THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OFARCHITECTURAL ENGINEERING

DOUBLE SKIN FAÇADE DESIGN AND ANALYSIS FOR THE UNIVERSITY RESEARCH BUILDING

ELIZABETH KIMBLE
SPRING 2014

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Architectural Engineering
with honors in Architectural Engineering

Reviewed and approved* by the following:

Richard Mistrick
Associate Professor of Architectural Engineering
Thesis Supervisor/Honors Adviser

Kevin Houser
Professor of Architectural Engineering
Faculty Reader

* Signatures are on file in the Schreyer Honors College.

URB University Research Building

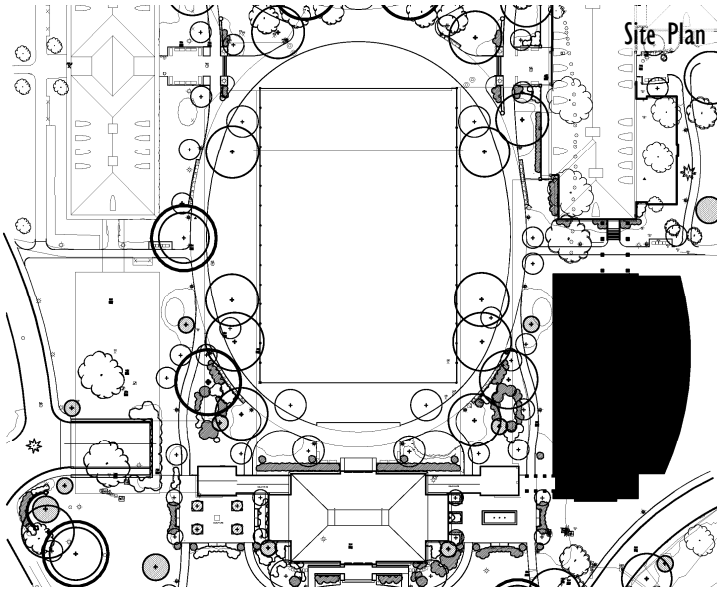
Northeast United States

Elizabeth Kimble - Lighting/Electrical Option

The URB was designed to provide a home for three collaborative research labs: the Extreme Materials Institute, the Individualized Health Initiative, and the Systems Institute. Each of these research programs pulls expertise from multiple departments within the university, and a main goal of the building was to provide a laboratory and office space to foster communication and collaboration.

East Façade

West Façade



Site Plan

Team

Owner: Confidential
Construction Manager: The Whiting Turner Contracting Company
Commissioning Agent: Strategic Building Solutions
Architect, Landscape Architect, Structural Engineer: The S/L/A/M Collaborative
Civil Engineer: Rummel, Klepper & Kahl, LLP (RK&K)
Geotechnical Engineer: D.W. Kozera, Inc.
Fire Suppression, Plumbing, HVAC and Electrical Engineer: James Posey Associates
Lighting Consultant: Bruce Dunlop Lighting Design LLC
IT/AV Consultant: speXsys, LLC

Stats

Size: 69,000 G.S.F.
Total Levels: 4 levels + mechanical penthouse
Dates of Construction: November 26, 2012 – May 29, 2014
Overall Project Cost: approximately $26 million

Systems

Architecture:

- Building core features laboratories and computer labs, surrounded on the exterior by open work areas, research labs, and private offices
- West façade reflects traditional building styles of the rest of the quad, while the east façade features a modern, curved glass curtain wall.

Structure:

- Spread footings in foundation
- Two-way post-tensioned concrete slabs support floors

Mechanical:

- Underfloor HVAC supply plenums throughout the building
- Five air handlers supply air to the building, and most mechanical equipment is located in the mechanical penthouse.

Electrical:

- Campus distribution system, operating at 13,200V
- Transformer brings 13.2kV down to 480Y/277V 3-phase power for use in building
- Generator located in a vault under a neighboring building provides for life safety and standby loads.

Lighting:

- Existing lighting design is primarily fluorescent, with LED downlights and exterior pole-mounted luminaires
- Advanced controls and low-mercury lamps help the building achieve LEED certification.

http://www.engr.psu.edu/ae/thesis/portfolios/2014/emk5189/index.html

ABSTRACT

This thesis is based upon a study of the University Research Building (URB), a fictionally named project located in the Mid-Atlantic region of the United States. The University Research Building is being constructed to house three collaborative research labs: the Extreme Materials Institute, the Individualized Health Initiative, and the Systems Institute. Each of these research programs pulls expertise from multiple departments within the university, and the URB will provide laboratory and office space to foster communication and collaboration. The building will also be home to the university's Computer Science department.

This thesis report focuses on the redesign of the eastern façade of the building. The façade was analyzed with regards to daylighting, and a new façade design was developed which utilizes a double skin façade with operable louvers to help reduce direct sunlight penetration in the eastern workspaces. Research was conducted into principles, best practices, and case studies related to double skin façade design, and the results of that study are included in this report. Also included are mechanical and architectural analyses to determine energy and aesthetic impacts of the façade alteration. Finally, new lighting designs were developed for several spaces throughout the building, with the goal of creating high-performance, energy efficient lighting design while reinforcing the identities and goals of the research labs housed in the URB.

Overall, the new façade will provide improved performance in the space. The greatest improvements can be seen in a reduction of direct sunlight penetration, as well as reduced cooling loads.

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to thank the many individuals who helped make this thesis possible:

Dr. Richard Mistrick	Honors Advisor, Honors Thesis Advisor AE Lighting Associate Professor, Penn State
Dr. Kevin Houser	AE Thesis Advisor, Honors Thesis Reader AE Lighting Professor, Penn State
Leslie Beahm	Electrical Advisor, Reese Engineering
Craig Casey	AE Lighting PhD Student
James Posey Associates	MEP Consulting Engineers Baltimore, MD
S|L|A|M Collaborative	Architects Glastonbury, CT

My family and friends for all of their support throughout this year.

Chapter 1

A Study of Double Skin Facades

Introduction

In recent years, as architects continue to be fascinated by the idea of an "airy, transparent, and light" building made of glass [4], and as the energy efficiency of our built environment becomes more of a focus within the building industry, double skin facades have seen an increase in popularity. These double skin facades offer several advantages for daylighting and thermal loads; however, they must be designed properly if they are to be effective. This paper will examine the basic structure and types of double skin façade systems, mechanical and daylighting impacts, analysis methods, and case studies.

Double Skin Façade Fundamentals

A double skin façade is typically defined as a building envelope construction consisting of "two transparent surfaces separated by a cavity" [16]. While all double skin facades share these basic components, they can be further classified based upon the method of partitioning, cavity ventilation, and airflow concept used [3, 1]. Partitioning methods include box window, corridor, shaft-box window, and multi-story facades. Ventilation can then be achieved naturally, mechanically, or through a hybrid strategy. Finally, the airflow can be classified into one of five categories: outdoor air curtain, indoor air curtain, air supply, air exhaust, or static air buffer [1, 3]. These airflow strategies can be seen in the figure below.

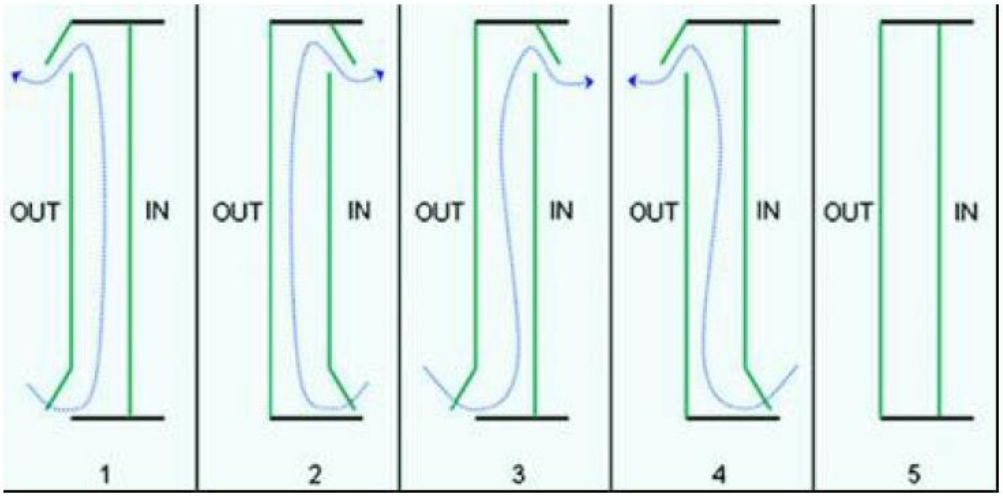


Figure 1 | Airflow strategies for double skin facades: 1) outdoor air curtain, 2) indoor air curtain, 3) air supply, 4) air exhaust, 5) static air buffer. [4]

While double skin facades typically feature one layer of double-glazing and one layer of single glazing, the location of the glass types will change based upon the airflow strategy. For example, a façade ventilated with outdoor air will typically locate the double-glazing on the interior glazed surface, while an indoor air curtain façade will typically feature double-glazing on the exterior surface [4]. Other features that vary across double skin façade designs include cavity depth, location and type of shading devices, and openings in the interior or exterior glazed surface. Each of these distinct characteristics can have a significant impact on the system's performance in various climates and orientations.

Advantages of Double Skin Facades

Poirazis' literature review on double skin facades provides several advantages of properly designed double skin façade systems. When adequate cavity depths are achieved, double skin façade systems can provide acoustic insulation from exterior noises such as roadways and airports. However, it is important to note that in some façade types, such as those featuring ventilation into the interior spaces, acoustic performance may actually be diminished due to

sound travelling from room to room through the façade cavity. Double skin facades can also provide thermal insulation, thereby helping to reduce mechanical loads. During the winter, thermal performance is best when ventilation openings are smallest or with thinner cavities. In the summer, increased ventilation of the cavity and the stack effect can aid in the extraction of heat from the cavity. For facades with operable interior glazing, nighttime ventilation may be utilized to help cool interior spaces in the summer months, while providing protection from burglary and rain. Protection of shading devices, glare protection, increased protection from wind loads, and increased thermal comfort in perimeter areas are other advantages of properly designed systems [13].

Disadvantages of Double Skin Facades

While there are many advantages to a properly designed double skin façade system, there are also some associated disadvantages. These include increased construction costs, problems with overheating if not properly designed, and increased weight of the structure [13]. There are also concerns regarding fire protection, especially with multi-story facades. The reduced compartmentalization of a double skin façade may allow fire to spread more easily between rooms and floors [4].

Best Practices and Design Recommendations

In order to have a positive impact on both heating and cooling loads, it is recommended that a more sophisticated control system allowing for the adjustment of the cavity ventilation is utilized. This would allow for less airflow in the winter, and increased airflow during the summer months. To avoid overheating, it is also recommended that the cavity depth be no less than 200

mm [13]. Barkkume's study of ventilated double skin facades stresses the importance of an open floor plan to the success of double skin façade system. He also suggests that underfloor air distribution systems and the resulting higher ceilings will also aid the design's performance [3].

Analysis Methods

Lawrence Berkeley National Laboratory (LBNL) is currently researching complex fenestration systems, such as fritted glass, woven roller shades, and venetian blinds. Research measuring the surface properties of glazing and shading materials has generated bidirectional scattering distribution function (BSDF) data, which is being compiled in a new Complex Glazing Database. This data can then be studied using Window 6 to compute total window performance. At that point, the Window 6 data can be used in energy and daylighting models using EnergyPlus and Radiance. The goal of this research and database development is to give design professionals tools to more accurately calculate the loads associated with complex fenestration systems, so that engineers can have the calculations and confidence required to accurately size building equipment, therefore reducing building energy use. [12]

Daylighting Analysis

While dynamic daylighting systems often offer the best performance, they are also quite complicated to analyze properly. While programs such as Radiance and Diva can provide more complex analysis, such tools are not as widely available to all design teams. Though Ecotect is more widely available, its accuracy has come into question when considering complex daylighting strategies. Recently, the University of Washington and the Integrated Design Lab

have partnered with the New Buildings Institute to develop daylighting guidelines and resources to help increase industry understanding of effective daylighting practices. [12]

More advanced daylighting calculations can be performed using various software platforms. These include AGi32 and Daysim. Rhino 3d modeling software can also be used with Grasshopper and Diva to calculate daylighting performance and to consider parametric façade design. This parametric design process allows designers to optimize the façade's performance with respect to different criteria, such as daylighting performance and mechanical loads.

Mechanical Analysis

The BESTFACADE project developed a simple calculation method for use in estimating the performance of different double skin façade types with respect to building energy. The method is based on the German DIN V 18599 standard, and considers the double skin façade as an attached sunspace, including gains and heat loss coefficients as well as an equivalent circuit. The results of the calculation method were verified using simulation tools like EnergyPlus, and while it does not provide a detailed assessment, its aim is to assist in preliminary design decisions related to double skin façade types [4]. The Center for the Built Environment (CBE) at UC Berkeley developed the Berkeley Comfort Model, which uses a computer model of the human body to calculate thermal comfort of occupants near glazing and window systems. While the current CBE tool is limited to analysis of simple glazing strategies, Sabine Hoffmann has developed "SoloCalc," which utilizes comfort evaluation equations from the Berkeley Comfort Model in conjunction with complex fenestration data from LBNL's Window 6.2. [12]

Mechanical performance can be further studied through the use of Computational Fluid Dynamics (CFD). Several studies have examined the accuracy of such advanced models, performing CFD analysis and comparing the results to experimentally collected data. These models allow for the analysis of much more complex systems, such as double skin facades with operable venetian blinds [4,6].

Case Studies

Cambridge Public Library

Figure 2 | Cambridge public library reading area (left), and the 1 foot wide louvers as seen from within the cavity (right). [5]

The Cambridge Public Library, located in Cambridge, MA and designed by William Rawn Associates with façade engineering by Arup, was the first United States project to incorporate the three key ingredients of European Double-skin curtain wall technology – 3’ deep airspace, multi-story thermal flue, and movable 1’ deep sunshades. The system features an upper portion of each story with operable horizontal aluminum louvers. The lower portion of the glazing is then left open to provide views, but is protected by a glass overhang. The louvers automatically adjust between open and closed positions to protect against direct daylight

penetration. The façade also features an exhaust vent with operable louvers, which allows for airflow within the façade during the summer, while in winter the vent can be closed off to create a static air barrier. The façade has realized a 50% reduction in energy use compared with a conventional curtain wall [5].

1 Bligh Street

The 1 Bligh Street building is a signature office tower located Sydney's central business district. It represents the first large scale use of a double skin façade in an Australian high-rise [1]. In order to maximize views of Sydney's harbor, clear, untinted glass was utilized in the curving glass façade. This presented a challenge for glare control and mechanical loads, and the double skin façade with a sophisticated narrow venetian blind system was created. The complexity of the building's elliptical façade required very advanced modeling and controls for the shading system. The Horiso group individually considered each of the 64 different glazing orientations, taking into account the sun's angle of incidence and the relative position of adjacent buildings. The final design features 897 individually programmed controllers and 1780 specialty venetian blinds. The double skin façade is also ventilated, allowing cool air to enter through the bottom of the cavity and extract heat through openings at the top. The façade's design has been hailed as a success – the building achieved a 42 percent CO_2 reduction compared with conventional office buildings of a similar size [8]. 1 Bligh Street has won numerous awards, such as the Winner for Sustainable Development in the 2013 Urban Taskforce Australia Development Excellence Awards and the 2012 Council on Tall Buildings and Urban Habitat's "Most outstanding new tall building in Asia and the Australasian region [2].

Occidental Chemical Building

The Occidental Chemical Building, originally known as the Hooker Building, is the oldest double skin façade in North America. The building provides an example of potential problems that can be encountered if a double skin façade system is not executed well. According to a report from the University of Waterloo's School of Architecture, excavation for new construction near the front of the building led to an increase in dirt accumulation within the wall cavity, and the intake grilles at the bottom of the façade were closed off. This stopped the intended airflow through the cavity, leading the façade to begin to trap heat and increasing the mechanical loads. Finally, the solar shading louvers ceased operation, and were not repaired. As a result, the façade's functionality suffered [3].

Telus Building

The Telus Building in Vancouver was originally built in 1947, and was renovated in 2000. As part of the renovation, a double skin façade was added to the exterior walls of the building, and allows for winter insulation, natural ventilation, and daylight control. Fritted glass and operable windows were key features that contributed to the design's energy performance – 61% below the ASHRAE 90.1 standard of the time [16, 17].

Conclusions

In conclusion, double skin facades can offer numerous benefits, such as reduced mechanical loads, improved daylighting performance, acoustic insulation, and increased natural ventilation. However, energy efficient performance requires a thoroughly integrated design process [3], and careful analysis. More tools are being developed to help improve simulation

accuracy and availability. Existing buildings examined through case studies can provide models for successful implementation of double skin facades as well as valuable “lessons learned.” As further studies are performed and more buildings incorporate double skin facades, best practice recommendations will likely become more consistent, and post occupancy performance data will become more widely available.

Chapter 2

Building Statistics

General Building Data

Name: University Research Building

Location: Mid-Atlantic United States

Building Occupant: Confidential

Occupancy Type: Laboratory and office space for three collaborative research centers.

Size: 69,000 G.S.F.

Total Levels: 4 levels + mechanical penthouse

Dates of Construction: November 26, 2012 – May 29, 2014

Overall Project Cost: Approximately $26 million

Project Delivery Method: Design-Bid-Build

Primary Project Team

Owner: Confidential

Construction Manager: The Whiting Turner Contracting Company

Commissioning Agent: Strategic Building Solutions

Architect, Landscape Architect, Structural Engineer: The S|L|A|M Collaborative

Civil Engineer: Rummel, Klepper & Kahl, LLP

Geotechnical Engineer: D.W. Kozera, Inc.

Fire Suppression, Plumbing, HVAC and Electrical Engineer: James Posey Associates

Lighting Consultant: Bruce Dunlop Lighting Design LLC

IT/AV Consultant: speXsys, LLC

Architecture

Design and Function: The building was designed to provide a home for three collaborative research labs: the Extreme Materials Institute, the Individualized Health Initiative, and the Systems Institute. Each of these research programs pulls expertise from multiple departments within the university, and a main goal of the building was to provide a laboratory and office space to foster communication and collaboration. To encourage this, the four floors of the building each contain a core area which features laboratories or computer labs. Surrounding this central core are private offices and open work areas and research labs. The corners of the building feature conference rooms and specialty labs.

Building Envelope

Façades: As the building is located on a traditional quad of campus, the façade facing the quad features a masonry veneer assembly on CMU, which respects the architectural style of surrounding buildings. On the east side of the building, facing away from the quad, a curving curtain wall system lends a modern feel to reflect the cutting-edge research being performed within.

Roof Systems: The URB features three roof system types: a new slate roof, a fully adhered membrane roofing system over ½" coverboard on minimum 5" thickness rigid insulation over a concrete roof deck, and pre-manufactured dormers with batten seam copper roof and openings for window units.

Sustainability Features

The URB is pursuing LEED Gold certification. Sustainability measures include:

- Daylight harvesting
- Lighting controls
- Enhanced refrigerant management
- Outdoor air delivery monitoring

Structure

The URB's structure consists of spread footings on in the foundation. The foundation follows an irregular layout, with some bays as wide as 25'-9", while other bays are as short as 15'. Shear walls can be found on the south and west sides of the building. The floors are supported by two-way post-tensioned concrete slabs. Concrete and steel columns are used in the building, as well as post-tensioned concrete beams. Common concrete column sizes are 16x28, 16x36, and 20x28. Steel reinforced concrete columns feature W10x49 wide flanges.

Mechanical

The University Research Building's HVAC system utilizes underfloor supply plenums throughout the building. Raised floor tiles host mechanical diffusers, while additional HVAC ducts run throughout the ceiling plenums. A mechanical penthouse contains much of the building's mechanical equipment, including the five air handling units which supply air to the building. Two of these air handling units are variable air volume air handling units with return air bypasses.

Electrical

The building's electrical system is supplied by the campus distribution loop at 13.2 kV. The building transformer drops the voltage down to 480/277V power for distribution to equipment throughout the building. The majority of the lighting is at 277V. An existing diesel fuel generator is located in a generator vault under an adjacent building, providing backup power to emergency and standby loads. Conduit provisions were made to provide for future photovoltaic arrays to be placed on the roof above the eastern curved façade; however, the arrays are not being installed at this time.

Lighting

The existing lighting design is primarily fluorescent, with LED downlights and exterior pole-mounted luminaires. The existing lighting was designed to provide appropriate lighting levels while also highlighting the building's architectural features. To help the building achieve LEED goals, the lighting design features advanced controls and low-mercury lamps.

Fire Protection

The building is classified as having Group B – Business occupancy. The building is designed to group B – sprinklered design standards. The entire building is protected with automatic sprinkler, automatic fire alarm, and automatic fire detection systems. The allowable exit travel distance is 300 feet.

Transportation

The URB has two main stairways – one at each of the north and south ends of the building. The building's single elevator is located on the north end of the building.

Telecommunications

The building features extensive telecommunications wiring, as it will be home to many offices and research labs, as well as the university's Computer Science department. Many offices feature television monitors for use in meetings and collaboration. The building features access control and security equipment throughout, as several specialty labs will be performing important research with limited access.

Chapter 3

Daylighting Depth

Overview

Daylighting analysis was given a high priority in this study due to the URB's east-facing glass façade. Because research labs and office spaces are bordered by this large area of glazing, direct sunlight penetration posed a potential problem, especially during the early morning hours of the workday. The original design features fritted glass; however, there is a potential need for additional interior shading during the hours in which sunlight strikes the east façade.

As a first step in the daylighting analysis, the site and surrounding buildings were studied. There is a building located to the northeast of the URB, and it was determined that this building would potentially shade some areas of the façade, but that the upper floors would remain exposed, and that at least some portion of the glass façade would receive direct sunlight despite the neighboring building's shadow in the early morning. As the day progresses, more of the façade will receive direct sunlight. While there is a building to the southeast of the URB, it is located down-hill and is not very tall. As a result, this building will not provide any shading.

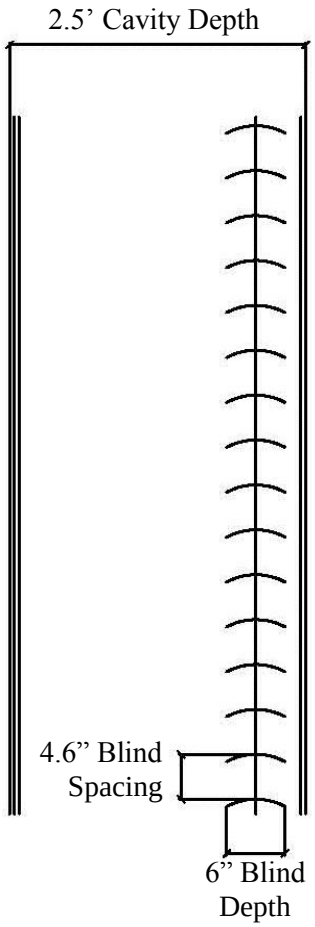
Schematic design of the new façade considered the basic principles of two case study buildings described in the initial double skin façade research. These buildings included the Cambridge Public Library and 1 Bligh Street, located in Sydney. Both buildings utilized operable louvers or blinds, but with slightly different overall implementation.

The Cambridge Public Library façade features 1'-wide adjustable louvers in the top half of each story, while a tinted glass overhang protects the lower half of the window and allows an unobstructed view to the exterior. While this design was aesthetically appealing, early analysis determined that it would not be a practical solution for the University Research Building. The

Cambridge Public Library façade is located on the southwest side of the building, and while it does encounter some low-angle sun at the end of the day, library patrons can choose to move to a different location if direct sunlight becomes bothersome, and so some direct sunlight penetration into the space is deemed acceptable for that application. In contrast, the URB's lab spaces will have assigned desks and workstations, so there is little flexibility for researchers and students to move around if direct sunlight becomes bothersome. Due to the façade's due-east orientation, low angle sun will be encountered for a significant portion of the early morning workday, and the overhang solution for the lower half of the glazing wall was deemed impractical.

The 1 Bligh Street double skin façade design was determined to be a more viable solution to the URB's daylighting needs. The design features narrower operable blinds located within the cavity of the double skin façade. While the Bligh Street implementation features a very advanced control system with individually calibrated blind angles for every segment of the building's curved façade, the URB's needs are simpler, as the glazed area of the building is largely east-facing in orientation, and a simpler control strategy would be more economical to implement. As a result, it was decided that a 6" operable blind system with 4 angle options (0° horizontal, 15°, 30°, and 45°) as well as a fully-raised setting would be analyzed.

Design



The new façade design features a 2.5’ cavity depth, with single-pane glazing on the exterior and double-pane glazing on the interior surface. Low-e coating glass was used on the interior glazed surface.

Figure 3 | Double Skin Facade Design

Analysis

Both the existing curtain wall façade and the double skin façade design were analyzed using the new version of Daysim daylighting software currently being developed by Penn State. The University research building was modeled, as well as the building located to the northeast, as it may shade the URB façade during some portions of the day.

For the double skin façade, each of the blind angle settings was modeled and incorporated as a shade setting within the Daysim run. The blinds were modeled geometrically

rather than using a bidirectional scattering distribution function (BSDF), so that any daylight passing directly through the space between blinds could be accurately calculated. Sensor points were located in the work area of the third floor research lab, extending from one foot inward from the façade to the edge of the corridor.

An sDA run was performed within Daysim. This provided direct-sunlight-only illuminance values for the original curtain wall façade, as well as general daylight illuminance values under each of the potential shade settings for the double skin façade design. These results were then studied within Excel using programs written in Visual Basic for Applications (VBA).

Results

For the original curtain wall façade, it was important to determine how much of a potential problem was posed by direct sunlight penetration into the work area. This was calculated by performing an $aSE_{1000\ lux,\ 250\ hr}$ analysis, which represents the percentage of sensor points which receive direct sunlight with an illuminance of at least 1000 lux for at least 250 hours of the year during working hours. For this analysis, a workday was considered to run from 8 am to 6 pm.

After performing the calculation, the original façade design was found to have an $aSE_{1000\ lux,\ 250\ hr}$ value of 34.3%. As it is generally recommended to seek a value of less than 10% from this metric, it is likely that direct sunlight infiltration into the URB's workspaces may pose a potential problem, and interior shades of some kind may need to be added. The results of this run can be seen in Figure 4.

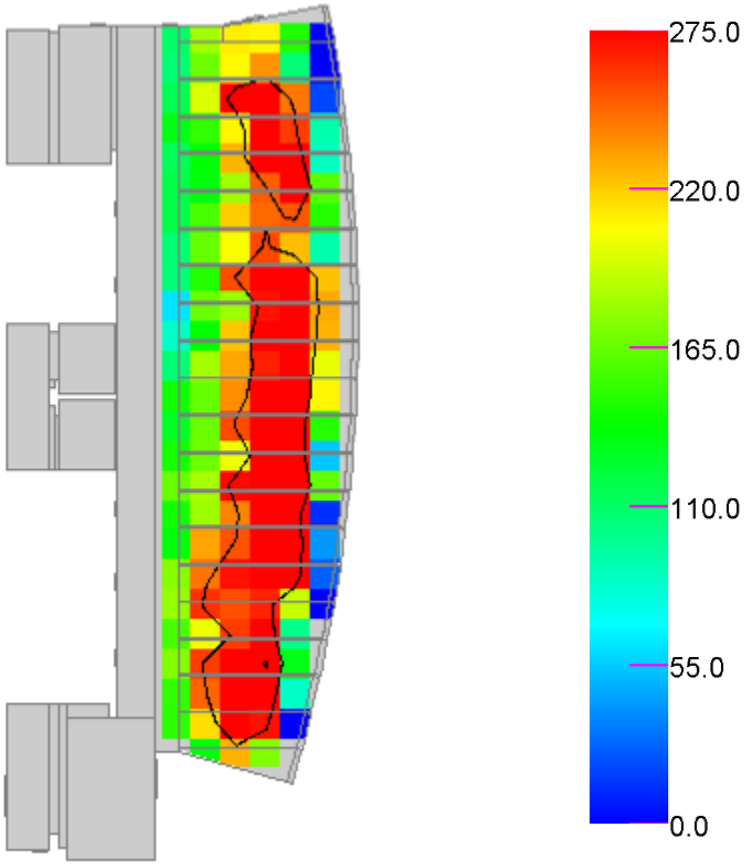


Figure 4 | Curtain Wall aSE Results - Contour line at 250 hours above 1000 lux direct sunlight

For the double skin façade design, a combined illuminance file was created to represent the façade performance if utilizing the four blind angle options and the fully raised setting. The illuminance values were selected for each hour based upon a control strategy for the blinds which combined profile angle analysis with a photosensor reading within the space. The lowest blind setting that would block all direct sunlight penetration was selected for each hour. If the average illuminance of the space with that shade setting was greater than 3000 lux, the next higher shade angle was selected. A spatial daylight autonomy calculation was performed using this combined illuminance file. Spatial Daylight Autonomy for the double skin façade ($sDA_{300\ lux,50\%}$) was

determined, which represents the percentage of sensor points with an illuminance greater than 300 lux at least 50% of the workday hours throughout the year. $sDA_{300\ lux,50\%}$ was found to be 100%, indicating the every sensor point location receives 300 lux at least 50% of the workday hours.

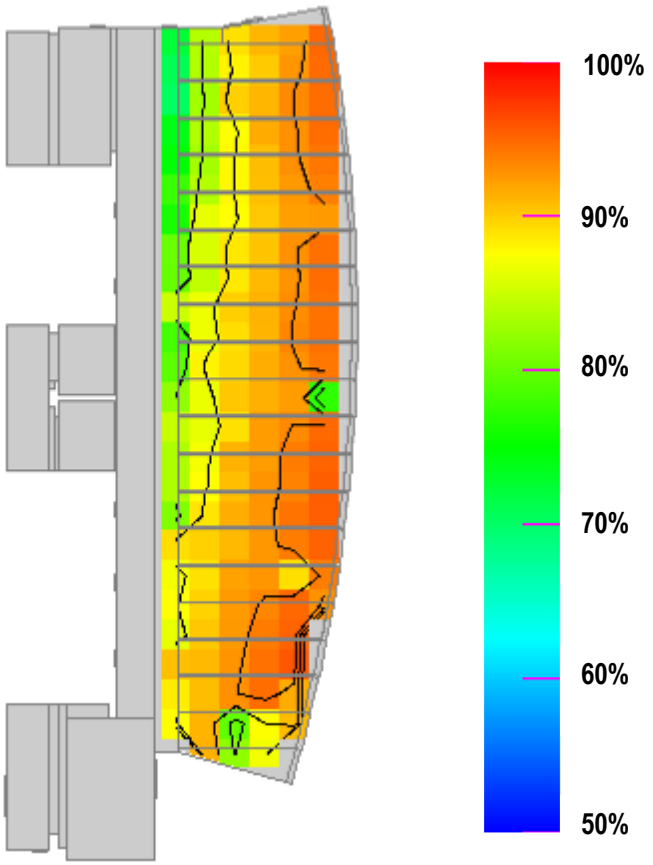


Figure 5 | Spatial Daylight Autonomy ($sDA_{300\ lux,50\%}$) with Double Skin Façade

For further analysis, the hours in which sensor point locations had illuminance values above 5000 lux and the percentage of workday hours under each shading condition were determined. This study found that only two out of 143 sensor point locations experienced

illuminance values of at least 5000 lux for 200 or more hours throughout the year. As neither point experienced above 250 hours, this was deemed acceptable. The shade condition frequencies can be seen in the table below.

Shade Setting	Percentage of Workday Hours
Blinds Raised	53.5%
0° - horizontal	23%
15°	10%
30°	10.5%
45°	3%

The blinds will be in the raised or horizontal position for over 75% of the occupied hours throughout the year. This will allow for fairly unobstructed views for the building occupants.

Conclusion

In summary, the new façade design performs well, as it blocks direct sunlight penetration into the space, and prevents average illuminance values above 3000 lux. It will also provide energy savings through reduced electric lighting loads, as 100% of the points located within the open office workspace area have a spatial daylight autonomy of at least 50% for 300 lux.

Chapter 4

Mechanical Breadth

The mechanical performance of the double skin façade – specifically with regards to energy use – was compared to that of the existing curtain wall design using two energy modelling programs, Design Advisor and EnergyPlus. Both programs were recommended for use by the BESTFACADE study [4].

First, MIT's Design Advisor website was used to approximate baseline energy savings for several façade configurations. The online tool has somewhat restricted flexibility, but does allow the user to select from several façade configurations and ventilation strategies, and to compare the results from each scenario. The user interface and setup of a run can be seen in the figure below.

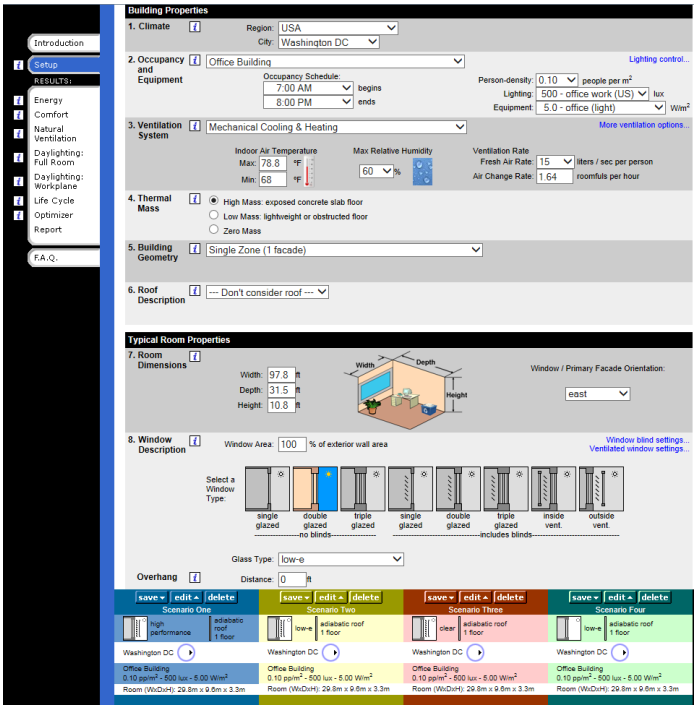
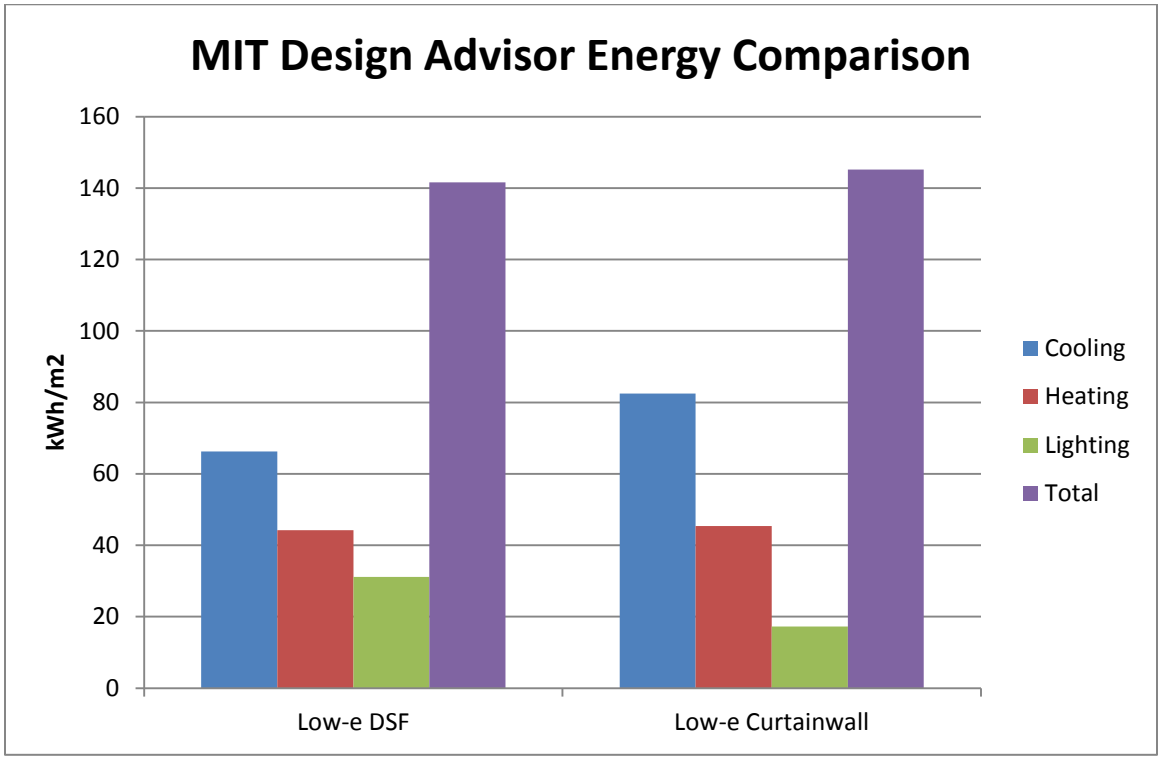


Figure 6 | MIT Design Advisor User Interface

The results of the Design Advisor run can be seen below, comparing the performance of a double skin façade with Low-e glazing on the interior layer vs. a curtain wall with low-e glazing as in the URB's original design. Overall, the double skin façade uses slightly less energy in total. The greatest savings come from significantly reduced cooling loads, though heating loads also decreased. The curtain wall has better calculated energy performance with reduced lighting loads. However, if additional interior shades are added to the curtain wall design to mitigate some of the direct sunlight penetration, this advantage will decrease, and the double skin façade will be a clearer choice for energy savings.



Next, a similar energy model was created using EnergyPlus and DesignBuilder. This software allows for more detailed model creation and specific input values. One floor of the URB – most detailed for the workspace zone nearest the east façade – was modeled for each scenario. An example model from within DesignBuilder can be seen in the following figure.

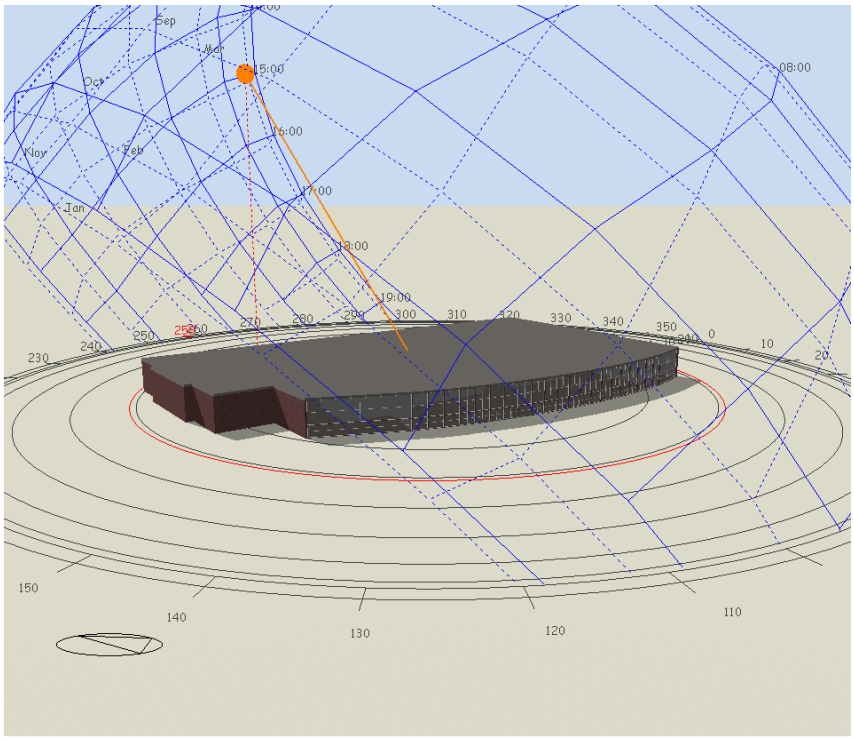
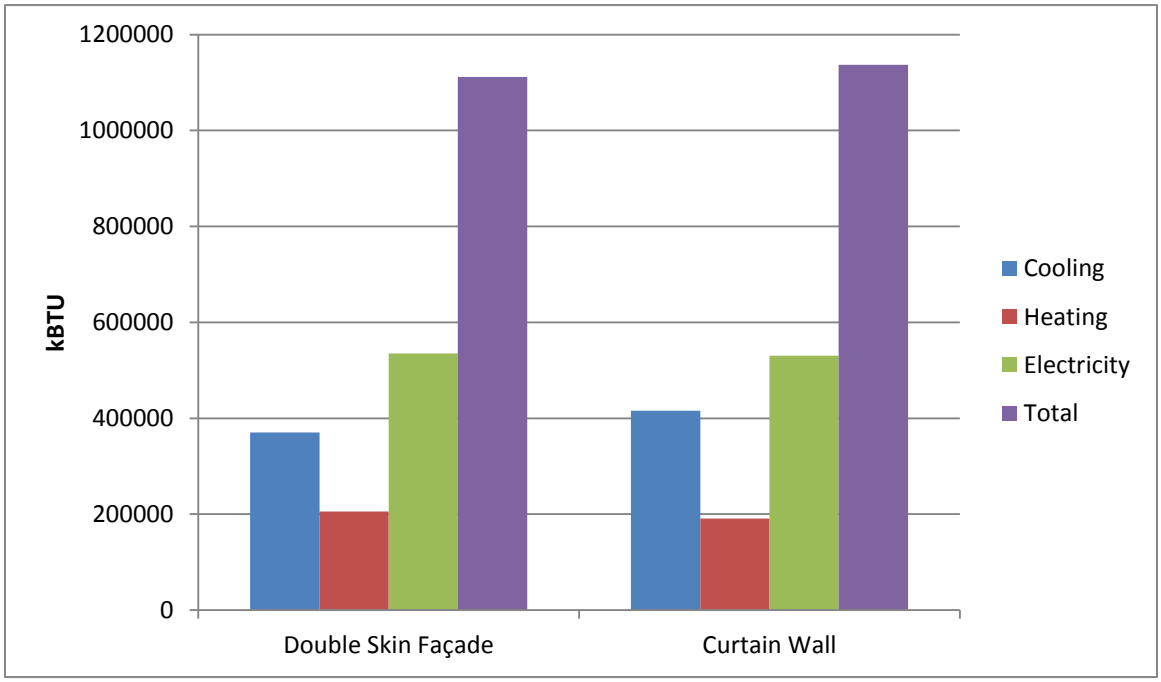


Figure 7 | DesignBuilder / EnergyPlus Model



Once again, the energy use for the portion of the building modeled can be compared across the three main loads of cooling, heating, and electricity (lighting and equipment loads combined). Once again, both facades perform similarly in terms of heating and electricity consumption. The largest energy savings comes from the lower cooling loads present with the implementation of the double skin façade with integral shading devices. Once again, the original curtain wall design has slightly lower electricity loads due to the reduced daylight levels present as a result of the double skin façade design's integral blinds.

Overall, there was not a very large difference in energy consumption between the two façades. The entire building would need to be modelled in greater deal before one might consider whether mechanical equipment could be resized. That being said, the similar results obtained using both energy modeling programs is a promising indicator that there are potential energy savings through the implementation of the double skin façade. The benefit of the double skin façade is increased if the curtain wall design does end up requiring an internal shading blind or screen to be installed, as this would lead to an increase in lighting loads.

Chapter 5

Architectural Breadth

The university campus consists mainly of buildings featuring federal style architecture, with symmetrical designs derived from classical inspiration. Given the University Research Building's location on a prominent campus quad, the surrounding architecture was an important consideration when redesigning the façade. The figure below shows the buildings located around the URB.

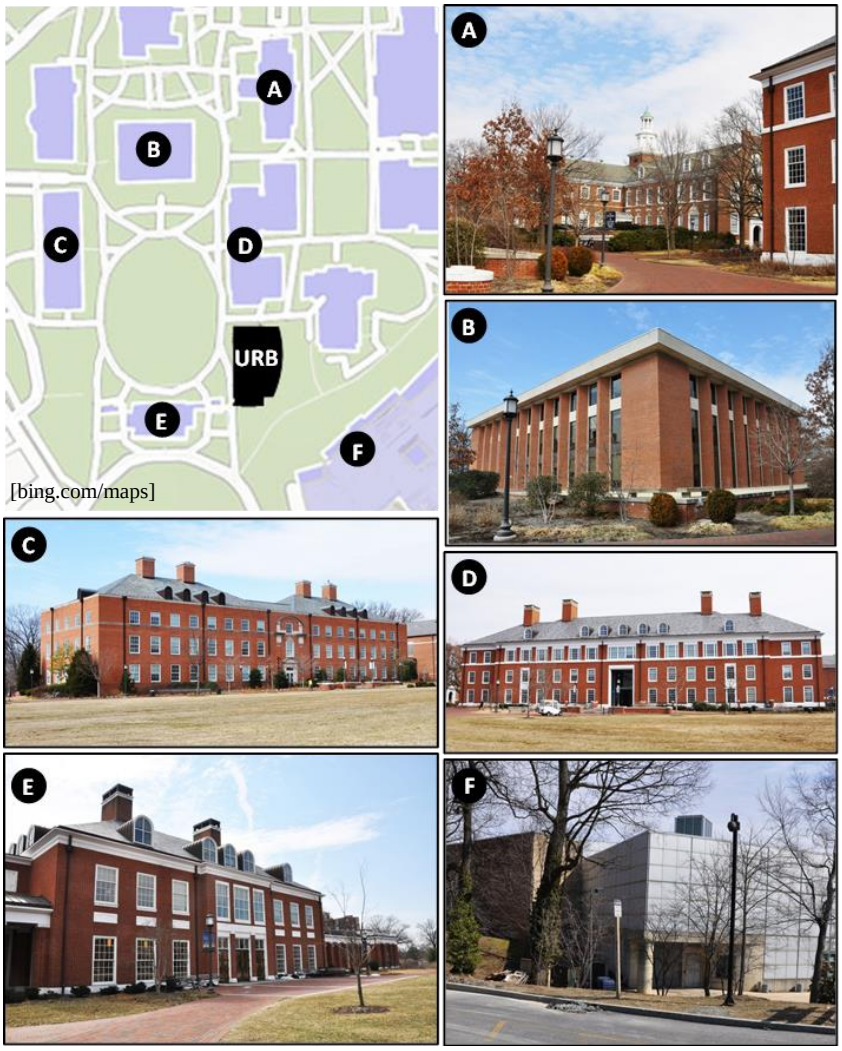


Figure 8 | Architectural Context

Buildings A, C, D, and E, shown above, have more traditional facades with red brick and symmetrically placed windows. Building E houses the campus visitor center and admissions office, and draws many prospective students and other visitors to this area of campus. Building E is a slightly more modern architectural style, though it is constructed using similar materials. Building F is an art museum located just across the street from the curtain wall façade of the URB.

Given the curtain wall façade's orientation facing away from the more historic quad, it was determined that a slightly more modern aesthetic would be acceptable, as long as a traditional federal-inspired façade remained on the building's west face. A similar architectural precedent can be seen on Penn State's campus with the Biobehavioral Health Building.

Figure 9 | Penn State Biobehavioral Health Building [Image Credit 22]

While the façade facing toward Old Main lawn – shown on the left side of the image above – is more traditional in style, the portion of the building facing towards the more modern Hub Robeson Center has a modern curtain wall design.

The University Research Building design can be seen below. The first image depicts the more traditional west façade, which faces the quad. The following images show the original

curtain wall design and the redesigned double skin façade system, which faces off campus and toward the art museum.

Figure 10 | URB Traditional West Façade

Figure 11 | URB East Facade Curtain Wall - Original Design

Figure 12 | URB East Facade with Double Skin Facade Redesign - Top image with operable louvers in raised position, bottom image with louvers lowered in horizontal orientation.

While it was determined that a more modern design was acceptable for the eastern façade of the University Research Building, for the redesign, the spandrel panel height on the exterior glass was decreased. While the inner glazing layer maintains taller spandrels to cover the floor slab and plenum height, the exterior glazing's shorter spandrel more closely resembles the stone courses present on the brick facades of the building.

Chapter 6

Lighting Design

The University Research Building is home to 3 specialized research labs and the department of computer science. As a major goal of the building's construction was to facilitate cooperative efforts and research, one goal of the lighting design was to reflect and inspire this collaboration. At the same time, it was important that areas of the building specially designated for each lab or department should have some aspects which reflected their individual identity. With this in mind, an image was selected to represent the spirit of the four groups.

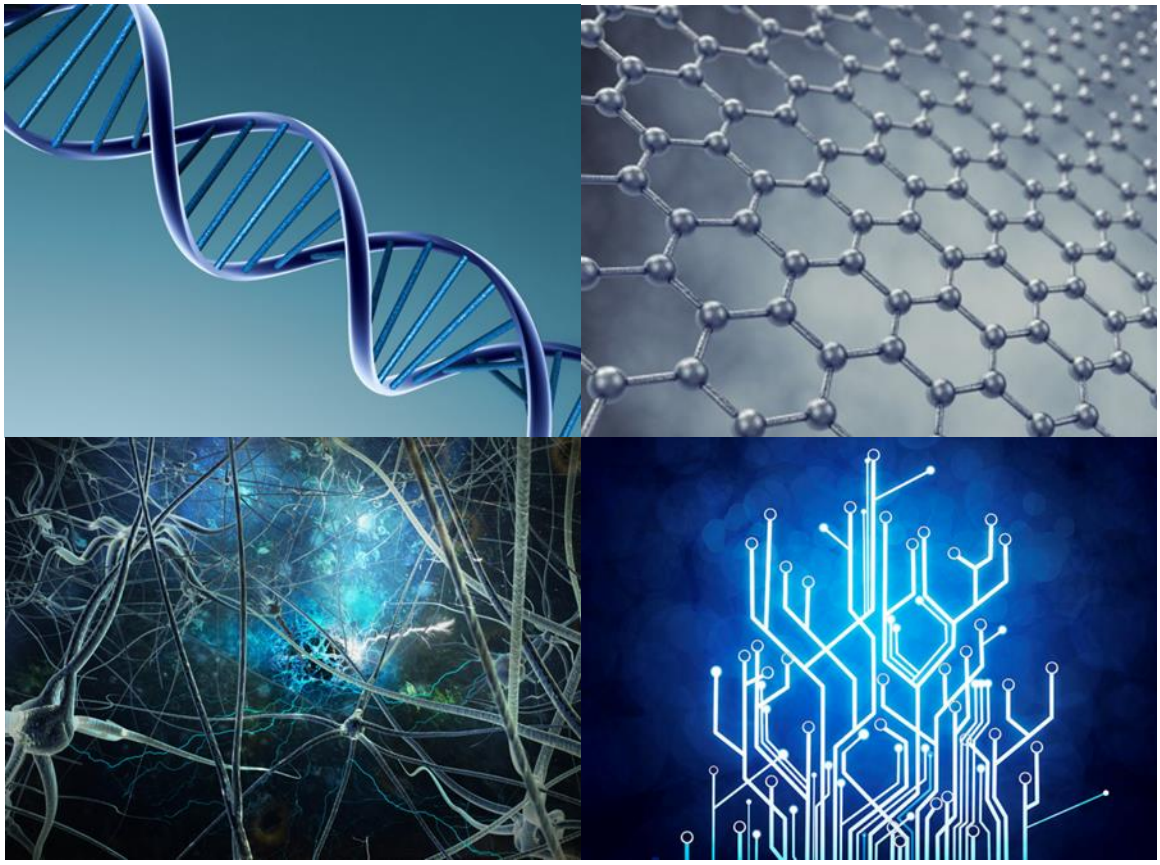


Figure 13 | Design inspiration images for the Individualized Health Initiative (top left), Extreme Materials Institute (top right), Systems Institute (bottom left), and Computer Science Department (bottom right). [Image credits 18-21]

Research Lab – Room 350

The research lab, located on the third floor, spans a majority of the eastern side of the building. The eastern wall of the space features floor-to-ceiling glass as part of the curtain wall on the building's east façade – this façade was also studied as part of daylighting, mechanical, and architecture breadths.

While the space is designated as a "lab", activities will be more similar to those often found in open offices. Primary visual tasks shall include reading, writing, and computer use. The research lab will be a collaborative work space for both the Systems Institute and the Individualized Health Initiative. Each group has its own reception area, with the Systems Institute reception on the north end of the research lab and the Individualized Health reception on the south end.

Areas:

IH Reception – 300 S.F.

Corridor – 810 S.F.

SI Reception – 271 S.F.

Research Lab – 2178 S.F.

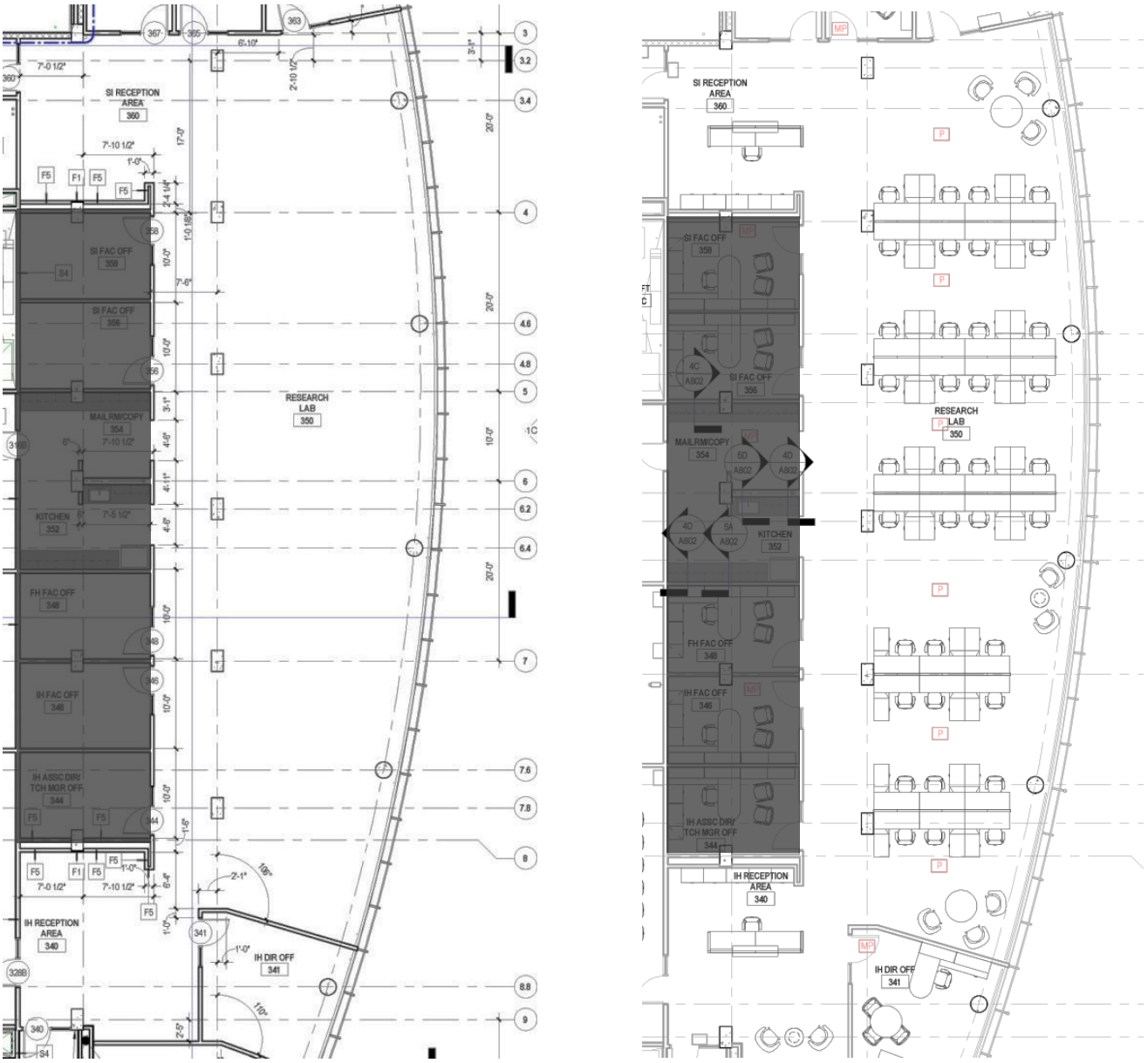


Figure 15 | Research Lab Floor and Furniture Plans

Finishes

Type	Manufacturer	Description	Color/Pattern	Reflectance
WP1	Marlite	Wood Paneling	Flat Cut Cherry #252	0.4
P2A	Benjamin Moore	Eggshell Finish Wall Paint	2058-40 Cool Blue	0.29
P1	Benjamin Moore	Eggshell Finish Wall Paint	OC-17 White Dove	0.78
P9	Master Coating Technologies	Waterbased Dry Erase Finish	"Wink" Clear Coat	0.85
CPT1	Shaw Contract	The Eccentric Tile 59587	67505 Audrey	0.1
RB1	Johnsonite	Traditional Rubber Wall Base, 4" Height	40 Black	0.1
APC1	Armstrong	Ultima Tegular #1912, 2'x2'	White	0.9
EXP	-	Exposed Concrete		0.35
SAC2	Tectum	Direct Attached Ceiling Panels, 2'x8'	White	0.75

Type	Manufacturer	τ	$\rho_{interior}$	$\rho_{exterior}$
IG2	Viracon	0.43	0.2	0.19
IGS	Viracon	0.49	0.23	0.2
TS Clear	Viracon	0.88	0.08	0.08

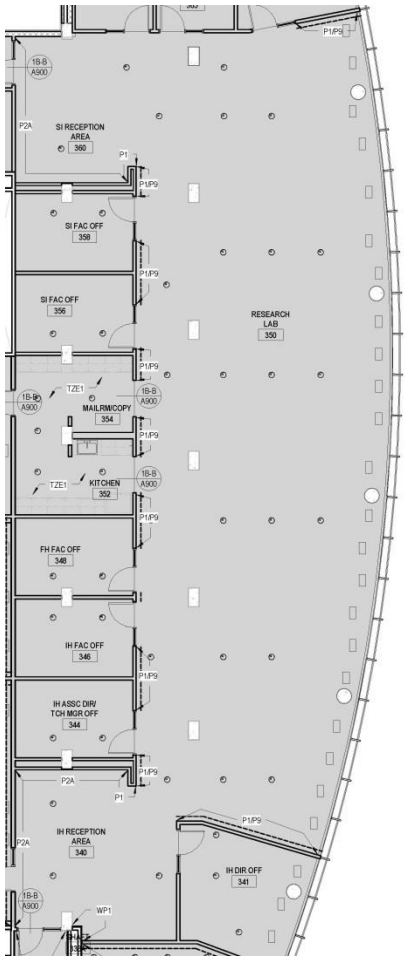


Figure 11 | Research Lab Finish Plan

The research lab features many finish types. The walls are mainly painted with white, eggshell finish paint. Some accent walls feature blue paint, wood paneling, or a dry-erase top-coat. The ceiling in the reception areas and corridor is a white acoustic ceiling tile. In the research space, the ceiling is exposed concrete with attached Tectum acoustic ceiling panels in a white finish. The floor is carpeted with dark, faintly patterned carpet. Glazing types IG2 and IGS are used in the curtain wall, while type TS Clear is used for interior glazing.

Design Criteria

ASHRAE/IES Standard 90.1 – 2010 Allowed LPD

Office, Open Plan: 0.98 W/S.F.

Corridor/Transition: 0.66 W/S.F.

Controls

ASHRAE/IES Standard 90.1 also requires lighting controls for the Research Lab – occupancy sensors are required throughout the open office space, while the lighting fixtures located in the daylight zone along the curtain require daylight harvesting.

Illuminance Criteria

Reception Desk

- E_h: 150 lux @ task area
- E_v: 50 lux
- Wall behind reception desk – focal : task: 1.5:1

Open Office Area

- E_h: 300-500 lux @ 2'-6" A.F.F.
- E_v: 50 lux
- Average:Min across task area: 1.5:1

The illuminance requirements listed above are derived from the recommendations listed in the *IES Handbook, 10th Edition*. The average horizontal and vertical illuminance levels are taken from the Applications sections on "Lighting for Offices" and "Common Applications". An average age of 25-65 was assumed for the visual ages of observers, as most graduate students and

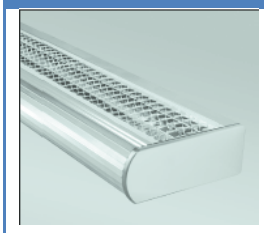
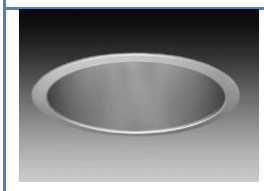
professors working in this space will likely fall within or near this age range. The average to minimum illuminance criteria is based upon Table 12.6 of the handbook.

Design Concept

In the reception area, wayfinding and circulation are the primary tasks. By lighting the wall behind the reception desk, visitors entering the space will have their attention drawn to their first destination with the receptionist. In the corridor, long lines of light arranged in a somewhat random pattern draw occupants down the hallway in the direction of primary circulation. In the work areas, light is focused on the desks, where the majority of visual tasks will be performed. Ambient light directed toward the ceiling will help provide general illumination for the entire workspace area.

Equipment

The reception areas at the North and South ends of the space have general ambient illumination provided by round LED downlights. Wall wash luminaires illuminate the wall behind the reception desk, creating a focal point for people entering the space and serving to highlight the research lab signage on the wall. In the circular ceiling cutout, LED tape lights provide a soft glow along the vertical wall of the cutout, while a custom fiber optic installation gives each lab a unique quality which reinforces the lab's mission. Recessed linear fluorescent slot fixtures are arranged in a randomized pattern leading down the corridor. Finally, furniture-mounted fixtures combining task and ambient lighting are installed on each desk in the open office area. These fixtures will allow for increased flexibility if the layout of the lab furniture should ever need to be changed.

	Type	Description	Lamp	Manufacturer
	A	Furniture-mounted task-ambient luminaires	(1) F35T5 3000K	The Lighting Quotient – Tambient
	B	LED Wall Wash	16W LED 3000K	The Lighting Quotient - Elliptipar
	C	LED Downlight	16W LED 3000K	Focal Point
	D	Recessed Fluorescent Slot	(1) T5 3000K	Focal Point
	E	LED Flexible Tape	Warm White LED	Elation Architectural
	F	Fiber Optics Installation	LED Remote Illuminator	Universal Fibre Optics

Lighting Layout

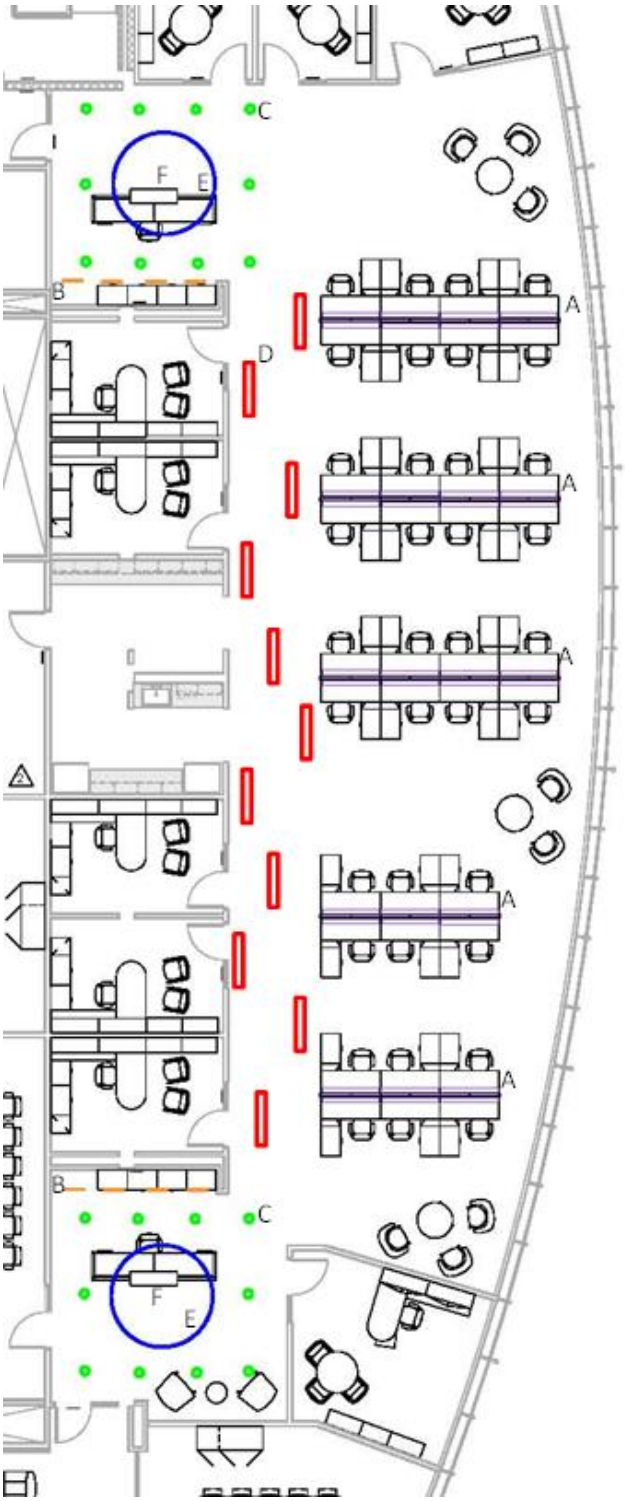


Figure 17 | Research Lab Lighting Plan

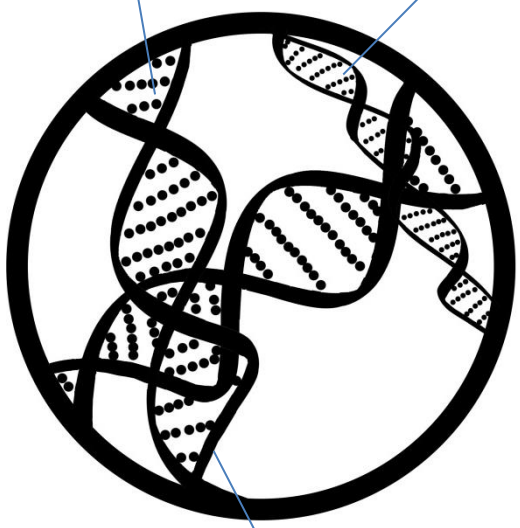


Figure 16 | Fiber Optic Detail - Individualized Health Initiative

Controls Narrative

The lighting for the reception area, corridor, and open office bays will be controlled by occupancy sensors so that the lights turn off when the space is unoccupied. Timeclock control will also be utilized to decrease the shutoff delay during hours in which the building is less likely to be utilized, such as later at night and on weekends.

As the east façade has been redesigned for daylight performance, daylighting control of the furniture-mounted lighting will be very important to fully realize potential energy savings. If possible, photocells will be integrated with each Type A luminaire, and will dim based upon sunlight on the desk. Otherwise, photocells located on the ceiling will zones of Type A fixtures based on the illuminance levels across each section of desks. The desks will be divided into at least two control zones for daylight dimming – the desks located in the first 15’ from the curtain wall, and the desks located nearer to the corridor.

Performance

Figure 18 | Rendered View of Individualized Health Initiative Reception Area

Figure 19 | Rendered View of Research Lab Open Workspace

Space	E_h (lux)	E_{avg}:E_{min}
Reception Desk	180	3.95
Corridor	163	2.59
Open Office Desks	560	2.65

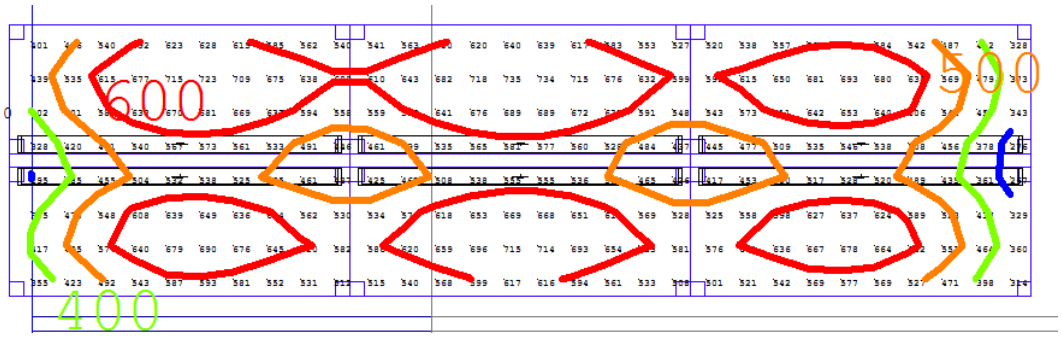


Figure 20 | Research Lab Desk Illuminance Calculation

Space	Allowance (W/ft2)	Area (ft2)	Allowed Watts
Office - Open Plan	0.98	2749	2694.02
Corridor/Transition	0.66	810	534.6
	Total Allowed Watts:		**3228.62**

Fixture	Watts/Fixture	Quantity	Designed Watts
Wall Wash	16	8	128
Round Downlights	16	16	256
Linear Recessed (1T5)	33	11	363
Flexible LED Tape	1.7	146	248.2
Tambient FL	41	36	1476
Fibre Optic Illuminator	20	4	80
	Total Designed Watts:		**2551.2**

Evaluation

The research lab lighting provides effective illumination on the task planes throughout the open office area, while allowing for potential reconfiguration. The reception lighting helps with way-finding by illuminating the wall behind the reception desk, while also branding each lab with a unique identity through the custom fiber optic installation. The lighting meets the illuminance criteria, and though the desk surface is slightly less uniform than the average to minimum illuminance ratio recommended by the IES, the minimum illuminance values only occur at the very edges of the end desk surfaces. As a result, the overall effect of the lighting for the majority of the work surface is fairly uniform. The proposed lighting design meets the energy code requirements, as it uses 21% fewer watts than allowed by ASHRAE/IES Standard 90.1.

.

Systems Institute Collaboration Theater – Room 328

The systems collaboration theater will be used for activities similar to those of a classroom or conference room. The space will host meetings, presentations, and discussions for faculty and students of the Systems Institute. Primary visual activities in the space shall include reading, writing, computer use, video conferencing, and A/V presentations. The space features glazed walls which provide views into the corridor and third floor commons area.

Areas:

SI Collaboration Theater – 921 S.F.

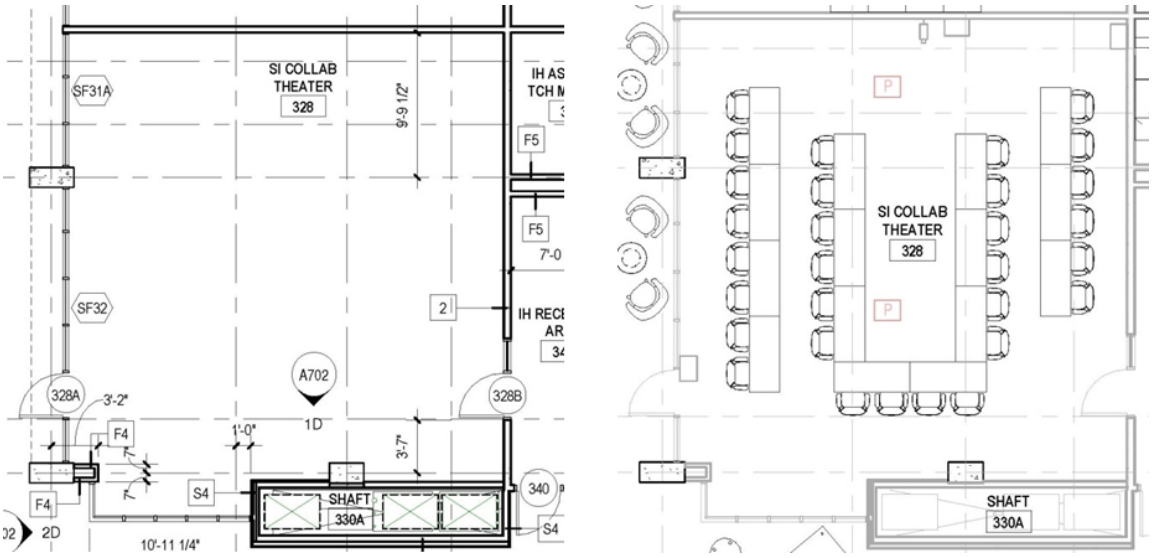


Figure 21 | SI Collaboration Theater Floor and Furniture Plans

Finishes

Type	Manufacturer	Description	Color/Pattern	Reflectance
APC1	Armstrong	Ultima Tegular #1912, 2'x2'	White	0.9
P1	Benjamin Moore	Eggshell Finish Wall Paint	OC-17 White Dove	0.78
P9	Master Coating Technologies	Waterbased Dry Erase Finish	"Wink" Clear Coat	0.85
P10	Benjamin Moore	Eggshell Finish Wall Paint	2167-10 Burnt Carame	0.21
RB1	Johnsonite	Traditional Rubber Wall Base, 4" Height	40 Black	0.1
WP1	Marlite	Wood Paneling	Flat Cut Cherry #252	0.4
EXP	-	Exposed Concrete	-	0.35
SAC1	Tectum	Direct Attached Ceiling Panels, 2'x8'	Natural	0.6
CPT5	Shaw Contract	Chroma Tile 59583	83515 Infinite	0.2

Type	Manufacturer	τ	$\rho_{interior}$	$\rho_{exterior}$
TS Clear	Viracon	0.88	0.08	0.08

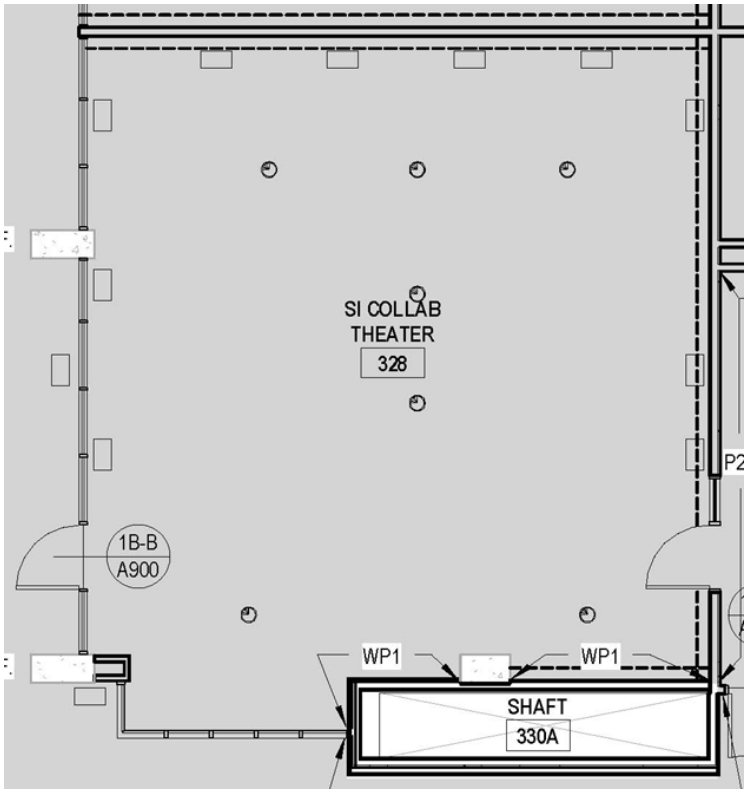


Figure 22 | SI Collaboration Theater Finish Plan

The SI Collaboration Theater features primarily white wall paint. Walls on the north, east and south sides of the room are also painted with a dry erase topcoat. The ceiling features Armstrong acoustic ceiling tiles, with a circular cutout in the southwest corner. For the proposed lighting design, the acoustic ceiling tiles were modified to a drywall ceiling construction.

Design Criteria

ASHRAE/IES Standard 90.1 – 2010 Allowed LPD

Conference/Meeting/Multipurpose: 1.23 W/S.F.

Controls

ASHRAE 90.1 also requires lighting controls for the SI Collaboration Theater – occupancy sensors are required to automatically turn off lighting within 30 minutes of all occupants leaving the space.

Illuminance Criteria

Conferencing - AV

- E_h: 30 lux
- E_v: 30 lux max.
- Max:Min across room area: 3:1

Whiteboards

- E_v: 300 lux
- Average:Min across task area: 3:1

Tables

- E_h: 300 lux @ 2’-6” A.F.F.
- Average:Min across task area: 1.5:1

The illuminance requirements listed above are derived from the recommendations listed in the *IES Handbook, 10th Edition*. The average horizontal and vertical illuminance levels are taken from the Applications section on “Lighting for Offices”. An average age of 25-65 was

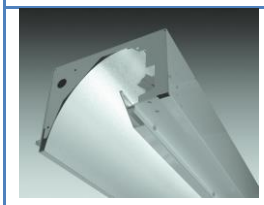
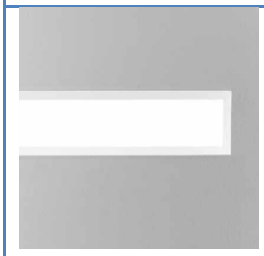
assumed for the visual ages of observers, as most graduate students and professors working in this space will likely fall within or near this age range.

Design Concept

The lighting design for the SI Collaboration Theater needed to be flexible to accommodate the wide variety of potential uses for the space. While general meetings will require higher illuminance levels, videoconferencing and presentations necessitate lower light levels, especially toward the north end of the space, where two large display monitors will be mounted. One goal of the lighting design for the space was to better incorporate the round cutout located in the southwest corner of the ceiling. The proposed design features a treatment of this circular cutout that mirrors the cutouts in the research lab, with a fiber optic design to represent the Systems Institute's individual identity. Recessed linear slot fixtures radiate out from the cutout, continuing the circular theme and providing general illumination for the space. The east wall features wall wash fixtures, which will light the whiteboard surface.

Equipment

Dimmable fluorescent lamps are used in the wall wash and recessed slot fixtures to allow for flexibility in scene programming. Lighting in the circular ceiling cutout features flexible LED tape and a fiber optic installation with an LED illuminator.

	Type	Description	Lamp	Manufacturer
	E	LED Flexible Tape	Warm White LED	Elation Architectural
	F	Fiber Optics Installation	LED Remote Illuminator	Universal Fibre Optics
	G	Fluorescent Wall Wash	32W T8 3000K	Focal Point
	H	3” Continuous Fluorescent Slot Fixture	28W T5 3000K	Focal Point

Lighting Layout

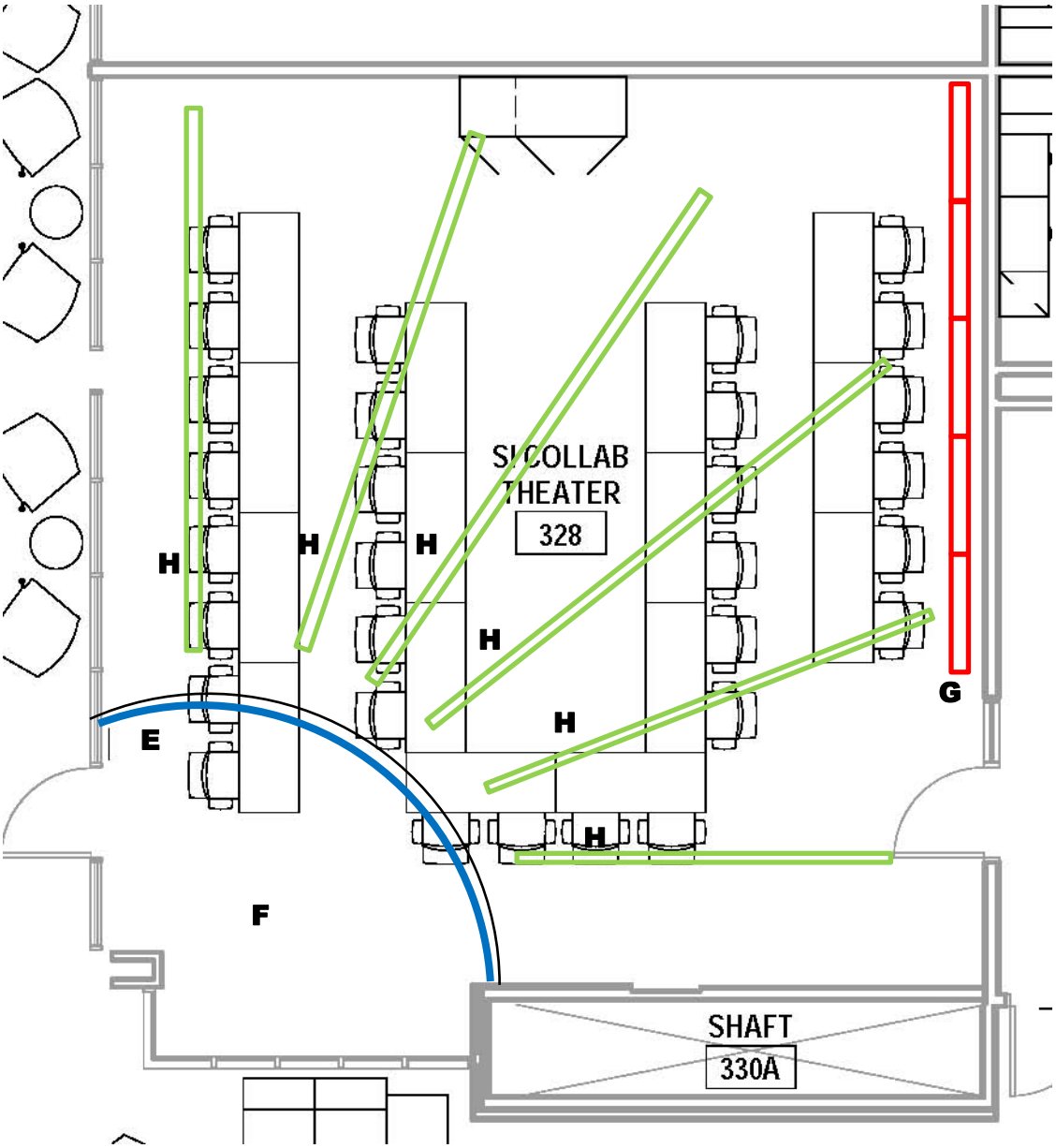


Figure 23 | SI Collaboration Theater Lighting Plan

Controls Narrative

The SI Collaboration Theater will feature a scene controller, allowing occupants to adjust the lighting elements to different output levels and to switch fixture groups on and off. The wall wash fixture s along the west wall will be controlled together as one lighting zone. Likewise, the LED tape lighting and fiber optic display will be switched together. The slot fixtures will be dimmable to 10% or lower, and the luminaires closest to the north wall with the display screens will be controlled separately from the slot fixtures located across the rest of the ceiling. While each lighting zone will be able to be manually adjusted, preset lighting scenes will include modes for a general lecture or meeting, whiteboard use, and video conferencing or presentations.

Performance

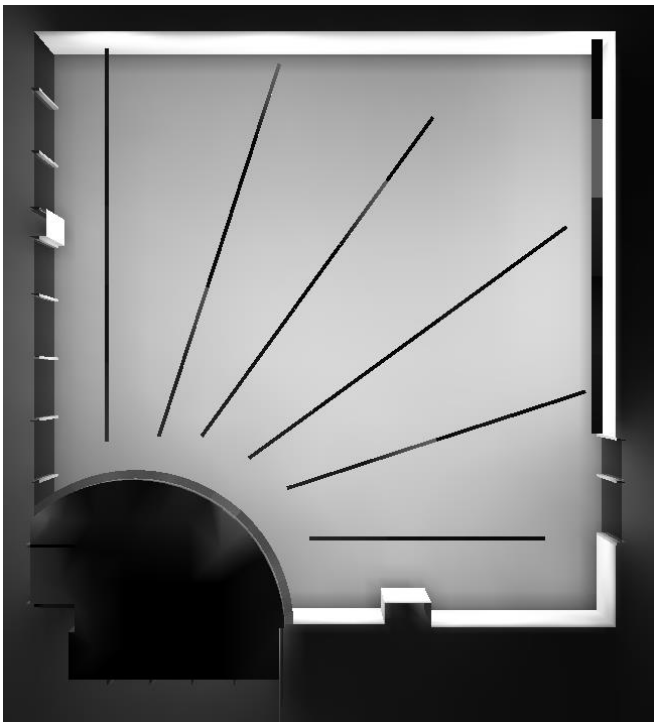


Figure 24 | SI Collaboration Theater Lighting as seen from above

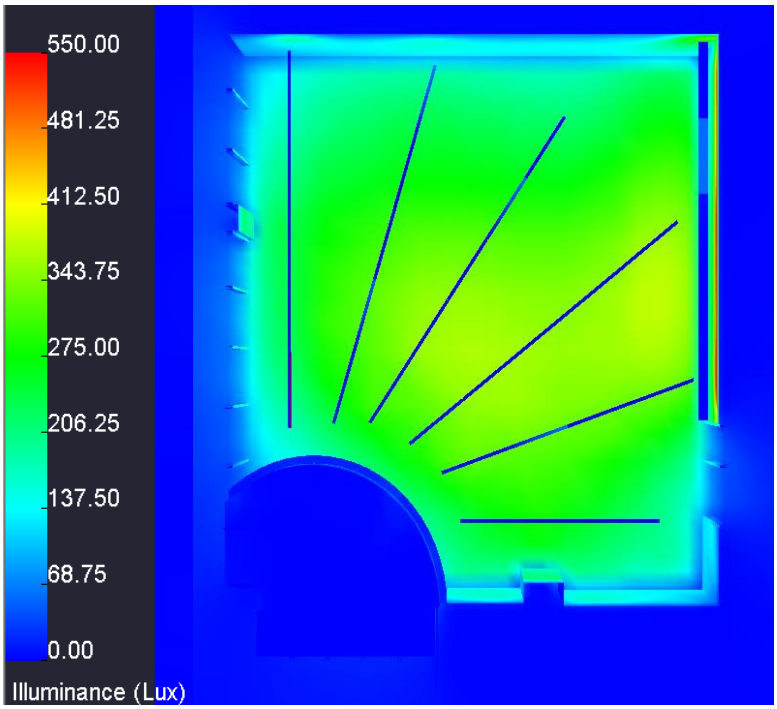


Figure 25 | Pseudocolor Redering of SI Collaboration Theater Lighting Performance

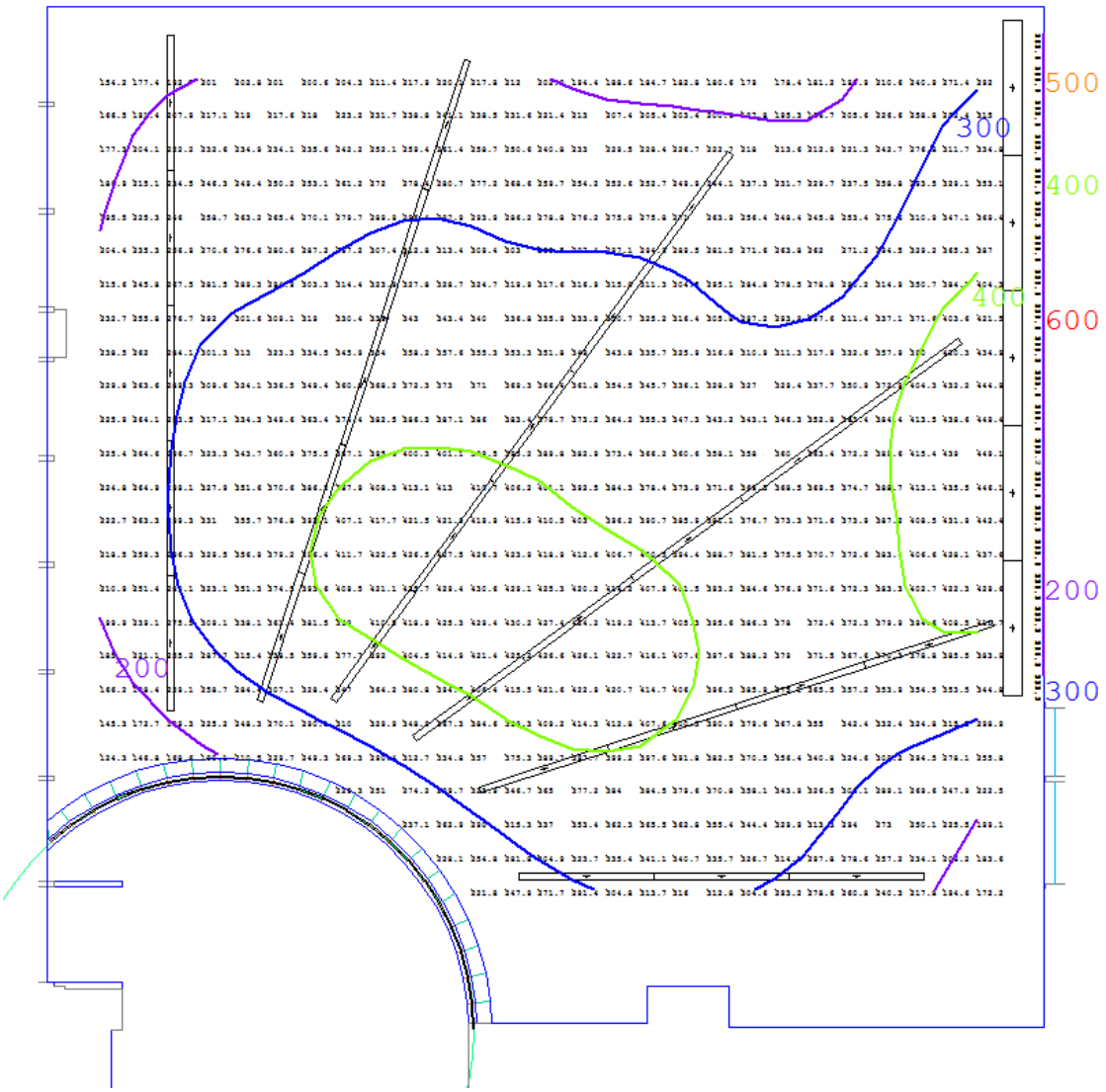


Figure 26 | SI Collaboration Theater Illuminance Calculation

Space	E (lux)	E_{avg}:E_{min}
Table Surfaces	E_h: 320	2.5
Whiteboard	E_v: 302	2.2

Space	Allowance (W/ft2)	Area (ft2)	Allowed Watts
Conference/Meeting/Multipurpose	1.23	921	1132.83
	Total Allowed Watts:		**1132.83**

Fixture	Watts/Fixture	Quantity	Designed Watts
Wall Wash	35	5	175
Recessed Slot	33	27	891
Flexible LED Tape	1.7	17.25	29.3
Fiber Optic Illuminator	20	1	20
	Total Designed Watts:		**1115.3**

Evaluation

The SI Collaboration Theater proposed lighting solution is flexible, and will allow for the many situations that may occur in the space. The lighting's radial pattern allows for flexibility in seating layout, and corresponds with the architecture of the space. The light levels meet the criteria established from the IES Handbook for average luminance for both the tables and the whiteboard area. The uniformity criteria are met for the whiteboard and conferencing requirements. Though the average to minimum uniformity ratio is slightly higher than is ideal for the task plane of the tables, the center of the room is fairly uniform, as can be seen in the contours of Figure 26. Finally, the space meets the requirements of ASHRAE/IES Standard 90.1 for lighting power density.

.

Commons Areas – Floors 1 & 2

The commons areas on the first and second floors of the building serve as the main entrance to the University Research Building and as areas for students and faculty to congregate and relax. In this space, lighting design was studied in order to create a psychological impression of relaxation. Primary activities in the commons areas include circulation, socialization, and some reading and writing at the tables on the upper level.

Areas:

1st Floor Commons – 1149 S.F.

2nd Floor Commons – 1200 S.F.

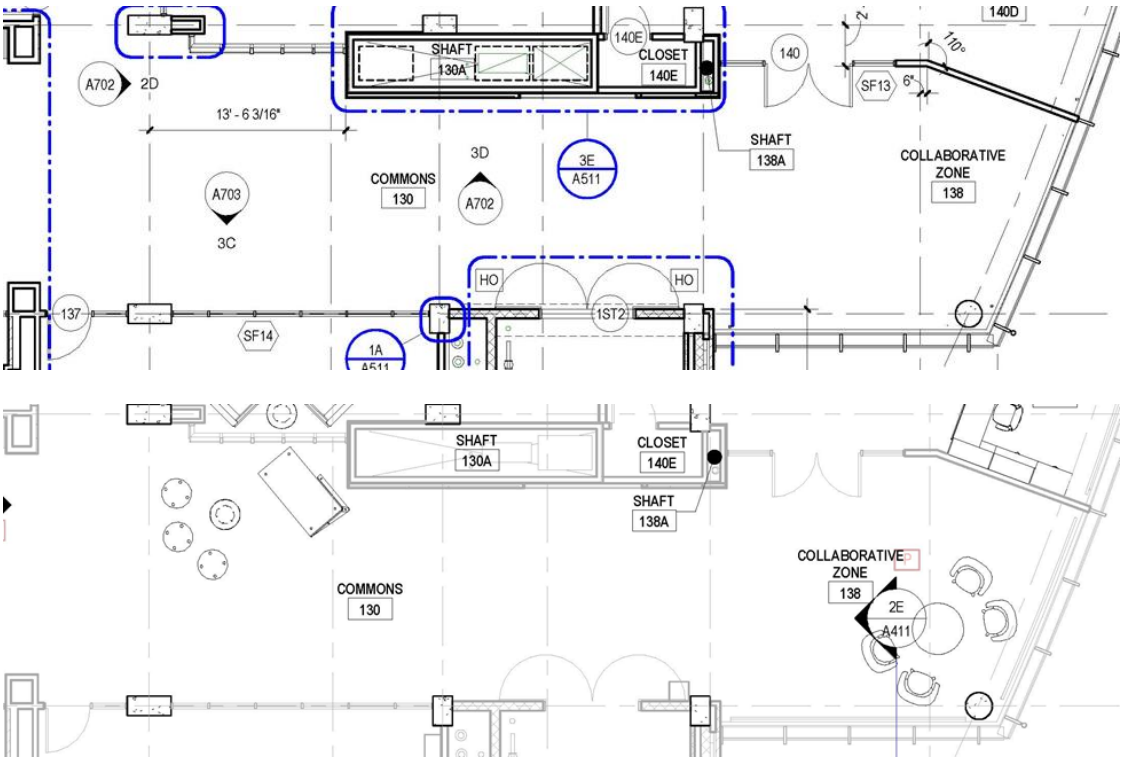


Figure 27 | 1st Floor Commons Floor and Furniture Plans

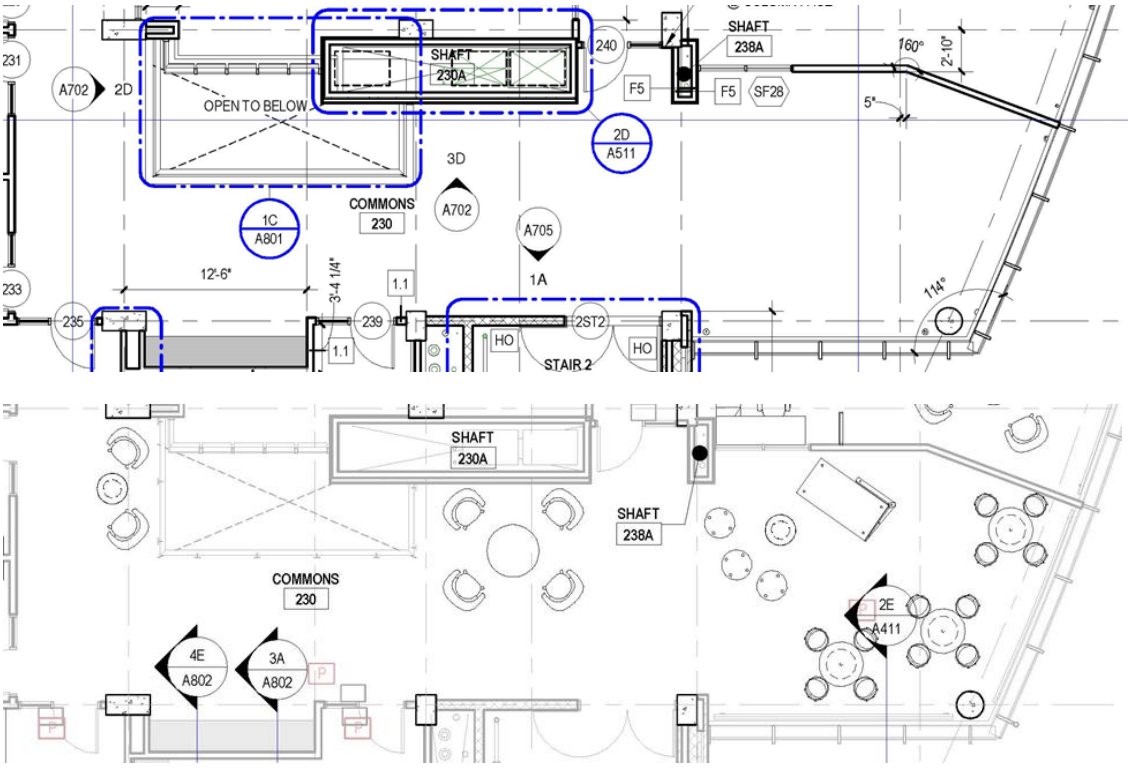


Figure 28 | 2nd Floor Commons Floor and Furniture Plans

Finishes

Type	Manufacturer	Description	Color/Pattern	Reflectance
TZE1	Nurazzo	Marble Line, 24"x24"	M105 Ivory Black	0.8
RB1	Johnsonite	Traditional Rubber Wall Base, 4" Height	40 Black	0.1
P1	Benjamin Moore	Eggshell Finish Wall Paint	OC-17 White Dove	0.78
WP1	Marlite	Wood Paneling	Flat Cut Cherry #252	0.4
P9	Master Coating Technologies	Waterbased Dry Erase Finish	"Wink" Clear Coat	0.85
P2C	Benjamin Moore	Eggshell Finish Wall Paint	2067-40 Blue Lapis	0.26
P10	Benjamin Moore	Eggshell Finish Wall Paint	2167-10 Burnt Carame	0.21
EXP	-	Exposed Concrete	-	0.35
WPC1	Armstrong	Woodworks Linear 4 1/2" Wide	Light Cherry	0.4
PGB1	Benjamin Moore	Standard Ceiling White	White	0.87

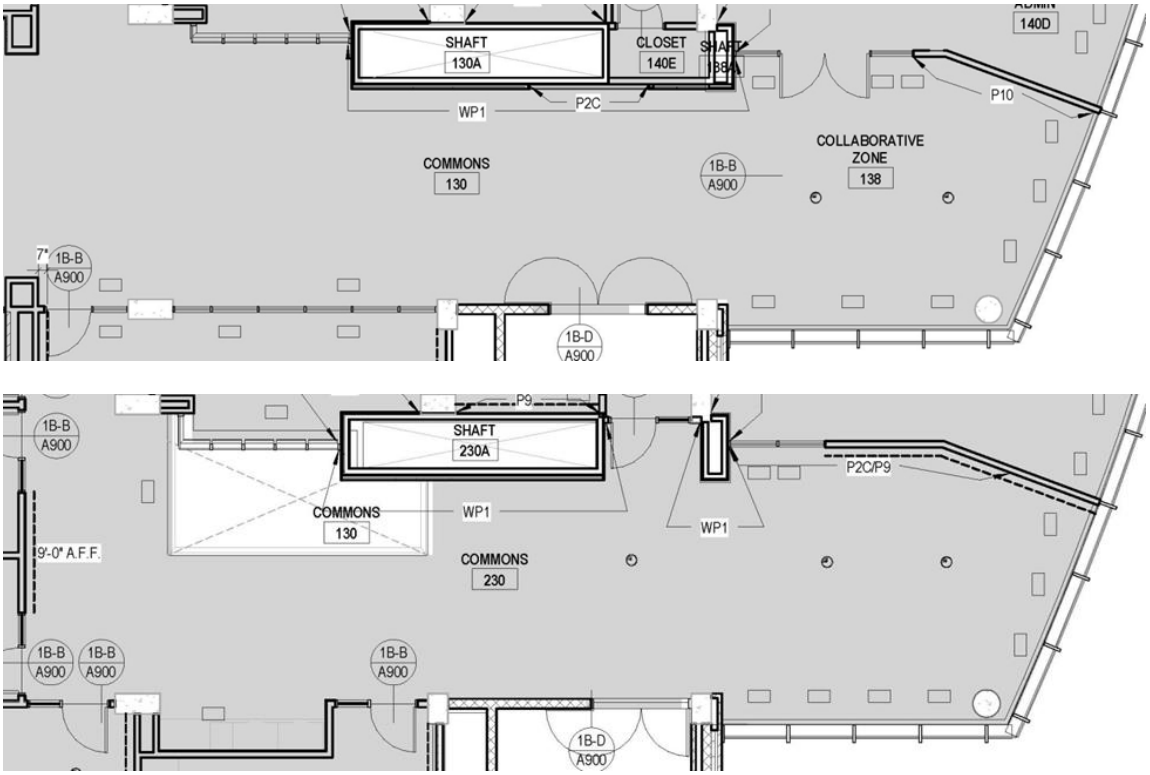


Figure 29 | 1st and 2nd Floor Commons Finish Plans

The commons areas feature a double-height opening connecting the upper and lower levels. This opening is bound on the north side by a slanted glass wall which looks into conference rooms. There is also a wood-paneled wall on the north side of the space.

Design Criteria

ASHRAE/IES Standard 90.1 – 2010 Allowed LPD

Lounge/Recreation: 0.73 W/S.F.

Illuminance Criteria

Social Lounge

- E_h: 100 lux
- Avg:Min across room area: 3:1

Reading Lounge

- E_h: 200 lux
- Average:Min across task area: 3:1

The illuminance requirements listed above are derived from the recommendations listed in the *IES Handbook, 10th Edition*. The average horizontal and illuminance levels above are taken from the Applications section on "Lighting for Education". An average age of 25-65 was assumed for the visual ages of observers, as most graduate students and professors working in this space will likely fall within or near this age range.

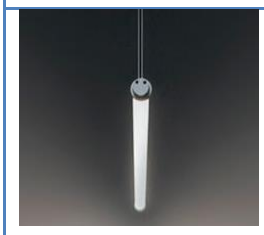
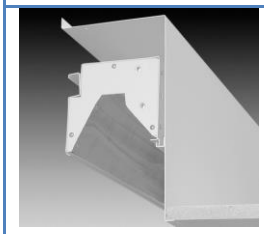
Design Concept

The commons areas create the first impression of the building for most visitors who will enter through the southern door of the building. They also serve as a collaboration space, seeking to foster communication and collaboration between colleagues from different labs and departments. As a result, one goal of the lighting design for the space was to foster feelings of relaxation. To achieve this impression, a non-uniform lighting design with peripheral wall emphasis was developed.

Equipment

Round LED downlights are arranged in a staggered pattern across the ceiling on both the upper and lower levels of the commons. A fluorescent wall grazing fixture grazes the wood paneling from above on both levels. On the upper level, an alcove which will feature a counter space utilizes two wall wash luminaires. Finally, the work zone on the upper level of the commons is complemented with pendants, creating higher light levels while still creating a more fun, relaxed impression through their staggered layout and mounting heights.

A light sculpture was developed to fill the double-height opening in the commons area. The sculpture represents the collaboration between the labs in the building through the intertwining pieces, each with a pattern derived from the inspirational images in Figure 13. The sculpture will utilize cracked side glow fiber optic fibers and RGBW LED illuminators.

	Type	Description	Lamp	Manufacturer
	C	LED Downlight	16W LED 3000K	Focal Point
	I	LED Pendant	LED 3000K	Lumenpulse
	J	Fluorescent Wall Graze	63W T5HO 3000K	Focal Point
	K	Fluorescent Wall Wash	32W T8 3000K	Focal Point
	L	Fiber Optic Light Sculpture	RGBW LED & Fiber Optics	Universal Fiber Optics

Lighting Layout

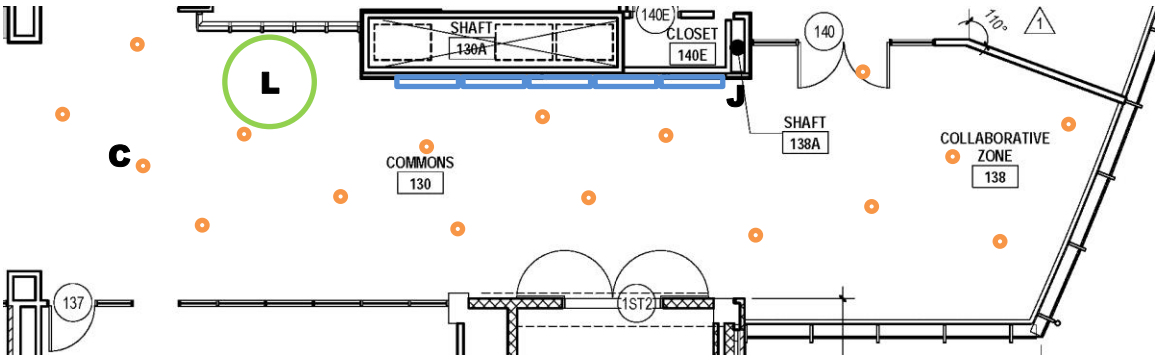


Figure 30 | 1st Floor Commons Lighting Layout

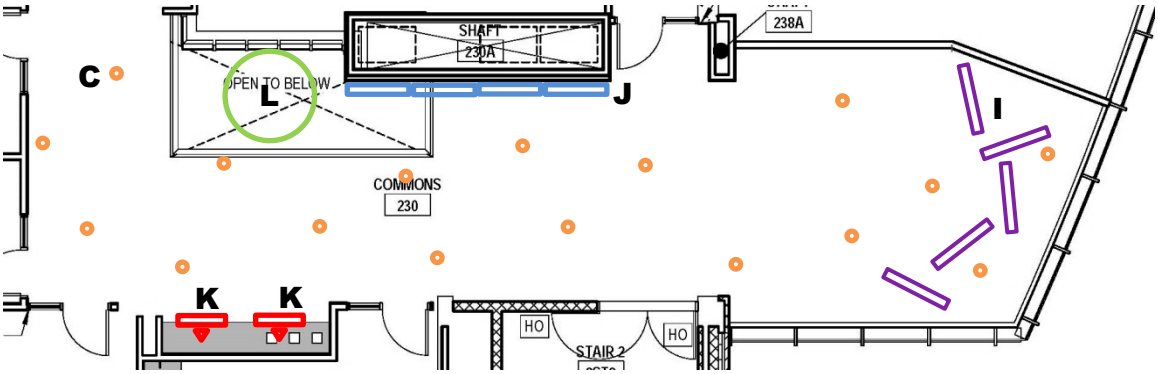


Figure 31 | 2nd Floor Commons Lighting Layout

Controls Narrative

The commons lighting will be controlled via a timeclock and occupancy sensors to control lights outside of regular building occupancy hours. Luminaires within the daylight zone at the southeast corner of the building with the glazed façade shall also be dimmed via photocell sensors.

Performance

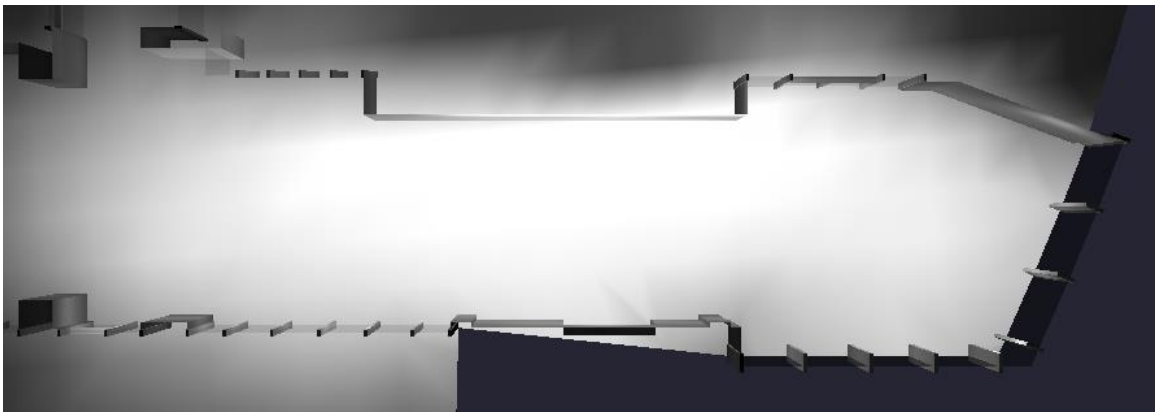


Figure 32 | 1st Floor Commons as seen from above

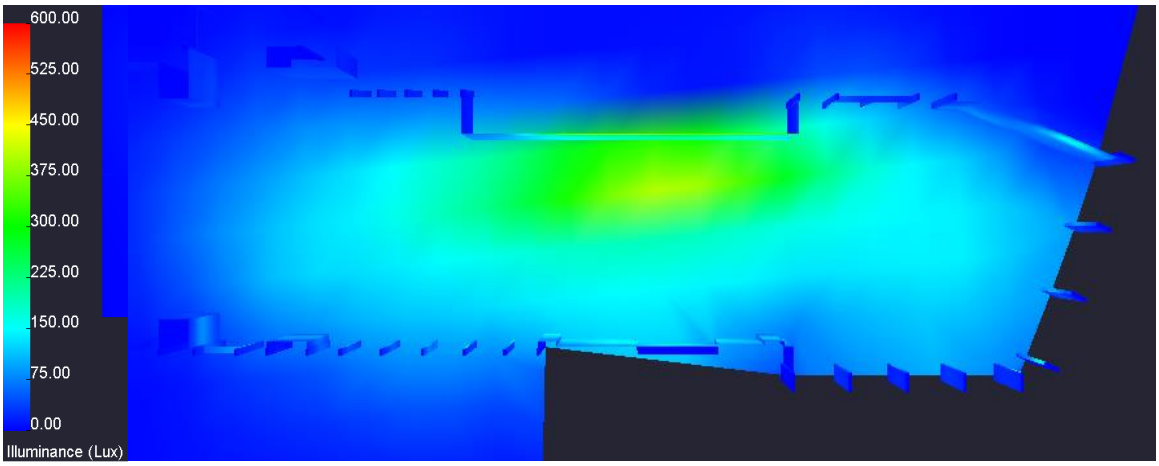


Figure 33 | Pseudocolor Rendering of 1st Floor Commons

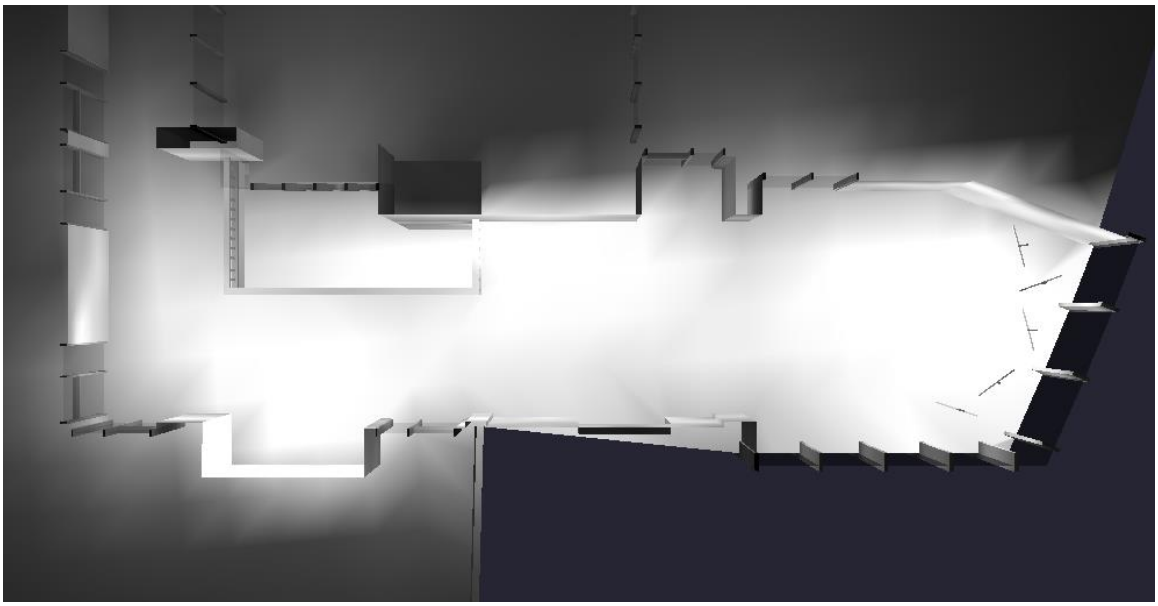


Figure 34 | 2nd Floor Commons as seen from above

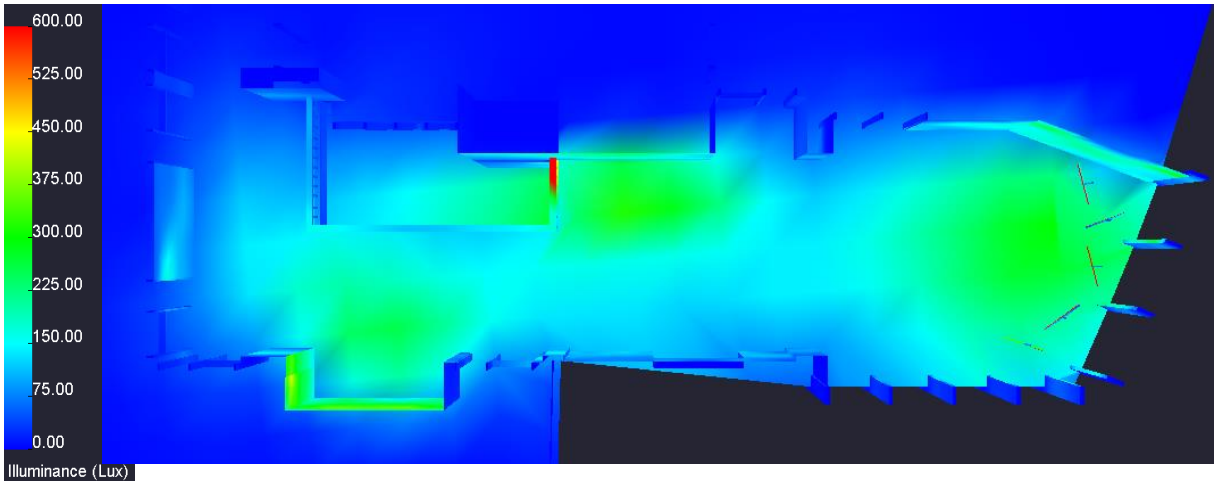


Figure 35 | Pseudocolor Rendering of 2nd Floor Commons

Figure 36 | Perspective rendering of 2nd Floor Commons

Figure 37 | Perspective rendering of 1st Floor Commons Area

Space	E_h (lux)	E_{avg}:E_{min}
Social Lounge Areas	170	3
Reading Areas	313	1.88

Space	Allowance (W/ft2)	Area (ft2)	Allowed Watts
Lounge	0.73	2349	1714.77
	Total Allowed Watts:		**1714.77**

Fixture	Watts/Fixture	Quantity	Designed Watts
Wall Graze	63	9	567
Wall Wash	35	2	70
Pendants	21	5	105
Round Downlights	17	34	578
Fiber Optic Illuminators	46	4	184
	Total Designed Watts:		**1504**

Evaluation

The commons lighting achieved the design goals by meeting the illuminance criteria and uniformity recommendations for the space. The design also satisfies the ASHRAE/IES Standard 90.1 lighting power density requirements, using 12.2% fewer watts than are allowed. The light sculpture adds visual interest to the space, while also representing the overarching goal of the building to support integration and collaboration.

Chapter 7

Conclusions

The overall goal of this thesis was to examine the University Research Building, specifically its curved east façade, in an attempt to improve daylighting and energy performance. The greatest advances were made in the daylighting metrics for annual sunlight exposure and spatial daylight autonomy without the space becoming over-bright. Mechanically, the double skin façade design will allow for slightly reduced energy loads for the space. If interior shades were added to the existing façade design to improve daylighting performance, the energy savings potential presented by the double skin façade design would be increased.

Although the new façade design does not fit exactly with the architectural style presented by the majority of the buildings on campus, there is an accepted precedent in which more modern façades are coupled with traditional design aesthetics. Finally, the lighting design was reimagined for three spaces throughout the building, representing the identities of individual lab spaces while also fostering a collaborative work environment.

These studies demonstrated the wide variety of design criteria and motivating factors that may be present in a building's design and construction. By placing a greater emphasis on daylighting performance, a building façade was reimagined.

Appendix A

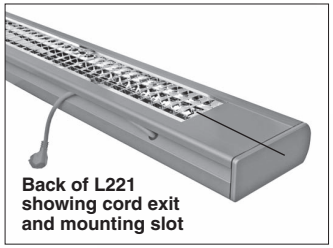
Luminaire Cutsheets

Task Ambient, Linear T5 Lamp

T5 Fluorescent

Tambour Styles L221, L222

Type A



Back of L221 showing cord exit and mounting slot

Continuous mounting slot (Style L221) accepts hang-on brackets and desk clamp stanchions for on-module and off-module mounting. Order brackets and stanchions separately.

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

Pre-drilled back panel option (Style L222) accepts bolt-on desk clamp stanchions

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

Housing: extruded aluminum, radiused edges

Personal control (optional): Rotary on/off switch or 100-50% dimmer on bottom of luminaire, located at right on units less than 4' long, centered on longer units.

Low profile: 6-7/16" (164mm) wide, 2-1/2" (64mm) high

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

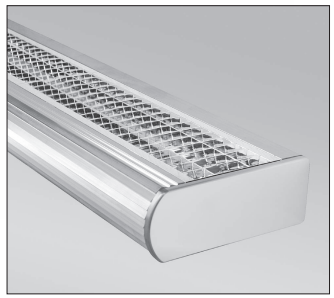
Downlight reflectors: specular extruded aluminum

T5 lamp(s) included

RJ11 dimming port (optional) for connection to remote wireless control hub. Order hub controller and RJ11 cable separately.

Removable decorative end plates provided. Remove for bridge stanchion mounting or when fit between furniture components dictates reduced luminaire length. **End plates** (underneath) are stamped steel, finished black, mate with optional bridge stanchions.

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

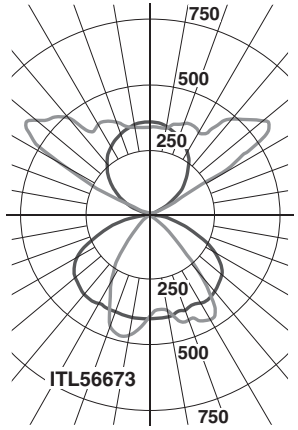


Features

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

TA 2.0

Performance



Lighter curve at left shows candlepower in 0° and 180° planes. Darker curve shows candlepower in 90° and 270° planes. High lamp position is shown. Consult website for alternate optics.

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

Specifications

Finish:

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

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

Reflector – extruded aluminum, chemically brightened and clear anodized.

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

Mounting:

L221 has a continuous mounting slot along the rear of the unit, and can be mounted to a wall, furniture panel, or desk clamp stanchion. L221 cords are routed along the mounting slot and can be specified for right- or left-hand exit.

L222 has a smooth back surface that is available pre-drilled to accept desk-clamp stanchion(s), or decorative end plates can be removed to accept bridge stanchions. L222 cord exits are specified left or right, rear or bottom of unit, depending on mounting method. Stanchions feature a cord management slot.

Electrical:

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

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

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

Standard:

UL listed or CSA certified.

tambient®
green in any color®

Project: Kimble Thesis

Type:

Sample number: L221-71S6-M-EL15-1-1R-0S-35

L	2	2	1	–	60S5	–	J	–	L	–	2	–	2		–	XX	–	30
Style					Length/Lamp(s) Code		Optic		Finish		Electrical		Cord	Cord Exit		Options		Lamp Color

Style

L221 Task ambient luminaire with integral hang-on mounting channel

L222 Task ambient luminaire with smooth back panel

Length/Lamps

Code	*Length (mm)*	*Lamp(s)*	*Input*
24S2*	24-3/4" (629)	1xF14T5	17W
36S3*	36-1/2" (927)	1xF21T5	25W
48S4	48-1/4" (1226)	1xF28T5	30W
60S5	59-3/4" (1518)	1xF35T5	41W
71S6	71-1/2" (1816)	2xF21T5	49W
83S7	83-1/4" (2115)	1xF21T5 + 1xF28T5	60W
95S8	95" (2413)	2xF28T5	58W

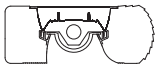
*Style L221 only; consult factory for Style L222.

Other lengths and lamping are available; consult factory. Subtract 3/8" from length for each decorative end plate removed in the field.

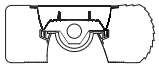
TA 2.1

Optic

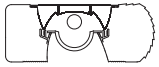
L Low-mount



M Mid-mount



H High-mount



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

(1) Consult factory.

L222 shown above. To avoid glare, do not install below 48" or above 66". For IES files (mid ITL56671, high ITL56673), see website (consult factory for low-mount).

Compatible controls and sensors from The Lighting Quotient are available; see controls data sheets.

Finish

EL02 Eggshell white
EL06 Dark bronze
EL07 Silver
EL08 Semigloss black
EL15 Warm metallic
TAPL Platinum
TASL Semigloss slate
XXXX Custom color (specify or submit sample)
or 4-digit RAL color code (color chart available)

Electrical

120 V only

1 Electronic ballast
T Dimming ballast and RJ11 dimming port or personal dimmer. Specify **0D** or **XD** option for personal dimmer.

Cord

90° SW rotation plug:

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

Straight plug:

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

Cord Exit

R Right rear
L Left rear
E Right bottom**
W Left bottom**

**For Style L222 with TSB bridge stanchions only.

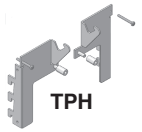
Options

00 None
0S On/off switch
0D Personal dimmer, dims to 50% (specify with voltage code **T**)
X0 Dual stanchion pre-drill (L222)
XS Dual stanchion pre-drill and on/off switch (L222)
XD Dual stanchion pre-drill and personal dimmer (L222), dims to 50% (specify with voltage code **T**)
XX Custom modification (specify)

Lamp Color

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

Mounting Accessories



TPH Panel Hooks, pair (L221)

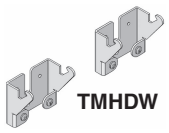
T	P	H	J	–	2
			System		Finish (at left)

Mount to slotted panel frame. Stamped and formed CRS, pair.

System

AC	Allsteel Concensys	**KD**	Knoll Dividends
AT	Allsteel Terrace	**KM**	Knoll Morrisson
HC	Haworth Compose	**S9**	Steelcase 9000
HP	Haworth Premise	**SA**	Steelcase Avenir
HU	Haworth Unigroup	**SK**	Steelcase Kick
M3	Herman Miller AO3	**SR**	Steelcase Answer
ME	Herman Miller Ethospace	**TD**	Teknion District
MV	Herman Miller Vivo/Canvas	**TL**	Teknion Leverage

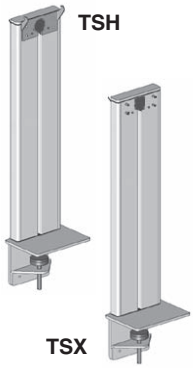
For a complete list of system-specific panel hooks, consult factory.



TMHDW Wall Brackets, pair (L221)

T	M	H	D	W	–	E	L	0	0

Mount to stud framed walls, millwork, other solid surfaces. Stamped and formed CRS, black, pair.



TSH Desk Clamp Stanchion (L221)
TSX Desk Clamp Stanchion (L222)

T	S	1		–	
			Height		Finish (at left)

Mount to edge of work surface – 1/2" to 3-1/4" thick. Extruded aluminum post. Resilient pads resist slippage, protect surfaces. Integral cord management.
TSH19-/TSX19- places top of luminaire 19-1/2" above work surface.
Sold individually; luminaires longer than 36-1/2" require two stanchions.

TST Bridge Stanchion, Intermediate

T	S	T		–	
			Height		Finish (at left)

Mounts to work surface. Standard use (**TST19-**) places the top of the luminaire 19-1/2" above the work surface. Features integral cord management slot, removable base plates, concealed interface plates.

tambient
green in any color®

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

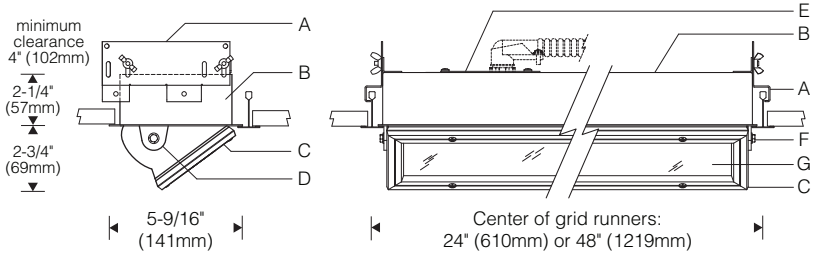
Lighting the Wall

Small semi-recessed adjustable, integral driver **Solid State (LED)**

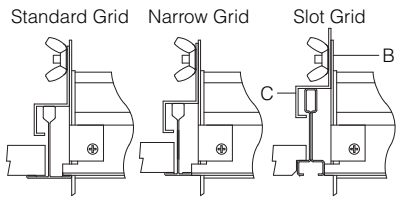
Style S215

Type B

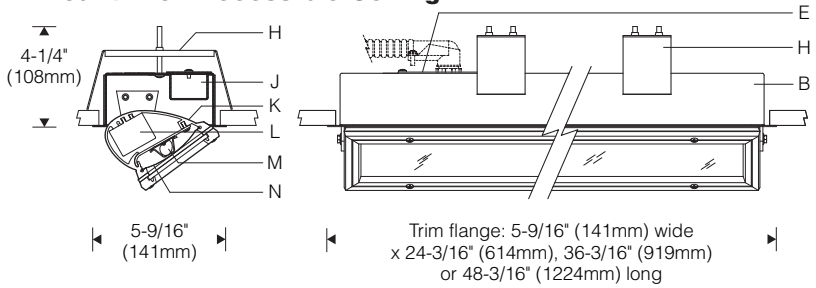
L Mount: Accessible Grid Ceiling 1:8 Scale



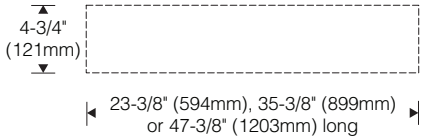
Ceiling Compatibility



T Mount: Non-Accessible Ceiling



Rough Opening (not to scale)



Specifications

- **A** Adjustable hanger clamps (grid ceiling)
- **B** Formed aluminum back box with 1/2" flange trim
- **C** Mitred extruded aluminum door frame, silicone gasket
- **D** Aluminum yoke arms
- **E** Splice access plate with (2) KOs (connector and conduit by others)
- **F** Hex head locking screws
- **G** Micro-prismatic tempered glass lens with holographic film
- **H** Toggle brackets (non-accessible ceiling)
- **J** Splice compartment
- **K** Extruded aluminum heat sink housing
- **L** Integral constant current driver
- **M** Removable light engine assembly with **fraqtir**™ acrylic refractor
- **N** Holographic diffuser

Optic Assembly:

Two-piece extruded aluminum heat sink housing and light engine. Exterior heat sink anodized for maximum emissivity. Removable interior extrusion treated to maximize thermal conductivity. Precision formed asymmetric optical light bar of high temperature, water-clear acrylic. Tempered micro-prismatic glass lens with elliptical distribution holographic diffuser; maximizes lateral distribution without disturbing asymmetric forward throw.

Finish:

Exterior surfaces – 6 stage pretreatment and electrostatically applied thermoset polyester powder coating for a durable abrasion, fade and corrosion resistant finish.

Extruded aluminum heat sink/housing, yoke arms, door frame and decorative end plates are finished in semigloss white.

Mounting:

Mounting/trim frame installs from below finished ceiling. Retrofits into existing non-accessible ceilings.

Spring clips provided for rigid ceilings (drywall, plaster) up to 1-3/4" (44mm) thick.

Supplemental support wires, bar hangers, etc. (by others) required for accessible ceilings. Where wire suspension is prohibited, order accessory universal mounting brackets for use with 1/2" EMT, 1-1/2" lathing or C channel (by others).

Electrical:

Integral electronic HPF constant current driver(s). Access plate on top of back box with two 1/2" knockouts for supply wiring. Internal splice compartment allows for access to splices below ceiling. For complete driver specifications, see Accessories Section.

Standard:

UL listed or CSA certified for dry locations.
5 year warranty, maximum ambient temperature 45°C (113°F).

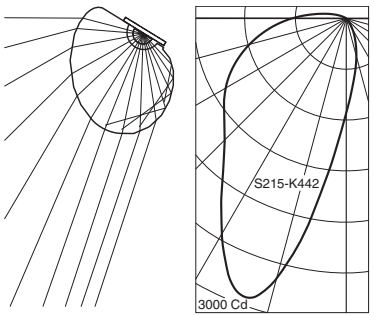
Features

- *Evenly lights entire wall – reflector aperture is shielded*
- *Adjustable aiming – tailor distribution to wall height and setback distance*
- *Shallow recessed depth – fits under ducts at core walls*
- *Several lumen packages that put the light on target*

SW 8.0

Performance

fraqtir *technology uses a combination of refraction and total internal reflection, creating a distribution of light ideal for illuminating surfaces uniformly. Glare is minimized while light delivered to the target is maximized, resulting in high application efficiency.*



For photometric and lumen maintenance reports, visit ***thelightingquotient.com***

L70(10k) > 60,000 per TM-21

U.S. Patent 8,465,190; foreign patents pending

LIGHT BY LUXEON

DLC DLC PLUS LISTED

LED lighting facts LED Product Partner

elliptipar® with fraqtir™ LED

To Order

Style S215

To form a Catalog Number

Project: _____ Type: _____

S	2	1	5	-	J	-	L	-	2	-	2	-		-	XX	-	30	-	Kimble Thes
1				2	3		4		5		6		7		8		9		10

1 Source

S = Solid state (LED)

2 Style

215 = Small semi-recessed indoor LED, adjustable, integral driver

3 Drive Current/Length/No. of LEDs

Solid State LED **fraqtir linear**
Length – Drive Current – # of Emitters

J	2	1

Number of Emitters:
14 = 2 x 7 LED boards (2ft unit)
21 = 3 x 7 LED boards (2ft unit)
18 = 3 x 6 LED boards (3ft unit)
28 = 4 x 7 LED boards (3ft unit)
24 = 4 x 6 LED boards (4ft unit)
42 = 6 x 7 LED boards (4ft unit)

Fixture Length:
2 = Nominal 2ft unit
3 = Nominal 3ft unit (**T** mount only)
4 = Nominal 4ft unit

Drive Current:
J = LXH8 emitters driven at **350mA**
K = LXH8 emitters driven at **700mA**

Style S215 would have the following options (L mount only offered in 2ft or 4ft lengths):

J214 = 2ft fixture, 14 LEDs @ 350mA, 16 watts, 920 lumens
K214 = 2ft fixture, 14 LEDs @ 700mA, 33 watts, 1550 lumens
J221 = 2ft fixture, 21 LEDs @ 350mA, 24 watts, 1380 lumens
K221 = 2ft fixture, 21 LEDs @ 700mA, 50 watts, 2330 lumens
J318 = 3ft fixture, 18 LEDs @ 350mA, 21 watts, 1180 lumens
K318 = 3ft fixture, 18 LEDs @ 700mA, 43 watts, 2000 lumens
J328 = 3ft fixture, 28 LEDs @ 350mA, 32 watts, 1840 lumens
K328 = 3ft fixture, 28 LEDs @ 700mA, 67 watts, 3100 lumens
J424 = 4ft fixture, 24 LEDs @ 350mA, 27 watts, 1580 lumens
K424 = 4ft fixture, 24 LEDs @ 700mA, 57 watts, 2660 lumens
J442 = 4ft fixture, 42 LEDs @ 350mA, 47 watts, 2763 lumens
K442 = 4ft fixture, 42 LEDs @ 700mA, 97 watts, 4730 lumens

Note: Dimming not available for all input voltages and control types – see **thelightingquotient.com** for additional dimming specifications and limitations.

SW 8.1

4 Mounting

L = Accessible ceiling grids (2ft and 4ft fixtures only)
T = Non-accessible ceilings (any S215 fixture length)

5 Finish

02 = Semigloss white housing, back box, end plates, door frame, yoke arms and visor (if applicable)
99 = Custom RAL or computer matched color to be specified, consult sales representative

6 Voltage/Driver

Electronic Driver	*Electronic Dimming Driver**
1 = 120V	**T** = 120V
2 = 277V	**V** = 277V

* Dimming not available for all input voltages and control types – see **thelightingquotient.com** for additional dimming specifications and limitations.

7 Option

00 = No options
0C = Modified to comply with Chicago plenum code
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Destination Requirement

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

9 Color Temperature*

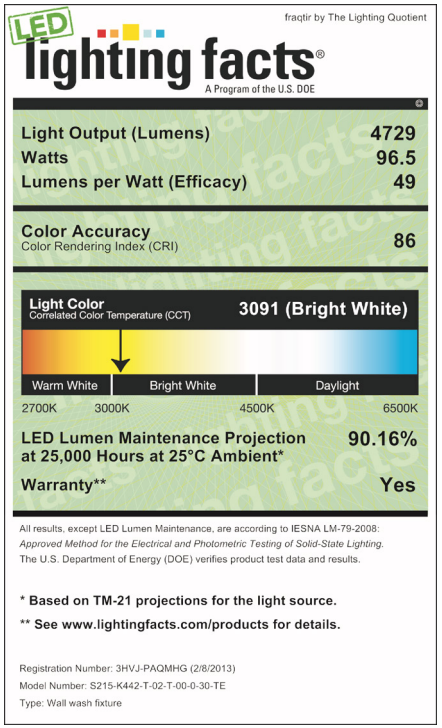
27 = 2700K, 80+ CRI
30 = 3000K, 80+ CRI
35 = 3500K, 80+ CRI
40 = 4000K, 80+ CRI

* Specify 3000K for DLC Qualified Product.

10 Dimming*

00 = Non-dimming
TE = LighTech 120-277V input, dimming range 100-10%, line voltage trailing edge/reverse phase/ELV dimming (controls by others)
M7 = Advance Xitanium 120-277V input, dimming for 120V only, dimming range 100%-10%, 0-10V analog controls by others
EL = eldoLED SOLOdrive 120-277V input, dimming range 100%-0.1%, 0-10V controls by others
L3 = Lutron A-Series 120-277V input, dimming range 100%-1%, Lutron EcoBus dimming (controls by others)
LH = Lutron A-Series 120-277V input, dimming range 100%-1%, Lutron 3-wire dimming (controls by others)
RS = Redwood Systems network platform. "Redwood Ready" luminaires are provided with a cord and connector to plug directly into the Redwood Adapter (all Redwood Systems components by others).

*Dimming range refers to % power input, % light output will vary.



elliptipar® with fraqtir™ LED

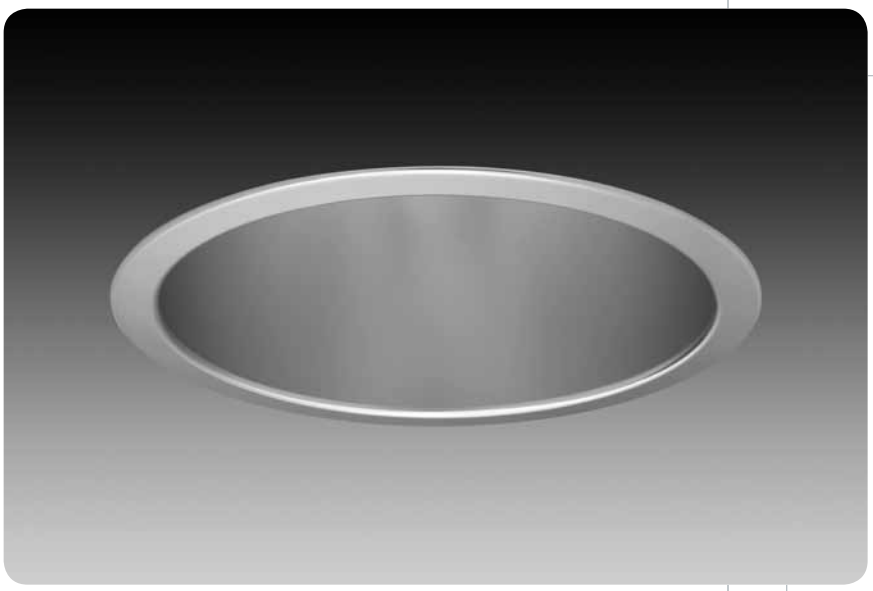
elliptipar *from* **The Lighting Quotient**
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **thelightingquotient.com**

Type C

6" aperture

id®

led



id The Intelligent Downlight®

FOCAL POINT®

features

LED module features remote phosphor technology enabling a high system efficacy, minimum 80 CRI and 3 SDCM color consistency.

1100, 1500, 2000 & 3000 lumen LED modules available.

Rated life is 50,000 hours at 70% lumen maintenance (L70).

Constant current driver senses LED module characteristics and delivers the designed output regardless of color temperature.

Flicker-free 0-10V analog dimming capability standard.

Self-flanged Clear Diffuse reflector cone features superior brightness control and 50 degree cutoff to light source and its image.

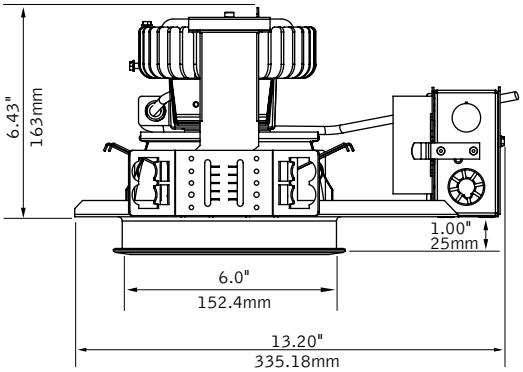
reflector options

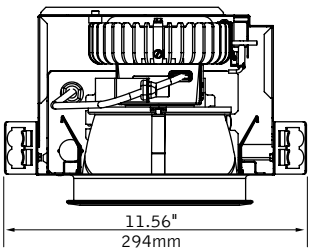
clear diffuse

warm diffuse

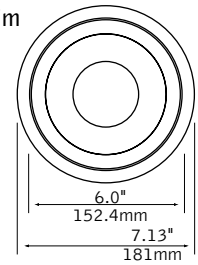
dimensional data

downlight





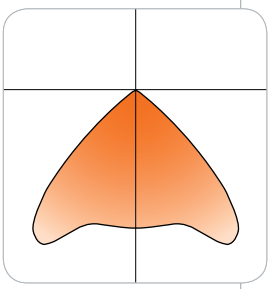
trim



performance

3000K, 2000 Lumen LED Module
Clear Diffuse Reflector
Total Luminaire Output: 1994lms

Photometric performance is measured in accordance with IESNA LM-79.



Visit focalpointlights.com for complete photometric data.

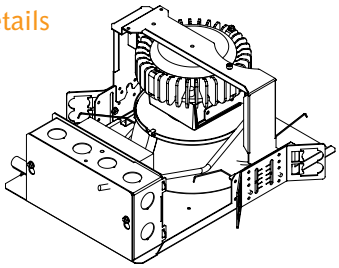
february 2014 V

fixture:

project:

Type C

details



housing specifications

led system
Powered by Philips' Fortimo™ LED DLM, Advance Xitanium LED driver and communication cable. Aluminum heat sink provides appropriate thermal management.

led module
Philips' Fortimo™ LED DLM features patented remote phosphor technology for superior efficacy and color consistency. Module may be specified in 3000K, 3500K or 4000K, CRI>80. Color accuracy within 3 SDCM.

construction
Thermally protected housing for new construction applications. Insulation to be kept 3" away from housing. Butterfly brackets allow mounting to ½ emt. Order bar hangers as an accessory. Die–cast aluminum heat sink designed for maximum thermal dissipation. Die-formed housing and integral junction box with (7) 1⁄2" pry outs. Accommodates ceiling thicknesses up to 1". For thicker ceiling consult factory. Fixture will not exceed 5 lb. 18" O.C. fixture to wall and 36" O.C. fixture to fixture spacing required.

electrical
Advance Xitanium multi-volt 120V-277V constant current driver includes standard 0-10V analog dimming. Power factor >.9 typical, 50/60Hz., 200-700mA. 120-277v<15% THD @ 100% power <20% THD when dimming. "Thermal Guard" offers protection from overheating in abnormal conditions; driver will dim DLM if necessary. Voltage specific thermal protectors included standard.

3000 lumen versions integrate an active cooling solution not recommended for quiet applications.

Performance Overview				
Nominal Output	Color Temp	System Watts	Delivered Lumens	Lumens/Watts
11LED	3000K	16	1151	70.2
15LED	3000K	21	1470	69.9
20LED	3000K	29	1994	69.5
30LED	3000K	41	2800	69.2

*Based on Clear Diffuse reflector cone
*Lumen output may vary +/- 5%
*Actual wattage may vary +/- 5%
*Rated output is the same for all available color temperatures.
*Wattage reduction with other color temperatures.

dimming
0-10V DC low voltage dimming capability is included with the standard Advance Xitanium driver. Dimming range is to 10% light output, some dimmers may require high and/or low end trim adjustment for proper function.

labels
UL and cUL Listed. Lensed trims suitable for Wet Location.

lifetime & warranty
LED System rated for 50,000 hours at 70% lumen output (L70). Rated life and lumen output based on maximum temperature of 65°C at Tc point on LED module. If Tc temperature rises above rated maximum due to end use conditions, lifetime and lumen output may decrease. 5 year limited warranty on LED system provided by Philips.

trim specifications

aesthetics
Parabolic reflector cone ensures glare free optics. Reflector is .050 spun aluminum.
Torsion springs pull trim tight to the ceiling with no visible fasteners within the trim.
Overlap trims are self-flanged. Non-painted trim matches reflector finish. White painted flange may also be specified.

optics
50-degree cut–off to light source and its image.

housing ordering

housing series		FL6D
ID LED Round	FL6D	
nominal output		11LED
1100 Lumen LED Module	11LED	
1500 Lumen LED Module	15LED	
2000 Lumen LED Module	20LED	
3000 Lumen LED Module	30LED	
color temperature		L30
3000K	L30	
3500K	L35	
4000K	L40	
driver		L3D
0-10V Dimming	LD1	
Lutron A-Series Eco System (not available with 30LED)	L3D	
voltage		277
120V	120	
277V	277	
trim type		RO
Round Overlap	RO	
housing type		T
Thermally Protected, Non-IC	T	
factory options		
Bar Hangers	BH	
Chicago Plenum (not available with 30LED)	CP	
Lutron EcoSystem Translator (30LED only, above ceiling access only)	TVI	

trim ordering

aperture		L6
6" Round Reflector	L6	
trim type		RD
Round	RD	
optic		DN
Downlight	DN	
Regress Frosted Lens (wet location)	RL	
Regress Clear Lens (wet location)	CL	
color		CD
Clear Diffuse	CD	
Warm Diffuse	WD	
flange finish		WP
Non-Painted	NP	
White Painted	WP	

a complete unit consists of two line items, housing and trim
example: FL6D-15LED-L30-LD1-120-RO-T |L6-RO-DN-CD-NP

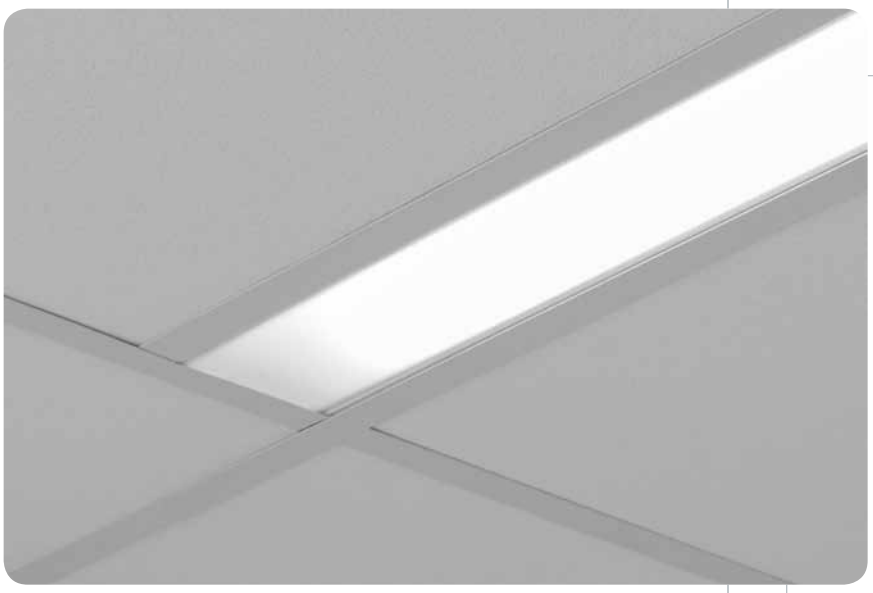
Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

Type D

FOCAL POINT®

grid

seem® 4



features

Narrow 4" aperture slot fluorescent luminaire that integrates with the ceiling for a clean unobtrusive aesthetic.

Frosted acrylic flush lens provides even illumination, high performance lens available for increased efficiency. Parabolic louver also available.

Allows for individual and continuous row mount in grid applications.

Available in 1 lamp T5, T5HO or T8 and 2 lamp T5 or T8 configurations, Seem 4 provides continuous illumination by combining 3' and 4' staggered lamps. Specify 1 lamp for even appearance and minimal lamp image, or 2 lamps when higher light levels are required.

sheilding options

lens

companion luminaires

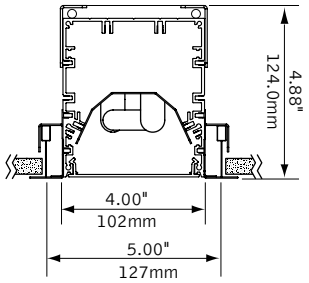
wall to ceilng corner

suspended

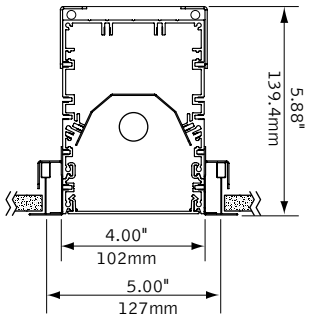
wall mount

dimensional data

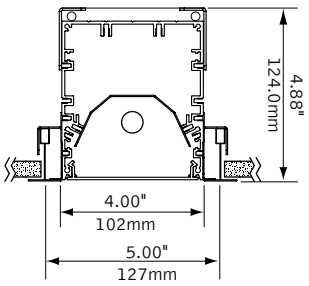
row mount T5/T5HO/T8



individual T8

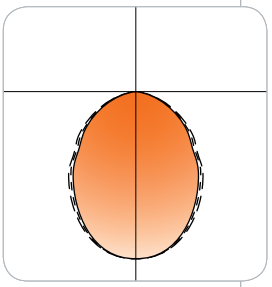


individual T5/T5HO



performance

1-Lamp T5 High Performance Lens	1-Lamp T5 Flush Satin Lens
77% Efficiency	56% Efficiency
999 cd @ 0˚	595 cd @ 0˚



Visit focalpointlights.com for complete photometric data.

march 2013 K

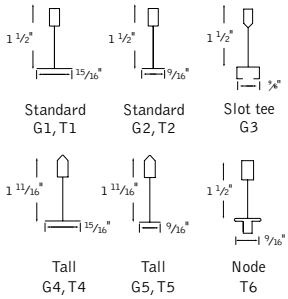
fixture:

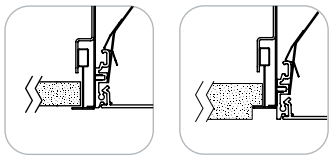
project:

Type D

mounting information

grid





lay-in tile (G) tegular tile (T)

Luminaire always rests at level of tile.

specifications

construction

One piece, .07" thick housing of 6063-T5 extruded aluminum.

20 Ga. steel end caps.

Luminaires include 22 Ga. steel, .35" wide flange rail finished in Matte Satin White.

Earthquake brackets standard on all luminaires.

Lengths 6' and longer configured with staggered lamps (6' & 12' 2-lamp T8 confgured with non-staggered lamps):

1-lamp T8:	4.47" overlap
2-lamp T8:	9.35" overlap
1-lamp T5/T5HO:	4.35" overlap
2-lamp T5:	2.00" overlap

2' unit weight:	18 lbs.
3' unit weight:	24 lbs.
4' unit weight:	30 lbs.
5' unit weight:	36 lbs.
6' unit weight:	43 lbs.
8' unit weight:	55 lbs.

optic

Reflectors fabricated of 22 Ga. steel finished in High Reflectance White powder coat.

Flush satin lens: extruded acrylic lens .07" thick with opal satin finish.

High performance flush lens: extruded acrylic lens .07" thick with increased light transmission.

Parabolic Louver: 0.75"H x 1.5" frequency fabricated of low iridescent semi-specular premium grade aluminum.

electrical

Luminaires are pre–wired with factory installed branch circuit wiring and over-molded quick connects.

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

Optional dimming ballasts available.

UL and cUL listed.

finish

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

ordering

luminaire series		FSM4
Seem 4	FSM4	
shielding		FL
Flush Satin Lens	FL	
High Performance Flush Lens (lamp image may be visible)	FLXP	
Parabolic Louver	PL	
lamping		1T5
One Lamp T8	1T8	
Two Lamp T8	2T8	
One Lamp T5	1T5	
Two Lamp T5	2T5	
One Lamp T5HO	1T5HO	
circuits		1
Single Circuit	1C	
Dual Circuit (2-lamp luminaires only)	2C	
voltage		277
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		S
Electronic Instant Start <20% THD (T8 only)	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
ceiling configurations		T2
Std. 15/16" Lay-in	G1	
Std. 15/16" Tegular	T1	
Std. 9/16" Lay-in	G2	
Std. 9/16" Tegular	T2	
9/16" Slot-tee Tegular	G3	
Tall 15/16" Lay-in	G4	
Tall 15/16" Tegular (not available in T8 individuals)	T4	
Tall 9/16" Lay-in	G5	
Tall 9/16" Tegular (not available in T8 individuals)	T5	
Node 9/16" Tegular	T6	
factory options		
Chicago Plenum	CP	
Emergency Circuit*	EC	
Emergency Battery Pack*	EM	
Flex Whip*	FW	
HLR/GLR Fuse	FU	
Include 3000K lamp	L830	L830
Include 3500K lamp	L835	
Include 4100K lamp	L841	
finish		WH
Matte White	WH	
luminaire length (designed to fit standard grid lengths)		4'
Specify luminaire/row length in 1' increments (lengths 6' and longer configured with staggered lamps. 6' & 12' 2-lamp T8 configured with non-staggered lamps, row mount not available)	X'	

* for more information see Reference section.

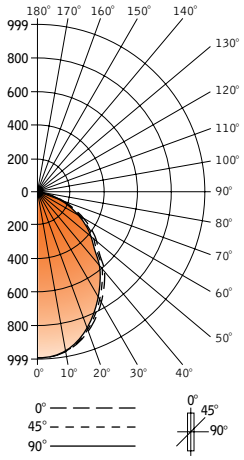
Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

Type D

seem™ 4

Filename: FSM4FLXP1T5.IES
Catalog #: FSM4-FLXP-1T5-1C-120-S-G1-WH-4'
Efficiency: 77%
Test #: 15712.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	999	999	999	999	999	
5°	997	996	994	994	994	95
15°	942	941	937	93	931	266
25°	831	827	817	806	802	378
35°	692	685	670	654	648	421
45°	510	503	484	466	458	375
55°	378	373	355	338	333	319
65°	236	23	219	210	205	219
75°	118	116	111	105	103	117
85°	31	29	28	28	28	31
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 1.1
Criterion: 1.1

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	738	25.5	33.3
	0°-40°	1159	40.0	52.2
	0°-60°	1853	63.9	83.5
	0°-90°	2220	76.6	100
Total Luminaire	0°-180°	2220	76.6	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	6091	5781	5470
55°	5566	5227	4903
65°	4716	7376	4097
75°	3850	3622	3361
85°	3004	2713	2713

CO-EFFICIENTS OF UTILIZATION

Floor		80				70			20 50		30		10		00
Ceiling															
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00	
RCR 0	91	91	91	91	89	89	89	85	85	81	81	78	78	77	
1	85	81	78	76	82	80	75	76	72	73	70	71	68	67	
2	78	72	68	64	76	71	63	68	62	66	60	64	59	58	
3	72	65	59	55	70	64	54	61	53	59	53	58	52	50	
4	66	58	52	47	65	57	47	55	46	54	46	52	45	44	
5	61	52	46	41	59	51	41	49	40	48	40	47	39	38	
6	56	47	40	36	55	46	36	45	35	44	35	42	35	33	
7	52	42	35	32	51	42	32	41	31	40	31	39	31	29	
8	48	38	32	8	47	38	28	37	27	36	27	35	27	26	
9	45	35	28	24	43	34	24	33	24	32	24	32	24	22	
10	41	31	26	22	40	31	22	30	21	30	21	29	21	20	

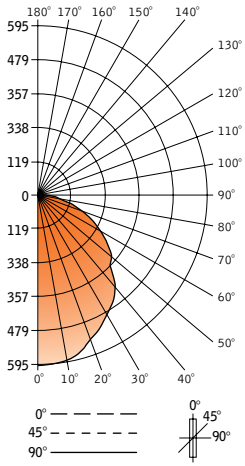
Numbers indicate percentage values of reflectivity.

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

seem™ 4

Filename: FSM4FL1T5.IES
Catalog #: FSM4-FL-1T5-1C-120-S-G1-WH-4'
Efficiency: 56%
Test #: 15711.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	595	595	595	595	595	
5°	591	591	591	591	591	56
15°	568	568	568	568	568	161
25°	515	515	515	515	515	238
35°	455	455	455	455	455	286
45°	353	355	355	355	355	275
55°	288	288	288	290	290	259
65°	198	196	198	198	199	196
75°	108	109	109	109	109	115
85°	28	28	28	28	29	31
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: 1.2

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	456	15.7	28.2
	0°-40°	742	25.6	45.9
	0°-60°	1275	44.0	78.9
	0°-90°	1617	55.8	100
Total Luminaire	0°-180°	1617	55.8	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	4216	4240	4240
55°	4241	4241	4270
65°	3957	3957	3977
75°	3524	3557	3557
85°	2713	2713	2810

CO-EFFICIENTS OF UTILIZATION

Floor		80				70			20 50		30		10		00
Ceiling															
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00	
RCR 0	66	66	66	66	65	65	65	62	62	59	59	57	57	56	
1	61	59	56	54	60	57	53	55	52	53	50	51	49	48	
2	56	52	48	45	54	51	44	49	43	47	42	45	41	40	
3	51	46	41	38	50	45	38	43	37	42	36	40	36	35	
4	47	41	36	32	46	40	32	39	32	37	31	36	31	30	
5	43	36	31	27	42	35	27	34	27	33	27	32	26	25	
6	40	32	27	24	39	32	24	31	23	30	23	29	23	22	
7	36	29	24	21	36	29	21	28	21	27	20	26	20	19	
8	34	26	21	18	33	26	18	25	18	24	18	24	18	17	
9	31	23	19	16	30	23	16	22	15	22	15	21	15	14	
10	29	21	17	14	28	21	14	20	14	20	14	19	14	13	

Numbers indicate percentage values of reflectivity.

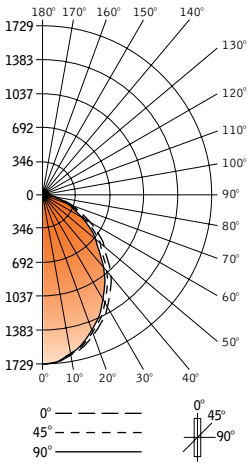
Go to www.focalpointlights.com for additional photometric data.

Type D

seem™ 4

Filename: FSM4FLXP2T5.IES
Catalog #: FSM4-FLXP-2T5-1C-120-S-G1-WH-4'
Efficiency: 65%
Test #: 15716.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1729	1729	1729	1729	1729	
5°	1718	1716	1714	1714	1712	164
15°	1600	1594	1583	1573	1569	449
25°	1422	1411	1384	1359	1349	641
35°	1182	1165	1128	1093	1080	709
45°	891	871	832	796	781	656
55°	654	639	604	575	562	544
65°	407	397	374	355	347	373
75°	203	200	188	180	176	200
85°	56	55	52	51	49	57
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 1.1
Criterion: 1.1

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	1254	21.6	33.1
	0°-40°	1963	33.8	51.9
	0°-60°	3153	54.4	83.3
	0°-90°	3784	65.2	100
Total Luminaire	0°-180°	3784	65.2	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	10642	9937	9328
55°	9630	8893	8275
65°	8133	7474	6934
75°	6624	6135	5743
85°	5426	5039	4748

CO-EFFICIENTS OF UTILIZATION

Floor																						
Ceiling	80				70			20	50		30		10		00							
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00								
RCR 0	78	78	78	78	76	76	76	72	72	69	69	67	67	65								
1	72	69	67	65	70	68	64	65	62	63	60	60	58	57								
2	66	62	58	54	65	60	54	58	53	56	51	54	50	49								
3	61	55	50	47	60	54	46	52	45	51	45	49	44	43								
4	56	49	44	40	55	49	40	47	40	46	39	44	39	37								
5	52	44	39	35	51	43	35	42	34	41	34	40	33	32								
6	48	40	34	31	47	39	30	38	30	37	30	36	30	28								
7	44	36	31	27	43	36	27	35	27	34	26	33	26	25								
8	41	33	27	24	40	32	24	31	23	30	23	30	23	22								
9	38	29	24	21	37	29	21	28	20	27	20	27	20	19								
10	35	27	22	18	34	26	18	26	18	25	18	25	18	17								

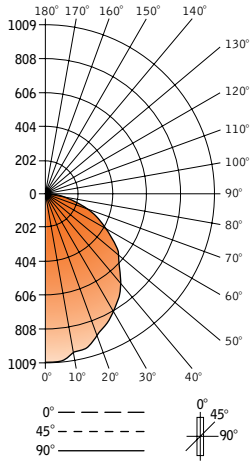
Numbers indicate percentage values of reflectivity.

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

seem™ 4

Filename: FSM4FL2T5.IES
Catalog #: FSM4-FL-2T5-1C-120-S-G1-WH-4'
Efficiency: 47%
Test #: 15715.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1009	1009	1009	1009	1009	
5°	1008	1006	1006	1006	1006	96
15°	954	952	952	952	952	270
25°	863	862	862	863	863	399
35°	759	761	761	761	759	478
45°	607	606	607	607	607	470
55°	488	488	489	491	491	439
65°	336	336	339	340	340	336
75°	181	183	184	184	184	194
85°	51	51	51	52	53	56
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: 1.2

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	765	13.2	27.9
	0°-40°	1243	21.4	45.4
	0°-60°	2152	37.1	78.6
	0°-90°	2738	47.2	100
Total Luminaire	0°-180°	2738	47.2	100

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	7250	7250	7250
55°	7185	7200	7230
65°	6714	6774	6794
75°	5906	6004	6004
85°	4942	4942	5136

CO-EFFICIENTS OF UTILIZATION

Floor																						
Ceiling	80				70			20	50		30		10		00							
Wall	70	50	30	10	70	50	10	50	10	50	10	50	10	00								
RCR 0	56	56	56	56	55	55	55	52	52	50	50	48	48	47								
1	52	50	48	46	50	48	45	47	44	45	42	43	41	40								
2	47	44	41	38	46	43	37	41	37	40	36	38	35	34								
3	43	39	35	32	42	38	32	37	31	35	31	34	30	29								
4	40	34	30	27	39	34	27	33	27	31	26	30	26	25								
5	36	30	26	23	35	30	23	29	23	28	23	27	22	21								
6	33	27	23	20	33	27	20	26	20	25	20	24	19	18								
7	31	24	20	17	30	24	17	23	17	23	17	22	17	16								
8	28	22	18	15	28	22	15	21	15	20	15	20	15	14								
9	26	20	16	13	25	19	13	19	13	18	13	18	13	12								
10	24	18	14	12	24	18	12	17	12	17	11	16	11	11								

Numbers indicate percentage values of reflectivity.

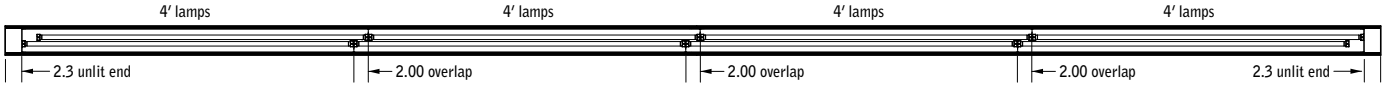
Go to www.focalpointlights.com for additional photometric data.

Type D

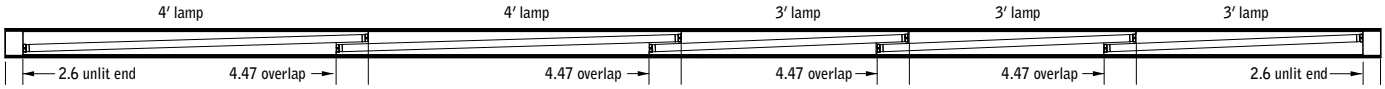
seem® 4 & 6 recessed run information

EXAMPLE 16' run

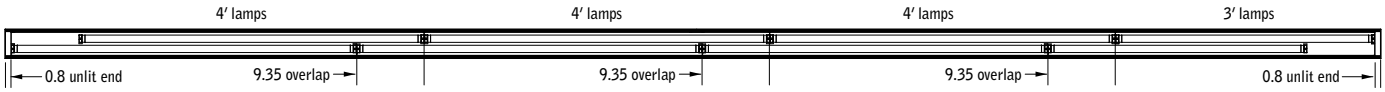
1-T5/T5HO



2-T5/T5HO (may exhibit noticeable socket shadows, color of lamp ends may be visible through lens)



1-T8



2-T8 (may exhibit noticeable socket shadows, color of lamp ends may be visible through lens)

notes:

- lamp overlap is consistent throughout run.
- unlit ends vary to provide even light throughout run.
- standard configurations listed, consult factory for additional options.
- 2T5HO not available with Seem 4

Type D

seem® 4 & 6 recessed run information

nominal run length (ft)	1-T5/T5HO (4.35″ overlap)			2-T5/T5HO (2.00″ overlap)			1-T8 (4.47‟ overlap)			2-T8 (9.35″ overlap)		
	lamp quantity		unlit ends (in)	lamp quantity		unlit ends (in)	lamp quantity		unlit ends (in)	lamp quantity		unlit ends (in)
	3'	4'		3'	4'		3'	4'		3'	4'	
6		2	0.3*	4		0.2	2		1.8	4		0.1*
7		2	0.3*	2	2	0.3	1	1	1.8	4		0.8
8	3		0.5		4	0.4		2	1.8	2	2	0.8
9	2	1	0.6	6		1.1	3		4.0		4	0.9
10	1	2	0.6	4	2	1.2	2	1	4.1	6		0.8
11		3	0.8	2	4	1.3	4		0.3	4	2	0.8
12	2	2	0.3*		6	1.3	3	1	0.3	8		0.1*
13	5		0.7	6	2	2.1	2	2	0.3		6	0.8
14	4	1	0.8	4	4	2.2	1	3	0.3	6	2	0.8
15	3	2	0.8	2	6	2.3		4	0.3	4	4	0.8
16	2	3	1.0		8	2.3	3	2	2.6	2	6	0.8
17	1	4	1.1	6	4	3.0	2	3	2.6		8	0.8
18		5	1.1	4	6	3.1	1	4	2.6	6	4	0.8
19	6	1	0.8	2	8	3.2	7		1.0	4	6	0.8
20	5	2	0.8		10	3.3	6	1	1.0	2	8	0.8
21	4	3	1.0	6	6	4.0	5	2	1.1		10	0.8
22	3	4	1.1	4	8	4.1	4	3	1.1	6	6	0.8
23	9		1.1	2	10	4.2	3	4	1.1	4	8	0.8
24	1	6	0.9		12	4.3	2	5	1.1	2	10	0.8
25	7	2	1.3	12	4	0.1*	1	6	1.1		12	0.8
26	6	3	1.2	18		0.3		7	1.2	6	8	0.8
27	5	4	1.3	16	2	0.3	10		1.8	4	10	0.8
28	11		1.0	14	4	0.4	9	1	1.8	2	12	0.8
29	10	1	1.1	12	6	0.6	8	2	1.8		14	0.8
30	9	2	1.2	10	8	0.7	7	3	1.8	6	10	0.8
31	8	3	1.3		16	0.2	6	4	1.8	4	12	0.8
32	7	4	1.4	6	12	0.8	5	5	1.8	2	14	0.8
33	13		1.2	4	14	0.9	4	6	1.8		16	0.8
34	12	1	1.2	2	16	1.1	3	7	1.9	6	12	0.8
35	11	2	1.3		18	1.1	2	8	1.9	4	14	0.8
36	10	3	1.4	6	14	1.8	1	9	1.9	2	16	0.8
37	9	4	1.5	4	16	1.9	7	5	0.3		18	0.9
38	15		1.3	2	18	2.0	6	6	0.3	6	14	0.8
39	14	1	1.3		20	2.1	5	7	0.4	4	16	0.8
40	13	2	1.4	6	16	2.8	4	8	0.4	2	18	0.8
41	12	3	1.6	4	18	2.8	3	9	0.4		20	0.9
42	11	4	1.7	2	20	2.9	2	10	0.4	6	16	0.8
43	10	5	1.8		22	3.1	1	11	0.4	4	18	0.9
44	9	6	1.9	6	18	3.7		12	0.4	2	20	0.9
45	8	7	1.9	26	4	0.1*	3	10	2.7		22	0.9
46	7	8	2.1	32	0	0.7*	2	11	2.7	6	18	0.9
47	13	4	1.8	22	8	0.3*	1	12	2.7	4	20	0.9
48	19		1.5	20	10	0.4*	7	8	1.1	2	22	0.9

* special lamp stagger to decrease end darkness.
note: 2T5HO not available with Seem 4

Flex LED Tape WP Installation Manual

Type E

SPECIFICATIONS

Average Rated Life: 30,000 hours
Operating Temperature: -40°c to 80°c

ELATION FLEX LED TAPE WP is a very thin and flexible LED circuit strip mounted inside a silicone water proof sleeve. It can be cut every 2" and put back together using simple soldering techniques and silicone seal kit. It comes available in RGB and Single Color versions. High output, low heat and easy installation make this product the ideal product for a variety of applications.

FLEX RGB WP+ TAPE SPECIFICATIONS

View Angle: 120°
Length: 3 meters / 9.8 feet
Width: 14 mm
Power Consumption: 43.2w
Voltage: DC12V
LEDs: 180 SMD
Wiring Diagram:

W	Power supply DC12V+
R	Red color LED DC12V-
G	Green color LED DC12V-
B	Blue color LED DC12V-

SINGLE COLOR TAPE SPECIFICATIONS

View Angle: 120°
Length: 6 meters / 20 feet
Width: 14 mm
Power Consumption: 28.8w
Voltage: DC12V
LEDs: 360 SMD
Wiring Diagram:

W	Power supply DC12V+
C	Color LED DC12V-

DMX Accessories

Flex RGB+ WP

Elar Driver-1

AL-150-12

Elar Driver-8

Flex PSU 4A

Flex LED Tape WP Installation Manual

Type E

PRODUCT ORDERING SPECIFICATIONS

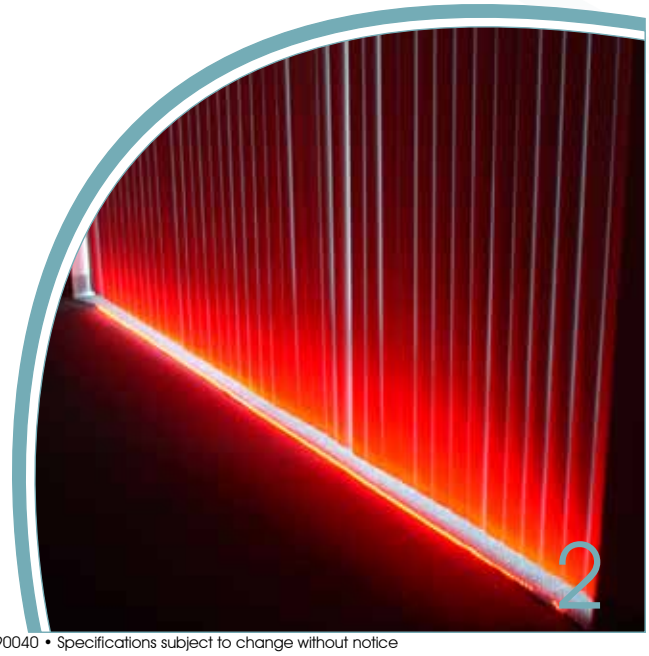
Order Number	Description
Flex RGB WP+	10’ roll RGB tape
Flex WW WP	20’ roll warm white tape, 3000°k
Flex CW WP	20’ roll cool white tape, 6000°k
Flex B WP	20’ roll blue tape
Flex R WP	20’ roll red tape
Flex G WP	20’ roll green tape
Flex A WP	20’ roll amber tape

DMX CONTROL OPTION ITEMS

Order Number	Description
ELAR Driver 1	3 channel DMX driver only
ELAR Driver 8 12 V	150W power supply and 32 channel DMX driver
ELAR PSU4A	50W power supply 4 amp
AL-150-12V	150W power supply 12.5 amp

ACCESSORIES

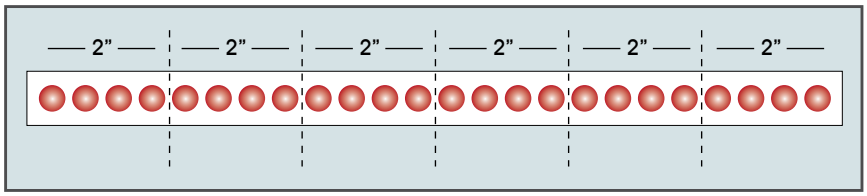
Order Number	Description
Flex Clip Kit	Mounting clips for WP tape
Flex IP Clip Kit	Silicon, end caps and 2 clips for WP tape



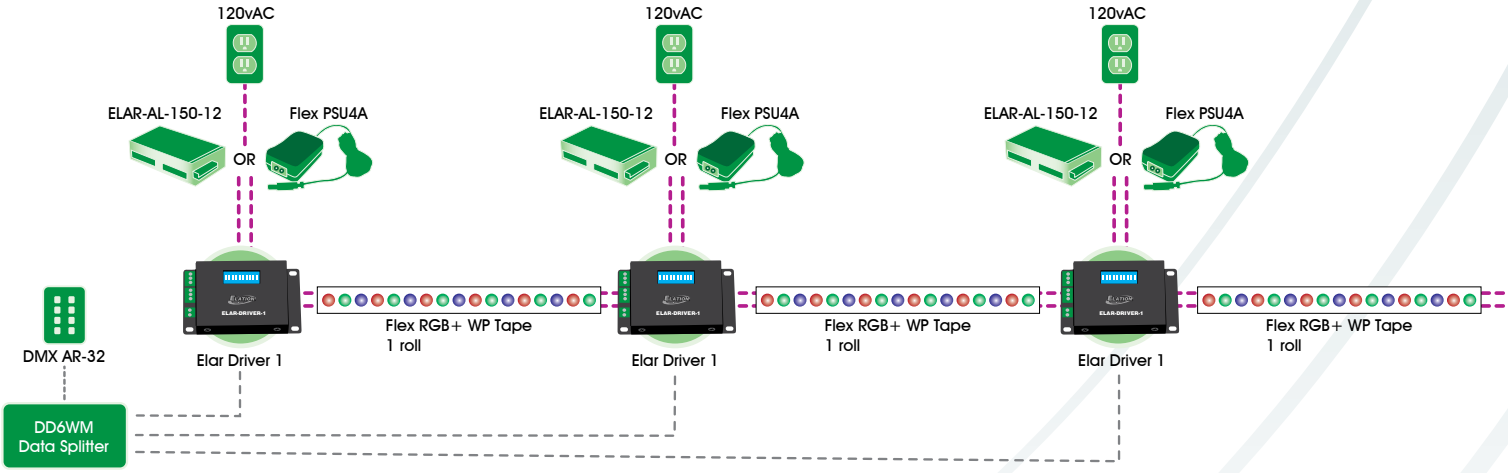
Flex LED Tape WP Installation Manual

Type E

Flex LED Tape WP can be cut every 2” and put back together using simple soldering techniques and silicone seal kit

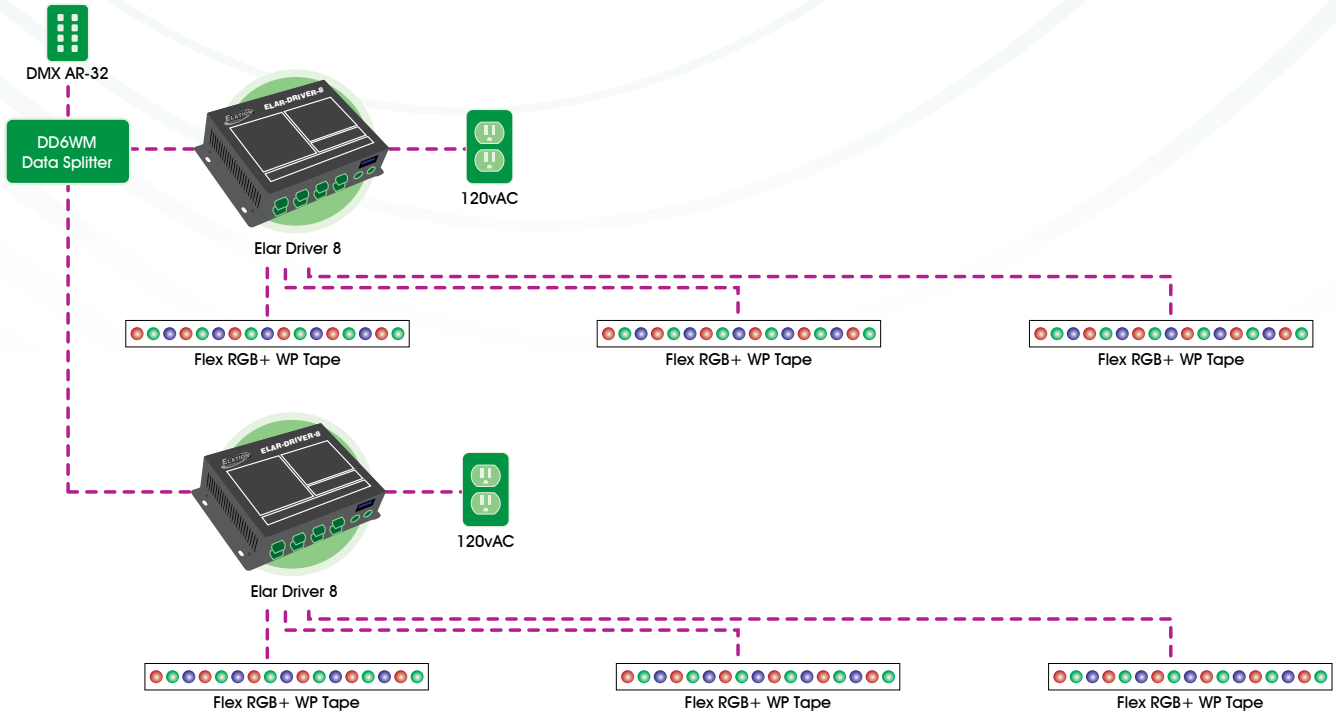


FLEX RGB WP+ ELAR DRIVER 1 DMX DIAGRAM



FLEX RGB WP+ ELAR DRIVER 8 DMX DIAGRAM

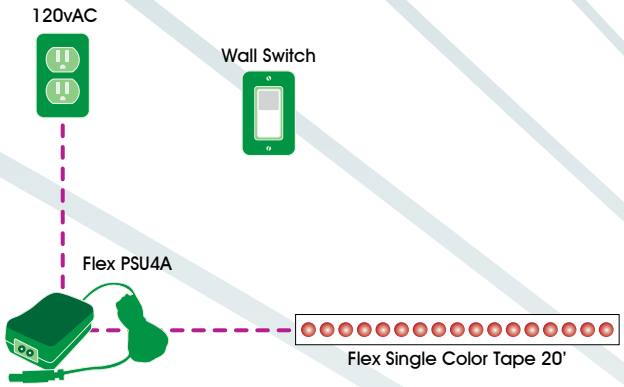
Maximum 3 Rolls Per ELAR Driver-8



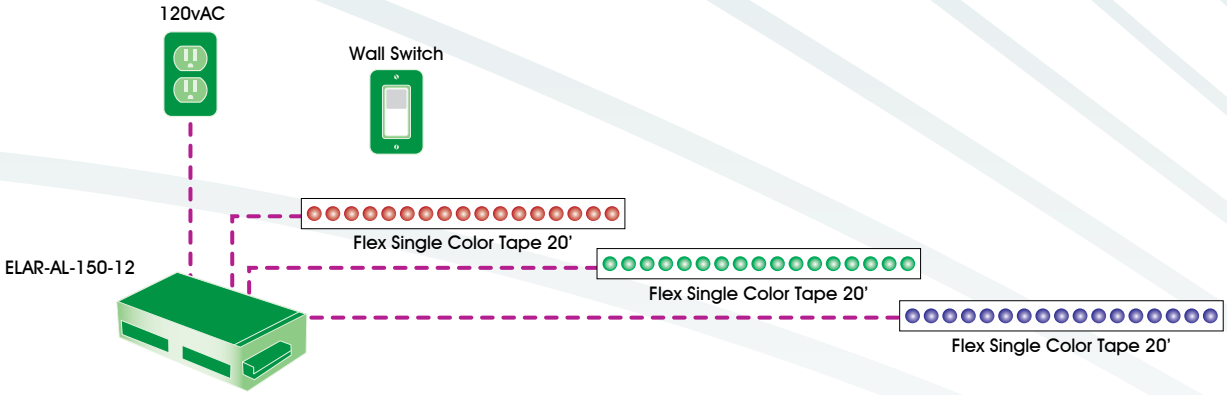
Type E

FLEX SINGLE COLOR TAPE DC12V POWER ON OFF DIAGRAM

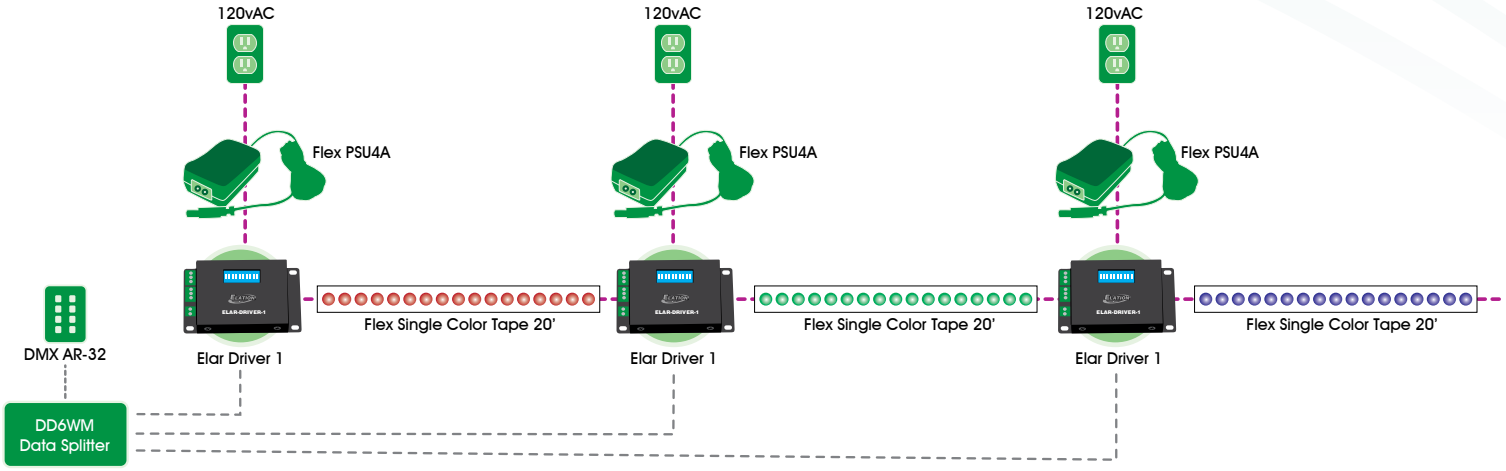
Maximum 1 Roll Per Flex PSU4A



Maximum 5 Rolls Per ELAR AL-150-12



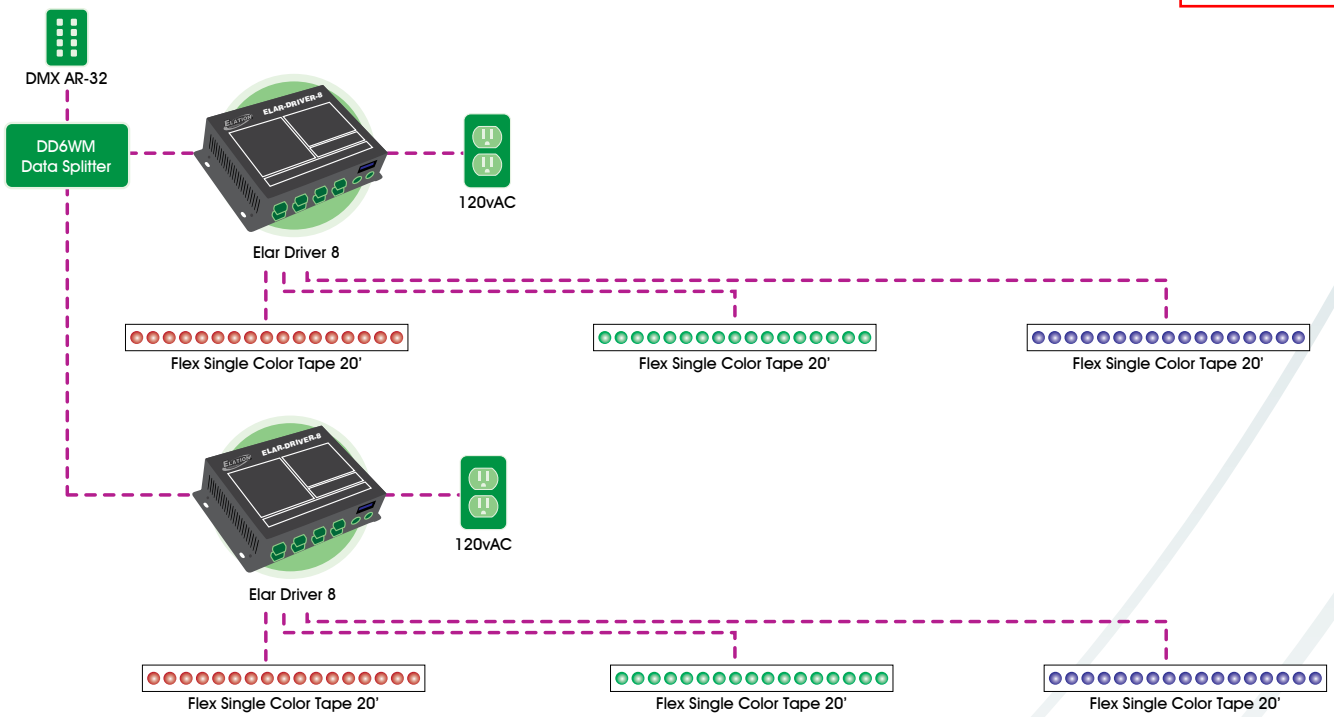
FLEX SINGLE COLOR TAPE ELAR DRIVER-1 DMX DIAGRAM



Type E

FLEX SINGLE COLOR TAPE ELAR DRIVER-8 DMX DIAGRAM

Maximum 5 Rolls Per ELAR Driver-8

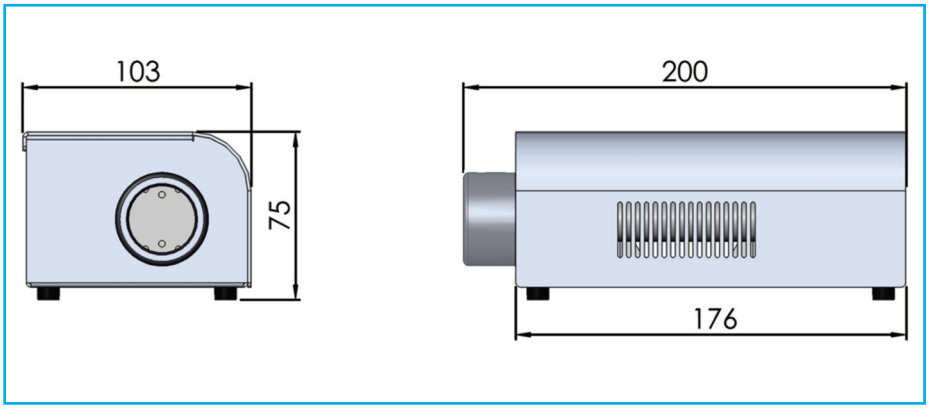


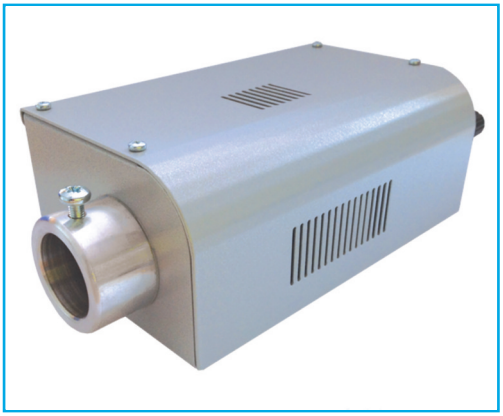
Light Source Specification

Type F

UFO UNIVERSAL FIBRE OPTICS

Vega Slimline





The UFO Vega offers the ultimate in LED brightness for architectural lighting projects.

With a long lamp life, and very bright white light output, the Vega fits perfectly in situations where tungsten halogen, or even metal halide options would normally be specified.

Very cool and almost silent running combined with a small unit size, make this light source suitable for use in restricted spaces, and when fitted in an IP rated enclosure it can easily be situated outside

Description	
Port connector size	30mm Diameter
Fibre type	Glass/Polymer
Mains Supply Voltage	100-240V AC, 50-60 Hz. 1.8A
PSU Output	24V DC, 2.5A, 60W Maximum
LED Power	Max. 20W
Power Connection	2.1 x 5.5 x 12mm
Min Ambient Temperature	-10°C
Max Ambient Temperature	+45°C
Fan	80mm 12V Crossflow
Thermal Protection	Thermal Cut Out switch 70°C
Dimming	Manual, DMX and 0-10V (receiving)
LED Type / Model	White light
LED Life	50,000 hours in ambient 25°C
Equivalent TH Light Output	120W
CRI	82 (typical)
Colour Temperature °K	4000°K
Material	Aluminium
Colour	Silver
Size	176mm (L) x 103mm (W) x 75mm (H)

Like all our range, this light source is undergoing constant improvements and upgrades, so we reserve the right to alter specifications as required..

Issue 2 | Revised: 140314

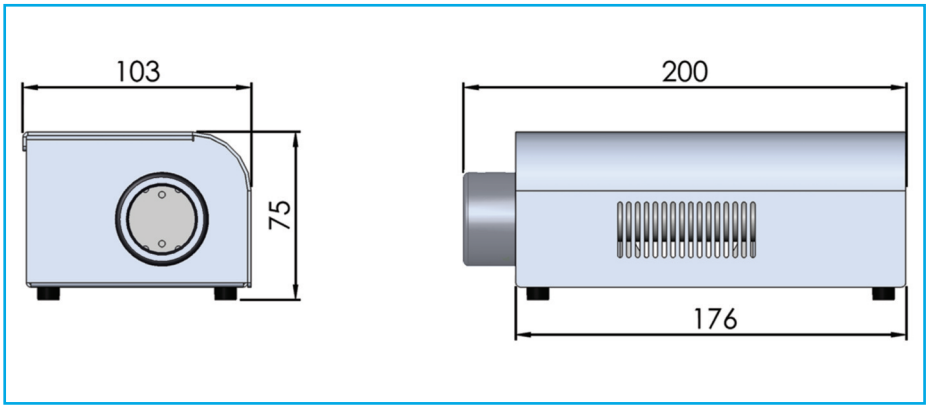
Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

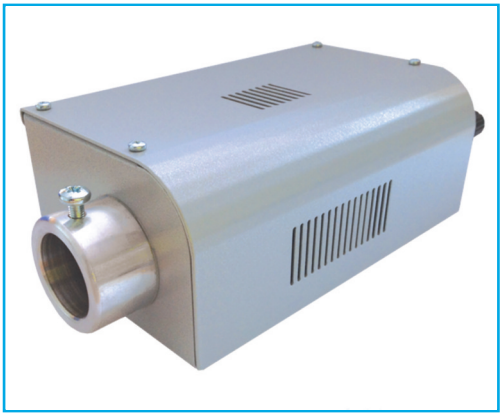
Light Source Specification

Type F

UFO UNIVERSAL FIBRE OPTICS

Vega Slimline





The UFO Vega offers the ultimate in LED brightness for architectural lighting projects.

With a long lamp life, and very bright white light output, the Vega fits perfectly in situations where tungsten halogen, or even metal halide options would normally be specified.

Very cool and almost silent running combined with a small unit size, make this light source suitable for use in restricted spaces, and when fitted in an IP rated enclosure it can easily be situated outside

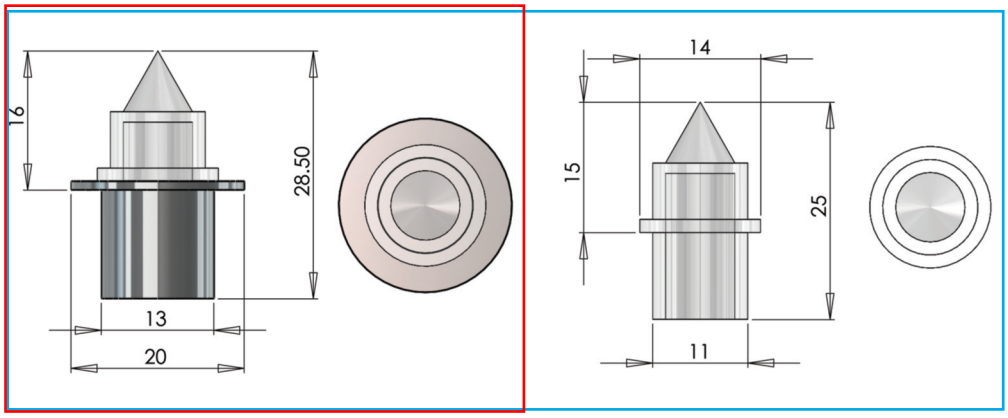
Description	
Port connector size	30mm Diameter
Fibre type	Glass/Polymer
Mains Supply Voltage	100-240V AC, 50-60 Hz. 1.8A
PSU Output	24V DC, 2.5A, 60W Maximum
LED Power	Max. 20W
Power Connection	2.1 x 5.5 x 12mm
Min Ambient Temperature	-10°C
Max Ambient Temperature	+45°C
Fan	80mm 12V Crossflow
Thermal Protection	Thermal Cut Out switch 70°C
Dimming	Manual, DMX and 0-10V (receiving)
LED Type / Model	White light
LED Life	50,000 hours in ambient 25°C
Equivalent TH Light Output	120W
CRI	82 (typical)
Colour Temperature °K	4000°K
Material	Aluminium
Colour	Silver
Size	176mm (L) x 103mm (W) x 75mm (H)

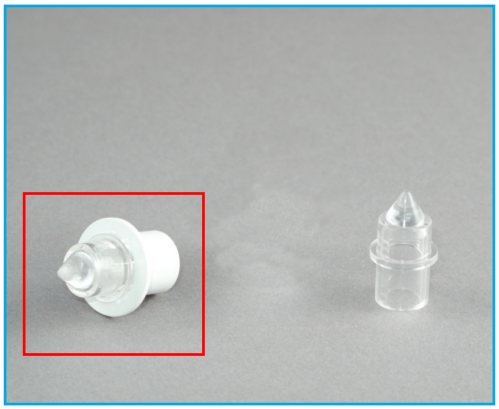
Like all our range, this light source is undergoing constant improvements and upgrades, so we reserve the right to alter specifications as required..

Issue 2 | Revised: 140314

Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

UFO 12DS/ 12DSF Sparkle Fitting





An acrylic sparkle point for an M8 ferrule.

Manufactured from clear acrylic, the UFO12DS is supplied as a sparkle bullet only. The 12DS/F is identical but additionally has a coloured flange.

Description	UFO 12DS	UFO 12DS/F
Material	Polycarbonate	Polycarbonate
Colours available	Clear	Clear body with coloured flange in black, white or chrome
Size	14 mm	20 mm
Weight	1.3 g	2.1 g
Mounting hole size	11 mm	13 mm
Ferrule size	M8	M8
Min. fibre size	2 mm	2 mm
Max. fibre size	4.5 mm	4.5 mm

Ideal for internal signage applications and sparkle effects on high ceilings.

Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

End Fitting Specification

Type F

UFO
UNIVERSAL FIBRE OPTICS

Crystal Fittings Range

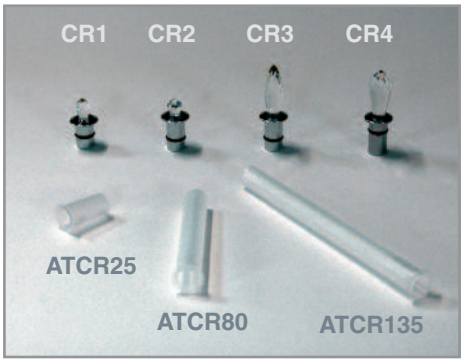
Overview

The UFO range of crystal fittings are all designed to give a bright sparkling point of light and a pattern of light cast onto the surrounding surfaces. They are made from high quality European real crystal glass. Four crystal fittings are available, each of a different size and shape to give alternative patterns and spreads of light. The crystals are attractive with a either a white light source or colour changing model.

The crystals are designed for use with 1.8mm active diameter glass fibre via a special UFO Crystal Ferrule connection.

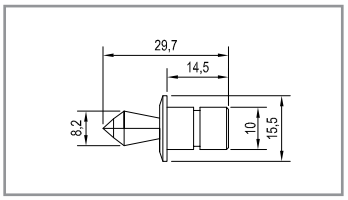
The crystal flanges are finished in Chrome or Gold colours as standard. Other finishes are available at extra cost.

Accessory tubes in three lengths are available to allow easy mounting through single or double skinned substrates. These are one diameter to fit all crystals.

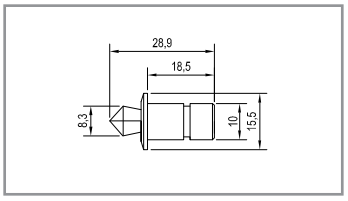


Specification

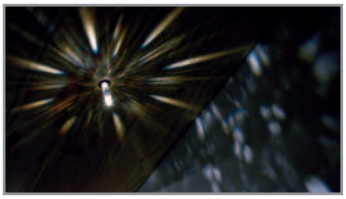
CR1
Flange Diameter = 15.5mm
Crystal Diameter = 8.2mm
Overall Length = 29.7mm
Recess depth = 14.5mm
Finishes: Chrome; Gold; Special
All dimensions are approximate and do not include ferrule or gland.

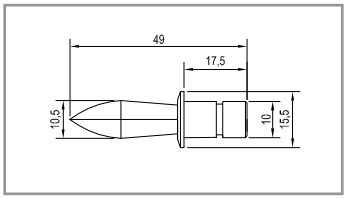


CR2
Flange Diameter = 15.5mm
Crystal Diameter = 8.3mm
Overall Length = 28.9mm
Recess depth = 18.5mm
Finishes: Chrome; Gold; Special
All dimensions are approximate and do not include ferrule or gland.

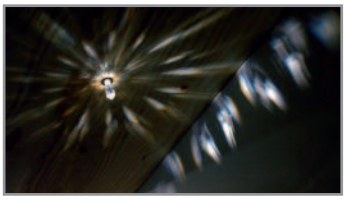


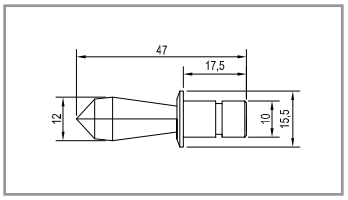
CR3
Flange Diameter = 15.5mm
Crystal Diameter = 10.5mm
Overall Length = 49.0mm
Recess depth = 17.5mm
Finishes: Chrome; Gold; Special
All dimension are approximate and do not include ferrule or gland.





CR4
Flange Diameter = 15.5mm
Crystal Diameter = 12.0mm
Overall Length = 47.0mm
Recess depth = 17.5mm
Finishes: Chrome; Gold; Special
All dimensions are approximate and do not include ferrule or gland.

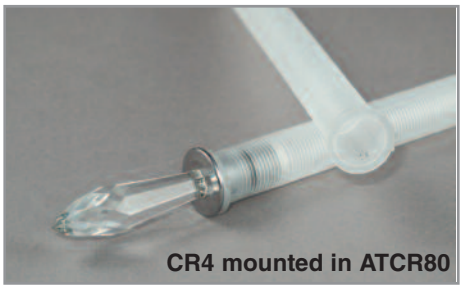





Assorted crystals in sauna

Accessory Tubes

ATCR25 = 25mm long
ATCR80 = 80mm long
ATCR135 = 135mm long
All with 15.3mm x 0.9mm flange in translucent plastic with internal and external ribbed finish to grip hole and crystal. Drill 12mm hole and insert tube from below. Pass fibre from above through tube and insert into crystal. Push crystal into tube.


CR4 mounted in ATCR80

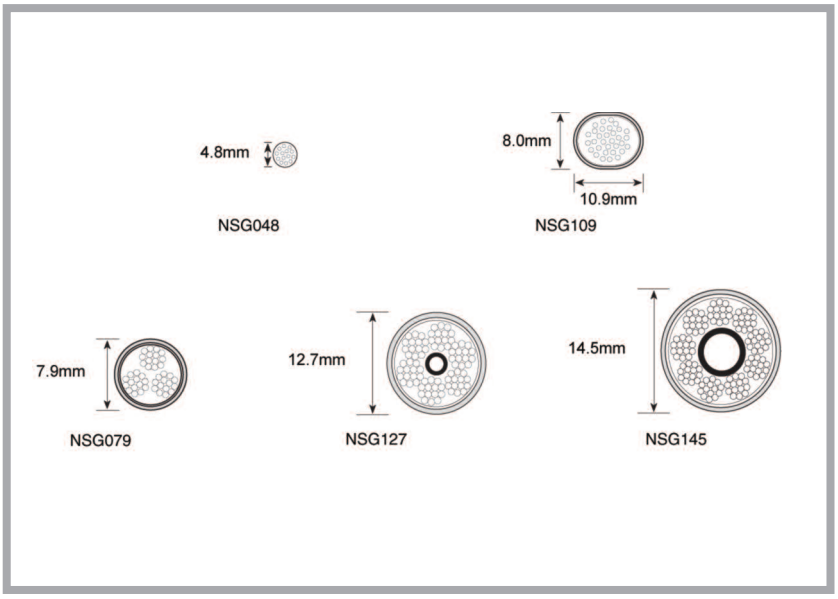
Home Place - Coldstream - TD12 4DT - UK
Tel: +44 (0)1890 883416 - Fax: +44 (0)1890 883062
www.fibreopticlighting.com
info@fibreopticlighting.com

Fibre Specification

Type F

UFO
UNIVERSAL FIBRE OPTICS

Polymer Side Sparkle Sideglow Fibre



A linear emitting fibre, suitable for use in multiple applications.

Universal Fibre Optics side sparkle sideglow fibre can be used to highlight the perimeter of pools, decks and walkways. It is also often used for illuminating the edges of steps. When attached to a UFO decorative light source, the colour of the light output can be changed and sparkle effects can also be easily achieved.

Suitable for interior or exterior applications, the fibre is UV protected and has an algaecide and fungicide treated exterior jacket for maximum durability against the elements.

Our Side Sparkle fibre is strong enough for use in pools or extremely cold environments and with no heat or electricity running through the cable typical lighting design restrictions are eliminated allowing for an almost unlimited range of design possibilities.

Product Specifications

Constructed from 0.75mm diameter PMMA acrylic optical fibres of twisted sub-bundles (NSG079, NSG127 and NSG145 only) within a flexible clear jacket.

The fibres in NSG127 & NSG145 are twisted around a highly reflective PVC internal core that offers flexible stability combined with maximum light output.

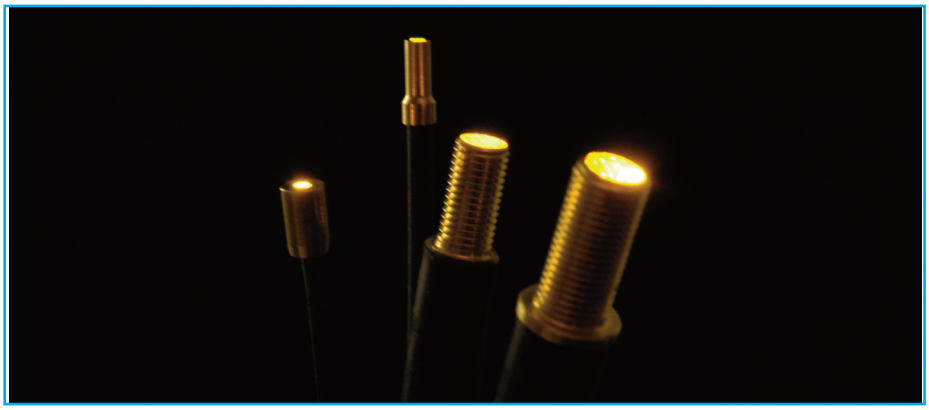
Product Code	Outer Diameter	Number of Fibres	Max. No. of Tails
NSG048	4.8mm	14	60
NSG109	Oval 10.9 x 8mm	32	28
NSG079	7.9mm	42	22
NSG127	12.7mm	84	11
NSG145	14.5mm	126	7

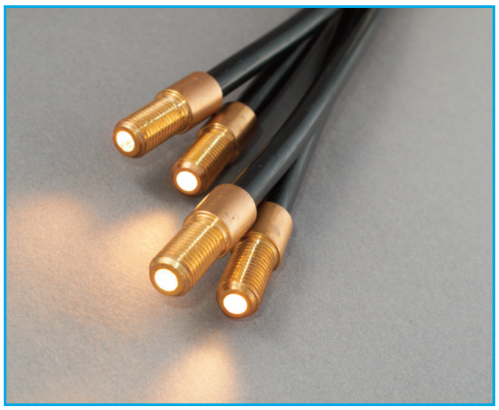
Home Place - Coldstream - TD12 4DT - UK
Tel: +44 (0)1890 883416 - Fax: +44 (0)1890 883062
www.fibreopticlighting.com
info@fibreopticlighting.com

Fibre Harness Specification

Type F

End Lit Glass Fibre Harness





Universal Fibre Optics glass fibre optic harnesses offer unparalleled light output, very long life and extraordinary colour characteristics.

Benefits of UFO glass fibre include:

- Compliance with the IEC fire retardant standard 60332-1-2
- Unique fused technology
- Resistance to high temperatures which offers the greatest possible light output without heat filters
- UV resistant common end
- Flexible multi-fibre construction
- High packing density which ensures compatibility with tightly focussed light sources
- High quality glass fibres offering exceptional transmission and colour characteristics
- Factory terminated common ends for superior quality, performance and longevity

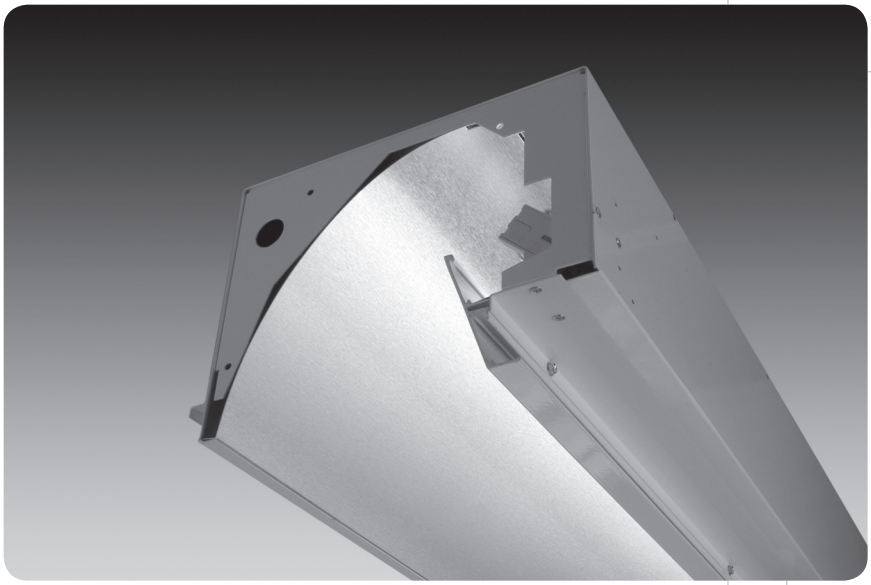
Size	1	1.5	1.8	2	8	12	18	24	36	-
Approx outer diameter	2.3mm	2.7mm	2.6mm	3.9mm	4.9mm	6.4mm	7.4mm	8.7mm	10.1mm	10.5mm
Approx active diameter	1mm	1.5mm	1.8mm	2mm	3mm	4.3mm	5mm	6mm	7mm	7.5mm
Minimum bend radius	7mm	8mm	10mm	15mm	18mm	20mm	40mm	50mm	70mm	80mm
Maximum no. of tails	400	270	160	135	68	38	25	17	12	10
Tail ferrule options	crimp	crimp tube	crimp tube	crimp tube 3mm	M8 M10	M8 M10	M8 M10	M8 M10	M10	M10
Common end	30mm fused technology harness									
Flexible sheathing	HFFR compounds - halogen free and flame retardant									
Operating temperature	Common end face: min. 0°C - max. 350°C Flexible tube: min. 0°C - max. 150°C Flexible sheathing: min. 0°C - max. 70°C									

Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

Type G

FOCAL POINT®

focus™ 4



features

High performance perimeter open wall washing system.

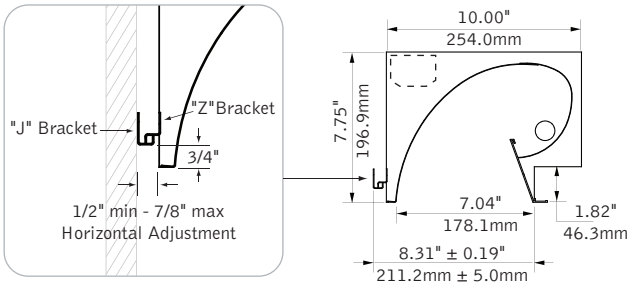
Includes an extruded aluminum splay, which conceals view to lamps.

Luminaire alignment is maintained with continuous angle and splice brackets.

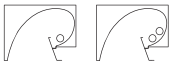
Reflector design eliminates direct and reflected lamp image.

Especially effective when mounted against reflective wall surfaces such as polished stone or mirrors.

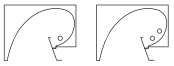
dimensional data



lamping options



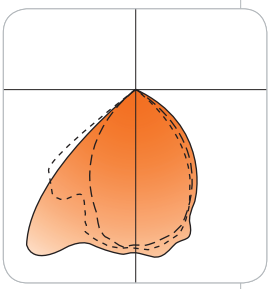
T8 LAMPS



T5/T5HO LAMPS

performance

1–Lamp T8
36% Efficiency
551cd @ 35°



Visit focalpointlights.com for complete photometric data.

idea everGreen™

Use in place of multiple halogen or compact fluorescent wall washers.

january 2014 D

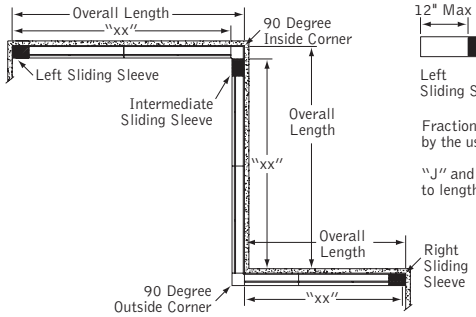
fixture:

project:

Type G

details

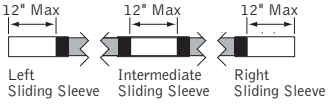
typical run layout



Luminaires must be installed prior to ceiling.

Start run from corner with any standard luminaire.
Corner to corner runs end with an intermediate sleeve.

sliding sleeves



Fractional Dimensions up to 12" are taken up by the use of a sliding sleeve.

"J" and "Z" angle brackets must be cut to length in field.

specifications

construction

20 Ga. steel housing.

24 Ga. steel reflector.

3-3/4"H x 3/4" W extruded aluminum splay mates with ceiling.

18 Ga. internal bulkheads join luminaires.

18 Ga. galvanized steel splice brackets are provided to ensure precise luminaire alignment.

20 Ga. steel continuous wall angles are provided to ensure horizontal alignment at wall.

Luminaires are available up to 8' nominal lengths.

4' unit weight: 26 lbs
8' unit weight: 47 lbs

optic

CNC roll-formed brush anodized .032" aluminum front reflector with specular .024" aluminum back reflector.

White Reflector also available.

electrical

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

Optional dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

finish

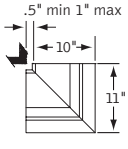
Polyester powder coat applied over a 5-stage pre–treatment.

Standard luminaire housing finished in Matte Satin White.

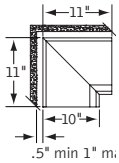
ordering

luminaire series		FW4
Focus 4	FW4	
shielding		NS
No Shielding, Open Optic	NS	
lamping		FL
One Lamp T8	1T8	
Two Lamp T8	2T8	
One Lamp T5	1T5	
Two Lamp T5	2T5	
One Lamp T5HO	1T5HO	
Two Lamp T5HO	2T5HO	
circuit		1T5
Single Circuit	1C	
Dual Circuit (Two lamps only)	2C	
voltage		1
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		277
Electronic Instant Start	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
mounting		RC
Recessed	RC	
factory options		
Air Return	AR	S
Emergency Circuit*	EC	T2
Emergency Battery Pack*	EM	
Flanged End (specify when run does not terminate at a wall)	FL	
HLR/GLR Fuse	FU	
Matte White Reflector	WR	
Include 3000K Lamp*	L830	
Include 3500K Lamp*	L835	
Include 4100K Lamp*	L841	
Sliding Sleeve	SS	
finish		WH
Matte Satin White	WH	
luminaire length		L830
Designate length in feet (Nominal lengths: 2',3',4',5',6',7',8') (All end caps are flat with no flange unless otherwise specified)	XX'	
corner options		4'
90-degree Inside Corner	FW4-IC90	
90-degree Outside Corner	FW4-OC90	

Outside



Inside



* for more information see Reference section.

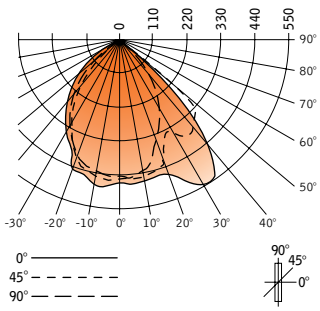
Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

Type G

focus™ 4

Filename:	FW4NS1T8.IES
Catalog #:	FW4-1T8-1C-120-E-RC-HW
Efficiency:	36%
Test #:	8643.1

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	488	488	488	488	488	
5°	485	488	488	490	491	47
15°	471	471	471	472	474	136
25°	509	479	445	427	427	202
35°	551	548	449	353	348	239
45°	329	374	419	272	255	201
55°	30	48	230	240	174	115
65°	19	21	24	151	97	68
75°	10	10	10	16	36	16
85°	3	3	3	3	9	4
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	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	384	13.5	37.5
	0°-40°	623	21.9	60.7
	0°-60°	938	32.9	91.5
	0°-90°	1026	36.0	100
Total Luminaire	0°-180°	1026	36	100.0

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

Type G

focus standard run length

Continuous Runs consist of standard fixture lengths. Left and Right End Trims and Sliding Sleeves are determinate, according to specific field conditions. Consult factory for details.

Example: 32' run = three 8' fixtures and one 7' fixture with a sliding sleeve expandable to 32'.

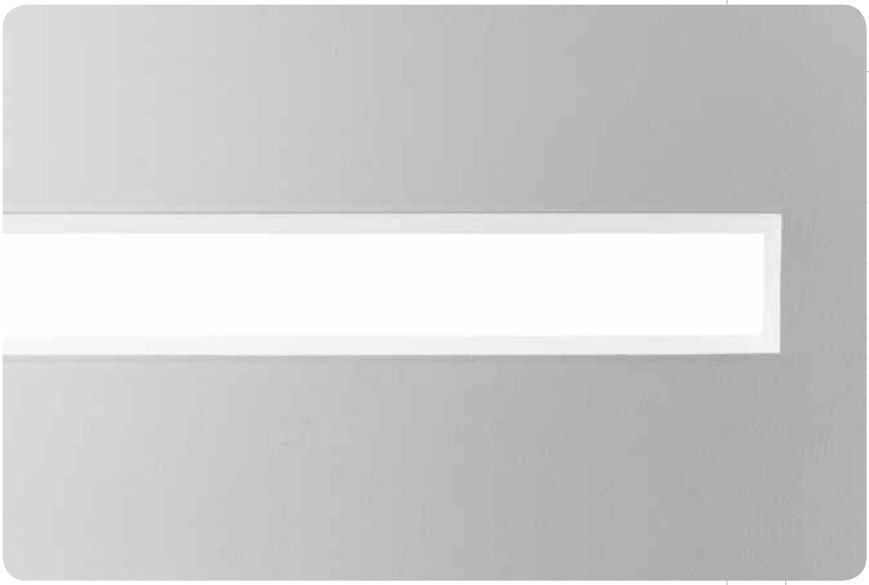
run length (in feet)	standard fixture lengths required	lamp sizes	sliding sleeve
4 – 5	4	4	1
5 – 6	5	5	1
6 – 7	6	3 3	1
7 – 8	7	4 3	1
8 – 9	8	4 4	1
9 – 10	6 3	3 3 3	1
10 – 11	6 4	3 3 4	1
11 – 12	8 3	4 4 3	1
12 – 13	8 4	4 4 4	1
13 – 14	7 6	4 3 3 3	1
14 – 15	8 6	4 4 3 3	1
15 – 16	8 7	4 4 4 3	1
16 – 17	8 8	4 4 4 4	1
17 – 18	8 6 3	4 4 3 3 3	1
18 – 19	8 6 4	4 4 4 3 3	1
19 – 20	8 8 3	4 4 4 4 3	1
20 – 21	8 8 4	4 4 4 4 4	1
21 – 22	8 7 6	4 4 4 3 3 3	1
22 – 23	8 8 6	4 4 4 4 3 3	1
23 – 24	8 8 7	4 4 4 4 4 3	1
24 – 25	8 8 8	4 4 4 4 4 4	1
25 – 26	8 8 6 3	4 4 4 4 3 3 3	1
26 – 27	8 8 6 4	4 4 4 4 4 3 3	1
27 – 28	8 8 8 3	4 4 4 4 4 4 3	1
28 – 29	8 8 8 4	4 4 4 4 4 4 4	1
29 – 30	8 8 7 6	4 4 4 4 4 3 3 3	1
30 – 31	8 8 8 6	4 4 4 4 4 4 3 3	1
31 – 32	8 8 8 7	4 4 4 4 4 4 4 3	1
32 – 33	8 8 8 8	4 4 4 4 4 4 4 4	1
33 – 34	8 8 8 6 3	4 4 4 4 4 4 3 3 3	1

run length (in feet)	standard fixture lengths required	lamp sizes	sliding sleeve
34 – 35	8 8 8 6 4	4 4 4 4 4 4 4 3 3	1
35 – 36	8 8 8 8 3	4 4 4 4 4 4 4 4 3	1
36 – 37	8 8 8 8 4	4 4 4 4 4 4 4 4 4	1
37 – 38	8 8 8 6 7	4 4 4 4 4 4 4 3 3 3	1
38 – 39	8 8 8 8 6	4 4 4 4 4 4 4 4 3 3	1
39 – 40	8 8 8 8 7	4 4 4 4 4 4 4 4 4 3	1
40 – 41	8 8 8 8 8	4 4 4 4 4 4 4 4 4 4	1
41 – 42	8 8 8 8 6 3	4 4 4 4 4 4 4 4 3 3 3	1
42 – 43	8 8 8 8 6 4	4 4 4 4 4 4 4 4 4 3 3	1
43 – 44	8 8 8 8 8 3	4 4 4 4 4 4 4 4 4 4 3	1
44 – 45	8 8 8 8 8 4	4 4 4 4 4 4 4 4 4 4 4	1
45 – 46	8 8 8 8 7 6	4 4 4 4 4 4 4 4 4 3 3 3	1
46 – 47	8 8 8 8 8 6	4 4 4 4 4 4 4 4 4 4 3 3	1
47 – 48	8 8 8 8 8 7	4 4 4 4 4 4 4 4 4 4 4 3	1
48 – 49	8 8 8 8 8 8	4 4 4 4 4 4 4 4 4 4 4 4	1
49 – 50	8 8 8 8 8 6 3	4 4 4 4 4 4 4 4 4 4 3 3 3	1
50 – 51	8 8 8 8 8 7 3	4 4 4 4 4 4 4 4 4 4 4 3 3	1
51 –52	8 8 8 8 8 8 3	4 4 4 4 4 4 4 4 4 4 4 4 3	1

Type H

infinite™ 3

FOCAL POINT®



features

Narrow 3" continuous slot T5 fluorescent.

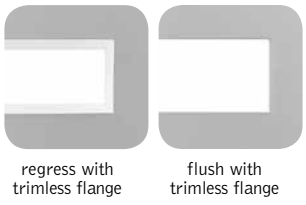
Continuous Flex Roll™ lens creates seamless appearance.

Designed for trim or trimless drywall applications.

Staggered lamp configurations help eliminate socket shadows and create an uninterrupted slot of light.

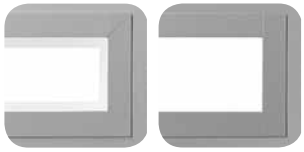
Shielding options include lens with regress or flush trim configurations.

shielding & mounting options



regress with trimless flange

flush with trimless flange



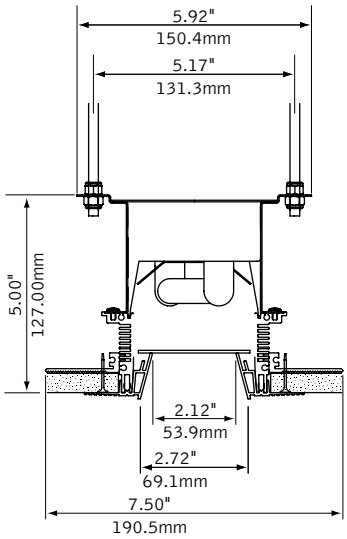
regress with trim flange

flush with trim flange

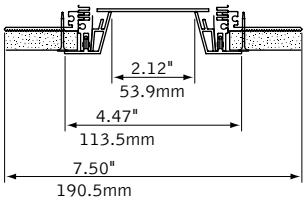
dimensional data

regress

with trimless flange

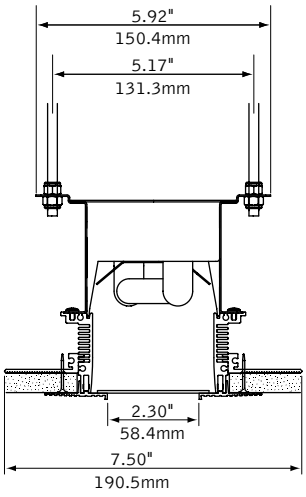


with trim flange

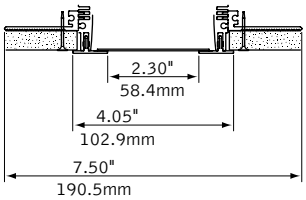


flush

with trimless flange

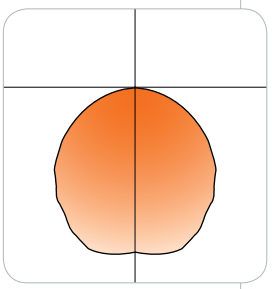


with trim flange



performance

1–Lamp T5HO
35% Efficiency
756 cd @ 10°



Visit focalpointlights.com for complete photometric data.

januaray 2011 B

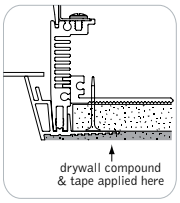
fixture:

project:

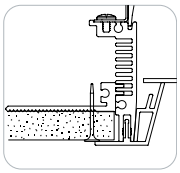
Type H

mounting information

trimless flange (XF)



trim flange (TF)



specifications

construction

One-piece 20 Ga. steel housing constructed with die–formed steel and aluminum extrusions.

Lower housing, backer flange and regress or flush trim constructed of 6063-T5 extruded aluminum.

4' unit weight: 30 lbs.

8' unit weight: 55 lbs.

optic

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

Continuous acrylic lens diffuser with satin frosted white finish.

Runs over 40' supplied with mulitple lenses.

electrical

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

Optional dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

finish

Exposed trims finished in Matte Satin White polyester powder coat applied over a 5-stage pre–treatment.

Reflector and socket bridges finished in High Reflectance White.

ordering

luminaire series		FIN3
Infinite 3	FIN3	
shielding		FL
Regress with Lens	SR	
Flush with Lens	FL	
lamping		1T5
One Lamp Staggered T5	1ST5	
One Lamp Staggered T5HO	1ST5HO	
circuits		1C
Single Circuit	1C	
voltage		1
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		277
Electronic Program Start <10% TDH	S	
Electronic Dimming Ballast* (Consult factory for dimming availability)	D	
mounting		S
Trim Drywall Flange	TF	
Trimless Drywall Flange	XF	
drywall ceiling thickness		T2
1/2" Ceiling	T1	
5/8" Ceiling	T2	
3/4" Ceiling	T3	
7/8" Ceiling	T4	
1" Ceiling	T5	
1 1/8" Ceiling	T6	
1 1/4" Ceiling	T7	
factory options		
Chicago Plenum	CP	
Emergency Circuit*	EC	
Emergency Battery Pack*	EM	
HLR/GLR Fuse	FU	
Include 3000K Lamp*	L830	
Include 3500K Lamp*	L835	
Include 4100K Lamp*	L841	
Lutron™ Sensor Feed* (EcoSystem ballast required)	SF	
finish		WH
Matte White Housing	WH	
luminaire length* (See Reference section for run length information.)		L830
integrator options (non-illuminated)		4'
90-degree Corner Solid Regress, Trimless	FIN3/ XF90-SR	
90-degree Corner Solid Regress, Trim Flange	FIN3/ TF90-SR	
90-degree Corner Flush Lens, Trimless	FIN3/ XF90-FL	
90-degree Corner Flush Lens, Trim Flange	FIN3/ TF90-FL	

NOTE: 3' & 4' lamps may appear to be different colors when combined in the same run. Consult lamp manufacturer for details.

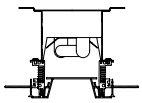
* for more information see Reference section.

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

Type H

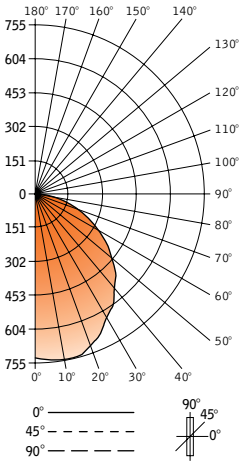
regress with trim flange

infinite™ 3



Filename: FIN3SR1ST5H.IES
Catalog #: FIN3-SR-1ST5HO-1C-120-S-TF-WH-4'
Efficiency: 35%
Test #: 13188.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	740	740	740	740	740	
5°	749	749	748	747	747	71
15°	754	750	746	740	733	211
25°	691	684	659	632	621	604
35°	610	599	545	510	496	347
45°	512	479	415	372	358	329
55°	388	343	276	232	216	259
65°	263	212	144	102	59	157
75°	135	59	47	41	41	69
85°	28	13	12	12	12	16
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 1.3
Criterion: 1.2

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	587	11.7	33.3
	0°-40°	934	18.7	52.9
	0°-60°	1522	30.4	86.3
	0°-90°	1764	35.3	100.0
Total Luminaire	0°-180°	1764	35.3	100.0

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	9274	7517	6484
55°	8664	6163	4823
65°	7970	4364	2697
75°	6680	2326	2029
85°	4115	1763	1763

CO–EFFICIENTS OF UTILIZATION

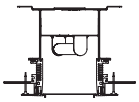
Floor	80				70			20	50		30		10		00
Ceiling	70	50	30	10	70	50	10	50	10	50	10	50	10	50	10	00
Wall																
RCR 0	42	42	42	42	41	41	41	39	39	38	38	36	36	35		
1	39	38	36	35	38	37	35	35	34	34	33	33	32	31		
2	36	34	32	30	35	33	30	32	29	31	28	30	28	27		
3	33	30	28	26	33	30	26	29	25	28	25	27	24	24		
4	31	27	24	22	30	27	22	26	22	25	22	24	21	21		
5	28	24	21	19	28	24	19	23	19	22	19	22	19	18		
6	26	22	19	17	26	22	17	21	17	20	17	20	16	16		
7	24	20	17	15	24	19	15	19	15	18	15	18	14	14		
8	22	18	15	13	22	18	13	17	13	17	13	16	13	12		
9	21	16	13	11	20	16	11	15	11	15	11	15	11	10		
10	19	15	12	10	19	14	10	14	10	14	10	13	10	09		

Numbers indicate percentage values of reflectivity.

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

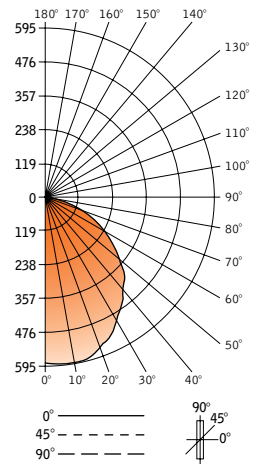
flush with trimless flange

infinite™ 3



Filename: FIN3FL1ST5H.IES
Catalog #: FIN3-FL-1ST5HO-1C-120-S-XF-WH-4'
Efficiency: 33%
Test #: 12971.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	586	586	586	586	586	
5°	589	588	588	589	589	56
15°	593	593	593	593	593	166
25°	538	538	538	538	537	249
35°	462	462	462	462	462	290
45°	389	389	389	388	389	301
55°	292	292	291	292	294	262
65°	196	197	197	196	196	195
75°	106	106	106	106	106	112
85°	26	26	27	27	28	29
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: 1.2

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	471	9.4	28.4
	0°-40°	761	15.2	45.8
	0°-60°	1324	26.5	79.7
	0°-90°	1661	33.2	100.0
Total Luminaire	0°-180°	1661	33.2	100.0

LUMINANCE DATA (CD/M²)

Vertical Angle	0°	45°	90°
45°	7418	7418	7418
55°	6865	6841	6912
65°	6254	6286	6254
75°	5523	5523	5523
85°	4023	4177	4332

CO–EFFICIENTS OF UTILIZATION

Floor	80				70			20	50		30		10		00
Ceiling	70	50	30	10	70	50	10	50	10	50	10	50	10	50	10	00
Wall																
RCR 0	40	40	40	40	39	39	39	37	37	35	35	34	34	33		
1	36	35	34	32	36	34	32	33	31	32	30	30	29	28		
2	33	31	29	27	33	30	27	29	26	28	25	27	25	24		
3	31	27	25	23	30	27	23	26	22	25	22	24	21	21		
4	28	24	22	19	27	24	19	23	19	22	19	22	19	18		
5	26	22	19	16	25	21	16	20	16	20	16	19	16	15		
6	24	19	16	14	23	19	14	18	14	18	14	17	14	13		
7	22	17	14	12	21	17	12	17	12	16	12	16	12	11		
8	20	16	13	11	20	15	11	15	11	14	11	14	11	10		
9	18	14	11	09	18	14	09	13	09	13	09	13	09	09		
10	17	13	10	08	17	13	08	12	08	12	08	12	08	08		

Numbers indicate percentage values of reflectivity.

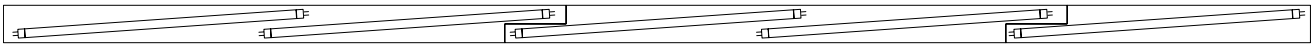
Go to www.focalpointlights.com for additional photometric data.

Type H

infinite 3 standard run length

Luminaires may be configured by specifying actual run lengths as shown.

Example: 17' - 9-11/16" run = two 8' and one 4'



8' start (nominal) | 8' intermediate (nominal) | 4' end (nominal)

run length actual	lamp configuration			run length actual	lamp configuration		
	all 3' lamps	all 4' lamps	3' & 4' lamps		all 3' lamps	all 4' lamps	3' & 4' lamps
2' - 11-1/4"	3			25' - 4-5/8"	6 6 6 6		
3' - 11-1/16"		4		26' - 3-7/16"			8 8 8 6
5' - 4-3/4"	6			27' - 10-5/8"	6 6 6 6 6 3		
6' - 4-9/16"			4 3	28' - 3"		8 8 8 8	
7' - 4-3/8"		8		28' - 10-7/16"			6 6 6 6 6 4
7' - 10-3/4"	6 3			30' - 4-5/8"	6 6 6 6 6 6		
8' - 10-9/16"			6 4	30' - 9"			8 8 8 8 3
9' - 10-5/16"			8 3	31' - 8-3/4"		8 8 8 8 4	
10' - 4-3/4"	6 6			32' - 10-9/16"	6 6 6 6 6 6 3		
10' - 10-1/8"		8 4		33' - 2-15/16"			8 8 8 8 6
12' - 4-5/16"			8 6	33' - 10-3/8"			6 6 6 6 6 6 4
12' - 10-11/16"	6 6 3			35' - 2-9/16"		8 8 8 8 8	
13' - 10-1/2"			6 6 4	35' - 4-9/16"	6 6 6 6 6 6 6		
14' - 3-7/8"		8 8		37' - 8-1/2"			8 8 8 8 8 3
14'- 10-5/16"			8 6 3	37'- 10-9/16"	6 6 6 6 6 6 6 3		
15' - 4-11/16"	6 6 6			38' - 8-5/16"		8 8 8 8 8 4	
15' - 10-1/8"			8 6 4	38' - 10-3/8"			6 6 6 6 6 6 6 4
16' - 9-7/8"			8 8 3	40' - 2-1/2"			8 8 8 8 8 6
17' - 4-1/4"			8 6 6	40' - 4-9/16"	6 6 6 6 6 6 6 6		
17' - 9-11/16"		8 8 4		42' - 2-1/8"		8 8 8 8 8 8	
17' - 10-11/16"	6 6 6 3			42' - 10-1/2"	6 6 6 6 6 6 6 3		
18' - 10-1/2"			6 6 6 4	44' - 8-1/16"			8 8 8 8 8 8 8 3
19' - 3-7/8"			8 8 6	45' - 4-1/2"	6 6 6 6 6 6 6 6 6		
20' - 4-11/16"	6 6 6 6			45' - 7-7/8"		8 8 8 8 8 8 4	
21' - 3-7/16"		8 8 8		47' - 2-1/16"			8 8 8 8 8 8 6
22' - 10-5/8"	6 6 6 6 3			47' - 10-1/2"	6 6 6 6 6 6 6 6 3		
23' - 9-7/16"			8 8 8 3	48' - 10-5/16"			6 6 6 6 6 6 6 6 4
23' - 10-7/16"			6 6 6 6 4	49' - 1-5/8"		8 8 8 8 8 8 8 8	
24' - 9-1/4"		8 8 8 4					

3' & 4' lamps may appear to be different colors when combined in the same run. Consult lamp manufacturer for details.

SPECIFICATION SHEET

lumentube®

PENDANT

Client: _____

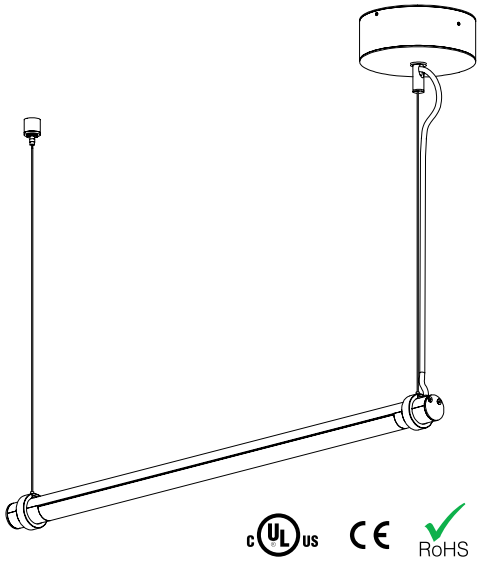
Project name: _____

Order #: _____

Type: _____ Qty: _____

Type I

FEATURES AND BENEFITS



Physical :

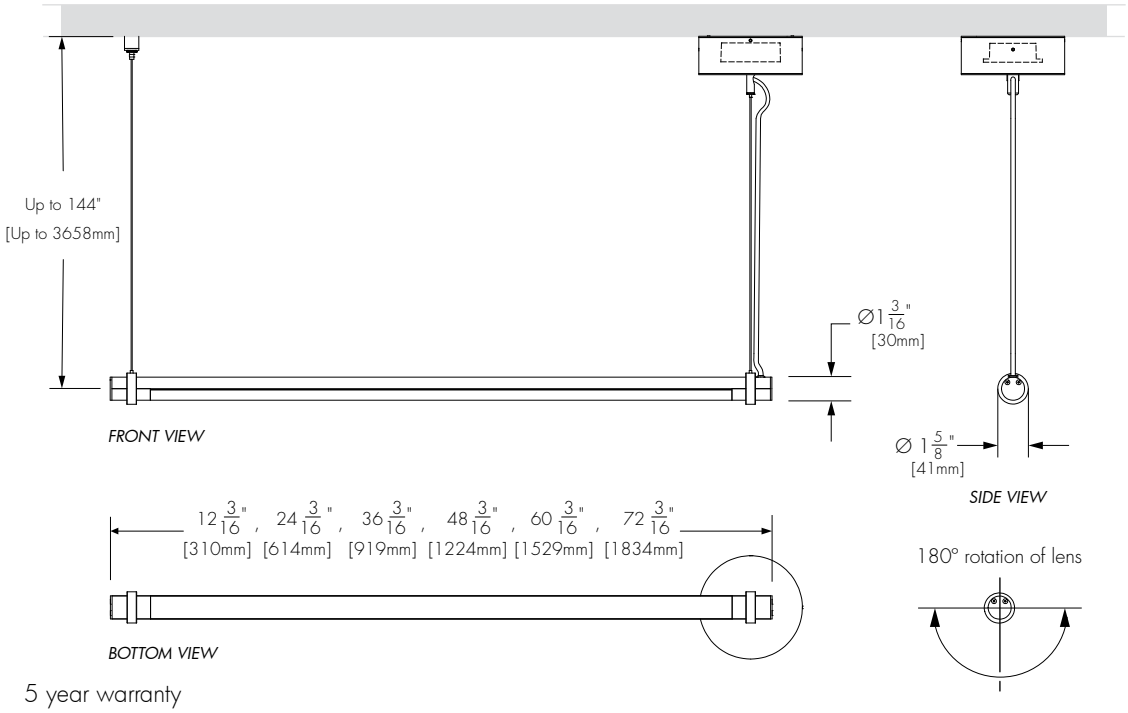
- Low copper content extruded aluminum housing
- Available in 1', 2', 3', 4', 5' or 6' sections
- Electro-statically applied polyester powder coat finish
- Clear or frosted lens
- Flat canopy version available with remote power supply

Performance :

- 284 delivered lumens per foot (4000K unit, clear lens)
- Lumen maintenance L70 @ 25°C - 80,000 hrs
- Lumen measurements comply with LM - 79 - 08 standard
- Operating temperatures: -25°C to 50°C

Electrical :

- 24V luminaire available with 100 to 277V power supply (not included)
- 5 watts per foot
- 0-10 volt dimming power supply available, see accessories on page 5
- 12ft power cable



5 year warranty

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

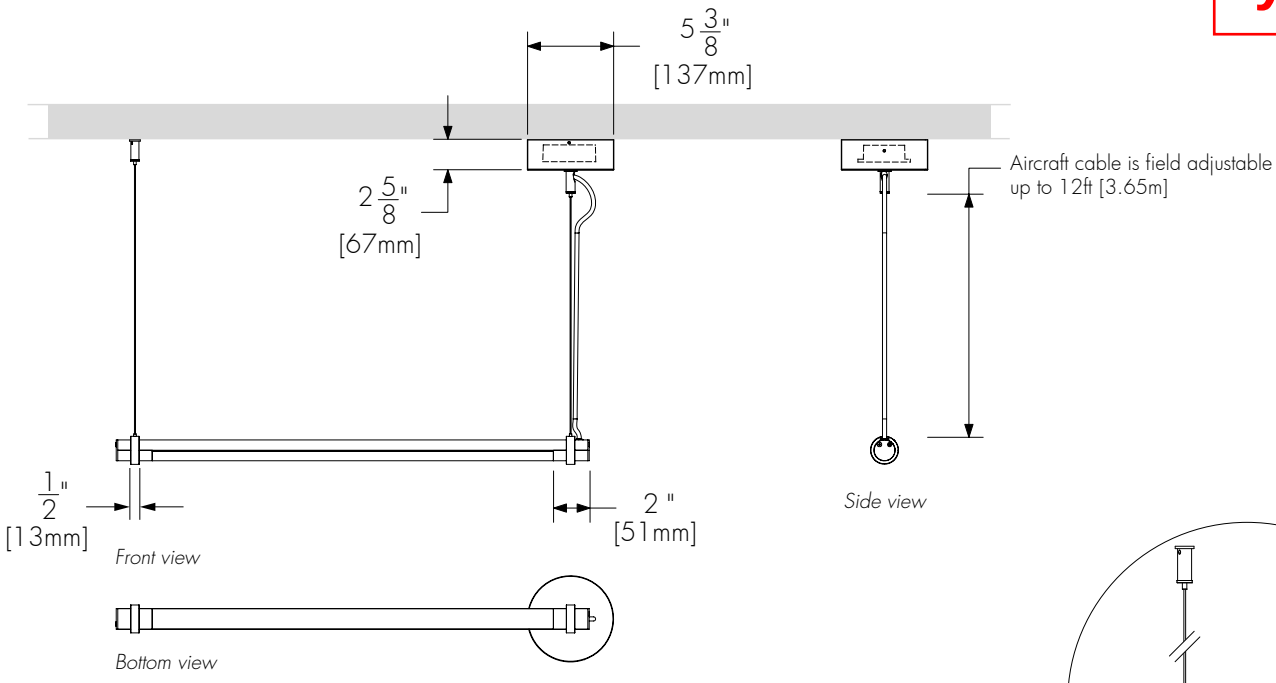
lumenpulse™

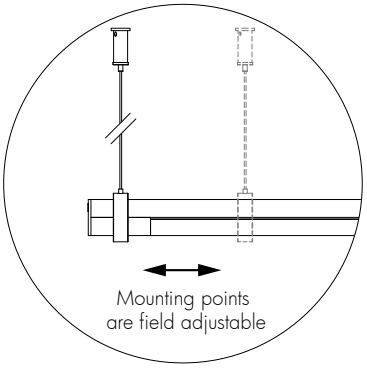
Sustainable architectural LED lighting systems

STANDARD CANOPY

(Standard unless otherwise specified)

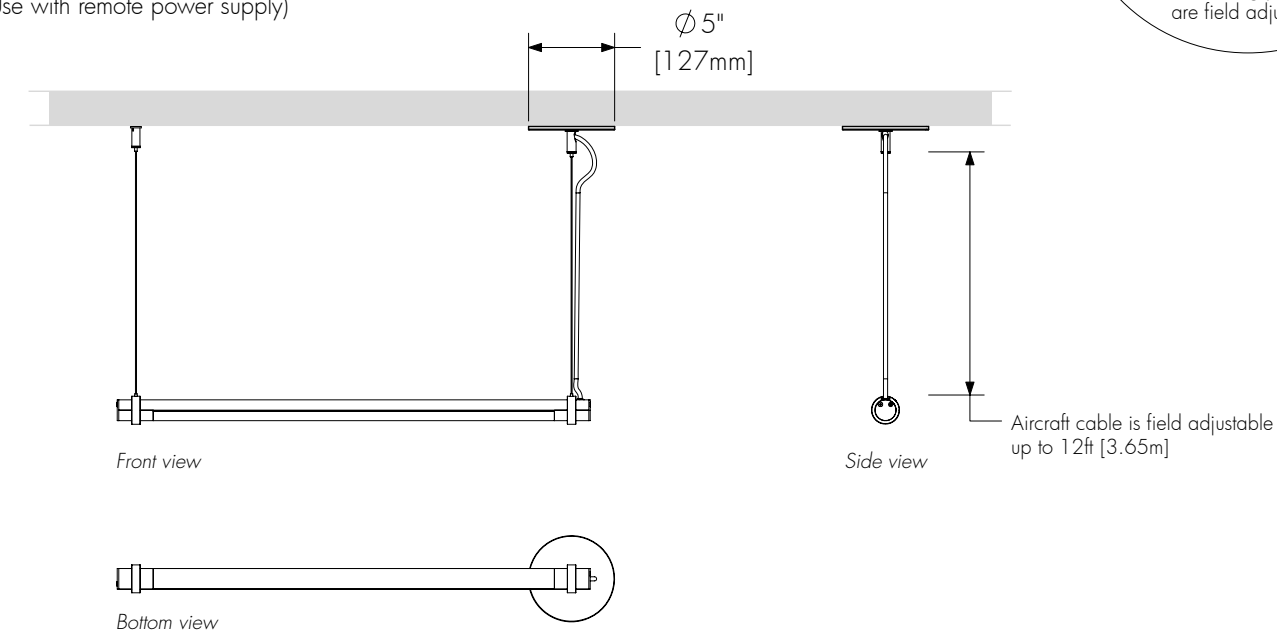
Type I





FLAT CANOPY OPTION

(Use with remote power supply)



Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

lumenpulse™

Sustainable architectural LED lighting systems

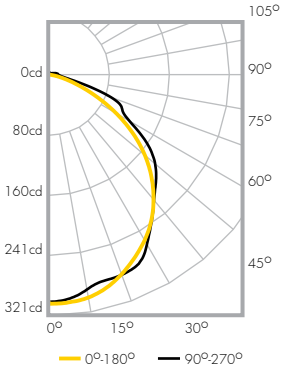
PHOTOMETRICS

Type I

Lumentube® 4' 2700K clear lens

Lamping	21.1 W
Lumens	885
Efficacy	42 lm/W

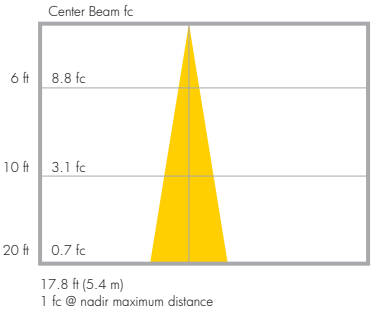
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	318	318	318	318	318
5	319	319	317	314	312
15	306	306	300	302	302
25	284	282	283	278	277
35	246	252	249	252	248
45	202	209	209	215	209
55	145	155	158	165	163
65	78	98	103	102	96
75	28	47	49	44	33
85	3	17	19	15	14
90	0	10	13	13	13
95	0	6	10	11	12
105	0	2	6	8	9
115	0	1	3	3	3
125	0	0	1	1	1
135	0	0	0	1	1
145	0	0	0	0	0

Illuminance at Distance

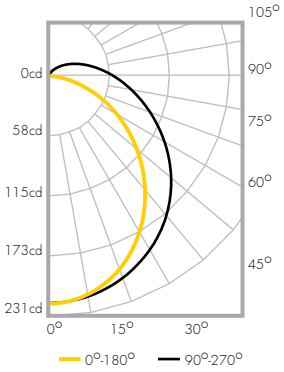


17.8 ft (5.4 m)
1 fc @ nadir maximum distance

Lumentube® 4' 2700K frosted lens

Lamping	21 W
Lumens	781
Efficacy	37 lm/W

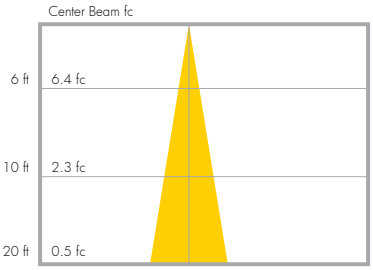
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	230	230	230	231	231
5	229	230	228	227	227
15	216	219	219	220	220
25	194	198	201	205	205
35	197	203	210	221	223
45	129	138	148	161	163
55	94	103	117	134	136
65	58	72	88	106	109
75	28	45	64	81	84
85	5	24	46	60	63
90	0	17	38	51	55
95	0	11	31	42	48
105	0	6	21	30	35
115	0	3	13	20	23
125	0	1	7	13	15
135	0	1	4	7	10
145	0	0	2	3	5
155	0	0	1	1	2
165	0	0	0	0	1

Illuminance at Distance

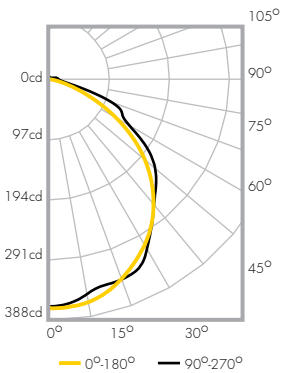


15.1 ft (4.6 m)
1 fc @ nadir maximum distance

Lumentube® 4' 3000K clear lens

Lamping	21 W
Lumens	1068
Efficacy	50 lm/W

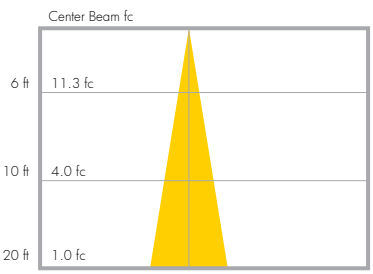
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	387	387	387	387	387
5	386	386	382	377	374
15	372	367	357	357	358
25	344	335	338	334	332
35	298	297	299	302	299
45	244	249	253	258	250
55	174	185	190	194	193
65	94	118	124	125	118
75	34	57	64	55	41
85	4	23	26	21	19
90	0	14	18	18	18
95	0	8	15	16	17
105	0	3	9	12	13
115	0	1	5	6	7
125	0	0	3	3	4
135	0	0	1	2	2
145	0	0	0	1	1

Illuminance at Distance



20.1 ft (6.1 m)
1 fc @ nadir maximum distance

Photometric data based on test results from an independent NIST traceable testing lab.IES data is available at **www.lumenpulse.com/en/support.**
Always refer to our website download section for the latest updates of our IES files.

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

lumenpulse™
Sustainable architectural LED lighting systems

SPECIFICATION SHEET

lumentube®

PENDANT

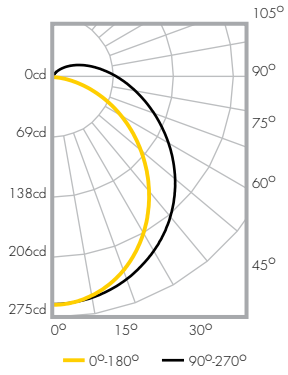
Type I

PHOTOMETRICS

Lumentube® 4'
3000K
frosted lens

Lamping	21 W
Lumens	933
Efficacy	44 lm/W

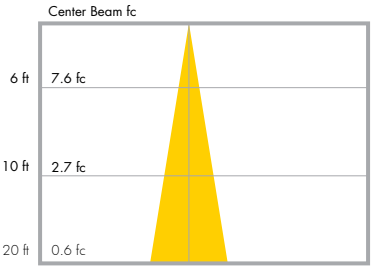
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	274	274	274	274	274
5	274	274	273	271	271
15	259	261	262	262	262
25	233	236	240	244	246
35	197	203	210	221	223
45	156	163	177	191	196
55	113	123	141	159	164
65	72	86	107	127	131
75	35	54	78	98	103
85	7	30	55	73	78
90	0	22	46	63	67
95	0	15	38	52	58
105	0	7	25	37	42
115	0	4	15	25	29
125	0	2	9	16	19
135	0	1	5	10	12
145	0	0	3	5	6
155	0	0	1	2	3
165	0	0	0	0	1

Illuminance at Distance

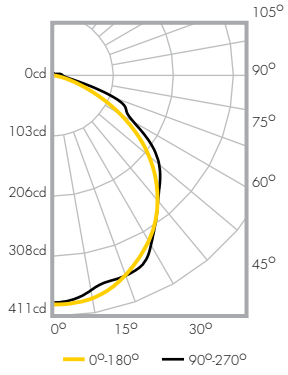


16.5 ft (5.0 m)
1 fc @ nadir maximum distance

Lumentube® 4'
4000K
clear lens

Lamping	21.1 W
Lumens	1134
Efficacy	53 lm/W

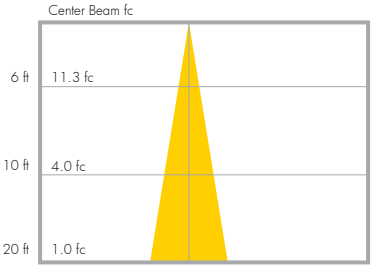
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	408	408	408	408	408
5	409	410	407	403	400
15	393	393	385	388	388
25	364	362	363	357	355
35	316	323	320	323	319
45	259	268	269	276	269
55	187	199	203	212	210
65	101	126	133	131	124
75	36	61	64	57	43
85	4	23	25	20	18
90	0	14	17	17	17
95	0	8	14	15	16
105	0	3	8	11	12
115	0	1	4	5	5
125	0	0	1	2	2
135	0	0	0	1	1
145	0	0	0	0	0

Illuminance at Distance

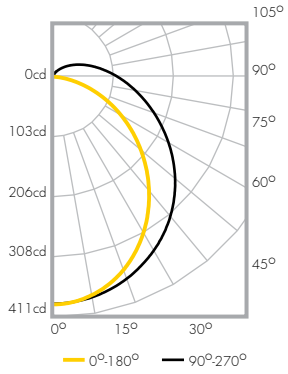


20.1 ft (6.1 m)
1 fc @ nadir maximum distance

Lumentube® 4'
4000K
frosted lens

Lamping	21 W
Lumens	1001
Efficacy	47 lm/W

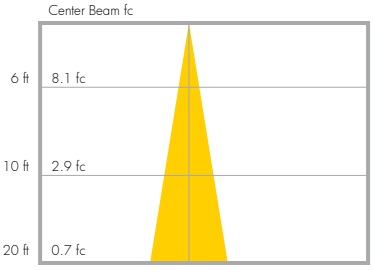
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	295	295	295	295	295
5	294	295	293	291	291
15	278	281	281	282	282
25	249	254	258	264	264
35	210	219	226	239	240
45	166	177	190	207	210
55	121	133	151	172	175
65	75	93	114	137	140
75	36	58	83	105	108
85	7	32	59	78	82
90	0	23	49	66	71
95	0	15	41	55	62
105	0	8	27	39	45
115	0	4	17	26	30
125	0	2	10	17	20
135	0	1	6	10	13
145	0	0	3	5	7
155	0	0	1	2	3
165	0	0	0	0	1

Illuminance at Distance



17.1 ft (5.2 m)
1 fc @ nadir maximum distance

Photometric data based on test results from an independent NIST traceable testing lab.IES data is available at **www.lumenpulse.com/en/support.**
Always refer to our website download section for the latest updates of our IES files.

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

lumenpulse™
Sustainable architectural LED lighting systems

Type I

ACCESSORIES

Order separately

Remote Power Supply Suitable for Standard Canopy:

PS24V25 Remote class 2 power supply 25W (120-277V to 24V DC)

PS24V40 Remote class 2 power supply 40W (120-277V to 24V DC)

Remote Power Supply Without Housing:

This product must be installed in accordance with applicable national and local electrical and construction codes by a person familiar with the construction and operation of the product and the hazards involved.

PS24V25 Remote power supply 25W (120-277V to 24V DC)

PS24V60 Remote power supply 60W (120-277V to 24V DC)

PS24V60D Remote power supply 60W c/w dimming module (120-277V to 24V DC)

PS24V100 Remote power supply 100W (120-277V to 24V DC)

PS24V100D Remote power supply 100W c/w dimming module (120-277V to 24V DC)

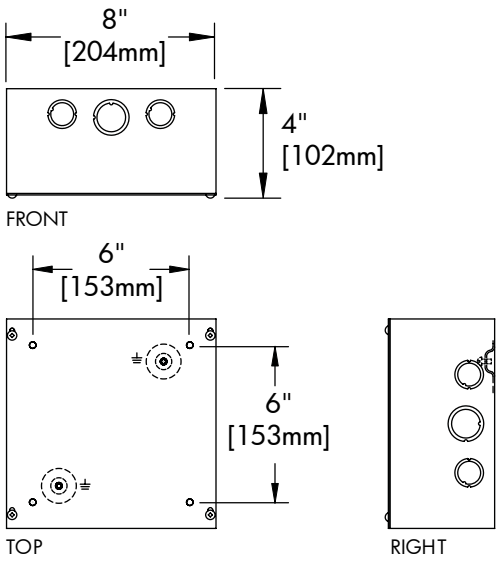
Remote Power Supply With Housing:

iPSBOX60 Interior remote power supply 60W with housing (120-277V to 24V DC)

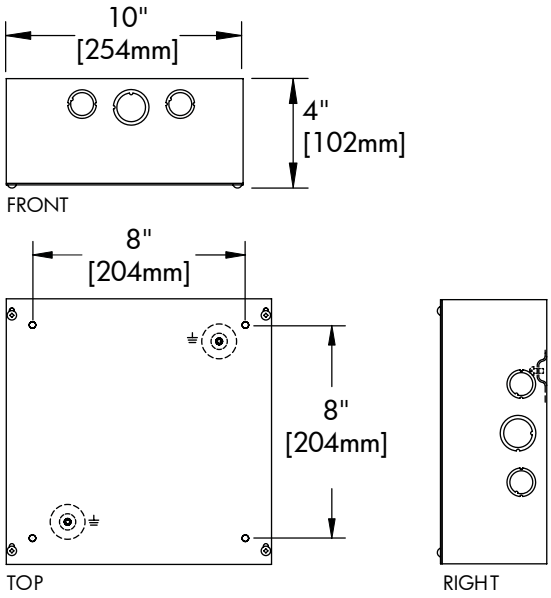
iPSBOX60D Interior remote dimming power supply 60W with housing (120-277V to 24V DC)

iPSBOX100 Interior remote power supply 100W with housing (120-277V to 24V DC)

iPSBOX100D Interior remote dimming power supply 100W with housing (120-277V to 24V DC)



iPSBOX60W DIMENSIONS



iPSBOX100W DIMENSIONS

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

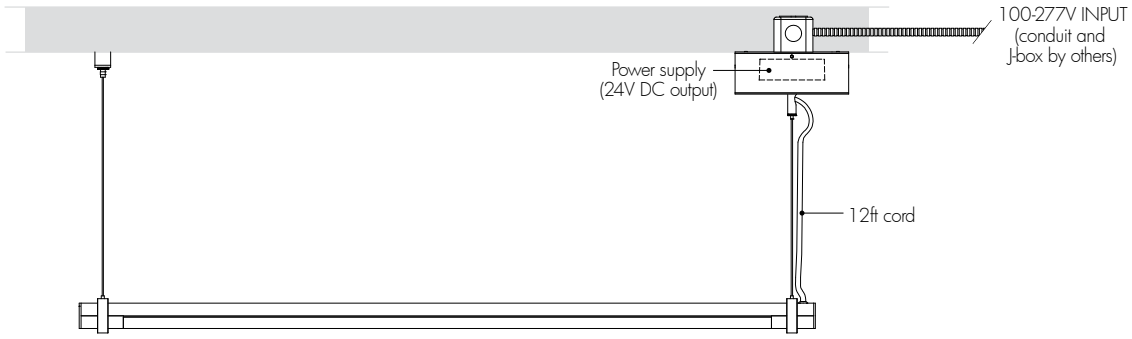
lumenpulse™

Sustainable architectural LED lighting systems

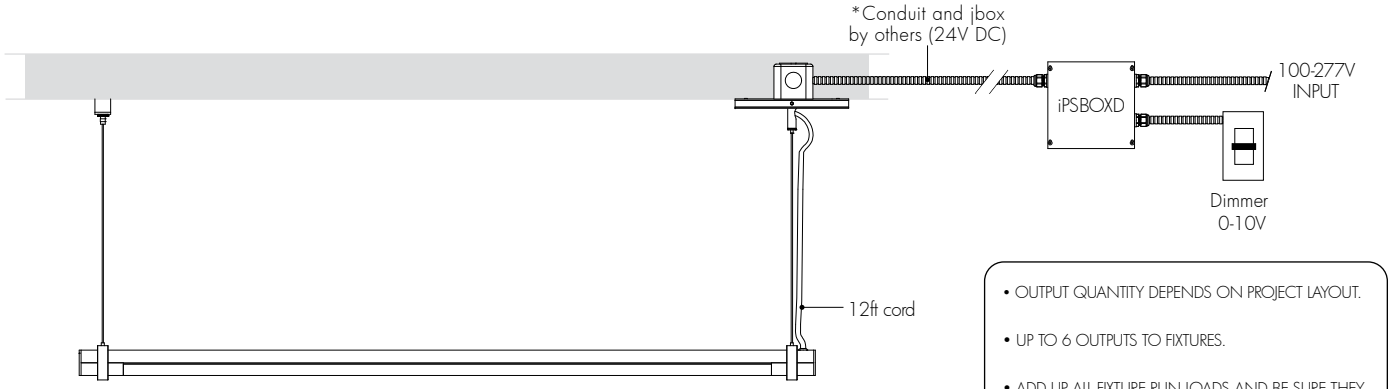
TYPICAL WIRING DIAGRAMS

Type I

Non-Dimming Version, power supply in canopy

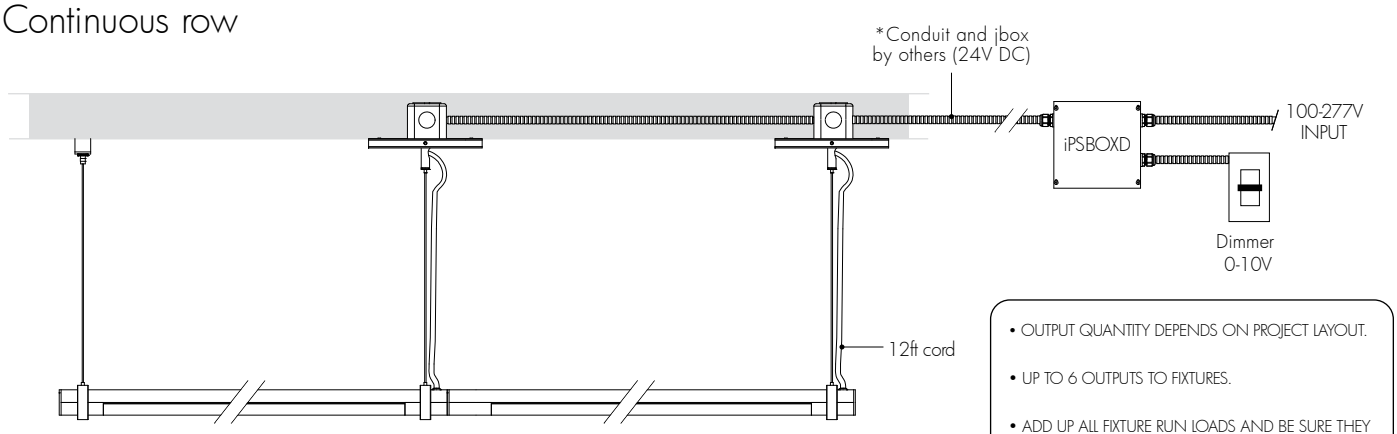


Dimming Version (0-10V), remote dimming power supply box



- OUTPUT QUANTITY DEPENDS ON PROJECT LAYOUT.
- UP TO 6 OUTPUTS TO FIXTURES.
- ADD UP ALL FIXTURE RUN LOADS AND BE SURE THEY DO NOT EXCEED THE CAPACITY OF THE iPSBOX .

Dimming Version (0-10V), remote dimming power supply box
Continuous row



- OUTPUT QUANTITY DEPENDS ON PROJECT LAYOUT.
- UP TO 6 OUTPUTS TO FIXTURES.
- ADD UP ALL FIXTURE RUN LOADS AND BE SURE THEY DO NOT EXCEED THE CAPACITY OF THE iPSBOX .

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

lumenpulse™
Sustainable architectural LED lighting systems

SPECIFICATION SHEET

lumentube®

PENDANT

Type I

HOW TO ORDER

LTP	24V	36	30K	FR	MS	FC
Housing	Voltage	Length	Colors and color temperatures	Lens	Finish	Option
1	2	3	4	5	6	7

1

Housing:

LTP - Lumentube® pendant fixture

2

Voltage:

*24V DC fixture. Refer to Lumentube pendant accessories on page 5 for remote power supply options.

3

Length:

12 - 12 3/16 inches (310mm) (0.25 kg / 0.56 lbs)

24 - 24 3/16 inches (614mm) (0.38 kg / 0.75 lbs)

36 - 36 3/16 inches (919mm) (0.57 kg / 1.25 lbs)

48 - 48 3/16 inches (1224mm) (0.76 kg / 1.67 lbs)

60 - 60 3/16 inches (1529mm) (0.95 kg / 2.09 lbs)

72 - 72 3/16 inches (1834mm) (1.14 kg / 2.51 lbs)

C__ - Continuous run, specify in 12" increments

4

Colors and Color temperatures:

27K - 2700K

30K - 3000K

40K - 4000K

5

Lens:

CL - Clear lens

FR - Frosted lens

6

Finish:

WH - White

BK - Black

MS - Metallic Silver

CC - Custom (please specify RAL color)

7

Option:

FC - Flat Canopy (refer to page 2 for details)

DIMMING OPTION

Dimming must be specified in remote Power Supply Box order code, see page 5.

Lumenpulse, 1751 Richardson, Suite 1505, Montreal (Quebec) Canada H3K 1G6 1.877.937.3003 P. 514.937.3003 F. 514.937.6289
info@lumenpulse.com **www.lumenpulse.com**

2014.04.01
AJ - R15

lumenpulse™

Sustainable architectural LED lighting systems

Type J

FOCAL POINT®

mini-grazer™

features

High performance, T5 or T5HO Fluorescent Wall Grazer.

Nautilus optic designed to highlight textured walls and ceilings evenly from ceiling to floor.

Swing down lamp tray allows for easy lamp accessibility.

Housing creates 6" architectural slot.

Great energy solution that replaces multiple MR16 or PAR lamps commonly used for grazing applications.

Housing designed for drywall or grid ceilings.

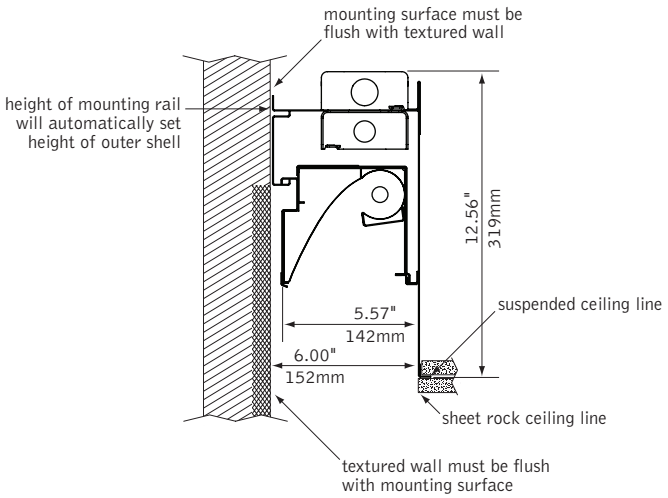
shielding options

open optic

baffle

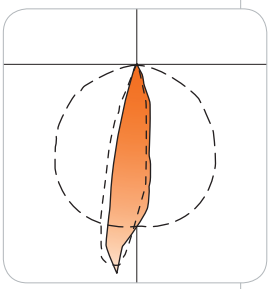
april 2009 A

dimensional data



performance

1-lamp T5HO
37% Efficiency
3734 cd @ 5°



Visit focalpointlights.com for complete photometric data.

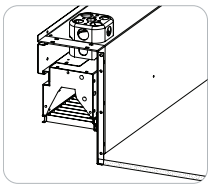
fixture:

project:

Type J

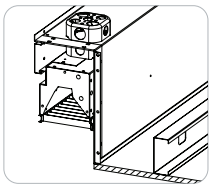
mounting information

Grid



Acoustical tile may rest on flange of luminaire.

Drywall

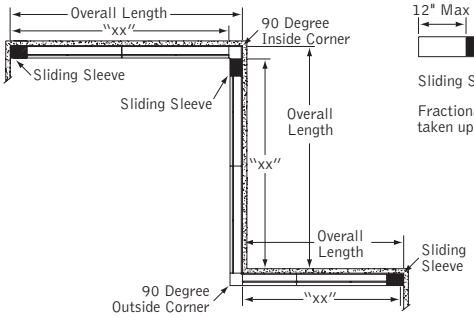


Mount drywall under luminaire and support to ceiling structure.

NOTE: Add drywall thickness to overall height of luminaire.

NOTE: Luminaire must be installed prior to ceiling.

typical run layout



Luminaires must be installed prior to ceiling.

Start run from corner with any standard luminaire.
Corner to corner runs end with a sliding sleeve.

sliding sleeves

Fractional Dimensions up to 12" are taken up by the use of a sliding sleeve.

specifications

construction

20 Ga. steel housing.
20 Ga. internal bulkheads.
20 Ga. steel rough–in housings are provided to create wall to wall slot.
20 Ga. steel sliding sleeve.
Optional baffle (.650"H x .800" frequency) provides 50° cutoff to lamp and held captive with torsion springs.
Luminaires are available in 3' and 4' lengths.

3' unit weight: 24 lbs
4' unit weight: 26 lbs

optic

CNC roll-formed specular .016" thick aluminum.

electrical

Electronic ballasts are thermally protected and have a Class "P" rating.
Consult factory for dimming specifications and availability.
UL and cUL listed.

finish

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

ordering

luminaire series		FMG
Mini-Grazer	FMG	
shielding		FL
No Shielding, Open Optic	NS	
Baffle, White	BB	
lamping		1T5
One Lamp T5	1T5	
One Lamp T5HO	1T5HO	
circuits		1C
Single Circuit	1C	
voltage		1
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		277
Electronic Dimming Ballast*	D	
Electronic Program Start <10% THD	S	
factory options		
Air Return	AR	S
Chicago Plenum	CP	T2
Emergency Circuit*	EC	
Emergency Battery Pack*	EM	
HLR/GLR Fuse	FU	
Include 3000K Lamp	L830	
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
12" Sliding Sleeve	SS	
finish		WH
Matte White Housing	WH	
luminaire length		
Designate overall run length dimension (light modules provided in 3' & 4' lengths)	XX'	
corner options		L830
90–degree Inside Corner	FMG-IC90	
90–degree Outside Corner	FMG-OC90	

NOTE: Not intended for drywall surfaces unless a Level 5 finish is specified.

* 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.

mini-grazer™

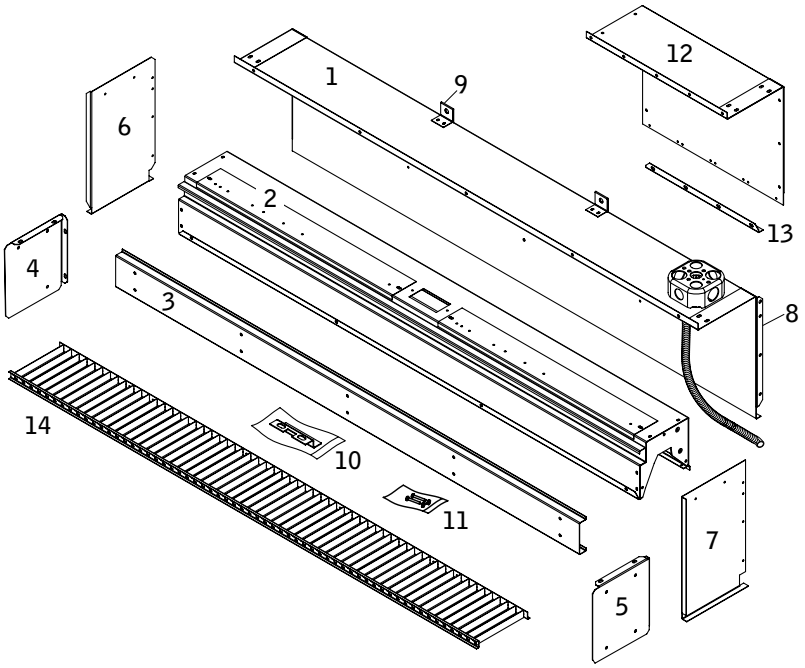
FMG

Type J

FOCAL POINT

⚠ ROUGH-IN SHELL MUST BE INSTALLED PRIOR TO CEILING ⚠

FOCAL POINT PARTS



KEY

ATTENTION

GLOVES REQUIRED

POWER OFF

POWER ON

PARTS LIST

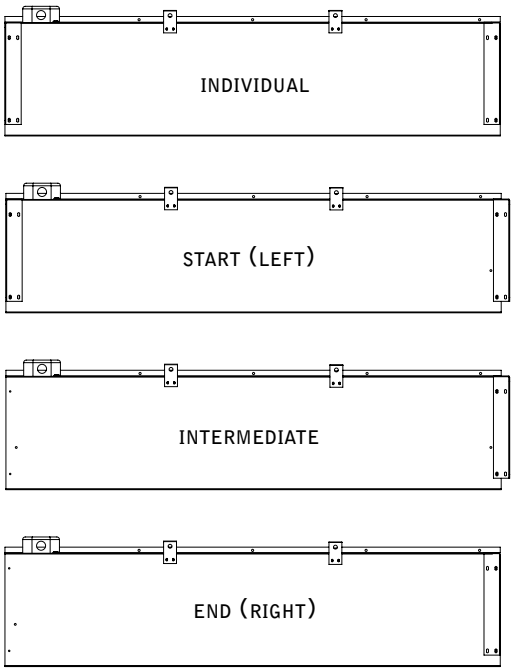
1 ROUGH-IN SHELL
2 LIGHT MODULE
3 WALL RAIL
4 FINISH END, RIGHT
5 FINISH END, LEFT
6 FLANGE END, RIGHT
7 FLANGE END, LEFT
8 JOINER BRACKET
9 MOUNTING BRACKET
10 LOCKING BRACKET (SHIPPED ATTACHED TO END OF LIGHT MODULE)
11 HARDWARE BAG

OPTIONAL

12 SLIDING SLEEVE
13 FINISH FLANGE
14 LOUVER

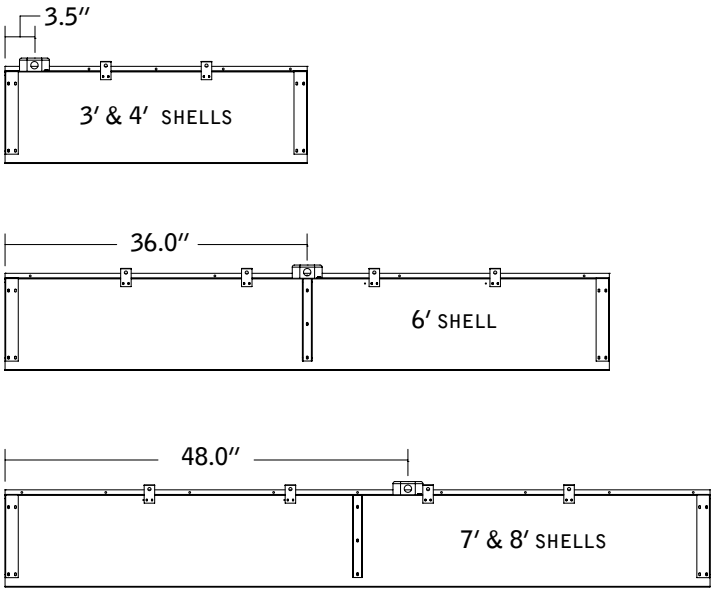
ROUGH-IN SHELL TYPES (4′ SHOWN)

(JOINER BRACKET LOCATION DETERMINES SHELL TYPE)



J-BOX LOCATIONS

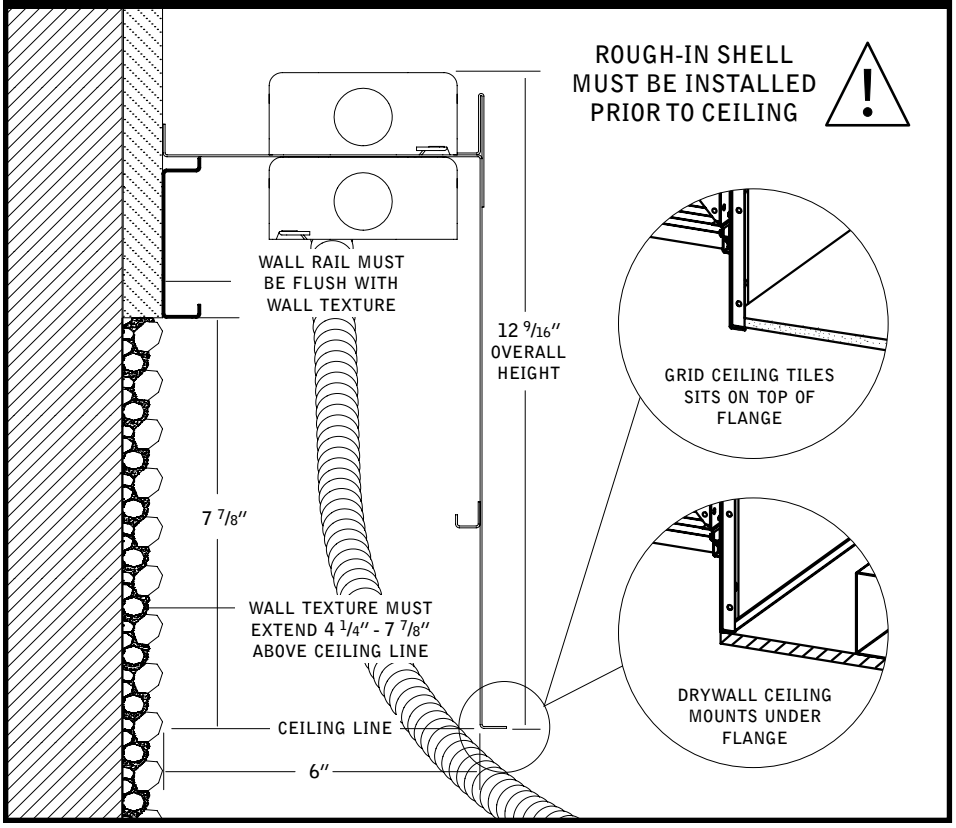
(ALL SHELLS COMES WITH J-BOX INSTALLED)



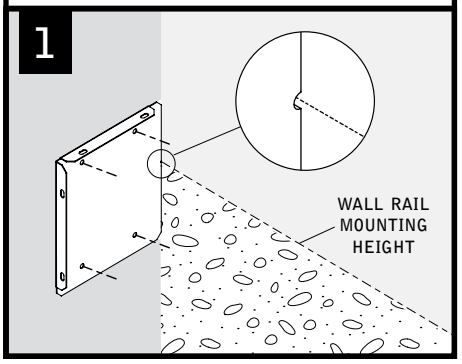
Luminaires must be installed by a qualified electrician (check with local and national codes for proper installation).
To prevent electrical shock, disconnect electrical supply before installation or servicing.

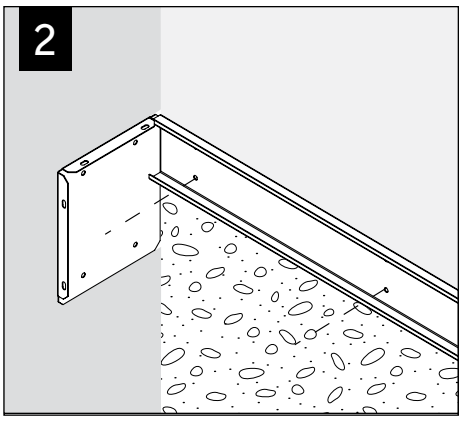
Type J

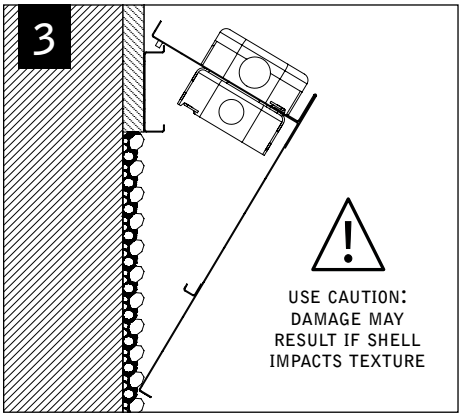
WALL/CEILING PREP

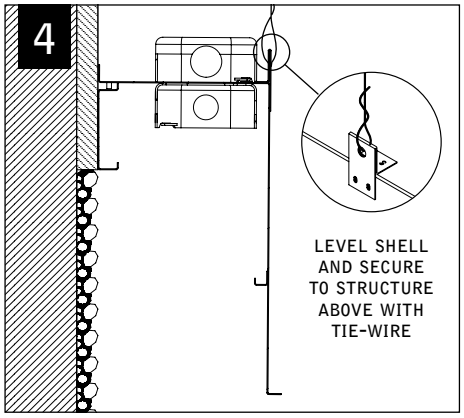


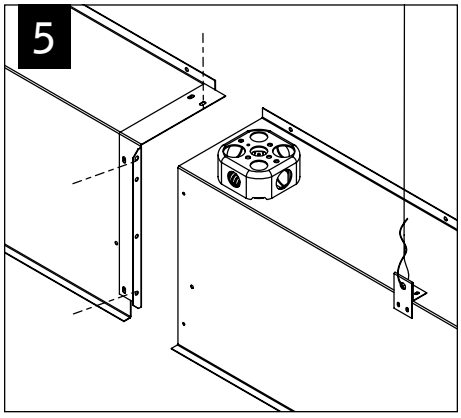
ENDS TERMINATING AT WALL





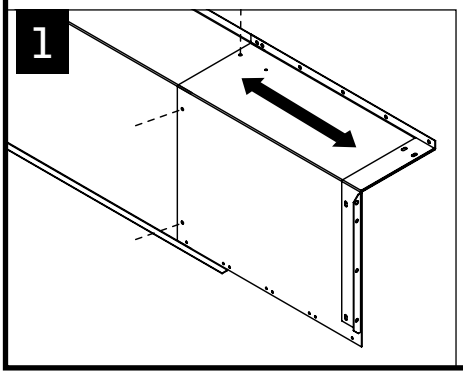


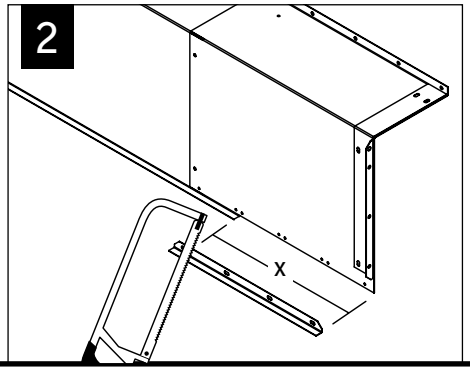


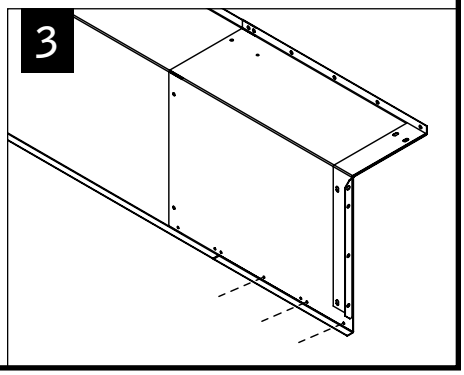


REPEAT STEPS 3 - 5 FOR ALL INTERMEDIATE SHELLS

SLIDING SLEEVE - OPTIONAL



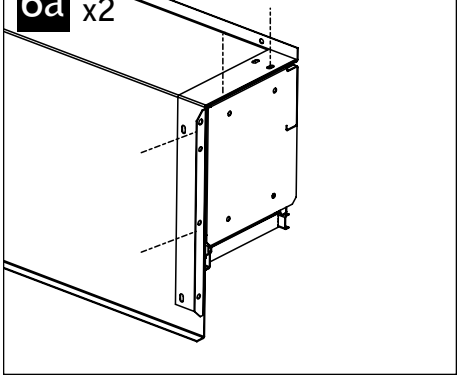




Luminaires must be installed by a qualified electrician (check with local and national codes for proper installation).
To prevent electrical shock, disconnect electrical supply before installation or servicing.

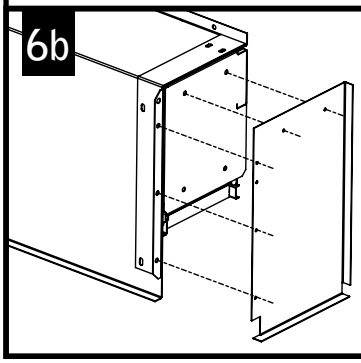
Type J

6a x2

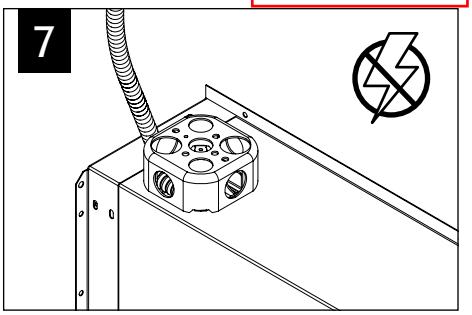


ENDS TERMINATING PRIOR TO WALL

6b



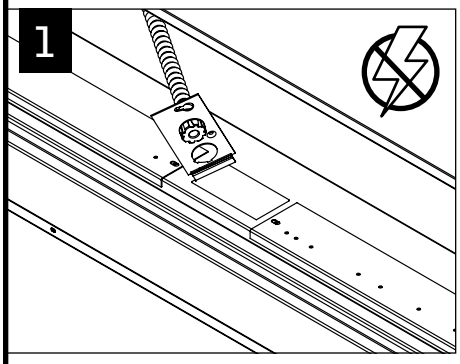
7



MAKE ELECTRICAL CONNECTIONS BEFORE INSTALLING DRYWALL CEILING

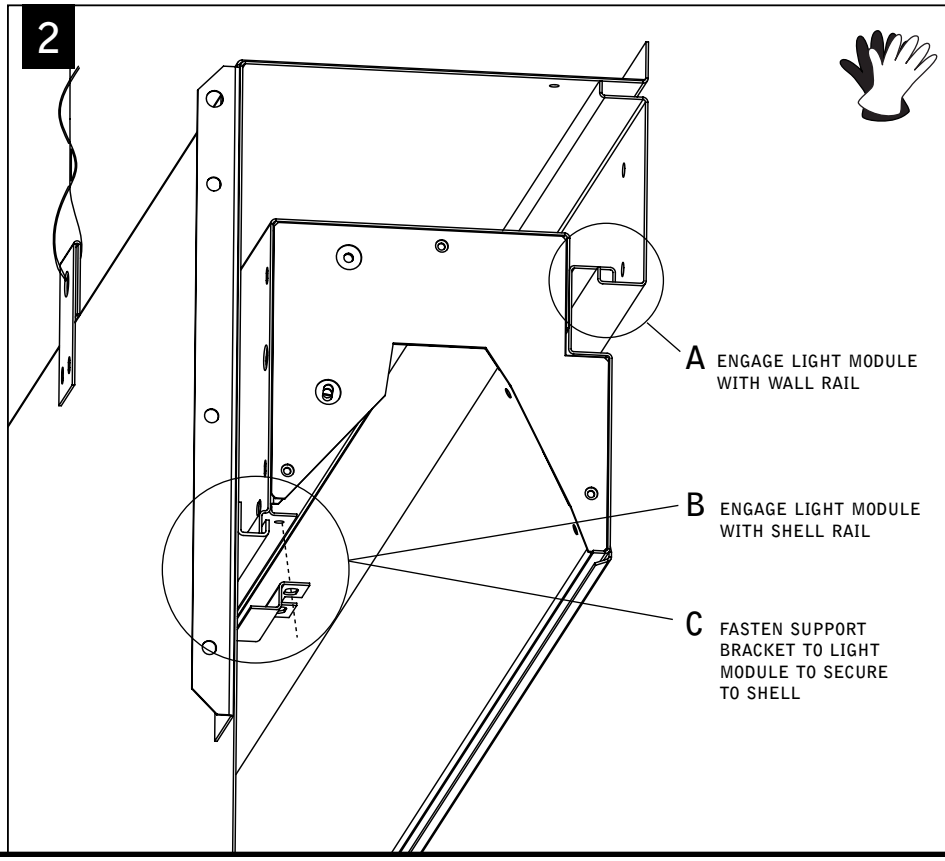
LIGHT MODULE INSTALLATION

1



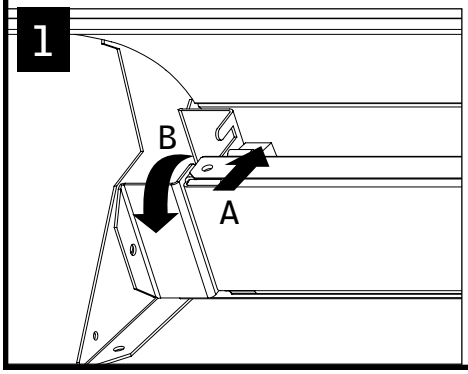
MAKE ELECTRICAL CONNECTIONS

2

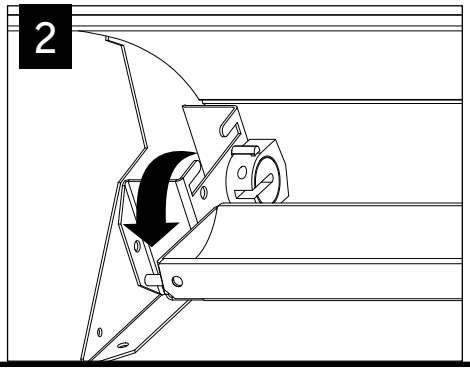


LAMPING

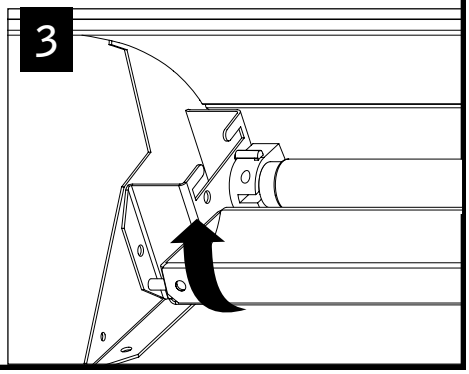
1



2



3

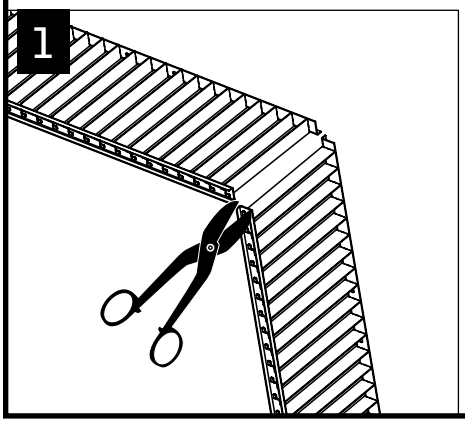


Luminaires must be installed by a qualified electrician (check with local and national codes for proper installation).
To prevent electrical shock, disconnect electrical supply before installation or servicing.

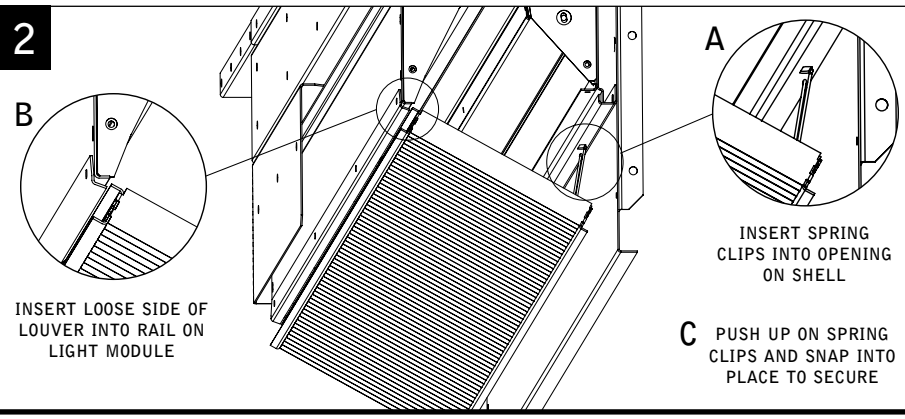
Type J

LOUVER (OPTIONAL) 4

1



2



BALLAST SERVICE 4

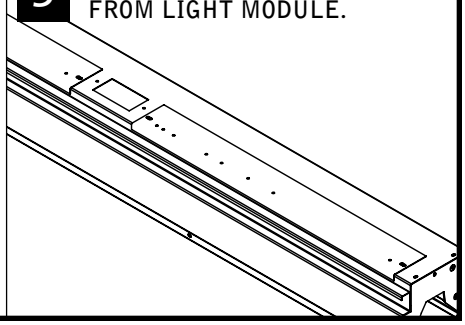
1 PULL DOWN ON SHELL SIDE OF LOUVER TO DISENGAGE.

2 RELEASE SPRING CLIPS AND REMOVE LOUVER.

3 REMOVE SUPPORT BRACKETS TO RELEASE MODULE FROM SHELL.

4 REMOVE LIGHT MODULE FROM SHELL AND DISCONNECT ELECTRICAL.

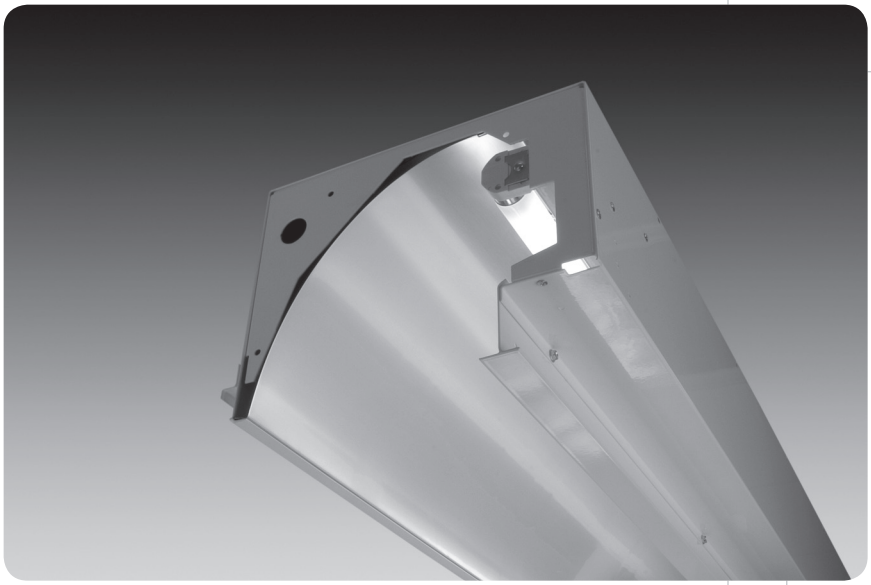
5 REMOVE BALLAST COVER(S) FROM LIGHT MODULE.



Type K

FOCAL POINT®

focus™ 3



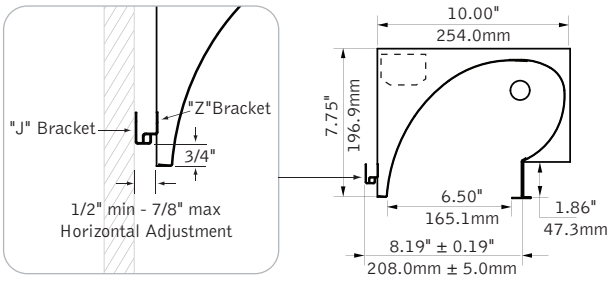
features

High performance perimeter open wall washing system.

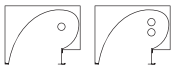
Luminaire alignment is maintained with continuous angle and splice brackets.

Focus™ 3 offers excellent vertical illumination without shielding.

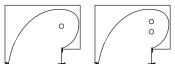
dimensional data



lamping options



T8 LAMPS

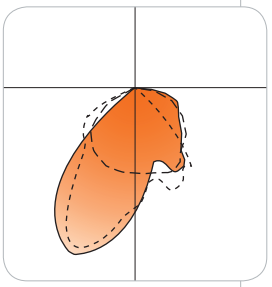


T5/T5HO LAMPS

performance

1–Lamp T8
81% Efficiency
1437cd @ 15°

everGreen™



Visit focalpointlights.com for complete photometric data.

january 2014 E

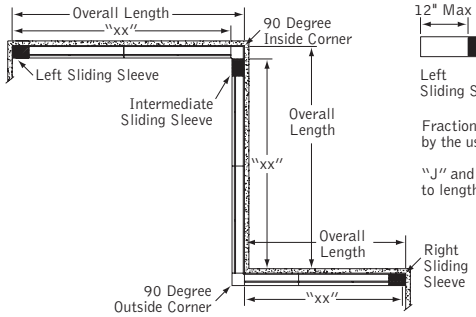
Type K

fixture:

project:

details

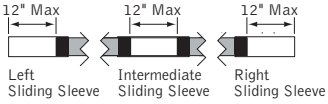
typical run layout



Luminaires must be installed prior to ceiling.

Start run from corner with any standard luminaire.
Corner to corner runs end with an intermediate sleeve.

sliding sleeves



Fractional Dimensions up to 12" are taken up by the use of a sliding sleeve.

"J" and "Z" angle brackets must be cut to length in field.

specifications

construction

20 Ga. steel housing.

20 Ga. steel T-rail mates with ceiling.

18 Ga. internal bulkheads join luminaires.

18 Ga. galvanized steel splice brackets are provided to ensure precise luminaire alignment.

20 Ga. steel continuous wall angles are provided to ensure horizontal alignment at wall.

Luminaires are available up to 8' nominal lengths.

4' unit weight: 36 lbs
8' unit weight: 49 lbs

optic

CNC roll-formed semi-specular .024" aluminum front reflector with specular .024" aluminum back reflector.

electrical

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

Optional dimming ballasts available.

Consult factory for dimming specifications and availability.

UL and cUL listed.

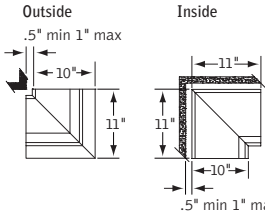
finish

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

Standard luminaire housing finished in Matte Satin White.

ordering

luminaire series		FW3
Focus 3	FW3	
shielding		NS
No Shielding, Open Optic	NS	
lamping		FL
One Lamp T8	1T8	
Two Lamp T8	2T8	
One Lamp T5	1T5	
Two Lamp T5	2T5	
One Lamp T5HO	1T5HO	
Two Lamp T5HO	2T5HO	
circuit		1T5
Single Circuit	1C	
Dual Circuit (Two lamps only)	2C	
voltage		1
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		277
Electronic Instant Start	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast*	D	
mounting		RC
Recessed	RC	
factory options		
Air Return	AR	S
Emergency Circuit*	EC	T2
Emergency Battery Pack*	EM	
Flanged End (specify when run does not terminate at a wall)	FL	
HLR/GLR Fuse	FU	
Matte White Reflector	WR	
Include 3000K Lamp*	L830	
Include 3500K Lamp*	L835	
Include 4100K Lamp*	L841	
Sliding Sleeve	SS	
finish		WH
Matte Satin White	WH	
luminaire length		L830
Designate length in feet (Nominal lengths: 2',3',4',5',6',7',8') (All end caps are flat with no flange unless otherwise specified)	XX'	
corner options		4'
90-degree Inside Corner	FW3-IC90	
90-degree Outside Corner	FW3-OC90	

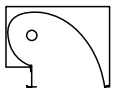


* for more information see Reference section.

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

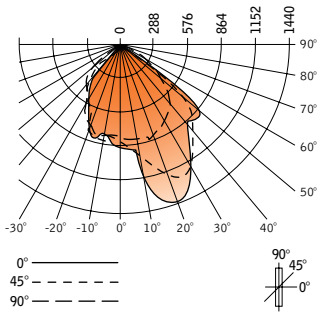
Type K

focus™ 3



Filename: FW3NS1T8.IES
Catalog #: FW3-1T8-1C-120-E-RC-HW
Efficiency: 81%
Test #: 8761.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1029	1029	1029	1029	1029	
5°	1106	1100	1089	1074	1020	94
15°	1437	1393	1244	1087	996	292
25°	1334	1382	1399	1131	915	471
35°	775	883	1101	1125	772	536
45°	665	622	631	948	613	440
55°	344	417	497	584	420	315
65°	22	55	223	265	252	110
75°	7	12	16	94	97	37
85°	3	3	4	7	19	6
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	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fixt
	0°-30°	858	30.1	37.3
	0°-40°	1394	48.9	60.5
	0°-60°	2149	75.4	93.3
	0°-90°	2303	80.8	100.0
Total Luminaire	0°-180°	2303	81	100.0

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

Type K

focus standard run length

Continuous Runs consist of standard fixture lengths. Left and Right End Trims and Sliding Sleeves are determinate, according to specific field conditions. Consult factory for details.

Example: 32' run = three 8' fixtures and one 7' fixture with a sliding sleeve expandable to 32'.

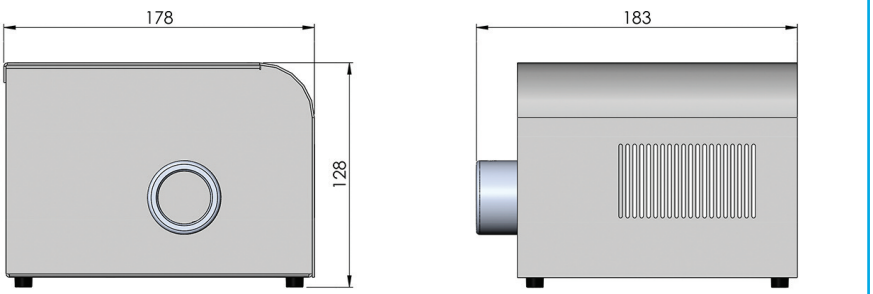
run length (in feet)	standard fixture lengths required	lamp sizes	sliding sleeve
4 – 5	4	4	1
5 – 6	5	5	1
6 – 7	6	3 3	1
7 – 8	7	4 3	1
8 – 9	8	4 4	1
9 – 10	6 3	3 3 3	1
10 – 11	6 4	3 3 4	1
11 – 12	8 3	4 4 3	1
12 – 13	8 4	4 4 4	1
13 – 14	7 6	4 3 3 3	1
14 – 15	8 6	4 4 3 3	1
15 – 16	8 7	4 4 4 3	1
16 – 17	8 8	4 4 4 4	1
17 – 18	8 6 3	4 4 3 3 3	1
18 – 19	8 6 4	4 4 4 3 3	1
19 – 20	8 8 3	4 4 4 4 3	1
20 – 21	8 8 4	4 4 4 4 4	1
21 – 22	8 7 6	4 4 4 3 3 3	1
22 – 23	8 8 6	4 4 4 4 3 3	1
23 – 24	8 8 7	4 4 4 4 4 3	1
24 – 25	8 8 8	4 4 4 4 4 4	1
25 – 26	8 8 6 3	4 4 4 4 3 3 3	1
26 – 27	8 8 6 4	4 4 4 4 4 3 3	1
27 – 28	8 8 8 3	4 4 4 4 4 4 3	1
28 – 29	8 8 8 4	4 4 4 4 4 4 4	1
29 – 30	8 8 7 6	4 4 4 4 4 3 3 3	1
30 – 31	8 8 8 6	4 4 4 4 4 4 3 3	1
31 – 32	8 8 8 7	4 4 4 4 4 4 4 3	1
32 – 33	8 8 8 8	4 4 4 4 4 4 4 4	1
33 – 34	8 8 8 6 3	4 4 4 4 4 4 3 3 3	1

run length (in feet)	standard fixture lengths required	lamp sizes	sliding sleeve
34 – 35	8 8 8 6 4	4 4 4 4 4 4 4 3 3	1
35 – 36	8 8 8 8 3	4 4 4 4 4 4 4 4 3	1
36 – 37	8 8 8 8 4	4 4 4 4 4 4 4 4 4	1
37 – 38	8 8 8 6 7	4 4 4 4 4 4 3 3 3	1
38 – 39	8 8 8 8 6	4 4 4 4 4 4 4 3 3	1
39 – 40	8 8 8 8 7	4 4 4 4 4 4 4 4 3	1
40 – 41	8 8 8 8 8	4 4 4 4 4 4 4 4 4	1
41 – 42	8 8 8 8 6 3	4 4 4 4 4 4 4 3 3 3	1
42 – 43	8 8 8 8 6 4	4 4 4 4 4 4 4 4 3 3	1
43 – 44	8 8 8 8 8 3	4 4 4 4 4 4 4 4 4 3	1
44 – 45	8 8 8 8 8 4	4 4 4 4 4 4 4 4 4 4	1
45 – 46	8 8 8 8 7 6	4 4 4 4 4 4 4 3 3 3	1
46 – 47	8 8 8 8 8 6	4 4 4 4 4 4 4 4 3 3	1
47 – 48	8 8 8 8 8 7	4 4 4 4 4 4 4 4 4 3	1
48 – 49	8 8 8 8 8 8	4 4 4 4 4 4 4 4 4 4	1
49 – 50	8 8 8 8 8 6 3	4 4 4 4 4 4 4 4 3 3 3	1
50 – 51	8 8 8 8 8 7 3	4 4 4 4 4 4 4 4 4 3 3	1
51 –52	8 8 8 8 8 8 3	4 4 4 4 4 4 4 4 4 4 3	1

Light Source Specification

Type L

Nova DMX



The UFO Nova DMX. Extremely high powered light output and full DMX control make this an LED light source capable of competing with all traditional light source types.

Utilising industry standard DMX to control the unit's colour change effects, plus the option of adding a twinkle wheel and an RF remote control, this is the ultimate light source for powering decorative fibre optic effect lighting.

A 50,000 hour lamp life and cool quiet running ensure that maintenance costs are reduced to almost nil.

Fitted with a standard 30mm fibre port connector, this light source is suitable for both new installations and retro-fitting to existing fibre optic installations.

Description	
Port connector size	30mm Diameter
Fibre type	Glass/Polymer
Mains Supply Voltage	100-240V AC, 50-60 Hz.
PSU output	24V, 2.5A
LED power	46W
Min Ambient Temperature	-10°C
Max Ambient Temperature	+30°C
Fan	80mm 12V Crossflow
Thermal protection	On board preset thermistor
LED type / model	RGBW
DMX	User addressable 0-255 (6 channel)
LED Life	50,000 hours in ambient 25°C
Lumen output	White: 1435 / Blue: 315 / Green: 1160 / Red: 700
Acoustic rating	20dB
Material	Aluminium
Colour	Silver
Size	183mm (L) x 178mm (W) x 128mm (H)

Like all our range, this light source is undergoing constant improvements and upgrades, so we reserve the right to alter specifications if required.

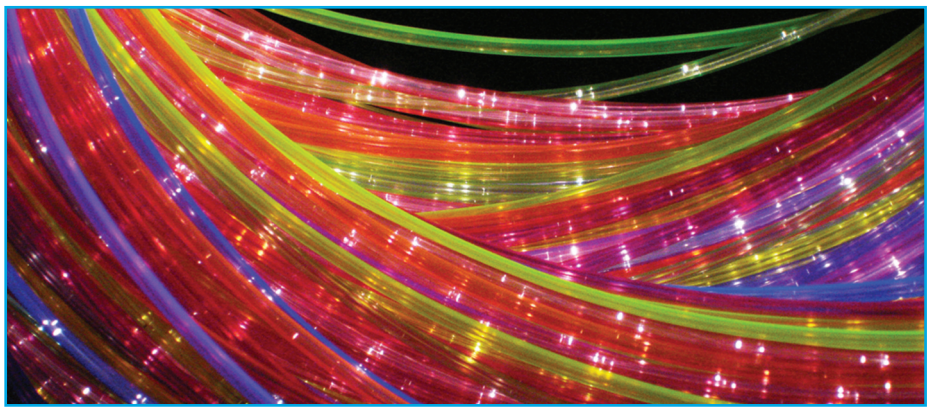
Issue 3 | Revised: 140314

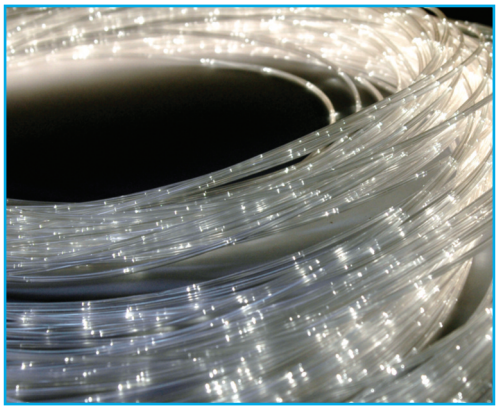
Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

Fibre Harness Specification

Type L

PMMA Side Sparkle Fibre Harness





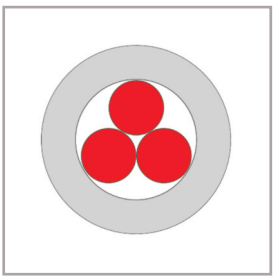
A decorative effect for indoor use with the added safety of a PMMA fibre core.

Ideal for multisensory environments, wall hanging and art installations. For indoor use only.

Available with a clear or uv reactive sheathing. UV reactive sheathing is either clear or multi-coloured.

These harnesses are all supplied with standard 30mm common ends and heat sealed terminations. Other lengths are available to special order - please contact us to discuss your requirements.

Specification	
Outer diameter	2.6 mm
Core construction	3 x 0.75mm chipped fibres
Core material	Polymethyl methacrylate resin
Cladding material	Fluorinated PMMA
Outer sheathing	Phthalate free PVC
Max. no. of tails	350
Max. run length	10m



Description	Part Num. (CL)	Part Num. (UV CL)
100 tails at 3.28’ (1m)	SEN-100-1-CL	SEN-100-1-UV
100 tails at 6.56’ (2m)	SEN-100-2-CL	SEN-100-2-UV
100 tails at 9.84’ (3m)	SEN-100-3-CL	SEN-100-3-UV
150 tails at 3.28’ (1m)	SEN-150-1-CL	SEN-150-1-UV
150 tails at 6.56’ (2m)	SEN-150-2-CL	SEN-150-2-UV
150 tails at 9.84’ (3m)	SEN-150-3-CL	SEN-150-3-UV
200 tails at 3.28’ (1m)	SEN-200-1-CL	SEN-200-1-UV
200 tails at 6.56’ (2m)	SEN-200-2-CL	SEN-200-2-UV
200 tails at 9.84’ (3m)	SEN-200-3-CL	SEN-200-3-UV

CERTIFIED PHTHALATE FREE

Issue 1 | Revised: 05072013

Universal Fibre Optics
Home Place | Coldstream | TD12 4DT | United Kingdom
Tel: +44 (0)1890 883416 | Fax: +44 (0)1890 883062
www.fibreopticlighting.com

BIBLIOGRAPHY

[1] "1 Bligh Street, Sydney." *Arup*. Arup. Web. 27 Feb 2014. <http://www.arup.com/projects/1_bligh_street_sydney.aspx>

[2] "Awards." *1 Bligh Sydney*. 1 Bligh Sydney, n.d. Web. 27 Feb 2014. <http://www.1bligh.com.au/Awards>.

[3] Barkkume, Allen. "Innovative building skins: Double glass wall ventilated facade." New Jersey Institute of Technology, 2007. Web.

[4] Blomsterberg, Ake. *Best Practice for Double Skin Facades - WP5 Best Practice Guidelines*. EIE/04/135/S07.38652. Intelligent Energy Europe, 2007. Web. 26 Feb. 2014.

[5] "Cambridge Public Library Case Study: A Double-skin Glass Wall." *Rawn Architecture*. William Rawn Associates, Architects, Inc. , 11 Oct. 2009. Web. 27 Feb 2014.

[6] Ghadamian, Hossein, Mohammad Ghadimi, et al. "Analytical solution for energy modeling of double skin facades building." *Energy and Buildings*. 50. (2012): 158-165. Web. 26 Feb. 2014.

[7] Haase, Matthias, and Alex Amato. "Ventilated facade design in hot and humid climate." The Green Room. Sept 2006. Lecture.

[8] "Horiso - An engineering triumph." *Window Furnishings Australia*. WFA. Web. 27 Feb 2014. <http://www.wfasource.com.au/news/horiso---an-engineering-triumph-20120706-18525.html>.

[9] Jiru, Teshome Edae, Yong-X. Tao, and Fariboz Haghighat. "Airflow and heat transfer in double skin facades." *Energy and Buildings*. 43. (2011): 2760-2766. Web. 26 Feb. 2014.

[10] Joe, Jaewan, Wonjun Choi, et al. "Load characteristics and operation strategies of building integrated with multi-story double skin facade." *Energy and Buildings*. 60. (2013): 185-198. Web. 26 Feb. 2014.

[11] Pasut, Wilmer, and Michele De Carli. "Evaluation of various CFD modelling strategies in predicting airflow and temperature in a naturally ventilated double skin facade." *Applied Thermal Engineering*. 37. (2012): 267-274. Web. 26 Feb. 2014.

[12] Perepelitza, Mark. *Building Enclosure Performance Research - Applications in Professional Practice*. Ed. ZGF Architects and Building Enclosure Technology and Environment Council (National Institute of Building Sciences)2012. Web. 26 Feb. 2014.

[13] Poirazis, Harris. International Energy Agency. Solar Heating & Cooling Programme. *Double skin facades - A literature review*. Lund: Department of Architecture and Built Environment, Division of Energy and Building Design, 2006. Web.

[14] Reinhart, Christoph F., and Jan Wienold. "The daylighting dashboard – A simulation-based design analysis for daylit spaces." *Building and Environment*. 46. (2011): 386-396. Web. 26 Feb. 2014.

[15] Shameri, M.A., M.A. Alghoul, et al. "Perspectives of double skin facade systems in buildings and energy saving." Renewable and Sustainable Energy Reviews. 15. (2011): 1468-1475. Web. 26 Feb. 2014.

[16] Shameri, M.A., M.A. Alghoul, et al. "Daylighting characteristics of existing double skin façade office buildings." *Energy and Buildings*. 59. (2013): 279-286. Web. 26 Feb. 2014.

[17] "William Farrell Building Revitalization for Telus ." *Green Building Brain*. Design Centre for Sustainability, n.d. Web. 27 Feb 2014.

Image Credits

[18] *DNA*. 2012. Graphic. johnkapeleris.comWeb. 9 Apr 2014.

[19] Goodrich, Marcia. *Graphene*. 2012. Graphic. mtu.edu/newsWeb. 9 Apr 2014.

[20] Neutrix, . *Neuron Spark*. 2010. Graphic. deviantart.comWeb. 9 Apr 2014.

[21] Silapasuwanchai, Setsiri. *Circuit Board Technology*. 2012. Graphic. fineartamerica.comWeb. 9 Apr 2014.

[22] *Biobehavioral Health Building*. 2014. Photograph. opp.psu.eduWeb. 9 Apr 2014.

Elizabeth Kimble

Academic Vita

emk5189@psu.edu

Local: 138 E. Beaver Ave., Apt. 20, State College, PA 16801

Permanent: 6267 Dawn Day Drive, Columbia, MD 21045

Education

Penn State University — University Park, PA

Schreyer Honors College

Bachelor/Master of Architectural Engineering - Lighting/Electrical Option

Five year professional degree - ABET accredited

Architecture Studies Minor

International Engineering Certificate

EIT status upon graduation in May 2014, Intern LC Certification

Work Experience

Penn State University — University Park, PA

Teaching Assistant

AE 461: Architectural Illumination Systems and Design, Fall 2013

Communications and Speech 100 for Engineers, Spring 2012-Fall 2013

Primera — Chicago, IL

Lighting Intern, Summer 2013

Assisted with lighting design activities for several projects, including lighting - related LEED documentation. Completed a redesign project of Primera's Chicago Office lighting.

James Posey Associates — Baltimore, MD

Electrical Intern, Summer 2012

Assisted with lighting/electrical design and construction administration for several projects, including Malone Hall at Johns Hopkins University.

SmithGroup JJR — Washington, DC

Electrical Intern, Winter Break 2011

NASA, Goddard Space Flight Center — Greenbelt, MD

ASRC Aerospace, Summers 2009-2011

Trax International, Summer 2008

Study Abroad

Sede di Roma — Summer 2011

Seven-week study abroad program in Rome, Italy through Penn State Architectural Engineering. Completed 12 credits of coursework in Architecture Studio, Architectural Theory, Daylighting Analysis, and Cartography.

Honors and Organizations

Tau Beta Pi Engineering Honor Society- PA Beta Chapter

Initiation Chair, 2012-2013, 2013-2014

PSU Student Chapter of the Illuminating Engineering Society

Treasurer, 2013-2014

UTREE - Undergraduate Teaching and Research Experiences in Engineering

Teaching Mentor, Spring 2012-Fall 2013

Springfield THON - Benefitting the Penn State Dance Marathon

Technology Chair, 2012-2013

Merchandise Captain, 2010-2011

S:PACE - Student Chapter of the Partnership for Achieving Construction Excellence

Treasurer, 2011-2012

2nd Year Representative, 2010-2011