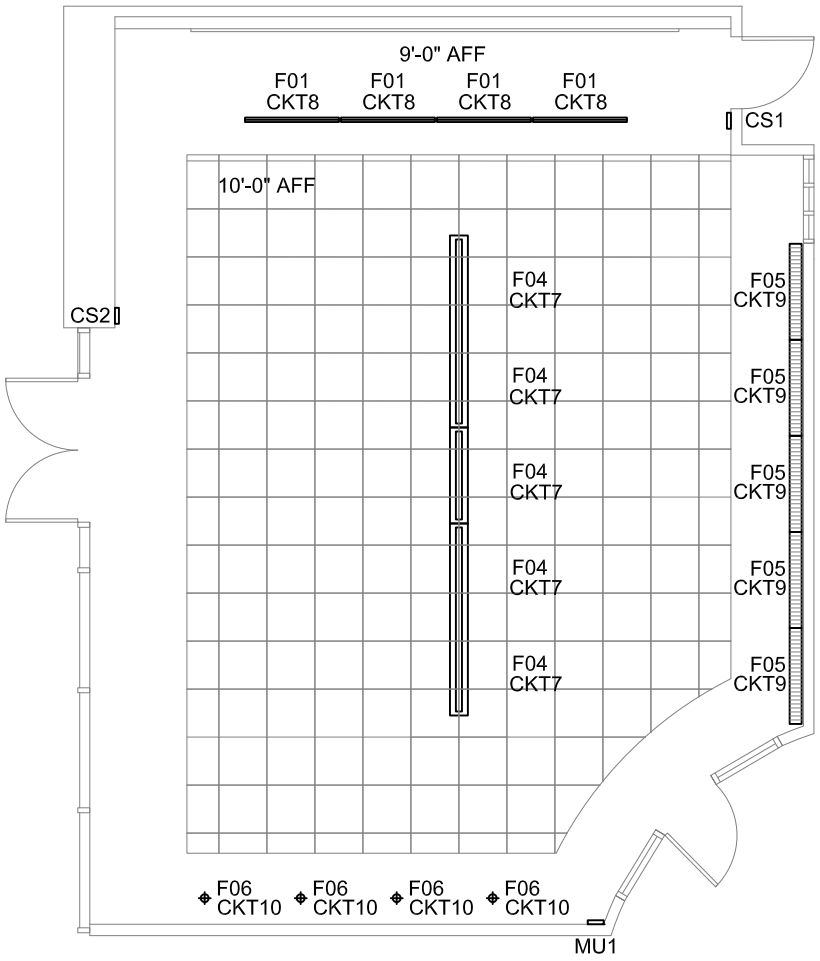
Facial rendering in the meeting mode is extremely important, and sufficient vertical illuminance at the table is critical. Ambient light is maximized to help soften shadows and provide a more favorable facial image.

## Technical Objectives

| DESCRIPTION | GOAL | RESULT | MET? |
|---|---|---|---|
| **Meeting / Classroom Mode** | Table: **30 fc** Avg. Horizontal | **33.7 fc** | **YES** |
| | Credenza: **15 fc** Avg. Horizontal | **25.0 fc** | **YES** |
| | Whiteboard: **30 fc** Avg. Vertical | **35.6 fc** | **YES** |
| | Faces: **15 fc** Avg. Vertical | **25.6 fc** | **YES** |
| **A/V Presentation Mode** | Projection Screen: **< 5 fc** Max Vertical | **2.6 fc** | **YES** |
| | Table: **15-30 fc** Avg. Horizontal | **16.3 fc** | **YES** |
| **Social Mode** | Faces: **15 fc** Avg. Vertical | **16.1 fc** | **YES** |
| | Credenza: **15 fc** Avg. Horizontal | **28.3 fc** | **YES** |
| **Power Density** (ASHRAE 90.1) | **1.3** W/SF (Space Method) | **0.56 fc** | **YES** |

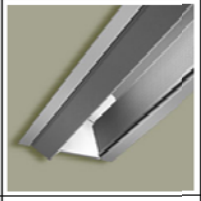
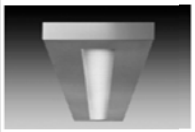
## Power Density Calculation

| FIXTURE | QUANTITY | WATTS | TOTAL WATTS |
|---|---|---|---|
| **F01** | 4 | 32 | 128 |
| **F04** | 5 | 32 | 160 |
| **F05** | 5 | 32 | 160 |
| **F06** | 4 | 35 | 140 |
| | | **TOTAL Watts** | 588 |
| | | **Area (SF)** | 1050 |
| | | **Power Density (W/SF)** | **0.56** |




| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Lighting Consultant:<br>Dr. Kevin Houser | Grant Kightlinger<br>L/E Option | Penn State University<br>AE Senior Thesis | CONF ROOM LIGHTING RCP<br>1/8" = 1'-0" |

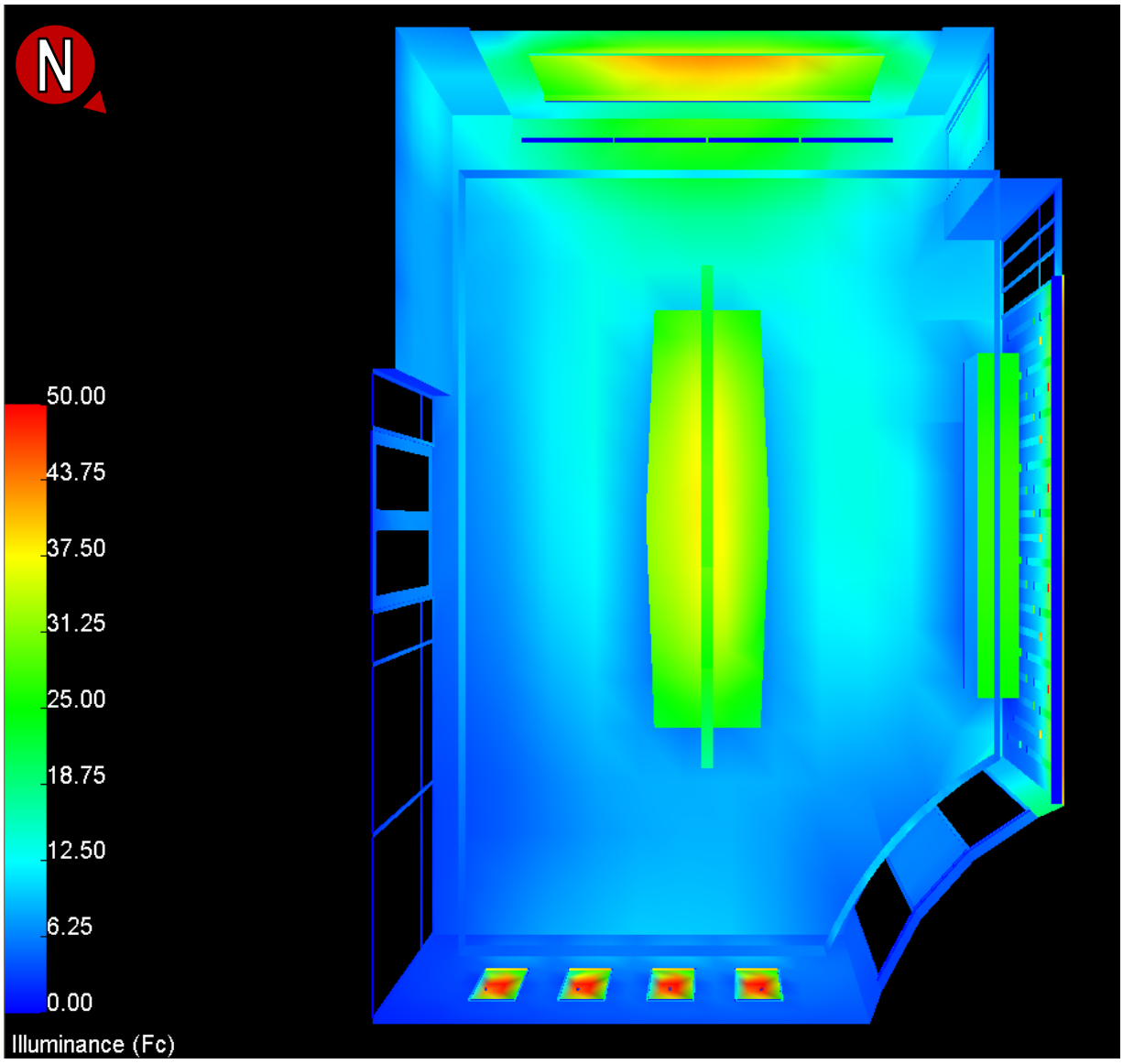
**Partial Fixture Schedule**

| TYPE | IMAGE | MANUF. | DESCRIPTION |
|---|---|---|---|
| **INDOOR FIXTURES** | | | |
| **F01** |  | FOCAL POINT | "AVENUE A" - NARROW APERTURE ASYMMETRIC WALL WASHER. SINGLE CIRCUIT, DRYWALL FLANGE, MATTE WHITE HOUSING, 4' NOMINAL LENGTH. STEEL CONSTRUCTION. |
| **F04** |  | FOCAL POINT | "TWELVE" - SUSPENDED INDIRECT/DIRECT LUMINIRE. PARALLEL BLADE LOUVER, 24" CABLE SUSPENSION, INTEGRAL WATTSTOPPER OCCUPANCY SENSOR, TITANIUM SILVER FINISH, FACTORY 20' RUN |
| **F05** |  | LIGHTOLIER | "PTS5-1" - RECESSED PERIMETER WALL WASH. STRAIGHT BLADE ALUMINUM LOUVER, DIE-FORMED STEEL CONSTRUCTION |
| **F06** |  | TECH LIGHTING | "SPOT" TRACK HEAD. COMPATIBLE WITH MONORAIL SYSTEM. 4.5" LENGTH. SATIN NICKEL FINISH. DESIGNER APPROVAL REQUIRED FOR LAMP SUBSTITUTION. |

## Meeting / Classroom Mode – Dimming Levels

| ZONE | OUTPUT LEVEL |
|---|---|
| 1 – Table Pendant | 100% |
| 2 – Whiteboard Wash | 100% |
| 3 – Credenza Wall | 80% |
| 4 – Rear Wall Accent | 100% |

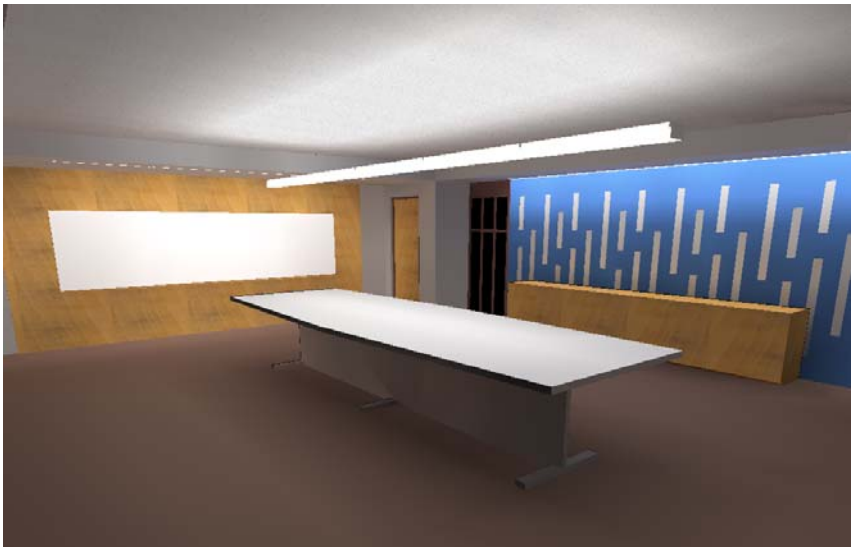
## Meeting / Classroom Mode – Pseudocolor Renderings



**Meeting / Classroom Mode - Statistics**

| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| Conference Table | 3'-0" | fc | 33.7 | 38.0 | 25.3 | 1.3 | 1.5 |
| Faces @ Table | Vertical | fc | 25.6 | 27.8 | 20.4 | 1.3 | 1.4 |
| Whiteboard | Vertical | fc | 35.6 | 46.0 | 20.2 | 1.8 | 2.3 |
| Credenza | 3'-0" | fc | 24.9 | 35.3 | 14.1 | 1.8 | 2.5 |
| Artwork | Vertical | fc | 46.7 | 197 | 11.2 | 4.2 | 17.6 |

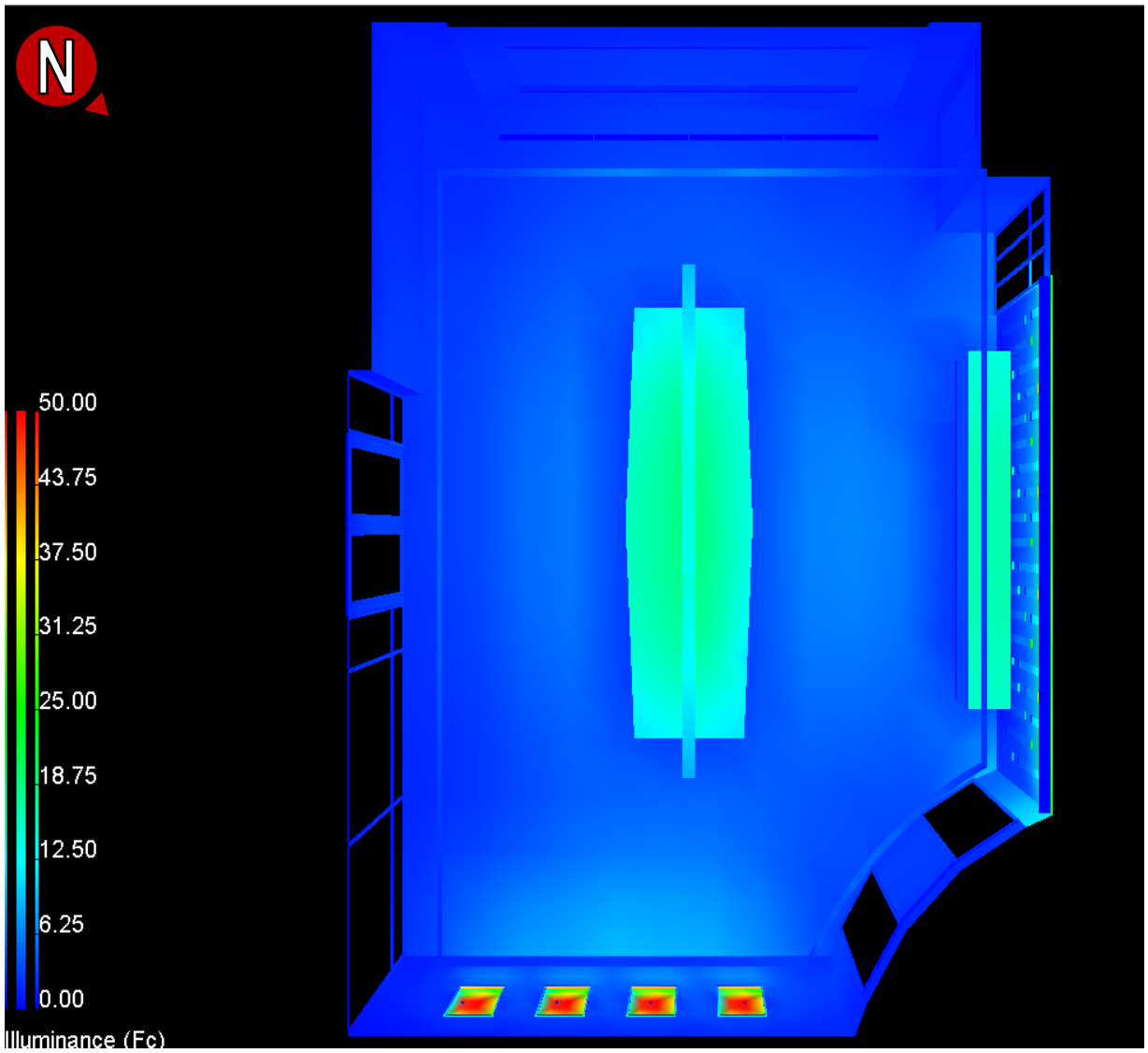
**Meeting / Classroom Mode - Renderings**



## A/V Presentation Mode – Dimming Levels

| ZONE | OUTPUT LEVEL |
|---|---|
| 1 – Table Pendant | 50% |
| 2 – Whiteboard Wash | OFF |
| 3 – Credenza Wall | 50% |
| 4 – Rear Wall Accent | 100% |

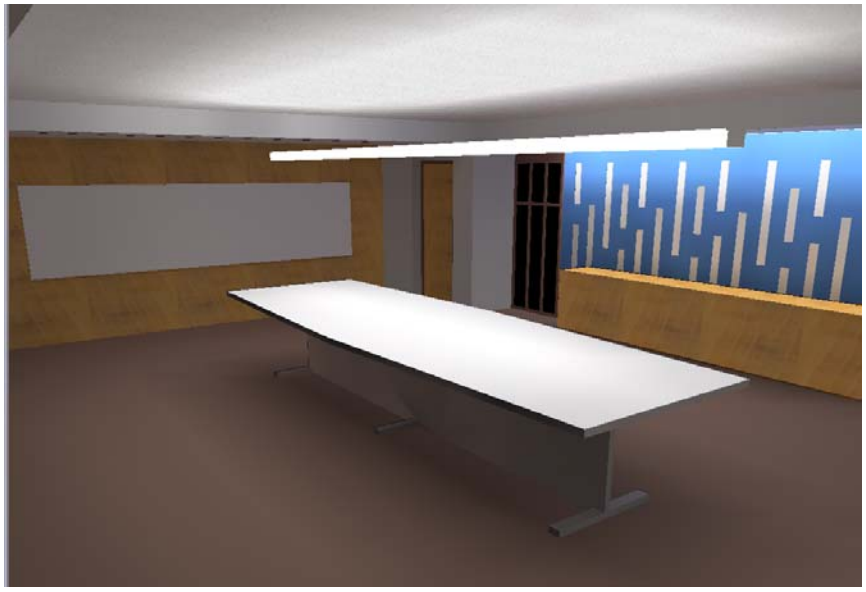
## A/V Presentation Mode – Pseudocolor Renderings



## A/V Presentation Mode – Statistics

| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| Conference Table | 3'-0" | fc | 16.3 | 18.5 | 12.6 | 1.3 | 1.5 |
| Faces @ Table | Vertical | fc | 12.3 | 13.5 | 10.1 | 1.2 | 1.3 |
| Projection Screen | Vertical | fc | 2.4 | 2.6 | 1.9 | 1.3 | 1.4 |
| Credenza | 3'-0" | fc | 14.8 | 24.9 | 6.5 | 2.3 | 3.8 |
| Artwork | Vertical | fc | 46.9 | 197 | 11.3 | 4.2 | 17.4 |

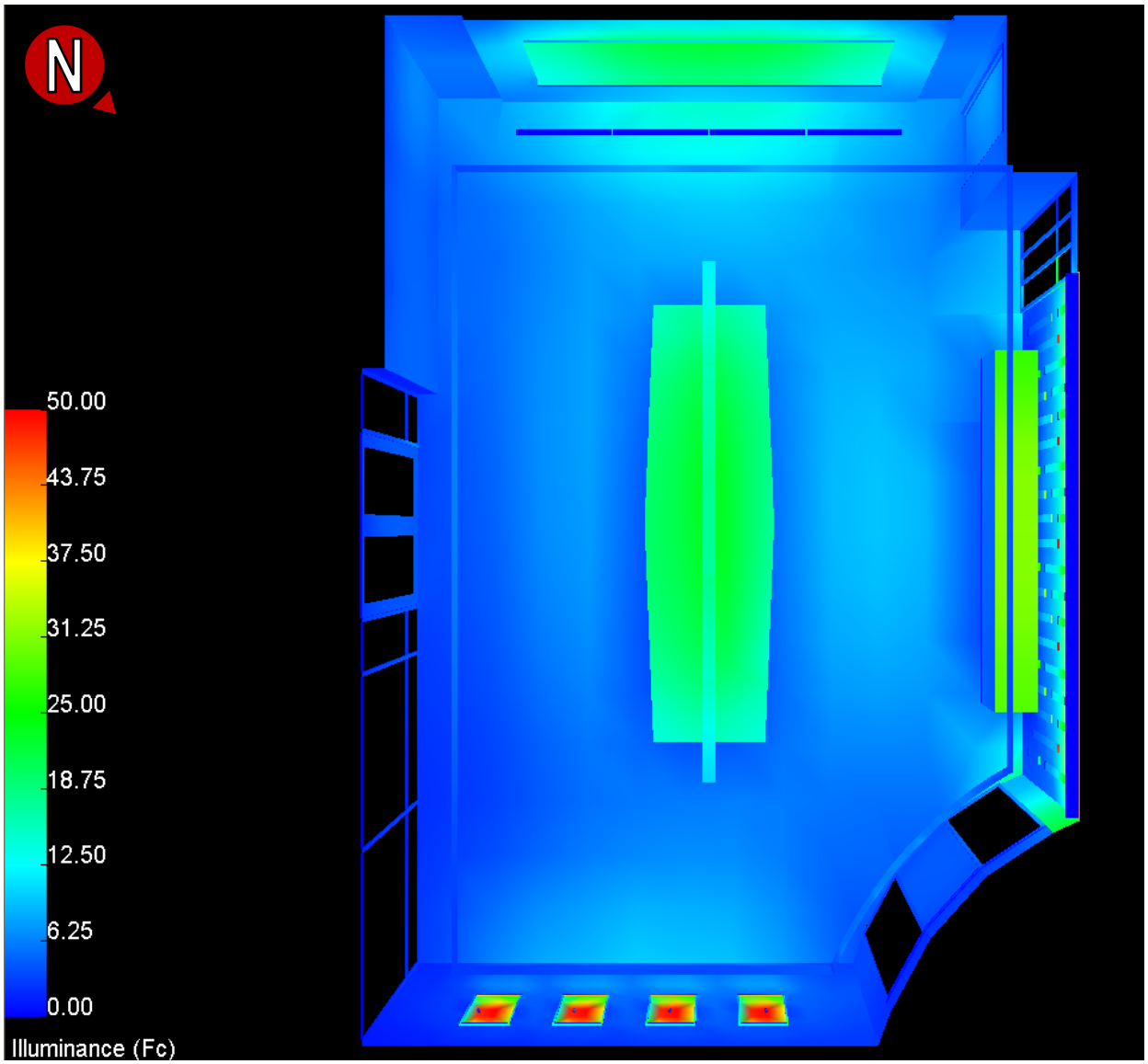
## A/V Presentation Mode – Renderings



**Social Mode – Dimming Levels**

| ZONE | OUTPUT LEVEL |
|---|---|
| 1 – Table Pendant | 60% |
| 2 – Whiteboard Wash | 50% |
| 3 – Credenza Wall | 100% |
| 4 – Rear Wall Accent | 100% |

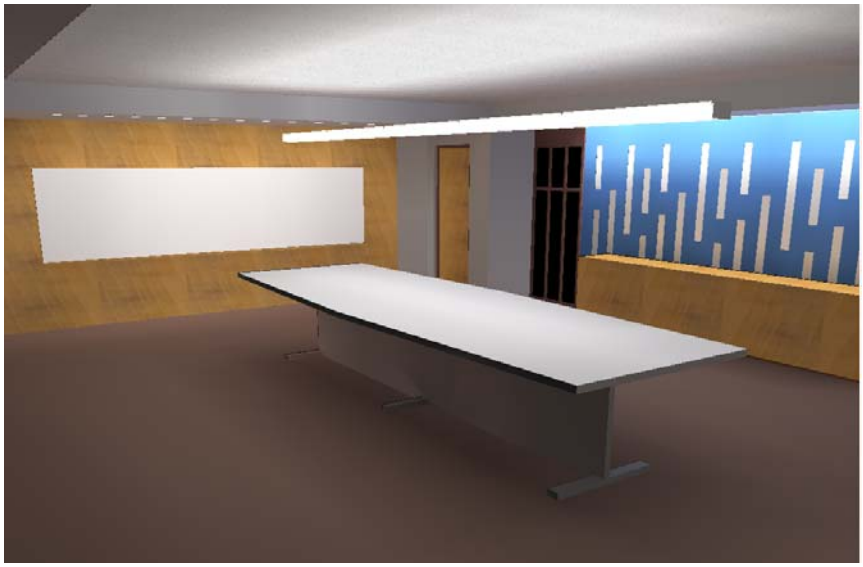
**Social Mode – Pseudocolor Renderings**



**Social Mode – Statistics**

| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| Conference Table | 3'-0" | fc | 20.6 | 23.2 | 15.6 | 1.3 | 1.5 |
| Faces @ Table | Vertical | fc | 16.1 | 17.4 | 13.0 | 1.2 | 1.3 |
| Whiteboard | Vertical | fc | 18.7 | 23.9 | 10.8 | 1.7 | 2.2 |
| Credenza | 3'-0" | fc | 28.3 | 41.4 | 14.4 | 2.0 | 2.9 |
| Artwork | Vertical | fc | 49.9 | 212 | 9.5 | 5.25 | 22.3 |

**Social Mode – Renderings**



**Light Loss Factors**

| FIXTURE | MAINT. CAT. | DISTR. | LLD | LDD | RSDD | BF | TOTAL LLF |
|---|---|---|---|---|---|---|---|
| **F01** | IV | DIRECT | 0.93 | 0.89 | 0.98 | 1.0 | 0.81 |
| **F04** | II | SEMI-INDIRECT | 0.93 | 0.94 | 0.94 | 1.0 | 0.82 |
| **F05** | IV | DIRECT | 0.93 | 0.89 | 0.98 | 1.0 | 0.81 |
| **F06** | IV | DIRECT | 0.85 | 0.89 | 0.98 | - | 0.74 |

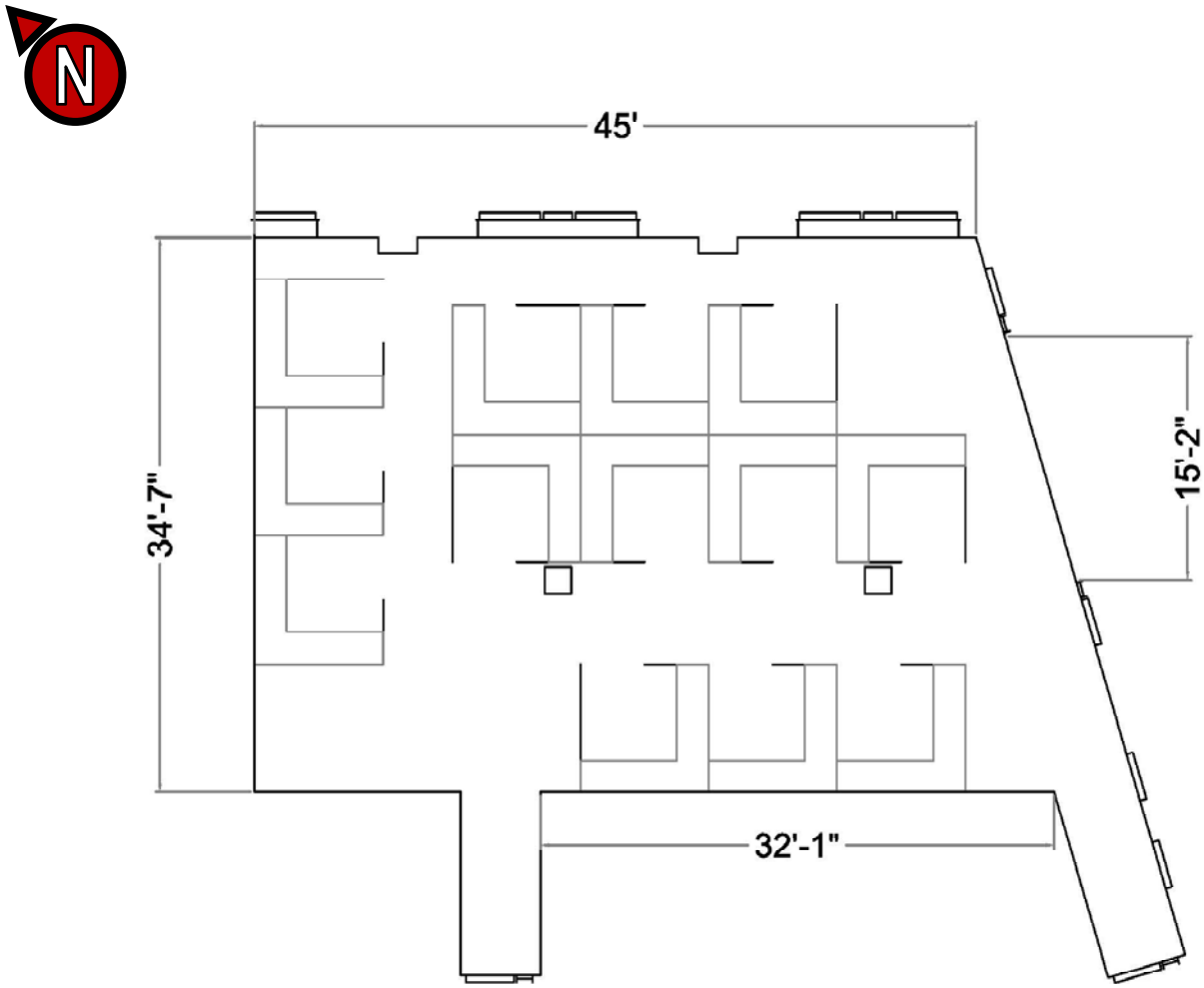
* Assumptions:

1. Clean Environment, 12-month cleaning cycle.
2. 35°C lamp data used in calculations.

## LIGHTING – OPEN OFFICE

Located on the third floor of the building, the open office contains workspaces for graduate students of the Biological Sciences department at UCI. The space measures approximately 1,840 square feet and features three large windows facing to the north-east. It is adjacent to two work rooms and several private faculty offices and is accessed through short corridors on the south wall.

### Dimensions




*Partial Third Floor Plan*
*Scale: NTS*

## Materials

### Floor

| | |
|---|---|
| Material: | Carpet |
| Manufacturer: | Designweave |
| Color: | Medium Brown |
| Reflectance: | 0.20 |

### Walls

| | |
|---|---|
| Material: | Painted Gypsum |
| Color: | Semi-Gloss White, Semi-Gloss Blue |
| Reflectance: | 0.6, 0.3 |

### Ceiling

| | |
|---|---|
| Material: | Gypsum |
| Color: | White |
| Reflectance: | 0.89 |

### Doors

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

### Glazing

| | |
|---|---|
| Material: | Heat Mirror 66 – Clear |
| Transmittance: | 0.56 |
| Shading Coefficient: | 0.44 |

### Window Framing

| | |
|---|---|
| Material: | Painted Steel |
| Transmittance: | 0.15 |

### Desks

| | |
|---|---|
| Material: | Wood - White Maple |
| Reflectance: | 0.60 |

**Design Concept Development**

The overarching design concept for the building embraces motion, especially radial or explosive motion between the interior and exterior of the structure. Parallel linear elements are used to support this sensation of unidirectional motion. Through the manipulation of color temperature and surface finishes, the inner spaces are given a cool, blue tone in contrast to the warmer exterior surfaces. Recessed ceiling strips are low-profile and are not distracting to the eye. Lighting elements below the ceiling have been avoided in this space to maintain views through the windows and to create a sleeker, custom appearance. The views from the exterior into the space played a large part in the decision to lay fixtures perpendicular to the window plane, which creates a more dramatic effect.

The office has been significantly redesigned since the schematic design presentation to create a more aesthetically exciting space from inside and outside the building. The unique lighting solution in this space relies and plays upon the overarching concepts of the architecture and lighting design without being too distracting. The windows have been highlighted as a central focus in the space and are framed by the lighting and the circulation paths between workspaces. Peripheral walls have been highlighted to accentuate color and architectural features which can be seen throughout the space.

## Design Objectives / Considerations

### Desired Perceptions

The space is intended to feel clean, cool and dynamic. Due to the relatively low ceiling height (10'-0"), fixtures are tucked away as much as possible to avoid visual clutter in the space. A strong connection to the outdoors should be felt during the day and at night.

### Focal Points

The main focal point of the space is intended to be the view of campus from the row of windows on the north wall. The north-south orientation and low profile of the ceiling fixtures draw the eye toward the windows. An announcement/posting area is highlighted on the slanted east wall, and becomes a secondary focus of the room. Columns and pilasters are also accented in blue for balance and visual interest.

### Glare

Reflected glare on computer screens from ceiling fixtures is a concern in this space. High contrast ratios have been avoided as much as possible. An assumption has been made that the computers in this space use flat, diffuse screen technology, greatly reducing the possibility of reflected glare from the ceiling fixtures. Please refer to the glare potential calculation on the next page for more information.

### Light Distribution on Task Plane

Sufficient and uniform illuminance of the work plane is a very important consideration. Paper-based and computer-based tasks are both common in the space. Multiple sources of light are used to create an ambient light and to reduce hard shadows. Individual task lighting allows the occupants to manually adjust their workspaces depending on the task at hand.

### Control / Daylight Integration

Although some flexibility of control is desired in the space, it has only one prevalent mode of use. The space is likely to be used at least 8 hours per day on weekdays, with intermittent use on weekends. Thus, the most important feature of the control system is simplicity. An occupancy sensor system will be organized in such a way that it will maintain illumination whenever there are people working, even if they are not moving about the space. A daylight-based dimming or switching system may be practical for luminaires near the window.

## Technical Objectives

| DESCRIPTION | GOAL | RESULT | MET? |
|---|---|---|---|
| **Workplane Illuminance** | **25 – 35** horizontal fc on workplane (3'-0") * | Avg. = **28.9** fc | **YES** |
| **Workplane Uniformity** | Workplane uniformity Max/Min ≤ **5:1** | Avg./Min = **4.9:1** | **YES** |
| **Circulation Illuminance** | **>10** horizontal fc in circulation areas (0'-0") | Avg.= **19.6** | **YES** |
| **Power Density** (ASHRAE 90.1) | **1.1** W/SF (Space Method) | **0.86** W/SF | **YES** |

* NOTE: This value does not include illumination from personal task lighting. Keeping the overall lighting at a lower level saves energy by allowing occupants to turn off task lights when absent or not performing visually intensive activities.

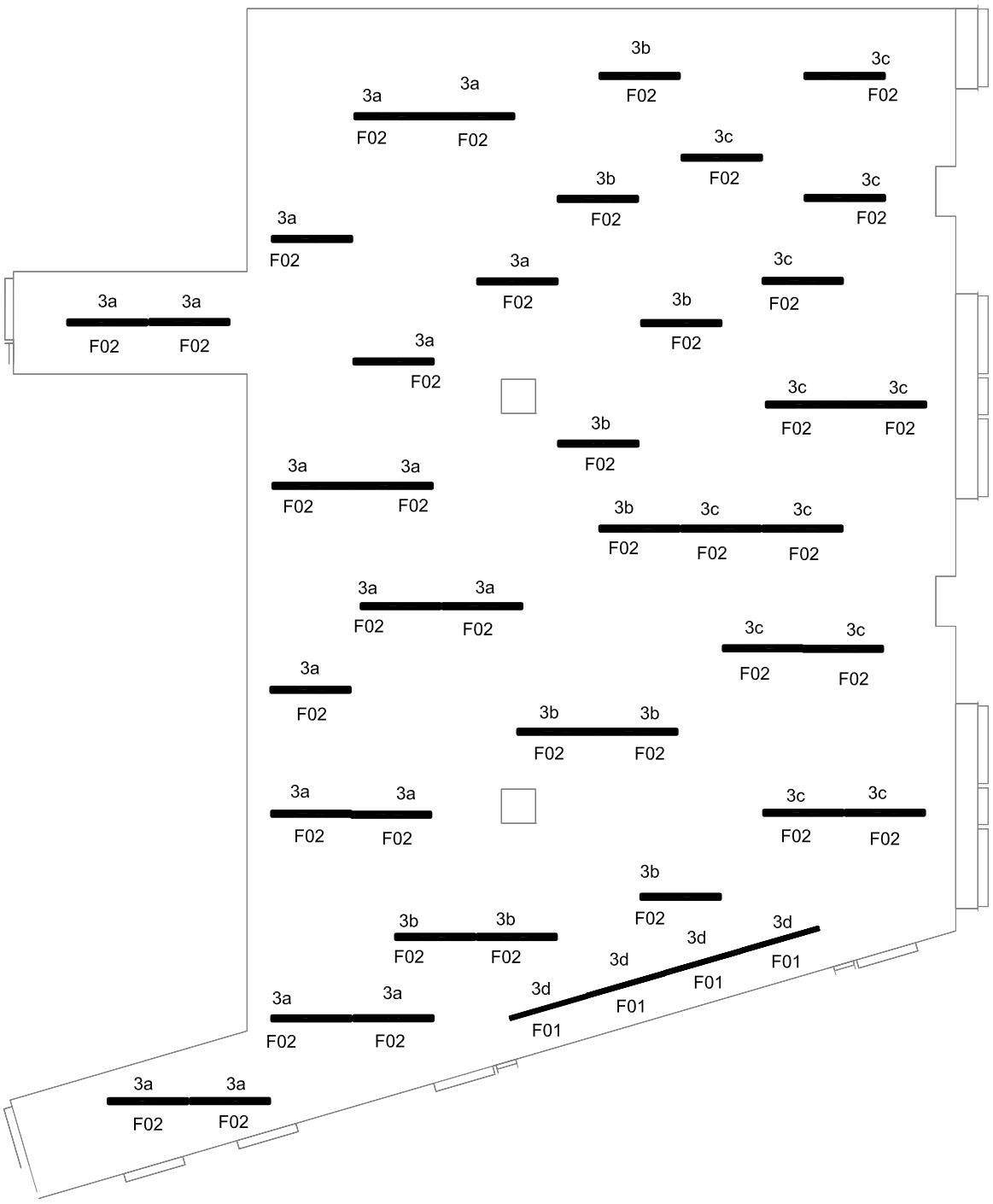
## Power Density Calculation

| FIXTURE | QUANTITY | WATTS | TOTAL WATTS |
|---|---|---|---|
| **F01** | 4 | 32 | 128 |
| **F02** | 40 | 32 | 1280 |
| **F03** | 13 | 13 | 169 |
| | | **TOTAL Watts** | 1577 |
| | | **Area (SF)** | 1840 |
| | | **Power Density (W/SF)** | **0.86** |

## Glare Potential Calculation

According to ANSI / IESNA RP-1-04, normal office spaces with regular use of visual display terminals (VDTs) should meet certain candlepower limits by vertical angle in order to reduce visual discomfort and reflected glare. The recommended practice names these maximum values as: 300 cd at 65 degrees, 185 cd at 75 degrees, and 60 cd at 85 degrees from the vertical. The following excerpt from the specifications of fixture type F02 show that the values for 65 degrees are only slightly over recommended values. To achieve a desirable aesthetic impression in the space, and with the assumption that modern desktop display terminals are not perfectly specular, the fixture has still been specified.

| Vertical Angle | Horizontal Angle 0° | 22.5° | 45° | 67.5° | 90° | Zonal Lumens |
|---|---|---|---|---|---|---|
| 65° | 356 | 338 | 310 | 297 | 293 | 315 |
| 75° | 165 | 158 | 150 | 144 | 142 | 160 |
| 85° | 35 | 37 | 38 | 38 | 40 | 41 |

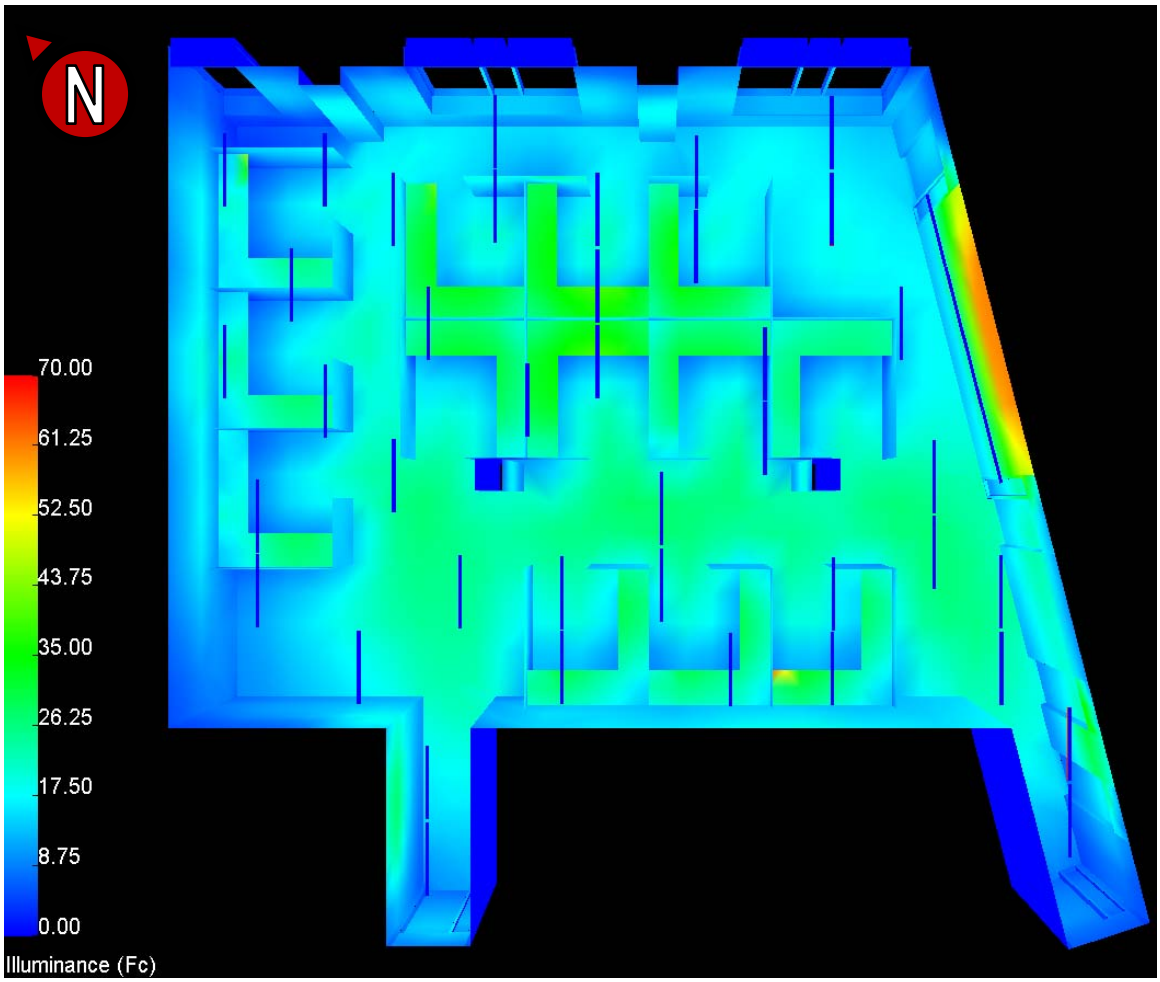



| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Lighting Consultant<br>Dr. Kevin Houser | Grant Kightlinger<br>L/E Option | Penn State University<br>AE Senior Thesis | OPEN OFFICE LIGHTING RCP<br>1/8" = 1'-0" |

**Partial Fixture Schedule**

| TYPE | IMAGE | MANUF. | DESCRIPTION |
|---|---|---|---|
| **INDOOR FIXTURES** | | | |
| **F01** |  | FOCAL POINT | "AVENUE A" - NARROW APERTURE ASYMMETRIC WALL WASHER. SINGLE CIRCUIT, DRYWALL FLANGE, MATTE WHITE HOUSING, 4' NOMINAL LENGTH. STEEL CONSTRUCTION. |
| **F02** |  | FOCAL POINT | "AVENUE B" - RECESSED SLOT FIXTURE. DIFFUSE FLUSH LENS, SINGLE CIRCUIT, DRYWALL FLANGE, MATTE WHITE HOUSING. STEEL CONSTRUCTION. |
| **F03** |  | LIGHTOLIER | "SURFSIDE" CFL PERSONAL TASK LIGHT. 20" ARM, SILVER FINISH, TABLE BASE |

**Pseudocolor Renderings**

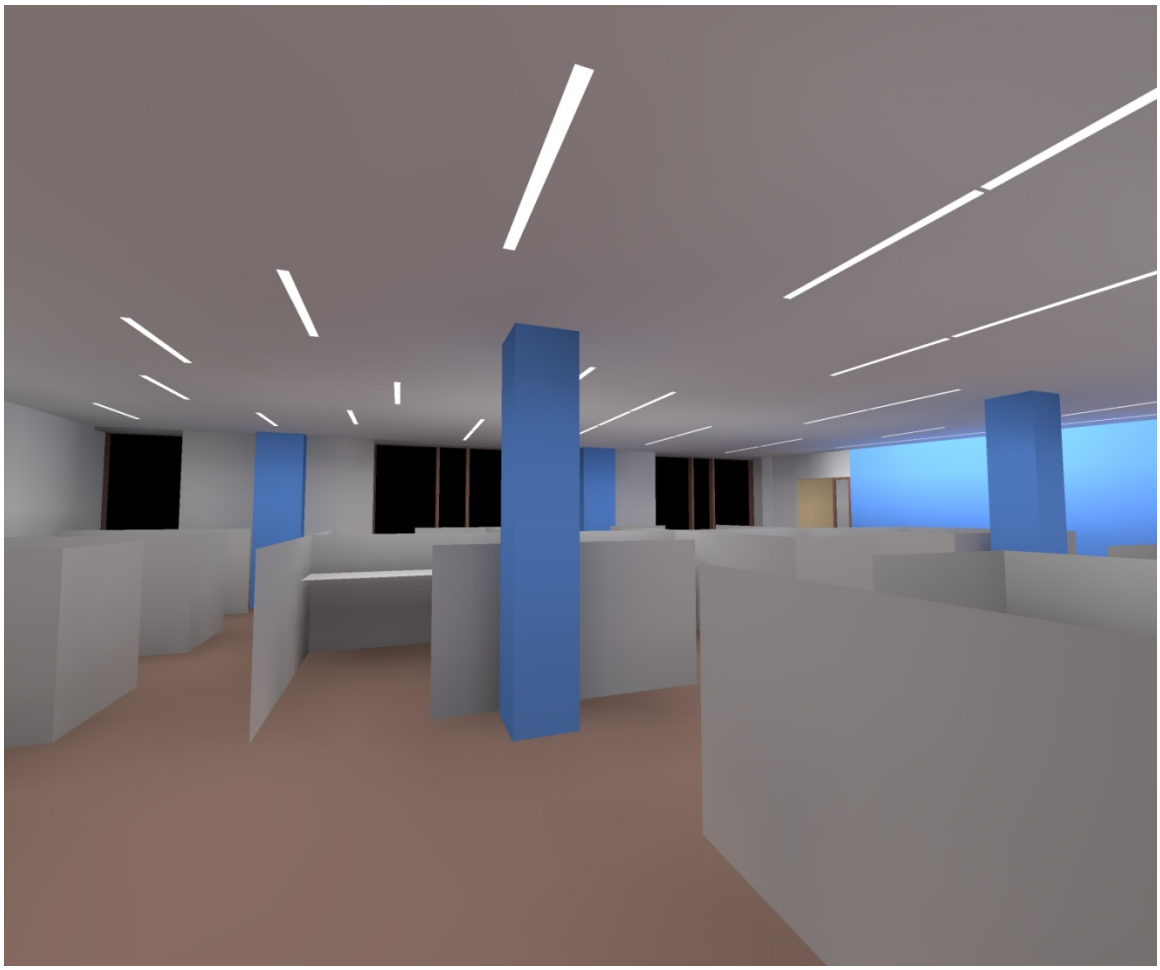



**Statistics**

| ZONE | HEIGHT | UNITS | AVG | MAX | MIN | AVG/MIN | MAX/MIN |
|---|---|---|---|---|---|---|---|
| Workplane | 3'-0" | fc | 28.9 | 41.8 | 8.4 | 3.4 | 4.9 |
| Circulation | 0'-0" | fc | 19.6 | 28.6 | 2.0 | 9.8 | 14.3 |

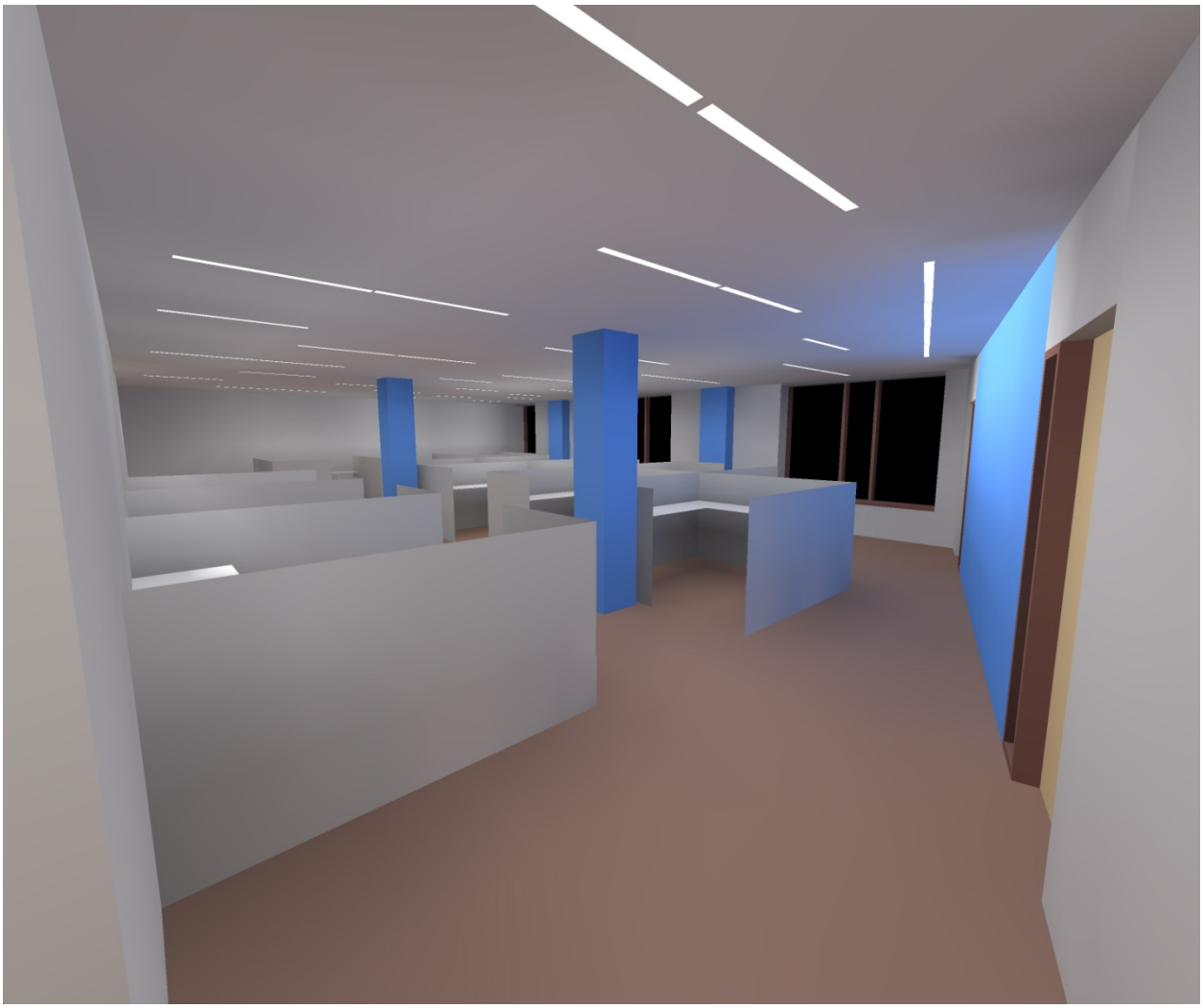
* NOTE: All calculations were completed in AGI32 and use grid spacing of 1'-0".

**Renderings**



**Perspective from West Entrance**

**Exterior View from North**



**Perspective from East Entrance**

## Light Loss Factors

| FIXTURE | MAINT. CAT. | DISTR. | LLD | LDD | RSDD | BF | TOTAL LLF |
|---|---|---|---|---|---|---|---|
| **F01** | IV | DIRECT | 0.93 | 0.89 | 0.98 | 1.0 | 0.81 |
| **F02** | VI | DIRECT | 0.93 | 0.87 | 0.98 | 1.0 | 0.79 |
| **F03** | IV | DIRECT | 0.80 | 0.89 | 0.98 | 1.0 | 0.70 |

* Assumptions:

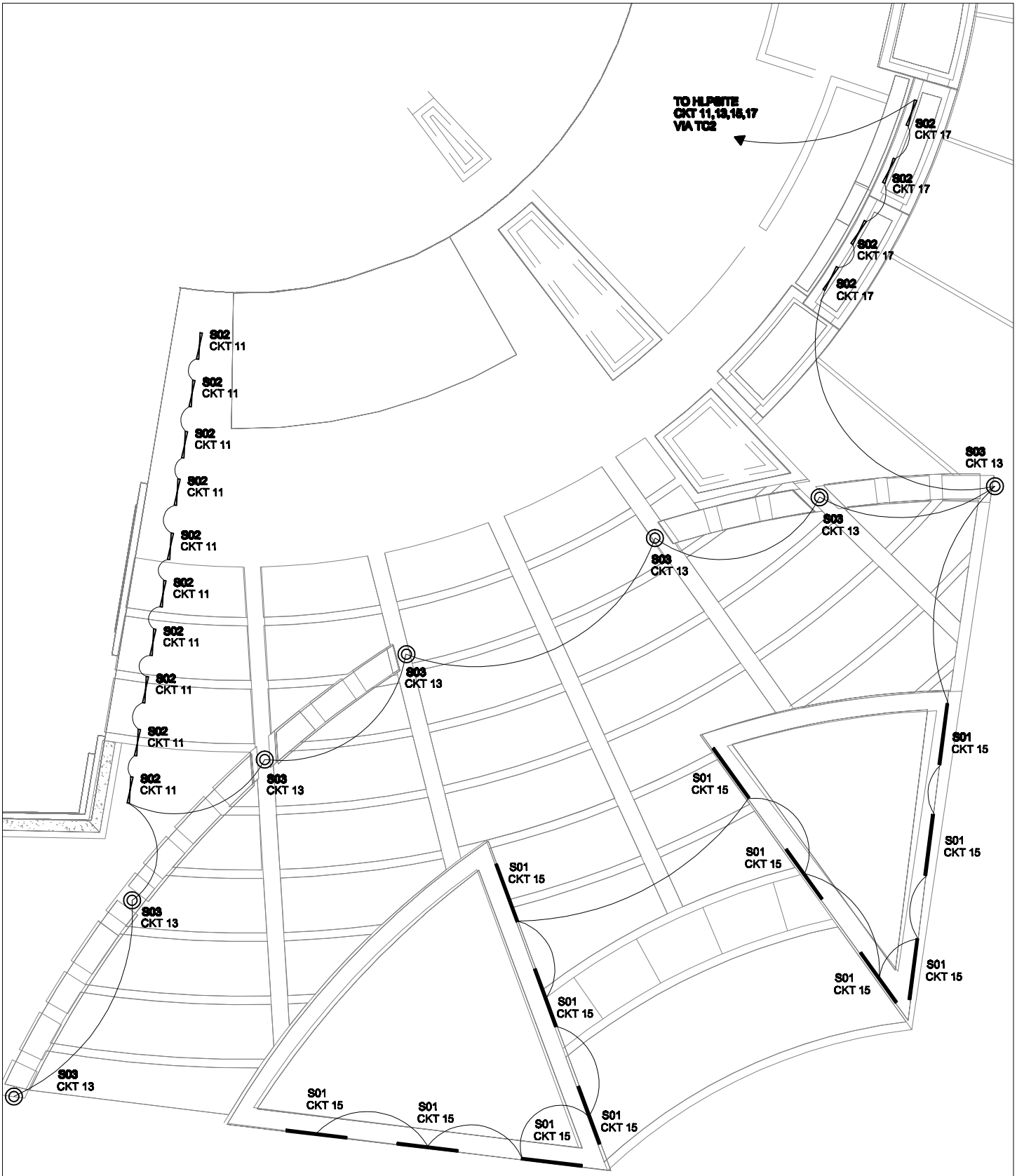
1. Clean Environment, 12-month cleaning cycle.
2. 35°C lamp data used in calculations.

# ELECTRICAL REDESIGN – NORTH FAÇADE AND PLAZA

The main entry to UCI Natural Science Unit II is marked by a four-story glass curtain wall, an outdoor stair feature and a 5875 square foot landscaped plaza. The scope of the proposed lighting redesign includes the inner plaza area, the curtain wall, the adjacent office wall, and stair wall at the west side of the plaza. Stairway lighting is not in scope.

## Control Scheme

The outdoor lighting of the building is to be controlled by a simple time clock device which will save energy and prolong lamp life by shutting off and/or lowering the lighting levels in the plaza and the exterior of the building when it is not in use.




| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Electrical Consultant:<br>Prof. T. Dannerth, PE | Grant Kightlinger<br>L/E Option | Penn State University<br>AE 882 Senior Thesis | PLAZA ELECTRICAL PLAN<br>3/32" = 1'-0" |

## Existing Panel Schedule

**PANEL** HLPSITE

| | | | | | |
|---|---|---|---|---|---|
| MOUNTING | SURFACE | DOUBLE LUG | NO | VOLTS | 277/480 | MAIN | M.L.O. |
| NEMA 3R | NO | 200% NEUTRAL | NO | PHASE | 3 | BUS | 100A |
| FEED THRU | NO | I/G BUS | NO | WIRE | 4 | A.I.C. | SEE SC REPORTS |

| NOTES | LOCATION | A | B | C | LTG | CONV | KIT | RECP | MISC | BKR | CIRC | | CIRC | BKR | MISC | RECP | KIT | CONV | LTG | A | B | C | LOCATION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EXTERIOR LTG | 2698 | | | 19 | | | | | 20/1 | 1 | | 2 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | | 720 | | 8 | | | | | 20/1 | 3 | | 4 | 20/1 | | | | | | | | | SPARE | |
| | HIGH BAY EXT LTG | | | 1988 | 14 | | | | | 20/1 | 5 | | 6 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | 750 | | | 15 | | | | | 20/1 | 7 | | 8 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | | 192 | | 6 | | | | | 20/1 | 9 | | 10 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | | | 910 | 9 | | | | | 20/1 | 11 | | 12 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | 1000 | | | 4 | | | | | 20/1 | 13 | | 14 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | | 804 | | 14 | | | | | 20/1 | 15 | | 16 | 20/1 | | | | | | | | | SPARE | |
| | EXTERIOR LTG | | | 250 | 5 | | | | | 20/1 | 17 | | 18 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 19 | | 20 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 21 | | 22 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 23 | | 24 | 20/1 | | | | | | | | | SPARE | |
| | SPACE | | | | | | | | | | 25 | | 26 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 27 | | 28 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 29 | | 30 | | | | | | | | | | SPACE | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

A= 4448 B= 1716 C= 3148

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL VA= | 9312 | W/LCL= | 11640 | AMPS= | **14** | TOTAL LCL= | 9312 | X .25 = | 2328 |
| HIGH PHASE VA= | 4448 | W/LCL= | 5560 | HIGH PHASE AMPS= | **20.1** | HIGH PHASE LCL= | 4448 | X .25 = | 1112 |

**New Panelboard Worksheet**

## PANELBOARD SIZING WORKSHEET

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Panel Tag----------> | | | | | HLPSITE | Panel Location: | | | Elec. Rm. 1282 | |
| Nominal Phase to Neutral Voltage-------> | | | | | 277 | Phase: | | | 3 | |
| Nominal Phase to Phase Voltage--------> | | | | | 480 | Wires: | | | 4 | |
| Pos | Ph. | Load Type | Cat. | Location | Load | Units | I. PF | Watts | VA | Remarks |
| 1 | A | EXTERIOR LTG | 3 | SITE | 2698 | va | 0.95 | 2563 | 2698 | |
| 2 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 3 | B | EXTERIOR LTG | 3 | SITE | 720 | va | 0.95 | 684 | 720 | |
| 4 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 5 | C | HIGH BAY EXT LTG | 3 | SITE | 1988 | va | 0.95 | 1889 | 1988 | |
| 6 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 7 | A | EXTERIOR LTG | 3 | SITE | 750 | va | 0.95 | 713 | 750 | |
| 8 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 9 | B | EXTERIOR LTG | 3 | SITE | 192 | va | 0.95 | 182 | 192 | |
| 10 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 11 | C | EXTERIOR LTG | 3 | SITE | 260 | w | 0.95 | 260 | 274 | |
| 12 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 13 | A | EXTERIOR LTG | 3 | SITE | 322 | w | 0.95 | 322 | 339 | |
| 14 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 15 | B | EXTERIOR LTG | 3 | SITE | 462 | w | 0.95 | 462 | 486 | |
| 16 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 17 | C | EXTERIOR LTG | 3 | SITE | 104 | w | 0.95 | 104 | 109 | |
| 18 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 19 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 20 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 21 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 22 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 23 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 24 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 25 | A | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 26 | A | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 27 | B | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 28 | B | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 29 | C | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 30 | C | SPACE | | - | | va | 1.00 | 0 | 0 | |
| 31 | A | | | | | va | 1.00 | 0 | 0 | |
| 32 | A | | | | | va | 1.00 | 0 | 0 | |
| 33 | B | | | | | va | 1.00 | 0 | 0 | |
| 34 | B | | | | | va | 1.00 | 0 | 0 | |
| 35 | C | | | | | va | 1.00 | 0 | 0 | |
| 36 | C | | | | | va | 1.00 | 0 | 0 | |
| 37 | A | | | | | va | 1.00 | 0 | 0 | |
| 38 | A | | | | | va | 1.00 | 0 | 0 | |
| 39 | B | | | | | va | 1.00 | 0 | 0 | |
| 40 | B | | | | | va | 1.00 | 0 | 0 | |
| 41 | C | | | | | va | 1.00 | 0 | 0 | |
| 42 | C | | | | | va | 1.00 | 0 | 0 | |
| PANEL TOTAL | | | | | | | | 61.2 | 61.6 | Amps= 74.1 |

| PHASE LOADING | | | | | | kW | kVA | % | Amps |
|---|---|---|---|---|---|---|---|---|---|
| PHASE TOTAL | A | | | | | 21.6 | 21.8 | 35% | 78.7 |
| PHASE TOTAL | B | | | | | 19.3 | 19.4 | 32% | 70.0 |
| PHASE TOTAL | C | | | | | 20.3 | 20.4 | 33% | 73.5 |

| LOAD CATAGORIES | | | Connected | | | Demand | | | | Ver. 1.03 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | kW | kVA | DF | kW | kVA | PF | | |
| 1 | receptacles | | 0.0 | 0.0 | 0.80 | 0.0 | 0.0 | | | |
| 2 | computers | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 3 | fluorescent lighting | | 7.2 | 7.6 | 0.95 | 6.8 | 7.2 | 0.95 | | |
| 4 | HID lighting | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 5 | incandescent lighting | | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | | | |
| 6 | HVAC fans | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 7 | heating | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 8 | kitchen equipment | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 9 | unassigned | | 54.0 | 54.0 | | 54.0 | 54.0 | 1.00 | | |
| Total Demand Loads | | | | | | 60.8 | 61.2 | | | |
| Spare Capacity | | | 20% | | | 12.2 | 12.2 | | | |
| Total Design Loads | | | | | | 73.0 | 73.4 | 0.99 | Amps= | 88.3 |

**New Panelboard Schedule**

## PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: HLPSITE
PANEL LOCATION: Elec. Rm. 1282
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B

| DESCRIPTION | LOCATION | LOAD (WATTS) | C/B SIZE | POS. NO. | A | B | C | POS. NO. | C/B SIZE | LOAD (WATTS) | LOCATION | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXTERIOR LTG | SITE | 2563 | 20A/1P | 1 | * | | | 2 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 684 | 20A/1P | 3 | | * | | 4 | 20A/1P | 3600 | - | SPARE |
| HIGH BAY EXT LTG | SITE | 1889 | 20A/1P | 5 | | | * | 6 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 713 | 20A/1P | 7 | * | | | 8 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 182 | 20A/1P | 9 | | * | | 10 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 260 | 20A/1P | 11 | | | * | 12 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 322 | 20A/1P | 13 | * | | | 14 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 462 | 20A/1P | 15 | | * | | 16 | 20A/1P | 3600 | - | SPARE |
| EXTERIOR LTG | SITE | 104 | 20A/1P | 17 | | | * | 18 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 19 | * | | | 20 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 21 | | * | | 22 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 23 | | | * | 24 | 20A/1P | 3600 | - | SPARE |
| SPACE | - | 0 | 20A/1P | 25 | * | | | 26 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 27 | | * | | 28 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 29 | | | * | 30 | 20A/1P | 0 | - | SPACE |
| 0 | 0 | 0 | 20A/1P | 31 | * | | | 32 | 20A/1P | 0 | 0 | 0 |
| 0 | 0 | 0 | 20A/1P | 33 | | * | | 34 | 20A/1P | 0 | 0 | 0 |
| 0 | 0 | 0 | 20A/1P | 35 | | | * | 36 | 20A/1P | 0 | 0 | 0 |
| 0 | 0 | 0 | 20A/1P | 37 | * | | | 38 | 20A/1P | 0 | 0 | 0 |
| 0 | 0 | 0 | 20A/1P | 39 | | * | | 40 | 20A/1P | 0 | 0 | 0 |
| 0 | 0 | 0 | 20A/1P | 41 | | | * | 42 | 20A/1P | 0 | 0 | 0 |

| | | | |
|---|---|---|---|
| CONNECTED LOAD (KW) - A | 21.60 | TOTAL DESIGN LOAD (KW) | 72.98 |
| CONNECTED LOAD (KW) - B | 19.33 | POWER FACTOR | 0.99 |
| CONNECTED LOAD (KW) - C | 20.25 | TOTAL DESIGN LOAD (AMPS) | 88 |

**Feeder Size**

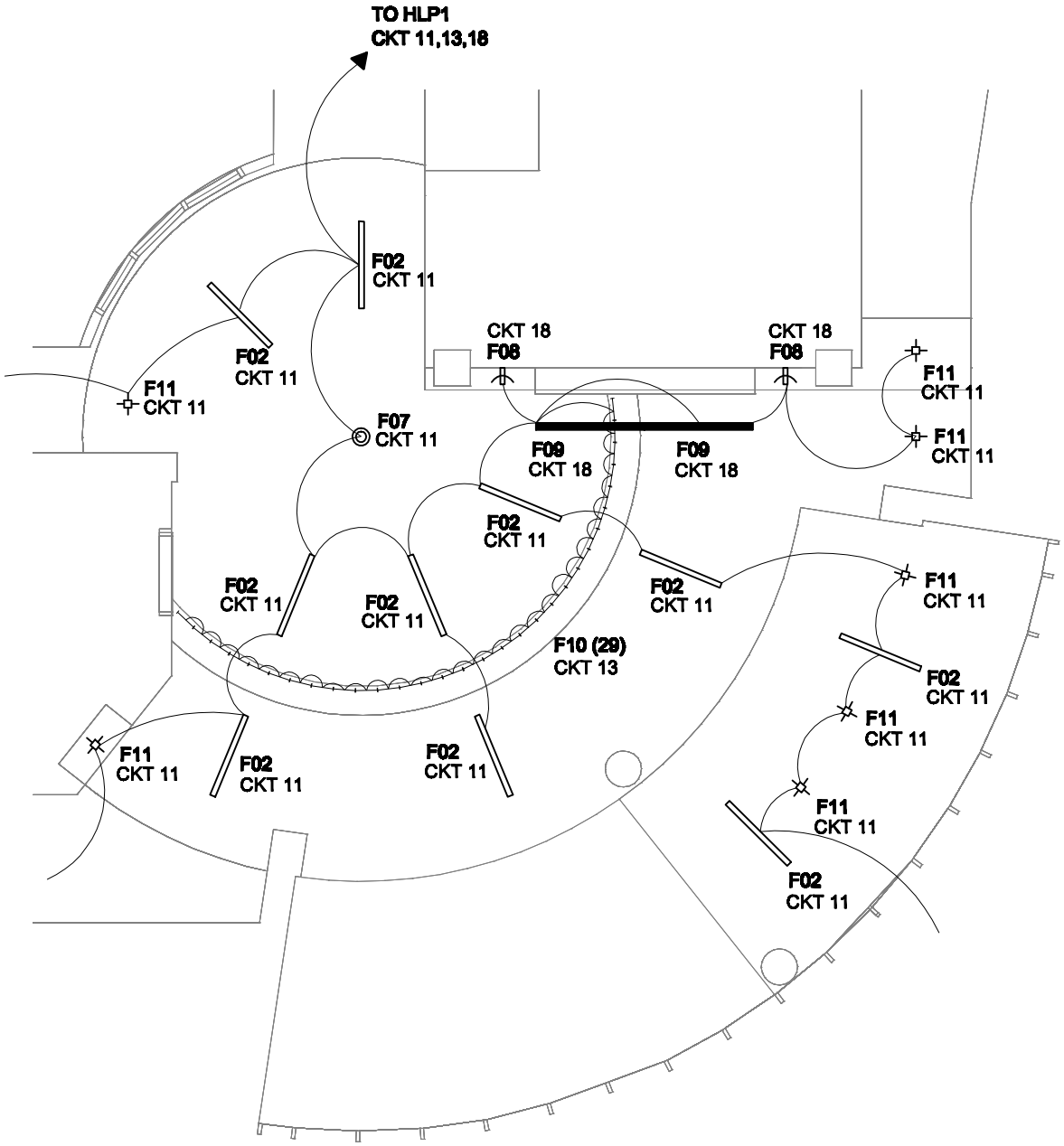
| | |
|---|---|
| **DESIGN LOAD (WITH 20% SPARE)** | 88 A |
| **CIRCUIT BREAKER SIZE** | 90 A |
| **x 125% FOR 4 CCC'S** | 112.5 A |
| **PHASE CONDUCTORS** | (3) #2 AWG, 75° CU THWN |
| **NEUTRAL CONDUCTOR** | (1) #2 AWG, 75° CU THWN |
| **GROUND CONDUCTIOR** | (1) #8 AWG, 75° CU THWN |

# ELECTRICAL REDESIGN – LOBBY

The lobby space adjacent to the north façade is the main entry point for the building. The lobby measures approximately 1230 square feet and features a large curved glass curtain wall to the north. This space is the primary access to classrooms and circulation. Above the main doorway, a double height atrium space connects the first and second floor lobbies. The main conference room is directly adjacent to the lobby on the first floor, and each level provides access to the main outdoor stair of the building.

## Control Scheme

Since the lobby is a public circulation space, easy access to user-customizable controls are not necessarily desired. The lobby system should be discreet and should serve the lighting needs of the space throughout the day without the need for any manual adjustment. However, a dimming system has also been specified to allow adjustments for special events within the lobby and the adjacent main conference room. One special feature within the room is an RGB led cove fixture which requires a separate controller to create visual effects for special events within the space. The fixtures in this space are divided into three zones: general ambient downlights, peripheral accent, and cove lighting.




| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Electrical Consultant:<br>Prof. T. Dannerth, PE | Grant Kightlinger<br>L/E Option | Penn State University<br>AE 882 Senior Thesis | 1F LOBBY ELEC RCP<br>1/8" = 1'-0" |

## Existing Panel Schedule

**PANEL** HLP1

| | | | | | |
|---|---|---|---|---|---|
| MOUNTING | SURFACE | DOUBLE LUG | NO | VOLTS | 277/480 | MAIN | 225A |
| NEMA 3R | NO | 200% NEUTRAL | NO | PHASE | 3 | BUS | 225A |
| FEED THRU | NO | I/G BUS | NO | WIRE | 4 | A.I.C. | SEE SC REPORTS |

| NOTES | LOCATION | A | B | C | LTG | CONV | KIT | RECP | MISC | BKR | CIRC | | CIRC | BKR | MISC | RECP | KIT | CONV | LTG | A | B | C | LOCATION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OFFICE LTG. | 2520 | | | 21 | | | | | 20/1 | 1 | | 2 | 20/1 | | | | | 15 | 1123 | | | CORRIDOR LTG. | |
| | OFFICE LTG. | | 2818 | | 24 | | | | | 20/1 | 3 | | 4 | 20/1 | | | | | 30 | | 2220 | | LAB 1128,1130 LTG. | |
| | OFFICE LTG. | | | 3120 | 26 | | | | | 20/1 | 5 | | 6 | 20/1 | | | | | 28 | | | 2220 | LAB 1124,1122 LTG. | |
| | CONF. RM. LTG. | 2328 | | | 39 | | | | | 20/1 | 7 | | 8 | 20/1 | | | | | 29 | 2280 | | | LAB 1118,1120 LTG. | |
| | OFFICE RESTROOM LTG. | | 2664 | | 38 | | | | | 20/1 | 9 | | 10 | 20/1 | | | | | 22 | | 1740 | | LAB 1114,1112,1110,1105 LTG. | |
| | LOBBY LTG. | | | 1548 | 43 | | | | | 20/1 | 11 | | 12 | 20/1 | | | | | 7 | | | 868 | LAB 1150 LTG. | |
| | LOBBY LTG. | 561 | | | 33 | | | | | 20/1 | 13 | | 14 | 20/1 | | | | | | | | | SPARE | |
| | CORRIDOR LTG. | | 331 | | 6 | | | | | 20/1 | 15 | | 16 | 20/1 | | | | | | | | | SPARE | |
| | CORRIDOR/RECEPTION LTG. | | | 863 | 20 | | | | | 20/1 | 17 | | 18 | 20/1 | | | | | | | | | SPARE | |
| A | EXIT SIGNS - OFFICE WING | 36 | | | 12 | | | | | 20/1 | 19 | | 20 | 20/1 | | | | | | | | | SPARE | |
| A | EXIT SIGNS - LAB WING | | 30 | | 10 | | | | | 20/1 | 21 | | 22 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 23 | | 24 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 25 | | 26 | 131313 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 27 | | 28 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 29 | | 30 | 20/1 | | | | | | | | | SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 31 | | 32 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 33 | | 34 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 35 | | 36 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | SPACE | | | | | | | | | | 37 | | 38 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 39 | | 40 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 41 | | 42 | | | | | | | | | | SPACE | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A= 8848 | | | | B= 9803 | | | | C= 8619 | |
| | TOTAL VA= | 27270 | W/LCL= | 34088 | | AMPS= | **41** | | TOTAL LCL= | 27270 | X .25 = 6818 |
| | HIGH PHASE VA= | 9803 | W/LCL= | 12254 | | HIGH PHASE AMPS= | **44.2** | | HIGH PHASE LCL= | 9803 | X .25 = 2451 |

**New Panelboard Worksheet**

## PANELBOARD SIZING WORKSHEET

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Panel Tag----------> | | | | | HLP1 | Panel Location: | | | Elec. Rm. 1282 | |
| Nominal Phase to Neutral Voltage-------> | | | | | 277 | Phase: | | | 3 | |
| Nominal Phase to Phase Voltage--------> | | | | | 480 | Wires: | | | 4 | |
| Pos | Ph. | Load Type | Cat. | Location | Load | Units | I. PF | Watts | VA | Remarks |
| 1 | A | OFFICE LTG | 3 | 1F | 2520 | va | 0.95 | 2394 | 2520 | |
| 2 | A | CORR. LTG | 3 | 1F | 1123 | va | 0.95 | 1067 | 1123 | |
| 3 | B | OFFICE LTG | 3 | 1F | 2818 | va | 0.95 | 2677 | 2818 | |
| 4 | B | LAB LTG | 3 | 1F | 2220 | va | 0.95 | 2109 | 2220 | |
| 5 | C | OFFICE LTG | 3 | 1F | 3120 | va | 0.95 | 2964 | 3120 | |
| 6 | C | LAB LTG | 3 | 1F | 2220 | va | 0.95 | 2109 | 2220 | |
| 7 | A | CONF RM LTG | 3 | 1F | 2328 | va | 0.95 | 2212 | 2328 | |
| 8 | A | LAB LTG | 3 | 1F | 2280 | va | 0.95 | 2166 | 2280 | |
| 9 | B | FFICE RESTRM LT | 3 | 1F | 2664 | va | 0.95 | 2531 | 2664 | |
| 10 | B | LAB LTG | 3 | 1F | 1740 | va | 0.95 | 1653 | 1740 | |
| 11 | C | LOBBY LTG | 3 | 1F | 945 | w | 0.95 | 945 | 995 | |
| 12 | C | LAB LTG | 3 | 1F | 868 | va | 0.95 | 825 | 868 | |
| 13 | A | LOBBY LTG | 3 | 1F | 87 | w | 0.95 | 87 | 92 | |
| 14 | A | SPARE | | - | 3600 | va | 0.95 | 3420 | 3600 | |
| 15 | B | CORRIDOR LTG | 3 | 1F | 331 | va | 0.95 | 314 | 331 | |
| 16 | B | SPARE | | - | 3600 | va | 0.95 | 3420 | 3600 | |
| 17 | C | ORR/RECEPTION L | 3 | 1F | 863 | va | 0.95 | 820 | 863 | |
| 18 | C | LOBBY LTG | 3 | 1F | 136 | w | 0.95 | 136 | 143 | |
| 19 | A | EXIT SIGNS OFFICE | 3 | 1F | 36 | va | 0.95 | 34 | 36 | |
| 20 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 21 | B | XIT SIGNS LAB WIN | 3 | 1F | 30 | va | 0.95 | 29 | 30 | |
| 22 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 23 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 24 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 25 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 26 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 27 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 28 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 29 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 30 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 31 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 32 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 33 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 34 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 35 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 36 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 37 | A | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 38 | A | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 39 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 40 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 41 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 42 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| PANEL TOTAL | | | | | | | | 67.9 | 69.6 | Amps= 83.7 |

| PHASE LOADING | | | | | | kW | kVA | % | Amps |
|---|---|---|---|---|---|---|---|---|---|
| PHASE TOTAL | A | | | | | 22.2 | 22.8 | 33% | 82.2 |
| PHASE TOTAL | B | | | | | 23.5 | 24.2 | 35% | 87.4 |
| PHASE TOTAL | C | | | | | 22.2 | 22.6 | 32% | 81.6 |

| LOAD CATAGORIES | | | Connected | | | Demand | | | | Ver. 1.03 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | kW | kVA | DF | kW | kVA | PF | | |
| 1 | receptacles | | 0.0 | 0.0 | 0.80 | 0.0 | 0.0 | | | |
| 2 | computers | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 3 | fluorescent lighting | | 25.1 | 26.4 | 0.95 | 23.8 | 25.1 | 0.95 | | |
| 4 | HID lighting | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 5 | incandescent lighting | | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | | | |
| 6 | HVAC fans | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 7 | heating | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 8 | kitchen equipment | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 9 | unassigned | | 42.8 | 43.2 | | 42.8 | 43.2 | 0.99 | | |
| Total Demand Loads | | | | | | 66.7 | 68.3 | | | |
| Spare Capacity | | | 20% | | | 13.3 | 13.7 | | | |
| Total Design Loads | | | | | | 80.0 | 81.9 | 0.98 | Amps= | 98.6 |

**New Panelboard Schedule**

## PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: HLP1
PANEL LOCATION: Elec. Rm. 1282
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS:

| DESCRIPTION | LOCATION | LOAD (WATTS) | C/B SIZE | POS. NO. | A | B | C | POS. NO. | C/B SIZE | LOAD (WATTS) | LOCATION | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFFICE LTG | 1F | 2394 | 20A/1P | 1 | * | | | 2 | 20A/1P | 1067 | 1F | CORR. LTG |
| OFFICE LTG | 1F | 2677 | 20A/1P | 3 | | * | | 4 | 20A/1P | 2109 | 1F | LAB LTG |
| OFFICE LTG | 1F | 2964 | 20A/1P | 5 | | | * | 6 | 20A/1P | 2109 | 1F | LAB LTG |
| CONF RM LTG | 1F | 2212 | 20A/1P | 7 | * | | | 8 | 20A/1P | 2166 | 1F | LAB LTG |
| FFICE RESTRM LT | 1F | 2531 | 20A/1P | 9 | | * | | 10 | 20A/1P | 1653 | 1F | LAB LTG |
| LOBBY LTG | 1F | 945 | 20A/1P | 11 | | | * | 12 | 20A/1P | 825 | 1F | LAB LTG |
| LOBBY LTG | 1F | 87 | 20A/1P | 13 | * | | | 14 | 20A/1P | 3420 | - | SPARE |
| CORRIDOR LTG | 1F | 314 | 20A/1P | 15 | | * | | 16 | 20A/1P | 3420 | - | SPARE |
| ORR/RECEPTION LT | 1F | 820 | 20A/1P | 17 | | | * | 18 | 20A/1P | 136 | 1F | LOBBY LTG |
| EXIT SIGNS OFFICE | 1F | 34 | 20A/1P | 19 | * | | | 20 | 20A/1P | 3600 | - | SPARE |
| XIT SIGNS LAB WIN | 1F | 29 | 20A/1P | 21 | | * | | 22 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 23 | | | * | 24 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 25 | * | | | 26 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 27 | | * | | 28 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 29 | | | * | 30 | 20A/1P | 3600 | - | SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 31 | * | | | 32 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 33 | | * | | 34 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 35 | | | * | 36 | 20A/1P | 0 | - | FUTURE SPARE |
| SPACE | - | 0 | 20A/1P | 37 | * | | | 38 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 39 | | * | | 40 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 41 | | | * | 42 | 20A/1P | 0 | - | SPACE |

| | | | |
|---|---|---|---|
| CONNECTED LOAD (KW) - A | 22.18 | TOTAL DESIGN LOAD (KW) | 79.99 |
| CONNECTED LOAD (KW) - B | 23.53 | POWER FACTOR | 0.98 |
| CONNECTED LOAD (KW) - C | 22.20 | TOTAL DESIGN LOAD (AMPS) | 99 |

*NOTE: Approximately 400 watts of fixture load exist outside the scope of the lobby lighting redesign on circuit 11 and have therefore been included in addition to the actual fixture load as designed.

**Feeder Size**

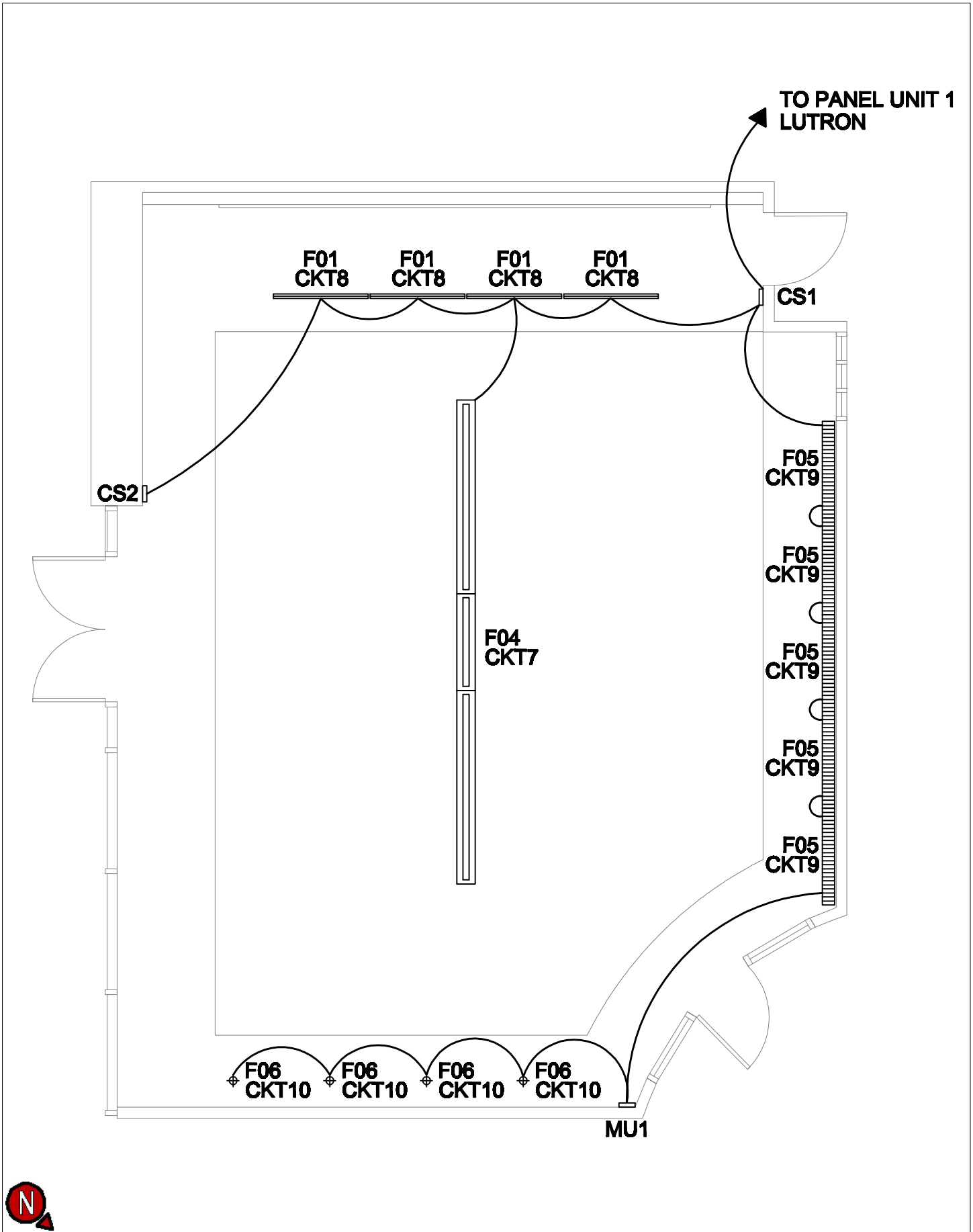
| | |
|---|---|
| **DESIGN LOAD (WITH 20% SPARE)** | 99 A |
| **CIRCUIT BREAKER SIZE** | 100 A |
| **x 125% FOR 4 CCC'S** | 125 A |
| **PHASE CONDUCTORS** | (3) #1 AWG, 75° CU THWN |
| **NEUTRAL CONDUCTOR** | (1) #1 AWG, 75° CU THWN |
| **GROUND CONDUCTIOR** | (1) #6 AWG, 75° CU THWN |

## ELECTRICAL REDESIGN – CONFERENCE ROOM

The main conference room is located on the first floor of the building. It measures approximately 1050 square feet. The room can be accessed through a main door connecting to the lobby to the north, and also through a secondary interior door to the west. Windows and doors on the southeast side of the room open to an outdoor patio space. On the southwest wall, a whiteboard is framed by a white maple wall. A credenza runs along the wall between the two interior entries, and a large conference table sits in the center of the room.

### Control Scheme

Flexibility of use is one of the most important design goals in this space. The lighting system should be able to adapt to several uses including face-to-face meetings, whiteboard lectures, A/V presentations and social gatherings. The overall aesthetic appearance is also crucial in this space. A Lutron control system has been selected to offer more streamlined user control over the lighting environment and to allow for more dramatic lighting transitions.




| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Electrical Consultant:<br>Prof. T. Dannerth, PE | Grant Kightlinger<br>L/E Option | Penn State University<br>AE 882 Senior Thesis | CONF ROOM ELEC RCP<br>3/16" = 1'-0" |

## Existing Panel Schedule

**PANEL** HLP1

| | | | | | |
|---|---|---|---|---|---|
| MOUNTING | SURFACE | DOUBLE LUG | NO | VOLTS | 277/480 | MAIN | 225A |
| NEMA 3R | NO | 200% NEUTRAL | NO | PHASE | 3 | BUS | 225A |
| FEED THRU | NO | I/G BUS | NO | WIRE | 4 | A.I.C. | SEE SC REPORTS |

| NOTES | LOCATION | A | B | C | LTG | CONV | KIT | RECP | MISC | BKR | CIRC | | CIRC | BKR | MISC | RECP | KIT | CONV | LTG | A | B | C | LOCATION | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OFFICE LTG. | 2520 | | | 21 | | | | | 20/1 | 1 | | 2 | 20/1 | | | | | 15 | 1123 | | | CORRIDOR LTG. | |
| | OFFICE LTG. | | 2818 | | 24 | | | | | 20/1 | 3 | | 4 | 20/1 | | | | | 30 | | 2220 | | LAB 1128,1130 LTG. | |
| | OFFICE LTG. | | | 3120 | 26 | | | | | 20/1 | 5 | | 6 | 20/1 | | | | | 28 | | | 2220 | LAB 1124,1122 LTG. | |
| | CONF. RM. LTG. | 2328 | | | 39 | | | | | 20/1 | 7 | | 8 | 20/1 | | | | | 29 | 2280 | | | LAB 1118,1120 LTG. | |
| | OFFICE RESTROOM LTG. | | 2664 | | 38 | | | | | 20/1 | 9 | | 10 | 20/1 | | | | | 22 | | 1740 | | LAB 1114,1112,1110,1105 LTG. | |
| | LOBBY LTG. | | | 1548 | 43 | | | | | 20/1 | 11 | | 12 | 20/1 | | | | | 7 | | | 868 | LAB 1150 LTG. | |
| | LOBBY LTG. | 561 | | | 33 | | | | | 20/1 | 13 | | 14 | 20/1 | | | | | | | | | SPARE | |
| | CORRIDOR LTG. | | 331 | | 6 | | | | | 20/1 | 15 | | 16 | 20/1 | | | | | | | | | SPARE | |
| | CORRIDOR/RECEPTION LTG. | | | 863 | 20 | | | | | 20/1 | 17 | | 18 | 20/1 | | | | | | | | | SPARE | |
| A | EXIT SIGNS - OFFICE WING | 36 | | | 12 | | | | | 20/1 | 19 | | 20 | 20/1 | | | | | | | | | SPARE | |
| A | EXIT SIGNS - LAB WING | | 30 | | 10 | | | | | 20/1 | 21 | | 22 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 23 | | 24 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 25 | | 26 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 27 | | 28 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 29 | | 30 | 20/1 | | | | | | | | | SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 31 | | 32 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 33 | | 34 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 35 | | 36 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | SPACE | | | | | | | | | | 37 | | 38 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 39 | | 40 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 41 | | 42 | | | | | | | | | | SPACE | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A= 8848 | | | | B= 9803 | | | | C= 8619 | |
| | TOTAL VA= | 27270 | W/LCL= | 34088 | AMPS= | **41** | TOTAL LCL= | 27270 | X .25 = | 6818 | |
| | HIGH PHASE VA= | 9803 | W/LCL= | 12254 | HIGH PHASE AMPS= | **44.2** | HIGH PHASE LCL= | 9803 | X .25 = | 2451 | |

**New Panelboard Worksheet**

## PANELBOARD SIZING WORKSHEET

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Panel Tag----------> | | | | | HLP1 | Panel Location: | | | ELEC RM 1282 | |
| Nominal Phase to Neutral Voltage-------> | | | | | 277 | Phase: | | | 3 | |
| Nominal Phase to Phase Voltage--------> | | | | | 480 | Wires: | | | 4 | |
| Pos | Ph. | Load Type | Cat. | Location | Load | Units | I. PF | Watts | VA | Remarks |
| 1 | A | OFFICE LTG | 3 | 1F | 2520 | va | 0.95 | 2394 | 2520 | |
| 2 | A | CORRIDOR LTG | 3 | 1F | 1123 | va | 0.95 | 1067 | 1123 | |
| 3 | B | OFFICE LTG | 3 | 1F | 2818 | w | 0.95 | 2818 | 2966 | |
| 4 | B | LAB 1128,1130 LTG | 3 | 1F | 2220 | va | 0.95 | 2109 | 2220 | |
| 5 | C | OFFICE LTG | 3 | 1F | 3120 | va | 0.95 | 2964 | 3120 | |
| 6 | C | LAB 1124,1122 LTG | 3 | 1F | 2220 | va | 0.95 | 2109 | 2220 | |
| 7 | A | CONF RM LTG | 3 | 1F | 160 | w | 0.95 | 160 | 168 | |
| 8 | A | CONF RM LTG | 3 | 1F | 128 | w | 0.95 | 128 | 135 | |
| 9 | B | CONF RM LTG | 3 | 1F | 160 | w | 0.95 | 160 | 168 | |
| 10 | B | CONF RM LTG | 3 | 1F | 140 | w | 0.95 | 140 | 147 | |
| 11 | C | LAB 1118,1120 LTG | 3 | 1F | 2280 | va | 0.95 | 2166 | 2280 | |
| 12 | C | SPARE | 3 | 1F | 3600 | va | 0.95 | 3420 | 3600 | |
| 13 | A | LAB LTG | 3 | 1F | 1740 | va | 0.95 | 1653 | 1740 | |
| 14 | A | LOBBY LTG | 3 | 1F | 1548 | va | 0.95 | 1471 | 1548 | |
| 15 | B | LAB 1150 LTG | 3 | 1F | 868 | va | 0.95 | 825 | 868 | |
| 16 | B | LOBBY LTG | 3 | 1F | 561 | va | 0.95 | 533 | 561 | |
| 17 | C | SPARE | 3 | - | 3600 | va | 0.95 | 3420 | 3600 | |
| 18 | C | CORRIDOR LTG | 3 | 1F | 331 | va | 0.95 | 314 | 331 | |
| 19 | A | EXIT SIGNS-OFFICE | 3 | 1F | 36 | va | 0.95 | 34 | 36 | |
| 20 | A | CORRIDOR LTG | 3 | 1F | 863 | va | 0.95 | 820 | 863 | |
| 21 | B | SPARE | 3 | - | 3600 | va | 0.95 | 3420 | 3600 | |
| 22 | B | SPARE | 3 | - | 3600 | va | 0.95 | 3420 | 3600 | |
| 23 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 24 | C | EXIT SIGNS-LAB | 3 | 1F | 30 | va | 0.95 | 29 | 30 | |
| 25 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 26 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 27 | B | OFFICE/RSTRM LTG | 3 | 1F | 2664 | va | 0.95 | 2531 | 2664 | |
| 28 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 29 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 30 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 31 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 32 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 33 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 34 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 35 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 36 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 37 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 38 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 39 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 40 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 41 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 42 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| PANEL TOTAL | | | | | | | | 70.5 | 72.5 | Amps= 87.3 |

| PHASE LOADING | | | | | | kW | kVA | % | Amps |
|---|---|---|---|---|---|---|---|---|---|
| PHASE TOTAL | A | | | | | 22.1 | 22.5 | 31% | 81.3 |
| PHASE TOTAL | B | | | | | 23.2 | 24.0 | 33% | 86.6 |
| PHASE TOTAL | C | | | | | 25.2 | 26.0 | 36% | 93.8 |

| LOAD CATAGORIES | | | Connected | | | Demand | | | | Ver. 1.03 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | kW | kVA | DF | kW | kVA | PF | | |
| 1 | receptacles | | 0.0 | 0.0 | 0.80 | 0.0 | 0.0 | | | |
| 2 | computers | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 3 | fluorescent lighting | | 38.1 | 40.1 | 0.95 | 36.2 | 38.1 | 0.95 | | |
| 4 | HID lighting | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 5 | incandescent lighting | | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | | | |
| 6 | HVAC fans | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 7 | heating | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 8 | kitchen equipment | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 9 | unassigned | | 32.4 | 32.4 | | 32.4 | 32.4 | 1.00 | | |
| Total Demand Loads | | | | | | 68.6 | 70.5 | | | |
| Spare Capacity | | | 20% | | | 13.7 | 14.1 | | | |
| Total Design Loads | | | | | | 82.3 | 84.6 | 0.97 | Amps= | 101.8 |

**New Panelboard Schedule**

## PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: HLP1
PANEL LOCATION: ELEC RM 1282
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B

| DESCRIPTION | LOCATION | LOAD (WATTS) | C/B SIZE | POS. NO. | A | B | C | POS. NO. | C/B SIZE | LOAD (WATTS) | LOCATION | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFFICE LTG | 1F | 2394 | 20A/1P | 1 | * | | | 2 | 20A/1P | 1067 | 1F | CORRIDOR LTG |
| OFFICE LTG | 1F | 2818 | 20A/1P | 3 | | * | | 4 | 20A/1P | 2109 | 1F | LAB 1128,1130 LTG |
| OFFICE LTG | 1F | 2964 | 20A/1P | 5 | | | * | 6 | 20A/1P | 2109 | 1F | LAB 1124,1122 LTG |
| CONF RM LTG | 1F | 160 | 20A/1P | 7 | * | | | 8 | 20A/1P | 128 | 1F | CONF RM LTG |
| CONF RM LTG | 1F | 160 | 20A/1P | 9 | | * | | 10 | 20A/1P | 140 | 1F | CONF RM LTG |
| LAB 1118,1120 LTG | 1F | 2166 | 20A/1P | 11 | | | * | 12 | 20A/1P | 3420 | 1F | SPARE |
| LAB LTG | 1F | 1653 | 20A/1P | 13 | * | | | 14 | 20A/1P | 1471 | 1F | LOBBY LTG |
| LAB 1150 LTG | 1F | 825 | 20A/1P | 15 | | * | | 16 | 20A/1P | 533 | 1F | LOBBY LTG |
| SPARE | - | 3420 | 20A/1P | 17 | | | * | 18 | 20A/1P | 314 | 1F | CORRIDOR LTG |
| EXIT SIGNS-OFFICE | 1F | 34 | 20A/1P | 19 | * | | | 20 | 20A/1P | 820 | 1F | CORRIDOR LTG |
| SPARE | - | 3420 | 20A/1P | 21 | | * | | 22 | 20A/1P | 3420 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 23 | | | * | 24 | 20A/1P | 29 | 1F | EXIT SIGNS-LAB |
| SPARE | - | 3600 | 20A/1P | 25 | * | | | 26 | 20A/1P | 3600 | - | SPARE |
| OFFICE/RSTRM LTG | 1F | 2531 | 20A/1P | 27 | | * | | 28 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 29 | | | * | 30 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 31 | * | | | 32 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 33 | | * | | 34 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 35 | | | * | 36 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 37 | * | | | 38 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 39 | | * | | 40 | 20A/1P | 0 | - | FUTURE SPARE |
| SPACE | - | 0 | 20A/1P | 41 | | | * | 42 | 20A/1P | 0 | - | SPACE |

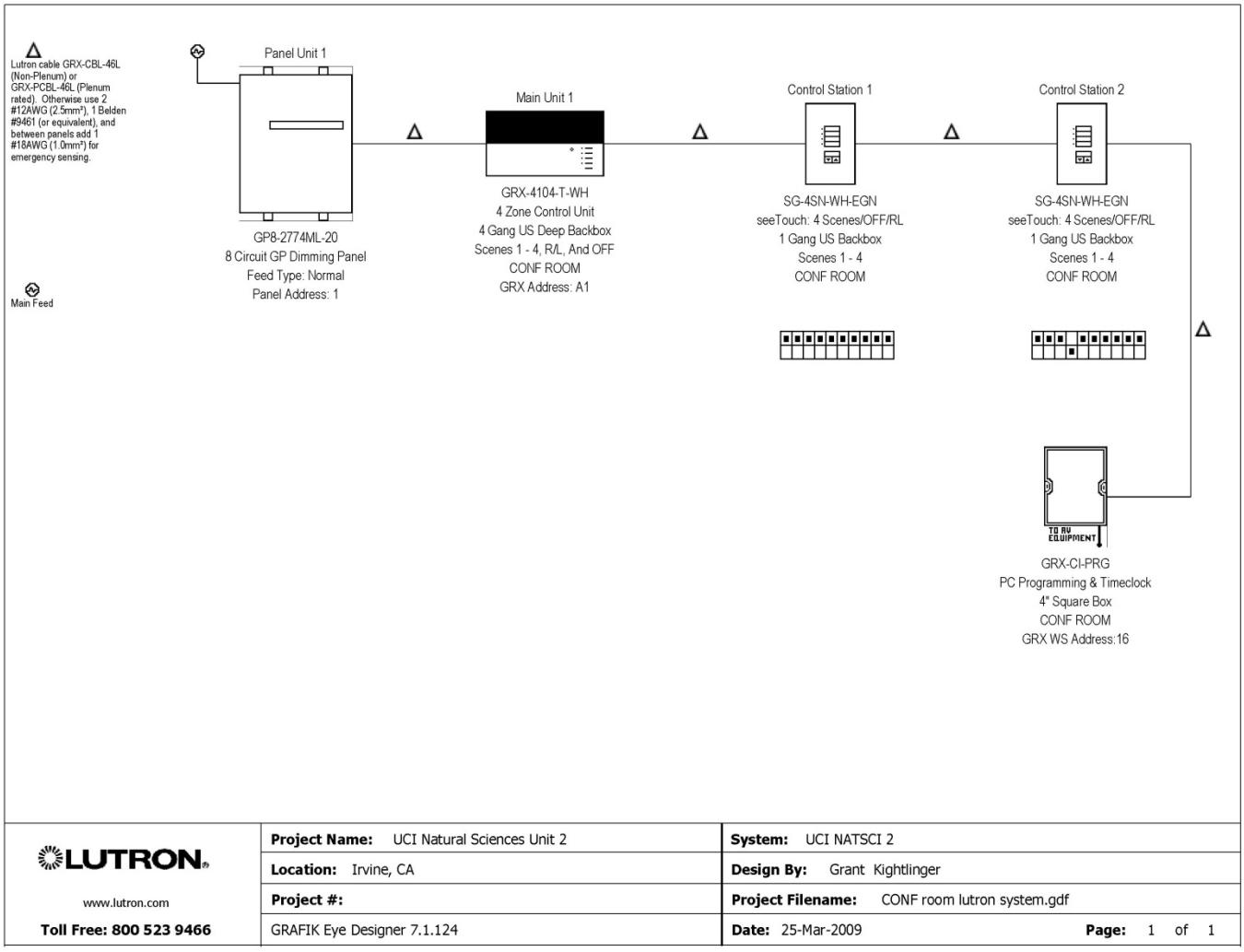
| | | | |
|---|---|---|---|
| CONNECTED LOAD (KW) - A | 22.13 | TOTAL DESIGN LOAD (KW) | 82.32 |
| CONNECTED LOAD (KW) - B | 23.16 | POWER FACTOR | 0.97 |
| CONNECTED LOAD (KW) - C | 25.22 | TOTAL DESIGN LOAD (AMPS) | 102 |

## Feeder Size

| | |
|---|---|
| **DESIGN LOAD (WITH 20% SPARE)** | 102 A |
| **CIRCUIT BREAKER SIZE** | 110 A |
| **x 125% FOR 4 CCC'S** | 137.5 A |
| **PHASE CONDUCTORS** | (3) 1/0 AWG, 75° CU THWN |
| **NEUTRAL CONDUCTOR** | (1) 1/0 AWG, 75° CU THWN |
| **GROUND CONDUCTIOR** | (1) #6 AWG, 75° CU THWN |

## LUTRON Control System Specifications

*NOTE: See lighting design section for scene dim levels, etc.



**Description:**

## UCI Natural Sciences Unit 2

**Design By:** Grant Kightlinger

**Company:**

**Address:**

**Phone:**

**Design For:**

**Company:**

**Address:**

**Phone:**

**Lutron Contact Information**
**USA** +1 610 282 3800
**UK** +44 (0)20 7702 0657
**Singapore** +65 6220 4666
**France** +33 (0)1 41 05 42 80

COMMISSIONING / STARTUP OPTION:
LCP128 Systems, Softswitch128 Systems, and GRAFIK Eye 4000 Systems containing LP, XP, or GP Power Panels include factory commissioning. Factory commissioning is optional for GRAFIK Eye 3000 and RadioTouch Systems.

Systems purchased with factory commissioning include 1 on-site visit by a Lutron field service engineer during normal business hours (M-F, 7am-6pm). Visits will include a complete system function test as well as system operation and maintenance training for the facilities team.

Please contact Lutron or check www.lutron.com for specific details about your warranty and commissioning program.

SCHEDULING:
Lutron requires 10 working days notice prior to system commissioning. Visits scheduled outside normal business hours, multiple visits or additional time on site due to circumstances beyond Lutron's direct control, or visits scheduled with less than 10 days notice will result in additional charges.

DELIVERY:
All standard products as listed in the current price guide ship within 48 hours unless otherwise indicated. Consult Lutron Customer Service for lead time on all Custom products. Build-to-order systems take approximately 4-6 weeks to manufacture after release of order from the distributor. Any changes to order will result in rescheduling, longer manufacturing time, and/or additional engineering charges.

CANCELLATION:
There will be a minimum cancellation charge of 25% of the value of this equipment should this order be cancelled.

RETURNS:
Custom products and systems are not returnable unless there is a defect in workmanship by Lutron Electronics Co., Inc.

LUTRON
Toll Free: 800 523 9466

**Project Type:** School/University
**Location:** Irvine, CA
**Project #:**
**Project Filename:** NEW PROJECT
GRAFIK Eye Designer 7.1.124
**Date:** 25-Mar-2009

## CONF ROOM Summary Load Schedule

| Lutron Zone | Customer Zone | Zone/Circuit Description | Customer Circuit # | Voltage | Load Type | Actual Load (W/VA) |
|---|---|---|---|---|---|---|
| A1-1 | Zone 1 | IND/DIR | 7 | 277V | FL - Eco-10 | 160 |
| A1-2 | Zone 2 | WHITEBD | 8 | 277V | FL - Eco-10 | 128 |
| A1-3 | Zone 3 | WALL WASH | 9 | 277V | FL - Eco-10 | 160 |
| A1-4 | Zone 4 | MR16s | 10 | 277V | Incandescent | 140 |

LUTRON
Toll Free: 800 523 9466

**Project Name:** UCI Natural Sciences Unit 2
**Location:** Irvine, CA
**Project #:**
**System:** UCI NATSCI 2
**Design By:** Grant Kightlinger
**Project Filename:** NEW PROJECT
GRAFIK Eye Designer 7.1.124
**Date:** 25-Mar-2009
**Page:** 1 of 1

## CONF ROOM GP Dimming Panel Load Schedule

**Panel Name:** Panel Unit 1
**Lutron Model No.:** GP8-2774ML-20
**Panel Address / Location:** 1 /

| Area/Room | Customer Circuit # | Customer Zone | Lutron Circuit | Lutron Zone | Zone/Circuit Description | Load Type | Actual Load (W/VA) | Max. Load (W/VA) | BRKR Size | Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| CONF ROOM | 10 | Zone 4 | 1 | A1-4 | MR16s | Incandescent | 140 | 4432 | 20A-1P | A |
| CONF ROOM | 7 | Zone 1 | 2 | A1-1 | IND/DIR | FL - Eco-10 | 160 | 4432 | 20A-1P | B |
| CONF ROOM | 9 | Zone 3 | 3 | A1-3 | WALL WASH | FL - Eco-10 | 160 | 4432 | 20A-1P | C |
| CONF ROOM | 8 | Zone 2 | 4 | A1-2 | WHITEBD | FL - Eco-10 | 128 | 4432 | 20A-1P | A |
| | | | 5 | | Spare | | 0 | 4432 | 20A-1P | |
| | | | 6 | | Spare | | 0 | 4432 | 20A-1P | |
| | | | 7 | | Spare | | 0 | 4432 | 20A-1P | |
| | | | 8 | | Spare | | 0 | 4432 | 20A-1P | |

**Phase A:** 268 W/VA
**Phase B:** 160 W/VA
**Phase C:** 160 W/VA

277/480V, 3Ø-4 Wire Main Lugs GP Dimming Panel containing 1 20A-1Pole branch breaker rated at 14,000AIC for each of the 8 dimming circuits. Max input feed = 60A

**Feed Type:** Normal

LUTRON
Toll Free: 800 523 9466

**Project Name:** UCI Natural Sciences Unit 2
**Location:** Irvine, CA
**Project #:**
**System:** UCI NATSCI 2
**Design By:** Grant Kightlinger
**Project Filename:** NEW PROJECT
GRAFIK Eye Designer 7.1.124
**Date:** 25-Mar-2009
**Page:** 1 of 1

## CONF ROOM Equipment Schedule

| Lutron Model No. | Device Name | Address | Description | Function | Location | Notes |
|---|---|---|---|---|---|---|
| GP8-2774ML-20 | Panel Unit 1 | Panel 1 | 277/480V, 3Ø-4 Wire Main Lugs GP Dimming Panel containing 1 20A-1Pole branch breaker rated at 14,000AIC for each of the 8 dimming circuits. Max input feed = 60A | - | | |
| GRX-4104-T-WH | Main Unit 1 | A1 | 4 Zone GRAFIK Eye 4000 Control Unit with Translucent Top Cover. For use with Lutron GP, LP, and XP Power Panels. 4 Gang US Backbox. | Scenes 1 - 4, R/L, And OFF | | |
| SG-4SN-WH-EGN | Control Station 1 | GRX WS 1 | seeTouch series GRAFIK Eye wallstation. Recalls preset light levels for up to 4 scenes plus off. Fine-tuning of light levels with master raise/lower. Noninsert Version; Optional Backlighting. 1 Gang US Backbox. | Scenes 1 - 4 | | |
| SG-4SN-WH-EGN | Control Station 2 | GRX WS 2 | seeTouch series GRAFIK Eye wallstation. Recalls preset light levels for up to 4 scenes plus off. Fine-tuning of light levels with master raise/lower. Noninsert Version; Optional Backlighting. 1 Gang US Backbox. | Scenes 1 - 4 | | |
| GRX-CI-PRG | | GRX WS 16 | RS232 and Ethernet Interface. Allows for PC Programming with GRX-3500 and GRX-4500 Control Units. Can also be used as an astronomic timeclock for any GRAFIK Eye system. Surface mount. | | | |

LUTRON

Toll Free: 800 523 9466

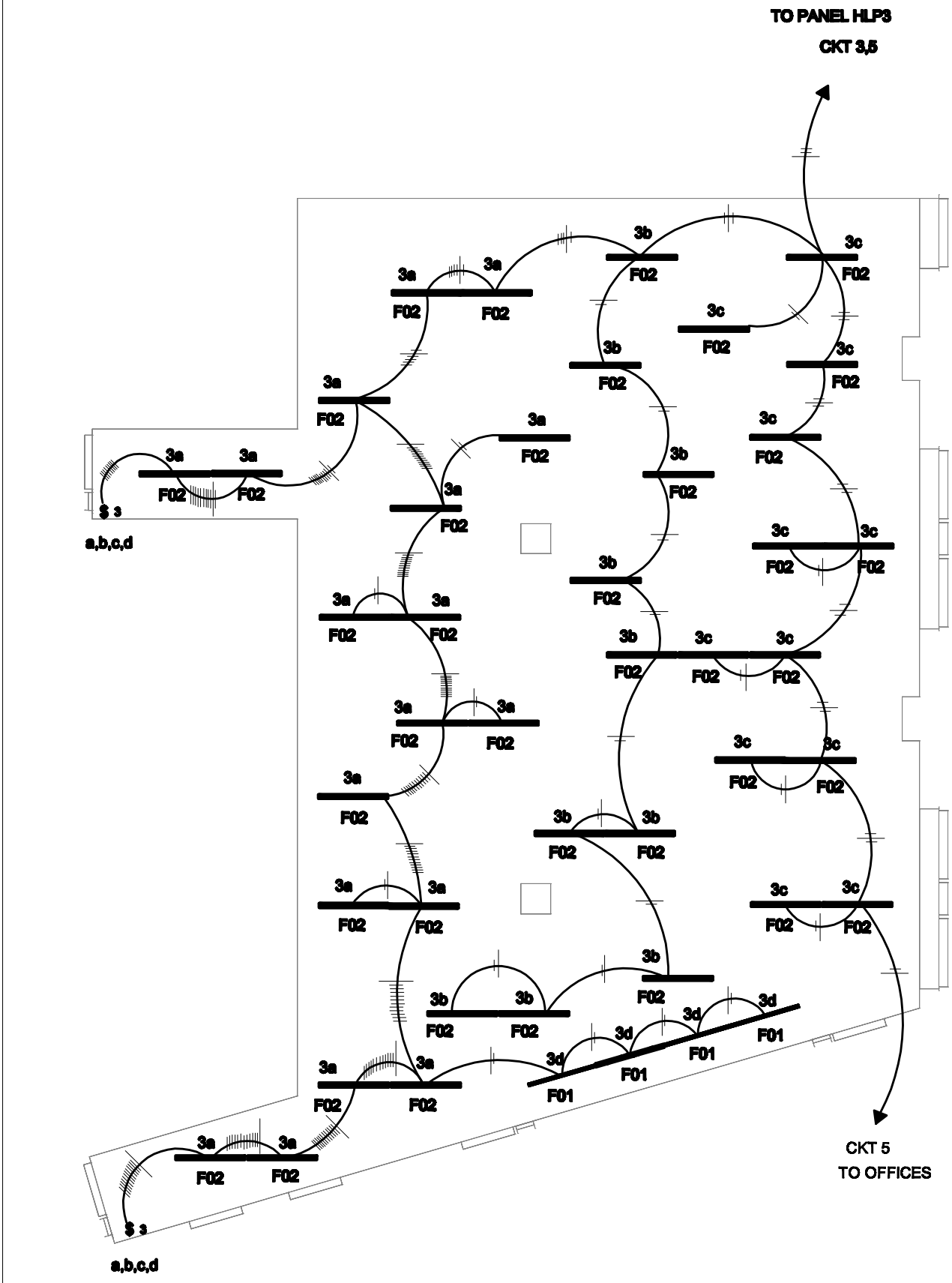
| | | |
|---|---|---|
| **Project Name:** UCI Natural Sciences Unit 2 | **System:** UCI NATSCI 2 | |
| **Location:** Irvine, CA | **Design By:** Grant Kightlinger | |
| **Project #:** | **Project Filename:** NEW PROJECT | |
| GRAFIK Eye Designer 7.1.124 | **Date:** 25-Mar-2009 | **Page:** 1 of 1 |

# ELECTRICAL REDESIGN – OPEN OFFICE

Located on the third floor of the building, the open office contains workspaces for graduate students of the Biological Sciences department at UCI. The space measures approximately 1,840 square feet and features three large windows facing to the north-east. It is adjacent to two work rooms and several private faculty offices and is accessed through short corridors on the south wall.

## Control Scheme

Although some flexibility of control is desired in the office, it has only one prevalent mode of use. The space is likely to be used at least 8 hours per day on weekdays, with intermittent use on weekends. Thus, the most important feature of the control system is simplicity. An occupancy sensor system is organized in such a way that it will maintain illumination whenever there are people working, even if they are not moving about the space. Please refer to the MAE daylight study section of this report for a more complete description of control details for this space.




| | | | | |
|---|---|---|---|---|
| UCI Nat. Sci. Unit II<br>Irvine, California | Electrical Consultant:<br>Prof. T. Dannerth, PE | Grant Kightlinger<br>L/E Option | Penn State University<br>AE 882 Senior Thesis | OPEN OFFICE ELEC. PLAN<br>1/8" = 1'-0" |

## Existing Panel Schedule

**PANEL** HLP3

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOUNTING | SURFACE | | | DOUBLE LUG | NO | | | VOLTS | 277/480 | | | MAIN | 225A | | | | | | | | | | |
| NEMA 3R | NO | | | 200% NEUTRAL | NO | | | PHASE | 3 | | | BUS | 225A | | | | | | | | | | |
| FEED THRU | NO | | | I/G BUS | NO | | | WIRE | 4 | | | A.I.C. | SEE SC REPORTS | | | | | | | | | | |
| NOTES | LOCATION | A | B | C | LTG | CONV | KIT | RECP | MISC | BKR | CIRC | | CIRC | BKR | MISC | RECP | KIT | CONV | LTG | A | B | C | LOCATION | NOTES |
| | OFFICE LTG | 3120 | | | 26 | | | | | 20/1 | 1 | | 2 | 20/1 | | | | | 15 | 725 | | | LAB CORRIDOR LTG | |
| | OPEN OFFICE LTG | | 2040 | | 17 | | | | | 20/1 | 3 | | 4 | 20/1 | | | | | 35 | | 2760 | | LAB LTG | |
| | OFFICE LTG | | | 3058 | 26 | | | | | 20/1 | 5 | | 6 | 20/1 | | | | | 28 | | | 2160 | LAB LTG | |
| | CONFERENCE RM LTG | 2484 | | | 52 | | | | | 20/1 | 7 | | 8 | 20/1 | | | | | 28 | 2160 | | | LAB LTG | |
| | OFFICE/RESTRM LTG | | 2664 | | 38 | | | | | 20/1 | 9 | | 10 | 20/1 | | | | | 34 | | 2640 | | LAB LTG | |
| | LOBBY LTG | | | 1368 | 38 | | | | | 20/1 | 11 | | 12 | 20/1 | | | | | 34 | | | 2640 | LAB LTG | |
| | LOBBY LTG | 561 | | | 33 | | | | | 20/1 | 13 | | 14 | 20/1 | | | | | 25 | 1800 | | | LAB LTG | |
| | CORRDOR LTG | | 331 | | 6 | | | | | 20/1 | 15 | | 16 | 20/1 | | | | | 34 | | 2820 | | LAB LTG | |
| | CORRDOR LTG | | | 1223 | 12 | | | | | 20/1 | 17 | | 18 | 20/1 | | | | | 33 | | | 2460 | LAB LTG | |
| A | EXIT SIGNS - OFFICE WING | 45 | | | 15 | | | | | 20/1 | 19 | | 20 | 20/1 | | | | | | | | | SPARE | |
| A | EXIT SIGNS - LAB WING | | 45 | | 15 | | | | | 20/1 | 21 | | 22 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 23 | | 24 | 20/1 | | | | | | | | | SPARE | |
| | SPARE | | | | | | | | | 20/1 | 25 | | 26 | 20/1 | | | | | | | | | SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 27 | | 28 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 29 | | 30 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | FUTURE SPARE | | | | | | | | | 20/1 | 31 | | 32 | 20/1 | | | | | | | | | FUTURE SPARE | |
| | SPACE | | | | | | | | | | 33 | | 34 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 35 | | 36 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 37 | | 38 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 39 | | 40 | | | | | | | | | | SPACE | |
| | SPACE | | | | | | | | | | 41 | | 42 | | | | | | | | | | SPACE | |
| | | A= 10895 | | | | | | | | B= 13300 | | | | | | | | | | C= 12909 | | | | |
| | TOTAL VA= | 37104 | W/LCL= | 46380 | | | | | | AMPS= | 56 | | | | | | | | TOTAL LCL= | 37104 | X .25 = | 9276 | | |
| | HIGH PHASE VA= | 13300 | W/LCL= | 16625 | | | | | | HIGH PHASE AMPS= | 60.0 | | | | | | | | HIGH PHASE LCL= | 13300 | X .25 = | 3325 | | |

**New Panelboard Worksheet**

## PANELBOARD SIZING WORKSHEET

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Panel Tag----------> | | | | | HLP3 | Panel Location: | | | Elec. Rm. 3277 | |
| Nominal Phase to Neutral Voltage-------> | | | | | 277 | Phase: | | | 3 | |
| Nominal Phase to Phase Voltage--------> | | | | | 480 | Wires: | | | 4 | |
| Pos | Ph. | Load Type | Cat. | Location | Load | Units | I. PF | Watts | VA | Remarks |
| 1 | A | OFFICE LTG | 3 | 3F | 3120 | va | 0.95 | 2964 | 3120 | |
| 2 | A | LAB CORR. LTG | 3 | 3F | 725 | va | 0.95 | 689 | 725 | |
| 3 | B | OPEN OFFICE LTG | 3 | 3F | 1408 | w | 0.95 | 1408 | 1482 | |
| 4 | B | LAB LTG | 3 | 3F | 2760 | va | 0.95 | 2622 | 2760 | |
| 5 | C | OFFICE LTG | 3 | 3F | 3058 | va | 0.95 | 2905 | 3058 | |
| 6 | C | LAB LTG | 3 | 3F | 2160 | va | 0.95 | 2052 | 2160 | |
| 7 | A | CONF RM LTG | 3 | 3F | 2484 | va | 0.95 | 2360 | 2484 | |
| 8 | A | LAB LTG | 3 | 3F | 2160 | va | 0.95 | 2052 | 2160 | |
| 9 | B | OFFICE/RSTRM LTG | 3 | 3F | 2664 | va | 0.95 | 2531 | 2664 | |
| 10 | B | LAB LTG | 3 | 3F | 2640 | va | 0.95 | 2508 | 2640 | |
| 11 | C | LOBBY LTG | 3 | 3F | 1368 | va | 0.95 | 1300 | 1368 | |
| 12 | C | LAB LTG | 3 | 3F | 2640 | va | 0.95 | 2508 | 2640 | |
| 13 | A | LOBBY LTG | 3 | 3F | 561 | va | 0.95 | 533 | 561 | |
| 14 | A | LAB LTG | 3 | 3F | 1800 | va | 0.95 | 1710 | 1800 | |
| 15 | B | CORRIDOR LTG | 3 | 3F | 331 | va | 0.95 | 314 | 331 | |
| 16 | B | LAB LTG | 3 | 3F | 2820 | va | 0.95 | 2679 | 2820 | |
| 17 | C | CORRIDOR LTG | 3 | 3F | 1223 | va | 0.95 | 1162 | 1223 | |
| 18 | C | LAB LTG | 3 | 3F | 2460 | va | 0.95 | 2337 | 2460 | |
| 19 | A | EXIT SIGNS - OFFIC | 3 | 3F | 45 | va | 0.95 | 43 | 45 | |
| 20 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 21 | B | EXIT SIGNS - LAB | 3 | 3F | 45 | va | 0.95 | 43 | 45 | |
| 22 | B | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 23 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 24 | C | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 25 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 26 | A | SPARE | | - | 3600 | va | 1.00 | 3600 | 3600 | |
| 27 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 28 | B | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 29 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 30 | C | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 31 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 32 | A | FUTURE SPARE | | - | 0 | va | 1.00 | 0 | 0 | |
| 33 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 34 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 35 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 36 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 37 | A | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 38 | A | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 39 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 40 | B | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 41 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| 42 | C | SPACE | | - | 0 | va | 1.00 | 0 | 0 | |
| PANEL TOTAL | | | | | | | | 56.3 | 58.1 | Amps= 70.0 |

| PHASE LOADING | | | | | | kW | kVA | % | Amps |
|---|---|---|---|---|---|---|---|---|---|
| PHASE TOTAL | A | | | | | 21.2 | 21.7 | 37% | 78.3 |
| PHASE TOTAL | B | | | | | 15.7 | 16.3 | 28% | 59.0 |
| PHASE TOTAL | C | | | | | 19.5 | 20.1 | 35% | 72.6 |

| LOAD CATAGORIES | | | Connected | | | Demand | | | | Ver. 1.03 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | kW | kVA | DF | kW | kVA | PF | | |
| 1 | receptacles | | 0.0 | 0.0 | 0.80 | 0.0 | 0.0 | | | |
| 2 | computers | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 3 | fluorescent lighting | | 34.7 | 36.5 | 0.95 | 33.0 | 34.7 | 0.95 | | |
| 4 | HID lighting | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 5 | incandescent lighting | | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | | | |
| 6 | HVAC fans | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 7 | heating | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 8 | kitchen equipment | | 0.0 | 0.0 | | 0.0 | 0.0 | | | |
| 9 | unassigned | | 21.6 | 21.6 | | 21.6 | 21.6 | 1.00 | | |
| Total Demand Loads | | | | | | 54.6 | 56.3 | | | |
| Spare Capacity | | | 20% | | | 10.9 | 11.3 | | | |
| Total Design Loads | | | | | | 65.5 | 67.6 | 0.97 | Amps= | 81.3 |

**New Panelboard Schedule**

## PANELBOARD SCHEDULE

VOLTAGE: 208Y/120V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: HLP3
PANEL LOCATION: Elec. Rm. 3277
PANEL MOUNTING: SURFACE

MIN. C/B AIC: 10K
OPTIONS: PROVIDE FEED THROUGH LUGS FOR PANELBOARD 1L1B

| DESCRIPTION | LOCATION | LOAD (WATTS) | C/B SIZE | POS. NO. | A | B | C | POS. NO. | C/B SIZE | LOAD (WATTS) | LOCATION | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFFICE LTG | 3F | 2964 | 20A/1P | 1 | * | | | 2 | 20A/1P | 689 | 3F | LAB CORR. LTG |
| OPEN OFFICE LTG | 3F | 1408 | 20A/1P | 3 | | * | | 4 | 20A/1P | 2622 | 3F | LAB LTG |
| OFFICE LTG | 3F | 2905 | 20A/1P | 5 | | | * | 6 | 20A/1P | 2052 | 3F | LAB LTG |
| CONF RM LTG | 3F | 2360 | 20A/1P | 7 | * | | | 8 | 20A/1P | 2052 | 3F | LAB LTG |
| OFFICE/RSTRM LTG | 3F | 2531 | 20A/1P | 9 | | * | | 10 | 20A/1P | 2508 | 3F | LAB LTG |
| LOBBY LTG | 3F | 1300 | 20A/1P | 11 | | | * | 12 | 20A/1P | 2508 | 3F | LAB LTG |
| LOBBY LTG | 3F | 533 | 20A/1P | 13 | * | | | 14 | 20A/1P | 1710 | 3F | LAB LTG |
| CORRIDOR LTG | 3F | 314 | 20A/1P | 15 | | * | | 16 | 20A/1P | 2679 | 3F | LAB LTG |
| CORRIDOR LTG | 3F | 1162 | 20A/1P | 17 | | | * | 18 | 20A/1P | 2337 | 3F | LAB LTG |
| EXIT SIGNS - OFFIC | 3F | 43 | 20A/1P | 19 | * | | | 20 | 20A/1P | 3600 | - | SPARE |
| EXIT SIGNS - LAB | 3F | 43 | 20A/1P | 21 | | * | | 22 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 23 | | | * | 24 | 20A/1P | 3600 | - | SPARE |
| SPARE | - | 3600 | 20A/1P | 25 | * | | | 26 | 20A/1P | 3600 | - | SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 27 | | * | | 28 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 29 | | | * | 30 | 20A/1P | 0 | - | FUTURE SPARE |
| FUTURE SPARE | - | 0 | 20A/1P | 31 | * | | | 32 | 20A/1P | 0 | - | FUTURE SPARE |
| SPACE | - | 0 | 20A/1P | 33 | | * | | 34 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 35 | | | * | 36 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 37 | * | | | 38 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 39 | | * | | 40 | 20A/1P | 0 | - | SPACE |
| SPACE | - | 0 | 20A/1P | 41 | | | * | 42 | 20A/1P | 0 | - | SPACE |

| | | | |
|---|---|---|---|
| CONNECTED LOAD (KW) - A | 21.15 | TOTAL DESIGN LOAD (KW) | 65.50 |
| CONNECTED LOAD (KW) - B | 15.71 | POWER FACTOR | 0.97 |
| CONNECTED LOAD (KW) - C | 19.46 | TOTAL DESIGN LOAD (AMPS) | 81 |

**Feeder Size**

| | |
|---|---|
| **DESIGN LOAD (WITH 20% SPARE)** | 81 A |
| **CIRCUIT BREAKER SIZE** | 90 A |
| **x 125% FOR 4 CCC'S** | 112.5 A |
| **PHASE CONDUCTORS** | (3) #2 AWG, 75° CU THWN |
| **NEUTRAL CONDUCTOR** | (1) #2 AWG, 75° CU THWN |
| **GROUND CONDUCTIOR** | (1) #8 AWG, 75° CU THWN |

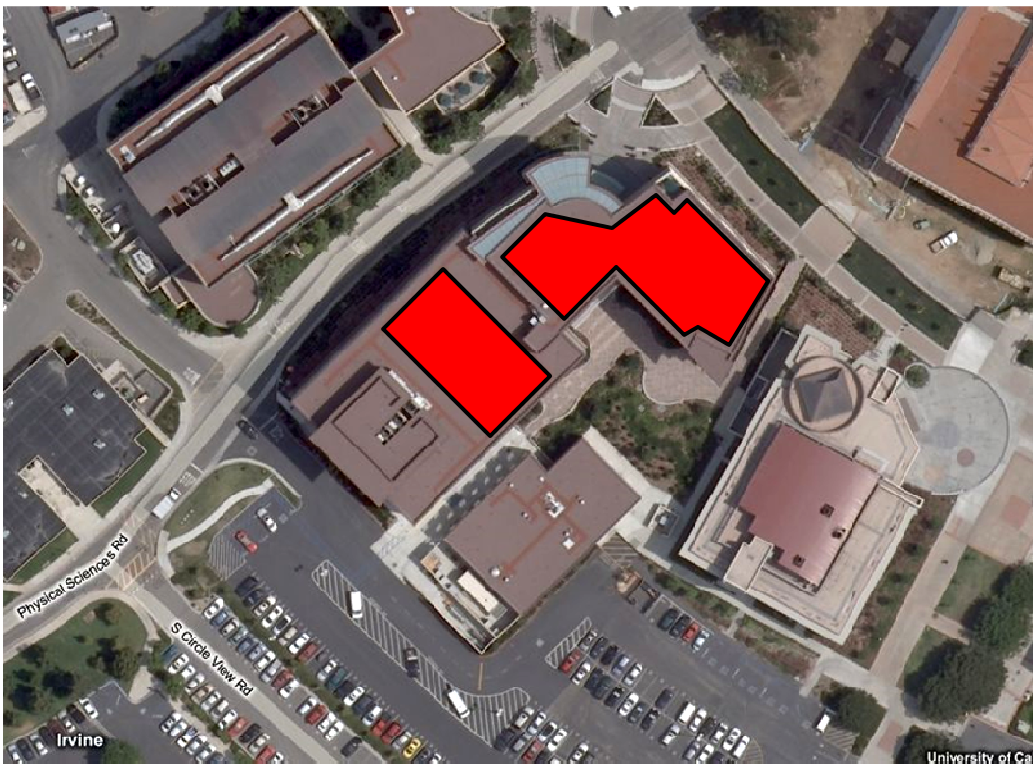
## ELECTRICAL DEPTH: PHOTOVOLTAIC ARRAY STUDY

Heightened energy costs and increased environmental awareness in the building industry demand the consideration of alternative energy solutions for new construction. The University of California is a leader is sustainable technologies research, and seeks to maintain its image of environmental responsibility. This study is intended to determine the economic feasibility of implementing a roof-based photovoltaic array system UCI Natural Science Unit II. RETScreen 4 energy modeling software has been used to estimate the power production and climate data for this study.

### System Scale

UCI Natural Science Unit II is taller than all surrounding buildings, and therefore is not in danger of shading from adjacent structures. The roof is vacant except for an equipment canopy area above the laboratory wing. This general area has been avoided due to possible shading. In addition, a roof area usability factor of 75% has been assumed for the analysis. This preserves enough extra space to allow for access to the panels for maintenance and repairs.

| | |
|---|---|
| Unoccupied Roof Area: | 21302 ft² |
| Usable Roof Area (assume 75%): | 15976 ft² |
| PV Unit Frame Area: | 13.6 ft² |
| Total Installable Units: | 1174 panels |




Available Roof Area
[maps.live.com]

**Photovoltaic Equipment**

The BP Solar 3165 photovoltaic panel has been used for this analysis. This particular model has been selected for its relatively high capacity (165 Watts) and also for its high module efficiency of 13.1%. Complete specifications for this equipment can be found at the end of this section.

| Typical electrical characteristics | BP 3165 | |
|---|---|---|
| | (STC)[1] | (NOCT)[2] |
| Rated power ($P_{max}$) | 165W | 119W |
| Voltage at $P_{max}$ ($V_{mp}$) | 35.2V | 31.3V |
| Current at $P_{max}$ ($I_{mp}$) | 4.7A | 3.8A |
| Short circuit current ($I_{sc}$) | 5.1A | 4.1A |
| Open circuit voltage ($V_{oc}$) | 44.2V | 40.2V |
| Limiting reverse current | 5.1A | |
| Module efficiency at STC | 13.1% | |
| Efficiency reduction at 200W/m$^2$ | < 3% | |
| Temperature coefficient of $I_{sc}$ | (0.065±0.015)%/ºC | |
| Temperature coefficient of $V_{oc}$ | -(0.36±0.05)%/ºC | |
| Temperature coefficient of $P_{max}$ | -(0.5±0.05)%/ºC | |
| NOCT[3] | 47±2ºC | |
| Maximum series fuse rating | 15A (BP ####N) / 20A (BP ####J) | |
| Application class | Class A installation (IEC 61730) | |
| Maximum system voltage | 1000V (IEC 61730) 600V (UL) | |

[www.bp.com]

## Climate Data

Climate information was unavailable for Irvine, California within the RETScreen database. Therefore, climate data for the nearby city of Long Beach was utilized for the purposes of this analysis. The following is a summary of the climate profile which was used.

| | Unit | Climate data location | Project location |
|---|---|---|---|
| Latitude | °N | 33.8 | 33.8 |
| Longitude | °E | -118.2 | -118.2 |
| Elevation | ft | 17 | 17 |
| Heating design temperature | °F | 6.2 | |
| Cooling design temperature | °F | 30.9 | |
| Earth temperature amplitude | °F | 13.5 | |

| Month | Air temperature | Relative humidity | Daily solar radiation - horizontal | Atmospheric pressure | Wind speed | Earth temperature | Heating degree-days | Cooling degree-days |
|---|---|---|---|---|---|---|---|---|
| | °F | % | kWh/m²/d | kPa | mph | °F | °F-d | °F-d |
| January | 55.2 | 64.4% | 2.79 | 101.8 | 5.6 | 55.2 | 285 | 162 |
| February | 56.7 | 66.7% | 3.61 | 101.7 | 6.3 | 56.8 | 217 | 186 |
| March | 57.9 | 67.2% | 4.73 | 101.5 | 7.2 | 60.7 | 201 | 246 |
| April | 60.8 | 65.8% | 5.99 | 101.4 | 7.4 | 65.5 | 108 | 324 |
| May | 63.5 | 68.3% | 6.43 | 101.3 | 7.4 | 70.2 | 28 | 419 |
| June | 66.7 | 69.7% | 6.71 | 101.2 | 7.2 | 75.2 | 0 | 502 |
| July | 70.9 | 68.9% | 7.26 | 101.2 | 6.9 | 79.0 | 0 | 647 |
| August | 72.1 | 68.9% | 6.67 | 101.2 | 6.7 | 79.5 | 0 | 686 |
| September | 70.5 | 69.5% | 5.37 | 101.1 | 6.3 | 76.6 | 0 | 616 |
| October | 66.7 | 68.2% | 4.16 | 101.4 | 5.8 | 70.2 | 0 | 519 |
| November | 60.3 | 66.3% | 3.13 | 101.6 | 5.6 | 61.5 | 124 | 308 |
| December | 55.2 | 65.5% | 2.59 | 101.7 | 5.1 | 55.5 | 285 | 162 |
| **Annual** | 63.1 | 67.5% | 4.96 | 101.4 | 6.4 | 67.2 | 1,247 | 4,776 |
| Measured at | ft | | | | 32.8 | 0.0 | | |

## System Performance

The estimated performance of the selected system was calculated using RETScreen software. The following results have been incorporated into the financial feasibility analysis.

| **Photovoltaic** | | | |
|---|---|---|---|
| Power capacity | kW | 193.71 | |
| Manufacturer | | BP Solar | |
| Model | | poly-Si - BP 3165 | 1174 unit(s) |

## Financial Analysis

### Initial Cost

RS Means 2009 section D5090 has been used to estimate the initial cost of the entire system described in this report. Cost figures include all necessary peripheral and installation equipment and labor for the proposed system. A similar 167 Watt, 60 unit array is priced at $112,810. Adjusted for the 1174 proposed panels, the initial system cost amounts to an estimated **$2,211,033** for the entire system.

### Utility Savings

According to RETScreen, the 15,917 ft² array is expected to produce approximately 270.5 MWh annually. At a utility cost of $90.33 per MWh (or $0.09033 per kWh), the system will save an estimated utility cost of **$24,434** per year.

| Month | Daily solar radiation - horizontal kWh/m²/d | Electricity ported to grid MWh |
|---|---|---|
| January | 2.79 | 13.54 |
| February | 3.61 | 15.63 |
| March | 4.73 | 22.37 |
| April | 5.99 | 26.94 |
| May | 6.43 | 29.63 |
| June | 6.71 | 29.65 |
| July | 7.26 | 32.62 |
| August | 6.67 | 29.98 |
| September | 5.37 | 23.70 |
| October | 4.16 | 19.36 |
| November | 3.13 | 14.47 |
| December | 2.59 | 12.60 |
| **Annual** | **4.96** | **270.48** |
| MWh/m² | 1.81 | |

*NOTE: Utility costs are based on Southern California Edison's TOU-8 time-of-use based rate structure. A mid-peak summer seasonal rate has been selected for use in this estimation. For more information on the utility rates for the UCI campus, see the electrical appendix of this report.

**Incentives – California Solar Initiative**

The California Solar Initiative (CSI) is a program which rewards utility customers of Southern California Edison for the production solar power technologies. SCE non-residential rewards for systems with capacities greater than 50 kW are currently set at $0.22 per kWh produced. Using the incentive calculator provided by the CSI website at www.csi-epbb.com, the total anticipated incentive amount for this system was determined to be **$293,169**.

| **Site Specifications:** | |
|---|---|
| Project Name | UCI Natural Science Unit II |
| ZIP Code | 92612 |
| City | Irvine |
| Utility | SCE |
| Customer Type | Commercial |
| Incentive Type | PBI |
| **PV System Specifications:** | |
| PV Module | BP Solar:SX3165I<br>165.0W STC, 146.1W PTC |
| Number of Modules | 1174 |

| **Results** | |
|---|---|
| Annual kWh | 266,517 |
| Summer Months | May-October |
| Summer kWh | 164,464 |
| **CEC-AC Rating** | **166.376 kW** |
| Capacity Factor[1] | 18.286% |
| Prevailing Capacity Factor[2] | 20.000% |
| **Design Factor[3]** | **91.430%** |
| **Eligible Annual kWh[4]** | **266,517** |
| **Incentive Rate** | **$0.22/kWh** |
| **Incentive[5]** | **$293,169** |
| Report Generated on | 4/2/2009 10:06:21 PM |

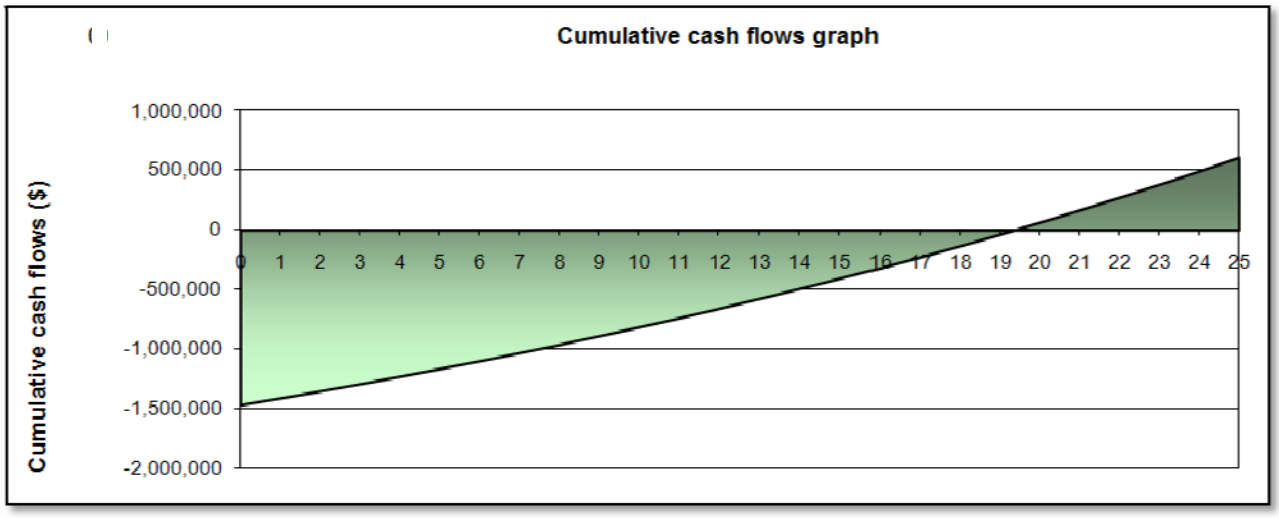
**Incentives – Federal Tax Credit**

An additional federal tax credit of approximately **$456,000** is also applicable to this project. This estimation was performed using the BP Solar Clean Power Estimator at bpsolar.cleanpowerestimator.com. The combination of these two incentives represents a total savings of $749,169 for this installation.

**System Financial Details**

The collected financial data has been entered into RETScreen and a cash flow analysis has been performed. The results predict an approximate equity payback period of 19.4 years for the proposed system.

| | | |
|---|---|---|
| **Financial parameters** | | |
| Inflation rate | % | 3.0% |
| Project life | yr | 25 |
| Debt ratio | % | 0% |
| **Initial costs** | | |
| Power system | $ | 2,211,033 |
| Other | $ | |
| **Total initial costs** | $ | 2,211,033 |
| **Incentives and grants** | $ | 749,169 |
| **Annual costs and debt payments** | | |
| O&M (savings) costs | $ | -24,434 |
| Fuel cost - proposed case | $ | 0 |
| | $ | |
| **Total annual costs** | $ | -24,434 |
| **Annual savings and income** | | |
| Fuel cost - base case | $ | 0 |
| Electricity export income | $ | 30,656 |
| | $ | |
| **Total annual savings and income** | $ | 30,656 |
| **Financial viability** | | |
| Pre-tax IRR - assets | % | 2.5% |
| Simple payback | yr | 26.5 |
| Equity payback | yr | 19.4 |



## Conclusions

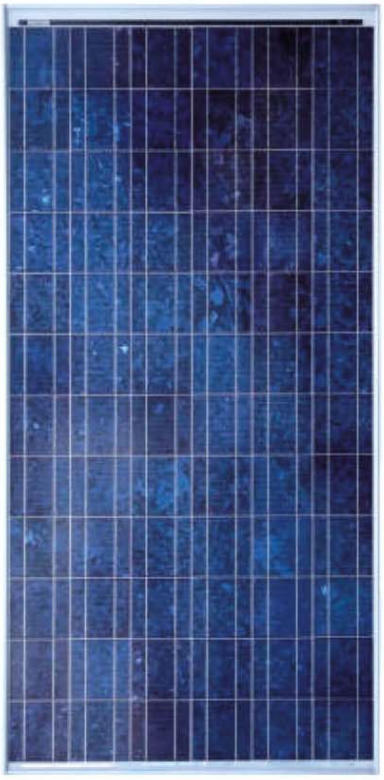
From the data collected in this study, the installation of a photovoltaic system on the roof of UCI Natural Science Unit II has been shown to be a viable option. Assuming a minimum 25 year system life (during which time the equipment is under warranty by BP Solar), a positive net result seems to be achievable for this project. The initial cost of installing the system represents a significant investment, but the overall economic value of the system needs to be considered.

In addition to the financial benefits of installing a photovoltaic system, social benefits for the university are also probable. A solar array on the roof of this building might allow students to perform unique hands-on studies of alternative energy solutions. Furthermore, the image of The University of California Irvine as an institution which is deeply committed to environmental issues and sustainable building methods will be highlighted. In turn, these opportunities may help to bring more students and faculty to the campus on a long-term level.

Based on these economic and social benefits, a photovoltaic array on the roof of UCI Natural Science Unit II is recommended.

# 165 watt photovoltaic module
# BP 3165

The BP 3165 is an advanced 165 watt module utilising anti-reflective coatings on both its multicrystalline cells and glass. The module also features IntegraBus™ technology which is a printed circuit board with integrated diodes that has been designed to ensure reliability whilst conducting higher currents. The BP 3165 has been designed for grid-connected solar applications, such as large commercial roofs, residential systems and photovoltaic (PV) power plants, as well as remote off-grid applications such as telecommunications, water pumping and residential systems. This 72-cell module offers superior value – greater performance from a white polyester back-sheet and innovative, high-efficiency cells.



BP 3165

| Performance | BP 3165 | BP 3160 |
|---|---|---|
| Rated power | 165W | 160W |
| Power tolerance | ±3% | ±3% |
| Nominal voltage | 24V | 24V |
| Warranty * | 90% of minimum warranted power output over 12 years<br>80% of minimum warranted power output over 25 years<br>Free from defects in materials and workmanship for 5 years | |

## Configuration

| | |
|---|---|
| BP 3165N | Universal frame, a sealed junction box with output cables and polarised Multicontact (MC III) connectors. |
| BP 3165J | Universal frame with an accessible junction box for cable connection. |

## Qualification test parameters

| | |
|---|---|
| Temperature cycling range | -40ºC to +85ºC |
| Damp heat test | 85ºC and 85% relative humidity |
| Front and rear static load test (eg: wind) | 2400Pa (equivalent to 245kg/m$^2$ load distributed) |
| Front load test (eg: snow) | 5400Pa† (equivalent to 550kg/m$^2$ load distributed) |
| Hailstone impact test | 25mm hail at 23m/s |
| Impulse voltage test | 8000V waveform impulse according to high voltage test techniques IEC60060-1 standard |
| Reverse current overload test | 135% of the overcurrent protection rating for two hours |

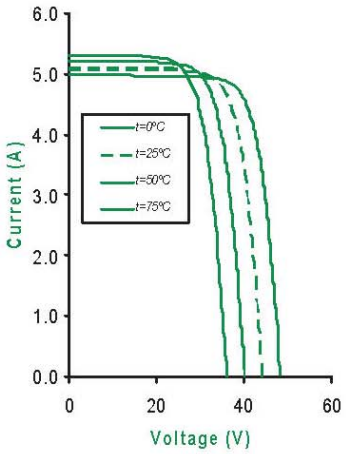
## Quality and safety

- Certified according to the extended version of the IEC 61215:2005 (crystalline silicon terrestrial photovoltaic modules – design qualification and type approval).
- Certified according to IEC 61730-1 and IEC 61730-2 (photovoltaic module safety qualification, requirements for construction and testing).
- Listed by Underwriter's Laboratories for electrical and fire safety (Class C fire rating).
- Approved by Factory Mutual Research in NEC Class 1, Division 2, Groups C and D hazardous locations (BP ####J).
- Module electrical measurements are calibrated to world radiometric reference via third party international laboratories.
- Manufactured in ISO 9001 and ISO 14001 certified factories.

* Refer to BP Solar's warranty document for terms and conditions.

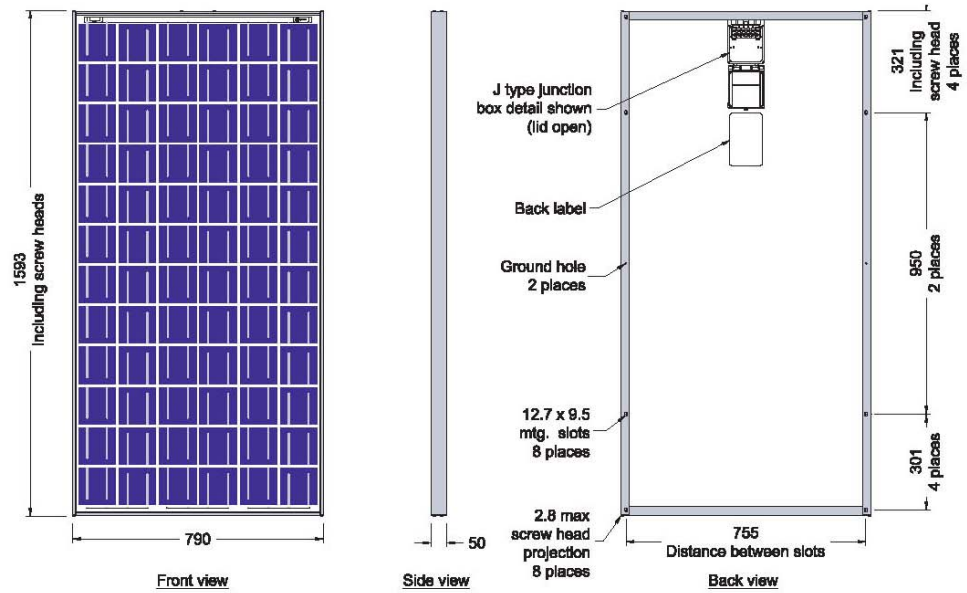
† When module mounted in accordance with BP Solar's installation instructions.

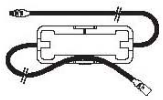
**BP3165 I-V Curves**



# 165 watt photovoltaic module
# BP 3165

## Module diagram



N type junction box detail with wire-hold feature (not to scale)

## Typical electrical characteristics

| | BP 3165 | | BP 3160 | |
|---|---|---|---|---|
| | (STC)[1] | (NOCT)[2] | (STC)[1] | (NOCT)[2] |
| Rated power ($P_{max}$) | 165W | 119W | 160W | 115W |
| Voltage at $P_{max}$ ($V_{mp}$) | 35.2V | 31.3V | 35.1V | 31.2V |
| Current at $P_{max}$ ($I_{mp}$) | 4.7A | 3.8A | 4.55A | 3.6A |
| Short circuit current ($I_{sc}$) | 5.1A | 4.1A | 4.8A | 3.9A |
| Open circuit voltage ($V_{oc}$) | 44.2V | 40.2V | 44.2V | 40.2V |
| Limiting reverse current | 5.1A | | 4.8A | |
| Module efficiency at STC | 13.1% | | 12.7% | |
| Efficiency reduction at 200W/m$^2$ | < 3% | | | |
| Temperature coefficient of $I_{sc}$ | (0.065±0.015)%/°C | | | |
| Temperature coefficient of $V_{oc}$ | -(0.36±0.05)%/°C | | | |
| Temperature coefficient of $P_{max}$ | -(0.5±0.05)%/°C | | | |
| NOCT[3] | 47±2°C | | | |
| Maximum series fuse rating | 15A (BP ####N) / 20A (BP ####J) | | | |
| Application class | Class A installation (IEC 61730) | | | |
| Maximum system voltage | 1000V (IEC 61730) 600V (UL) | | | |

## Mechanical characteristics

| | |
|---|---|
| Solar cells | 72 multicrystalline cells (125 x 125mm) connected in series. |
| Construction | Front: high transmission 3.2mm tempered anti-reflective coated glass.<br>Encapsulant: EVA.<br>Rear: white polyester. |
| Frame | Clear anodised aluminium, alloy type 6063T6. Colour: silver. |
| Diodes | IntegraBus™ technology includes 3 Schottky bypass diode – one for every 24 cells – on a printed circuit board. |
| Output cables (N type) | RHW AWG# 12 (3.3mm$^2$) cable with polarised weatherproof DC-rated MC III connectors; asymmetrical lengths 1250mm (-) and 800mm (+). |
| Junction box (J type) | IP65 junction box with four terminal screw connection block, accepts PG 13.5, M20, 13mm conduit, or cable fittings accepting 6 – 12mm diameter cable. Terminals accept 2.5 – 10mm$^2$ (8 to 14 AWG) wire. |
| Dimensions | 1593 x 790 x 50mm (overall tolerances ±3mm) |
| Weight | 15.4kg |

Your BP Solar Dealer:

1. Standard test conditions (STC), irradiance of 1000W/m$^2$ at an AM1.5G solar spectrum and a cell temperature of 25°C.
2. 800W/m$^2$, NOCT, AM 1.5G solar spectrum.
3. Normal operating cell temperature (NOCT) air temperature of 20°C; irradiance 800W/m$^2$; wind speed 1m/s.

# ELECTRICAL DEPTH: COPPER VS. ALUMINUM FEEDERS

The focus of this depth study is to determine the economic and other impacts of changing the entire electrical feeder system from copper to aluminum conductors for UCI Natural Science Unit II. Basic advantages and disadvantages have been studied and are presented here, along with a calculation of the estimated financial impact of the change for this particular building project.

## Copper Considerations

The existing system in the building uses Copper THWN conductors throughout. Copper feeders are preferable for several reasons over aluminum feeders and have probably been chosen in this case for their long-term value as opposed to an initial installation cost. The higher conductivity of copper allows the wires to be smaller than aluminum for the same load. This, in turn, means that they are easier and less expensive to install in terms of labor. In addition, conduit sizes can generally be smaller with copper feeders for the reason stated above, and this saves additional labor time and cost. Another advantage of copper conductors is their higher resiliency to physical stress which reduces maintenance cost for the system over its life. This type of feeder is generally preferred by contractors.

## Aluminum Considerations

Perhaps the most obvious advantage of using aluminum feeders is their significantly lower material cost. This leads to attractive initial installation savings for project owners. Aluminum is also a lighter-weight metal than copper. However, notable disadvantages of aluminum conductors include lower conductivity which requires larger wire sizes and conduit sizes. This represents additional labor and material cost for the project. Generally, aluminum feeders are considered to be less resilient and do not last as long as a copper feeder system. Both feeder types are made of recyclable materials.

**Cost Comparison**

The following cost comparison utilizes RS Means version 2009 estimations for material and labor costs for conduit and conductors. The run lengths for each feeder have been estimated based on panel locations. A full feeder schedule is available in the electrical appendix of this report.

| | | | | EXISTING - COPPER FEEDERS | | | | PROPOSED - ALUMINUM FEEDERS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PHASE | NEUTRAL | GROUND | CONDUIT | PHASE | NEUTRAL | GROUND | CONDUIT | |
| TAG | TOTAL FT | PROTECTION | TAG FT | | | | | | | | | |
| 1 | 264 | - | 264 | $14,890 | $7,445 | $3,622 | $104 | $6,716 | $3,358 | $2,661 | $176 | * |
| 2 | 110 | 4000A | 110 | $51,183 | $17,061 | $17,061 | $239 | $23,087 | $7,696 | $11,447 | $478 | * |
| 3 | 380 | 600A | 800 | $33,888 | $0 | $4,912 | $138 | $16,896 | $0 | $3,456 | $267 | |
| 4 | 121 | 225A | 2489 | $51,224 | $17,075 | $4,406 | $416 | $29,719 | $9,906 | $3,099 | $416 | |
| 5 | 279 | 400A | 795 | $22,419 | $0 | $1,662 | $133 | $10,112 | $0 | $1,550 | $137 | * |
| 6 | 156 | 225A | 156 | $2,140 | $0 | $276 | $11 | $1,242 | $0 | $194 | $13 | |
| 7 | 356 | 500A | 356 | $13,144 | $0 | $2,186 | $62 | $7,519 | $0 | $1,538 | $119 | |
| 8 | 120 | 1000A | 120 | $11,437 | $3,812 | $1,638 | $60 | $5,702 | $1,901 | $990 | $71 | |
| 9 | 135 | 225A | 4844 | $99,690 | $66,460 | $8,574 | $809 | $57,837 | $38,558 | $6,031 | $957 | |
| 10 | 160 | 1200A | 480 | $60,998 | $40,666 | $10,752 | $379 | $30,413 | $20,275 | $6,106 | $463 | |
| 11 | 428 | 700A | 428 | $36,209 | $0 | $3,193 | $169 | $16,332 | $0 | $2,773 | $286 | * |
| 12 | 50 | 250A | 50 | $1,197 | $0 | $89 | $8 | $621 | $0 | $62 | $8 | |
| 13 | 110 | 125A | 110 | $1,013 | $0 | $138 | $8 | $713 | $0 | $107 | $10 | |
| 14 | 254 | 100A | 254 | $1,916 | $639 | $230 | $15 | $1,433 | $478 | $199 | $22 | |
| 15 | 296 | 600A | 672 | $10,140 | $3,380 | $1,216 | $78 | $7,580 | $2,527 | $1,055 | $116 | |
| 16 | 296 | 800A | 672 | $56,851 | $18,950 | $5,013 | $265 | $25,644 | $8,548 | $4,355 | $449 | * |
| 17 | 888 | 2000A | 888 | $225,374 | $75,125 | $42,517 | $1,284 | $101,658 | $33,886 | $29,304 | $1,780 | * |
| 18 | 148 | 350A | 296 | $12,521 | $0 | $619 | $58 | $5,648 | $0 | $577 | $99 | * |
| 19 | 20 | 800A | 20 | $1,692 | $0 | $149 | $8 | $763 | $0 | $130 | $13 | * |
| 20 | 148 | 175A | 698 | $9,528 | $0 | $876 | $60 | $5,759 | $0 | $681 | $60 | |
| 21 | 82 | 25A | 82 | $154 | $0 | $51 | $3 | $140 | $0 | $47 | $3 | |
| 22 | 82 | 60A | 82 | $435 | $145 | $51 | $5 | $306 | $102 | $47 | $5 | |
| 23 | 75 | 70A | 442 | $2,347 | $0 | $400 | $20 | $1,651 | $0 | $347 | $26 | |
| 24 | 75 | 150A | 442 | $4,946 | $1,649 | $555 | $38 | $3,342 | $1,114 | $347 | $38 | |
| 25 | 112 | 50A | 112 | $422 | $141 | $70 | $5 | $328 | $109 | $64 | $6 | |
| 26 | 135 | 150A | 320 | $3,581 | $0 | $402 | $23 | $2,419 | $0 | $312 | $28 | |
| 27 | 75 | 400A | 360 | $15,228 | $10,152 | $752 | $87 | $6,869 | $4,579 | $702 | $142 | * |
| 28 | 148 | 50A | 296 | $1,114 | $0 | $185 | $13 | $866 | $0 | $169 | $13 | |
| | | | | **$745,681** | **$262,699** | **$111,594** | **$4,498** | **$371,313** | **$133,037** | **$78,349** | **$6,201** | |
| | | | | **TOTAL COPPER COST:** | | | | **TOTAL ALUMINUM COST:** | | | | |
| | | | | **$1,124,472** | | | | **$588,900** | | | | |

NOTES:

- Tags marked with a * symbol have been split into additional runs to avoid feeder sizes over 500KCMIL conductors.
- Please see the full feeder schedule for specific run origins and destinations. This table is a summary of tag totals.

## Cost Data

The following cost data was used for this analysis and was obtained from RS Means 2009.

| | COPPER WIRE | | | ALUMINUM WIRE | | |
|---|---|---|---|---|---|---|
| SIZE | MATL | LABOR | TOTAL | MATL | LABOR | TOTAL |
| - | 0 | 0 | 0 | 0 | 0 | 0 |
| #10 | $25 | $38 | $63 | $16 | $21 | $37 |
| #8 | $44 | $47 | $91 | $23 | $34 | $57 |
| #6 | $68 | $58 | $126 | $32 | $47 | $79 |
| #4 | $106 | $71 | $177 | $40 | $58 | $98 |
| #3 | $134 | $75 | $209 | $47 | $65 | $111 |
| #2 | $168 | $84 | $252 | $54 | $71 | $125 |
| #1 | $213 | $94 | $307 | $79 | $84 | $162 |
| "1/0" | $259 | $114 | $373 | $94 | $94 | $188 |
| "2/0" | $325 | $130 | $455 | $112 | $104 | $216 |
| "3/0" | $410 | $150 | $560 | $138 | $114 | $252 |
| "4/0" | $515 | $171 | $686 | $154 | $121 | $275 |
| 250KCMIL | $610 | $188 | $798 | $188 | $130 | $318 |
| 300KCMIL | $725 | $198 | $923 | $259 | $139 | $398 |
| 350KCMIL | $850 | $209 | $1,059 | $264 | $150 | $414 |
| 400KCMIL | $970 | $221 | $1,191 | $310 | $163 | $473 |
| 500KCMIL | $1,175 | $235 | $1,410 | $340 | $188 | $528 |

| | CONDUIT PRICING | | |
|---|---|---|---|
| INCHES | MATL | LABOR | TOTAL |
| | | | |
| 0.75 | $1.05 | $2.31 | $3.36 |
| 1 | $1.84 | $2.62 | $4.46 |
| 1.25 | $2.81 | $2.98 | $5.79 |
| 1.5 | $3.78 | $3.34 | $7.12 |
| 2 | $4.88 | $3.76 | $8.64 |
| 2.5 | $11.70 | $5.00 | $16.70 |
| 3 | $13.75 | $6.00 | $19.75 |
| 3.5 | $17.40 | $6.70 | $24.10 |

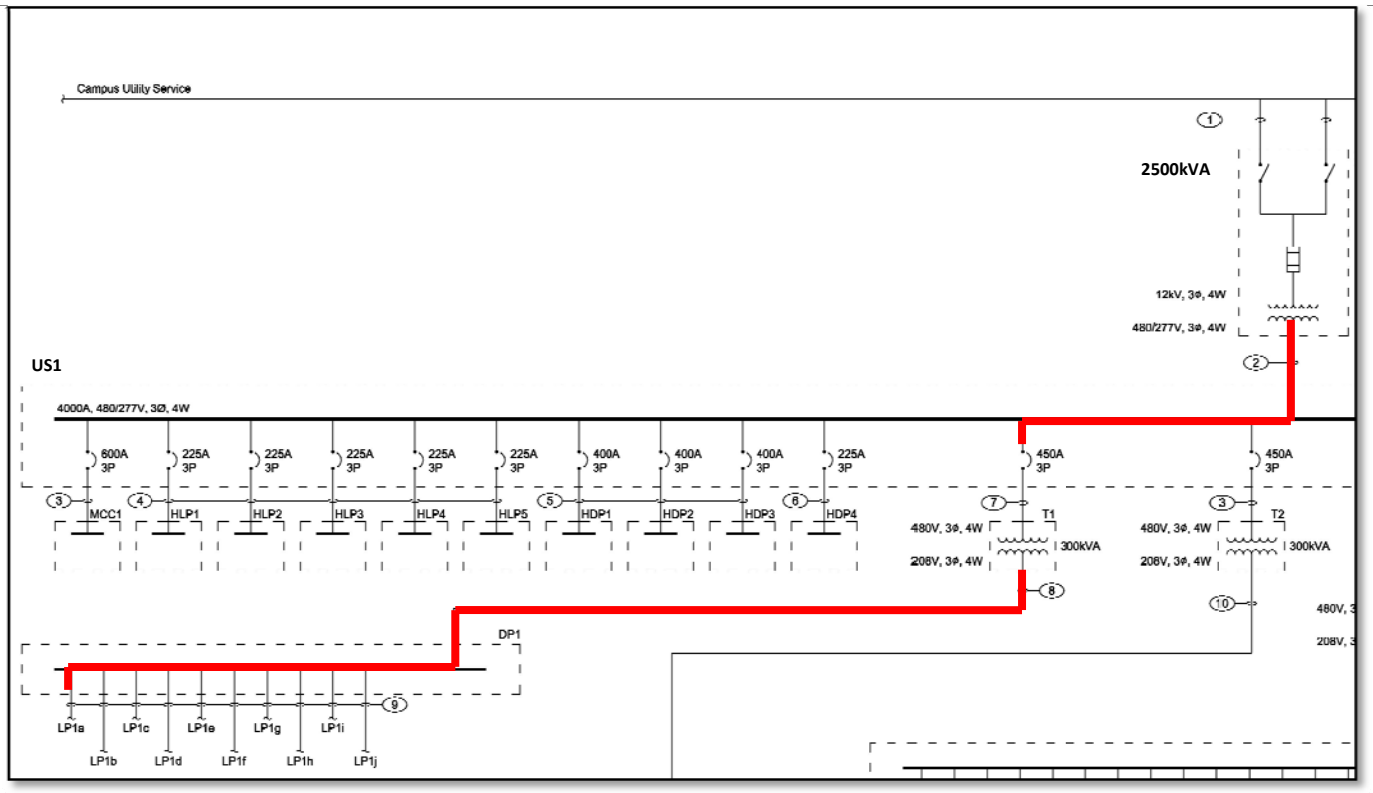
## Conclusions / Recommendation

A total cost estimate of the existing system which uses copper feeders has been found to be $1,124,472. This is in comparison to approximately $588,900 for an all aluminum feeder system. The significant difference in these two figures is most likely a result of several long runs of feeders throughout the building which serve to amplify the price difference between the two wire types. An installation cost savings of $555,572 (approximately 48%) applies to the aluminum system.

Although this is a very significant savings, the higher maintenance cost of aluminum systems was not included in this analysis and would reduce this difference somewhat. The recommended course of action in this case would depend somewhat on the budget of the project. However, based on the potential for a 48% savings in this particular case, very serious consideration of using aluminum feeders is recommended.

# SHORT CIRCUIT ANALYSIS

## Short Circuit Analysis Path




## Analysis Summary

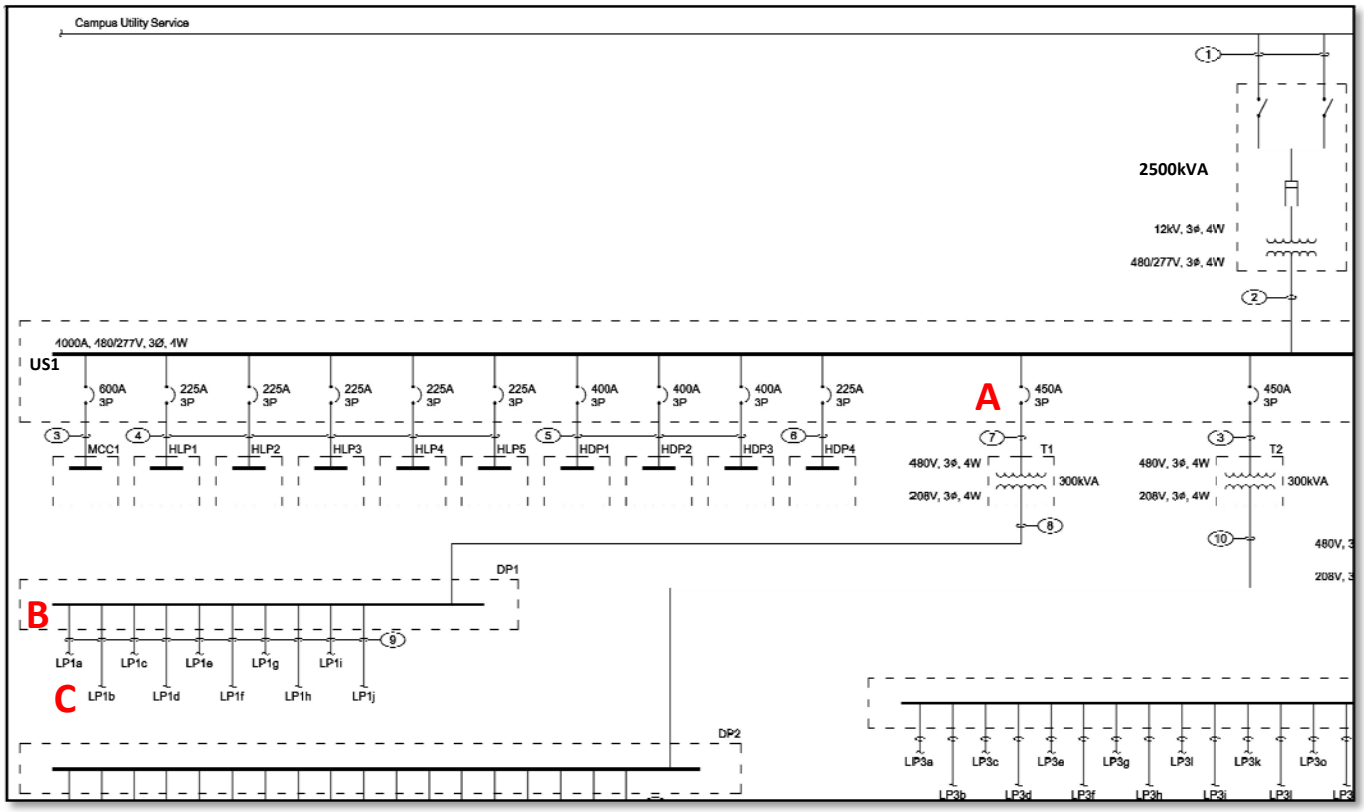
| LOCATION | FAULT CURRENT | STANDARD BREAKER RATING |
|---|---|---|
| **UTILITY XFMR SECONDARY** | 52,303 A | 65,000A |
| **SWITCHBOARD US1** | 48,680 A | 50,000 A |
| **PANEL DP1** | 12,415 A | 14,000 A |
| **PANEL LP1a** | 5,309 A | 14,000 A |

**Analysis Details**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **UTILITY XFMR SECONDARY** | | | | | | | |
| **Base kVA (Assumed)** | 10000 | | | | | | |
| **Avail. Utility Fault (kVA)** | 1000000 | | | | | | |
| **System Voltage (kV)** | 0.48 | | | | | | |
| | | | | | | | |
| **Utility Transformer (kVA)** | 2500.00 | **X (p.u.)** | 0.010000 | (Base kVA / Utility S.C. kVA) | | | |
| | | | | | | | |
| **Average % Z** | 5.50 | **X (p.u.)** | 0.219240 | (%X * Base kVA) / (100 *XFMR kVA) | | | |
| **Average X/R** | 12.00 | **R (p.u.)** | 0.018270 | (%R * Base KVA) / (100 *XFMR kVA) | | | |
| **R (%)** | 0.4568 | | | | | | |
| **X (%)** | 5.4810 | **ΣX(p.u.)** | 0.229240 | | | | |
| | | **ΣR(p.u.)** | 0.018270 | | | | |
| | | **ΣZ(p.u.)** | 0.229967 | $\sqrt{(\Sigma X(p.u.))^2+(\Sigma R(p.u.))^2}$ | | | |
| **SHORT CIRCUIT CURRENT (A)** | **52303.73** | | | | | | |
| **US1** | | | | | | | |
| **Number of Sets** | 11 | **X(p.u.)** | 0.016189 | | | | |
| **Length (Ft)** | 110.00 | **R(p.u.)** | 0.010286 | | | | |
| **Wire Size** | 500KCMIL | | | | | | |
| **(TABLE 7) $X_L$** | 0.03730000 | | | | | | |
| **(TABLE 7) R** | 0.02370000 | **ΣX(p.u.)** | 0.245429 | | | | |
| **X** | 0.00037300 | **ΣR(p.u.)** | 0.028556 | | | | |
| **R** | 0.00023700 | **ΣZ(p.u.)** | 0.247085 | $\sqrt{(\Sigma X(p.u.))^2+(\Sigma R(p.u.))^2}$ | | | |
| **SHORT CIRCUIT CURRENT (A)** | **48680.13** | | | | | | |
| **DP1** | | | | | | | |
| **Number of Sets** | 3 | **X(p.u.)** | 0.383691 | | | | |
| **Length (Ft)** | 120.00 | **R(p.u.)** | 0.708210 | | | | |
| **Wire Size** | 350KCMIL | | | | | | |
| **(TABLE 7) $X_L$** | 0.04150000 | | | | | | |
| **(TABLE 7) R** | 0.07660000 | **ΣX(p.u.)** | 0.629120 | | | | |
| **X** | 0.00166000 | **ΣR(p.u.)** | 0.736767 | | | | |
| **R** | 0.00306400 | **ΣZ(p.u.)** | 0.968823 | $\sqrt{(\Sigma X(p.u.))^2+(\Sigma R(p.u.))^2}$ | | | |
| **SHORT CIRCUIT CURRENT (A)** | **12415.21** | | | | | | |
| **LP1a** | | | | | | | |
| **Number of Sets** | 1 | **X(p.u.)** | 0.623498 | | | | |
| **Length (Ft)** | 65.00 | **R(p.u.)** | 1.150841 | | | | |
| **Wire Size** | 4/0 | | | | | | |
| **(TABLE 7) $X_L$** | 0.04150000 | | | | | | |
| **(TABLE 7) R** | 0.07660000 | **ΣX(p.u.)** | 1.252618 | | | | |
| **X** | 0.00269750 | **ΣR(p.u.)** | 1.887608 | | | | |
| **R** | 0.00497900 | **ΣZ(p.u.)** | 2.265417 | $\sqrt{(\Sigma X(p.u.))^2+(\Sigma R(p.u.))^2}$ | | | |
| **SHORT CIRCUIT CURRENT (A)** | **5309.46** | | | | | | |

# OVERCURRENT PROTECTION DEVICE COORDINATION STUDY

## Overcurrent Protection Devices




**A** – 450A 3P Circuit Breaker at US1

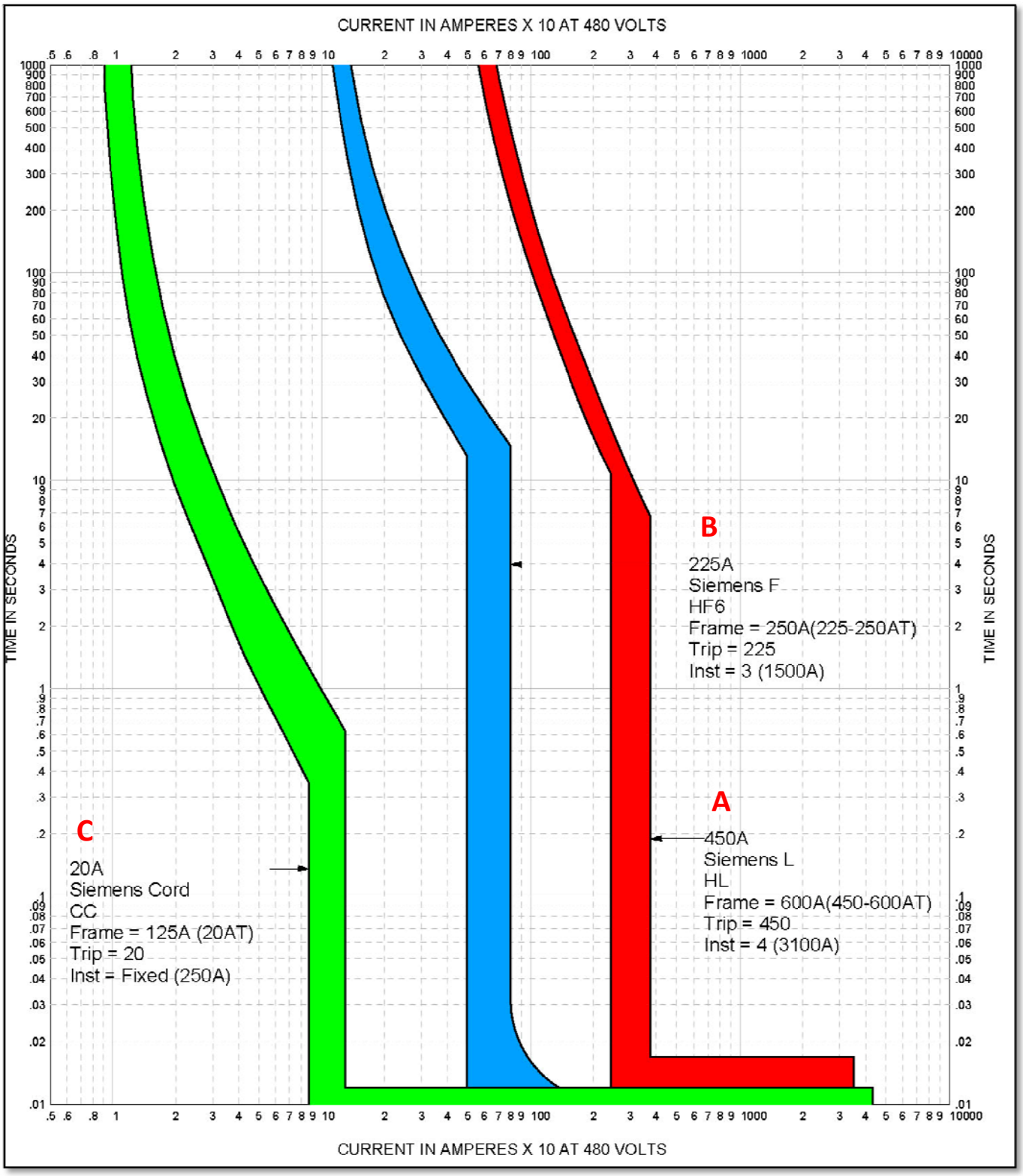
**B** – 225A 3P Molded Case Circuit Breaker at DP1

**C** – 20A 1P Molded Case Circuit Breaker at LP1a

## Coordination Study Results

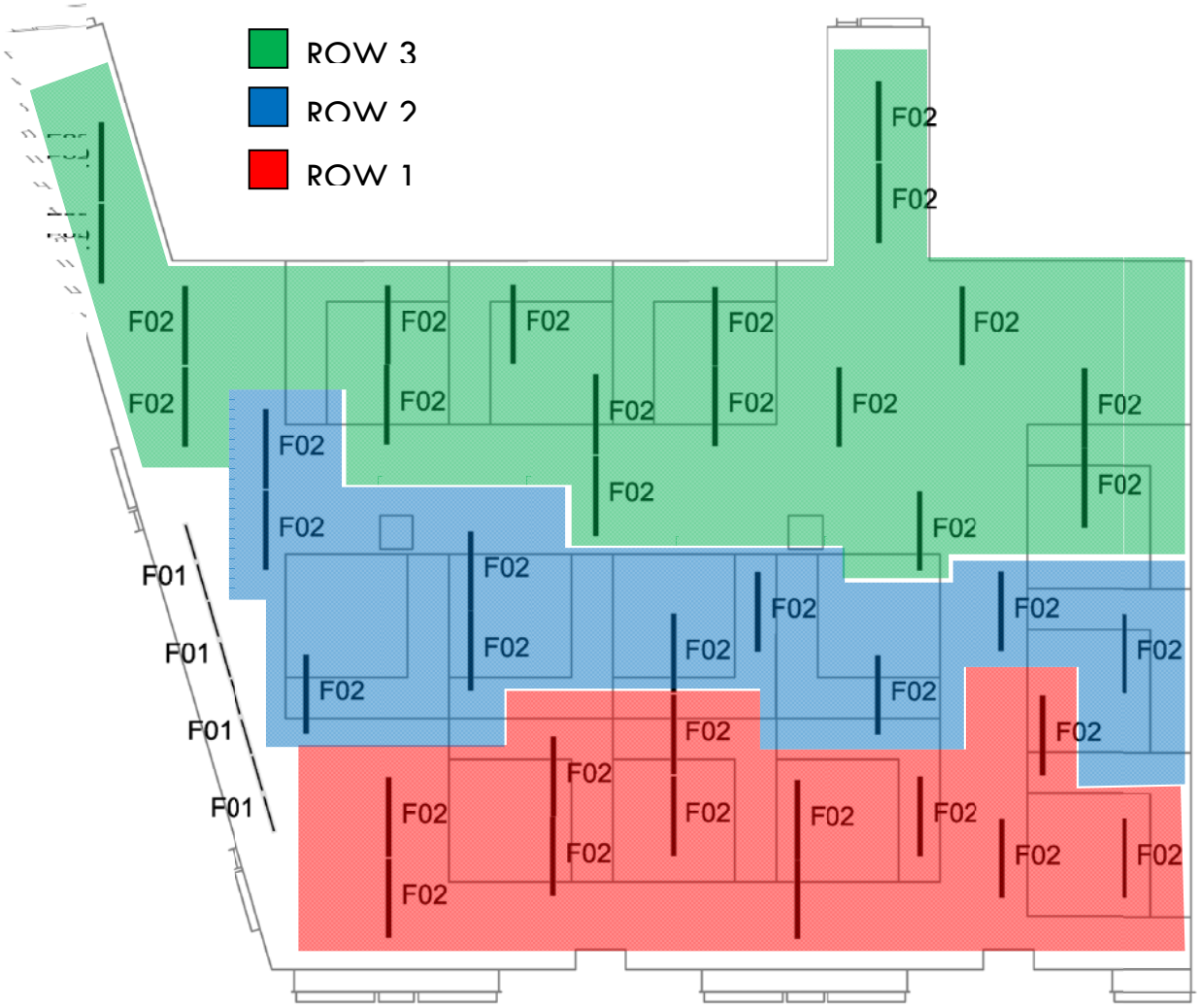
As can be seen from the following figure, there is limited overlap between the three selected circuit breakers, and they appear to be properly coordinated with the protection device closes to the possible fault being the first to trip. All circuit breakers have been assumed to be Siemens molded-case style for this study.

**Time-Current Curves**



## MAE DEPTH – DAYLIGHTING STUDY

To complete the MAE additional depth requirement for thesis, a daylighting analysis for the third floor open office space has been performed. Three northern windows provide diffuse natural light into the space throughout the year. The purpose of the following study is to propose an effective photosensor dimming system for the open office with the goal of providing long-term economic benefits. Once an appropriate system has been determined, the annual energy saved can then be estimated based on the lighting power use in the space.




Office Lighting Plan

**Critical Point Analysis**

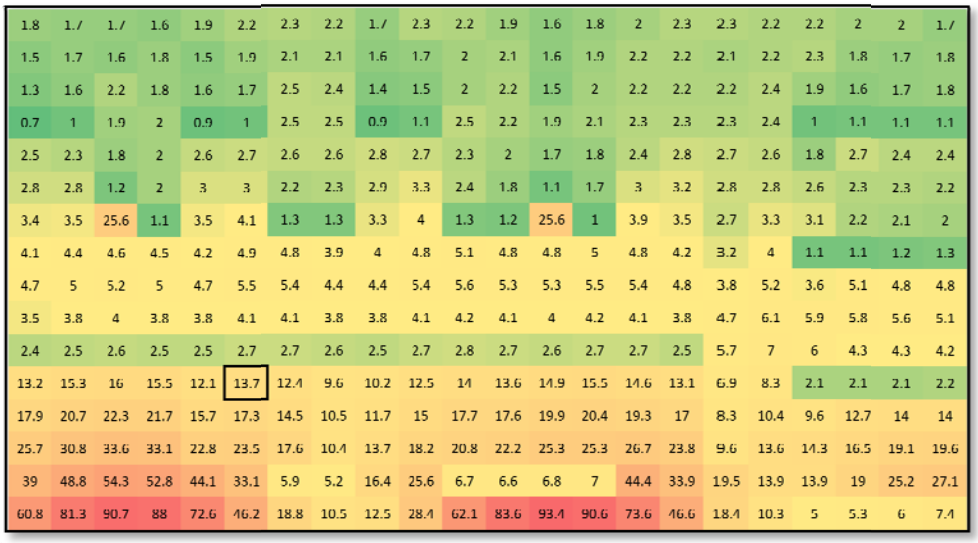
AGI32 lighting software was used to study several daylight scenarios for the building. The worst-case scenario (the time of year when the least natural daylight is available on the workplane) was determined to be the winter solstice, December 21. Due to the north-facing orientation of the windows, low-angle winter sun rays are unable to enter the space directly. A rough solar study of the northern wall is also performed within the photovoltaic electrical depth analysis for this report.

Using December 21 as a date inputting the longitude and latitude of Irvine, California to simulate the project's location, a calculation with sunny and overcast sky conditions was performed and recorded. In addition to natural light, the artificial lighting system within the office has been divided into three distinctly controllable zones—one near the windows, one toward the opposite wall, and one in between with row one being nearest the windows. Through the coordinated dimming of the ceiling recessed fixtures in the space, a fairly uniform light condition should be attainable in the office without the distraction of the luminaires being switched on and off as the light varies throughout the day.

Each combination of active rows has been calculated with no added natural light. The AGI calculation output was then imported into Microsoft Excel for comparison. Based on this data, an appropriate photosensor location has been chosen for the space and is shown here outlined in black.

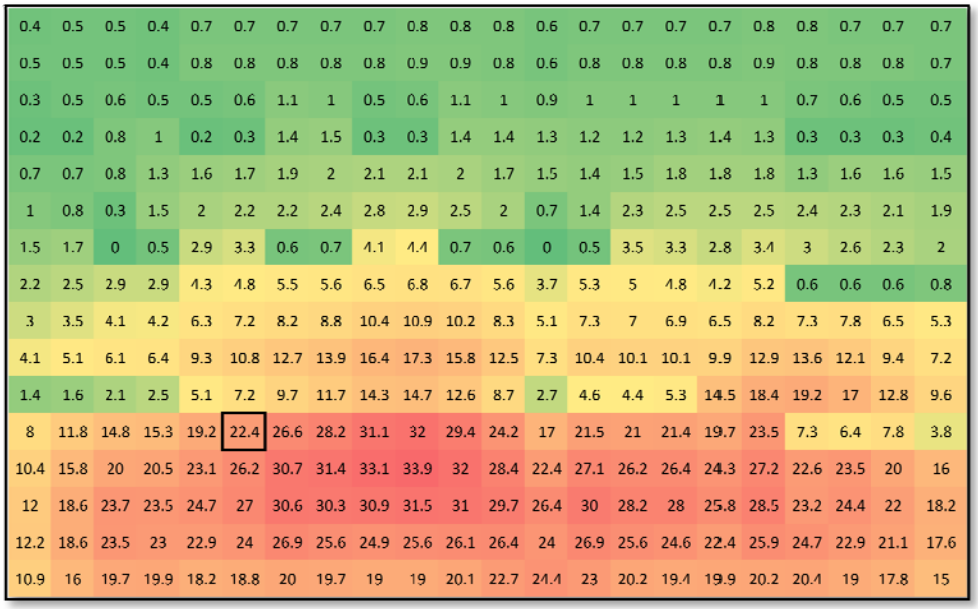
| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.1 | 5.2 | 5.2 | 5.1 | 5.5 | 6.3 | 6.7 | 6.4 | 5.3 | 6.5 | 6.6 | 6.2 | 5.1 | 5.3 | 5.9 | 6.9 | 6.8 | 6.8 | 6.6 | 6.3 | 6.2 | 5.6 |
| 4.7 | 5.2 | 5.5 | 5.3 | 5 | 6.2 | 6.8 | 6.7 | 5.1 | 5.9 | 6.5 | 6.6 | 5 | 5.8 | 6.5 | 7 | 6.8 | 6.7 | 6.4 | 5.7 | 5.6 | 5.4 |
| 4 | 5.2 | 6.1 | 5.5 | 4.7 | 5.5 | 7.7 | 7.4 | 4.7 | 5.2 | 6.5 | 6.6 | 5 | 6.2 | 6.7 | 6.7 | 6.7 | 6.9 | 6.1 | 5.2 | 5.2 | 5.2 |
| 2.5 | 3.3 | 6.1 | 6.4 | 2.9 | 3.5 | 8.1 | 8 | 3 | 3.6 | 7.5 | 7 | 6.1 | 6.4 | 6.8 | 7.1 | 7.2 | 7.2 | 3.4 | 3.7 | 3.6 | 3.6 |
| 7.1 | 6.7 | 5.8 | 6.5 | 8 | 8.4 | 8 | 8.2 | 8.4 | 8.2 | 7.3 | 6.6 | 5.7 | 6 | 7.2 | 8.1 | 8.1 | 7.8 | 5.5 | 7.7 | 7.4 | 7.4 |
| 8.2 | 7.7 | 4 | 6.5 | 9 | 9.1 | 7.6 | 7.7 | 9.1 | 9.8 | 7.7 | 6.1 | 4.1 | 5.7 | 8.7 | 9.3 | 8.6 | 8.4 | 7.9 | 7.5 | 7.2 | 7.1 |
| 9.6 | 9.7 | 10.9 | 3.9 | 10.2 | 11.6 | 4.7 | 4.7 | 10.1 | 11.5 | 4.7 | 4.2 | 10.9 | 3.4 | 10.7 | 10.1 | 8.3 | 9.4 | 9 | 7.1 | 6.9 | 6.8 |
| 10.9 | 11.7 | 12.3 | 11.9 | 11.7 | 13.4 | 13.3 | 11.4 | 11.5 | 13.3 | 14.1 | 13.3 | 12.9 | 13.5 | 13 | 11.8 | 9.5 | 11.2 | 3.8 | 3.9 | 4 | 4.5 |
| 12.1 | 13.1 | 13.5 | 12.8 | 13 | 14.6 | 14.7 | 12.7 | 12.5 | 14.7 | 15.1 | 14.4 | 13.9 | 14.5 | 14.5 | 13.1 | 11.1 | 13.8 | 10.1 | 13.8 | 13.5 | 12.9 |
| 11.2 | 12.2 | 13.1 | 12.4 | 12.5 | 13.6 | 13.6 | 12.6 | 12.4 | 13.9 | 14 | 13.7 | 13.2 | 13.9 | 13.7 | 12.6 | 13.2 | 16.1 | 15.7 | 15.7 | 14.7 | 13.9 |
| 7.2 | 7.9 | 8.4 | 8 | 8.2 | 8.9 | 8.9 | 8.5 | 8.4 | 9.1 | 9.2 | 9 | 8.6 | 9 | 8.8 | 8.2 | 15.6 | 18.4 | 17.3 | 14.1 | 13.7 | 13.2 |
| 28.5 | 32.4 | 33.4 | 32.2 | 27.4 | 30.9 | 29.4 | 25.2 | 25.1 | 29.2 | 31.3 | 29.9 | 31 | 32.6 | 32 | 29.5 | 18.4 | 21.5 | 6.9 | 6.9 | 6.9 | 7.1 |
| 34.7 | 39 | 41.4 | 40.2 | 31.6 | 35.6 | 33 | 27 | 27.3 | 32.3 | 35.2 | 34.5 | 36.1 | 38 | 37.5 | 34.8 | 21.3 | 25.3 | 21.9 | 28.2 | 29.9 | 29 |
| 44.5 | 50.8 | 54.3 | 53.6 | 39.5 | 43.9 | 37.5 | 26.9 | 30 | 35.5 | 37.8 | 38.3 | 40.5 | 41.8 | 45.6 | 44.1 | 23.2 | 31.5 | 31.7 | 33.5 | 35.4 | 34.6 |
| 56.6 | 66.8 | 72.4 | 71.6 | 62.9 | 53.3 | 19.2 | 16.4 | 34.8 | 44.9 | 22.4 | 22 | 21.9 | 23.2 | 64.2 | 54.5 | 38.7 | 33.5 | 31.6 | 34.7 | 39 | 40.3 |
| 70.6 | 88.8 | 98.5 | 97.7 | 85.6 | 64.2 | 41.1 | 29.4 | 29.8 | 44.8 | 72.5 | 92 | 103 | 102 | 87.2 | 64.9 | 40.1 | 29 | 15.3 | 16.1 | 17.5 | 19.7 |

Clear Sky



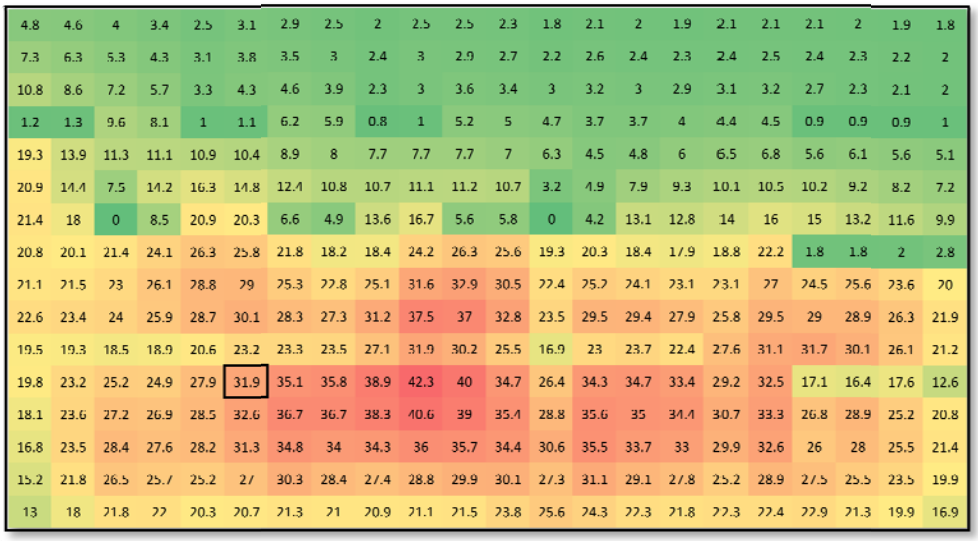
| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.8 | 1.7 | 1.7 | 1.6 | 1.9 | 2.2 | 2.3 | 2.2 | 1.7 | 2.3 | 2.2 | 1.9 | 1.6 | 1.8 | 2 | 2.3 | 2.3 | 2.2 | 2.2 | 2 | 2 | 1.7 |
| 1.5 | 1.7 | 1.6 | 1.8 | 1.5 | 1.9 | 2.1 | 2.1 | 1.6 | 1.7 | 2 | 2.1 | 1.6 | 1.9 | 2.2 | 2.2 | 2.1 | 2.2 | 2.3 | 1.8 | 1.7 | 1.8 |
| 1.3 | 1.6 | 2.2 | 1.8 | 1.6 | 1.7 | 2.5 | 2.4 | 1.4 | 1.5 | 2 | 2.2 | 1.5 | 2 | 2.2 | 2.2 | 2.2 | 2.4 | 1.9 | 1.6 | 1.7 | 1.8 |
| 0.7 | 1 | 1.9 | 2 | 0.9 | 1 | 2.5 | 2.5 | 0.9 | 1.1 | 2.5 | 2.2 | 1.9 | 2.1 | 2.3 | 2.3 | 2.3 | 2.4 | 1 | 1.1 | 1.1 | 1.1 |
| 2.5 | 2.3 | 1.8 | 2 | 2.6 | 2.7 | 2.6 | 2.6 | 2.8 | 2.7 | 2.3 | 2 | 1.7 | 1.8 | 2.4 | 2.8 | 2.7 | 2.6 | 1.8 | 2.7 | 2.4 | 2.4 |
| 2.8 | 2.8 | 1.2 | 2 | 3 | 3 | 2.2 | 2.3 | 2.9 | 3.3 | 2.4 | 1.8 | 1.1 | 1.7 | 3 | 3.2 | 2.8 | 2.8 | 2.6 | 2.3 | 2.3 | 2.2 |
| 3.4 | 3.5 | 25.6 | 1.1 | 3.5 | 4.1 | 1.3 | 1.3 | 3.3 | 4 | 1.3 | 1.2 | 25.6 | 1 | 3.9 | 3.5 | 2.7 | 3.3 | 3.1 | 2.2 | 2.1 | 2 |
| 4.1 | 4.4 | 4.6 | 4.5 | 4.2 | 4.9 | 4.8 | 3.9 | 4 | 4.8 | 5.1 | 4.8 | 4.8 | 5 | 4.8 | 4.2 | 3.2 | 4 | 1.1 | 1.1 | 1.2 | 1.3 |
| 4.7 | 5 | 5.2 | 5 | 4.7 | 5.5 | 5.4 | 4.4 | 4.4 | 5.4 | 5.6 | 5.3 | 5.3 | 5.5 | 5.4 | 4.8 | 3.8 | 5.2 | 3.6 | 5.1 | 4.8 | 4.8 |
| 3.5 | 3.8 | 4 | 3.8 | 3.8 | 4.1 | 4.1 | 3.8 | 3.8 | 4.1 | 4.2 | 4.1 | 4 | 4.2 | 4.1 | 3.8 | 4.7 | 6.1 | 5.9 | 5.8 | 5.6 | 5.1 |
| 2.4 | 2.5 | 2.6 | 2.5 | 2.5 | 2.7 | 2.7 | 2.6 | 2.5 | 2.7 | 2.8 | 2.7 | 2.6 | 2.7 | 2.7 | 2.5 | 5.7 | 7 | 6 | 4.3 | 4.3 | 4.2 |
| 13.2 | 15.3 | 16 | 15.5 | 12.1 | 13.7 | 12.4 | 9.6 | 10.2 | 12.5 | 14 | 13.6 | 14.9 | 15.5 | 14.6 | 13.1 | 6.9 | 8.3 | 2.1 | 2.1 | 2.1 | 2.2 |
| 17.9 | 20.7 | 22.3 | 21.7 | 15.7 | 17.3 | 14.5 | 10.5 | 11.7 | 15 | 17.7 | 17.6 | 19.9 | 20.4 | 19.3 | 17 | 8.3 | 10.4 | 9.6 | 12.7 | 14 | 14 |
| 25.7 | 30.8 | 33.6 | 33.1 | 22.8 | 23.5 | 17.6 | 10.4 | 13.7 | 18.2 | 20.8 | 22.2 | 25.3 | 25.3 | 26.7 | 23.8 | 9.6 | 13.6 | 14.3 | 16.5 | 19.1 | 19.6 |
| 39 | 48.8 | 54.3 | 52.8 | 44.1 | 33.1 | 5.9 | 5.2 | 16.4 | 25.6 | 6.7 | 6.6 | 6.8 | 7 | 44.4 | 33.9 | 19.5 | 13.9 | 13.9 | 19 | 25.2 | 27.1 |
| 60.8 | 81.3 | 90.7 | 88 | 72.6 | 46.2 | 18.8 | 10.5 | 12.5 | 28.4 | 62.1 | 83.6 | 93.4 | 90.6 | 73.6 | 46.6 | 18.4 | 10.3 | 5 | 5.3 | 6 | 7.4 |

Overcast



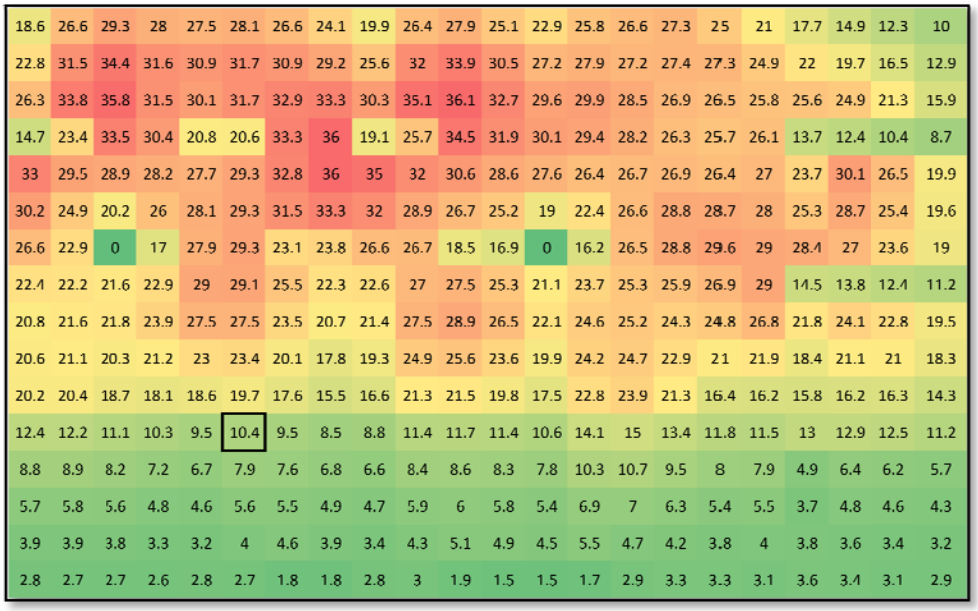
| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.4 | 0.5 | 0.5 | 0.4 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 |
| 0.5 | 0.5 | 0.5 | 0.4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.8 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.8 | 0.8 | 0.8 | 0.7 |
| 0.3 | 0.5 | 0.6 | 0.5 | 0.5 | 0.6 | 1.1 | 1 | 0.5 | 0.6 | 1.1 | 1 | 0.9 | 1 | 1 | 1 | 1 | 1 | 0.7 | 0.6 | 0.5 | 0.5 |
| 0.2 | 0.2 | 0.8 | 1 | 0.2 | 0.3 | 1.4 | 1.5 | 0.3 | 0.3 | 1.4 | 1.4 | 1.3 | 1.2 | 1.2 | 1.3 | 1.4 | 1.3 | 0.3 | 0.3 | 0.3 | 0.4 |
| 0.7 | 0.7 | 0.8 | 1.3 | 1.6 | 1.7 | 1.9 | 2 | 2.1 | 2.1 | 2 | 1.7 | 1.5 | 1.4 | 1.5 | 1.8 | 1.8 | 1.8 | 1.3 | 1.6 | 1.6 | 1.5 |
| 1 | 0.8 | 0.3 | 1.5 | 2 | 2.2 | 2.2 | 2.4 | 2.8 | 2.9 | 2.5 | 2 | 0.7 | 1.4 | 2.3 | 2.5 | 2.5 | 2.5 | 2.4 | 2.3 | 2.1 | 1.9 |
| 1.5 | 1.7 | 0 | 0.5 | 2.9 | 3.3 | 0.6 | 0.7 | 4.1 | 4.4 | 0.7 | 0.6 | 0 | 0.5 | 3.5 | 3.3 | 2.8 | 3.4 | 3 | 2.6 | 2.3 | 2 |
| 2.2 | 2.5 | 2.9 | 2.9 | 4.3 | 4.8 | 5.5 | 5.6 | 6.5 | 6.8 | 6.7 | 5.6 | 3.7 | 5.3 | 5 | 4.8 | 4.2 | 5.2 | 0.6 | 0.6 | 0.6 | 0.8 |
| 3 | 3.5 | 4.1 | 4.2 | 6.3 | 7.2 | 8.2 | 8.8 | 10.4 | 10.9 | 10.2 | 8.3 | 5.1 | 7.3 | 7 | 6.9 | 6.5 | 8.2 | 7.3 | 7.8 | 6.5 | 5.3 |
| 4.1 | 5.1 | 6.1 | 6.4 | 9.3 | 10.8 | 12.7 | 13.9 | 16.4 | 17.3 | 15.8 | 12.5 | 7.3 | 10.4 | 10.1 | 10.1 | 9.9 | 12.9 | 13.6 | 12.1 | 9.4 | 7.2 |
| 1.4 | 1.6 | 2.1 | 2.5 | 5.1 | 7.2 | 9.7 | 11.7 | 14.3 | 14.7 | 12.6 | 8.7 | 2.7 | 4.6 | 4.4 | 5.3 | 14.5 | 18.4 | 19.2 | 17 | 12.8 | 9.6 |
| 8 | 11.8 | 14.8 | 15.3 | 19.2 | 22.4 | 26.6 | 28.2 | 31.1 | 32 | 29.4 | 24.2 | 17 | 21.5 | 21 | 21.4 | 19.7 | 23.5 | 7.3 | 6.4 | 7.8 | 3.8 |
| 10.4 | 15.8 | 20 | 20.5 | 23.1 | 26.2 | 30.7 | 31.4 | 33.1 | 33.9 | 32 | 28.4 | 22.4 | 27.1 | 26.2 | 26.4 | 24.3 | 27.2 | 22.6 | 23.5 | 20 | 16 |
| 12 | 18.6 | 23.7 | 23.5 | 24.7 | 27 | 30.6 | 30.3 | 30.9 | 31.5 | 31 | 29.7 | 26.4 | 30 | 28.2 | 28 | 25.8 | 28.5 | 23.2 | 24.4 | 22 | 18.2 |
| 12.2 | 18.6 | 23.5 | 23 | 22.9 | 24 | 26.9 | 25.6 | 24.9 | 25.6 | 26.1 | 26.4 | 24 | 26.9 | 25.6 | 24.6 | 22.4 | 25.9 | 24.7 | 22.9 | 21.1 | 17.6 |
| 10.9 | 16 | 19.7 | 19.9 | 18.2 | 18.8 | 20 | 19.7 | 19 | 19 | 20.1 | 22.7 | 24.4 | 23 | 20.2 | 19.4 | 19.9 | 20.2 | 20.4 | 19 | 17.8 | 15 |

Row One Active



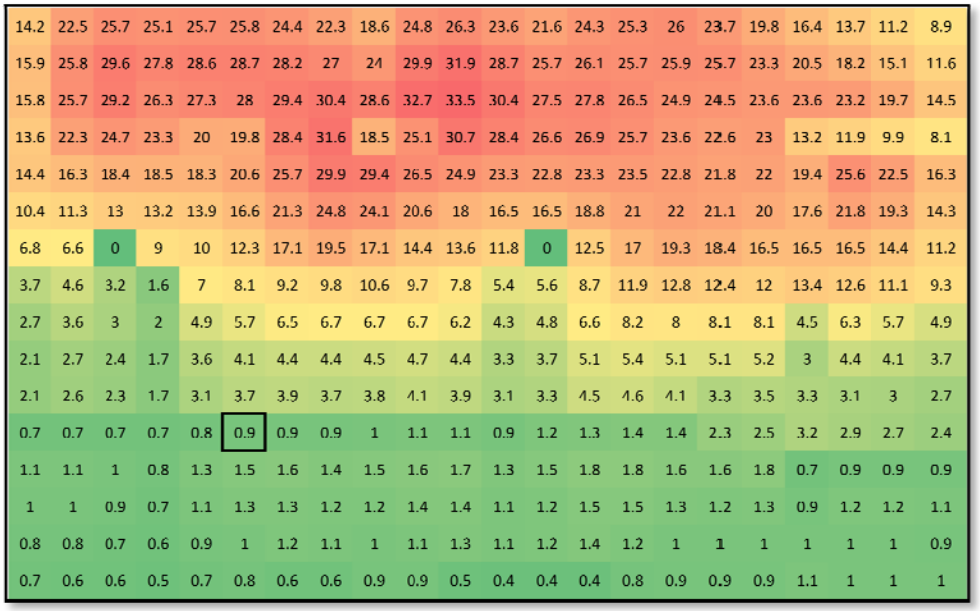
| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.8 | 4.6 | 4 | 3.4 | 2.5 | 3.1 | 2.9 | 2.5 | 2 | 2.5 | 2.5 | 2.3 | 1.8 | 2.1 | 2 | 1.9 | 2.1 | 2.1 | 2.1 | 2 | 1.9 | 1.8 |
| 7.3 | 6.3 | 5.3 | 4.3 | 3.1 | 3.8 | 3.5 | 3 | 2.4 | 3 | 2.9 | 2.7 | 2.2 | 2.6 | 2.4 | 2.3 | 2.4 | 2.5 | 2.4 | 2.3 | 2.2 | 2 |
| 10.8 | 8.6 | 7.2 | 5.7 | 3.3 | 4.3 | 4.6 | 3.9 | 2.3 | 3 | 3.6 | 3.4 | 3 | 3.2 | 3 | 2.9 | 3.1 | 3.2 | 2.7 | 2.3 | 2.1 | 2 |
| 1.2 | 1.3 | 9.6 | 8.1 | 1 | 1.1 | 6.2 | 5.9 | 0.8 | 1 | 5.2 | 5 | 4.7 | 3.7 | 3.7 | 4 | 4.4 | 4.5 | 0.9 | 0.9 | 0.9 | 1 |
| 19.3 | 13.9 | 11.3 | 11.1 | 10.9 | 10.4 | 8.9 | 8 | 7.7 | 7.7 | 7.7 | 7 | 6.3 | 4.5 | 4.8 | 6 | 6.5 | 6.8 | 5.6 | 6.1 | 5.6 | 5.1 |
| 20.9 | 14.4 | 7.5 | 14.2 | 16.3 | 14.8 | 12.4 | 10.8 | 10.7 | 11.1 | 11.2 | 10.7 | 3.2 | 4.9 | 7.9 | 9.3 | 10.1 | 10.5 | 10.2 | 9.2 | 8.2 | 7.2 |
| 21.4 | 18 | 0 | 8.5 | 20.9 | 20.3 | 6.6 | 4.9 | 13.6 | 16.7 | 5.6 | 5.8 | 0 | 4.2 | 13.1 | 12.8 | 14 | 16 | 15 | 13.2 | 11.6 | 9.9 |
| 20.8 | 20.1 | 21.4 | 24.1 | 26.3 | 25.8 | 21.8 | 18.2 | 18.4 | 24.2 | 26.3 | 25.6 | 19.3 | 20.3 | 18.4 | 17.9 | 18.8 | 22.2 | 1.8 | 1.8 | 2 | 2.8 |
| 21.1 | 21.5 | 23 | 26.1 | 28.8 | 29 | 25.3 | 22.8 | 25.1 | 31.6 | 32.9 | 30.5 | 22.4 | 25.2 | 24.1 | 23.1 | 23.1 | 27 | 24.5 | 25.6 | 23.6 | 20 |
| 22.6 | 23.4 | 24 | 25.9 | 28.7 | 30.1 | 28.3 | 27.3 | 31.2 | 37.5 | 37 | 32.8 | 23.5 | 29.5 | 29.4 | 27.9 | 25.8 | 29.5 | 29 | 28.9 | 26.3 | 21.9 |
| 19.5 | 19.3 | 18.5 | 18.9 | 20.6 | 23.2 | 23.3 | 23.5 | 27.1 | 31.9 | 30.2 | 25.5 | 16.9 | 23 | 23.7 | 22.4 | 27.6 | 31.1 | 31.7 | 30.1 | 26.1 | 21.2 |
| 19.8 | 23.2 | 25.2 | 24.9 | 27.9 | 31.9 | 35.1 | 35.8 | 38.9 | 42.3 | 40 | 34.7 | 26.4 | 34.3 | 34.7 | 33.4 | 29.2 | 32.5 | 17.1 | 16.4 | 17.6 | 12.6 |
| 18.1 | 23.6 | 27.2 | 26.9 | 28.5 | 32.6 | 36.7 | 36.7 | 38.3 | 40.6 | 39 | 35.4 | 28.8 | 35.6 | 35 | 34.4 | 30.7 | 33.3 | 26.8 | 28.9 | 25.2 | 20.8 |
| 16.8 | 23.5 | 28.4 | 27.6 | 28.2 | 31.3 | 34.8 | 34 | 34.3 | 36 | 35.7 | 34.4 | 30.6 | 35.5 | 33.7 | 33 | 29.9 | 32.6 | 26 | 28 | 25.5 | 21.4 |
| 15.2 | 21.8 | 26.5 | 25.7 | 25.2 | 27 | 30.3 | 28.4 | 27.4 | 28.8 | 29.9 | 30.1 | 27.3 | 31.1 | 29.1 | 27.8 | 25.2 | 28.9 | 27.5 | 25.5 | 23.5 | 19.9 |
| 13 | 18 | 21.8 | 22 | 20.3 | 20.7 | 21.3 | 21 | 20.9 | 21.1 | 21.5 | 23.8 | 25.6 | 24.3 | 22.3 | 21.8 | 22.3 | 22.4 | 22.9 | 21.3 | 19.9 | 16.9 |

Rows One and Two Active



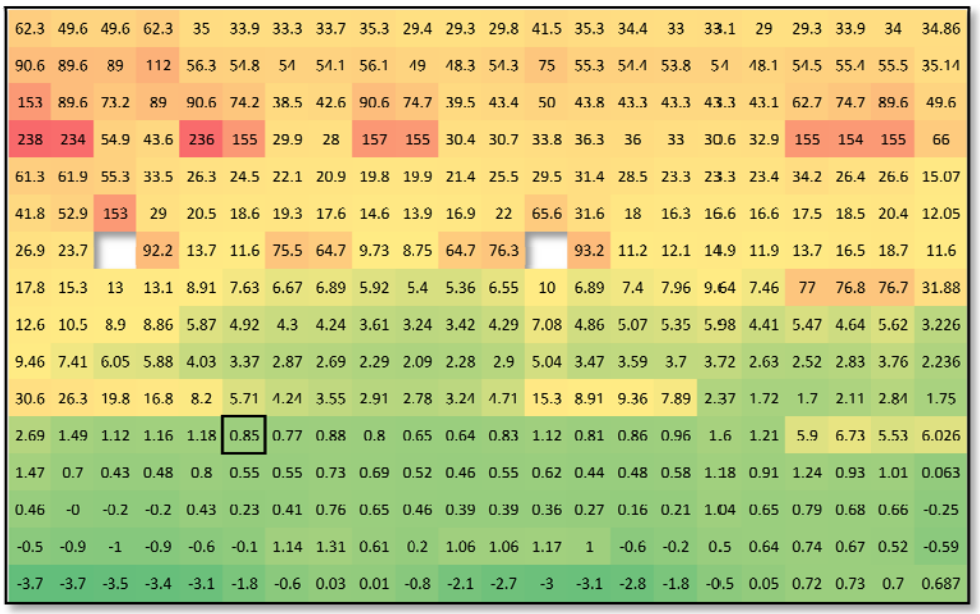
| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18.6 | 26.6 | 29.3 | 28 | 27.5 | 28.1 | 26.6 | 24.1 | 19.9 | 26.4 | 27.9 | 25.1 | 22.9 | 25.8 | 26.6 | 27.3 | 25 | 21 | 17.7 | 14.9 | 12.3 | 10 |
| 22.8 | 31.5 | 34.4 | 31.6 | 30.9 | 31.7 | 30.9 | 29.2 | 25.6 | 32 | 33.9 | 30.5 | 27.2 | 27.9 | 27.2 | 27.4 | 27.3 | 24.9 | 22 | 19.7 | 16.5 | 12.9 |
| 26.3 | 33.8 | 35.8 | 31.5 | 30.1 | 31.7 | 32.9 | 33.3 | 30.3 | 35.1 | 36.1 | 32.7 | 29.6 | 29.9 | 28.5 | 26.9 | 26.5 | 25.8 | 25.6 | 24.9 | 21.3 | 15.9 |
| 14.7 | 23.4 | 33.5 | 30.4 | 20.8 | 20.6 | 33.3 | 36 | 19.1 | 25.7 | 34.5 | 31.9 | 30.1 | 29.4 | 28.2 | 26.3 | 25.7 | 26.1 | 13.7 | 12.4 | 10.4 | 8.7 |
| 33 | 29.5 | 28.9 | 28.2 | 27.7 | 29.3 | 32.8 | 36 | 35 | 32 | 30.6 | 28.6 | 27.6 | 26.4 | 26.7 | 26.9 | 26.4 | 27 | 23.7 | 30.1 | 26.5 | 19.9 |
| 30.2 | 24.9 | 20.2 | 26 | 28.1 | 29.3 | 31.5 | 33.3 | 32 | 28.9 | 26.7 | 25.2 | 19 | 22.4 | 26.6 | 28.8 | 28.7 | 28 | 25.3 | 28.7 | 25.4 | 19.6 |
| 26.6 | 22.9 | 0 | 17 | 27.9 | 29.3 | 23.1 | 23.8 | 26.6 | 26.7 | 18.5 | 16.9 | 0 | 16.2 | 26.5 | 28.8 | 29.6 | 29 | 28.4 | 27 | 23.6 | 19 |
| 22.4 | 22.2 | 21.6 | 22.9 | 29 | 29.1 | 25.5 | 22.3 | 22.6 | 27 | 27.5 | 25.3 | 21.1 | 23.7 | 25.3 | 25.9 | 26.9 | 29 | 14.5 | 13.8 | 12.4 | 11.2 |
| 20.8 | 21.6 | 21.8 | 23.9 | 27.5 | 27.5 | 23.5 | 20.7 | 21.4 | 27.5 | 28.9 | 26.5 | 22.1 | 24.6 | 25.2 | 24.3 | 24.8 | 26.8 | 21.8 | 24.1 | 22.8 | 19.5 |
| 20.6 | 21.1 | 20.3 | 21.2 | 23 | 23.4 | 20.1 | 17.8 | 19.3 | 24.9 | 25.6 | 23.6 | 19.9 | 24.2 | 24.7 | 22.9 | 21 | 21.9 | 18.4 | 21.1 | 21 | 18.3 |
| 20.2 | 20.4 | 18.7 | 18.1 | 18.6 | 19.7 | 17.6 | 15.5 | 16.6 | 21.3 | 21.5 | 19.8 | 17.5 | 22.8 | 23.9 | 21.3 | 16.4 | 16.2 | 15.8 | 16.2 | 16.3 | 14.3 |
| 12.4 | 12.2 | 11.1 | 10.3 | 9.5 | 10.4 | 9.5 | 8.5 | 8.8 | 11.4 | 11.7 | 11.4 | 10.6 | 14.1 | 15 | 13.4 | 11.8 | 11.5 | 13 | 12.9 | 12.5 | 11.2 |
| 8.8 | 8.9 | 8.2 | 7.2 | 6.7 | 7.9 | 7.6 | 6.8 | 6.6 | 8.4 | 8.6 | 8.3 | 7.8 | 10.3 | 10.7 | 9.5 | 8 | 7.9 | 4.9 | 6.4 | 6.2 | 5.7 |
| 5.7 | 5.8 | 5.6 | 4.8 | 4.6 | 5.6 | 5.5 | 4.9 | 4.7 | 5.9 | 6 | 5.8 | 5.4 | 6.9 | 7 | 6.3 | 5.4 | 5.5 | 3.7 | 4.8 | 4.6 | 4.3 |
| 3.9 | 3.9 | 3.8 | 3.3 | 3.2 | 4 | 4.6 | 3.9 | 3.4 | 4.3 | 5.1 | 4.9 | 4.5 | 5.5 | 4.7 | 4.2 | 3.8 | 4 | 3.8 | 3.6 | 3.4 | 3.2 |
| 2.8 | 2.7 | 2.7 | 2.6 | 2.8 | 2.7 | 1.8 | 1.8 | 2.8 | 3 | 1.9 | 1.5 | 1.5 | 1.7 | 2.9 | 3.3 | 3.3 | 3.1 | 3.6 | 3.4 | 3.1 | 2.9 |

Rows Two and Three Active



| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14.2 | 22.5 | 25.7 | 25.1 | 25.7 | 25.8 | 24.4 | 22.3 | 18.6 | 24.8 | 26.3 | 23.6 | 21.6 | 24.3 | 25.3 | 26 | 23.7 | 19.8 | 16.4 | 13.7 | 11.2 | 8.9 |
| 15.9 | 25.8 | 29.6 | 27.8 | 28.6 | 28.7 | 28.2 | 27 | 24 | 29.9 | 31.9 | 28.7 | 25.7 | 26.1 | 25.7 | 25.9 | 25.7 | 23.3 | 20.5 | 18.2 | 15.1 | 11.6 |
| 15.8 | 25.7 | 29.2 | 26.3 | 27.3 | 28 | 29.4 | 30.4 | 28.6 | 32.7 | 33.5 | 30.4 | 27.5 | 27.8 | 26.5 | 24.9 | 24.5 | 23.6 | 23.6 | 23.2 | 19.7 | 14.5 |
| 13.6 | 22.3 | 24.7 | 23.3 | 20 | 19.8 | 28.4 | 31.6 | 18.5 | 25.1 | 30.7 | 28.4 | 26.6 | 26.9 | 25.7 | 23.6 | 22.6 | 23 | 13.2 | 11.9 | 9.9 | 8.1 |
| 14.4 | 16.3 | 18.4 | 18.5 | 18.3 | 20.6 | 25.7 | 29.9 | 29.4 | 26.5 | 24.9 | 23.3 | 22.8 | 23.3 | 23.5 | 22.8 | 21.8 | 22 | 19.4 | 25.6 | 22.5 | 16.3 |
| 10.4 | 11.3 | 13 | 13.2 | 13.9 | 16.6 | 21.3 | 24.8 | 24.1 | 20.6 | 18 | 16.5 | 16.5 | 18.8 | 21 | 22 | 21.1 | 20 | 17.6 | 21.8 | 19.3 | 14.3 |
| 6.8 | 6.6 | 0 | 9 | 10 | 12.3 | 17.1 | 19.5 | 17.1 | 14.4 | 13.6 | 11.8 | 0 | 12.5 | 17 | 19.3 | 18.4 | 16.5 | 16.5 | 16.5 | 14.4 | 11.2 |
| 3.7 | 4.6 | 3.2 | 1.6 | 7 | 8.1 | 9.2 | 9.8 | 10.6 | 9.7 | 7.8 | 5.4 | 5.6 | 8.7 | 11.9 | 12.8 | 12.4 | 12 | 13.4 | 12.6 | 11.1 | 9.3 |
| 2.7 | 3.6 | 3 | 2 | 4.9 | 5.7 | 6.5 | 6.7 | 6.7 | 6.7 | 6.2 | 4.3 | 4.8 | 6.6 | 8.2 | 8 | 8.1 | 8.1 | 4.5 | 6.3 | 5.7 | 4.9 |
| 2.1 | 2.7 | 2.4 | 1.7 | 3.6 | 4.1 | 4.4 | 4.4 | 4.5 | 4.7 | 4.4 | 3.3 | 3.7 | 5.1 | 5.4 | 5.1 | 5.1 | 5.2 | 3 | 4.4 | 4.1 | 3.7 |
| 2.1 | 2.6 | 2.3 | 1.7 | 3.1 | 3.7 | 3.9 | 3.7 | 3.8 | 4.1 | 3.9 | 3.1 | 3.3 | 4.5 | 4.6 | 4.1 | 3.3 | 3.5 | 3.3 | 3.1 | 3 | 2.7 |
| 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 1 | 1.1 | 1.1 | 0.9 | 1.2 | 1.3 | 1.4 | 1.4 | 2.3 | 2.5 | 3.2 | 2.9 | 2.7 | 2.4 |
| 1.1 | 1.1 | 1 | 0.8 | 1.3 | 1.5 | 1.6 | 1.4 | 1.5 | 1.6 | 1.7 | 1.3 | 1.5 | 1.8 | 1.8 | 1.6 | 1.6 | 1.8 | 0.7 | 0.9 | 0.9 | 0.9 |
| 1 | 1 | 0.9 | 0.7 | 1.1 | 1.3 | 1.3 | 1.2 | 1.2 | 1.4 | 1.4 | 1.1 | 1.2 | 1.5 | 1.5 | 1.3 | 1.2 | 1.3 | 0.9 | 1.2 | 1.2 | 1.1 |
| 0.8 | 0.8 | 0.7 | 0.6 | 0.9 | 1 | 1.2 | 1.1 | 1 | 1.1 | 1.3 | 1.1 | 1.2 | 1.4 | 1.2 | 1 | 1 | 1 | 1 | 1 | 1 | 0.9 |
| 0.7 | 0.6 | 0.6 | 0.5 | 0.7 | 0.8 | 0.6 | 0.6 | 0.9 | 0.9 | 0.5 | 0.4 | 0.4 | 0.4 | 0.8 | 0.9 | 0.9 | 0.9 | 1.1 | 1 | 1 | 1 |

Row Three Active



| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 62.3 | 49.6 | 49.6 | 62.3 | 35 | 33.9 | 33.3 | 33.7 | 35.3 | 29.4 | 29.3 | 29.8 | 41.5 | 35.3 | 34.4 | 33 | 33.1 | 29 | 29.3 | 33.9 | 34 | 34.86 |
| 90.6 | 89.6 | 89 | 112 | 56.3 | 54.8 | 54 | 54.1 | 56.1 | 49 | 48.3 | 54.3 | 75 | 55.3 | 54.4 | 53.8 | 54 | 48.1 | 54.5 | 55.4 | 55.5 | 35.14 |
| 153 | 89.6 | 73.2 | 89 | 90.6 | 74.2 | 38.5 | 42.6 | 90.6 | 74.7 | 39.5 | 43.4 | 50 | 43.8 | 43.3 | 43.3 | 43.3 | 43.1 | 62.7 | 74.7 | 89.6 | 49.6 |
| 238 | 234 | 54.9 | 43.6 | 236 | 155 | 29.9 | 28 | 157 | 155 | 30.4 | 30.7 | 33.8 | 36.3 | 36 | 33 | 30.6 | 32.9 | 155 | 154 | 155 | 66 |
| 61.3 | 61.9 | 55.3 | 33.5 | 26.3 | 24.5 | 22.1 | 20.9 | 19.8 | 19.9 | 21.4 | 25.5 | 29.5 | 31.4 | 28.5 | 23.3 | 23.3 | 23.4 | 34.2 | 26.4 | 26.6 | 15.07 |
| 41.8 | 52.9 | 153 | 29 | 20.5 | 18.6 | 19.3 | 17.6 | 14.6 | 13.9 | 16.9 | 22 | 65.6 | 31.6 | 18 | 16.3 | 16.6 | 16.6 | 17.5 | 18.5 | 20.4 | 12.05 |
| 26.9 | 23.7 | | 92.2 | 13.7 | 11.6 | 75.5 | 64.7 | 9.73 | 8.75 | 64.7 | 76.3 | | 93.2 | 11.2 | 12.1 | 14.9 | 11.9 | 13.7 | 16.5 | 18.7 | 11.6 |
| 17.8 | 15.3 | 13 | 13.1 | 8.91 | 7.63 | 6.67 | 6.89 | 5.92 | 5.4 | 5.36 | 6.55 | 10 | 6.89 | 7.4 | 7.96 | 9.64 | 7.46 | 77 | 76.8 | 76.7 | 31.88 |
| 12.6 | 10.5 | 8.9 | 8.86 | 5.87 | 4.92 | 4.3 | 4.24 | 3.61 | 3.24 | 3.42 | 4.29 | 7.08 | 4.86 | 5.07 | 5.35 | 5.98 | 4.41 | 5.47 | 4.64 | 5.62 | 3.226 |
| 9.46 | 7.41 | 6.05 | 5.88 | 4.03 | 3.37 | 2.87 | 2.69 | 2.29 | 2.09 | 2.28 | 2.9 | 5.04 | 3.47 | 3.59 | 3.7 | 3.72 | 2.63 | 2.52 | 2.83 | 3.76 | 2.236 |
| 30.6 | 26.3 | 19.8 | 16.8 | 8.2 | 5.71 | 4.24 | 3.55 | 2.91 | 2.78 | 3.24 | 4.71 | 15.3 | 8.91 | 9.36 | 7.89 | 2.37 | 1.72 | 1.7 | 2.11 | 2.84 | 1.75 |
| 2.69 | 1.49 | 1.12 | 1.16 | 1.18 | 0.85 | 0.77 | 0.88 | 0.8 | 0.65 | 0.64 | 0.83 | 1.12 | 0.81 | 0.86 | 0.96 | 1.6 | 1.21 | 5.9 | 6.73 | 5.53 | 6.026 |
| 1.47 | 0.7 | 0.43 | 0.48 | 0.8 | 0.55 | 0.55 | 0.73 | 0.69 | 0.52 | 0.46 | 0.55 | 0.62 | 0.44 | 0.48 | 0.58 | 1.18 | 0.91 | 1.24 | 0.93 | 1.01 | 0.063 |
| 0.46 | -0 | -0.2 | -0.2 | 0.43 | 0.23 | 0.41 | 0.76 | 0.65 | 0.46 | 0.39 | 0.39 | 0.36 | 0.27 | 0.16 | 0.21 | 1.04 | 0.65 | 0.79 | 0.68 | 0.66 | -0.25 |
| -0.5 | -0.9 | -1 | -0.9 | -0.6 | -0.1 | 1.14 | 1.31 | 0.61 | 0.2 | 1.06 | 1.06 | 1.17 | 1 | -0.6 | -0.2 | 0.5 | 0.64 | 0.74 | 0.67 | 0.52 | -0.59 |
| -3.7 | -3.7 | -3.5 | -3.4 | -3.1 | -1.8 | -0.6 | 0.03 | 0.01 | -0.8 | -2.1 | -2.7 | -3 | -3.1 | -2.8 | -1.8 | -0.5 | 0.05 | 0.72 | 0.73 | 0.7 | 0.687 |

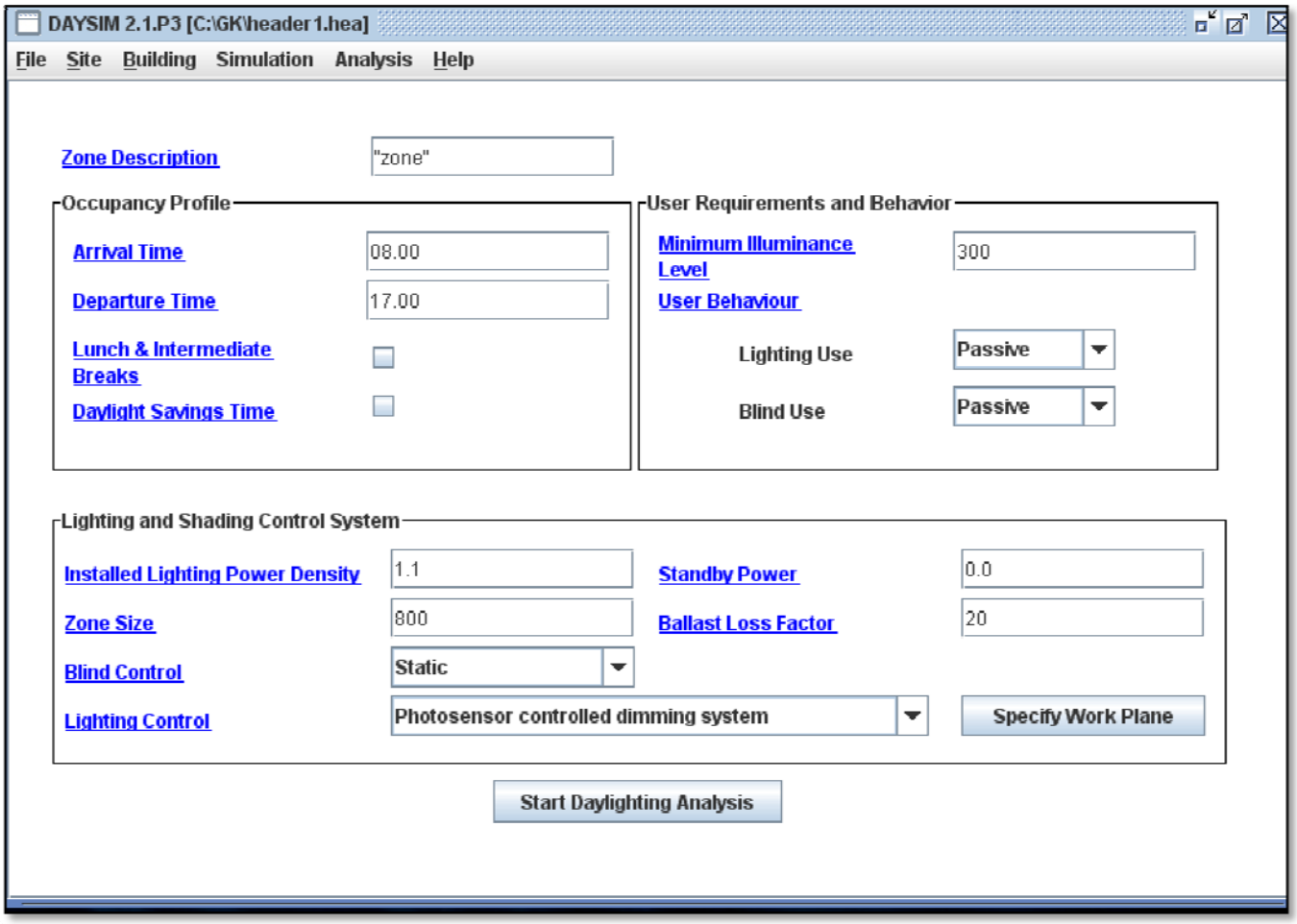
Dim Level = (Target Level – Clear Condition) / Row One Active

*NOTE: These plots also show striations formed by the cubicle walls within the room, and care was taken not to select a photosensor location which could be shaded at some point during the day.

## Daysim Analysis

After the critical point has been determined, Daysim simulation software can be used to quantify any savings which might be achieved by the implementation of a dimming photosensor system. The room and surrounding geometry were modeled in AutoCAD and then imported into the program. Daysim is then able to simulate long-term use of the system and provide estimates of the total energy used by the lighting system annually. The original target value for illuminance on the work plane was 30fc without the use of personal task lighting. The analysis was run without blinds or shades because the windows are well protected from direct solar glare by their orientation and position within the building. An additional analysis was completed using a target illuminance value of over 1 million, thereby preventing the system from ever dimming and providing a data set for a comparable non-dimming lighting solution.

## Daysim Inputs



## Results

### Daysim Simulation Report (Non-Dimming System)

***In short…***

- Daylight Factor (DF) Analysis: 100% of all illuminance sensors have a daylight factor of 2% or higher. If the sensors are evenly distributed across 'all spaces occupied for critical visual tasks', the investigated lighting zone should qualify for the LEED-NC 2.1 daylighting credit 8.1 (see www.usgbc.org/LEED/).
- Daylight Autonomy (DA) Analysis: The daylight autonomy for the core workplane sensor is 0% .
- Useful Daylight Index (UDI) Analysis: The Useful Daylight Indices for the Lighting Zone are $UDI_{<100}$=1%, $UDI_{100-2000}$=38%, $UDI_{>2000}$=61% .
- Continuous Daylight Autonomy ($DA_{con}$)and $DA_{max}$ Analysis: 0% of all illuminance sensors have a $DA_{con}$ above 40% . 0% of all illuminance sensors have a $DA_{max}$ above 5% .
- Electric Lighting Use: The predicted annual electric lighting energy use in the investigated lighting zone is: 3.6 kWh/unit area. Assuming a lighting zone size of 800 [unit area], this corresponds to a **total annual lighting energy use of 2914.7 kWh.**

### Daysim Simulation Report (Photosensor Dimming System)

***In short…***

- Daylight Factor (DF) Analysis: 100% of all illuminance sensors have a daylight factor of 2% or higher. If the sensors are evenly distributed across 'all spaces occupied for critical visual tasks', the investigated lighting zone should qualify for the LEED-NC 2.1 daylighting credit 8.1 (see www.usgbc.org/LEED/).
- Daylight Autonomy (DA) Analysis: The daylight autonomy for the core workplane sensor is 98% .
- Useful Daylight Index (UDI) Analysis: The Useful Daylight Indices for the Lighting Zone are $UDI_{<100}$=1%, $UDI_{100-2000}$=38%, $UDI_{>2000}$=61% .
- Continuous Daylight Autonomy ($DA_{con}$)and $DA_{max}$ Analysis: 100% of all illuminance sensors have a $DA_{con}$ above 80% . 100% of all illuminance sensors have a $DA_{max}$ above 5% .
- Electric Lighting Use: The predicted annual electric lighting energy use in the investigated lighting zone is: 0.6 kWh/unit area. Assuming a lighting zone size of 800 [unit area], this corresponds to a **total annual lighting energy use of 477.0 kWh.**

## Conclusion

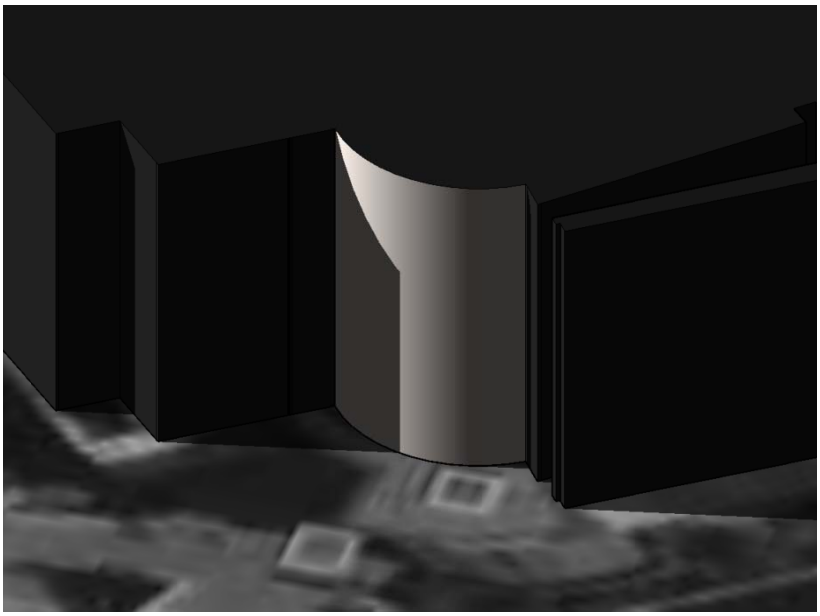
The simulation results indicated a possible lighting power savings of approximately 2437.7 kWh. At an approximate utility cost of $0.09033 per kWh (see the derivation of this value in the photovoltaic electrical depth study), the installation of a photosensor dimming system in the office space has the potential to save just $220 per year. This is likely not enough savings to warrant the installation of photosensor system in this space financially. The low savings is likely due to the relatively small size of the windows in comparison to the space. In addition, since the orientation of the windows is to the north, the amount of available daylight is limited.

## MECHANICAL BREADTH – CURTAIN WALL STUDY

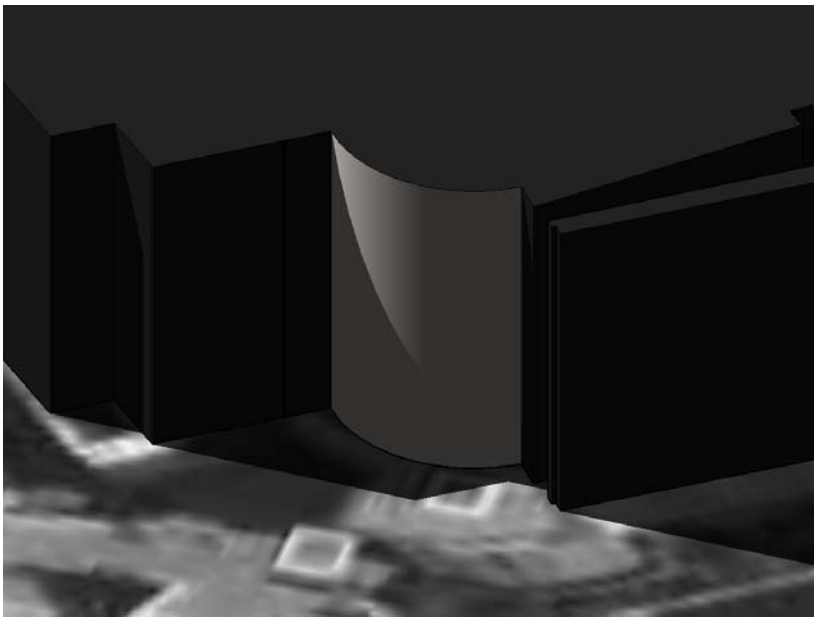
One of the most prominent architectural features of the building is the four-story glass curtain wall between the lobby and the north plaza space. Although visually important to the architecture, this large expanse of glazing has the potential to be a weak point in the building envelope. The thermal impact of the north curtain wall is the subject of this mechanical breadth study.

### Solar Study

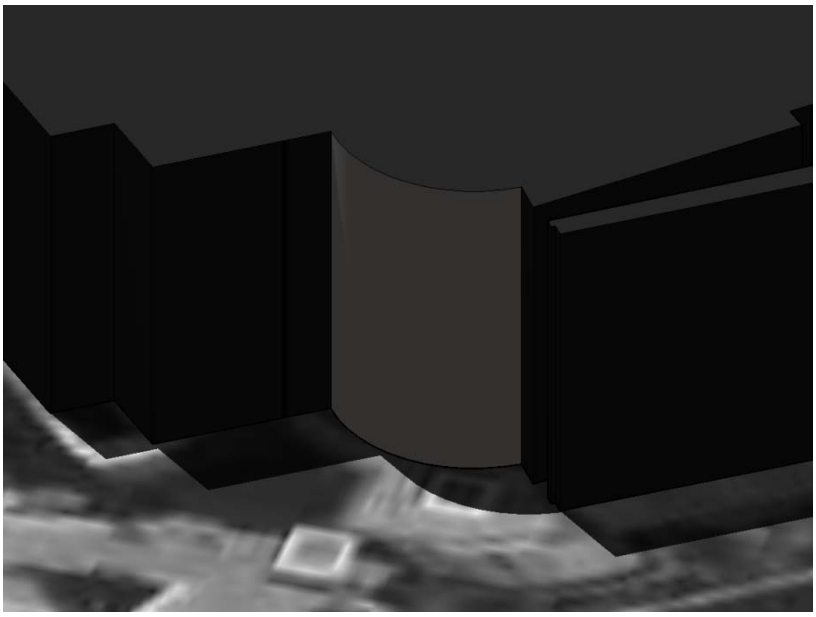
A solar penetration study was performed for the curtain wall to determine the amount of possible solar gain for the lobby. Because the curtain wall faces roughly north, the summer solstice was determined to be the worst-case scenario for daylight penetration into the space, as the sun travels to its most northern point in the sky at noon. Several times were analyzed on this day. As illustrated by the figures below, very little direct sunlight is able to enter the space, even on the solstice. This information suggests that the solar heat gain calculated in this study may be somewhat high as compared to the real value if the calculation assumes no additional shading of the curtain wall.



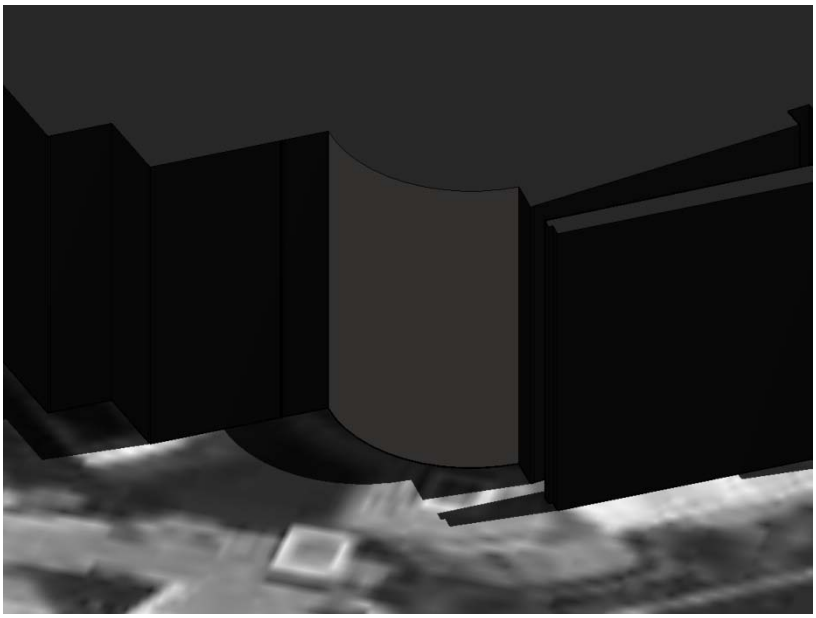
Summer Solstice – June 21 – 7AM



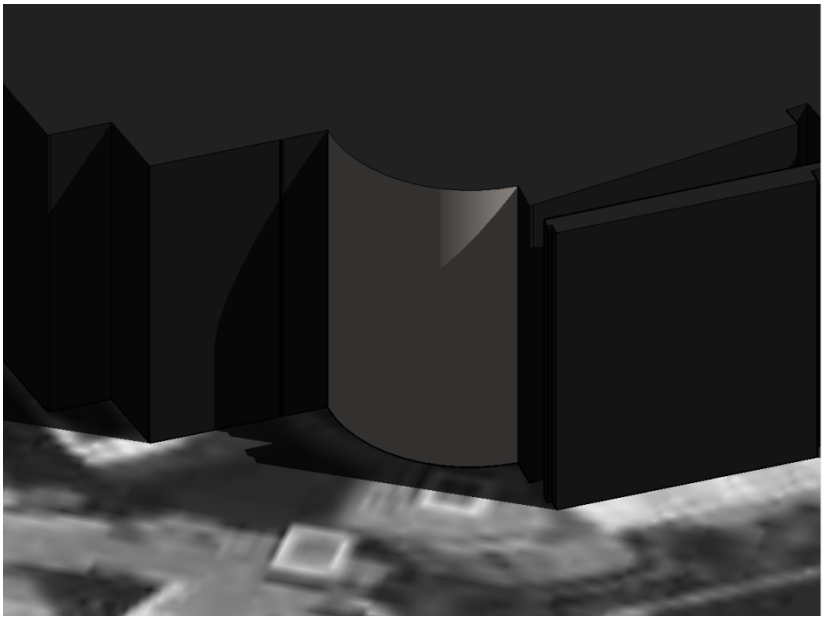
Summer Solstice – June 21 – 9AM



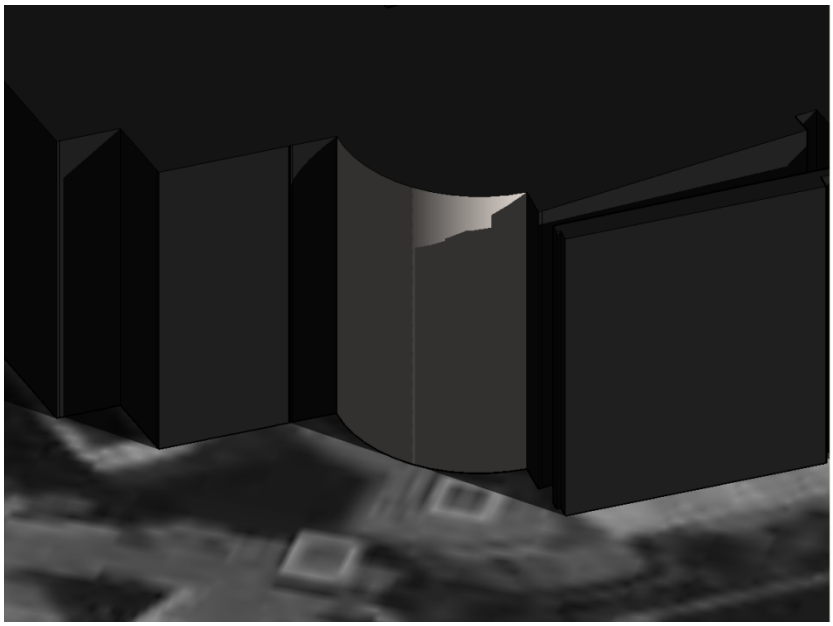
Summer Solstice – June 21 – 11AM



Summer Solstice – June 21 – 1PM



Summer Solstice – June 21 – 3PM



Summer Solstice – June 21 – 5PM

**Existing Glazing**

The curtain wall glazing is defined in the project specifications to be 1" thick insulated Heat Mirror 66 Clear with a U-value of 0.29 and a minimum shading coefficient (SC) of 0.44. Using the online window heat gain calculation tool at *http://susdesign.com/windowheatgain/index.php*, approximate heat gain values in BTU/ft²/day have been calculated for each month based on climate data for Los Angeles, California.

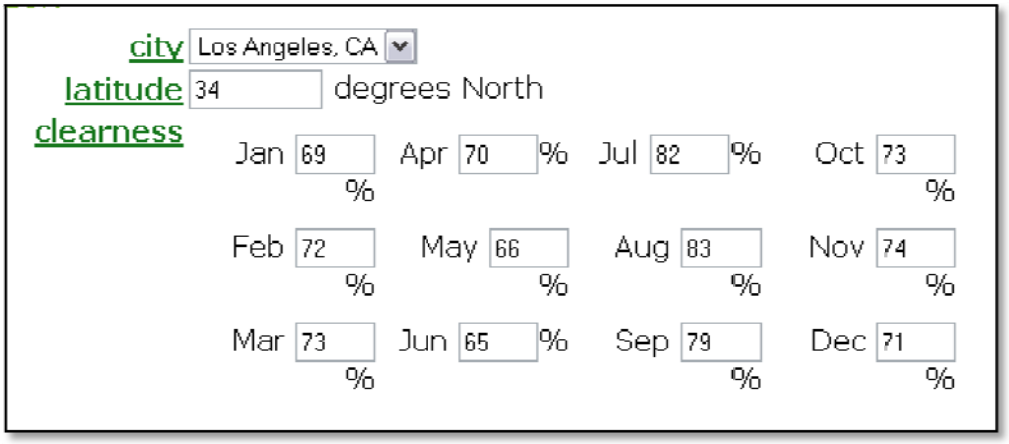
**Input Data Assumptions / Calculations**

Solar Heat Gain Coefficient (SHGC):
SHGC = SC x 0.87 = 0.44 x 0.87 = 0.3696 ≈ 0.37

Ground Surface Reflectance:
New Concrete = 0.32

Façade Orientation:
North

**Climate Data**




* Based on National Climatic Data Center (NCDC) measurements – www.ncdc.noaa.gov

**Output and Calculated Heat Gain**

| Month | Heat Gain Rate (BTU per ft² per Day) | Calculated Heat Gain (BTU per Day) | Days | Monthly Heat Gain (BTU) |
|---|---|---|---|---|
| January | 52 | 139457 | 31 | 4323182 |
| February | 71 | 190413 | 28 | 5331567 |
| March | 93 | 249414 | 31 | 7731845 |
| April | 113 | 303052 | 30 | 9091556 |
| May | 139 | 372781 | 31 | 11556199 |
| June | 157 | 421054 | 31 | 12631630 |
| July | 178 | 477374 | 30 | 14798585 |
| August | 140 | 375462 | 31 | 11263874 |
| September | 102 | 273551 | 30 | 8480088 |
| October | 74 | 198459 | 31 | 5953762 |
| November | 56 | 150185 | 31 | 4655735 |
| December | 47 | 126048 | 30 | 3781444 |
| | | **ANNUAL TOTAL** | 365 | 99599467 |

* Curtain wall glass area used for these calculations: 2681.9 ft²

**Modified Glazing**

A new curtain wall glazing has been selected as a comparison to analyze energy savings over the existing system. PPG SOLARBAN 70XL glass has been chosen for its low solar heat gain coefficient and superior visible light transmission, which is an important architectural design quality. Partial product specifications are included below.

***Solarban*® 70XL Glass Performance — Commercial Insulating Glass Unit**

Insulating Vision Unit Performance Comparisons 1-inch (25mm) units with 1/2-inch (13mm) airspace and two 1/4-inch (6mm) lites; interior lite clear unless otherwise noted

| Glass Type | Transmittance | | | Reflectance | | U-Value (Imperial) | | European U-Value | Shading Coefficient | Solar Heat Gain Coefficient | Light to Solar Gain (LSG) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ultra-violet % | Visible % | Total Solar Energy % | Visible Light % | Total Solar Energy % | Winter Night-time | Summer Day-time | | | | |
| Coated | | | | | | | | | | | |
| ***SOLARBAN*® 70XL Solar Control Low-E Glass*** | | | | | | | | | | | |
| *SOLARBAN* 70XL (2) *STARPHIRE* | 6 | 64 | 25 | 12 | 52 | 0.28 | 0.26 | 1.50 | 0.32 | 0.27 | 2.37 |
| *SOLARBAN* 70XL (3) *SOLEXIA* | 3 | 56 | 20 | 11 | 13 | 0.28 | 0.26 | 1.50 | 0.37 | 0.32 | 1.74 |
| *SOLARBAN* 70XL (3) *ATLANTICA* | 2 | 49 | 17 | 10 | 8 | 0.28 | 0.26 | 1.50 | 0.32 | 0.28 | 1.74 |
| *SOLARBAN* 70XL (3) *CARIBIA* | 2 | 49 | 17 | 9 | 8 | 0.28 | 0.26 | 1.50 | 0.32 | 0.28 | 1.75 |
| *SOLARBAN* 70XL (3) *AZURIA* | 4 | 49 | 17 | 9 | 8 | 0.28 | 0.26 | 1.50 | 0.33 | 0.29 | 1.70 |
| *SOLARBAN* 70XL (3) Bronze | 3 | 38 | 15 | 8 | 20 | 0.28 | 0.26 | 1.50 | 0.30 | 0.26 | 1.48 |
| *SOLARBAN* 70XL (3) Gray | 2 | 32 | 13 | 7 | 15 | 0.28 | 0.26 | 1.50 | 0.27 | 0.24 | 1.34 |
| *SOLARBAN* 70XL (3) *OPTIGRAY* 23 | 1 | 17 | 7 | 5 | 7 | 0.28 | 0.26 | 1.50 | 0.19 | 0.16 | 1.04 |
| *SOLARBAN* 70XL (3) *GRAYLITE* | 1 | 10 | 5 | 5 | 11 | 0.28 | 0.26 | 1.50 | 0.16 | 0.14 | 0.71 |

www.ppg.com

**Input Data**

Solar Heat Gain Coefficient (SHGC):

SHGC = 0.27

**Output and Calculated Heat Gain**

| Month | Heat Gain Rate (BTU per ft² per Day) | Calculated Heat Gain (BTU per Day) | Days | Monthly Heat Gain (BTU) |
|---|---|---|---|---|
| January | 38 | 101911 | 31 | 3159249 |
| February | 52 | 139457 | 28 | 3904810 |
| March | 67 | 179686 | 31 | 5570254 |
| April | 82 | 219914 | 30 | 6597412 |
| May | 101 | 270869 | 31 | 8396950 |
| June | 114 | 305734 | 31 | 9172012 |
| July | 130 | 348644 | 30 | 10807956 |
| August | 102 | 273551 | 31 | 8206537 |
| September | 75 | 201141 | 30 | 6235359 |
| October | 54 | 144821 | 31 | 4344637 |
| November | 41 | 109957 | 31 | 3408663 |
| December | 34 | 91184 | 30 | 2735512 |
| | | **ANNUAL TOTAL** | 365 | 72539350 |

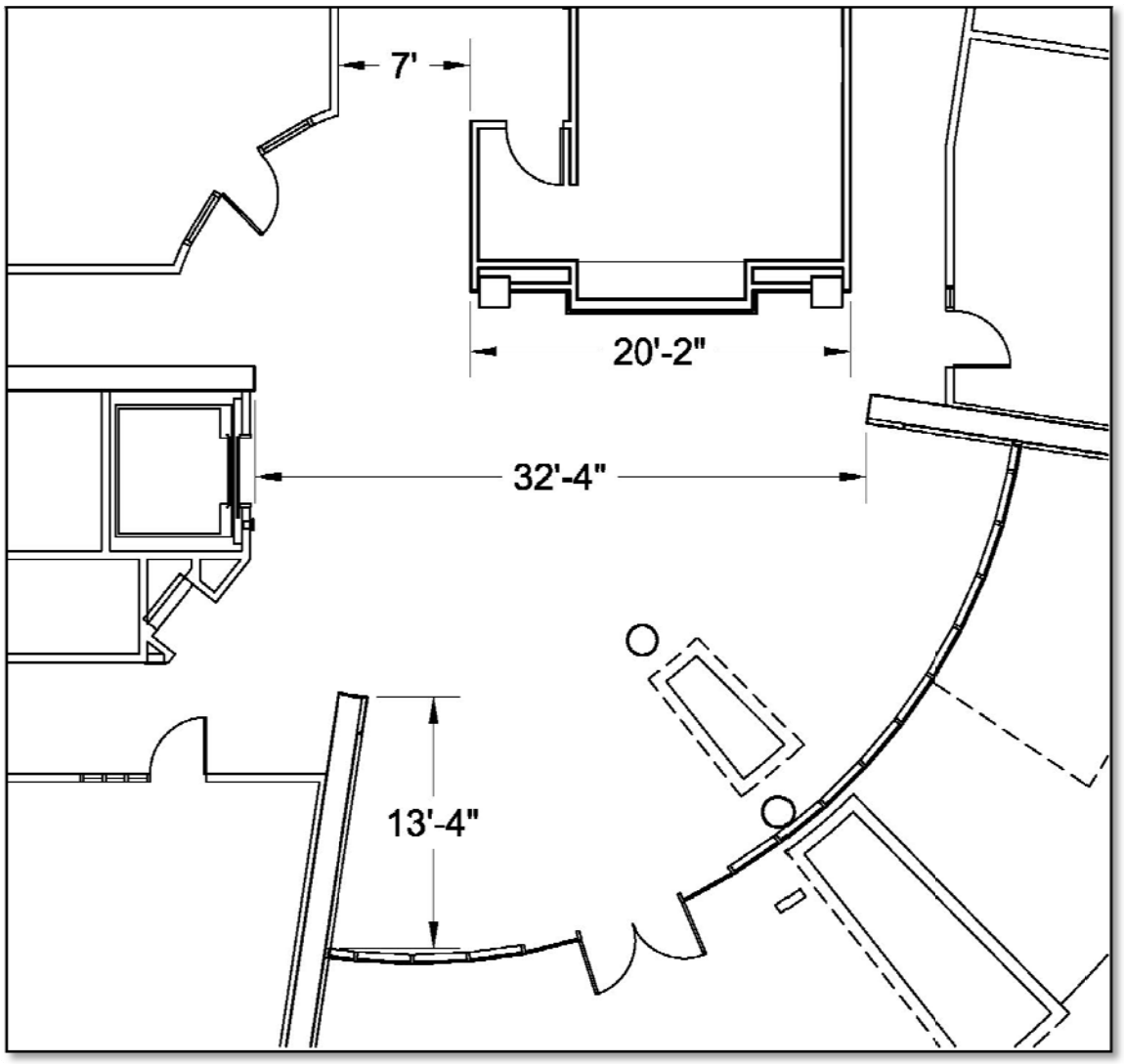
**Conclusions**

After completing the thermal gain analysis, the modified curtain wall system using PPG SOLARBAN 70XL glass is expected to reduce the annual heat gain from 99,599 kBTU to 72,539 kBTU. This represents an approximate 27% reduction in cooling load for this space. Although the initial installation cost would be higher, consideration of a more thermally resistant glazing system for the north curtain wall is recommended.

## ACOUSTICS BREADTH – LOBBY ANALYSIS

The main entry lobby of the building is an important space within Natural Science Unit II and the surrounding campus. This area is intended to be a place for social and academic interaction between student and faculty at the university. In order to accommodate comfortable conversation in this space, an appropriate acoustic environment is required. For this reason, an analysis of the acoustics in the first floor lobby space has been analyzed in this study. The main purpose of the analysis is to determine whether the lobby area meets recommended professional standards of acoustical quality. It is unlikely that this type of analysis was performed during the design and construction of the project. In addition, an architectural change to a portion of the ceiling (from acoustic ceiling tile to gypsum) was made during the lighting redesign of this space. The effects of this change have also been determined in the following analysis.

### Room Dimensions




*Partial First Floor Plan*
*Scale: NTS*

**Material Properties**

| DESCRIPTION | MATERIAL | ABSORPTION COEEFFICIENT (α) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz |
| Floor 1 | Carpet on Concrete | 0.020 | 0.060 | 0.140 | 0.370 | 0.600 | 0.650 |
| Floor 2 | Stone | 0.010 | 0.010 | 0.015 | 0.020 | 0.020 | 0.020 |
| Interior Walls | Gypsum Wall Board | 0.290 | 0.100 | 0.050 | 0.040 | 0.070 | 0.090 |
| Wooden Panel Wall | Wood | 0.150 | 0.110 | 0.100 | 0.070 | 0.060 | 0.070 |
| Concrete Walls | Concrete | 0.010 | 0.010 | 0.015 | 0.020 | 0.020 | 0.020 |
| ACT Ceiling | Acoustic Ceiling Tile | 0.760 | 0.930 | 0.830 | 0.990 | 0.990 | 0.940 |
| Ceiling 2 | Gypsum | 0.290 | 0.10 | 0.050 | 0.040 | 0.070 | 0.090 |
| Interior Doors | Wood | 0.190 | 0.140 | 0.090 | 0.060 | 0.060 | 0.050 |
| Elevator Doors | Steel | 0.050 | 0.100 | 0.100 | 0.100 | 0.070 | 0.020 |
| Exterior Doors | Steel | 0.050 | 0.100 | 0.100 | 0.100 | 0.070 | 0.020 |
| Curtain Wall | Glass - Heavy | 0.180 | 0.060 | 0.040 | 0.050 | 0.020 | 0.020 |
| Curtain Wall Framing | Steel | 0.050 | 0.100 | 0.100 | 0.100 | 0.070 | 0.020 |
| Interior Windows | Glass - Ordinary | 0.180 | 0.060 | 0.040 | 0.030 | 0.020 | 0.020 |
| Corridor Openings | Open | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 | 0.600 |

**Reverberation Time – Existing**

| DESCRIPTION | SURFACE AREA S [ft²] | S x α | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz |
| Floor 1 | 696 | 13.92 | 41.76 | 97.44 | 257.52 | 417.60 | 452.40 |
| Floor 2 | 534 | 5.34 | 5.34 | 8.01 | 10.68 | 10.68 | 10.68 |
| Interior Walls | 517 | 149.93 | 51.70 | 25.85 | 20.68 | 36.19 | 46.53 |
| Wooden Panel Wall | 132 | 19.80 | 14.52 | 13.20 | 9.24 | 7.92 | 9.24 |
| Concrete Walls | 330 | 3.30 | 3.30 | 4.95 | 6.60 | 6.60 | 6.60 |
| ACT Ceiling | 499 | 372.40 | 455.70 | 406.70 | 485.10 | 485.10 | 460.60 |
| Ceiling 2 | 490 | 144.71 | 49.90 | 24.95 | 19.96 | 34.93 | 44.91 |
| Interior Doors | 42 | 7.98 | 5.88 | 3.78 | 2.52 | 2.52 | 2.10 |
| Elevator Doors | 24 | 1.20 | 2.40 | 2.40 | 2.40 | 1.68 | 0.48 |
| Exterior Doors | 42 | 2.10 | 4.20 | 4.20 | 4.20 | 2.94 | 0.84 |
| Curtain Wall | 594 | 106.92 | 35.64 | 23.76 | 29.70 | 11.88 | 11.88 |
| Curtain Wall Framing | 18 | 0.90 | 1.80 | 1.80 | 1.80 | 1.26 | 0.36 |
| Interior Windows | 48 | 8.64 | 2.88 | 1.92 | 1.44 | 0.96 | 0.96 |
| Corridor Openings | 226 | 135.60 | 135.60 | 135.60 | 135.60 | 135.60 | 135.60 |
| **Space Volume (V)** | | 13,530 ft³ | | | | | |
| **a = Σ (S x α)** | | 837.14 | 810.62 | 754.56 | 987.44 | 1155.86 | 1183.18 |
| **$T_{60}$ = 0.05 x V/a** | | 0.808 | 0.835 | 0.897 | 0.685 | 0.585 | 0.572 |

**a** = Room Absorption (Sabins)

**$T_{60}$** = Reverberation Time (Seconds)

**Reverberation Time – Designed**

| DESCRIPTION | SURFACE AREA S [ft²] | S x α | | | | | |
|---|---|---|---|---|---|---|---|
| | | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz |
| Floor 1 | 696 | 13.92 | 41.76 | 97.44 | 257.52 | 417.60 | 452.40 |
| Floor 2 | 534 | 5.34 | 5.34 | 8.01 | 10.68 | 10.68 | 10.68 |
| Interior Walls | 517 | 149.93 | 51.70 | 25.85 | 20.68 | 36.19 | 46.53 |
| Wooden Panel Wall | 132 | 19.80 | 14.52 | 13.20 | 9.24 | 7.92 | 9.24 |
| Concrete Walls | 330 | 3.30 | 3.30 | 4.95 | 6.60 | 6.60 | 6.60 |
| **ACT Ceiling** | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Ceiling 2** | 989 | 286.81 | 98.90 | 49.45 | 39.56 | 69.23 | 89.01 |
| Interior Doors | 42 | 7.98 | 5.88 | 3.78 | 2.52 | 2.52 | 2.10 |
| Elevator Doors | 24 | 1.20 | 2.40 | 2.40 | 2.40 | 1.68 | 0.48 |
| Exterior Doors | 42 | 2.10 | 4.20 | 4.20 | 4.20 | 2.94 | 0.84 |
| Curtain Wall | 594 | 106.92 | 35.64 | 23.76 | 29.70 | 11.88 | 11.88 |
| Curtain Wall Framing | 18 | 0.90 | 1.80 | 1.80 | 1.80 | 1.26 | 0.36 |
| Interior Windows | 48 | 8.64 | 2.88 | 1.92 | 1.44 | 0.96 | 0.96 |
| Corridor Openings | 226 | 135.60 | 135.60 | 135.60 | 135.60 | 135.60 | 135.60 |
| **Space Volume (V)** | | 13,530 ft³ | | | | | |
| **a = Σ (S x α)** | | 742.44 | 403.92 | 372.36 | 521.94 | 705.06 | 766.68 |
| **$T_{60}$ = 0.05 x V/a** | | 0.911 | 1.675 | 1.817 | 1.296 | 0.959 | 0.882 |

**Comparison / Analysis**

| | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz |
|---|---|---|---|---|---|---|
| **$T_{60}$ – Existing (Seconds)** | 0.808 | 0.835 | 0.897 | 0.685 | 0.585 | 0.572 |
| **$T_{60}$ – Designed (Seconds)** | 0.911 | 1.675 | 1.817 | 1.296 | 0.959 | 0.882 |
| **Difference (Seconds)** | 0.103 | 0.840 | 0.920 | 0.611 | 0.374 | 0.310 |

The removal of the acoustic ceiling tile from the center of the lobby creates a notable increase in the reverberation times within the space. This difference has the potential to adversely affect the quality of speech recognition in the lobby. Any increase in reverberation time is undesirable in the space. However, the final values for reverberation time are still marginally acceptable for a large public space such as this. Several unknown variables such as plant life and human occupancy in the space will also likely act to decrease the reverberation time here.

If the project budget allows, addition of sound absorbing materials back into the space should be used to improve the acoustic performance. Another option is to change the lighting design back to be integrated into an acoustic tile ceiling in the lobby. For this project, the lighting design and visual experience of the space from indoors and outdoors are of greater importance than a minor improvement in acoustic quality. Ideally, a new sound dampening method would allow the lighting appearance to stay fairly constant while still reducing the reverberation time in the room.

## SUMMARY / CONCLUSION

The solutions presented within this report are generally promising and have met most of the technical design criteria set forth at the beginning of the project. The proposed design represents an improvement in the occupant experience of the engineered systems for the building and the nearby campus. As much as possible, the breadth and depth topics have been related to one another and the impact of one system on another is clearly visible from the results.

The lighting redesign was successful in creating a more exciting and appropriate occupant experience within the building. The building has been defined internally and externally as a prominent fixture on the UCI campus. The architectural themes of the building have been integrated into the lighting design so as to for a cohesive and elegant design solution in the four spaces. Electrical depth topics produced acceptable and definitive results in most cases, with both depth studies revealing a potential for the university to save energy and money through the modification of existing building systems.

In studying the mechanical and acoustical properties of the lobby, results have indicated that although the existing systems are somewhat sufficient, there is certainly potential for improvement of the systems and, in the case of the mechanical study, potential to save money on annual energy costs and to be seen as a more environmentally responsible institution.

The thesis project as a whole has been an excellent opportunity to gain first-hand knowledge of the building construction industry and its many fields. The experience provided by the project is unique and will be extremely valuable in the pursuit of a position in the industry as a professional.

## ACKNOWLEDGEMENTS

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Andrea Hartranft
Mike Barber
Sean Good

Design Support

Naomi Miller
Billy Hodges
Chip Israel

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Carrier-Johnson Architects – Gary Hipolite, Philip Pipal
Tangram Interiors – Tom Walsh
Fox + Fox Design – John Fox, Debra Fox

Others

AE Colleagues
Friends and Family

# Appendix

# LIGHTING EQUIPMENT SCHEDULE

| TYPE | MANUF. | CATALOG # | LAMP(S) | BALLAST | INPUT WATTS | VOLTS | MOUNTING | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| **INDOOR FIXTURES** | | | | | | | | |
| **F01** | FOCAL POINT | FAVA-NS-1T5-1C-277-S-F-WH-4' | (1) 28W T5, 4100K, CRI=85, FP28/841/ECO | ADVANCE ICN-2S28-N | 30 (PER FX) | 277 | CEILING SEMI-RECESSED | "AVENUE A" - NARROW APERTURE ASYMMETRIC WALL WASHER. SINGLE CIRCUIT, DRYWALL FLANGE, MATTE WHITE HOUSING, 4' NOMINAL LENGTH. STEEL CONSTRUCTION. |
| **F02** | FOCAL POINT | FAVB-FL-1T5-1C-277-D-F-WH-4' | (1) 28W T5, 4100K, CRI=85, FP28/841/ECO | DIMMING: LUTRON ECO-T528-277-2 | 30 (PER FX) | 277 | CEILING RECESSED | "AVENUE B" - RECESSED SLOT FIXTURE. DIFFUSE FLUSH LENS, SINGLE CIRCUIT, MATTE WHITE HOUSING. STEEL CONSTRUCTION. |
| **F03** | LIGHTOLIER | SU-F-L-S-T-SL | (1) 13W CFL, 4-PIN/2G7 BASE, 3500K, INCLUDED | IN-LINE ELECTRONIC | 13 | 120 | TABLE | "SURFSIDE" CFL PERSONAL TASK LIGHT. 20" ARM, SILVER FINISH, TABLE BASE |
| **F04** | FOCAL POINT | FTWS-PB-1-1-277-D-J12-TS-20' | (1) 28 W T5, 4100K, CRI=85, FP28/841/ECO | DIMMING: LUTRON ECO-T528-277-2 | 30 (PER FX) | 277 | CEILING SUSPENDED | "TWELVE" - SUSPENDED INDIRECT/DIRECT LUMINIRE. PARALLEL BLADE LOUVER, 24" CABLE SUSPENSION, INTEGRAL WATTSTOPPER OCCUPANCY SENSOR, TITANIUM SILVER FINISH, FACTORY 20' RUN |
| **F05** | LIGHTOLIER | PTS5-1-S-S-2-4 | (1) 28W T5, 4100K, CRI=85, FP28/841/ECO | DIMMING: LUTRON ECO-T528-277-2 | 30 (PER FX) | 277 | CEILING RECESSED | "PTS5-1" - RECESSED PERIMETER WALL WASH. STRAIGHT BLADE ALUMINUM LOUVER, DIE-FORMED STEEL CONSTRUCTION. |
| **F06** | TECH LIGHTING | 700-MO-SPT6-04-S | (1) 35W SOLUX MR16, 4100K, 17 DEGREE SPREAD | N/A | 35 | 12 | TRACK-MOUNTED | "SPOT" TRACK HEAD. COMPATIBLE WITH MONORAIL SYSTEM. 4.5" LENGTH. SATIN NICKEL FINISH. DESIGNER APPROVAL REQUIRED FOR LAMP SUBSTITUTION. |
| **F06-A** | TECH LIGHTING | 700MOA-48+24-S | N/A | N/A | N/A | 12 | CEILING SURFACE | "MONORAIL" LOW-VOLTAGE STRAIGHT RAIL TRACK. 48" + 24" FOR TOTAL 72" OVERALL RUN. SATIN NICKEL FINISH WITH CLEAR INSULATOR. SEE CUTSHEETS FOR ADDITIONAL EQUIPMENT. |
| **F07** | LOUIS POULSEN | BAL-1/18W CF GX24q-2 - 277V - WHT | (1) 18W CFL, 4100K, CRI=82, PL-T 18W/841/4P/ ALTO | OSRAM QTP 1x18CF/UNV | 20 | 277 | CEILING SEMI-RECESSED | "BALLERUP" SEMI RECESSED DECORATIVE CFL DOWNLIGHT. |
| **F08** | LIGHTOLIER | 48023ALU | (1) 28W T5, 4100K, CRI=85, FP28/841/ECO | ADVANCE ICN-2S28-N | 30 (PER FX) | 277 | WALL MOUNTED | "SOLI" WALL-MOUNTED DECORATIVE T5 FIXTURE. METALLIC ALUMINUM FINISH, SEE DIFFUSER SPECIFICATION BELOW (ORDER SEPERATELY). ADA COMPLIANT |
| **F09** | ELLIPTIPAR | F101-T335-X-01-2-000 | (1) 35W T5, 4100K, CRI=85, F35T5/841/ ALTO | ADVANCE ICN-2S28-N | 38 (PER FX) | 277 | WALL CANTILEVER MOUNTED | "STYLE 102" WALL CANTILEVER-MOUNTED WALL WASH LUMINAIRE. BRIGHT ALUMINUM FLUTED HOUSING WITH SILVER END PLATES, 18" CANTILEVEL ARM. 5' LENGTH. |
| **F10** | COLOR KINETICS | 101-000066-00 | 45 LEDs (15 RED, 15 GREEN, 15 BLUE) | N/A | 3W | 24V DC | COVE MOUNTED | "iCOLOR COVE QLX" COVE-MOUNTED RGB COLOR-CHANGING COVE FIXTURE. 120 DEGREE CANDLEPOWER DISTRIBUTION, ADJUSTABLE POSITION MOUNTING BRACKET. |
| **F10-A** | COLOR KINETICS | PDS-60ca 24V | N/A | N/A | N/A | 277 | REMOTE | 277V AC - 24V DC LED POWER SUPPLY. |
| **F10-B** | COLOR KINETICS | 101-000008 | N/A | N/A | N/A | N/A | REMOTE | "COLORDIAL" DMX LED CONTROLLER. |
| **F11** | PHILIPS | OM4-1H-32 PLT-SQ-CS-120/277 | (1) 32W CFL, 4100K, CRI=82, PL-T 32W/841/4P/ ALTO | OSRAM QTP 2X32CF/UNV BM | 35 (PER FX) | 277 | CEILING RECESSED | "OMEGA REVELATION" 4-INCH SQUARE CFL DOWNLIGHT. CLEAR SPECULAR REFLECTOR. |
| **F12** | SCHMITZ | 26237.06 | (2) 28W T5, 4100K, CRI=85, FP28/841/ECO | ADVANCE ICN-2S28-N BF | 60 (PER FX) | 277 | PENDANT | "TOOL" PENDANT FIXTURE. NO DOWNLIGHT. RIBBED ACRYLIC TUBE, SATIN NICKEL FINISH. ADJUSTABLE SUSPENSION CABLE. |
| **OUTDOOR / SITE FIXTURES** | | | | | | | | |
| **S01** | BEGA | 2007 P | (1) 35W T5, 3000K, CRI=85, F35T5/830/ALTO | ADVANCE ICN-2S28, BF | 38.5 (PER FX) | 277 | WALL RECESSED | RECESSED LINEAR WALL FIXTURE. STAINLESS STEEL FINISH. RATED FOR WET LOCATION. |
| **S02** | BEGA | 8642 P | (1) 24W T5HO, 3000K, CRI=85, F24T5/830/HO/ALTO | ADVANCE ICN-2S24, BF | 26 (PER FX) | 277 | IN-GRADE RECESSED | IN-GRADE RECESSED FLODLIGHT. LINEAR FLUORESCENT. DRIVE OVER. RATED FOR WET LOCATION. STAINLESS STEEL FINISH. |
| **S03** | BEGA | 8989 P | (1) 36W CFL, 3000K, CRI=82, PL-L 36W/830/4P | ADVANCE ICN-2S54, BF | 46 | 277 | POLE | LINEAR STAINLESS STEEL POLE-MOUNTED SITE FIXTURE. RATED FOR WET LOCATION. |

**VISUAL INDEX**

# avenue® a

FOCAL POINT®

## FEATURES

Narrow aperture high performance T5/T5HO asymmetric wall wash.

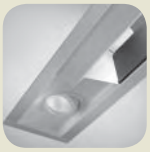
Precision micro-optic delivers shadow free illumination from the ceiling to the floor.

Features 2" narrow aperture for clean unobtrusive aesthetic.

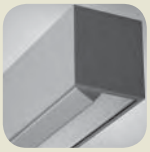
Drywall installation is available, which allows for both individual or continuous row mount capability.

Great solution for conference rooms, highlighting artwork, corridors, white board or any application that requires high levels of vertical illumination.

### companion luminaire



mr16



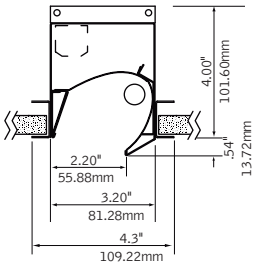
linear

recessed wall mount

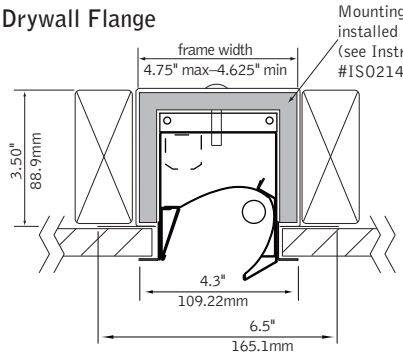
November 2007

## DIMENSIONAL DATA

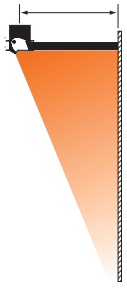
### Grid Mount



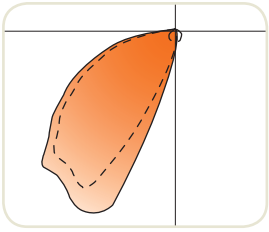

### Drywall Flange




24-30" Recommended Distance from Wall



## PERFORMANCE



1–Lamp T5HO
57% Efficiency
1933 cd @ 25°

See **Photometric** section for additional performance data.

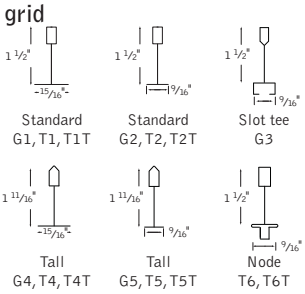
fixture type:

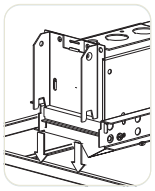
project name:

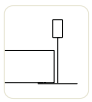


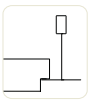
## DETAILS

### grid






### drywall

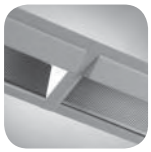
2' unit (cutout dimension: 3.5" x 23.6")

3' unit (cutout dimension: 3.5" x 35.6")

4' unit (cutout dimension: 3.5" x 47.6")

5' unit (cutout dimension: 3.5" x 59.6")

Drywall flange version provided with mounting yoke.



row mount detail

## SPECIFICATIONS

### construction

One-piece 20 Ga. steel housing.
Grid luminaires include 20 Ga. steel, .5" wide universal flange rail.

Drywall flange option is provided with 20 Ga. steel, .5" wide flange kit and 20 Ga. galvanized steel mounting yoke.

| | |
|---|---|
| 2' unit weight: | 5 lbs. |
| 3' unit weight: | 6 lbs. |
| 4' unit weight: | 7 lbs. |
| 5' unit weight: | 8 lbs. |

### optic

.020" specular aluminum upper reflector and .020" semi-specular lower reflector.
24 Ga. perforated matte black diffuser with 24% opening.

### please note:

radial cut-off louver FAVA-RL or the clear lens FAVA-CL cannot be field installed on the non-shielded profile FAVA-NS.

### electrical

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

### emergency

Emergency battery packs provide 90 minutes of illumination.
Initial lumen output for lamp types are as follows:

| | |
|---|---|
| T5 Lamp: | Up to 550 lumens |
| T5HO Lamps: | Up to 825 lumens |

Battery pack requires unswitched hot from same branch circuit as AC ballast.

### finish

Polyester powder coat applied over a 5-stage pre-treatment.
Standard luminaire housing finished in Matte Satin White or Matte Black.
Perforated diffuser always finished in Matte Black.

## ORDERING

| | | |
|---|---|---|
| **luminaire series** | | FAVA |
| Avenue A | FAVA | |
| **shielding** | | NS |
| No Shielding, Open Optic (Radial cut-off louver FAVA-RL or the clear lens FAVA-CL cannot be field installed on the non-shielded profile FAVA-NS) | NS | |
| **lamping** | | 1T5 |
| One Lamp T5 | 1T5 | |
| One Lamp T5HO | 1T5HO | |
| **circuits** | | 1C |
| Single Circuit | 1C | |
| **voltage** | | 277 |
| 120 Volt | 120 | |
| 277 Volt | 277 | |
| 347 Volt (Consult factory for availability) | 347 | |
| **ballast** | | S |
| Electronic Program Start <10% THD | S | |
| Electronic Dimming Ballast | D | |
| **ceiling configurations** (For mounting configurations, see Reference section) | | G1 |
| Drywall Flange (Consult factory for custom variations) | F | |
| Std. 15/16" Lay-in | G1 | |
| Std. 15/16" Tegular | T1 | |
| Std. 15/16" Tegular, against Tee | T1T | |
| Std. 9/16" Lay-in | G2 | |
| Std. 9/16" Tegular | T2 | |
| Std. 9/16" Tegular, against Tee | T2T | |
| 9/16" Slot-tee Tegular | G3 | |
| Tall 15/16" Lay-in | G4 | |
| Tall 15/16" Tegular | T4 | |
| Tall 15/16" Tegular, against Tee | T4T | |
| Tall 9/16" Lay-in | G5 | |
| Tall 9/16" Tegular | T5 | |
| Tall 9/16" Tegular, against Tee | T5T | |
| Node 9/16" Tegular | T6 | |
| Node 9/16" Tegular, against Tee | T6T | |
| **factory options** | | - |
| Chicago Plenum | CP | |
| Emergency Circuit | EC | |
| Emergency Battery Pack (3' & 4' Luminaires Only) | EM | |
| Seismic Brackets | EQ | |
| HLR/GLR Fuse | FU | |
| Include 3000K Lamp | L830 | |
| Include 3500K Lamp | L835 | |
| Include 4100K Lamp | L841 | |
| **finish** | | WH |
| Matte White Housing | WH | |
| Titanium Silver | TS | |
| Matte Black Housing (Perforated diffuser always painted black) | BK | |
| **luminaire length** | | 4' |
| 2' Nominal Housing | 2' | |
| 3' Nominal Housing | 3' | |
| 4' Nominal Housing | 4' | |
| 5' Nominal Housing (Dimming not available with 5' lamps) (For continuous row mount in drywall ceiling, specify luminaire run length, ie 24') | 5' | |

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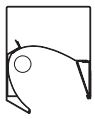
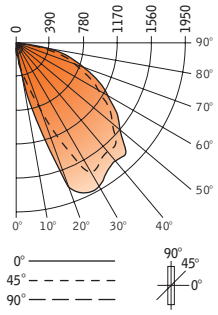
# avenue® a



Filename: FAVANS1T5H.IES
Catalog #: FAVA-NS-1T5HO-1C-120-S-G-WH-4'
Efficiency: 57%
Test #: 12355.0

## CANDLEPOWER DISTRIBUTION




| Vertical Angle | Horizontal Angle 0° | 22.5° | 45° | 67.5° | 90° | Zonal Lumens |
|---|---|---|---|---|---|---|
| 0° | 108 | 108 | 108 | 108 | 108 | |
| 5° | 276 | 256 | 214 | 154 | 101 | 13 |
| 15° | 919 | 771 | 499 | 291 | 102 | 85 |
| 25° | 1933 | 1873 | 1300 | 415 | 101 | 279 |
| 35° | 1832 | 1799 | 1695 | 707 | 96 | 408 |
| 45° | 1806 | 1775 | 1647 | 1296 | 88 | 610 |
| 55° | 1434 | 1416 | 1329 | 1108 | 74 | 580 |
| 65° | 1072 | 1052 | 962 | 811 | 56 | 473 |
| 75° | 655 | 631 | 568 | 458 | 39 | 294 |
| 85° | 317 | 294 | 224 | 129 | 14 | 119 |
| 90° | 183 | 165 | 112 | 40 | 2 | |
| 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 | |

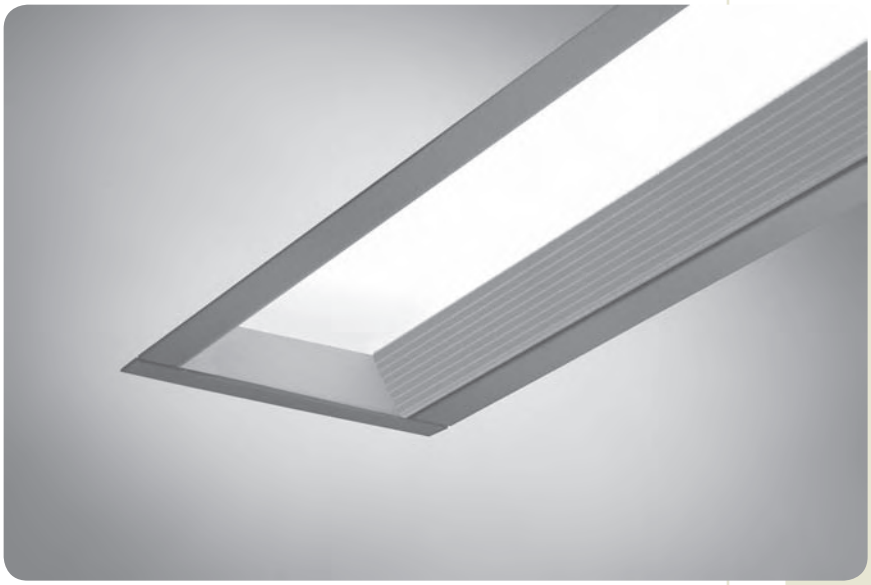
## LUMEN SUMMARY

| | Zone | Lumens | % Lamp | % Fixt |
|---|---|---|---|---|
| | 0°-30° | 376 | 7.5 | 13.2 |
| | 0°-40° | 784 | 15.7 | 27.4 |
| | 0°-60° | 1975 | 39.5 | 69.0 |
| | 0°-90° | 2861 | 57.2 | 100.0 |
| Total Luminaire | 0°-180° | 2861 | 57.2 | 100.0 |

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

# avenue® b

FOCAL POINT®



## FEATURES

Narrow 3" slot T5 fluorescent with opaque satin lens.

Shielding options include corrugated, solid regressed trim, concave louver as well as flush lens.

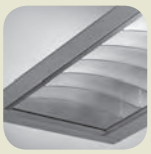
Drywall installation is available, which allows for both individual or continuous row mount capability.

Avenue® B is a great solution for general illumination in a narrow aperture.

### shielding options

corrugated regress trim

solid regress trim

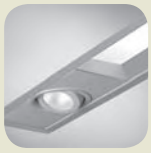


concave louver

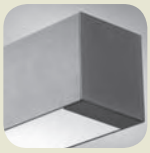
flush lens

microglow™ lens

### companion luminaire



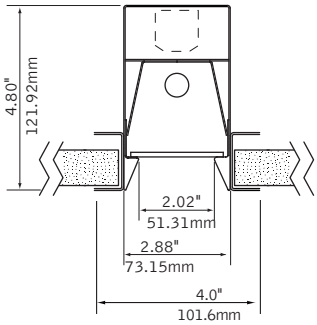
mr16



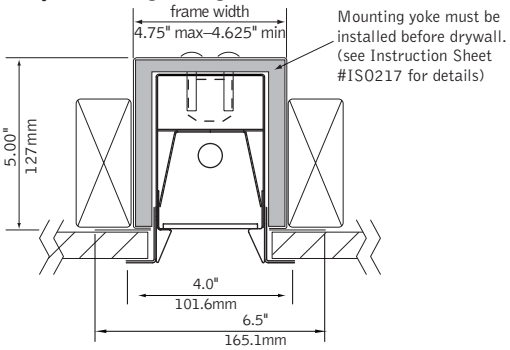
linear

## DIMENSIONAL DATA

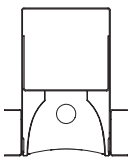
### Grid Mount (Regress Trim Shown)



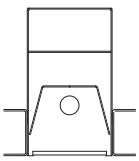

### Drywall Flange (Regress Trim Shown)



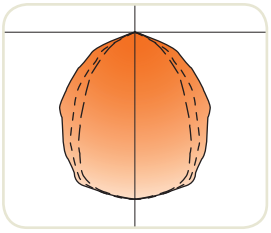

### Louver



### Flush Lens



## PERFORMANCE



1–Lamp T5
62% Efficiency
1466 cd @ 0°

See **Photometric** section for additional performance data.

january 2008

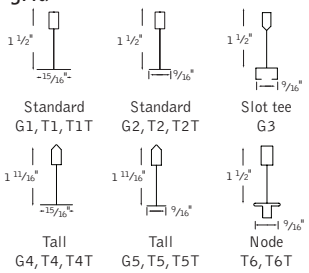
fixture type:

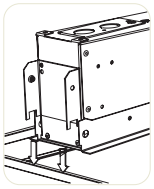
project name:



## DETAILS

### grid





### drywall

2' unit (cutout dimension: 3.5" x 23.6")

3' unit (cutout dimension: 3.5" x 35.6")

4' unit (cutout dimension: 3.5" x 47.6")

5' unit (cutout dimension: 3.5" x 59.6")

Drywall flange version provided with mounting yoke.

## SPECIFICATIONS

### construction

One-piece 20 Ga. steel housing.

Corrugated and solid regress trim constructed of 6063-T5 extruded aluminum finished in Matte Satin White.

Grid luminaires include 20 Ga. steel, .5" wide flange rail finished in Matte Satin White.

Drywall flange option is provided with 20 Ga. steel, .5" wide flange kit and 20 Ga. galvanized steel mounting yoke.

| | |
|---|---|
| 2' unit weight: | 5 lbs. |
| 3' unit weight: | 6 lbs. |
| 4' unit weight: | 7 lbs. |
| 5' unit weight: | 8 lbs. |

### optic

22 Ga. steel reflectors finished in High Reflectance White powder coat.

Frosted Acrylic lens diffuser .118" thick.

Clear Acrylic MicroGlow™ diffuser .125" thick with miniature prismatic pattern.

Concave parabolic louver: 1"H x 1" 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.

Optional DALI and other dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

### emergency

Emergency battery packs provide 90 minutes of illumination.

Initial lumen output for lamp types are as follows:

| | |
|---|---|
| T5 Lamp: | Up to 550 lumens |
| T5HO Lamps: | Up to 825 lumens |

Battery pack requires unswitched hot from same branch circuit as AC ballast.

### finish

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

Standard luminaire housing finished in Matte Satin White.

## ORDERING

| | | |
|---|---|---|
| **luminaire series** | | FAVB |
| Avenue B | FAVB | |
| **shielding** | | NS |
| Corrugated Regressed Trim Frst.Lns | CR | |
| Solid Regressed Trim Frosted Lens | SR | |
| Concave Parabolic Louver | PL | |
| Flush Frosted Lens | FL | |
| Corrugated Regressed Trim with MicroGlow™ Lens | CRM | |
| Solid Regressed Trim MicroGlow™ Lens | SRM | |
| Flush MicroGlow™ Lens | FLM | |
| White Concave Parabolic Louver | PW | |
| **lamping** | | 1T5 |
| One Lamp T5 | 1T5 | |
| One Lamp T5HO | 1T5HO | |
| **circuits** | | 1C |
| Single Circuit | 1C | |
| **voltage** | | 277 |
| 120 Volt | 120 | |
| 277 Volt | 277 | |
| 347 Volt (Consult factory for availability) | 347 | |
| **ballast** | | S |
| Electronic Program Start <10% THD | S | |
| Electronic Dimming Ballast | D | |
| **ceiling configurations** (For mounting configurations, see Reference section) | | G1 |
| Drywall Flange (Consult factory for custom variations) | F | |
| Std. 15/16" Lay-in | G1 | |
| Std. 15/16" Tegular | T1 | |
| Std. 15/16" Tegular, against Tee | T1T | |
| Std. 9/16" Lay-in | G2 | |
| Std. 9/16" Tegular | T2 | |
| Std. 9/16" Tegular, against Tee | T2T | |
| 9/16" Slot-tee Tegular | G3 | |
| Tall 15/16" Lay-in | G4 | |
| Tall 15/16" Tegular | T4 | |
| Tall 15/16" Tegular, against Tee | T4T | |
| Tall 9/16" Lay-in | G5 | |
| Tall 9/16" Tegular | T5 | |
| Tall 9/16" Tegular, against Tee | T5T | |
| Node 9/16" Tegular | T6 | |
| Node 9/16" Tegular, against Tee | T6T | |
| **factory options** | | - |
| Chicago Plenum | CP | |
| Emergency Circuit | EC | |
| Emergency Battery Pack (3' & 4' Luminaires Only) | EM | |
| Seismic Brackets | EQ | |
| HLR/GLR Fuse | FU | |
| Include 3000K Lamp | L830 | |
| Include 3500K Lamp | L835 | |
| Include 4100K Lamp | L841 | |
| **finish** | | WH |
| Matte White Housing | WH | |
| **luminaire length** | | WH |
| 2' Nominal Housing | 2' | |
| 3' Nominal Housing | 3' | |
| 4' Nominal Housing | 4' | |
| 5' Nominal Housing (Dimming not available with 5' lamps) (For continuous row mount in drywall ceiling, specify luminaire run length, ie 24') | 5' | |

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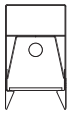
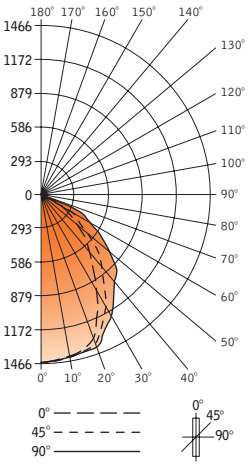
## regress with lens
# avenue® b



Filename: FAVBSR1T5HO.IES
Catalog #: FAVB-SR-1T5HO-1C-120-S-G1-WH-4'
Efficiency: 62%
Test #: 12914.0

### CANDLEPOWER DISTRIBUTION




| Vertical Angle | 0° | 22.5° | 45° | 67.5° | 90° | Zonal Lumens |
|---|---|---|---|---|---|---|
| 0° | 1466 | 1466 | 1466 | 1466 | 1466 | |
| 5° | 1457 | 1457 | 1456 | 1456 | 1456 | 139 |
| 15° | 1432 | 1428 | 1417 | 1399 | 1393 | 401 |
| 25° | 1311 | 1299 | 1254 | 1187 | 1150 | 575 |
| 35° | 1102 | 1073 | 958 | 837 | 793 | 599 |
| 45° | 934 | 866 | 701 | 586 | 553 | 565 |
| 55° | 649 | 578 | 426 | 357 | 335 | 416 |
| 65° | 404 | 328 | 232 | 187 | 174 | 257 |
| 75° | 184 | 133 | 77 | 60 | 58 | 103 |
| 85° | 39 | 21 | 19 | 18 | 17 | 24 |
| 90° | 0 | 0 | 0 | 0 | 0 | |
| 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: 1.1

### LUMEN SUMMARY

| | Zone | Lumens | % Lamp | % Fixt |
|---|---|---|---|---|
| | 0°-30° | 1115 | 22.3 | 36.2 |
| | 0°-40° | 1714 | 34.3 | 55.7 |
| | 0°-60° | 2695 | 53.9 | 87.5 |
| | 0°-90° | 3078 | 61.6 | 100.0 |
| Total Luminaire | 0°-180° | 3078 | 62 | 100.0 |

### LUMINANCE DATA (CD/M²)

| Vertical Angle | 0° | 45° | 90° |
|---|---|---|---|
| 45° | 16467 | 12359 | 9750 |
| 55° | 14106 | 9259 | 7281 |
| 65° | 11918 | 6844 | 5133 |
| 75° | 8863 | 3709 | 2794 |
| 85° | 5579 | 2718 | 2432 |

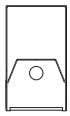
### CO-EFFICIENTS OF UTILIZATION

| Floor | | 80 | | | 70 | | | 50 | 30 | 10 | 00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ceiling | | | | | | | | 20 | | | |
| Wall | 70 | 50 | 30 | 10 | 70 | 50 | 10 | 50 | 10 | 10 | 00 |
| RCR 0 | 73 | 73 | 73 | 73 | 72 | 72 | 72 | 68 | 65 | 63 | 62 |
| 1 | 68 | 66 | 64 | 62 | 67 | 65 | 61 | 62 | 59 | 60 | 57 | 58 | 56 | 54 |
| 2 | 63 | 59 | 56 | 53 | 62 | 58 | 52 | 56 | 51 | 54 | 50 | 52 | 49 | 48 |
| 3 | 59 | 53 | 49 | 46 | 57 | 52 | 45 | 51 | 45 | 49 | 44 | 48 | 43 | 42 |
| 4 | 54 | 48 | 43 | 40 | 59 | 47 | 40 | 46 | 39 | 45 | 39 | 43 | 38 | 37 |
| 5 | 50 | 43 | 38 | 35 | 49 | 42 | 34 | 41 | 34 | 40 | 34 | 39 | 33 | 32 |
| 6 | 46 | 39 | 34 | 31 | 45 | 39 | 30 | 37 | 30 | 36 | 30 | 36 | 30 | 29 |
| 7 | 43 | 35 | 31 | 27 | 42 | 35 | 27 | 34 | 27 | 33 | 27 | 32 | 26 | 25 |
| 8 | 40 | 32 | 27 | 24 | 39 | 32 | 24 | 31 | 24 | 30 | 23 | 29 | 23 | 22 |
| 9 | 37 | 29 | 24 | 21 | 36 | 29 | 21 | 28 | 21 | 27 | 21 | 27 | 20 | 19 |
| 10 | 34 | 26 | 22 | 19 | 33 | 26 | 19 | 25 | 18 | 25 | 18 | 24 | 18 | 17 |

Numbers indicate percentage values of reflectivity.

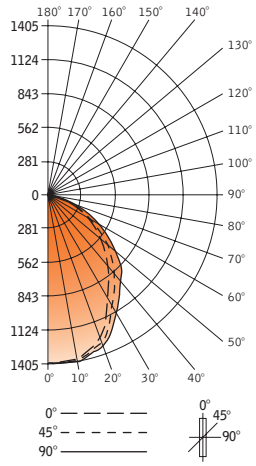
Go to www.focalpointlights.com for additional photometric data.

## flush lens
# avenue® b



Filename: FAVBFL1T5.IES
Catalog #: FAVB-FL-1T5HO-1C-120-S-G1-WH-4'
Efficiency: 65%
Test #: 13734.0

### CANDLEPOWER DISTRIBUTION




| Vertical Angle | 0° | 22.5° | 45° | 67.5° | 90° | Zonal Lumens |
|---|---|---|---|---|---|---|
| 0° | 1397 | 1397 | 1397 | 197 | 1397 | |
| 5° | 1395 | 1395 | 1394 | 1391 | 1392 | 133 |
| 15° | 1361 | 1357 | 1342 | 1329 | 1324 | 381 |
| 25° | 1242 | 1228 | 1192 | 1159 | 1145 | 552 |
| 35° | 1029 | 1005 | 950 | 903 | 885 | 599 |
| 45° | 8446 | 812 | 747 | 700 | 684 | 586 |
| 55° | 580 | 550 | 501 | 471 | 464 | 458 |
| 65° | 356 | 338 | 310 | 297 | 293 | 315 |
| 75° | 165 | 158 | 150 | 144 | 142 | 160 |
| 85° | 35 | 37 | 38 | 38 | 40 | 41 |
| 90° | 0 | 0 | 0 | 0 | 0 | |
| 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: 1.0

### LUMEN SUMMARY

| | Zone | Lumens | % Lamp | % Fixt |
|---|---|---|---|---|
| | 0°-30° | 1066 | 21.3 | 33.0 |
| | 0°-40° | 1665 | 33.3 | 51.6 |
| | 0°-60° | 2709 | 54.2 | 84.0 |
| | 0°-90° | 3225 | 64.5 | 100.0 |
| Total Luminaire | 0°-180° | 3225 | 64.5 | 100.0 |

### LUMINANCE DATA (CD/M²)

| Vertical Angle | 0° | 45° | 90° |
|---|---|---|---|
| 45° | 19577 | 17286 | 15828 |
| 55° | 16546 | 14293 | 13237 |
| 65° | 13784 | 12003 | 11344 |
| 75° | 10432 | 9483 | 8977 |
| 85° | 6571 | 7134 | 7510 |

### CO-EFFICIENTS OF UTILIZATION

| Floor | | 80 | | | 70 | | | 50 | 30 | 10 | 00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ceiling | | | | | | | | 20 | | | |
| Wall | 70 | 50 | 30 | 10 | 70 | 50 | 10 | 50 | 10 | 10 | 00 |
| RCR 0 | 77 | 77 | 77 | 77 | 75 | 75 | 75 | 72 | 72 | 69 | 69 | 66 | 66 | 65 |
| 1 | 71 | 69 | 66 | 64 | 70 | 67 | 63 | 64 | 61 | 62 | 59 | 60 | 57 | 56 |
| 2 | 66 | 61 | 57 | 54 | 64 | 60 | 53 | 58 | 52 | 56 | 51 | 54 | 50 | 49 |
| 3 | 61 | 55 | 50 | 46 | 59 | 54 | 46 | 52 | 45 | 50 | 44 | 49 | 44 | 42 |
| 4 | 56 | 49 | 44 | 40 | 55 | 48 | 40 | 47 | 39 | 45 | 39 | 44 | 38 | 37 |
| 5 | 51 | 44 | 38 | 34 | 50 | 43 | 34 | 42 | 34 | 41 | 34 | 39 | 33 | 32 |
| 6 | 48 | 40 | 34 | 30 | 46 | 39 | 30 | 38 | 30 | 37 | 30 | 36 | 29 | 28 |
| 7 | 44 | 36 | 30 | 27 | 43 | 35 | 27 | 34 | 26 | 33 | 26 | 32 | 26 | 25 |
| 8 | 43 | 32 | 27 | 23 | 40 | 32 | 23 | 31 | 23 | 30 | 23 | 29 | 23 | 22 |
| 9 | 37 | 29 | 24 | 20 | 37 | 29 | 20 | 28 | 20 | 27 | 20 | 26 | 20 | 19 |
| 10 | 35 | 26 | 21 | 18 | 34 | 26 | 18 | 25 | 18 | 25 | 18 | 24 | 18 | 17 |

Numbers indicate percentage values of reflectivity.

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

Surfside is a sleek, contemporary adjustable arm task light with two arm sizes and two distinctively different light sources. Available in either 13 watt compact fluorescent or state of the art LED versions, Surfside will provide the right amount of light where needed in the task area. Surfside is available in black or silver with 10 solid or transparent colored shade options. The shade assemblies are easily interchangeable to suit user preference.

SURFSIDE



## Ordering Information

| SU | F | — | L | S | T | — | SL |
|---|---|---|---|---|---|---|---|
| **Series** | **Lamps** | | **Arm** | **Color** | **Mounting** | | **Options** |

**SU** = Surfside

**F** = 13W Compact Fluorescent
**L** = LED 8x1w

**S** = 14"
**L** = 20"

**B** = Black
**S** = Silver

**E** = Edge Clamp
**F** = Floor Stand
**P** = Panel Bracket
**S** = Slat Wall Bracket
**T** = Table Base
**Z** = Zero Clearance Bracket

**Shade Color Options**
**AM** = Amber
**BK** = Black (solid)
**BL** = Blue
**BW** = Blue White
**GN** = Green
**PL** = Purple
**SM** = Smoke
**SI** = Silver (solid)
**WN** = Wine
**WT** = White (solid)

**Example = SUF–SSP–WT**

**Note:** Colorsnot designated as solid are transparent.

## Dimensions

Shade


Entire Fixture


## Shade Color Options



Solid Color Shade Color Options

# SURFSIDE

Fluorescent / LED Task Light

## Features

**Lamp:** 13w compact fluorescent 4-pin /2G7 base (3500k). Lamps included. Or 8x1w LEDs (6500k). LEDs included.

**Electrical:** Wired for 120V 60Hz operation.

**Ballast:** In-line hybrid electronic ballast with quick connect cord.

**Transformer (LED):** In-line transformer with quick connect cord. Primary input: 120V. Secondary output: 12V.

**Power Cord:** Quick connect. Minimum 6ft (182mm) long.

**Arm:** Extruded aluminum, spring-balanced arm with adjustable tension joints. Available in 14" or 20" lengths.

**Shade:** Hi-impact polycarbonate with a perforated reflector and prismatic lens. Solid or transparent colors. See color options in options block.

**Finish:** Matte black or silver

**Listing:** UL/cUL listed.

## Mounting Options

**Edge Clamp (E):** Clamps onto edge of desk or table.

**Floor Stand (F):** Weighted floor base.

**Panel Bracket (P):** Attaches to 1" slotted panel standard. Consult factory for furniture compatibility.

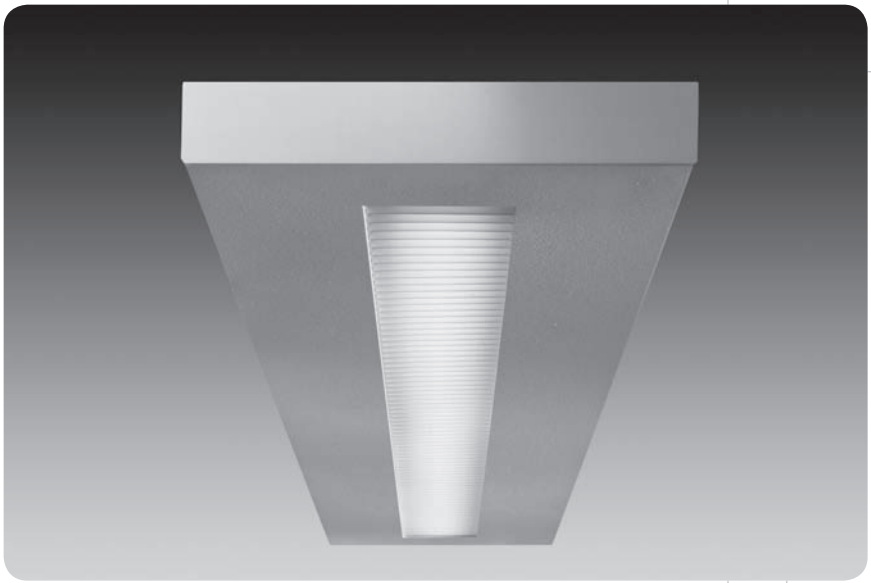
**Slat Wall Bracket (S):** Attaches to many furniture slat wall systems. Consult factory for furniture compatibility.

**Table Base (T):** 9" diameter weighted base for desktop use.

**Zero Clearance Bracket (Z):** Two-piece edge clamp for tight spaces. Clamps onto edge of desk or table.

louver/indirect

# twelve™



Covered by the following U.S. Patents: 5,733,028; 5,914,487; 5,967,652; 6,043,873; 6,064,061; 6,088,091; 6,238,077; 6,266,136; 6,334,700.

FOCAL POINT®

## features

Suspended direct/indirect ideal for low ceiling applications.

Twelve™ delivers 70% indirect/30% direct illumination.

The CU Filter precisely controls lamp brightness above the fixture to allow for 12" suspension lengths.

Sleek rectilinear design adds clean style to any space.

Parallel blade louver with acrylic lens diffuser provides comfortable downlight shielding.

Excellent choice for lower ceiling applications and areas where ceiling uniformity is important.

### shielding options

solid indirect

louver

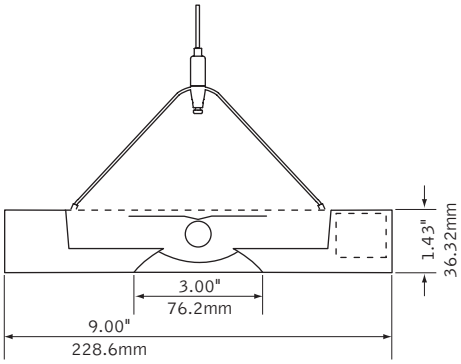
### sensor options

daylight / occupancy sensor

### companion luminaire

wall mount

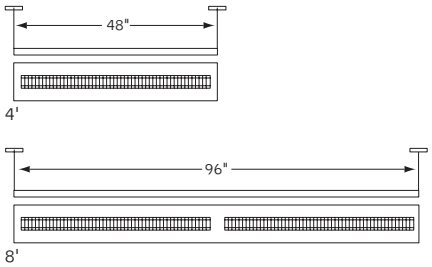
## dimensional data




### lamping options

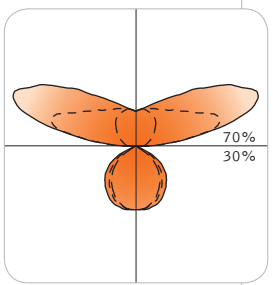
T5/T5HO LAMPS

### fixture information




## performance

1–Lamp T5HO
90% Efficiency
1264 cd @ 115°




Visit focalpointlights.com for complete photometric data.

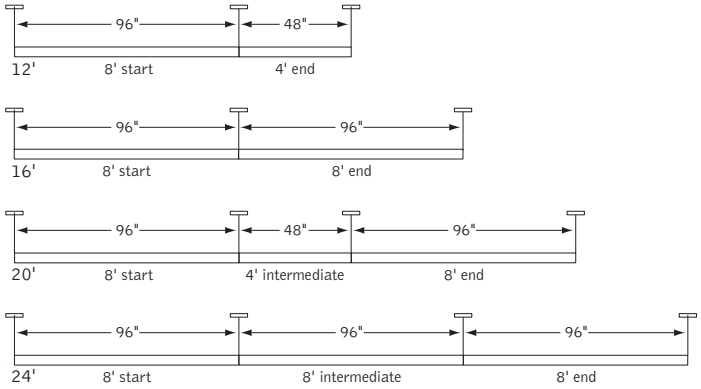
everGreen™

july 2008

fixture:

project:

## suspension information




Consult factory for additional row length information.

## specifications

### construction

One-piece 20 Ga. steel housing.
14 Ga. steel end caps mechanically attach flush to housing with concealed fasteners.
For row installation, internal brackets form hairline joint.
Standard lengths are available in 4' and 8'.
All luminaires are provided with Y-cable suspension mounted on 48" or 96" centers.

4' unit weight: 20 lbs.
8' unit weight: 38 lbs.

### optic

Reflector fabricated of low iridescent, semi specular premium grade aluminum.
Parallel Blade Louver: 24 Ga. steel, .5"H x 2.8"W x .56" frequency.
Louver blade finished to match housing and backed with an acrylic lens diffuser.
24 Ga. steel Ceiling Uniformity Filter (CU Filter) finished in high reflectance white powder coat.

### electrical

Luminaires are pre–wired with factory installed branch circuit wiring and over-molded quick connects.
Factory installed SJT power cord at feed location is included.
Electronic ballasts are thermally protected and have a Class "P" rating.
Optional dimming ballasts available.
UL and cUL listed.

### sensors

Lutron Daylight sensor is a directional sensor that operates with a Lutron EcoSystem ballast. The sensor has an integrated IR receiver for EcoSystem programming. One sensor controls multiple fixtures or groups of fixtures differently. Sensor should be mounted 1 to 2 times the effective window height (from 3' AFF, or bottom of window to top of window).

Lutron IR sensor controls individual or grouped EcoSystem ballasts or BMFs. Sensor provides a flashing LED response to indicate signal reception and received IR signals from up to 8' away when mounted on a 10' ceiling. Order Lutron IR remote accessory (LOR).

Wattstopper Daylight sensor is a closed loop system that measures total light level from daylight and electric light. A 0-10V dimming ballast is required, one sensor controls multiple fixtures. Sensor should be mounted 6-12' from window. Wattstopper daylight setup remote required for programming; one included per order. Order additional setup remote accessory (WYSR) or occupant controller remote accessory (WOR) for increased control.

Wattstopper Occupancy sensor is a passive infrared sensor designed for cubicles and small offices. It has built-in daylight sensing that will hold lights off when adequate ambient light exists. One sensor controls multiple fixtures.

### finish

Polyester powder coat applied over a 5-stage pre–treatment.
Canopy finished in Matte Satin White.

## ordering

| | | |
|---|---|---|
| **fixture series** | | FTWS |
| twelve | FTWS | |
| **shielding** | | NS |
| Parallel Blade Louver with CU Filter | PB | |
| Solid, no lens, 100% indirect | SD | |
| **lamping** | | 1T5 |
| 1 Lamp T5 | 1T5 | |
| 1 Lamp T5HO | 1T5HO | |
| 2 Lamp T5 | 2T5 | |
| 2 Lamp T5HO | 2T5HO | |
| **circuit** | | 277 |
| Single Circuit | 1C | |
| Dual Circuit (Multiple lamp luminaires only) | 2C | |
| **voltage** | | S |
| 120 Volt | 120 | |
| 277 Volt | 277 | |
| 347 Volt | 347 | |
| **ballast** | | G1 |
| Electronic Program Start <10% THD | S | |
| Electronic Dimming Ballast* | D | |
| **mounting** | | - |
| 12" Cable Suspension (5" canopy at feed locations and 2" canopy non–feed locations) (specify "C" in place of "J" for 5" dia. canopies both at power feed and non–feed locations) (suspension may be adjusted up to 24". Consult factory for lengths longer than 24") | J12 | |
| Stem Mount (specify stem length in inches Standard stem lengths 6, 12, 18, 24, 36, 48". Stem painted white unless otherwise specified) | S__ | |
| **factory options** | | |
| Emergency Circuit* | EC | WH |
| Emergency Battery Pack* | EM | |
| HLR/GLR Fuse | FU | 4' |
| Include 3000K Lamp | L830 | |
| Include 3500K Lamp | L835 | |
| Include 4100K Lamp (factory installed lamps recommended) | L841 | |
| Lutron™ Daylight Sensor* (EcoSystem ballast required) | LY1 | |
| Lutron™ IR Receiver* (EcoSystem ballast required) | LIR | |
| Lutron™ Sensor Feed* (EcoSystem ballast required) | SF | |
| WattStopper™ Daylight Sensor* (0–10V dimming ballast required) | WY1 | W01 |
| WattStopper™ Occupancy Sensor* | W01 | |
| **finish** | | TS |
| Matte Satin White | WH | |
| Titanium Silver (louver painted to match housing) | TS | |
| **fixture run length** | | 20' |
| 4' | 4' | |
| 8' | 8' | |
| 12' (8'+4') | 12' | |
| 16' (8'+8') | 16' | |
| 20' (8'+4'+8') | 20' | |
| 24' (8'+8'+8') (individual units may not be field modified for continuous row mount) | 24' | |
| **remotes** (specify quantity) | | |
| WattStopper™ Daylight Setup Remote* (required for daylight programming, one included per order) | WYSR | |
| WattStopper™ Occupant Controller* | WOR | |

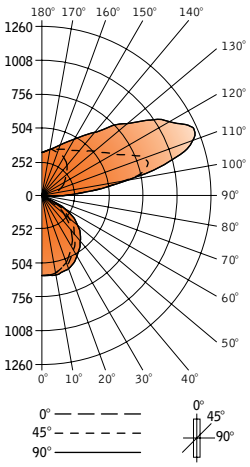
* for more information see Reference section.

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

louver
# twelve™

Filename: FTWSPB1T5H.IES
Catalog #: FTWS-PB-1T5HO-1C-120-S-C12-WH-4'
Efficiency: 90%
Test #: 12096.0

## CANDLEPOWER DISTRIBUTION




| Vertical Angle | Horizontal Angle 0° | 22.5° | 45° | 67.5° | 90° | Zonal Lumens |
|---|---|---|---|---|---|---|
| 0° | 590 | 590 | 590 | 590 | 590 | |
| 5° | 587 | 589 | 590 | 593 | 593 | 56 |
| 15° | 551 | 553 | 562 | 575 | 582 | 160 |
| 25° | 486 | 492 | 510 | 537 | 553 | 238 |
| 35° | 394 | 404 | 429 | 464 | 486 | 273 |
| 45° | 290 | 301 | 333 | 376 | 407 | 263 |
| 55° | 178 | 193 | 226 | 269 | 301 | 208 |
| 65° | 86 | 99 | 126 | 157 | 177 | 127 |
| 75° | 29 | 41 | 52 | 60 | 59 | 52 |
| 85° | 0 | 7 | 11 | 11 | 7 | 9 |
| 90° | 0 | 0 | 1 | 1 | 1 | |
| 95° | 17 | 171 | 105 | 74 | 69 | 107 |
| 105° | 75 | 364 | 788 | 952 | 937 | 690 |
| 115° | 136 | 315 | 772 | 1151 | 1264 | 729 |
| 125° | 202 | 312 | 609 | 928 | 1051 | 555 |
| 135° | 255 | 330 | 516 | 722 | 806 | 406 |
| 145° | 321 | 355 | 449 | 550 | 302 | 285 |
| 155° | 357 | 373 | 415 | 462 | 490 | 194 |
| 165° | 373 | 377 | 385 | 399 | 410 | 110 |
| 175° | 365 | 365 | 365 | 364 | 364 | 35 |
| 180° | 352 | 352 | 352 | 352 | 352 | |

Spacing 1.1
Criterion: 1.3

## LUMEN SUMMARY

| | Zone | Lumens | % Lamp | % Fixt |
|---|---|---|---|---|
| | 0°-30° | 454 | 9.1 | 10.1 |
| | 0°-90° | 1387 | 27.7 | 30.8 |
| | 90°-130° | 2082 | 41.6 | 46.3 |
| | 90°-180° | 3112 | 62.2 | 69.2 |
| Total Luminaire | 0°-180° | 4498 | 90.0 | 100.0 |

## LUMINANCE DATA (CD/M²)

| Vertical Angle | 0° | 45° | 90° |
|---|---|---|---|
| 45° | 2147 | 2466 | 3014 |
| 55° | 1625 | 2063 | 2748 |
| 65° | | | |
| 75° | 1066 | 1531 | 2193 |
| 85° | 587 | 1052 | 1194 |

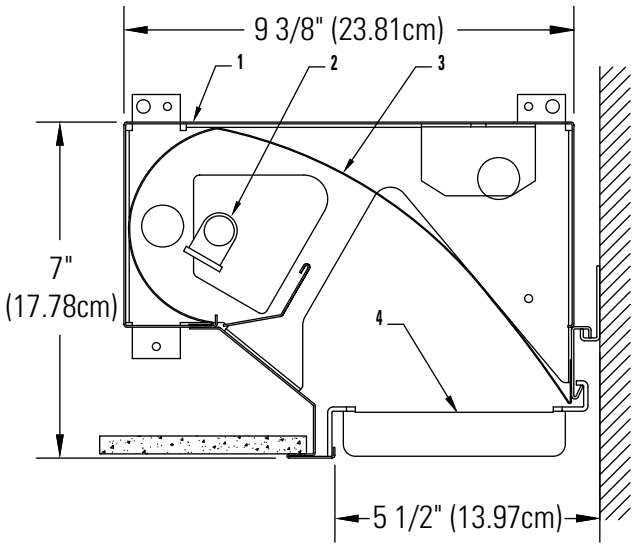
## CO-EFFICIENTS OF UTILIZATION

| Floor | | 80 | | | 70 | | 50 | | 30 | | 10 | 00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ceiling | | | | | | | 20 | | | | | |
| Wall | 70 | 50 | 30 | 10 | 70 | 50 | 10 | 50 | 10 | 50 | 10 | 00 |
| RCR 0 | 92 | 92 | 92 | 92 | 83 | 83 | 83 | 65 | 65 | 49 | 49 | 35 | 35 | 28 |
| 1 | 85 | 81 | 78 | 75 | 76 | 73 | 68 | 58 | 54 | 44 | 42 | 31 | 30 | 24 |
| 2 | 77 | 71 | 66 | 62 | 69 | 64 | 56 | 51 | 46 | 39 | 36 | 28 | 26 | 21 |
| 3 | 71 | 63 | 57 | 52 | 64 | 57 | 47 | 46 | 39 | 35 | 31 | 25 | 23 | 19 |
| 4 | 65 | 56 | 49 | 44 | 58 | 51 | 40 | 41 | 33 | 31 | 27 | 23 | 20 | 16 |
| 5 | 59 | 50 | 43 | 38 | 53 | 45 | 35 | 36 | 29 | 28 | 23 | 21 | 17 | 14 |
| 6 | 55 | 45 | 38 | 33 | 49 | 40 | 30 | 33 | 25 | 25 | 20 | 19 | 15 | 12 |
| 7 | 51 | 40 | 33 | 29 | 45 | 36 | 26 | 30 | 22 | 23 | 18 | 17 | 13 | 11 |
| 8 | 47 | 36 | 30 | 25 | 42 | 33 | 23 | 27 | 19 | 21 | 16 | 15 | 12 | 09 |
| 9 | 43 | 33 | 27 | 22 | 39 | 30 | 20 | 24 | 17 | 19 | 14 | 14 | 10 | 08 |
| 10 | 40 | 30 | 24 | 20 | 36 | 27 | 18 | 22 | 15 | 17 | 12 | 13 | 09 | 07 |

Numbers indicate percentage values of

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

F05




Quarter Scale

## Module Ordering Information

| Family | Lamps | Lamp Type | Shielding | Voltage | Length | Options |
|---|---|---|---|---|---|---|
| PTS5 | 1 | S | S | 2 | 4 | |
| | **1** = 1 Lamp | **S** = Standard<br>**H** = HO | **O** = Open<br>**L** = Lens<br>**S** = Straight Blade Louver | **1** = 120V<br>**2** = 277V<br>**3** = 347V<br>**D1** = 120V Dim.<br>**D2** = 277V Dim.<br>**E1** = 120V Emerg.<br>**E2** = 277V Emerg. | **2** = Two-Foot<br>**3** = Three-Foot<br>**4** = Four-Foot<br>**6** = Six-Foot<br>**8** = Eight-Foot | **Blank** = No Options<br>**A** = Adjustable*<br>**X4** = 4 thru wires<br>**X5** = 5 thru wires<br>**A4** = Adjustable 4 thru wires*<br>**A5** = Adjustable 5 thru wires* |

** only available on Two-Foot, Three-Foot and Four-Foot versions. See length variations of adjustable fixtures on page 2.*

## Features

1. **Housing:** Die-formed 20 gauge pre-painted steel. Integral heavy gauge bulkheads support housing and trim, permitting modules to be bolted together in continuous runs and facilitate suspension.
2. **Lamping:** Cross-sectional one linear T5 fluorescent lamp. Provided by others.
3. **Reflector:** Precision parabolic roll-formed semi-specular aluminum.
4. **Louver:** Lift and shift straight blade louver constructed from die-formed aluminum and painted to match housing. Louver blades are 1" (2.54cm) high on 1-1/8" (2.86cm) centers. (Optional)

## Mounting

"J" Rail is first mounted to the wall and the modules connect to the rail for 1/4" (0.64cm) wall adjustment. Modules are hung from suspension wires attached to the fixture bulkheads and the structure above.

## Electrical

**Electronic Ballast:** Programmed start, 3 conductor, 12 gauge wire. Color-coded quick connectors allow easy connection for modular fixutres. Factory installed ballast disconnect allows the ballast to be disconnected from and reconnected to incoming power under load without turning the entire circuit off.

**Dimming:** T5 lamp uses PowerSpec® HDF. Use PowerSpec® HDF compatible three-wire control (extra control lead required).

T5 HO lamp uses Advance Mark X. Use Advance compatible two-wire control (no extra control lead required).

**Emergency Battery Pack:** 450 Lumens @ 90 minimum.

## Ordering Instructions

**Individual Fixtures:**

1. Order number of MODULES required.
2. Order one END SET per MODULE.

**Continuous Rows:**

1. Determine run length.
2. Order the appropriate number of MODULES for the complete ROW.
3. Stagger rows must be completed with an adjustable module. (2-light only)
4. Non-stagger rows must be completed with an adjustable module unless row lengths are in precise 1 foot (30.48cm) intervals.
5. Order one END SET per ROW.

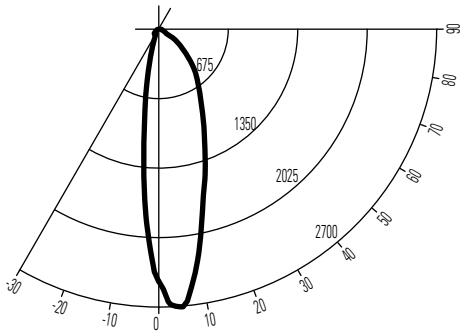
## Labels

UL, cUL and IBEW

| Job Information | Type: |
|---|---|
| **Job Name:** | |
| **Cat. No.:** | |
| **Lamp(s):** | |
| **Notes:** | |

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

## Performance & Quick Calculators




**Report No:** ITL53559
**Cat No:** PTS51HS14
**Lamps:** 1 F54T5
**Lumens:** 5000
**Efficiency:** 37.2%

**CANDLEPOWER**

| ZONE | 0 | 45 | 90 | 135 | 180 |
|---|---|---|---|---|---|
| DEG. | | | | | |
| 180 | 0 | 0 | 0 | 0 | 0 |
| 175 | 0 | 0 | 0 | 0 | 0 |
| 165 | 0 | 0 | 0 | 0 | 0 |
| 155 | 0 | 0 | 0 | 0 | 0 |
| 145 | 0 | 0 | 0 | 0 | 0 |
| 135 | 0 | 0 | 0 | 0 | 0 |
| 125 | 0 | 0 | 0 | 0 | 0 |
| 115 | 0 | 0 | 0 | 0 | 0 |
| 105 | 0 | 0 | 0 | 0 | 0 |
| 95 | 0 | 0 | 0 | 0 | 0 |
| 90 | 21 | 28 | 0 | 0 | 0 |
| 85 | 27 | 39 | 12 | 10 | 0 |
| 75 | 34 | 78 | 53 | 45 | 9 |
| 65 | 66 | 190 | 106 | 89 | 20 |
| 55 | 224 | 262 | 176 | 128 | 34 |
| 45 | 428 | 408 | 433 | 130 | 60 |
| 35 | 673 | 686 | 997 | 123 | 55 |
| 25 | 1036 | 1163 | 1558 | 203 | 83 |
| 15 | 1674 | 1943 | 2044 | 611 | 343 |
| 5 | 2708 | 2681 | 2376 | 1811 | 1594 |
| 0 | 2450 | 2450 | 2450 | 2450 | 2450 |

**COEFFICIENTS OF UTILIZATION**

% EFFECTIVE CEILING CAVITY REFLECTANCE

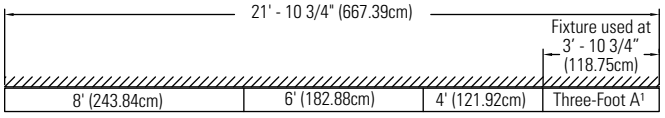
| | 80 | | | 70 | | | 50 | | |
|---|---|---|---|---|---|---|---|---|---|
| | % WALL REFLECTANCE | | | | | | | | |
| ROOM CAVITY RATIO | 70 | 50 | 30 | 70 | 50 | 30 | 50 | 30 | 10 |
| 0 | 44 | 44 | 44 | 43 | 43 | 43 | 41 | 41 | 41 |
| 1 | 41 | 40 | 39 | 40 | 39 | 38 | 28 | 37 | 36 |
| 2 | 39 | 36 | 34 | 38 | 36 | 34 | 34 | 33 | 32 |
| 3 | 36 | 33 | 31 | 35 | 33 | 30 | 32 | 30 | 28 |
| 4 | 34 | 30 | 28 | 33 | 30 | 28 | 29 | 27 | 25 |
| 5 | 32 | 28 | 25 | 31 | 28 | 25 | 27 | 25 | 23 |
| 6 | 30 | 26 | 23 | 29 | 26 | 23 | 25 | 23 | 21 |
| 7 | 28 | 24 | 22 | 28 | 24 | 22 | 24 | 21 | 20 |
| 8 | 27 | 23 | 20 | 26 | 23 | 20 | 22 | 20 | 18 |
| 9 | 25 | 21 | 19 | 25 | 21 | 19 | 21 | 19 | 17 |
| 10 | 24 | 20 | 18 | 24 | 20 | 18 | 20 | 17 | 16 |

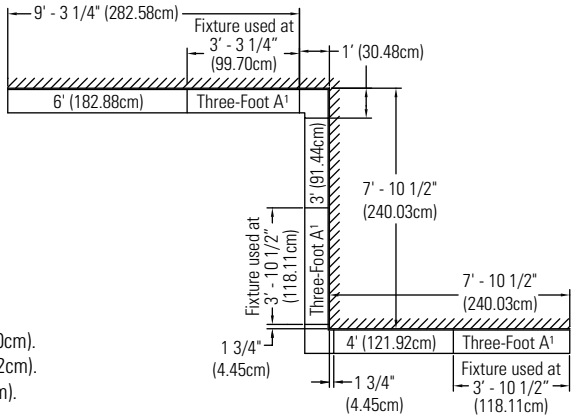
Floor cavity reflectance = 20%

**ZONAL LUMEN SUMMARY**

| ZONE | LUMENS | % BARELAMP | % LUMINAIRE |
|---|---|---|---|
| 0-90 | 1861 | 37.2 | 100.0 |
| 90-180 | 0.0 | 0.0 | 0.0 |
| 0-180 | 1861 | 37.2 | 100.0 |

## Sample Run



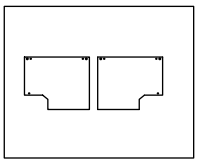




[1] *A = Adjustable Fixture or Adjustable Staggered Fixture*

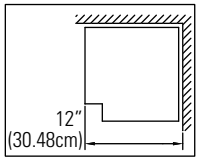
**For Fixture Using non-Staggered Lamps**
The Four-Foot Adjustable Fixture has a range of 48.75"(123.83cm) - 60"(152.40cm).
The Three-Foot Adjustable Fixture has a range of 36.75"(93.35cm) - 48"(121.92cm).
The Two-Foot Adjustable Fixture has a range of 24.75"(62.87cm) - 36"(91.44cm).

**For Fixture Using Staggered Lamps**
The Four-Foot Adjustable Staggered Fixture has a range of 51"(129.54cm) - 60"(152.40cm).
The Three-Foot Adjustable Staggered Fixture has a range of 39"(99.06cm) - 48"(121.92cm).
The Two-Foot Adjustable Staggered Fixture has a range of 27"(68.58cm) - 36"(91.44cm).

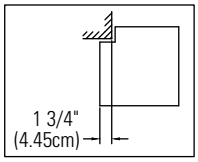
## End Plate and Corner Block Accessories



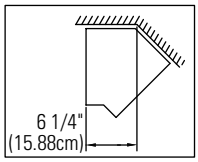
**End Cap Set:**
PTSEP



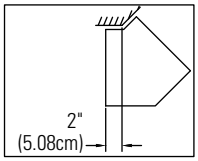

**90° Inside Corner:**
PTS9ØINCO - Open
PTS9ØINCL - Lens
PTS9ØINCS - Straight Blade Louver




**90° Outside Corner:**
PTS9ØOTCO - Open
PTS9ØOTCL - Lens
PTS9ØOTCS -Straight Blade Louver




**135° Inside Corner:**
PTS135INCO - Open
PTS135INCL - Lens
PTS135INCS - Straight Blade Louver




**135° Outside Corner:**
PTS135OTCO - Open
PTS135OTCL - Lens
PTS135OTCS - Straight Blade Louver

**Job Information** **Type:** F05

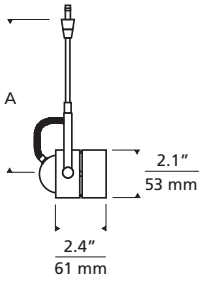
LOW-VOLTAGE ELEMENTS

# Spot

| FreeJack | MonoRail | Two-Circuit MonoRail | Wall MonoRail | Kable Lite | T~trak™ |
|---|---|---|---|---|---|
|  |  |  |  | N/A |  |

## ARCHITECTURAL HEAD

SPOT WITH EGGCRATE LOUVER
*Shown approximately 50% actual size.*




Socket terminates with FreeJack male connector, which may be installed into a system connector. Elements ordered with a system prefix include a connector for that system.

### DESCRIPTION
Classic head rotates 360˚ around stem, pivots 290˚. Can hold one lens or louver (sold separately). Low-voltage, MR16 lamp of up to 50 watts (not included).

### SYSTEM
Available for FreeJack, MonoRail, Two-Circuit MonoRail, and Wall MonoRail. For use on T~trak, order FreeJack version and T~trak FreeJack Connector (sold separately).

### COLOR
None.

### FINISH
Chrome, satin nickel.

### LAMP
Low-voltage halogen MR16 lamp up to 50 watts (not included).

### ACCESSORIES AND OPTICAL CONTROLS
Compatible optical controls (sold separately): Eggcrate Louver, Glass Lens.

### WEIGHT
0.84 lb./0.38 kg. ±

### ORDERING INFORMATION

| 700 | SYSTEM | SPT6 | LENGTH (A) | FINISH |
|---|---|---|---|---|
| | **FJ** FREEJACK | | **04** 4.5" | **C** CHROME |
| | **MO** MONORAIL | | **06** 6" | **S** SATIN NICKEL |
| | **MO2** TWO-CIRCUIT MONORAIL | | **12** 12" | |
| | | | **18** 18" | |
| | **WMO** WALL MONORAIL | | | |

TECH LIGHTING®

7400 Linder Avenue
Skokie, Illinois 60077
T 847.410.4400
F 847.410.4500

www.techlighting.com

700 MO SPT6 04 S

FIXTURE TYPE: F06

JOB NAME: UCI NAT. SCI. II

# Straight Rail

ANTIQUE BRONZE - BROWN INSULATOR

ANTIQUE BRONZE - CLEAR INSULATOR

CHROME - CLEAR INSULATOR

SATIN NICKEL - CLEAR INSULATOR

SHOWN ACTUAL SIZE
*(0.60" height x 0.30" width)*

mo_straight_rail_spec.pdf

## DESCRIPTION

Low-voltage conductor of two individual conductive metal pieces fused together by a plastic separator. Hand-bendable, field-cuttable MonoRail is rated for 300 watts at 12 volts, 600 watts at 24 volts. Each piece of rail is shipped with conductive connectors to join rail pieces end to end. Order additional connectors if cutting and rejoining rails. Standard MonoRail bends horizontally to a radius as small as 6" and vertically to a radius as small as 24".

## COLOR

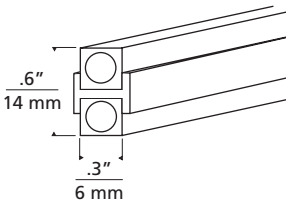
Insulator is available in clear and brown.

## FINISH

Antique bronze, chrome, satin nickel.

## WEIGHT

**24":** 0.27 lb./0.12 kg. ±
**48":** 0.55 lb./0.25 kg. ±
**96":** 1.10 lb./0.50 kg. ±




## ORDERING INFORMATION

**700MOA**

| LENGTH | | FINISH/INSULATOR | |
|---|---|---|---|
| **24** | 24" (0.6 m) | **BRZ** | ANTIQUE BRONZE W/ BROWN INSULATOR |
| **48** | 48" (1.2 m) | **Z** | ANTIQUE BRONZE W/ CLEAR INSULATOR |
| **96** | 96" (2.4 m) | **C** | CHROME W/ CLEAR INSULATOR |
| | | **S** | SATIN NICKEL W/ CLEAR INSULATOR |

TECH LIGHTING®

7400 Linder Avenue
Skokie, Illinois 60077
T 847.410.4400
F 847.410.4500

**www.techlighting.com**

700MOA 48+24 S

**FIXTURE TYPE:** T01

**JOB NAME:** UCI NAT. SCI II

# Ballerup

compact fluorescent

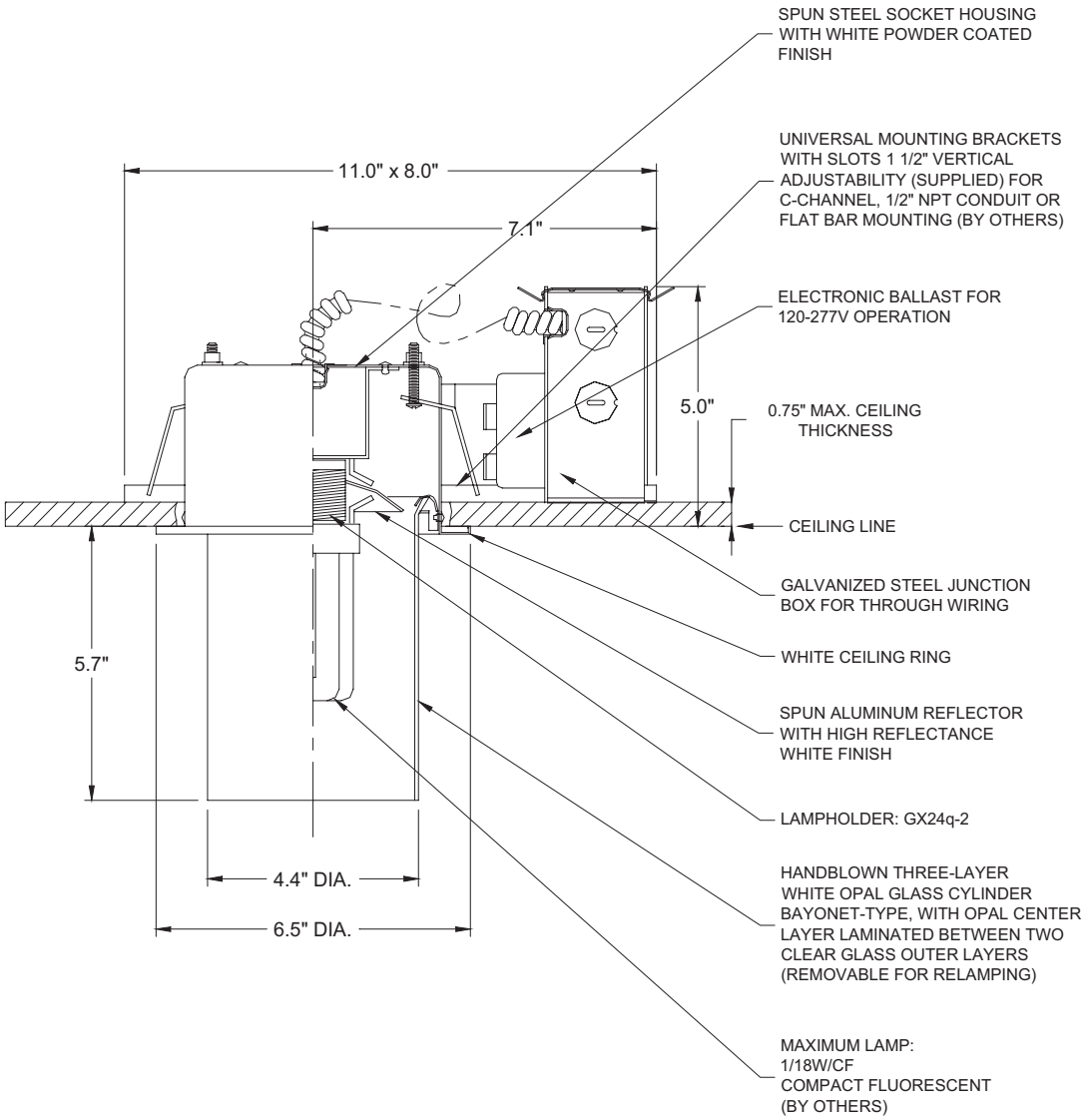
**Design:** C. J. Nørgaard Pedersen
and P. Hougaard Nielsen

**Type:** F07

**Project:**

**Catalog Number:**

NOTES:
1. SUITABLE FOR ACCESSIBLE NON-ACCESSIBLE CEILING TYPES
2. CEILING CUTOUT = 5.5" DIAMETER




louis poulsen

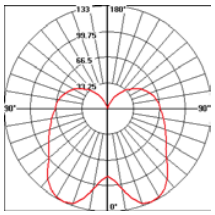
Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550

www.louispoulsen.com

# Ballerup

semi-recessed & surface

compact fluorescent




Photometric Report: BAL-1-18W-GX24Q-2.IES
Report No.: L3453
Poulsen Report No.: BAL-1-18W-GX24Q-2.IES
Luminaire: Ballerup Ceiling, Opal, Compact Fluorescent
Lamp: 1/18W/GX24Q-2
Efficiency: 86.6%
Description: All data shown are per 1000 lumens. This report can be used for calculation on all versions listed below. Use only actual lumen data when calculating.

Candlepower Distribution

| Vertical Angle | Candela |
|---|---|
| 0 | 88 |
| 5 | 93 |
| 10 | 105 |
| 25 | 133 |
| 40 | 120 |
| 55 | 92 |
| 70 | 79 |
| 85 | 70 |
| 90 | 67 |
| 120 | 50 |
| 150 | 16 |
| 180 | 0.1 |

Zonal Lumen Summary

| Zone | Lumens | % Lamp | % Fixture |
|---|---|---|---|
| 0-30 | 104 | 10.4 | 12 |
| 0-40 | 184 | 18.4 | 21.2 |
| 0-60 | 351 | 35.1 | 50.4 |
| 0-90 | 590 | 59 | 68.1 |
| 90-120 | 190 | 19 | 21.9 |
| 90-130 | 230 | 23 | 26.6 |
| 90-150 | 271 | 27.1 | 31.3 |
| 90-180 | 276 | 27.6 | 31.9 |
| 0-180 | 866 | 86.6 | 100.0 |

Coefficients of Utilization - Zonal Cavity Method
Effective Floor Cavity Reflectance 20%

| Ceiling Reflectance (%) | 80 | | | | 70 | | | | 50 | | | 30 | | | 10 | | | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wall Reflectance (%) | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| Room Cavity Ratio | | | | | | | | | | | | | | | | | | |
| 0 | 97 | 97 | 97 | 97 | 91 | 91 | 91 | 91 | 81 | 81 | 81 | 72 | 72 | 72 | 63 | 63 | 63 | 59 |
| 1 | 85 | 79 | 75 | 70 | 79 | 75 | 70 | 66 | 66 | 62 | 59 | 58 | 55 | 53 | 50 | 48 | 46 | 42 |
| 2 | 76 | 68 | 61 | 55 | 71 | 63 | 57 | 52 | 56 | 51 | 47 | 49 | 45 | 41 | 42 | 39 | 37 | 33 |
| 3 | 68 | 58 | 51 | 44 | 64 | 55 | 48 | 42 | 48 | 43 | 38 | 42 | 38 | 34 | 37 | 33 | 30 | 27 |
| 4 | 62 | 51 | 43 | 37 | 58 | 48 | 41 | 35 | 42 | 36 | 32 | 37 | 32 | 28 | 32 | 28 | 25 | 22 |
| 5 | 57 | 45 | 37 | 31 | 53 | 43 | 35 | 30 | 38 | 31 | 27 | 33 | 28 | 24 | 29 | 25 | 21 | 19 |
| 6 | 52 | 40 | 32 | 27 | 49 | 38 | 31 | 25 | 34 | 28 | 23 | 30 | 25 | 21 | 26 | 22 | 18 | 16 |
| 7 | 48 | 36 | 29 | 23 | 45 | 34 | 27 | 22 | 30 | 24 | 20 | 27 | 22 | 18 | 23 | 19 | 16 | 14 |
| 8 | 45 | 33 | 25 | 20 | 42 | 31 | 24 | 19 | 28 | 22 | 18 | 24 | 19 | 16 | 21 | 17 | 14 | 12 |
| 9 | 42 | 30 | 23 | 18 | 39 | 28 | 22 | 17 | 25 | 20 | 16 | 22 | 18 | 14 | 20 | 16 | 13 | 11 |
| 10 | 39 | 27 | 21 | 16 | 36 | 26 | 20 | 15 | 23 | 18 | 14 | 21 | 16 | 13 | 18 | 14 | 11 | 10 |

## Design
C. J. Nørgaard Pedersen & P. Hougaard Nielsen

## Concept
Ballerup creates symmetrical down light illumination. The vertical three layer opal glass cylinder provides both the ceiling and the rest of the space with soft, diffuse illumination, with the majority of light directed downward.

## Finish
White, powder coated. White opal glass.

## Material
Diffuser: Handblown white opal glass. Housing: Spun steel.

## Mounting
Semi-recessed: Mounting frame with two vertically adjustable brackets spaced equally at 180° to be installed prior to closing the ceiling. Ceiling types: Accessible and non-accessible ceilings. Ceiling cutout: 5.5" diameter.

## Weight
Max. 10 lbs.

## Label
cUL, Damp location. IBEW.

| Product code | Light source | Voltage | Finish | Options |
|---|---|---|---|---|
| BAL | 1/18W/CF GX24q-2<br>1/100W/A-19/CL medium | 120-277V<br>120/277V<br>120V<br>277V | WHT | EMPK<br>LUTRON DIMMING |

Specification notes:
a. CF variants provided with one 120-277V electronic ballast.
b. Incandescent variants only available in 120V.
c. EMPK (emergency power pack) is available in dual tap 120/277V with remote mounted test switch.
d. LUTRON dimming 120V or 277V is digital dimming.

Info notes:
I. The comparable EU version has the following classification: Ingress Protection Code: IP20.

louis poulsen

Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550

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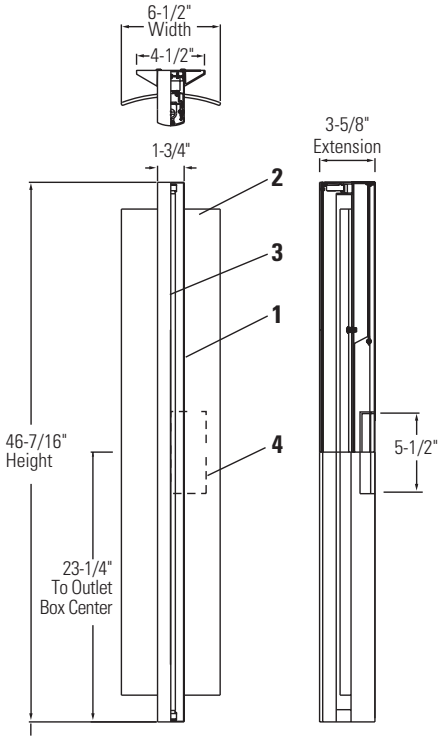
F08




**Note:**
**Luminaire can be ordered with or without diffuser shield. Order each separately.**
**Can be mounted vertically or horizontally.**

**Fixture Ordering Information**

| Catalog No. | Finish | Wattage | Voltage | Lamping | Options |
|---|---|---|---|---|---|
| **48023ALU** | Powder Coated | 28W | 120/277V | T-5 Miniature Bi-Pin Fluorescent | See Below |
| **48023AL54U** | Metallic **Aluminum** | 54W | 120/277V | T-5 Miniature Bi-Pin Fluorescent HO | |

**Diffuser Ordering Information**

| Catalog No. | Description | Dimensions |
|---|---|---|
| **40876** | Translucent Etched Soda Lime Glass w/ Pencil Polished Edges | 43" L x 6.5" W x 5 mm Thick |
| **40916** | Extruded Opal Virgin Acrylic w/ Pencil Polished Edges | 43" L x 6.5" W x 5 mm Thick |

## Features

1. **Housing:** Extruded and die-cast aluminum ballast and lamp chamber.
2. **Optional Diffuser/Reflector:** Curved etched glass or extruded opal virgin acrylic.
3. **Optics:** Internal white acrylic diffuser covers slit on front cover.
4. **J-Box Covers:** Die-cast split covers to enclose 4" octagonal J-Box (J-Box by others).

## Mounting

Mounts directly to switch box or 4" octagonal J-Box. Octagonal box mounting requires use of "J-Box Covers" and "Support Plate" supplied standard.

## Electrical

**Ballast:** Electronic

| 120/277V | 28W | 54W |
|---|---|---|
| Total Input Watts: | 33W | 62W |
| Max. Line Current: | 120V = 0.28<br>277V = 0.12 | 120V=.51<br>277V=.21 |
| Power Factor: | .98 | .98 |
| Ballast Factor: | 1.00 | 1.00 |
| THD: | 120V = <10%<br>277V = <10% | 120V = <10%<br>277V = <10% |
| Starting Temp: | 0°F / -18°C | 0°F / -18°C |

## Finish

All painted parts utilized the powder coat process. Lightolier Metallic Aluminum Powder Coat Enamel.

## Options

**Dimming:** (Voltage Specific/54W HO lamps only)
Add **MX1** suffix code (for 120V) to Cat. No.
Add **MX2** suffix code (for 277V) to Cat. No.
for example: 48023AL4MX1
**Emergency:** Integral Bodine LP550 emergency battery pack, test switch and light, add **E** suffix code.
**DALI:** Digital Dimming System ballast 120/277V. For 28W lamps add **28DA** suffix code to Cat. No. For 54W lamps add **54DA** suffix code to Cat. No.
for example: 48023AL54DA

## Labels

cULus Listed. Suitable for Damp Locations.

Job Information Type:

Job Name:

Cat. No.:

Lamp(s):

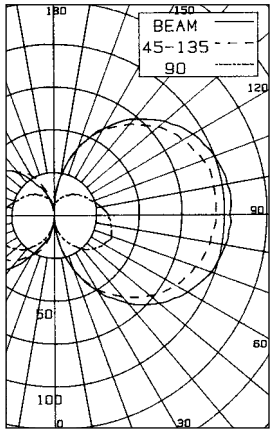
Notes:

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


LIGHTOLIER

F08

CERTIFIED TEST REPORT NO. 2221FR
COMPUTED BY LSI PROGRAM **TEST-LITE**
LIGHTOLIER ARCHITECTURAL DECORATIVE LUMINAIRE SOLI
CAT. NO. 48023ALU / 40876, ETCHED GLASS SHIELD
1-28W SYLVANIA T-5 LAMP. LUMEN RATING = 2610 LMS.
UNIVERSAL BALLAST #B228PUNVC




Prepared For:
Lightolier
Fall River, MA
Date: May 11, 2003

| ZONE ➤ DEG. ▼ | 90 | 67.5 | 45 | 22.5 | Beam |
|---|---|---|---|---|---|
| | CANDLEPOWER | | | | |
| | CANDELAS | | | | |
| 0 | 2 | 2 | 2 | 2 | 2 |
| 5 | 5 | 4 | 5 | 6 | 6 |
| 15 | 10 | 13 | 24 | 27 | 25 |
| 25 | 16 | 30 | 42 | 45 | 43 |
| 35 | 22 | 41 | 56 | 59 | 59 |
| 45 | 28 | 52 | 68 | 70 | 74 |
| 55 | 32 | 60 | 78 | 80 | 85 |
| 65 | 35 | 67 | 85 | 87 | 94 |
| 75 | 35 | 72 | 91 | 92 | 100 |
| 85 | 33 | 75 | 94 | 95 | 103 |
| 95 | 30 | 77 | 95 | 97 | 104 |
| 105 | 26 | 77 | 95 | 96 | 102 |
| 115 | 22 | 74 | 90 | 92 | 97 |
| 125 | 20 | 68 | 84 | 85 | 90 |
| 135 | 17 | 61 | 74 | 76 | 79 |
| 145 | 14 | 50 | 63 | 66 | 66 |
| 155 | 12 | 41 | 50 | 53 | 50 |
| 165 | 9 | 25 | 33 | 35 | 33 |
| 175 | 7 | 11 | 14 | 15 | 15 |
| 180 | 6 | 6 | 6 | 6 | 6 |

Tested according to IES procedures.
Test distance exceeds five times the greatest luminous opening of luminaire.

COEFFICIENTS OF UTILIZATION
% EFFECTIVE CEILING CAVITY REFLECTANCE

| | 80 | | | 70 | | | 50 | | | 30 | | | 10 | | | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % WALL REFLECTION | | | | | | | | | | | | | | | |
| ROOM CAVITY RATIO | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| 0 | 27 | 27 | 27 | 25 | 25 | 25 | 21 | 21 | 21 | 17 | 17 | 17 | 14 | 14 | 14 | 12 |
| 1 | 21 | 20 | 19 | 20 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 12 | 10 | 10 | 9 | 8 |
| 2 | 18 | 16 | 14 | 16 | 15 | 13 | 13 | 12 | 11 | 11 | 10 | 9 | 8 | 7 | 7 | 5 |
| 3 | 15 | 13 | 11 | 14 | 12 | 10 | 11 | 10 | 8 | 9 | 8 | 7 | 7 | 6 | 6 | 4 |
| 4 | 13 | 11 | 9 | 12 | 10 | 8 | 10 | 8 | 7 | 8 | 6 | 5 | 6 | 5 | 4 | 3 |
| 5 | 12 | 9 | 7 | 11 | 8 | 7 | 9 | 7 | 6 | 7 | 5 | 4 | 5 | 4 | 3 | 2 |
| 6 | 10 | 8 | 6 | 9 | 7 | 6 | 8 | 6 | 5 | 6 | 5 | 4 | 5 | 3 | 3 | 2 |
| 7 | 9 | 7 | 5 | 8 | 6 | 5 | 7 | 5 | 4 | 5 | 4 | 3 | 4 | 3 | 2 | 2 |
| 8 | 8 | 6 | 5 | 8 | 6 | 4 | 6 | 5 | 3 | 5 | 4 | 3 | 4 | 3 | 2 | 1 |
| 9 | 7 | 5 | 4 | 7 | 5 | 4 | 6 | 4 | 3 | 4 | 3 | 2 | 3 | 2 | 2 | 1 |
| 10 | 7 | 5 | 3 | 6 | 4 | 3 | 5 | 4 | 3 | 4 | 3 | 2 | 3 | 2 | 1 | 1 |

DETERMINED IN ACCORDANCE WITH CURRENT IES PUBLISHED PROCEDURES
20% FLOOR CAVITY REFLECTANCE

DISTRIBUTION

| Zone | Lumens | % Lamp | % Luminaire |
|---|---|---|---|
| 0-30 | 18 | 0.7 | 2.87 |
| 0-40 | 43 | 1.6 | 6.61 |
| 0-60 | 128 | 4.9 | 19.69 |
| 0-90 | 323 | 12.4 | 49.44 |
| 40-90 | 279 | 10.7 | 42.83 |
| 60-90 | 194 | 7.4 | 29.75 |
| 90-180 | 330 | 12.7 | 50.56 |
| 0-180 | 653 | 25.0 | 100.00 |

** EFFICIENCY = 25.0% **

Note:
For 54 watt lamp, multiply calculated footcandle values by 1.7

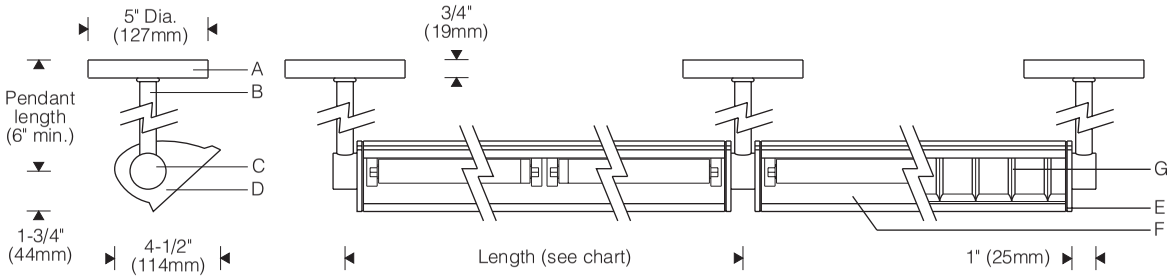
LIGHTOLIER

Job Information Type:

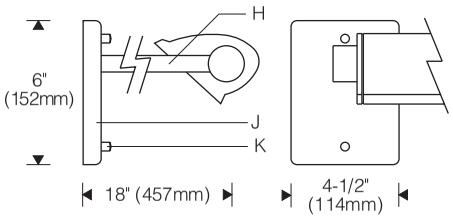
**Lightolier** a Genlyte company www.lightolier.com
631 Airport Road, Fall River, MA 02720 • (508) 679-8131 • Fax (508) 674-4710
We reserve the right to change details of design, materials and finish.

F09

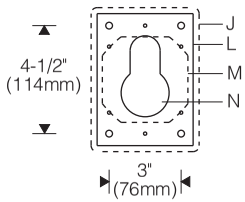
### Pendant Mount 1:8 Scale




### Cantilever Mount 1:8 scale




### Mounting Plate




| *Nominal Lamp Length* | *Length (center to center of hangers)* | |
|---|---|---|
| | *T8* | *T5* |
| 1 x 2' | 26-7/16" (672mm) | 24-7/16" (621mm) |
| 1 x 3' | 38-7/16" (976mm) | 36-1/4" (921mm) |
| 1 x 4' | 50-7/16" (1281mm) | 48" (1219mm) |
| 1 x 5' | 62-5/16" (1583mm) | 60" (1524mm) |
| 2 x 3' | 74-15/16" (1903mm) | 72" (1829mm) |
| 2 x 4' | 98-15/16" (2513mm) | 96" (2438mm) |
| 2 x 5' | 122-15/16" (3123mm) | 120" (3048mm) |

## Specifications

**A** Round aluminum canopy (pendant mount)
**B** 11/16" O.D. aluminum pendant stem
**C** Machined aluminum mounting hub
**D** Die-cast aluminum end plates
**E** Aluminum reveal plates (black)
**F** Specular extruded aluminum reflector
**G** Optional snap-in specular parabolic cross baffle
**H** 11/16" O.D. cantilever arm
**J** Rectangular aluminum canopy (cantilever mount)
**K** Chrome cap nuts
**L** Cantilever mounting plate
**M** Outlet box (by others)
**N** Splice access opening

**Finish:**
*Style 101* fluted - bright clear anodized aluminum housing. Painted end plates in choice of silver or semi-gloss black.

*Style 102* smooth - semi-gloss white housing and end plates.

Painted surfaces - 6 stage pretreatment and electrostatically applied thermoset powder coat for stable, long lasting and corrosion resistant finish.

Reflector - extruded high purity aluminum with clear anodized specular finish. All luminaire hardware - stainless steel. All mounting hardware - zinc or cadmium plated.

**Mounting:**
Pendant or cantilever mounting hangers (ordered separately); specify end and intermediate hangers.

Pendant assembly furnished with canopy for mounting on recessed outlet box. Optional hang-straight allows mounting on slopes up to 45° (in the plane perpendicular to wall).

Cantilever wall plate mounts over recessed outlet box (suitable backing structure required). Adjustable interface plate (concealed under canopy) allows for leveling of arms. **Cantilever limited to single lamp reflectors (up to 5' long).**

**Electrical:**
Use 90°C wire for supply connections.

Remote electronic HPF thermally protected class P ballast (with end-of-life protection for T5 lamps). Aluminum ballast enclosure includes four 7/8" diameter entries and a knockout for an accessory fuse.

**Maximum wire length between electronic ballast and fixture is 7' for two-lamp reflectors and 12' for one-lamp reflectors, less length of stem or arm.**

For dimming, see Styles 105/106 with integral dimming ballast.

For complete ballast specifications, see Accessories Section.

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

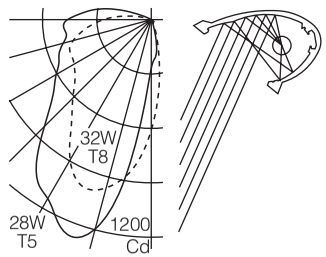
## Features

- *Unequaled low energy wall lighting with T5 or T8 lamps*
- *Machined aluminum mounting hub attaches to pendant stem or cantilever arm without exposed threads*
- *Die-cast end plate joins at articulated black reveal - no exposed fasteners*
- *Optional snap-in specular parabolic cross baffle*

W 4.0

## Performance

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




*For complete photometrics, see www.elliptipar.com.*

**elliptipar**

## To Order

## Style 101 / 102

***To form a Catalog Number***

F [ ] - [ ] - [ ] [ ] - [ ] - [ ] [ ]

1 2 3 4 5 6 7 8

Project: **UCI NATURAL SCIENCES UNIT 2**

Type: **F09**

### 1 Source

**F** = Linear fluorescent

### 2 Style

**101** = Small fluted surface, **remote** ballast
**102** = Small smooth surface, **remote** ballast

### 3 Lamp

**T** **3** **35** = **Lamp Code**

**Lamp Wattage** (see chart below)

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

**A** = T8 Fluorescent
**T** = T5 Fluorescent

Example: **A325** = two nominal 3' reflectors, each for use with one 25W T8 lamp; one 2-lamp ballast

*Reflector Configuration*

| | |
|---|---|
| **1** | 1-Lamp Ballast<br>1-Lamp Reflector |
| **2** | 2-Lamp Ballast<br>2-Lamp Reflector |
| **3** | 2-Lamp Ballast<br>1-Lamp Reflector 1-Lamp Reflector |

*Lamp Wattage*

| *Lamp Length (nominal)* | *Lamp Wattage (Lamp Number)* | | |
|---|---|---|---|
| | *T8* | *T5* | *T5 HO* |
| 2' | **17** (F17T8) | **14** (F14T5) | **24** (F24T5/HO) |
| 3' | **25** (F25T8) | **21** (F21T5) | **39** (F39T5/HO) |
| 4' | **32** (F32T8) | **28** (F28T5) | **55** (F54T5/HO) |
| 5' | **40** (F40T8) | **35** (F35T5) | **80** (F80T5/HO) |

For complete lamp and ballast information, see Accessories Section. Standard T5 lamp color is 3000K / 80+ CRI. T8 lamps by others.

### 4 Mounting

**X** = For use with end and intermediate hangers. Available in pendant or cantilever (order separately).

**Note:** Cantilevers are limited to use with single lamp reflectors (Configuration **1** or **3**) up to 5' long.

### 5 Finish

*Style 101 Fluted*

**01** = Bright aluminum housing with silver end plates
**81** = Bright aluminum housing with semi-gloss black end plates

*Style 102 Smooth*

**02** = Semi-gloss white reflector and end plates
**99** = Custom RAL or computer matched color to be specified, consult sales representative

### 6 Voltage/Ballast

*Electronic*

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

*Dimming**

* For dimming, see Styles 105/106 with integral dimming ballast.

### 7 Option (See Accessories Section for specifications)

**00** = No options
**0B** = Snap-in parabolic cross baffle, specular finish, provides 35° lengthwise shielding
**0E** = Remote emergency battery pack
**XX** = For modification not listed, include detailed description. Consult factory prior to specification.

### 8 Standard

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

### Example

**F102 - A132 - X - 02 - 1 - 000**

Small smooth surface model for use with one 32W T8 lamp in nominal 4 foot reflector. Semi-gloss white. Remote 1-lamp 120V electronic ballast. UL. (Order pendant or cantilever mounting hangers separately.)

### Mounting Hangers

For individually mounted luminaires, order two end hangers for each reflector.

For a continuous row, order two end hangers. To determine the quantity of intermediate hangers, total the number of reflectors in the row and subtract one. Example: a row of five reflectors requires 2 end hangers and 4 intermediate hangers.

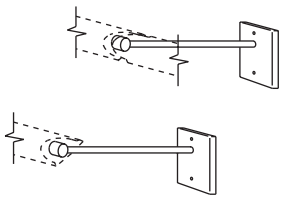
Note: In determining hanger quantities, treat Reflector Configuration **3** as *two* reflectors.

**HS** [ ] [ ] **18** [ ] = **Cantilever** hanger with wall plate, 18" (457mm) setback **(Limited to single lamp reflectors up to 5' long)**

**0** = UL
**J** = CSA

**02** = Semi-gloss white
**07** = silver
**08** = Semi-gloss black

**C** = Intermediate
**D** = End



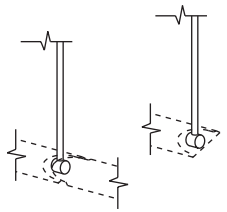
**HS** [ ] [ ] [ ] [ ] = **Pendant** hanger with canopy

**0** = UL
**J** = CSA

**Length** in inches, up to 60" (1.5m), 6" minimum

**02** = semi-gloss white
**07** = silver
**08** = semi-gloss black

**F** = Intermediate, straight
**G** = End, straight
**J** = Intermediate, swivel (up to 45°)
**K** = End, swivel (up to 45°)



### Accessories

Order separately. See Accessories Section for specifications.

**AFK000X** [ ] = Ballast **fuse** kit

**0** = UL
**J** = CSA



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

# iColor Cove QLX

## CK INTELLIGENT SERIES

*Preliminary*


**iColor Cove® QLX is a compact linear fixture that generates saturated color and dynamic effects in alcoves, accent areas, and other interior spaces. The fixture is available with a wide (120° x 120°) or medium (100° x 40°) beam. An integrated rotating mount and optional mounting track provide precise positioning, and end-to-end connections ensure a simple installation.**

- Integral mounting bracket with 180° rotation
- 24 VDC input power
- End-to-end connectors
- Two standard lengths: 6 in (152 mm) and 12 in (305 mm)
- Optibin® technology ensures uniform light quality
- Chromasic® technology provides precise and cost-efficient digital control

CHROMACORE® CK TECHNOLOGY

CHROMASIC® CK TECHNOLOGY

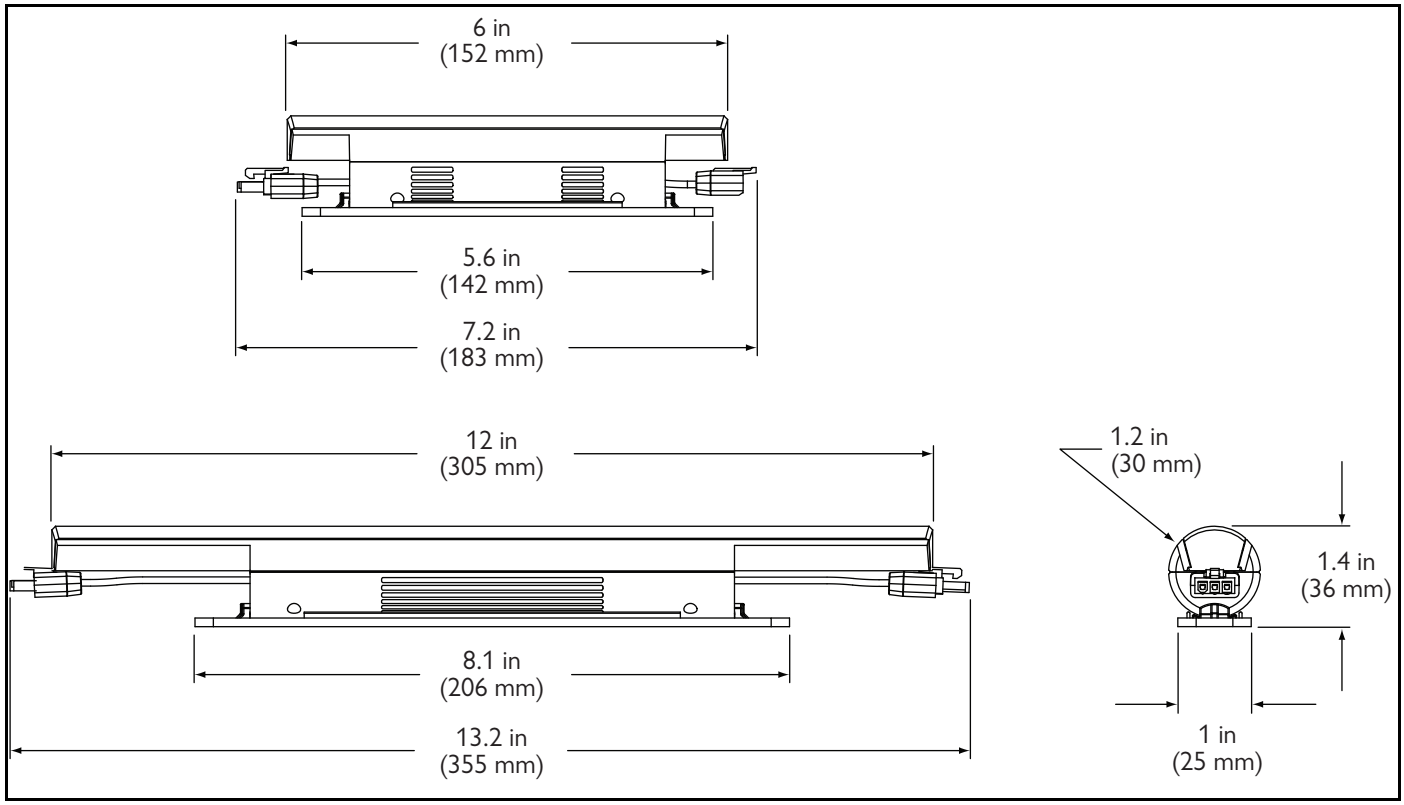
OPTIBIN® CK TECHNOLOGY

c UL us LISTED

CE

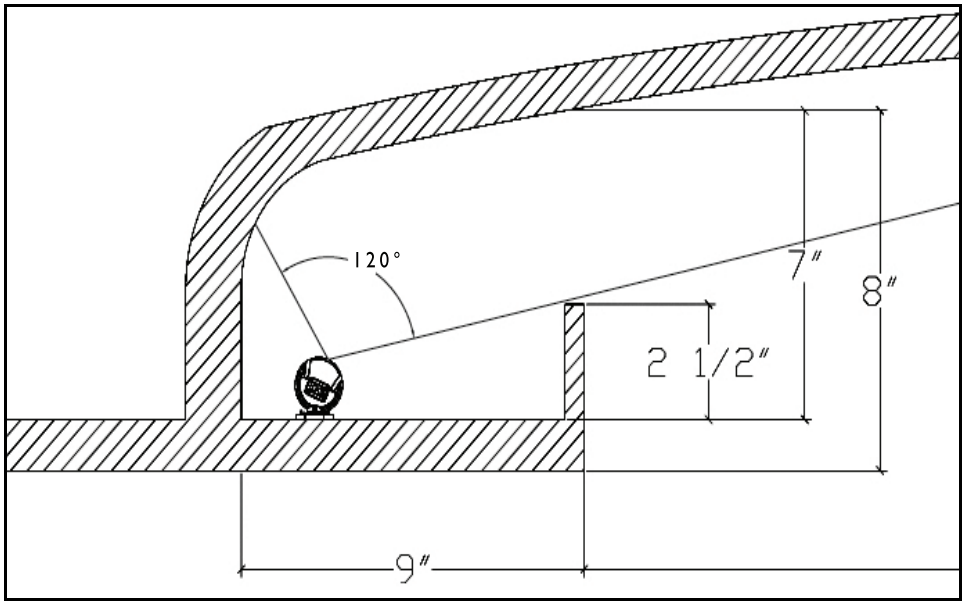
PHILIPS

## iColor Cove QLX Dimensions




## Typical Installation Cut-Away

iColor Cove QLX fixtures can be used effectively in numerous applications. A typical ceiling cove construction cut-away is shown below. (See “Installation Details” on page 9.)



F10

# iColor Cove QLX Specifications

Specifications are subject to change without notice.

| | 6-Inch Fixture | 12-Inch Fixture |
|---|---|---|
| **Length** | 6 in (152 mm) | 12 in (305 mm) |
| **Width** | 1.25 in (32 mm) (tube diameter) | |
| **Height** | 1.37 in (35 mm) | |
| **Weight** | 3 oz. (85 g) | 5 oz. (142 g) |
| **LEDs Per Fixture** | 5 each: red, green, and blue | 10 each: red, green, and blue |
| **Total Output (Lumens)** | 26: Wide (120° x 120°) beam angle:<br>20.8: Medium (100° x 40°) beam angle | 49.8: Wide (120° x 120°) beam angle<br>46.1: Medium (100° x 40°) beam angle |
| **Efficacy (Lm/W)[a]** | 13: Wide (120° x 120°) beam angle<br>10.4: Medium (100° x 40°) beam angle | 16.6: Wide (120° x 120°) beam angle<br>15.4: Medium (100° x 40°) beam angle |
| **Source** | High-brightness LEDs. | |
| **Color Range** | 16.7 million (8-bit) additive RGB colors; continuously variable intensity | |
| **Beam Angle** | 120° x 120° or 100° x 40° | |
| **Mixing Distance** | 2 in (51 mm) to uniform light | |
| **Housing** | Charcoal gray, UL-recognized, injection-molded plastic | |
| **Lens** | Clear polycarbonate. V-0 flame rating. F1 UV rating. | |
| **Medium-Beam Optics** | Polycarbonate. | |
| **Environment** | UL Dry; IP20 | |
| **Fixture Connectors** | IEC 15 A (max) with C13 plug | |
| **Configuration** | See “Maximum Number of Fixtures and Cables” below. | |
| **Listings** | CE, PSE, RoHS, UL/CUL, WEEE, C-Tick | |
| **Control** | Chromasic input data | |
| **Operating Voltage** | 24 VDC from a Philips or Color Kinetics DMX In / Chromasic Out power supply | |
| **Power Consumption** | 2 W maximum at full output steady state. | 3 W maximum at full output steady state. |
| **Temperature Range** | -4°F – 122°F (-20°C – 50°C) operating temperature | |
| **Humidity Range** | 0 – 95% non-condensing | |
| **LED Source Life** | 50,000 hours, based on LED manufacturers’ test data | |

a. Measurements made at full RGB.

## Maximum Number of Fixtures and Cables

If no jumper cables are used, you may interconnect as many as either 30 6 in (152 mm) fixtures (on a single 60W power supply) or 20 12 in (305 mm) fixtures (on a single 60W power supply).

If you plan to use jumper cables:

- The maximum number of 1 ft (305 mm) jumper cables is nine; the maximim number of 5 ft (1524 mm) jumper cables is five.
- If you plan to combine jumper cables of different lengths, please contact support@colorkinetics.com for help with planning your configuration.

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# Ordering Information

## iColor Cove QLX Item Numbers

| Fixture Length | Beam Angle | Item Number | Part Number |
|---|---|---|---|
| **12 in (305 mm)** | Wide 120° x 120° | 101-000066-00 | 910503700217 |
| | Medium 100° x 40° | 101-000066-01 | 910503700219 |
| **6 in (152 mm)** | Wide 120° x 120° | 101-000066-02 | 910503700218 |
| | Medium 100° x 40° | 101-000066-03 | 910503700220 |

## Accessories for iColor Cove QLX Fixtures

iColor Cove QLX fixtures are part of a low-voltage system made up of the fixtures and:

- One or more compatible power supplies from the list below.
- One leader cable used to connect each power supply output port to a series of fixtures.
- A Philips, Color Kinetics, or other DMX512-based controller that works with iColor Cove QLX fixtures. The number of fixtures that can be addressed varies with each controller and jumper cable length. For information on Philips or Color Kinetics controllers, see http://www.colorkinetics.com/support/systemguide/SysMatrix.pdf.

| Compatible Philips and Color Kinetics Power Supplies | Item Number | Part Number |
|---|---|---|
| sPDS-60ca 24V — provides 60W output that can be split between two ports. | 109-000021-02 (DMX / Ethernet) | 910503700106 |
| PDS-60ca — provides 60W output that can be split between two ports. | 109-000016-00 (preprogrammed) or 109-000016-01 (DMX) | 910503700095 |
| sPDS-480ca 24V — provides eight 60W output ports | 109-000026-00 | 910503700110 |

| Leader Cable | Item Number | Part Number |
|---|---|---|
| 30 ft (9144 mm) leader cable | 108-000015-00 | 910503700072 |

Depending on the installation's design, you may need optional jumper cables to add space between fixtures. Optional mounting tracks ensure straight runs of fixtures.

| Jumper Cables | Item Number | Part Number |
|---|---|---|
| 1 ft (305 mm) jumper cable | 108-000020-00 | 910503700079 |
| 5 ft (1524 mm) jumper cable | 108-000020-01 | 910503700080 |

| Mounting Track | Item Number | Part Number |
|---|---|---|
| Box of 25 mounting tracks — 4 ft (1219 mm) in length — for straight runs | 523-000006-00 | 910403326201 |

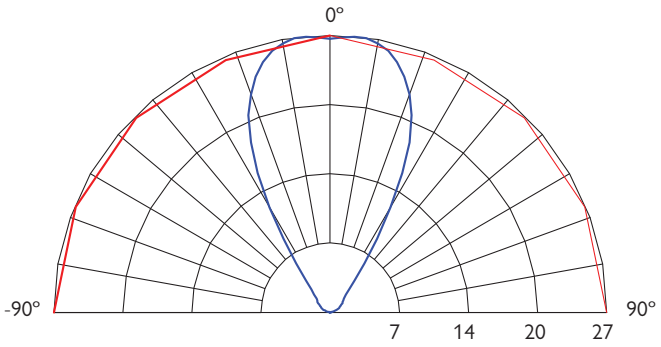
F10

# 12 Inch iColor Cove QLX — Medium Beam Photometrics

This photometric data is based on test results from an independent testing lab. IES files are available at http://www.colorkinetics.com/support/ies.

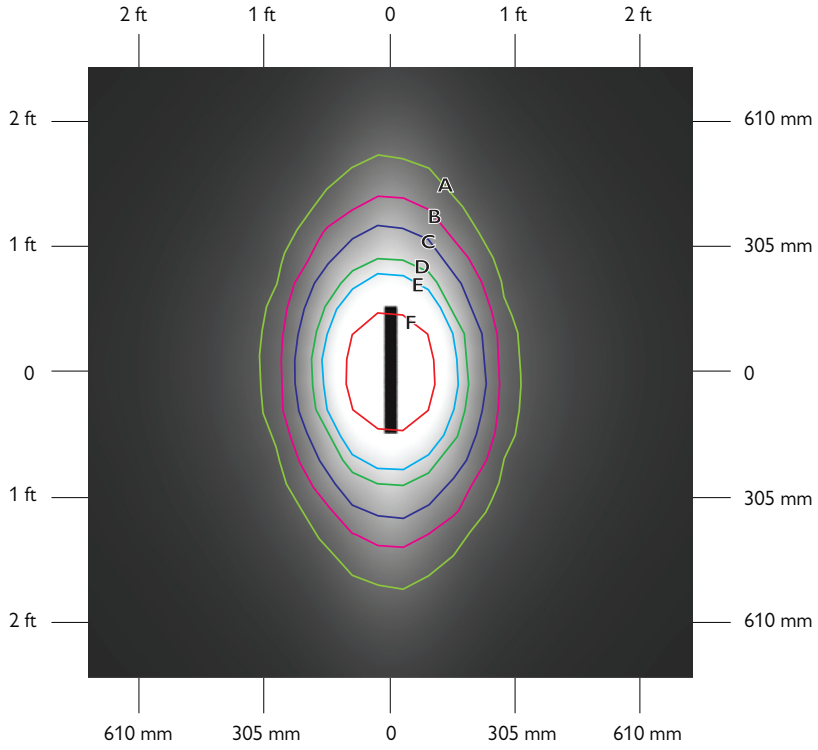
## Candle Power Distribution

*Data to come later:* The dashed line indicates that x candela is x% of peak.




## Illuminance Distribution

This illustration shows the plane x ft (x mm) from the fixture. Data is in footcandles and (lux).




A 1.5 fc (16 lux) B 3 fc (32 lux) C 5 fc (54 lux)
D 8 fc (86 lux) E 10 fc (108 lux) F 15 fc (161 lux)

## Illuminance Beam Angle

This illustration shows measurement of the center beam and the fixture's angle. Data is in footcandles and (lux).

*Illustration to come later*

F10

# 12 Inch iColor Cove QLX — Wide Beam Photometrics

This photometric data is based on test results from an independent testing lab. IES files are available at http://www.colorkinetics.com/support/ies.

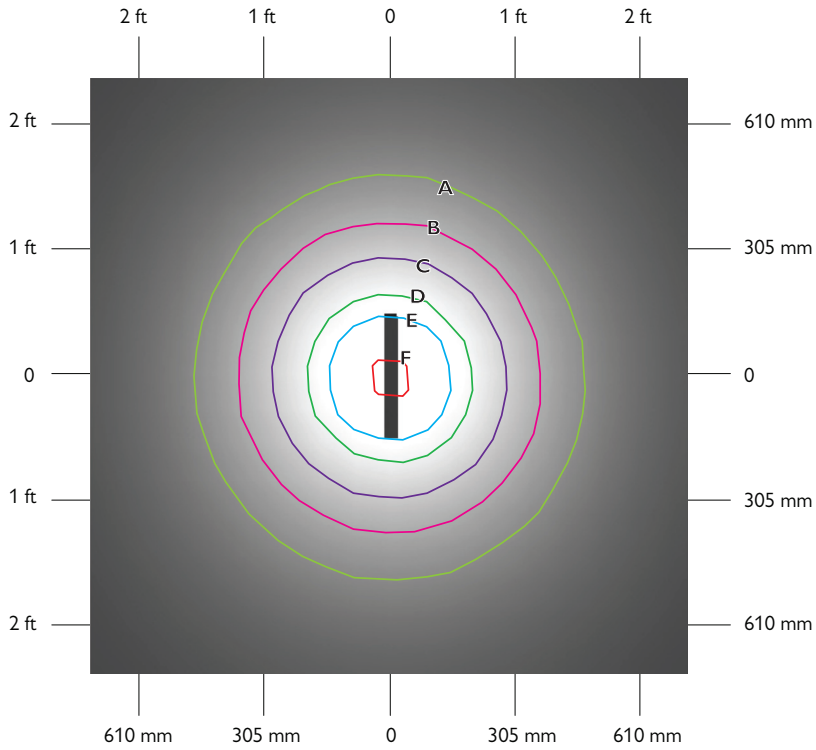
## Candle Power Distribution

*Data to come later:* The dashed line indicates that x candela is x% of peak.

*Illustration to come later*

## Illuminance Distribution

This illustration shows the plane x ft (x mm) from the fixture. Data is in footcandles and (lux).




A 1.5 fc (16 lux) B 3 fc (32 lux) C 5 fc (54 lux)
D 8 fc (86 lux) E 10 fc (108 lux) F 13 fc (140 lux)

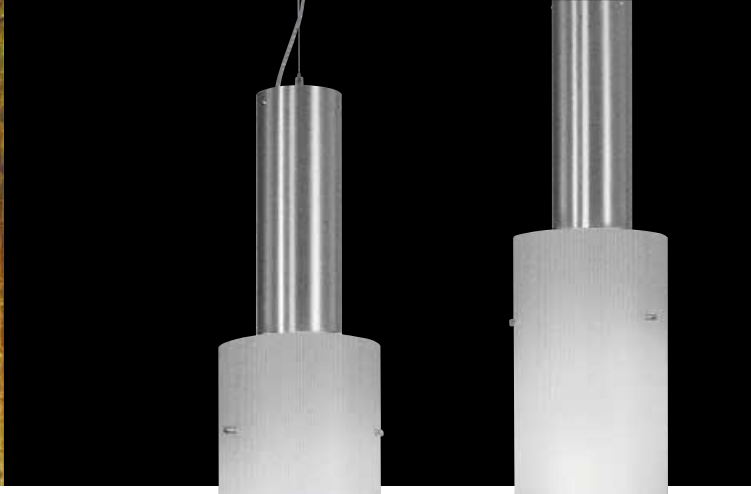
## Illuminance Beam Angle

This illustration shows measurement of the center beam and the fixture's angle. Data is in footcandles and (lux).

*Illustration to come later*

PENDANT LIGHTS

# TOOL





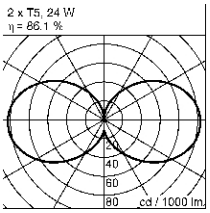
**TOOL**

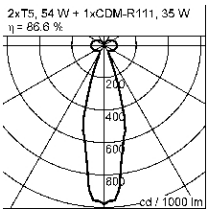
*satin nickel*
*ribbed acrylic tube satin*
*with electronic ballast*
*120 / 277 VAC*

*contact factory for dimming options*

*add HO for high output T5 lamp*

*mounting note: canopy to fit standard junction box*



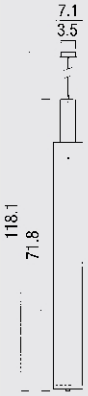

*2 x T5, 28 W*
*and*
*1 x CDM-R111, 35 W, GX8.5*
**36237.06**

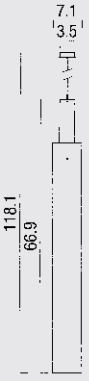
*2 x T5 HO, 54 W*
*and*
*1 x CDM-R111, 35 W, GX8.5*
**36214.06**

*please specify*
*120 or 277 VAC*

*2 x T5, 28 W*
**26237.06**

*2 x T5 HO, 54 W*
**26213.06**



T5 | CDM-R111 | GX24q-3/4 | 2G11

F11

# TOOL

*2 x T5, 14 W*
*and*
*1 x CDM-R111, 35 W, GX8.5*
**36238.06**

*2 x T5 HO, 24 W*
*and*
*1 x CDM-R111, 35 W, GX8.5*
**36212.06**

*please specify*
*120 or 277 VAC*

*2 x T5, 14 W*
**26238.06**

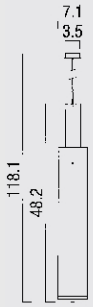
*2 x T5 HO, 24 W*
**26211.06**

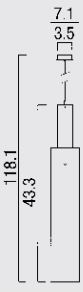
*2 x 2G11, 24 W*
**26210.06**

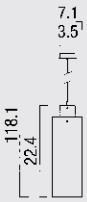
*2 x 2G11, 18 W*
**26209.06**

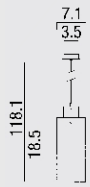
*1 x GX24q-3, 32 W*
**16207.06**

*1 x GX24q-4, 42 W*
**16208.06**





*see chapter*
*wall lights*

*see chapter*
*ceiling lights*

Recessed wall luminaires · faceplate stainless steel

**Housing:** Aluminum outer rough-in housing provided. The outer housing is provided with (2) ½" conduit openings suitable for through wiring. Inner housing made from die-cast aluminum end caps welded to an aluminum extrusion. The welds are continuous and ground flat to provide a watertight inner lamp housing module. All aluminum used in the construction is marine grade and copper free.

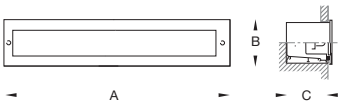
**Enclosure:** Faceplate is constructed of machined stainless steel, secured to the inner housing with captive stainless steel fasteners. Tempered white glass, ⅜" thick, machined to be flush with the faceplate. Fully gasketed with a molded silicone "U" channel gasket. The inner lamp module is fully sealed and independent of the outer housing installation.

**Electrical:** Lampholders; Fluorescent T5 HO, G5 miniature bi-pin. Ballasts; integral electronic, universal voltage 120 V through 277 V, class P, HPF, program start, minimum start temperature of 0 °F. Ballasts have circuitry to reliably shut down the system at the end of lamp life. Standard T5 lamping available on request.

**Finish:** #4 brushed stainless steel. Custom colors are not available. Stainless steel requires regular cleaning and maintenance, much like household appliances, to maintain its luster and to prevent tarnishing or the appearance of rust like stains.

**U.L.** listed, suitable for wet locations. Protection class: IP 65. Not suitable for installation inside of a spa, sauna, or in the wall of a shower/bath stall. BEGA does not recommend luminaires with non-isolated metal parts be used in these applications.

Type: S01
BEGA Product: 2007P
Project: UCI NAT SCI II
Voltage: 277
Color:
Options:
Modified:




**Unshielded** light · **white** safety glass

| | | Lamp* | Lumen | A | B | C |
|---|---|---|---|---|---|---|
| **2007 P** | ADA | 80 W FL T5 HO | 7000 | 60 7/8 | 5 | 5 |

* Standard T5 lamping available

**BEGA-US** 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 FAX (805) 566-9474 www.bega-us.com

# Drive-over in-grade floodlights for linear fluorescent lamps

Type: S02
BEGA Product: 8642P
Project: UCI NAT SCI II
Voltage: 277
Color:
Options:
Modified:

**Enclosure:** Outer housing: Constructed of high tensile strength, copper free die-cast aluminum alloy.

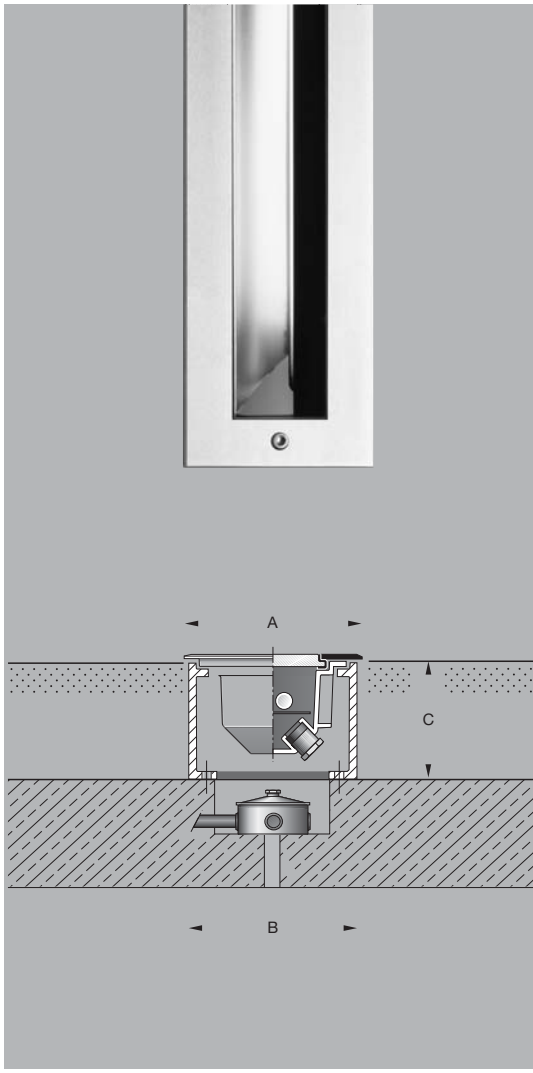
**Inner housing:** One piece copper free die-cast aluminum housing with welded end caps. Trim/Faceplate is heavy gauge, machined stainless steel secured to the inner housing by stainless steel threaded welded studs. Relamping requires removal of inner housing/trim/faceplate assembly from outer housing by means of two flush, socket head stainless steel screws. ½" thick tempered glass machined flush to faceplate. Reflector of pure anodized aluminum. One piece molded U-channel, high temperature silicone gasket.

**Electrical:** Lampholders: Fluorescent T5 HO, rated 660 W, 600 V. Ballasts are electronic, universal voltage 120 V through 277 V. Inner housing pre-wired with three (3) feet of 18/3 waterproof cable, cable clamp, and waterproof cable gland entry into housing. A separate weatherproof single gang wiring box for power supply must be provided (by contractor).

**Finish:** Machined #4 stainless steel. Custom colors are not available.

**U.L.** Listed, suitable for wet locations and vehicle drive over. Protection class: IP 67.

**Note:** A foundation and proper drainage must be supplied by the contractor. These luminaires are designed to bear pressure loads up to 11,000 lbs. from vehicles with pneumatic tires. The luminaires must not be used for traffic lanes where they are subject to horizontal pressure from vehicles braking, accelerating and changing direction.




**Asymmetrical** floodlights · **clear** safety glass

| | Lamp | β | Lumen | T | A | B | C |
|---|---|---|---|---|---|---|---|
| **8642P** | 1 24 W FL T5 HO | 65 x 92° | 2000 | 40° | 4 5/8 x 25 | 4 3/16 x 24 5/8 | 4 15/16 |

β = Beam angle

**BEGA-US** 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 FAX (805) 566-9474 www.bega-us.com

Light building elements · STAINLESS STEEL

**Post construction:** Seamless stainless steel tubing with a machined top insert and a machined base internally welded into an assembly.

**Lamp enclosure:** Seamless stainless steel tubing with machined diffuser opening, louvers or slot. The lamp enclosure is secured to the post with two captive stainless steel set screws. One piece, handblown three-ply opal glass. Fully gasketed using high temperature silicone rubber O-ring gaskets. Free space of at least dimension 'B' is required above the luminaires for relamping.

**Electrical:** Lampholders; 2G11 rated 75 W, 250 V. Ballasts are electronic, universal voltage 120 V through 277 V.

**Anchor base:** Heavy gauge stainless steel with four (4) threaded stainless steel studs which accept BEGA #896 A anchorage kit (supplied).

**Finish:** #4 brushed stainless steel. Stainless steel requires regular cleaning and maintenance, much like household appliances, to maintain its luster and to prevent tarnishing or the appearance of rust like stains.

**U.L.** listed, suitable for wet locations. Protection class IP 65.

Type: S02
BEGA Product: 8989P
Project: UCI NAT SCI II
Voltage: 277V
Color: STEEL
Options:
Modified:


Light building elements · **unshielded** — Light sector 140°/140°

| | Lamp | Lumen | A | B | C | D | Anchorage |
|---|---|---|---|---|---|---|---|
| **8989 P** | 1 39 W CF twin-4p | 2900 | 4 3/8 | 31 1/2 | 98 1/2 | 8 7/8 | **896 A** |

**BEGA-US** 1000 BEGA Way, Carpinteria, CA 93013 (805) 684-0533 FAX (805) 566-9474 www.bega-us.com

# Eco-10 Overview

Eco-10 lighting management electronic dimming ballasts are designed to maximize the benefits of a lighting management system. Eco-10 offers 100% to 10% dimming, and is ideal for use in any space where saving energy is the primary goal of the design.

**Eco-10, case type C**
1.18 in. w (30 mm) x 1.00 in. h (25 mm) x 18.00 in. l (457 mm)

**Eco-10, case type D**
1.58 in. w (40 mm) x 1.00 in. h (25 mm) x 9.50 in. l (241 mm)

**Eco-10, case type F**
2.38 in. w (60 mm) x 1.50 in. h (38 mm) x 9.50 in. l (241 mm)

## Features

- Continuous, flicker-free dimming from 100% to 10%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models available for T5 and T5-HO linear, T8 linear and U-bent, and T5 twin-tube lamps
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range maintains power quality
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry (for T5 and T5-HO linear models) ensures safe operation throughout entire lamp life cycle
- For linear lamps, ballasts maintain consistent light output for different lamp lengths, ensuring uniformity
- Ultra-quiet operation
- Protected from miswires of any input power to control lead
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase

## Specifications

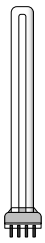
### Performance

- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10 °C (50 °F)
- Ambient Temperature Operating Range: 10 °C (50 °F) to 60 °C (140 °F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120 V or 277 V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .85 for T8 and T5 twin-tube lamps, equal to 1.0 for T5 lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 20%
- Maximum Inrush Current: 7 amps per ballast at 120 V, 3 amps per ballast at 277 V
- Sound Rating: Inaudible in a 27 dBa ambient
- Maximum Ballast Case Temperature: 75 °C (167 °F)

### Standards

- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74) – specific model numbers only
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

# Eco-10 Ballast Models

| Lamp Type | Lamp Watts (length) | Lamps per ballast | Case Type | 120 VOLTS Ballast Current (amps) | 120 VOLTS **Eco-10** Model Number | 277 VOLTS Ballast Current (amps) | 277 VOLTS **Eco-10** Model Number |
|---|---|---|---|---|---|---|---|
| **T5 linear**  5/8 in. diameter | 14 W (22 in.) | 1 | C | .17 | E 3 T514 C 120 1 | .08 | E 3 T514 C 277 1 |
| | | 2 | C | .32 | E 3 T514 C 120 2 | .14 | E 3 T514 C 277 2 |
| | 21 W (34 in.) | 1 | C | .25 | E 3 T521 C 120 1 | .11 | E 3 T521 C 277 1 |
| | | 2 | C | .43 | E 3 T521 C 120 2 | .19 | E 3 T521 C 277 2 |
| | 28 W (45.3 in.) | 1 | C | .30 | ECO-T528-120-1 | .14 | ECO-T528-277-1 |
| | | 2 | C | .55 | ECO-T528-120-2 | .25 | ECO-T528-277-2 |
| **T5-HO linear high output**  5/8 in. diameter | 24 W (21.5 in.) | 1 | C | .26 | ECO-T524-120-1 | .13 | ECO-T524-277-1 |
| | | 2 | C | .45 | ECO-T524-120-2 | .20 | ECO-T524-277-2 |
| | 39 W (33.4 in.) | 1 | C | .38 | ECO-T5H39-120-1 | .17 | ECO-T5H39-277-1 |
| | | 2 | C | .76 | ECO-T5H39-120-2 | .31 | ECO-T5H39-277-2 |
| | 54 W (45.3 in.) | 1 | C | .58 | ECO-T554-120-1 | .25 | ECO-T554-277-1 |
| | | 2 | C | 1.1 | ECO-T554-120-2 | .45 | ECO-T554-277-2 |
| **T5 Twin-Tube**  5/8 in. diameter | 36/39 W (16 in.) | 1 | F | .33 | ECO-T539-120-1* | .14 | ECO-T539-277-1* |
| | | 2 | F | .58 | ECO-T539-120-2* | .25 | ECO-T539-277-2* |
| | | 3 | F | .85 | ECO-T539-120-3* | .35 | ECO-T539-277-3* |
| | 40 W (22 in.) | 1 | F | .33 | ECO-T540-120-1* | .14 | ECO-T540-277-1* |
| | | 2 | F | .61 | ECO-T540-120-2* | .25 | ECO-T540-277-2* |
| | | 3 | F | .88 | ECO-T540-120-3* | .38 | ECO-T540-277-3* |
| | 50 W (22 in.) | 1 | F | .38 | ECO-T550-120-1* | .17 | ECO-T550-277-1* |
| | | 2 | F | .69 | ECO-T550-120-2* | .32 | ECO-T550-277-2* |

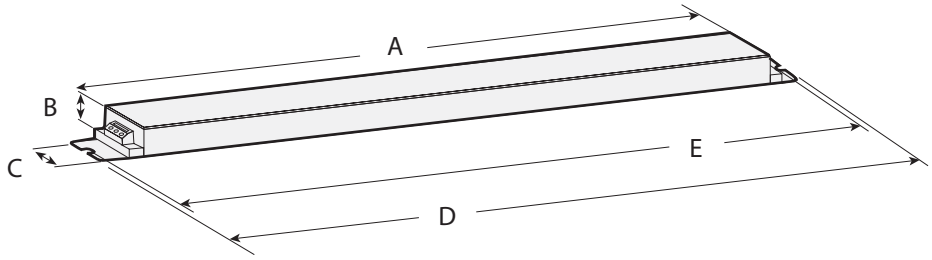
*UL certified only

## Eco-10 Ballast Models continued ...

| Lamp Type | | | | 120 VOLTS | | 277 VOLTS | |
|---|---|---|---|---|---|---|---|
| | Lamp Watts (length) | Lamps per ballast | Case Type | Ballast Current (amps) | **Eco-10** Model Number | Ballast Current (amps) | **Eco-10** Model Number |
| **T8 linear and U-bent**  1 in. diameter | 17 W (24 in.) | 1 | F | .19 | ECO-T817-120-1 | .08 | ECO-T817-277-1 |
| | | 2 | F | .31 | ECO-T817-120-2 | .15 | ECO-T817-277-2 |
| | | 3 | F | .43 | ECO-T817-120-3 | .20 | ECO-T817-277-3 |
| | 25 W (36 in.) | 1 | F | .24 | ECO-T825-120-1 | .12 | ECO-T825-277-1 |
| | | 2 | F | .43 | ECO-T825-120-2 | .19 | ECO-T825-277-2 |
| | 32 W (48 in.) | 1 | C | - - | - - | - - | - - |
| | | 1 | D | .34 | ECO-T832-120-1-L | .14 | ECO-T832-277-1-L |
| | | 1 | D | .34 | ECO-T832-120-1-T | .14 | ECO-T832-277-1-T |
| | | 1 | F | - - | - - | .15 | ECO-T832-277-1 |
| | | 2 | C | - - | - - | - - | - - |
| | | 2 | D | .53 | ECO-T832-120-2-L | .23 | ECO-T832-277-2-L |
| | | 2 | D | .53 | ECO-T832-120-2-T | .23 | ECO-T832-277-2-T |
| | | 2 | F | - - | - - | .22 | ECO-T832-277-2 |
| | | 3 | F | .82 | ECO-T832-120-3 | .35 | ECO-T832-277-3 |

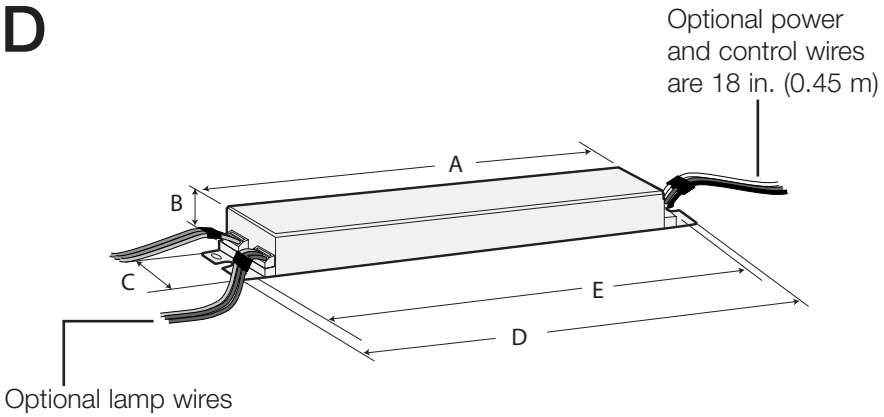
## Eco-10 Case Dimensions

### C




A 16.12 in. (409 mm)
B 1.00 in. (25 mm)
C 1.18 in. (30 mm)
D 18.00 in. (457 mm)
E 17.70 in. (450 mm)
(mounting centers)

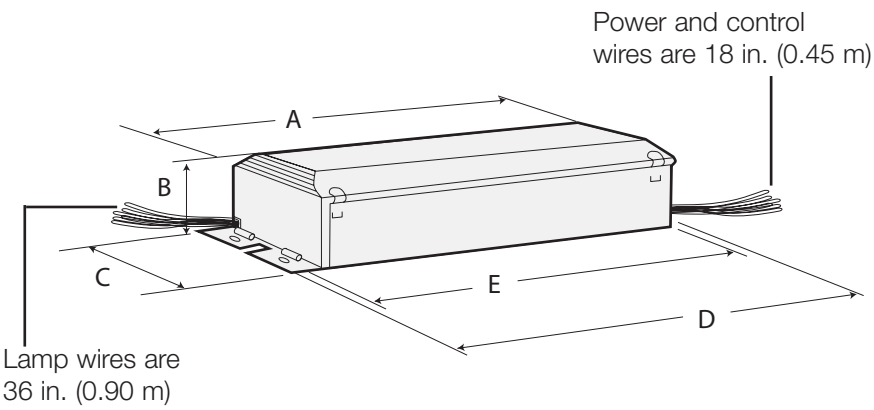
### D




A 7.13 in. (181 mm)
B 1.00 in. (25 mm)
C 1.58 in. (40 mm)
D 9.50 in. (241 mm)
E 8.91 in. (226 mm)
(slot mounting centers)

If using four hole mount, mounting centers are 9.00" (229 mm) x 1.06 in. (27 mm).

### F

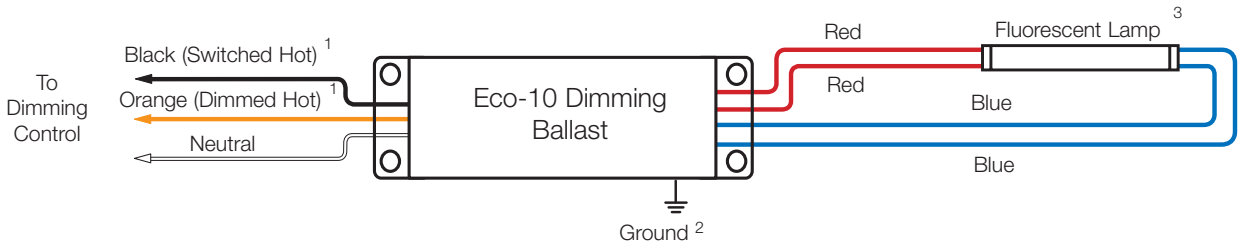



A 8.30 in. (211 mm)
B 1.50 in. (38 mm)
C 2.38 in. (60 mm)
D 9.50 in. (241 mm)
E 8.91 in. (226 mm)
(slot mounting centers)

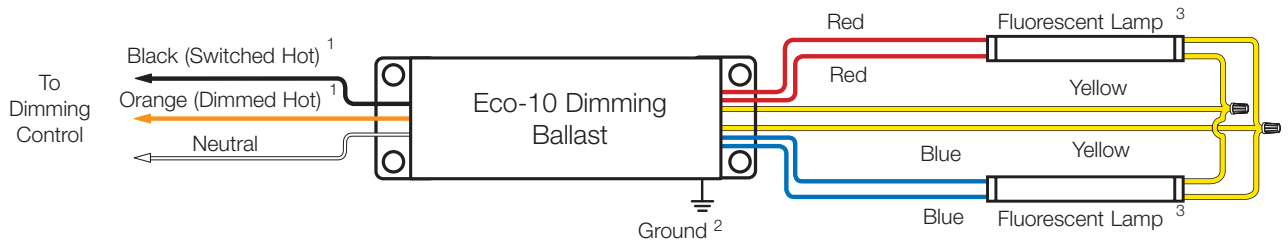
If using four hole mount, mounting centers are 9.21 in. (234 mm) x 1.70 in. (43 mm).

# Eco-10 Wiring Diagrams

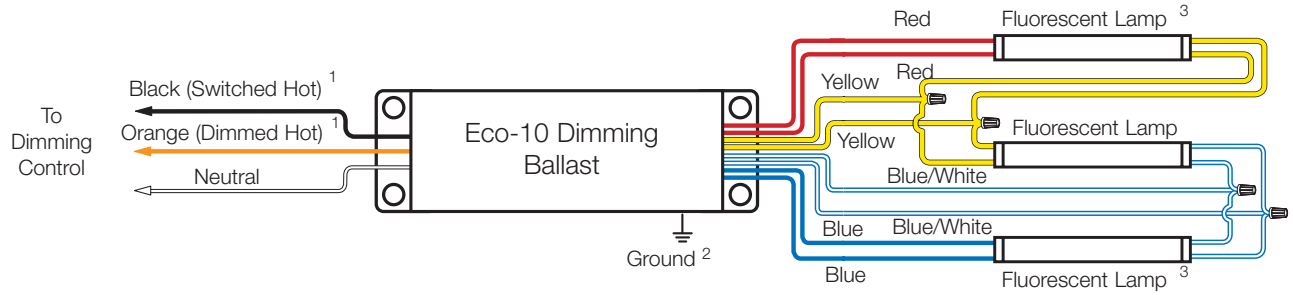
## One T5 or T8 lamp




## Two T5 or T8 lamps




## Three T8 lamps

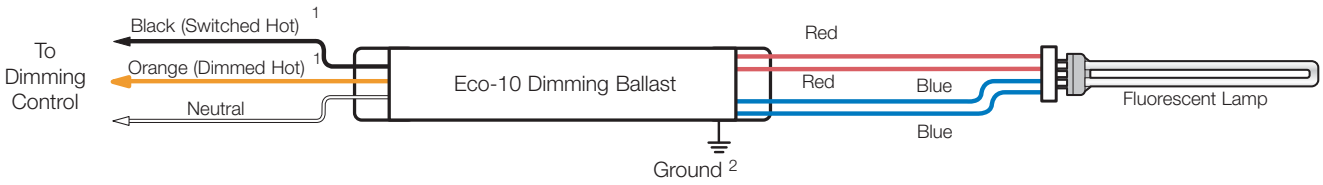



[1] Dimming control wire colors do not necessarily match ballast wire colors (e.g. control 'dimmed hot' may be yellow, and ballast 'dimmed hot' may be orange. Wire colors shown are for Lutron ballasts and controls only.
[2] Ballast and lighting fixture must be effectively grounded.
[3] Includes 31 W T8 U-bent lamps

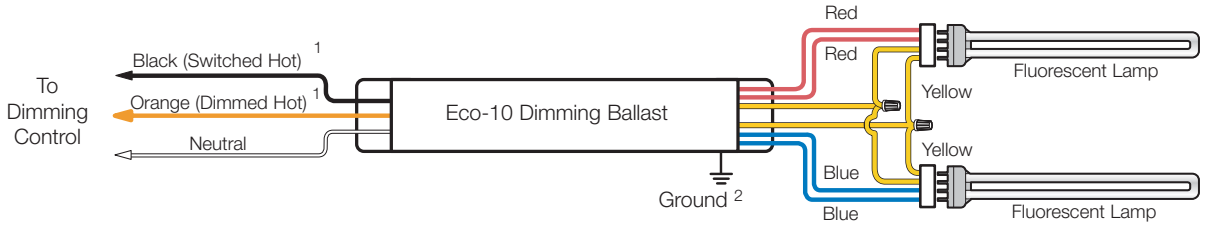
Note: For T5 and T8 lamps, maximum lamp-to-ballast wire length is 7 feet (2 m).

# Eco-10 Wiring Diagrams continued

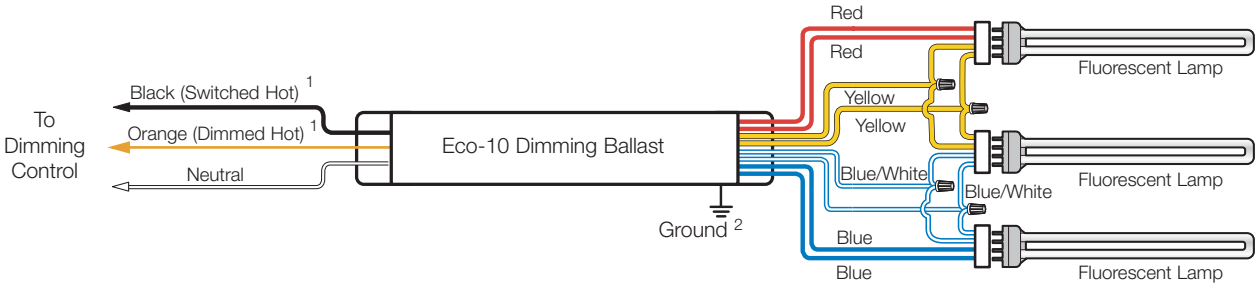
## One T5 twin-tube lamp




## Two T5 twin-tube lamps




## Three T5 twin-tube lamps




[1] Dimming control wire colors do not necessarily match ballast wire colors (e.g. control 'dimmed hot' may be yellow, and ballast 'dimmed hot' may be orange). Wire colors shown are for Lutron ballasts and controls only.
[2] Ballast and lighting fixture must be effectively grounded.

Note: For T5 twin-tube lamps, maximum lamp-to-ballast wire length is 3 feet (1 m).

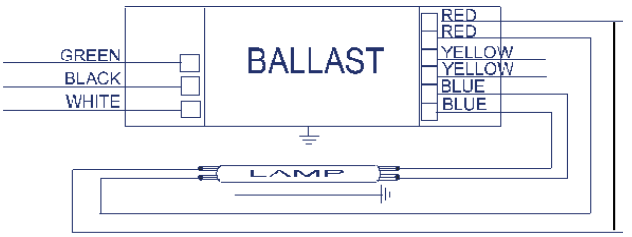
PHILIPS ADVANCE

| ICN-2S54@277V | |
|---|---|
| Brand Name | CENTIUM T5 |
| Ballast Type | Electronic |
| Starting Method | Programmed Start |
| Lamp Connection | Series/Parallel |
| Input Voltage | 120-277 |
| Input Frequency | 50/60 HZ |
| Status | Active |

## Electrical Specifications

| Lamp Type | Num. of Lamps | Rated Lamp Watts | Min. Start Temp (°F/C) | Input Current (Amps) | Input Power (ANSI Watts) | Ballast Factor | MAX THD % | Power Factor | MAX Lamp Current Crest Factor | B.E.F. |
|---|---|---|---|---|---|---|---|---|---|---|
| * FT36W/2G11 | 1 | 36 | -20/-29 | 0.18 | 46 | 1.22 | 20 | 0.96 | 1.7 | 2.65 |
| FT36W/2G11 | 2 | 36 | -20/-29 | 0.32 | 86 | 1.20 | 10 | 0.98 | 1.7 | 1.40 |

## Wiring Diagram




For 1 lamp operation, do not use yellow leads

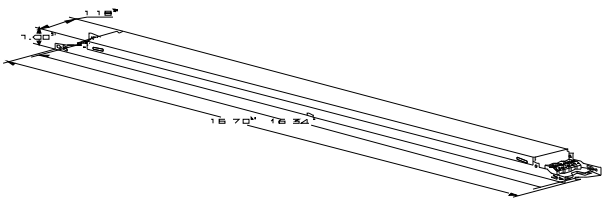
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

### Standard Lead Length (inches)

| | in. | cm. |
|---|---|---|
| Black | 31 | 78.7 |
| White | 31 | 78.7 |
| Blue | 28 | 71.1 |
| Red | 28 | 71.1 |
| Yellow | 48 | 121.9 |
| Gray | | 0 |
| Violet | | 0 |

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

## Enclosure



### Enclosure Dimensions

| OverAll (L) | Width (W) | Height (H) | Mounting (M) |
|---|---|---|---|
| 16.70 " | 1.18 " | 1.00 " | 16.34 " |
| 16 7/10 | 1 9/50 | 1 | 16 17/50 |
| 42.4 cm | 3 cm | 2.5 cm | 41.5 cm |

**Revised 03/11/2009**

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

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PHILIPS
ADVANCE

| ICN-2S54@277V | |
|---|---|
| Brand Name | CENTIUM T5 |
| Ballast Type | Electronic |
| Starting Method | Programmed Start |
| Lamp Connection | Series/Parallel |
| Input Voltage | 120-277 |
| Input Frequency | 50/60 HZ |
| Status | Active |

## Electrical Specifications

**Notes:**

Section I - Physical Characteristics

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

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

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

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

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

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

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

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

2.13 Ballast shall have a hi-low switching option when operating (4) F54T5/HO lamps to allow switching from 4-2 lamps, 3-2 lamps or 3-1 lamp.

2.14 Four-lamp ballast shall have semi-independent lamp operation.

Section III - Regulatory Requirements

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

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

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

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

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

3.6 Ballast shall comply with UL Type CC rating.

Section IV - Other

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

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

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

**Revised 03/11/2009**



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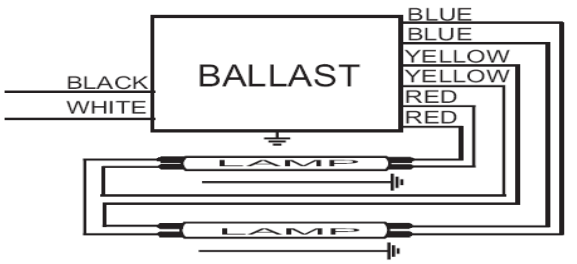
PHILIPS ADVANCE

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

## Electrical Specifications

| Lamp Type | Num. of Lamps | Rated Lamp Watts | Min. Start Temp (°F/C) | Input Current (Amps) | Input Power (ANSI Watts) | Ballast Factor | MAX THD % | Power Factor | MAX Lamp Current Crest Factor | B.E.F. |
|---|---|---|---|---|---|---|---|---|---|---|
| F14T5 | 1 | 14 | 0/-18 | 0.07 | 17 | 1.07 | 10 | 0.98 | 1.7 | 6.29 |
| F14T5 | 2 | 14 | 0/-18 | 0.12 | 33 | 1.04 | 10 | 0.98 | 1.7 | 3.15 |
| F21T5 | 1 | 21 | 0/-18 | 0.10 | 25 | 1.06 | 10 | 0.98 | 1.7 | 4.24 |
| F21T5 | 2 | 21 | 0/-18 | 0.18 | 49 | 1.02 | 10 | 0.98 | 1.7 | 2.08 |
| F28T5 | 1 | 28 | 0/-18 | 0.12 | 31 | 1.05 | 10 | 0.98 | 1.7 | 3.39 |
| * F28T5 | 2 | 28 | 0/-18 | 0.22 | 60 | 1.00 | 10 | 0.98 | 1.7 | 1.67 |

## Wiring Diagram



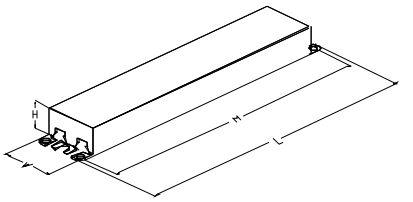

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

### Standard Lead Length (inches)

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

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

## Enclosure




### Enclosure Dimensions

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

**Revised 03/03/2009**

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

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

## Electrical Specifications

**Notes:**

Section I - Physical Characteristics

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

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

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

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

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

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

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

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

2.13 Ballast shall have a hi-low switching option when operating (4) F54T5/HO lamps to allow switching from 4-2 lamps, 3-2 lamps or 3-1 lamp.

2.14 Four-lamp ballast shall have semi-independent lamp operation.

Section III - Regulatory Requirements

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

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

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

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

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

3.6 Ballast shall comply with UL Type CC rating.

Section IV - Other

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

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

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

**Revised 03/03/2009**



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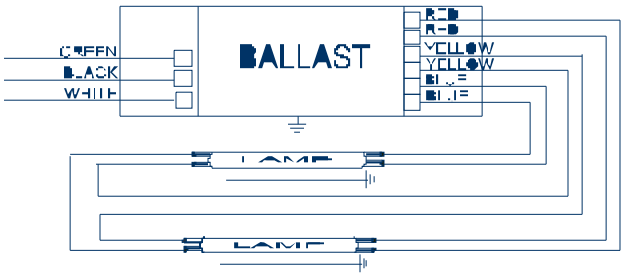
| ICN-2S24@277V | |
|---|---|
| Brand Name | CENTIUM T5 |
| Ballast Type | Electronic |
| Starting Method | Programmed Start |
| Lamp Connection | Series |
| Input Voltage | 277 |
| Input Frequency | 50/60 HZ |
| Status | Active |

## Electrical Specifications

| Lamp Type | Num. of Lamps | Rated Lamp Watts | Min. Start Temp (°F/C) | Input Current (Amps) | Input Power (ANSI Watts) | Ballast Factor | MAX THD % | Power Factor | MAX Lamp Current Crest Factor | B.E.F. |
|---|---|---|---|---|---|---|---|---|---|---|
| F24T5/HO | 1 | 24 | 0/-18 | 0.10 | 27 | 1.02 | 10 | 0.98 | 1.7 | 3.78 |
| * F24T5/HO | 2 | 24 | 0/-18 | 0.19 | 52 | 1.00 | 10 | 0.98 | 1.7 | 1.92 |
| F39T5/HO | 1 | 39 | 0/-18 | 0.15 | 40 | 0.90 | 10 | 0.98 | 1.7 | 2.25 |
| FC12T5 | 1 | 40 | 0/-18 | 0.15 | 40 | 0.84 | 10 | 0.98 | 1.7 | 2.10 |
| FC9T5 | 1 | 22 | 0/-18 | 0.10 | 27 | 1.02 | 10 | 0.98 | 1.7 | 3.78 |
| FC9T5 | 2 | 22 | 0/-18 | 0.19 | 52 | 1.00 | 10 | 0.98 | 1.7 | 1.92 |
| FT24W/2G11 | 1 | 24 | 0/-18 | 0.10 | 27 | 1.02 | 10 | 0.98 | 1.7 | 3.78 |
| FT24W/2G11 | 2 | 24 | 0/-18 | 0.19 | 52 | 1.00 | 10 | 0.98 | 1.7 | 1.92 |
| FT36W/2G11 | 1 | 36 | 0/-18 | 0.13 | 34 | 0.90 | 10 | 0.98 | 1.7 | 2.65 |
| FT40W/2G11/RS | 1 | 40 | 0/-18 | 0.17 | 47 | 1.00 | 10 | 0.98 | 1.7 | 2.13 |

## Wiring Diagram



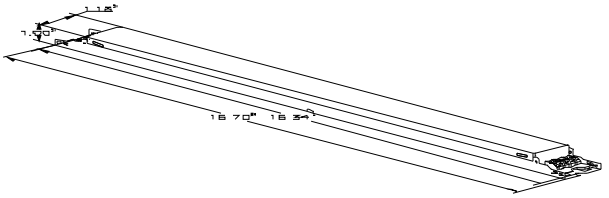

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

### Standard Lead Length (inches)

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

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

## Enclosure



### Enclosure Dimensions

| OverAll (L) | Width (W) | Height (H) | Mounting (M) |
|---|---|---|---|
| 16.70 " | 1.18 " | 1.00 " | 16.34 " |
| 16 7/10 | 1 9/50 | 1 | 16 17/50 |
| 42.4 cm | 3 cm | 2.5 cm | 41.5 cm |

**Revised 09/01/2004**

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


**PHILIPS LIGHTING ELECTRONICS N.A.**

10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018

Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance

Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS ADVANCE

| ICN-2S24@277V | |
|---|---|
| Brand Name | CENTIUM T5 |
| Ballast Type | Electronic |
| Starting Method | Programmed Start |
| Lamp Connection | Series |
| Input Voltage | 277 |
| Input Frequency | 50/60 HZ |
| Status | Active |

## Electrical Specifications

**Notes:**

Section I - Physical Characteristics

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

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

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

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

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.

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

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less in accordance with lamp manufacturer recommendations.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -29C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

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

2.13 Ballast shall have a hi-low switching option when operating (4) F54T5/HO lamps to allow switching from 4-2 lamps, 3-2 lamps or 3-1 lamp.

2.14 Four-lamp ballast shall have semi-independent lamp operation.

Section III - Regulatory Requirements

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

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

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

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

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

3.6 Ballast shall comply with UL Type CC rating.

Section IV - Other

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

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

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

**Revised 09/01/2004**

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

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9/4/2009

# F28T5/841 ALTO TG 1LP

Product family description

| Product data | |
|---|---|
| Product Number | 166744 |
| Full product name | F28T5/841 ALTO TG 1LP |
| Ordering Code | F28T5/841 TG |
| Pack type | 1 Lamp |
| Pieces per Sku | 1 |
| Skus/Case | 40 |
| Pack UPC | 046677166748 |
| EAN2US | |
| Case Bar Code | 50046677166743 |
| Successor Product number | |
| System Description | High Efficiency |
| Base | Miniature Bipin |
| Base Information | Green [Green Base] |
| Bulb | T5 [16mm] |
| Packing Type | 1LP [1 Lamp] |
| Packing Configuration | 40 |
| Rated Avg. Life | 24000 hr |
| Type | F28T5 |
| Feature | ALTO® |
| Ordering Code | F28T5/841 TG |
| Pack UPC | 046677166748 |
| Case Bar Code | 50046677166743 |
| Watts | 28W |
| Lamp Wattage EL | 28.0 W |
| Dimmable | Yes |
| Color Code | 841 [CCT of 4100K] |
| Color Rendering Index | 85 Ra8 |

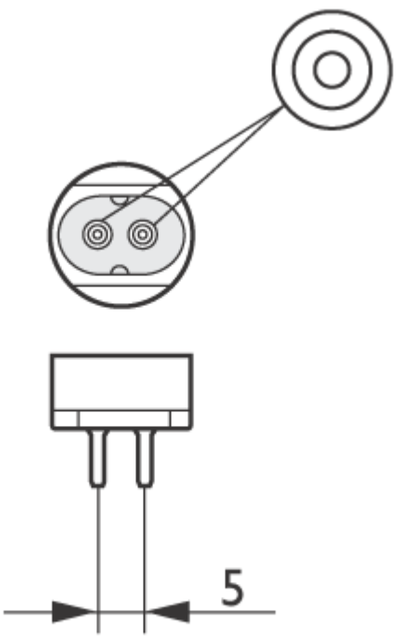
A47

PHILIPS

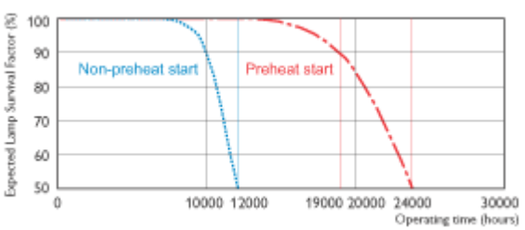
9/4/2009

| Product data | |
|---|---|
| Color Designation | 841 |
| Color Description | na [-] |
| Color Temperature | 4000 K |
| Initial Lumens | - Lm |
| Overall Length C | 1163.2 mm |
| Diameter D | 17 mm |
| Special Note | TuffGuard™ [TuffGuard Coated] |
| Product Number | 166744 |

TL5 HE

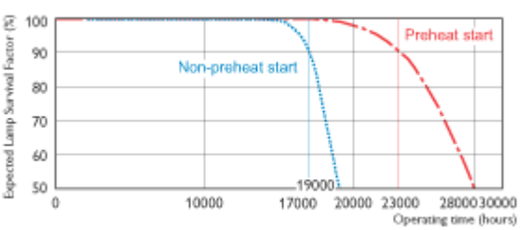



Base Miniature Bipin




Life Expectancy 3h cycle

TL5 HE



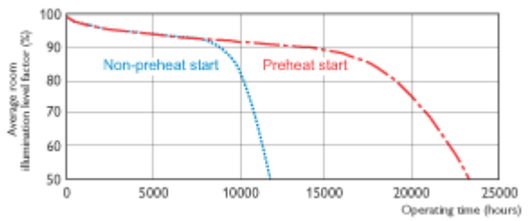

Life Expectancy 12h cycle

TL5 HE

A48

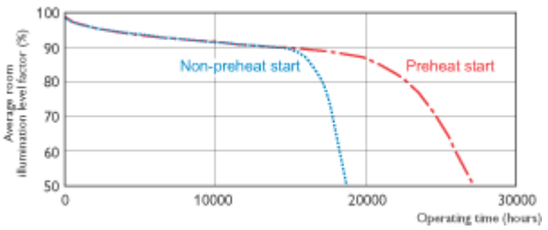
PHILIPS

9/4/2009



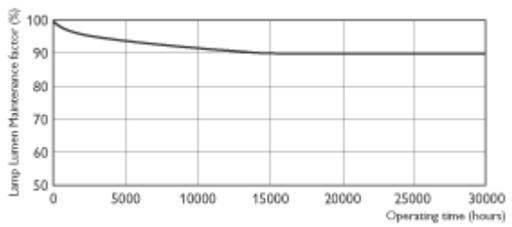

Service Life 3h cycle

TL5 HE




Service Life 12h cycle

TL5 HE




TL5 HE

9/4/2009

# PL-C ALTO 13W/841 G24q-1 /4P 1CT

Product family description

| Product data | |
|---|---|
| Product Number | 383281 |
| Full product name | PL-C ALTO 13W/841 G24q-1 /4P 1CT |
| Ordering Code | PL-C 13W/841/4P/ALTO |
| Pack type | 1 Lamp in a Folding Carton |
| Pieces per Sku | 1 |
| Skus/Case | 50 |
| Pack UPC | 046677240004 |
| EAN2US | |
| Case Bar Code | 60046677240006 |
| Successor Product number | |
| Base | G24q-1 |
| Base Information | 4P |
| Execution | /4P [4 Pins] |
| Packing Type | 1CT [1 Lamp in a Folding Carton] |
| Packing Configuration | 5X10BOX |
| Avg. Life | 10000 hr |
| Rated Avg. Life | 12000 hr |
| Ordering Code | PL-C 13W/841/4P/ALTO |
| Pack UPC | 046677240004 |
| Case Bar Code | 60046677240006 |
| Watts | 13W |
| Lamp Wattage EL | 12.5 W |
| Dimmable | Yes |
| Mercury (Hg) Content | - mg |
| Color Code | 840 [CCT of 4000K] |
| Color Rendering Index | 82 Ra8 |
| Color Designation | Cool White |

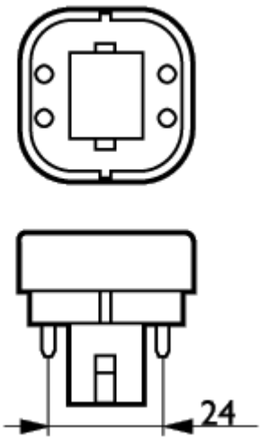


PHILIPS

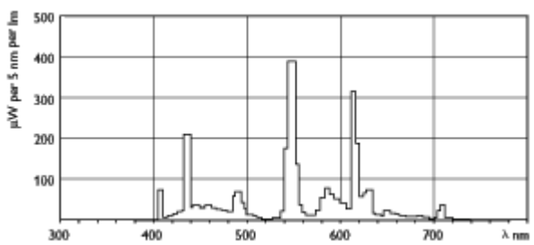
9/4/2009

| Product data | |
|---|---|
| Color Description | 840 Cool White |
| Color Temperature | 4000 K |
| Initial Lumens | 900 Lm |
| Initial Lumens | 900 Lm |
| Overall Length C | 142.9 mm |
| Diameter D | 27.1 mm |
| Diameter D1 | 27.1 mm |
| Product Number | 383281 |

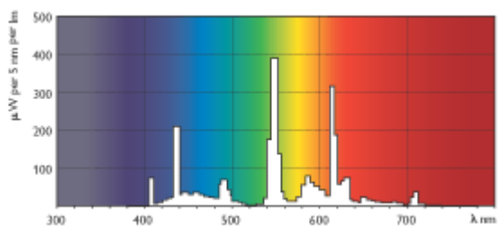
PL-C 13W




Base G24q-1




PL-C/840




PL-C/840


PL-C

SoLux 4100K 35W Specs.

## Technical Data SoLux 4100 Kelvin

**PHYSICAL**
Bulb Type: MR 16
Cover Glass: Yes
Bulb Diameter: 2" (50mm)
Maximum Overall Length: 1 3/4 " (45 mm
Base 2 pin / GX5.3

**ELECTRICAL**
Watts: 35
Volts: 12
Filament. C-8
Burning Position: Any

**LIGHT**
Life: 4000 Hrs.
Color Temperature: 4100 Kelvin
Color Rendition Index. 98+ C.R.I.

**IR EMISSION**
56 % Less Than
Standard MR16 50W

**UV VALUES**
UV : 9.75 Microwatt / Lumen
UVA: 9.39 Microwatt / Lumen (380-315 nm)
UVB: 0.36 Microwatts / Lumen (315-280nm)

**CANDLEPOWER**
#35011 (10°) = 7897
#35012 (17°) = 2782
# 35014 (24°) = 1701
# 35013 (36°) = 1048

Part Number 35011 35012 35014 35013

| 10° | | | | | | 17° | | | | 24° | | | | 36° | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Distance** | | **Beam Diameter** | | **Illuminance** | | **Beam Diameter** | | **Illuminance** | | **Beam Diamter** | | **Illuminance** | | **Beam Diameter** | | **Illuminance** | |
| Feet | Meters | Feet | Meters | fc | Lux | Feet | Meters | fc | Lux | Feet | Meters | fc | Lux | Feet | Meters | fc | Lux |
| 2 | 0.6 | 0.35 | 0.11 | 2038.7 | 21936.1 | 0.60 | 0.20 | 718.2 | 7727.8 | 0.90 | 0.26 | 439.1 | 4725.0 | 1.30 | 0.40 | 270.5 | 2911.1 |
| 4 | 1.2 | 0.70 | 0.21 | 509.7 | 5484.0 | 1.20 | 0.40 | 179.5 | 1931.9 | 1.70 | 0.52 | 109.8 | 1181.3 | 2.60 | 0.80 | 67.6 | 727.8 |
| 6 | 1.8 | 1.05 | 0.32 | 226.5 | 2437.3 | 1.80 | 0.55 | 79.8 | 858.6 | 2.60 | 0.78 | 48.8 | 525.0 | 3.90 | 1.20 | 30.1 | 323.5 |
| 8 | 2.4 | 1.40 | 0.43 | 127.4 | 1371.0 | 2.40 | 0.73 | 44.9 | 483.0 | 3.40 | 1.04 | 27.4 | 295.3 | 5.20 | 1.60 | 16.9 | 181.9 |
| 10 | 3.0 | 1.75 | 0.53 | 81.5 | 877.4 | 3.00 | 0.91 | 28.7 | 309.1 | 4.30 | 1.30 | 17.6 | 189.0 | 6.50 | 2.00 | 10.8 | 116.4 |



**Tailored Lighting Inc.**
**1-800-254-4487**

9/4/2009

# PL-T 18W/841/4P 1CT

Product family description
PL-T Triple 4pin Fluorescent Lamp with Amalgam.

## Features/Benefits

- ALTO® Lamp Technology - Passes EPA's TCLP test for non-hazardous waste.
- Utilizes amalgam technology to provide > 90% of rated lumens in ambient temperatures from 23F to 130F.
- Triple tube design available in 18, 26, 32, and 42W.
- Excellent Color Rendering - 82 Color Rendering Index (CRI).
- Broad Range of Color Temperature - Available in 2700, 3000, 3500 and 4100K.
- Dimmable - PL-T 4-pin lamps may be used with electronic dimming ballasts.
- Long Life - 12,000 hours.
- Energy Saving - Designed for use with electronic ballasts for lower operating costs and flicker-free starting.

## Applications

- Ideal for downlights and medium bay multi-lamp fixtures for general lighting.

## Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

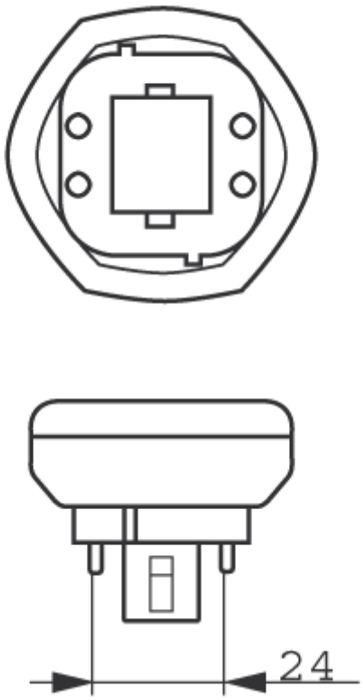
| Product data | |
|---|---|
| Product Number | 268227 |
| Full product name | PL-T 18W/841/4P 1CT |
| Ordering Code | 268227 |
| Pack type | 1 Lamp in a Folding Carton |
| Pieces per Sku | 1 |
| Skus/Case | 12 |
| Pack UPC | 046677268220 |
| EAN2US | |



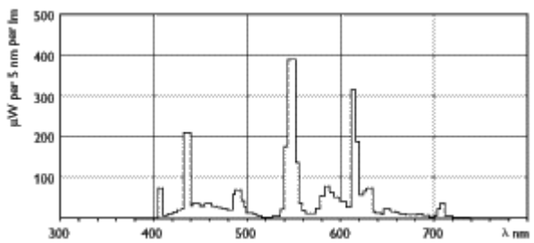
PHILIPS

| Product data | |
|---|---|
| Case Bar Code | 50046677268225 |
| Successor Product number | |
| Base | GX24q-2 |
| Base Information | 4P |
| Execution | /4P [4 Pins] |
| Packing Type | 1CT [1 Lamp in a Folding Carton] |
| Packing Configuration | 12 |
| Avg. Hrs. Life | 16000 hr |
| Ordering Code | PL-T 18W/841/4P/ALTO |
| Pack UPC | 046677268220 |
| Case Bar Code | 50046677268225 |
| Watts | 18W |
| Lamp Wattage EL | 16.5 W |
| Lamp Voltage | 100 V |
| Dimmable | Yes |
| Color Code | 840 [CCT of 4000K] |
| Color Rendering Index | 82 Ra8 |
| Color Designation | Cool White |
| Color Description | 840 Cool White |
| Color Temperature | 4000 K |
| Initial Lumens | 1200 Lm |
| Initial Lumens | 1200 Lm |
| Overall Length C | 116.4 mm |
| Diameter D | 39.85 mm |
| Diameter D1 | 39.65 mm |
| Product Number | 268227 |

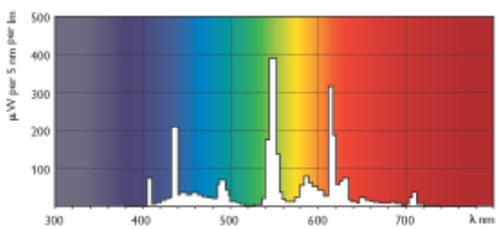
PL-T 18W




Base GX24q-2




PL-T/840




PL-T/840

9/4/2009

# F35T5/841 TG

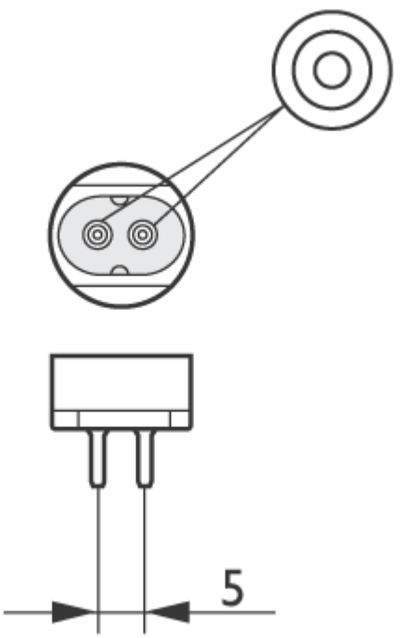
Product family description

| Product data | |
|---|---|
| Product Number | 167338 |
| Full product name | F35T5/841 TG |
| Ordering Code | F35T5/841 TG |
| Pack type | 1 Lamp |
| Pieces per Sku | 1 |
| Skus/Case | 40 |
| Pack UPC | 046677167332 |
| EAN2US | |
| Case Bar Code | 50046677167337 |
| Successor Product number | |
| System Description | High Efficiency |
| Base | Miniature Bipin |
| Base Information | Green Plate |
| Bulb | T5 [16mm] |
| Packing Type | 1LP [1 Lamp] |
| Packing Configuration | 40 |
| Rated Avg. Life | 24000 hr |
| Type | F35T5 |
| Feature | na [Not Applicable] |
| Ordering Code | F35T5/841 TG |
| Pack UPC | 046677167332 |
| Case Bar Code | 50046677167337 |
| Watts | 35W |
| Lamp Wattage EL | 35 W |
| Dimmable | Yes |
| Color Code | 841 [CCT of 4100K] |
| Color Rendering Index | 85 Ra8 |

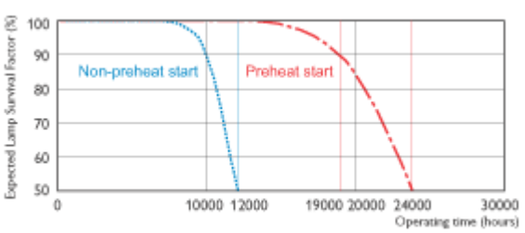
9/4/2009

| Product data | |
|---|---|
| Color Designation | 841 |
| Color Description | na [-] |
| Color Temperature | 4000 K |
| Initial Lumens | - Lm |
| Overall Length C | 1463.2 mm |
| Diameter D | 17 mm |
| Product Number | 167338 |

TL5 HE

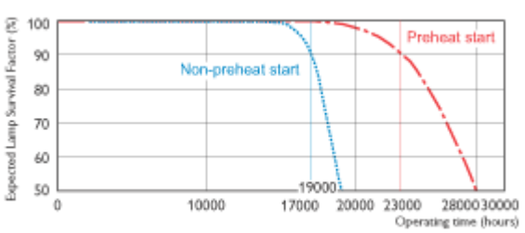



Base Miniature Bipin




Life Expectancy 3h cycle

TL5 HE

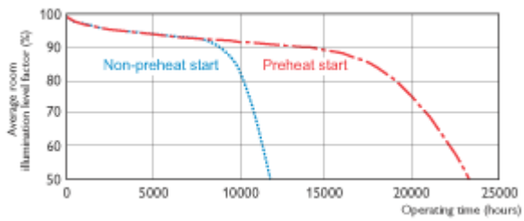



Life Expectancy 12h cycle

TL5 HE

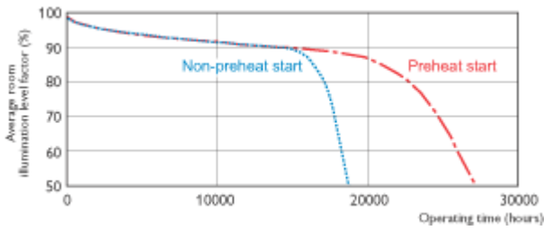


PHILIPS



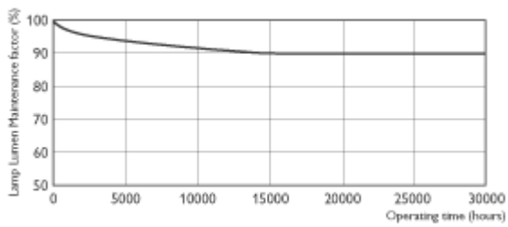

Service Life 3h cycle

TL5 HE




Service Life 12h cycle

TL5 HE




TL5 HE

9/4/2009

# PL-T 32W/841/4P 1CT

Product family description
PL-T Triple 4pin Fluorescent Lamp with Amalgam.

## Features/Benefits

- ALTO® Lamp Technology - Passes EPA's TCLP test for non-hazardous waste.
- Utilizes amalgam technology to provide > 90% of rated lumens in ambient temperatures from 23F to 130F.
- Triple tube design available in 18, 26, 32, and 42W.
- Excellent Color Rendering - 82 Color Rendering Index (CRI).
- Broad Range of Color Temperature - Available in 2700, 3000, 3500 and 4100K.
- Dimmable - PL-T 4-pin lamps may be used with electronic dimming ballasts.
- Long Life - 12,000 hours.
- Energy Saving - Designed for use with electronic ballasts for lower operating costs and flicker-free starting.

## Applications

- Ideal for downlights and medium bay multi-lamp fixtures for general lighting.

## Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

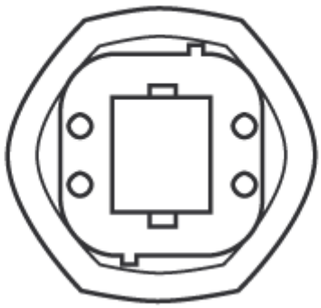
| Product data | |
|---|---|
| Product Number | 268722 |
| Full product name | PL-T 32W/841/4P 1CT |
| Ordering Code | 268722 |
| Pack type | 1 Lamp in a Folding Carton |
| Pieces per Sku | 1 |
| Skus/Case | 12 |
| Pack UPC | 046677268725 |
| EAN2US | |

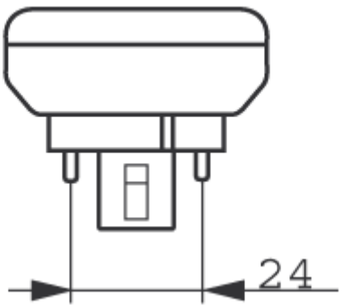
9/4/2009

| Product data | |
|---|---|
| Case Bar Code | 50046677268720 |
| Successor Product number | |
| Base | GX24q-3 |
| Base Information | 4P |
| Execution | /4P [4 Pins] |
| Packing Type | 1CT [1 Lamp in a Folding Carton] |
| Packing Configuration | 12 |
| Avg. Hrs. Life | 16000 hr |
| Ordering Code | PL-T 32W/841/4P/ALTO |
| Pack UPC | 046677268725 |
| Case Bar Code | 50046677268720 |
| Watts | 32W |
| Lamp Wattage EL | 32.0 W |
| Lamp Voltage | - V |
| Dimmable | Yes |
| Color Code | 840 [CCT of 4000K] |
| Color Rendering Index | 82 Ra8 |
| Color Designation | Cool White |
| Color Description | 840 Cool White |
| Color Temperature | 4000 K |
| Initial Lumens | - Lm |
| Initial Lumens | 2400 Lm |
| Overall Length C | 141.4 mm |
| Diameter D | 39.85 mm |
| Diameter D1 | 39.65 mm |
| Product Number | 268722 |

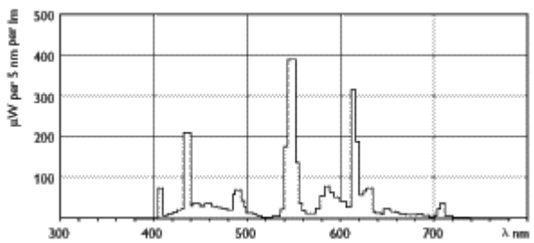
9/4/2009

PL-T 32W

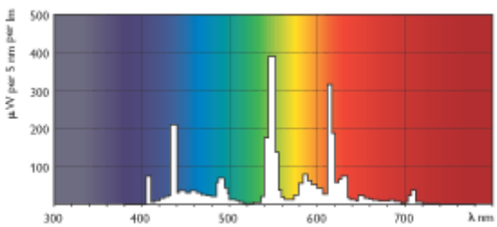





Base GX24q-3




PL-T/840




PL-T/840

9/4/2009

# 24W/841 Min Bipin T5 HO ALTO UNP

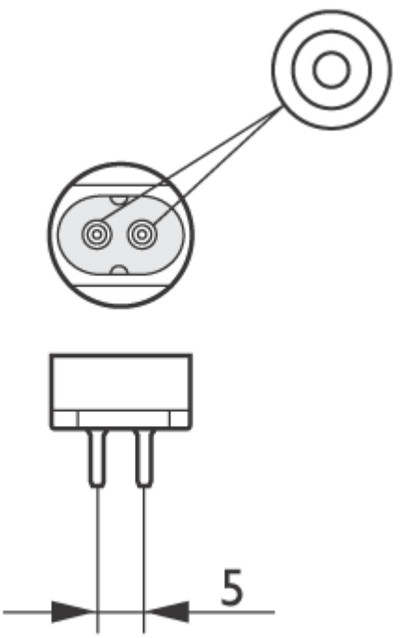
Product family description

| Product data | |
|---|---|
| Product Number | 290213 |
| Full product name | 24W/841 Min Bipin T5 HO ALTO UNP |
| Ordering Code | F24T5/841/HO/ALTO |
| Pack type | Unpacked |
| Pieces per Sku | 1 |
| Skus/Case | 40 |
| Pack UPC | 046677290214 |
| EAN2US | |
| Case Bar Code | 50046677290219 |
| Successor Product number | |
| System Description | High Output |
| Base | Miniature Bipin |
| Base Information | Green [Green Base] |
| Bulb | T5 [16mm] |
| Packing Type | UNP [Unpacked] |
| Packing Configuration | 40 |
| Rated Avg. Life | 24000 hr |
| Type | na |
| Feature | na [Not Applicable] |
| Ordering Code | F24T5/841/HO/ALTO |
| Pack UPC | 046677290214 |
| Case Bar Code | 50046677290219 |
| Watts | 24W |
| Lamp Wattage EL | 22.5 W |
| Dimmable | Yes |
| Color Code | 840 [CCT of 4000K] |
| Color Rendering Index | 85 Ra8 |

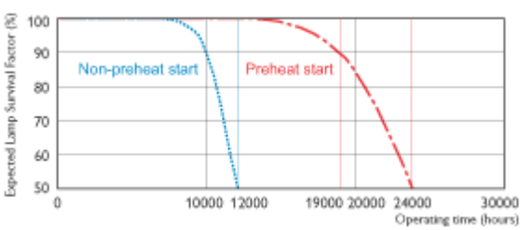
9/4/2009

| Product data | |
|---|---|
| Color Designation | Cool White |
| Color Description | 840 Cool White |
| Color Temperature | 4000 K |
| Initial Lumens | - Lm |
| Overall Length C | 563.2 mm |
| Diameter D | 17 mm |
| Special packing | ALTO |
| Product Number | 290213 |

TL5 HO

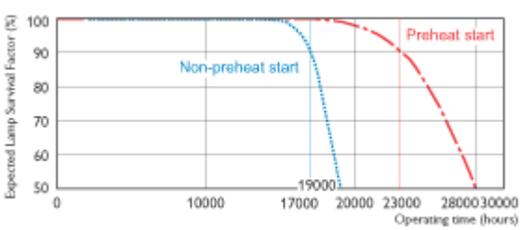



Base Miniature Bipin




Life Expectancy 3h cycle

TL5 HO



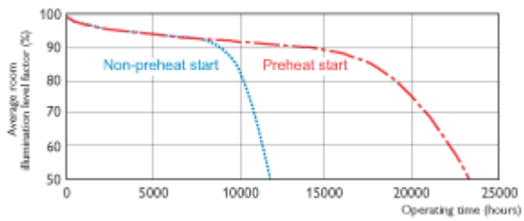

Life Expectancy 12h cycle

TL5 HO



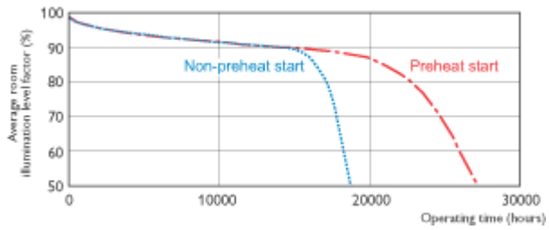
PHILIPS

9/4/2009



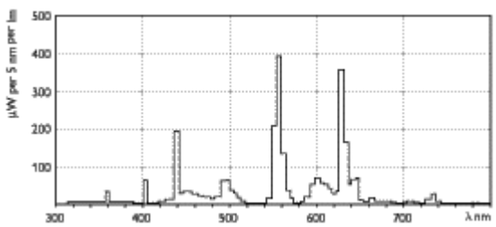

Service Life 3h cycle

TL5 HO

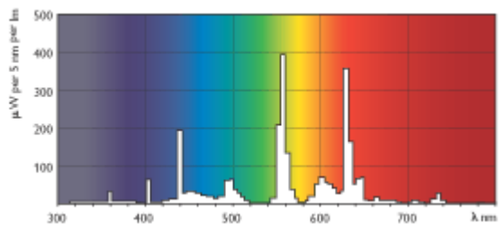



Service Life 12h cycle

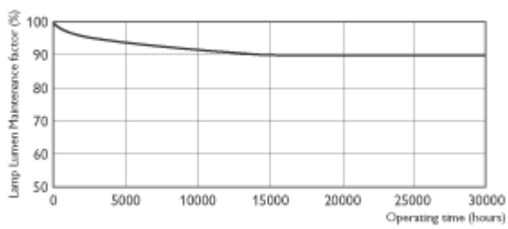
TL5 HO




TL5 HO/840




TL5 HO/840




TL5 HO

9/4/2009

# PL-L 36W/830 2G11/4P 1CT

Product family description
PL-L Long 4pin Fluorescent Lamp.

## Features/Benefits

- High lumen Output in a slim, compact size.
- Broad range of available wattages: 18, 24, 36, 40, 50, 55, and 80W.
- Excellent Color Rendering - 82 Color Rendering Index (CRI); 55W available with 91 CRI.
- Available in 3000, 3500 and 4100K; 55W available as 5000K only.
- Dimmable - PL-L 4-pin lamps may be used with electronic dimming ballasts.
- Long life: 15,000 to 20,000 hours average life depending on wattage.

## Applications

- Ideal for commercial interior lighting applications in 2'x2' fixtures,1'x2' fixtures, and indirect lighting.

## Notes

- Rated average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Lamp life is appreciably longer if lamps are started less frequently. (202)
- Approximate Initial Lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life, when the output is measured during operation on a reference ballast under standard laboratory conditions. (203)
- Design Lumens are the approximate lamp lumen output at 40% of the lamp's Rated Average Life. This output is based upon measurements obtained during lamp operation on a reference ballast under standard laboratory conditions. (208)

| Product data | |
|---|---|
| Product Number | 345116 |
| Full product name | PL-L 36W/830 2G11/4P 1CT |
| Ordering Code | 345116 |
| Pack type | 1 Lamp in a Folding Carton |
| Pieces per Sku | 1 |
| Skus/Case | 25 |
| Pack UPC | 046677345112 |
| EAN2US | |
| Case Bar Code | 50046677345117 |
| Successor Product number | |

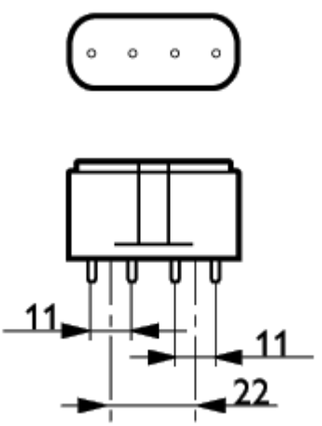
A65

PHILIPS

9/4/2009

| Product data | |
|---|---|
| Base | 2G11 |
| Base Information | 4P |
| Bulb Finish | Silicon |
| Execution | /4P [4 Pins] |
| Packing Type | 1CT [1 Lamp in a Folding Carton] |
| Packing Configuration | 25 |
| Avg. Life | 15000 hr |
| Rated Avg. Life | 20000 hr |
| Ordering Code | PL-L 36W/830/4P |
| Pack UPC | 046677345112 |
| Case Bar Code | 50046677345117 |
| Watts | 36W |
| Lamp Wattage EL | 32.0 W |
| Dimmable | Yes |
| Color Code | 830 [CCT of 3000K] |
| Color Rendering Index | 82 Ra8 |
| Color Designation | Warm White |
| Color Description | 830 Warm White |
| Color Temperature | 3000 K |
| Initial Lumens | 2900 Lm |
| Initial Lumens | 2900 Lm |
| Overall Length C | 416.6 mm |
| Diameter D | 38 mm |
| Diameter D1 | 18 mm |
| Product Number | 345116 |

PL-L 36W

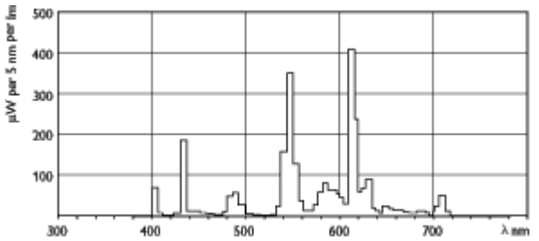



Base 2G11

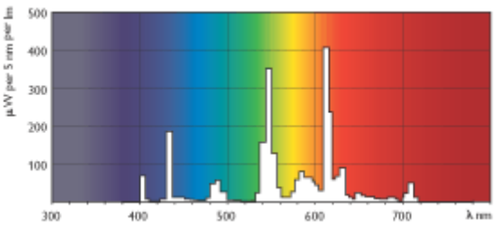


PHILIPS

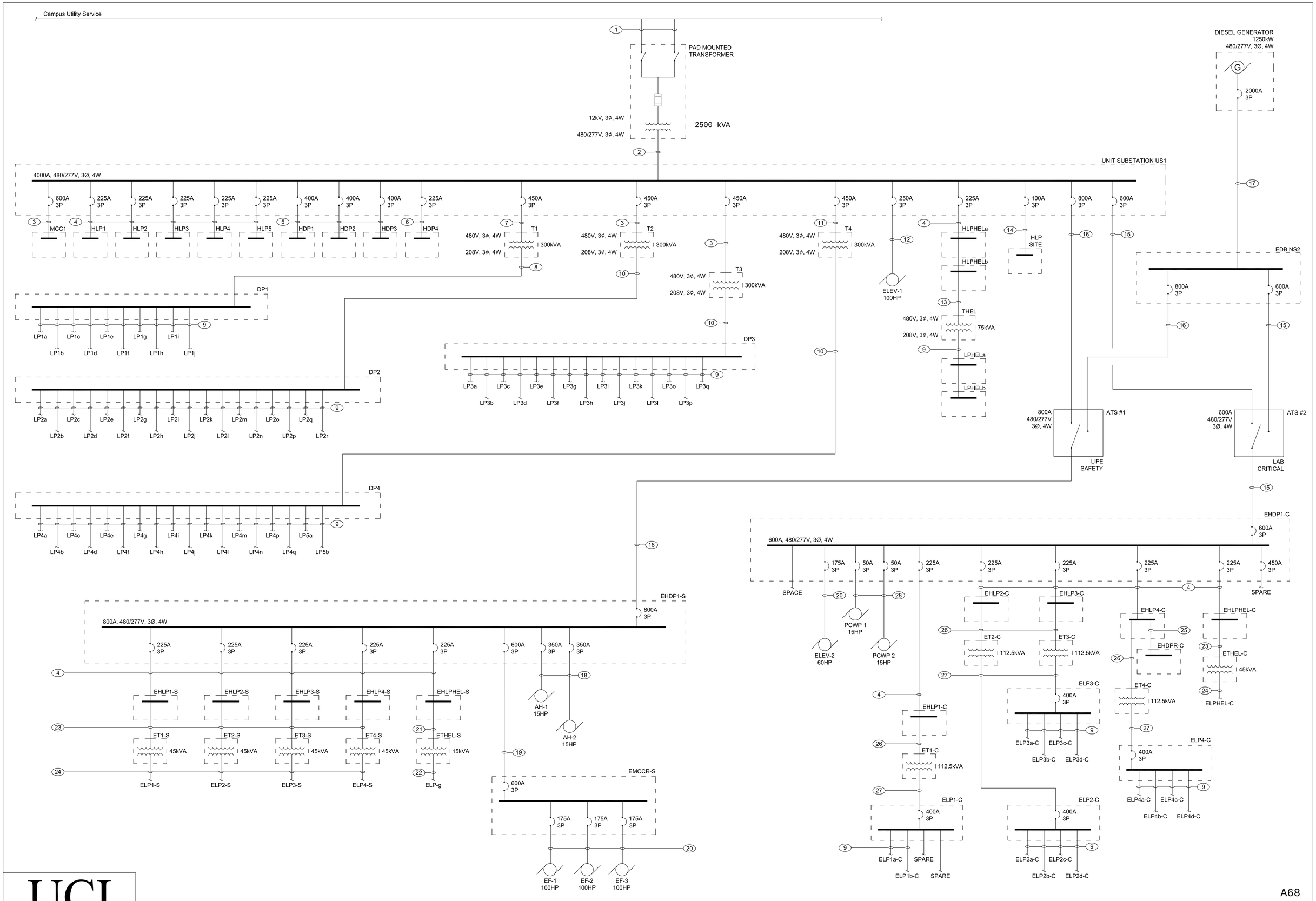
9/4/2009




PL-L/830




PL-L/830




A68

| UCI | Student Name: | Electrical Consultant: | Assignment: | Date: | The Pennsylvania State University | Drawing Title: |
|---|---|---|---|---|---|---|
| Natural Sciences, Unit II<br>Irvine, California | Grant W. Kightlinger<br>Lighting/Electrical Option | Professor T. Dannerth, PE | THESIS SUMMARY REPORT | APRIL 7, 2009 | Architectural Engineering<br>AE 481 - Senior Thesis Project | Single-Line Diagram |

## *FEEDER SCHEDULE*

| Tag | From | To | No. of Sets | Conduit (Per Set) | | Conductors (Per Set) | | | | | | | | | Size of Overcurrent Protection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Phase Conductors | | | Neutral Conductors | | | Ground Conductors | | | |
| | | | | Size | Type | No. | Size | Type | No. | Size | Type | No. | Size | Type | |
| 1 | UTILITY | XFMR | 2 | 5" | EMT | 2 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 4/0 | CU THWN | - |
| 2 | XFMR | US1 | 11 | 4" | EMT | 3 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 4000A |
| 3 | US1 | MCC1 | 2 | 3" | EMT | 2 | 350KCMIL | CU THWN | - | - | CU THWN | 1 | #1 | CU THWN | 600A |
| 3 | US1 | T2 | 2 | 3" | EMT | 2 | 350KCMIL | CU THWN | - | - | CU THWN | 1 | #1 | CU THWN | 600A |
| 3 | US1 | T3 | 2 | 3" | EMT | 2 | 350KCMIL | CU THWN | - | - | CU THWN | 1 | #1 | CU THWN | 600A |
| 4 | US1 | HLP1 | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | US1 | HLP2 | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | US1 | HLP3 | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | US1 | HLP4 | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | US1 | HLP5 | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | US1 | HPHELa | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-C | EHLPHEL-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-C | EHLP4-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-C | EHLP3-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-C | EHLP2-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-C | EHLP1-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-S | EHLPHEL-S | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-S | EHLP1-S | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-S | EHLP2-S | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-S | EHLP3-S | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 4 | EHDP1-S | EHLP4-S | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 1 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 5 | US1 | HDP1 | 1 | 3" | EMT | 2 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | #3 | CU THWN | 400A |
| 5 | US1 | HDP2 | 1 | 3" | EMT | 2 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | #3 | CU THWN | 400A |
| 5 | US1 | HDP3 | 1 | 3" | EMT | 2 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | #3 | CU THWN | 400A |
| 6 | US1 | HDP4 | 1 | 2.5" | EMT | 2 | 4/0 | CU THWN | - | - | CU THWN | 1 | #4 | CU THWN | 225A |
| 7 | US1 | T1 | 2 | 2.5" | EMT | 2 | 300KCMIL | CU THWN | - | - | CU THWN | 1 | #1 | CU THWN | 500A |
| 8 | T1 | DP1 | 3 | 4" | EMT | 3 | 350KCMIL | CU THWN | 1 | 350KCMIL | CU THWN | 1 | 2/0 | CU THWN | 1000A |
| 9 | DP1 | LP1a | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1b | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1c | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1d | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1e | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1f | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1g | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1h | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1i | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP1 | LP1j | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2a | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2b | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2c | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2d | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2e | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2f | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2g | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2h | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2i | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |

## *FEEDER SCHEDULE (CONTINUED)*

| Tag | From | To | No. of Sets | Conduit (Per Set) | | Conductors (Per Set) | | | | | | | | | Size of Overcurrent Protection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Phase Conductors | | | Neutral Conductors | | | Ground Conductors | | | |
| | | | | Size | Type | No. | Size | Type | No. | Size | Type | No. | Size | Type | |
| 9 | DP2 | LP2j | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2k | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2l | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2m | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2n | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2o | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2p | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2q | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP2 | LP2r | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3a | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3b | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3c | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3d | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3e | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3f | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3g | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3h | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3i | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3j | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3k | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3l | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3o | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3p | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP3 | LP3q | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4a | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4b | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4c | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4d | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4e | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4f | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4g | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4h | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4i | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4j | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4k | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4l | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4m | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4n | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4p | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP4q | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP5a | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | DP4 | LP5b | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP1-C | ELP1a-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP1-C | ELP1b-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP2-C | ELP2a-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP2-C | ELP2b-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP2-C | ELP2c-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |

## *FEEDER SCHEDULE (CONTINUED)*

| Tag | From | To | No. of Sets | Conduit (Per Set) | | Conductors (Per Set) | | | | | | | | | Size of Overcurrent Protection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Phase Conductors | | | Neutral Conductors | | | Ground Conductors | | | |
| | | | | Size | Type | No. | Size | Type | No. | Size | Type | No. | Size | Type | |
| 9 | ELP2-C | ELP2d-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP3-C | ELP3a-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP3-C | ELP3b-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP3-C | ELP3c-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP3-C | ELP3d-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP4-C | ELP4a-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP4-C | ELP4b-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP4-C | ELP4c-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | ELP4-C | ELP4d-C | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 9 | THEL | LPHELa | 1 | 2.5" | EMT | 3 | 4/0 | CU THWN | 2 | 4/0 | CU THWN | 1 | #4 | CU THWN | 225A |
| 10 | T2 | DP2 | 4 | 3" | EMT | 3 | 350KCMIL | CU THWN | 2 | 350KCMIL | CU THWN | 1 | 3/0 | CU THWN | 1200A |
| 10 | T3 | DP3 | 4 | 3" | EMT | 3 | 350KCMIL | CU THWN | 2 | 350KCMIL | CU THWN | 1 | 3/0 | CU THWN | 1200A |
| 10 | T4 | DP4 | 4 | 3" | EMT | 3 | 350KCMIL | CU THWN | 2 | 350KCMIL | CU THWN | 1 | 3/0 | CU THWN | 1200A |
| 11 | US1 | T4 | 2 | 3.5" | EMT | 3 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | 1/0 | CU THWN | 700A |
| 12 | US1 | ELEV-1 | 1 | 2.5" | EMT | 3 | 250KCMIL | CU THWN | - | - | CU THWN | 1 | #4 | CU THWN | 250A |
| 13 | HLPHELb | THEL | 1 | 1.5" | EMT | 3 | #1 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 125A |
| 14 | US1 | HLP SITE | 1 | 1.25" | EMT | 3 | #2 | CU THWN | 1 | #2 | CU THWN | 1 | #8 | CU THWN | 100A |
| 15 | US1 | ATS #2 | 2 | 3" | EMT | 3 | #2 | CU THWN | 1 | #2 | CU THWN | 1 | #8 | CU THWN | 600A |
| 15 | EDB NS2 | ATS #2 | 2 | 3" | EMT | 3 | #2 | CU THWN | 1 | #2 | CU THWN | 1 | #8 | CU THWN | 600A |
| 15 | ATS #2 | EHDP1-C | 2 | 3" | EMT | 3 | #2 | CU THWN | 1 | #2 | CU THWN | 1 | #8 | CU THWN | 600A |
| 16 | US1 | ATS #1 | 2 | 4" | EMT | 3 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 1/0 | CU THWN | 800A |
| 16 | EDB NS2 | ATS #1 | 2 | 4" | EMT | 3 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 1/0 | CU THWN | 800A |
| 16 | ATS #1 | EHDP1-S | 2 | 4" | EMT | 3 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 1/0 | CU THWN | 800A |
| 17 | GENERATOR | EDB NS2 | 6 | 4" | EMT | 3 | 500KCMIL | CU THWN | 1 | 500KCMIL | CU THWN | 1 | 250KCMIL | CU THWN | 2000A |
| 18 | EHDP1-S | AH-1 | 1 | 3" | EMT | 3 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | #3 | CU THWN | 350A |
| 18 | EHDP1-S | AH-2 | 1 | 3" | EMT | 3 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | #3 | CU THWN | 350A |
| 19 | EHDP1-S | EMCCR-S | 2 | 3" | EMT | 3 | 500KCMIL | CU THWN | - | - | CU THWN | 1 | 1/0 | CU THWN | 800A |
| 20 | EHDP1-S | ELEV-2 | 1 | 1.5" | EMT | 3 | 2/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 175A |
| 20 | EMCCR-S | EF-1 | 1 | 1.5" | EMT | 3 | 2/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 175A |
| 20 | EMCCR-S | EF-2 | 1 | 1.5" | EMT | 3 | 2/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 175A |
| 20 | EMCCR-S | EF-3 | 1 | 1.5" | EMT | 3 | 2/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 175A |
| 21 | EHLPHEL-S | ETHEL-S | 1 | 3/4" | EMT | 3 | #10 | CU THWN | - | - | CU THWN | 1 | #10 | CU THWN | 25A |
| 22 | ETHEL-S | ELP-g | 1 | 1" | EMT | 3 | #4 | CU THWN | 1 | #4 | CU THWN | 1 | #10 | CU THWN | 60A |
| 23 | EHLPHEL-C | ETHEL-C | 1 | 1" | EMT | 3 | #4 | CU THWN | - | - | CU THWN | 1 | #8 | CU THWN | 70A |
| 23 | EHLP1-S | ET1-S | 1 | 1" | EMT | 3 | #4 | CU THWN | - | - | CU THWN | 1 | #8 | CU THWN | 70A |
| 23 | EHLP2-S | ET2-S | 1 | 1" | EMT | 3 | #4 | CU THWN | - | - | CU THWN | 1 | #8 | CU THWN | 70A |
| 23 | EHLP3-S | ET3-S | 1 | 1" | EMT | 3 | #4 | CU THWN | - | - | CU THWN | 1 | #8 | CU THWN | 70A |
| 23 | EHLP4-S | ET4-S | 1 | 1" | EMT | 3 | #4 | CU THWN | - | - | CU THWN | 1 | #8 | CU THWN | 70A |
| 24 | ETHEL-C | ELPHEL-C | 1 | 2" | EMT | 3 | 1/0 | CU THWN | 1 | 1/0 | CU THWN | 1 | #6 | CU THWN | 150A |
| 24 | ET1-S | ELP1-S | 1 | 2" | EMT | 3 | 1/0 | CU THWN | 1 | 1/0 | CU THWN | 1 | #6 | CU THWN | 150A |
| 24 | ET2-S | ELP2-S | 1 | 2" | EMT | 3 | 1/0 | CU THWN | 1 | 1/0 | CU THWN | 1 | #6 | CU THWN | 150A |
| 24 | ET3-S | ELP3-S | 1 | 2" | EMT | 3 | 1/0 | CU THWN | 1 | 1/0 | CU THWN | 1 | #6 | CU THWN | 150A |
| 24 | ET4-S | ELP4-S | 1 | 2" | EMT | 3 | 1/0 | CU THWN | 1 | 1/0 | CU THWN | 1 | #6 | CU THWN | 150A |
| 25 | EHLP4-C | EHDPR-C | 1 | 1" | EMT | 3 | #6 | CU THWN | 1 | #6 | CU THWN | 1 | #10 | CU THWN | 50A |
| 26 | EHLP2-C | ET2-C | 1 | 1.5" | EMT | 3 | 1/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 150A |
| 26 | EHLP3-C | ET3-C | 1 | 1.5" | EMT | 3 | 1/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 150A |
| 26 | EHLP4-C | ET4-C | 1 | 1.5" | EMT | 3 | 1/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 150A |
| 26 | EHLP1-C | ET1-C | 1 | 1.5" | EMT | 3 | 1/0 | CU THWN | - | - | CU THWN | 1 | #6 | CU THWN | 150A |
| 27 | ET1-C | ELP1-C | 1 | 4" | EMT | 3 | 500KCMIL | CU THWN | 2 | 500KCMIL | CU THWN | 1 | #3 | CU THWN | 400A |

| FEEDER SCHEDULE (CONTINUED) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tag | From | To | No. of Sets | Conduit (Per Set) | | Conductors (Per Set) | | | | | | | | | Size of Overcurrent Protection |
| | | | | | | Phase Conductors | | | Neutral Conductors | | | Ground Conductors | | | |
| | | | | Size | Type | No. | Size | Type | No. | Size | Type | No. | Size | Type | |
| 27 | ET2-C | ELP2-C | 1 | 4" | EMT | 3 | 500KCMIL | CU THWN | 2 | 500KCMIL | CU THWN | 1 | #3 | CU THWN | 400A |
| 27 | ET3-C | ELP3-C | 1 | 4" | EMT | 3 | 500KCMIL | CU THWN | 2 | 500KCMIL | CU THWN | 1 | #3 | CU THWN | 400A |
| 27 | ET4-C | ELP4-C | 1 | 4" | EMT | 3 | 500KCMIL | CU THWN | 2 | 500KCMIL | CU THWN | 1 | #3 | CU THWN | 400A |
| 28 | EHDP1-C | PCWP 1 | 1 | 1" | EMT | 3 | #6 | CU THWN | - | - | CU THWN | 1 | #10 | CU THWN | 50A |
| 28 | EHDP1-C | PCWP 2 | 1 | 1" | EMT | 3 | #6 | CU THWN | - | - | CU THWN | 1 | #10 | CU THWN | 50A |

**NOTES:**

1. REFER TO SINGLE-LINE DIAGRAM FOR FEEDER TAGS
CU = COPPER