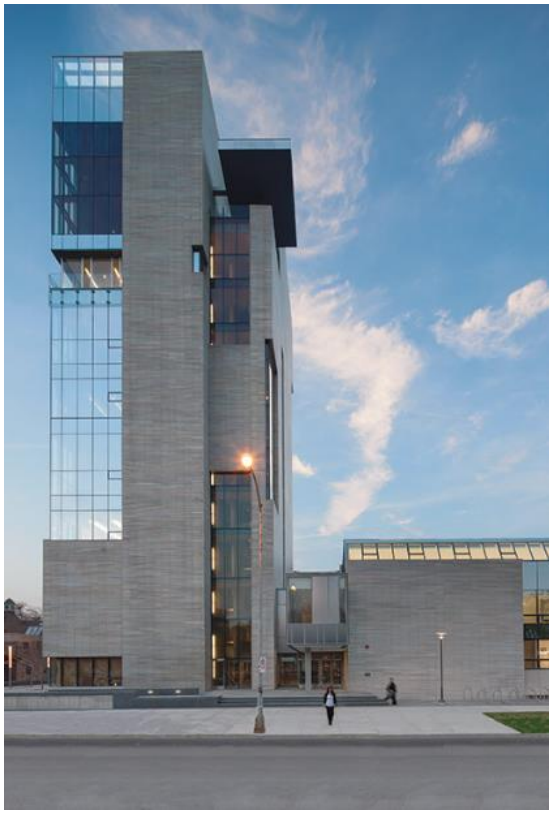
AE Senior Thesis Final Report

Reva and David Logan Center for the Arts | Chicago, IL



Sean Kim | Lighting/Electrical option

Faculty Advisor | Dr. Kevin Houser

9 April, 2014

Submitted to the Department of Architectural Engineering
College of Engineering
The Pennsylvania State University

Reva and David **Logan** Center for the Arts

Sean Kim | Lighting/Electrical option

Project Team

Owner | University of Chicago
Design Architect | Tod Williams Billie Tsien Architects LLP
MEP Engineer | Ambrosino Depinto & Schmieder Consulting Engineers
Structural Engineer | Severud Associates
Lighting Design | Renfro Design Group
CM | Turner Construction LLC

Building Statics

Location | 915 E 60th St. Chicago, IL 60637
Function Type | Multidisciplinary Arts Center
Size | 184,000 SF
Story | 11 story tower with 3 story adjacent building
Construction Dates | June 2010 – October 2012
Cost | $114,000,000 (overall cost)

Architectural

- Inspired by *"flat prairies of the Midwest and the great towers of Chicago"*
- 170 foot height tower with open air terraces and Rooftop decks
- Light filled glass with lime stone
- Saw tooth skylight roof
- Solar panels roof
- Green roof system of the Auditorium
- Exterior insulation and finish system

Structural

- 12" thick Cast-In-Place Concrete flat slab
- Light weight concrete on composite metal deck
- W14 x 22 and W16 x 31 for typical Beam with W21 x 50 for typical girders
- Fully grouted CMU wall with #6@16" O.C. vertical for sound isolation
- HSS6 x 6x 1/4 for Diagonal braced lateral framing

Lighting/Electrical

- Building Service system 277/480 volts 3 phase 4 wire wye
- 600KW Diesel engine generator
- Incandescent 120 volts, and 277 volt for fluorescent and HID single phase 2 wire
- Passive Infrared occupancy sensor with time delay.
- Line-voltage controlled motorized window shades
- "LUTRON" lighting control system

Mechanical

- (6) AHU's for adjacent building, (3) AHU's for tower, and (2) AHU's for Auditorium
- Variable Air Volume box system.
- (1) Air-Cooled Chiller system to serve theaters
- (2) Hot-water pump at 125 psi, and (6) Chilled –water pump at 125 psi
- (1) Air compressor located at main mechanical room.

http://www.engr.psu.edu/ae/thesis/portfolios/2013/dyk5087/index.html

ACKNOWLEDGEMENTS

I would like to thank the following individuals for all their effort, expertise, and who supported me to complete this AE thesis successfully.

Kevin W. Houser, PhD, PE, LC, LEED AP	Thesis Advisor, Professor of Architectural Engineering, The Pennsylvania State University
Richard G. Mistrick, PhD, PE	Associate Professor of Architectural Engineering The Pennsylvania State University
M. Kevin Parfitt, PE	Director of Senior Thesis Program, Associate Professor of Architectural Engineering, The Pennsylvania State University
W. Blair Malcom, PE	Electrical Engineer Office of Physical Plant The Pennsylvania State University
Moses D.F. Ling, PE, RA	Associate Professor of Architectural Engineering The Pennsylvania State University
Eric Eichler, LEED AP	Senior Project Manager, Facilities Services, The University of Chicago
Adrian J. Degifis	Interium Project and Finance Coordinator Logan Center for the Arts The University of Chicago

EXECUTIVE SUMMARY

The Reva and David Logan Center for the Arts is located in Chicago, IL. As a campus building of the University of Chicago, It is a multidisciplinary arts center for the students, faculties, and staffs. This art center building consists of performance hall, gallery rooms, craft studios, painting rooms, theaters, classrooms, and many other spaces for housing playwrights and painters, musicians, and filmmakers, dancers and sculptors. With many sustainable and energy efficient designs such as solar panels on the roof, saw-tooth skylights, and ground and water source heat pumps, the building received LEED Gold certification. However, the lighting, electrical, acoustical, and mechanical systems are conducted for the possibility to reflect the better sustainability goals such as energy saving, and cost.

The lighting depth was conducted on the four spaces as Performance hall, Performance penthouse, Main lobby, and Courtyard. All spaces were analyzed for their existing lighting system with space purpose, and interior finishes. And then, all the design criteria for each space were developed with IES Lighting Handbook, 10th edition and ASHRAE Standard 90.1. The new lighting design of the Performance hall was developed with three concepts that are inspired from the type of performance. Those concepts are called as Modernism, Sophisticated, and Classical, and the color of lights, mounting types and the light distribution were considered to deliver those concepts. The new lighting design of the Performance penthouse was considered with flexibility for supporting many activities and collaborating daylight in the space. By giving different lighting zones with control system, the flexible lighting was supported. The design concept of Main lobby was inspired from the idea of Midwest Park which is a significant landmark of the University of Chicago. Two long horizontal lines were applied into the ceiling, and cove lighting was used to provide powerful atmosphere into the space. The lighting design of Courtyard was considered with light trespass because the space is surrounded by buildings.

The electrical depth was studied on the high-efficiency transformer and the size of generator. The all existing dry-type transformers in the building are designed as NEMA TP-1, K-rated transformer for the energy efficiency. To provide better energy saving, NEMA Premium efficiency transformer from EATON is applied. This transformer provided 30 percent less losses than similar-sized NEMA TP-1 models while lowering energy consumption. The generator size was reduced by subtracting a load of the switchboard *LL-EM-LL* that is served by extra emergency service from the power utilities.

The acoustical breadth was conducted on the reverberation time for the performance hall to determine how the space dose functions acoustically well. The mechanical breadth was conducted on the glazing type of the corridor located on the first floor to determine the solar heat gain and cooling load. And two different proposed glazing types were compared with existing one for the costs how much it is required for the cooling load.

TABLE OF CONTENTS

PROJECT BACKGROUND

David Logan and his wife Reva Logan who are alumni of the Law School at The University of Chicago are long time supporters of the arts and have a wide range of philanthropic interest. On May 3, 2007, David and Reva Logan and their sons and grandchildren had generously committed a $35 Million gift to support the University's Center for the creative and performing arts. With their efforts and supports, *The Reva and David Logan Center for the Arts* is constructed at the campus of the University of Chicago. The Logan Center is a hub for the variety of arts activity that takes place across the University of Chicago and beyond the borders of the campus.

Figure 1 | **David Logan and Reva Logan**

"The Logan family sees the center not as a building project…But as a way to improve the quality of life for students and faculty of the University, as well as the community"

- *David Logan*

"The Reva and David Logan Center for the Arts advances arts practice, inquiry, and presentation at the University of Chicago, and fosters meaningful collaboration and cultural engagement at the University, in the south side, and in the city of Chicago"

- *Mission of Logan Center*

SITE INFORMATION

The Reva and David Logan Center of the Arts is located on the campus of the University of Chicago at 915 East 60th Street.

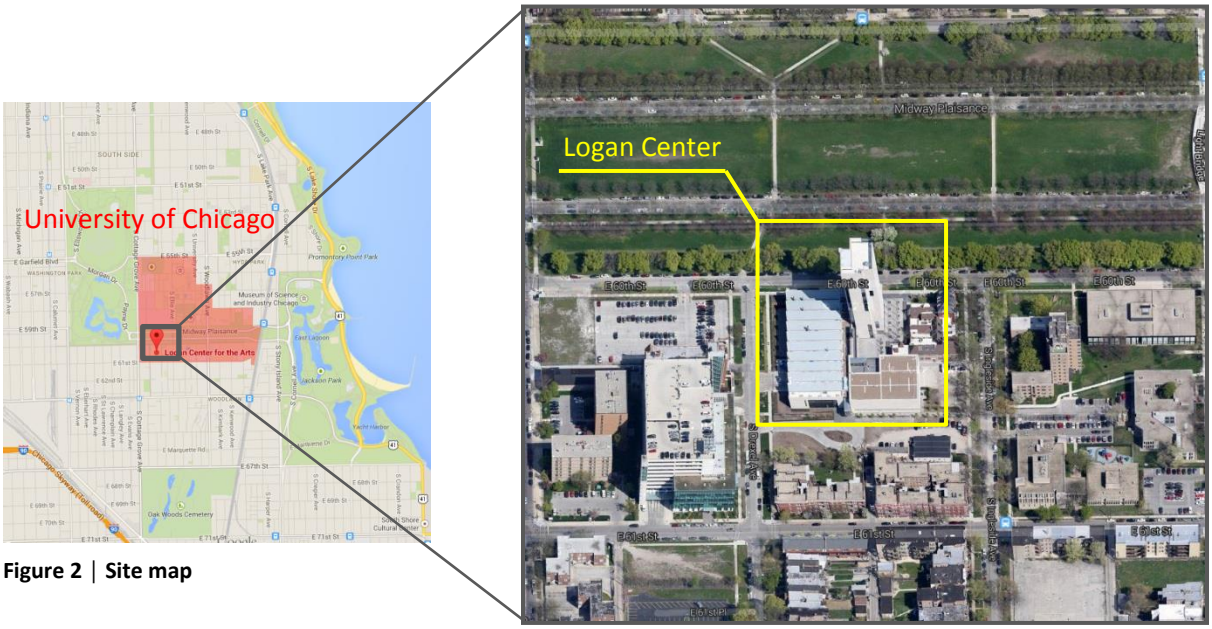


Figure 2 | **Site map**

The Logan Center is surrounded by campus building such as Midway Studio, and Department of Safety and Security. Midway Studios is the historic home and studios of sculptor Lorado Taft. It was the personal studio and residence of Taft from 1905 until his death in 1936, and additions were made in later years to create studio and classroom for the students in the University.

The north side of the Logan Center is exposed to the Midway Plaisance Park aka Midway. The Midway was developed and began as a vision by Paul Cornell who was a land developer in the mid of 1800. After several years, Frederick Law Olmsted who is famous for creating New York City's Central Park was hired to design Midway Park. Over the ensuing decades, the Midway gradually came to be a part of the University of Chicago, and Lorado Taft, and Eero Saarinen added their vision to the Midway. It is joining with Washington Park at its west end and Jackson Park at its east end.

Figure 3 | **History of Midway Park**

GENERAL BUILDING DATA

Building Name: Reva and David Logan Center for the Arts

Location and Site: 915 E 60th St, Chicago, IL, 60637

Building Occupant Name: University of Chicago

Occupancy or function types: Multidisciplinary arts center

Size: 184,000 square foot

Number of stories above grade: 11-story tower with 3-story adjacent building.

Primary project team:

Owner: University of Chicago

Project Manager: Eric Eichler, Senior Project manager at The University of Chicago

Design Architect: Tod Williams Billie Tsien Architects LLP www.twbta.com

Associate Architect: Holabrid & Root www.holabird.com

Structural Engineer: Severud Associates www.severud.com

MEP Engineer: Ambrosino Depinto & Schmieder Consulting Engineers www.adsce.com

Lighting Design: Renfro Design Group www.renfrodesign.com

Landscape Architect: Hargreaves Associates www.hargreaves.com

Civil Engineer: David Mason & Associates www.davidmason.com

LEED Consultant: Steven Winter Associates, Inc www.swinter.com

Construction Manager: Turner Construction, LLC www.turnerconstruction.com

Dates of construction

Start Date: June 2010

Completion Date: October 2012

Cost: $114,000,000 (overall cost)

Project Delivery: Design-Bid-Build

ARCHITECTURE

The Reva and David Logan Center for the Arts is inspired by the "flat prairies of the Midwest and the great towers of Chicago", the art center is comprised of a light-filled glass and stone tower and a three-story "Plains" building with saw-tooth roof. "Plains" building is lit by north facing skylights and houses beautifully lit studios, a gallery, music practice rooms, a 450-seat auditorium, a 120-seat Theater and a black box theater as well as a 2,000 square foot exhibition space. The 170-foot tower houses a performance penthouse, screening room, rooftop deck, classrooms, rehearsal rooms, and performance labs on different floors and connected these programs with generous elevators and stairways with offering dramatic distant views of Lake Michigan and downtown Chicago.

> *"Through the collaborative work of our faculty, students, and professional arts organizations, we are now forging an integrative model that is unique among our peer institutions. Scholars, practicing artists, and students are crafting new curricular, co-curricular and public programs that productively combine research, teaching, and creative expression. The David and Reva Logan Center for the Arts will add luster to the university's already rich history of groundbreaking artistic exploration and accomplishment, and become a model of its kind on the national stage."*
>
> - *Larry Norman, Deputy Provost for the Arts*

> *"The idea of the long, low, skylit building of studios and theaters, and the tower of the arts came from imagining the flat prairies of the Midwest and the great towers of Chicago. The quiet low "plains" building will provide three floors of beautifully lit studios, a gallery, music practice rooms and theaters that are spatial surprises. The presence of the tower on the south side of the Midway announces a new home for the creative life of students and faculty and a public venue for residents of the city."*
>
> - *Tod Williams and Billie Tsien, Architects of Logan Center*
>
> -

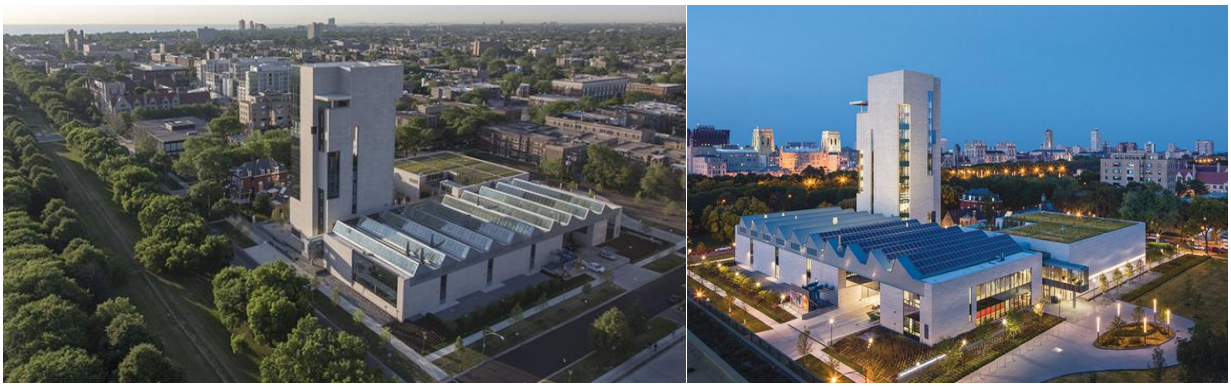


Figure 4 | **Images of Reva and David Logan Center for the Arts**

Major national code

- Illinois Chicago Building Code
- Illinois Chicago Municipal Code
- Illinois Chicago Mechanical Code
- Illinois Chicago Energy Code
- Illinois Chicago Electrical Code
- International Building Code
- National Electrical Code
- National Fire Alarm Code

Zoning: Subarea I – Planned Development #43, Chicago Zoning Ordinance

- Maximum Floor Area Ratio (FAR): 2.20
- Maximum Percent Site: 46.00%
- Maximum Building Height: 200ft

Historical requirements: Not application

BUILDING ENCLOSURE

Windows:

- Clear Vision: Low-E insulated glass, Low-IRON outer lite, Neutral High-performance
- Skylight Glazing: Clear outer lite, Neutral High-performance, Low-E on Surface
- Translucent Reflective Spandrel: Low outer lite, Reflective pyrolitic coating
- Laminated Glazing: Laminated Lite, Clear lite
- High Performance Acoustical Glazing: Laminated lite, low-IRON lite, PVB, Low-E coating

Building facades: The Building façade is generally consists of limestone, painted steel sheet and curtain wall systems which is aluminum framing with 4-side structurally glazed insulated glass units. Exterior Insulation and finish system (EIFS) is applied to this building.

Roofing: The roofing system is considered as two types which are solar panel with skylight, and green roof. The Skylight roof is shaped as saw-tooth, it is 4-side structurally glazed insulated laminated glazing on aluminum skylight framing, and mounted on HSS framing. On the other side, Solar panels have been installed. For the green roof, there are 7 different botanic, with medium growing soil is covered above the light weight aggregates with filter fabric on the roof of theaters. As supplier's requirement, the gravel zone is installed on the edge of soil. Please reference attached drawing for the specific.

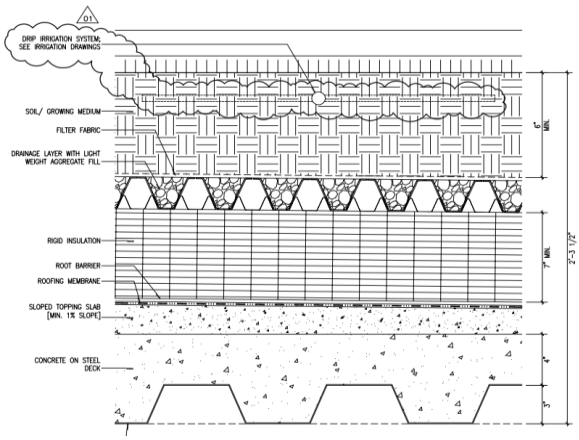


Figure 5 | **Green Roof Assembly at Auditorium**

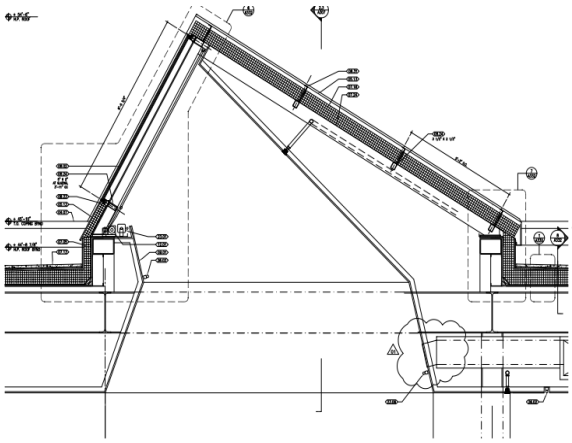


Figure 6 | **Skylights Section view**

SUSTAINABILITY FEATURES

This project is submitted for Leadership in Energy and Environmental Design (LEED) certification to the US Green Building Council.

- Version: LEED 2009 for New Construction
- Rating: LEED Gold Certification.
    - Ground and water source heat pumps
    - Radiant heating and cooling system
    - Saw-tooth skylight
    - Daylighting
    - Three green roofs
    - Solar panels roof

STRUCTURAL SYSTEM

The main structural system of the Logan Center for the Arts consists of steel columns, beams, and diagonal bracing frame. The slab construction is 12 inch thick cast-in-place concrete flat slab reinforced with a continuous #5 @ 8 inch on center bottom grid placed. Typical beams of adjacent building are W14 x 22, W16 x 31 or 36, and W18 x 40, while the typical girders are W21 x 50. Typical beams and columns of tower are reinforcing concrete systems. The roof system of the adjacent building consists of W10 x 15 for beam, while girders are W36 x 150. The lateral bracing frame system is applied to the adjacent building, and it consists of HSS6 x 6 x 1/4, 3/8 and 1/2.

ELECTRICAL SYSTEM

(2) 12.47kV primary service from the power company is fed into the Logan Center for the Arts. There is a service transformer to step down into 480/277V on the outside. Two service switchboards (SS-1, and SS-2) serve three main distribution switchboards with 480/277V which are HV-EM-LL, HV-DP-LL-S2, and MDSB. The dry-type transformer is used to step down into 208/120V for the panelboards to serve the lighting loads, receptacles, and other loads. There are two emergency services from the power company to serve the fire pump, and low-voltage switch boards for the emergency lighting loads. In addition to the emergency service systems, there is (1) 600kW diesel-powered engine generator on the lower level. This generator with automatic transfer switch systems serves main mechanical loads, fire pump, and low-voltage switchboard in case of power outage.

MECHANICAL SYSTEM

(11) Custom air handling units serve the entire building. Each of three air handlings unit with single zone type serves the Screening room, Black Box Theater, and Studio Theater. (1) Air handlings unit with displacement type serves the auditorium with 13,500 CFM. All AHU's are located at the lower level except the one AHU with 23,500 CFM to serve the tower. (1) Air-cooled chiller is located at the outside of the building to serve the theaters. It is served by one chilled water pump with 125 pressures and 175 GPM. (2) Hot water pumps with end suction type and (2) heat exchangers with U-tube type are located at the steam room on the lower level. They serve the heated water with (2) domestic hot water heaters. Variable frequency drive devices are equipped for most of the HVAC equipment.

LIGHTING SYSTEM

As the Logan Center for the Arts building is for the multidisciplinary center for the arts, the primary lighting system is divided into the general lighting and theater lighting systems. Fully recessed compact fluorescent 6" aperture downlight is used for the corridor and the lobby. In addition, fully recessed compact fluorescent wallwasher is used for the wall of the lobby for the events such as gallery. Surface side mounted fluorescent linear single lamp T5HO and recessed fluorescent T5HO with frosted acrylic are used for the most of the studio rooms on the first level. For the special rooms including performance studio and rehearsal room, custom light fixtures are used based on the purpose of individual activities. Linear fluorescent T8 fixture with various mounted types is used for most of the classrooms. For the theaters such as auditorium, Studio Theater, and Black Box Theater, the orchestra light fixture and worklight fixture are installed. To control the daylight during the daytime, the motorized shaded is used.

CONSTRUCTION

The primary construction management firm for the Logan Center for the Arts is Turner Construction Co. The schedule construction operation in the sequence is used to obtain the best results where installation of one part of the work depends on installation of other components, before or after its own installation. Total size of the Logan Center for the Arts is 184,000 SF, and the building consists of 11-story tower with 3-story adjacent building. Since the project site was adjacent to the existing building which is Midway Studio, the building envelop restoration of adjacent Midway Studios and extension of south campus utility corridor is started first before the foundation excavation. The construction date is from June 2010 to October 2012 with $114,000,000 overall cost. The project delivery method is Design-Bid-Build.

FIRE PROTECTION

750 GPM fire pump with (2) 8” incoming and (1) 4” incoming domestic water services serves the fire protection system for the entire building. In addition, the wet sidewall type sprinkler is used for the stair enclosure. The various type sprinklers which are heads, upright, pendent and concealed types are used based on the purpose of the space.

TRANSPORTATION

The Logan Center for the Arts has vertical transportation system which is elevator. On the north of the building, (2) passenger elevators with ADA auto dialer telephone are located to serve all floors including tower. They are traction system and connected to each motor which are 40HP and 60HP. For emergency case, those motors are fed by emergency switchboard. On the south of the building, (1) passenger elevator and (1) freight elevator are located to serve only floors of the adjacent building. They are hydraulic system and connected to each motor which are 40HP and 75HP.

TELECOMMUNICATIONS

(4) Low voltage telecom service entrances with 4” sleeves are located on each north and south of the lower level. Network closet rooms are located on every floor of the tower to serve the data services such as the phone. (5) Outdoor cameras and indoor fixed cameras are installed for security purposes. In addition, the card reader devices are used to access from the outside to inside of the building with local audible alarm devices or into the special rooms such as AV control rooms, network closet, theater backstage, studio, and supply rooms.

LIGHTING DEPTH

Large Work Space | Performance Hall

Space Description

The space of performance hall, located on the first floor, is a largest theater with a 474-seat. This space is used primarily for concert, performance, and full orchestra. With drop-down shades along the perimeter of the ceiling, it also allows the acoustics to be altered for music, dance or film. For various activities and applications of the theater, three different lighting design concepts will be developed.

Dimension

W 64’ (backward), W 45’ – 3 3/8” (forward)
L 102’ – 6”
H 21’ – 6” (lowest), H 35’ (highest)

Area: 3,943 SF for seating area, with 1,660 SF for stage area

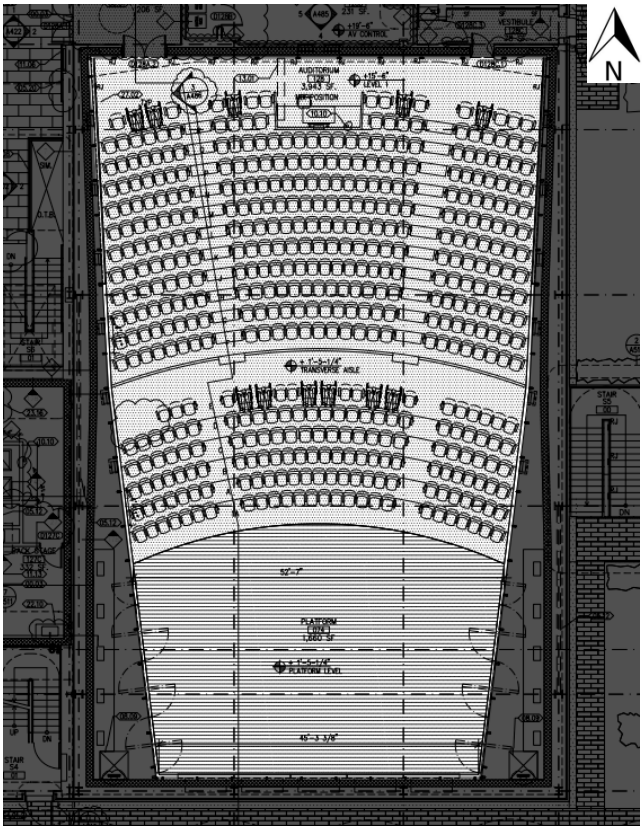


Figure 7 | **Floor Plan of Performance Hall**

Interior Finish

The space of performance hall is divided into the auditorium and the platform. The wall and ceilings’ finishes of auditorium and platform are same except the floor. The epoxy terrazzo finish with low reflectance is used on the floor of the auditorium, and the wood finish is used on the floor of the platform. The table on the below describes the finishes for the each surface.

Space	Surface	Description	Reflectance
Auditorium	Floor	3/8” Epoxy Terrazzo Finish with ¾” Reveal	0.2
	Wall	Type 2 – Acoustically Transparent Fabric Wall System with Support frame	0.5
		Perforated Wood Sliding Panels	0.35
	Ceiling	Type 1 – Fabric Over Nomex Reflector Fabric	0.6
		Type 1 – Fabric Over GWB	0.6
Platform	Floor	Resilient Slide Wood Floor	0.5
	Wall	Type 2 – Acoustically Transparent Fabric Wall System with Support frame	0.5
		Perforated Wood Sliding Panels	0.35
	Ceiling	Type 1 – Fabric Over Nomex Reflector Fabric	0.6
		Type 1 – Fabric Over GWB	0.6

Table 1 | **Interior Finish of Performance Hall**

Design Considerations

As the theater/auditorium serves different functions such as film, performance, music, and orchestra, the different lighting requirements will be considered with the flexibility of design, control and installation. The lighting quality in the theater should have excellent dimming range and very high color rendering (CRI≥85) with ambient lighting. According to the IES, The Lighting Handbook 10th, Illuminance uniformity targets work in conjunction with illuminance uniformities and surface reflectance all of which must be addressed as part of the design to avoid visual discomfort, glare, and strain. Also, no light or zero light is recommended for the task or application during the performance except the aisle lighting.

Design Criteria

Application Type	E_h (lux)	E_v (lux)	Avg:Min	Note
Audience – During production	2	1	2:1	E_h@floor, E_v@5' AFF
Audience – Pre/Post show, intermissions	100	30	2:1	E_h@floor, E_v@5' AFF
Circulation – During Production	2	4	5:1/2:1	E_h@floor, E_v@5' AFF
Circulation – Pre/Post show, intermission	100	30	2:1	E_h@floor, E_v@5' AFF

Table 2 | **Illuminance Recommendation [IES Lighting Handbook 10th Edition]**

Application Type	Power Density (W/ft^2)
Audience/Seating Area for Performing Arts Theater	2.6

Table 3 | **Energy Allowance [ASHRAE Standard 90.1]**

In addition, the egress lighting will be considered to contribute to the safety of occupants in the space. According to NFPA 101 (2009), Life Safety Code Excerpt, the minimum of 0.2 foot candles of illumination will be required to be provided onto all floor area's during period of performances. The following lists describe the illumination of means of Egress.

- *7.8.1.3*: The floors and other walking surfaces within an exit and within the portions of the exit access and exit discharge designated in 7.8.1.1 shall be illuminated as follows:
  (1) During conditions of stair use, the minimum illumination for new stairs shall be at least 10 ft-candle (108 lux), measured at the walking surfaces.
  (2) The minimum illumination for floors and walking surfaces, other than new stairs during conditions of stair use, shall be to values of at least 1 ft-candle (10.8 lux), measured at the floor.
  (3) In assembly occupancies, the illumination of the floors of exit access shall be at least 0.2 ft-candle (2.2 lux) during periods of performances or projections involving directed light.
  (4) The minimum illumination requirements shall not apply where operations or processes require low lighting levels.
- *7.8.1.4*: Required illumination shall be arranged so that the failure of any single lighting unit does not result in an illumination level of less than 0.2 ft-candle (2.2 lux) in any designated area.

Design Approach & Concept

The main idea of the lighting design for the performance came from the word which is "Artistic" The flexible lighting needs to be applied into the space to support various activities. Since this space is used for various performance activities, three design concepts are developed from those ideas. Those performance activities are divided into three categories which are modernism, classical, and sophisticated. The modern performance ideas are inspired from the following images. To support this idea, Linear fluorescent with cool color output is used.

Figure 8 | **Examples of Modern Performances**

Sophisticated might be hard to expressed as lighting design, however few words could be come out from this concept. They are "Simple" and "Intense". The sophisticated performance ideas are inspired from the following images. To support this idea, the lighting design should be simplified, not using too much lighting fixtures, and gives powerful atmosphere in the space.

Figure 9 | **Examples of Sophisticated Performances**

Classical performances could be identified as orchestra, music, piano, and voice performance. The lighting design should be settled, and provides warm atmosphere to support those performances, and make an audience to feel comfort. The color output and light distribution will be key points to express "classical". The following images show some examples of classical performances.

Figure 10 | **Examples of Classical Performances**

Computer Rendering

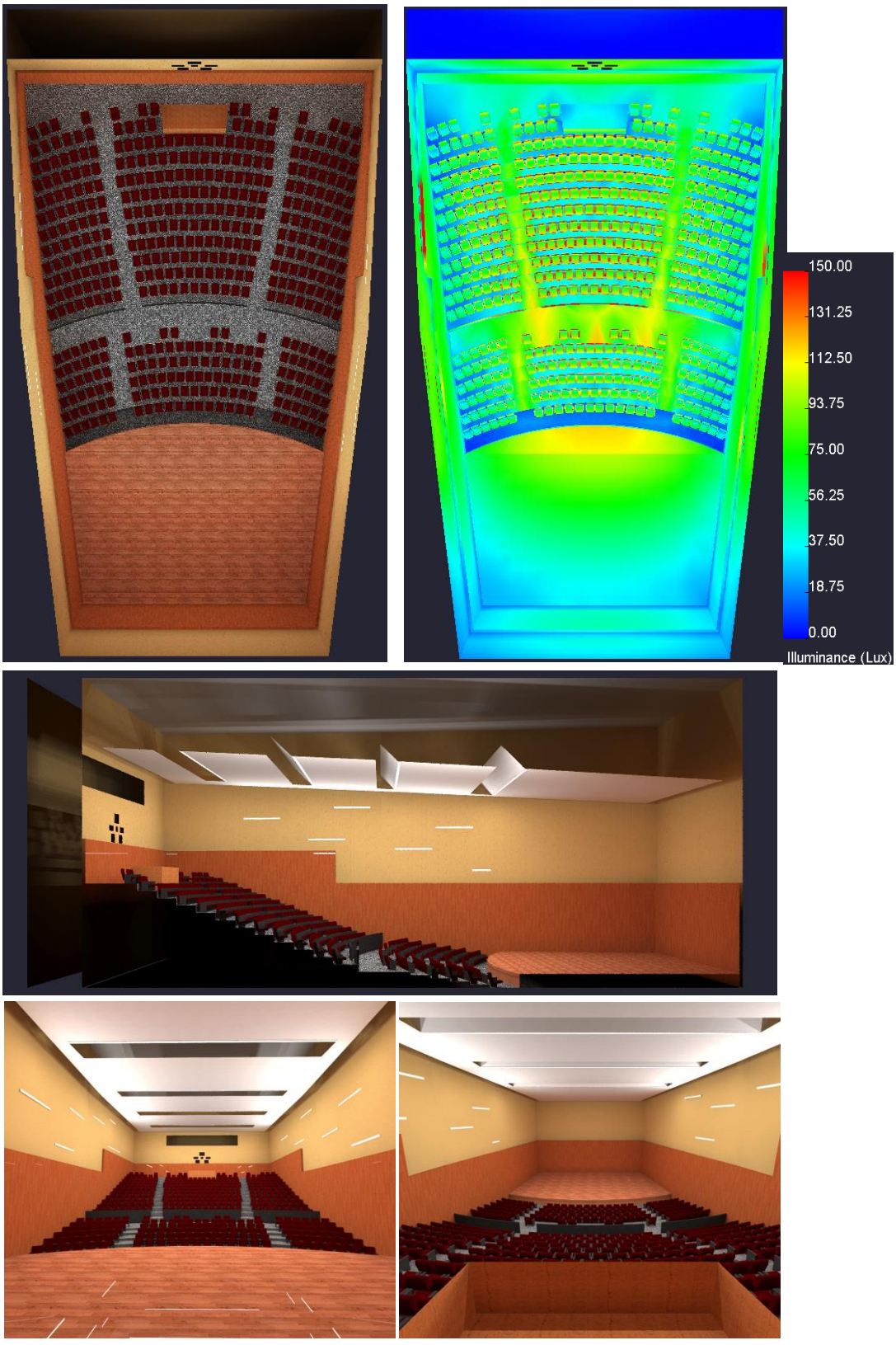


Figure 11 | **Rendering Images of Modernism**

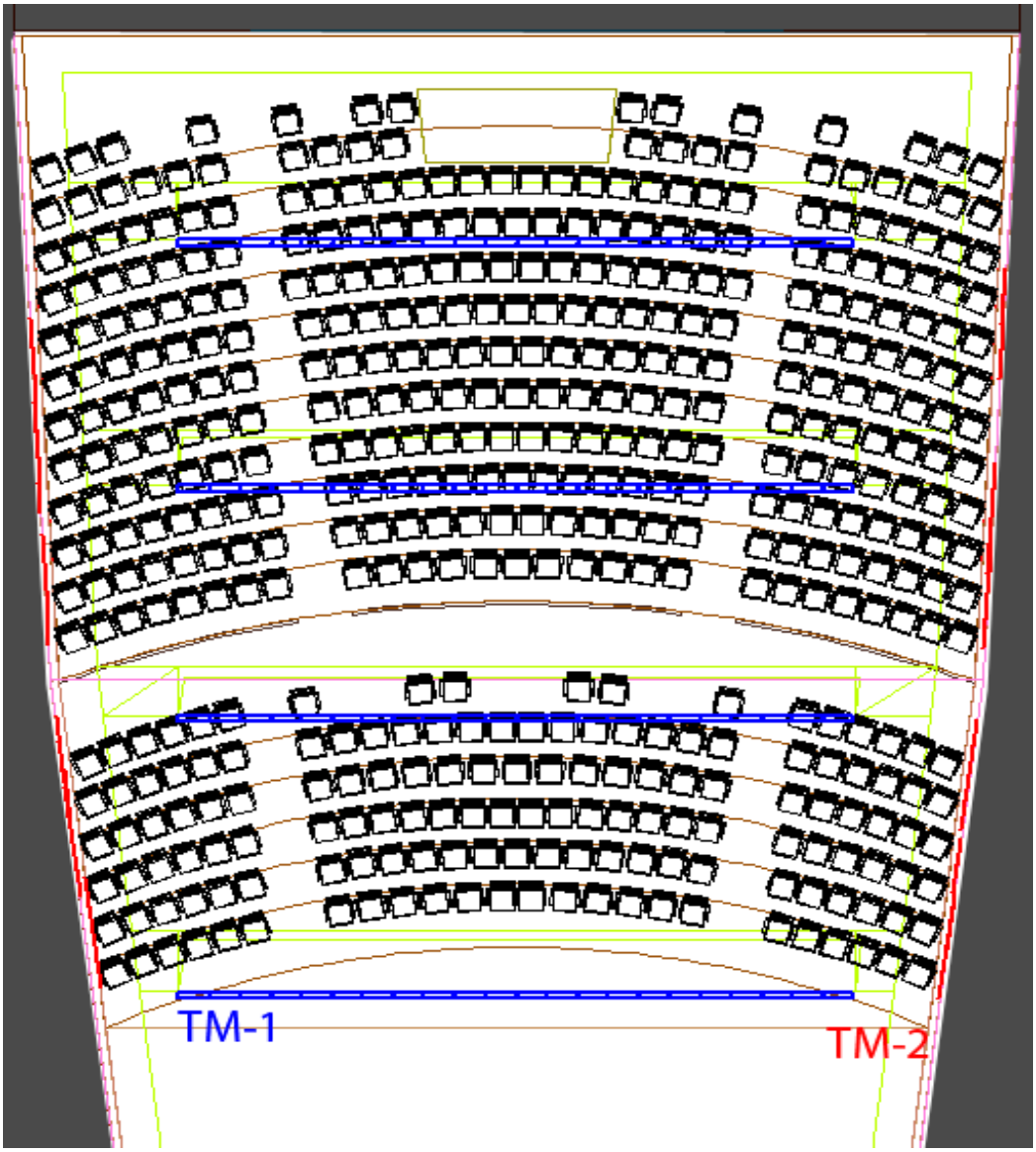


Figure 12 | **Lighting Plan of Performance hall - Modernism**

TM-1 | 4’ Linear Recessed LED

TM-2 | 4’ Linear Recessed LED

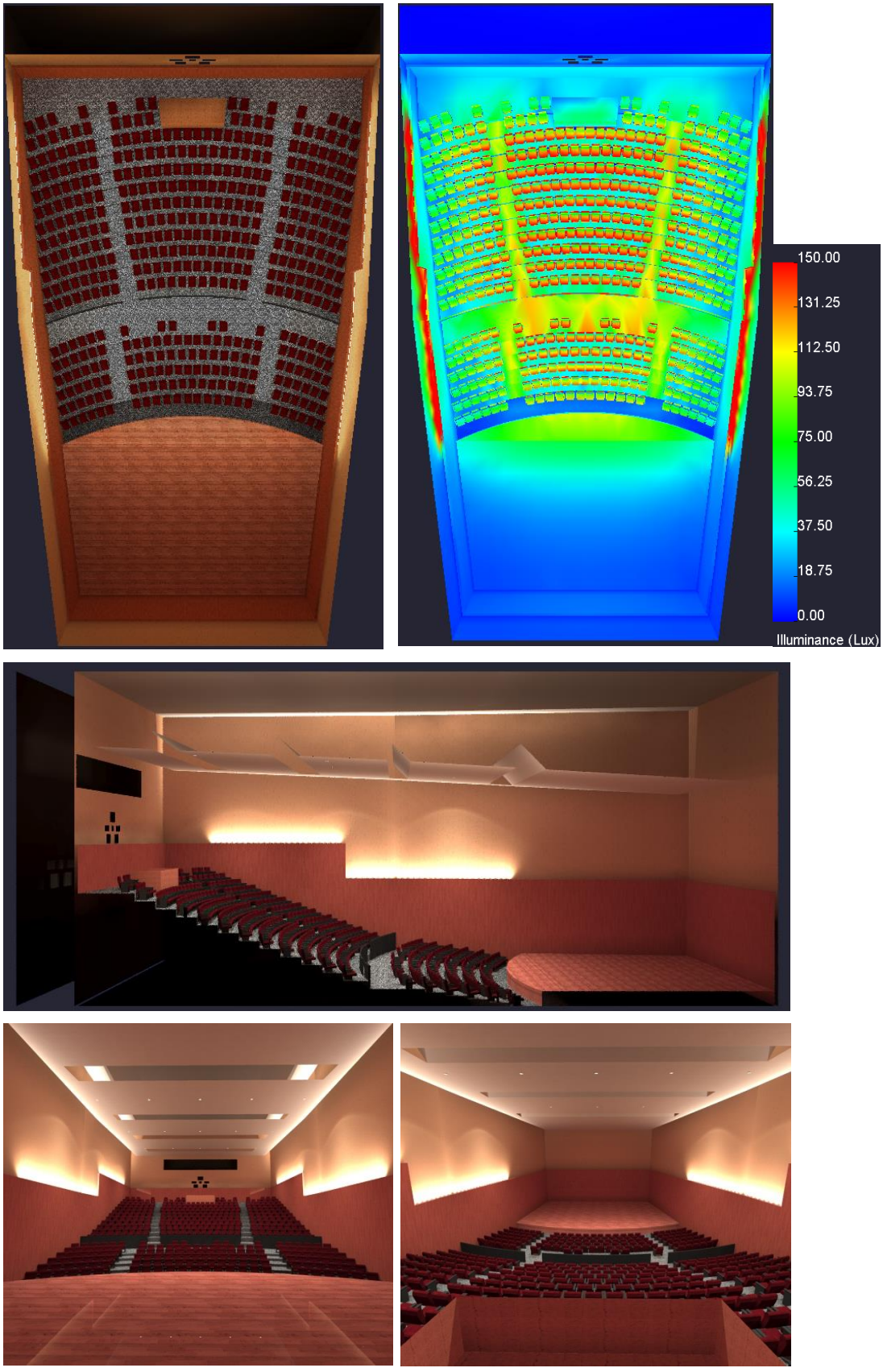


Figure 13 | **Rendering Images of Sophisticated**

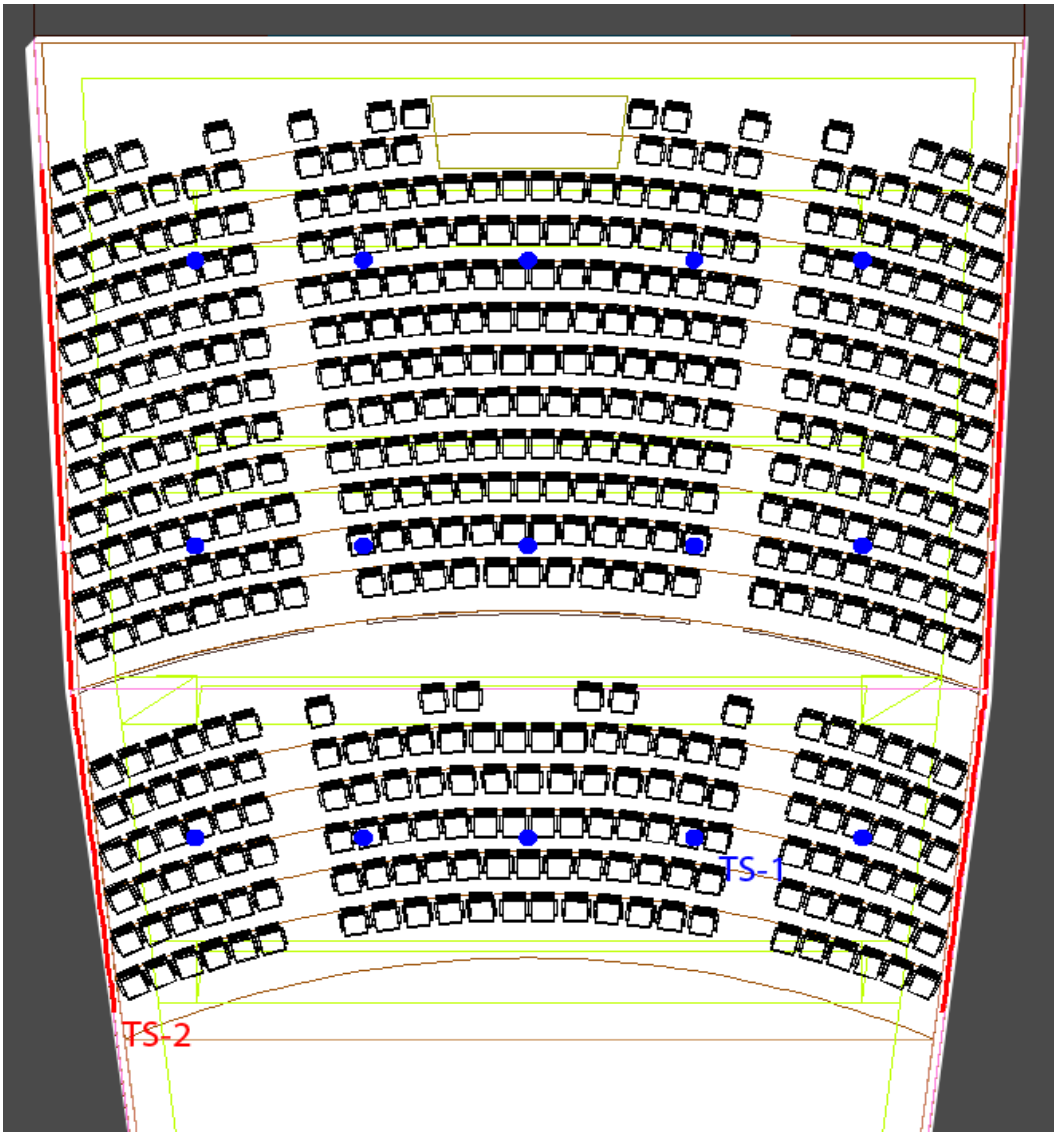


Figure 14 | **Lighting Plan of Performance hall - Sophisticated**

TS-1 | 6” Recessed downlight fixture with Metal halide lamp

TS-2 | Linear Recessed LED

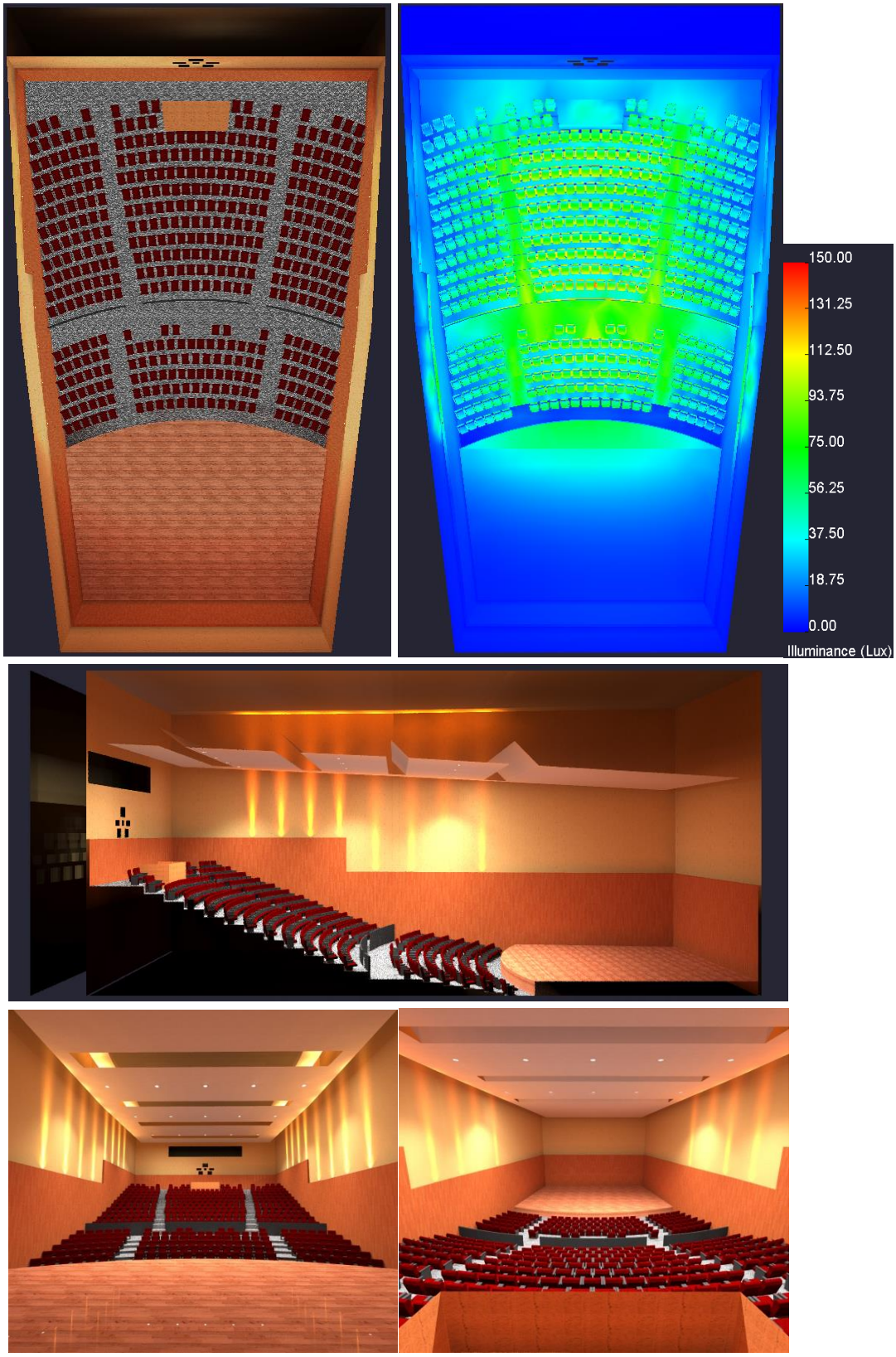


Figure 15 | **Rendering Images of Classical**

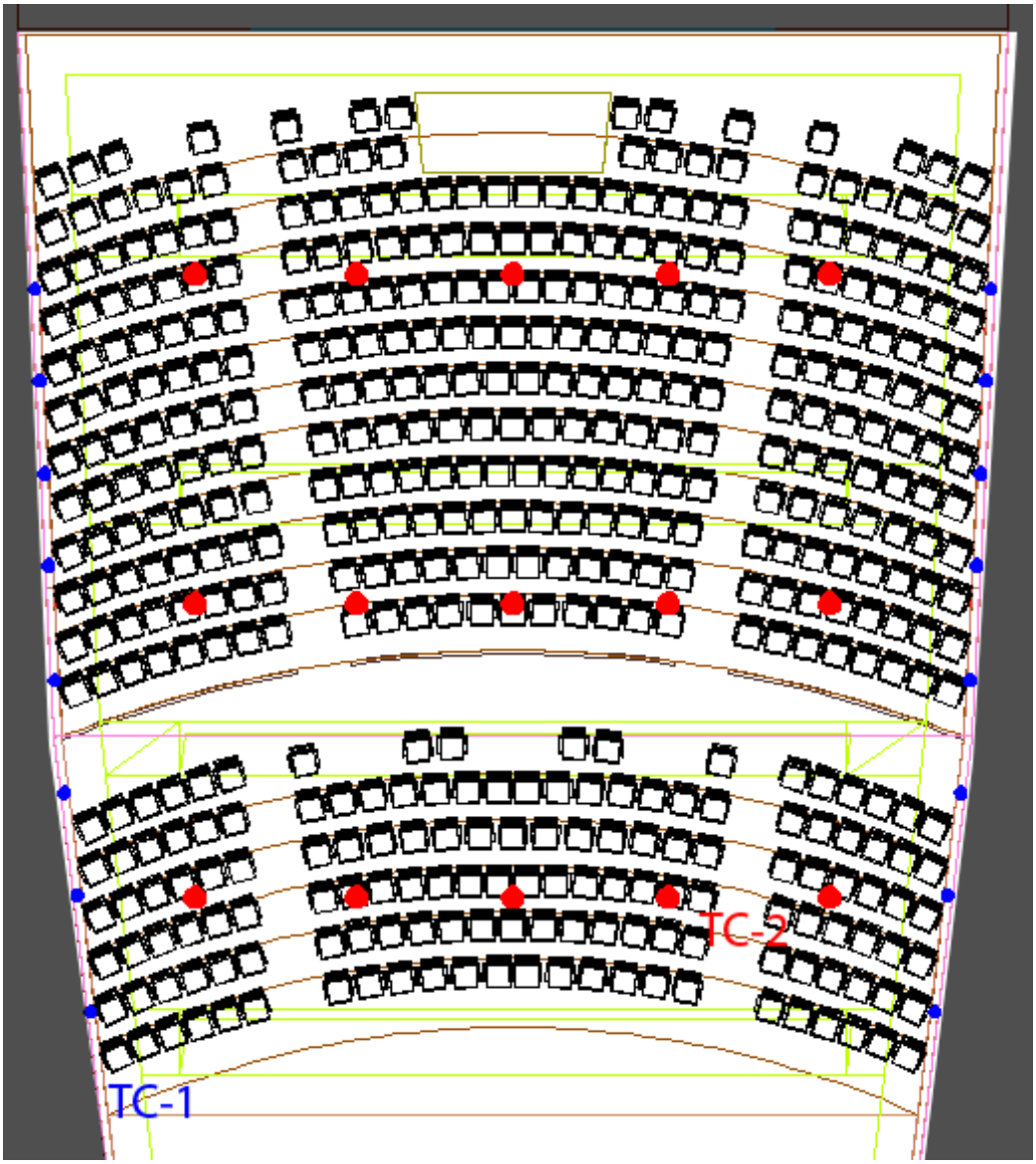


Figure 16 | **Lighting Plan of Performance hall - Classical**

TC-1 | 8” Recessed downlight fixture with Metal Halide

TC-2 | Uplight fixture with LED

Egress Lighting

Since the egress lighting is required on the space for the safety, and to allow occupants to find a way, LEDs aisle lighting is mounted on the arm of the chairs to give small amount of lights on the passageways. Those aisle lightings are faced down to avoid light distraction during the performance. Additionally, LED exit lighting is mounted above egress doors and main entrance doors.

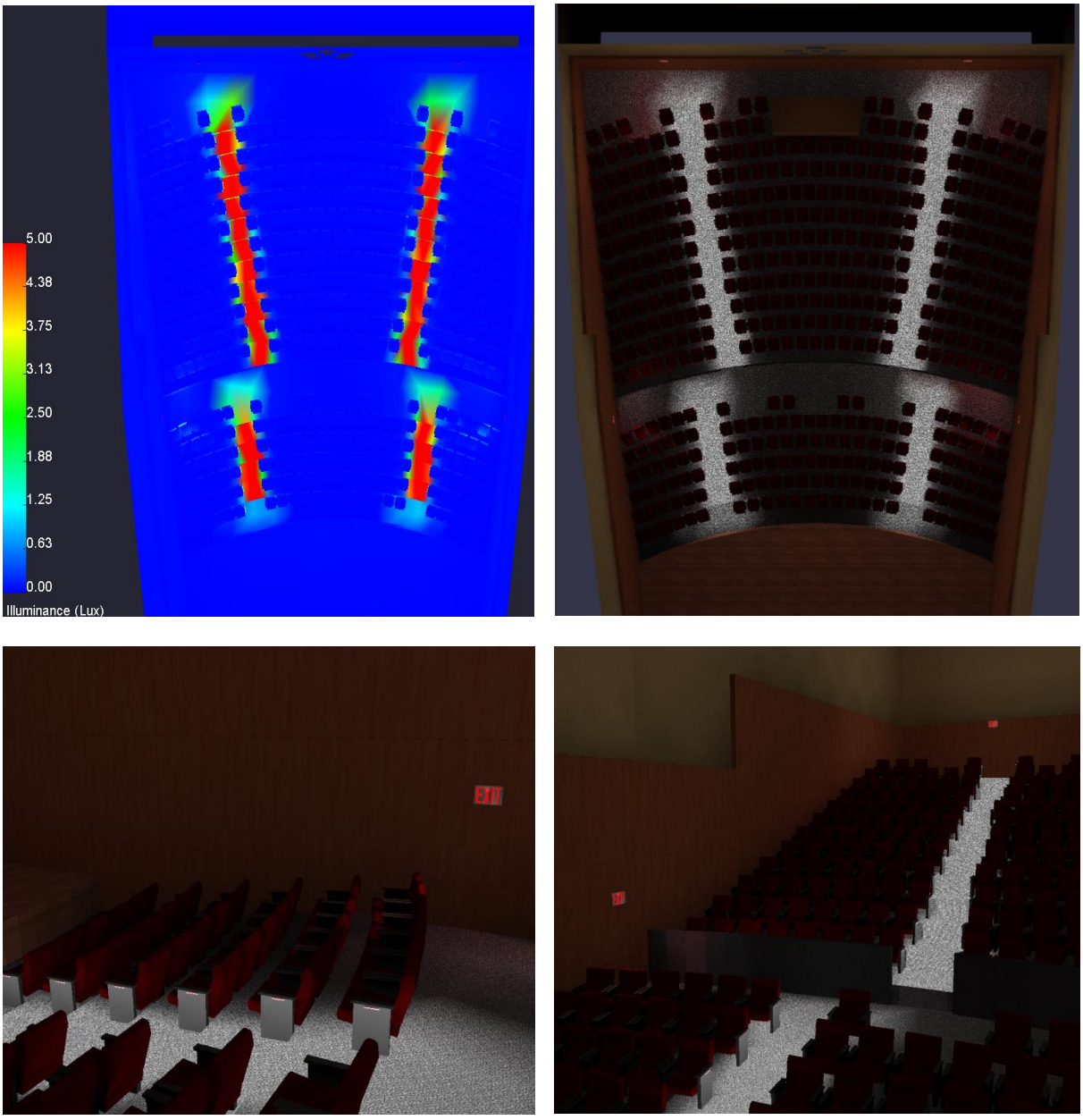


Figure 17 | **Rendering Images of Egress lighting**

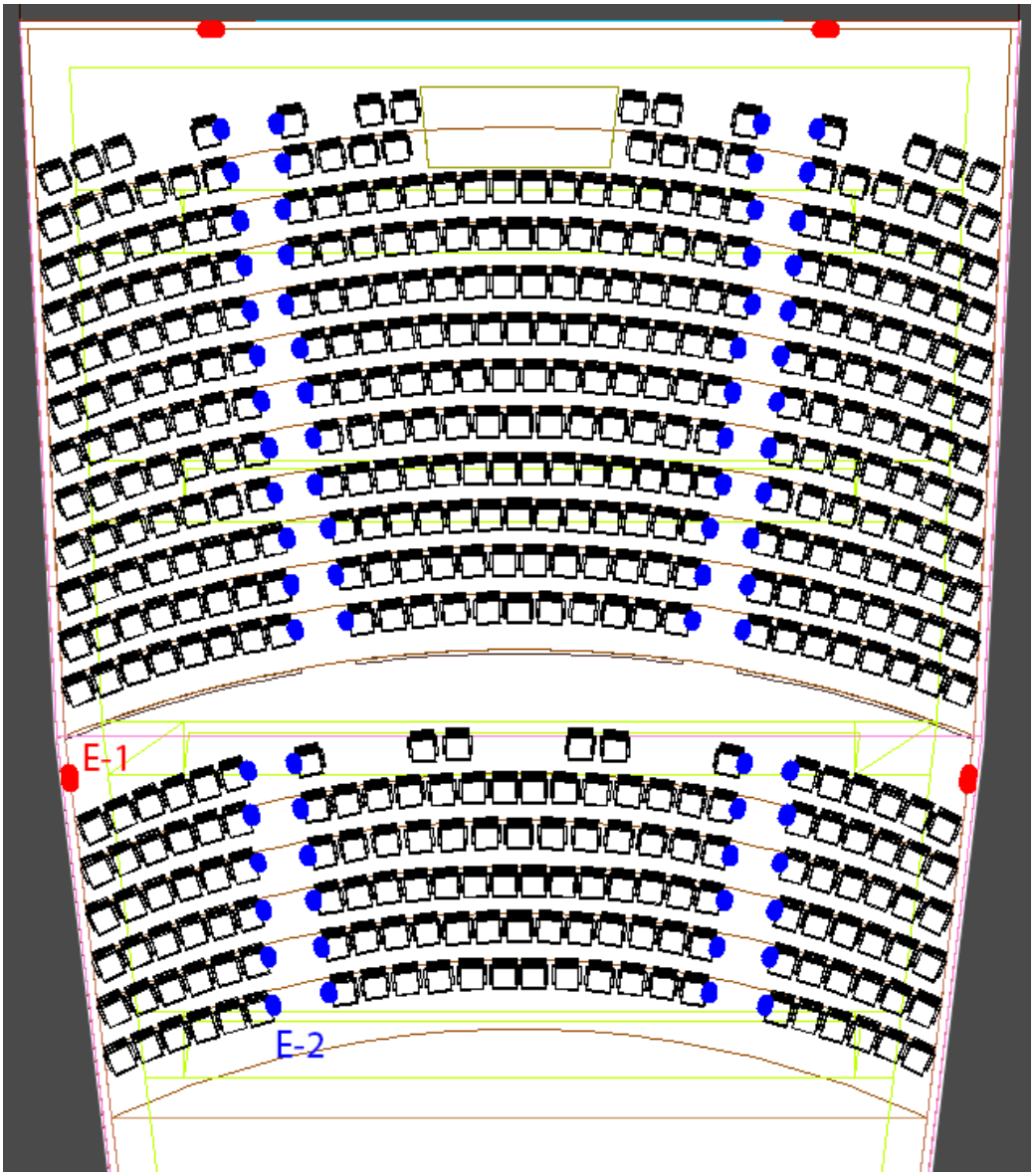


Figure 18 | Lighting Plan of Performance hall - Egress Lighting

E-1 | LED EXIT panel

E-2 | 4-13/16” long LED Seat light

Calculation Data

	Eh (Lux)	Avg:Min
IES Design Criteria	100	2:1
Scene 1 – Modernism	112.3	1.8:1
Scene 2 – Sophisticated	117.8	2.2:1
Scene 3 – Classical	95.3	2.1:1
	Eh (fc)	-
N.F.P.A. Code minimum	0.2 fc	-
Egress Lighting	0.38 fc	-

	Power Density (W/ft^2)
ASHRAE 90.1 (2010)	2.6
Scene 1 – Modernism	0.72
Scene 2 – Sophisticated	0.76
Scene 3 – Classical	0.57

Performance Summary

The all three lighting designs in the performance hall are acceptable with IES design criteria. For the scene 1 - Modernism concept, the linear LED fixtures provided uniform light distribution into the space rather than other two scenes. Also, those fixtures were contributed to provide very ambient light into the space with good color appearance. For the scene 2 – Sophisticated, the metal halide downlights provided highest average illuminance with the 2.2:1 ratio of the average to the minimum than other two scenes. However, the linear LED on the wall perimeter created the unique light patterns onto the side wall, and it showed powerful, but simple light atmosphere in the space. For the scene 3 – Classical, the LED uplight was used to express classical 'Doric column', and provided majestic and warmth environment into the space. However, those uplights gave unnecessarily lights to the above the acoustical ceiling and it should be considered to avoid these lights.

The LED's aisle lighting was mounted on the arm of the chairs to give small amount of lights on the passage ways with 0.38 average foot candle.

Special Purpose Space | Performance Penthouse

Space Description

The Performance Penthouse is located on the ninth floor of the tower. This space houses performances, dance, class, seminars and banquets, with reconfigurable seating for up to 100 people. The full-height windows are located on the North-East, and allow daylights into the space with offering spectacular views along a vista. This space will be analyzed for daylight study and control system integration.

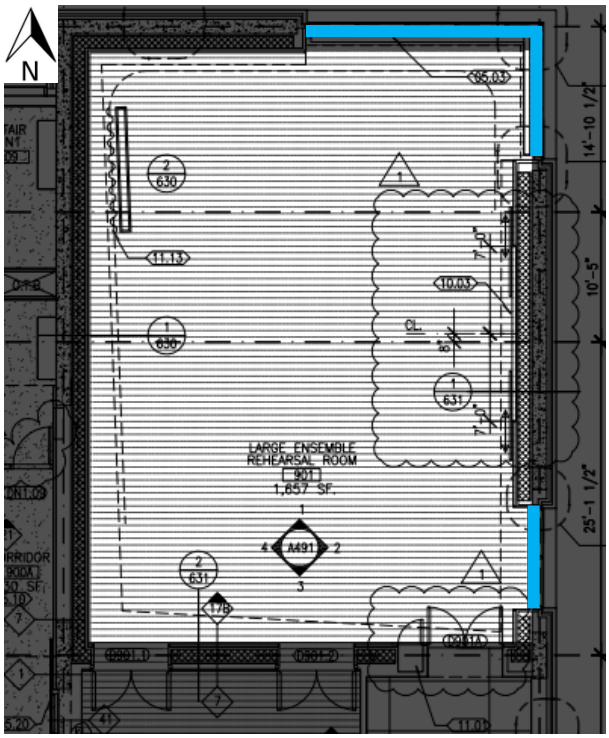


Figure 19 | **Floor Plan of Performance Penthouse**

Dimension

W 34’ x L 47’ x H 30’

Area: 1.657 ft^2

Interior Finish

The most interior finish of the Performance Penthouse is wood panel except the ceiling panel. Solid wood batten panel and walnut wood panel are used for the interior of the wall. The ceiling panel is hanged 5’ below, and consists of acoustical painted metal panel. The table 2.1 describes materials with its reflectance about the each surface.

Space	Surface	Description	Reflectance
Performance Penthouse	Floor	Strup Wood	0.35
	Wall	Solid wood batten panels with Type 4 – Fabric wrapped fiberglass panels behind	0.27
		Perforated wood; panels, sliding panels, panel clad wall	0.3
	Ceiling	Acoustical perforated painted metal panels	0.2

Table 4 | **Interior Finish of Performance Penthouse**

Glazing

The glazed aluminum curtain wall system is applied to the space on the North-East wall. It is high performance acoustical glazing, and consists of 1/2" Laminated Lite [1/4” Low-Iron Lite / .060 PVB / 1/4" Low-Iron Lite with Low-E Coating on surface #4], 1/2” Air space, and 3/4” Laminated Lite [3/8” Low-Iron Lite / 0.060 PVB / 3/8” Clear Lite]. The location of the glazed aluminum curtain wall is showed by blue line on figure xx.

Design Considerations

For various performances in the Performance Penthouse, the daylighting system will be considered to enhance interior environments with providing excellent color rendering. The full-height windows will provide spectacular views along the vista during daytime and nighttime. It helps to connect people to the exterior world, and it would be motivated to the performing people.

In order to provide different work environments to the space, the dimming control system will be considered. It will save the energy by dimming or off the light during daytime. Moreover, the scene control system will be used to serve different tasks during nighttime.

Design Criteria

Application Type	E_h (lux)	E_v (Lux)	Avg:Min	Note
Dance (Performance)	300	500	1.5:1	E_h, and E_v @4' AFF
Music	300	500	2:1	E_h, and E_v @4' AFF
Music Classroom	300	200	2:1	E_h, and E_v @4' AFF

Table 5 | **Illuminance Recommendation [IES Lighting Handbook 10th Edition]**

Application Type	Power Density (W/ft^2)
Classroom/Lecture/Training	1.4

Table 6 | **Energy Allowance [ASHRAE Standard 90.1]**

Design Approach & Concept

The main idea of the lighting design concept for the space came from the words which is "Cultural", because this space holds a lot of activities such as class, banquet, music, and ballet. To support those activities, the lighting design should be considered with flexible and lighting control. Also, the uniform light distribution will be important in this space. The up and down custom pendent fixtures with dimming system will be applied to provide ambient lights. In addition, spot lights will be added to give different lighting scenes for the various activities.

Computer Rendering

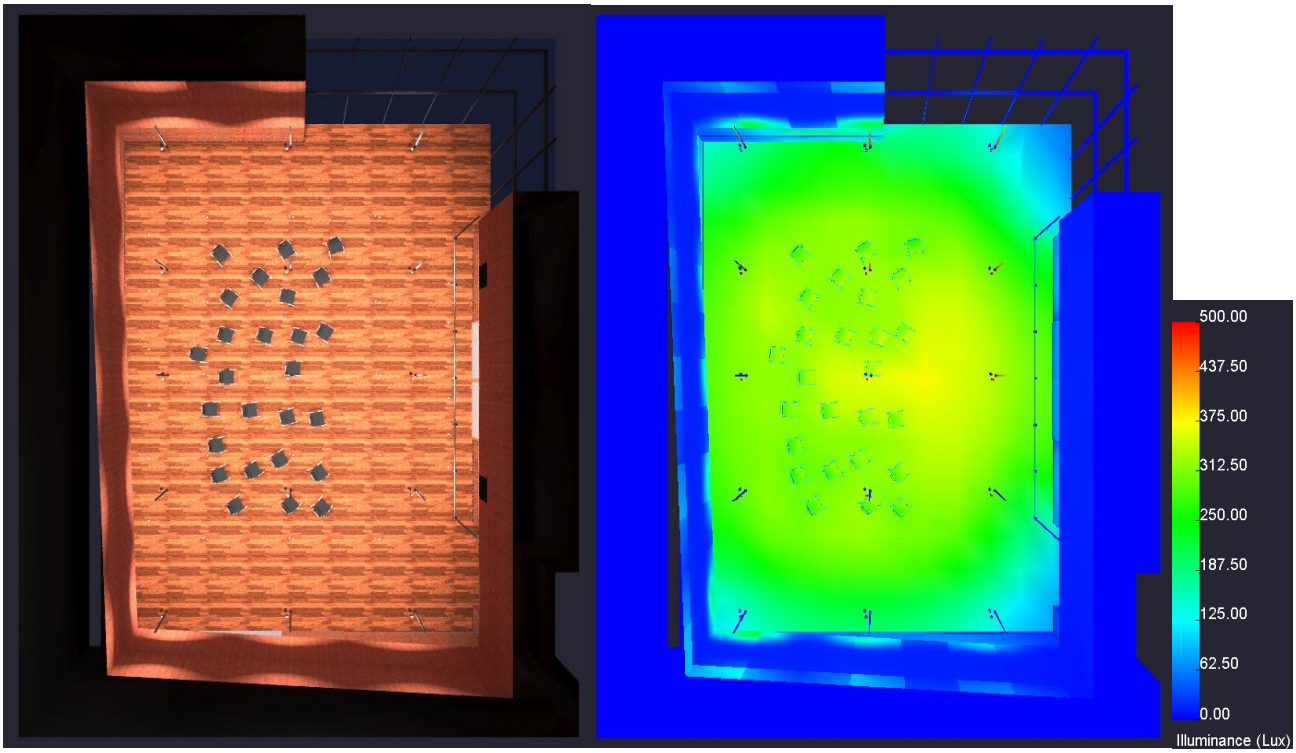
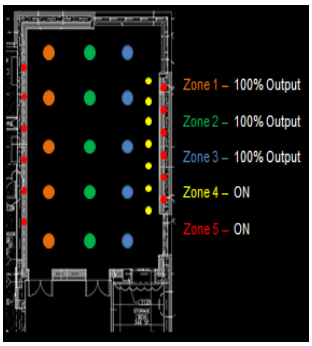
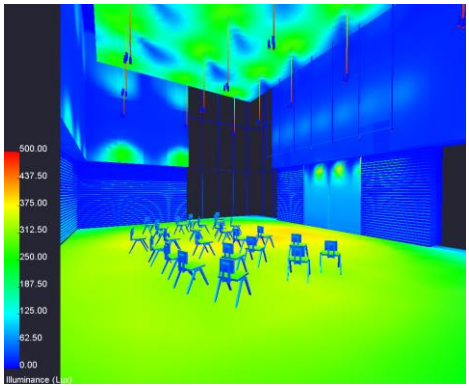


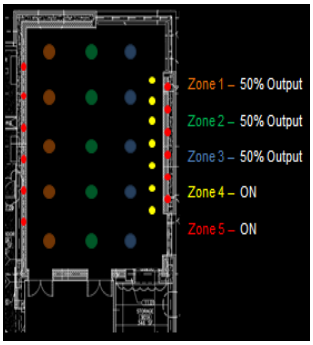
Figure 20 | **Rendering image of Performance Penthouse**

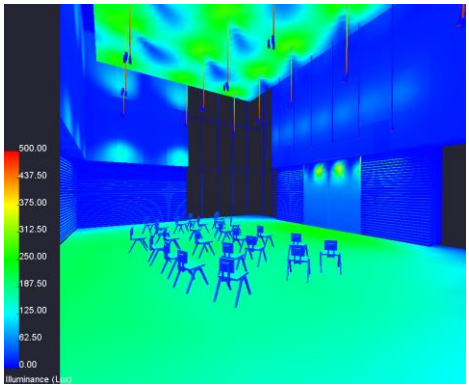
Scene 1 – All Lights On



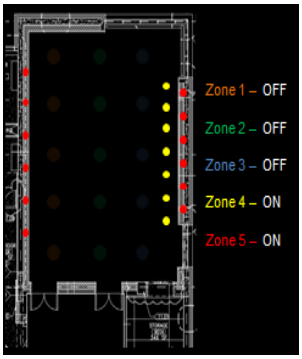


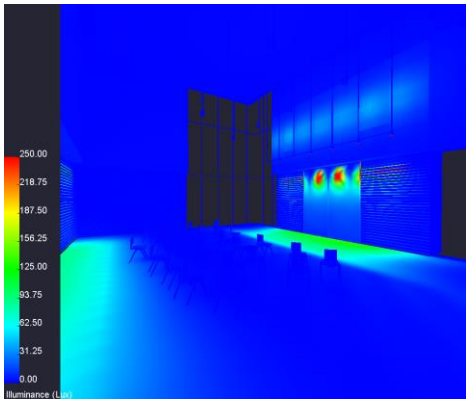
Scene 2 – 50% Output of Zone 1,2 and 3



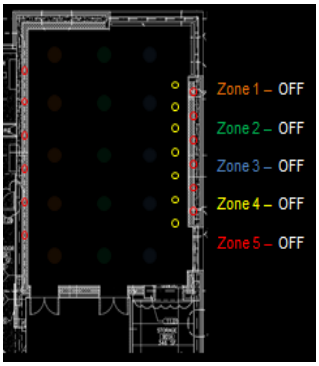


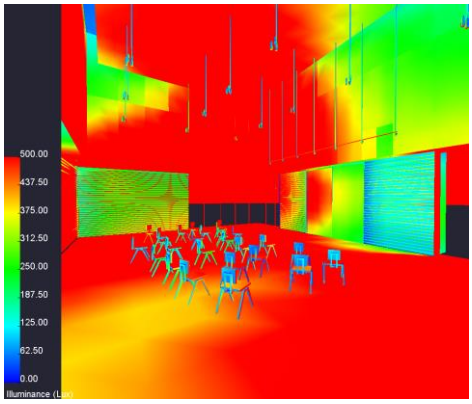
Scene 3 – Lights Off of Zone 1, 2 and 3



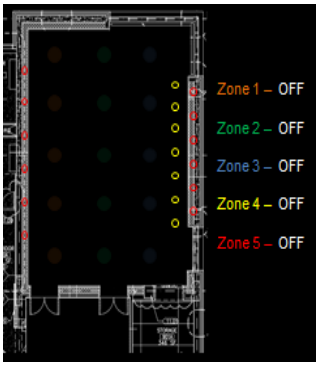


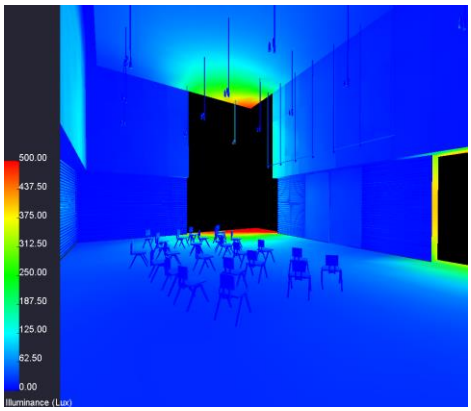
Scene 4 – During Daytime @ 7:30 on June,21



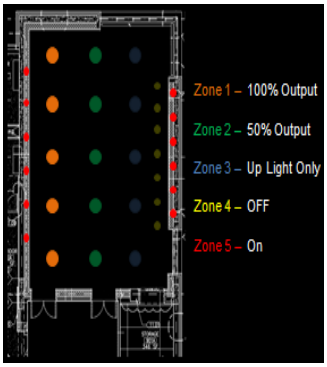


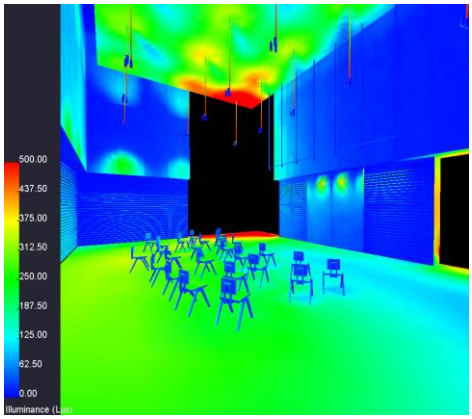
Scene 5 – During Daytime with shade @ 7:30 on June, 21





Scene 6 – 100% Output on Zone1, 50% Output on Zone 2, Only uplight on Zone 3 with Recessed downlight





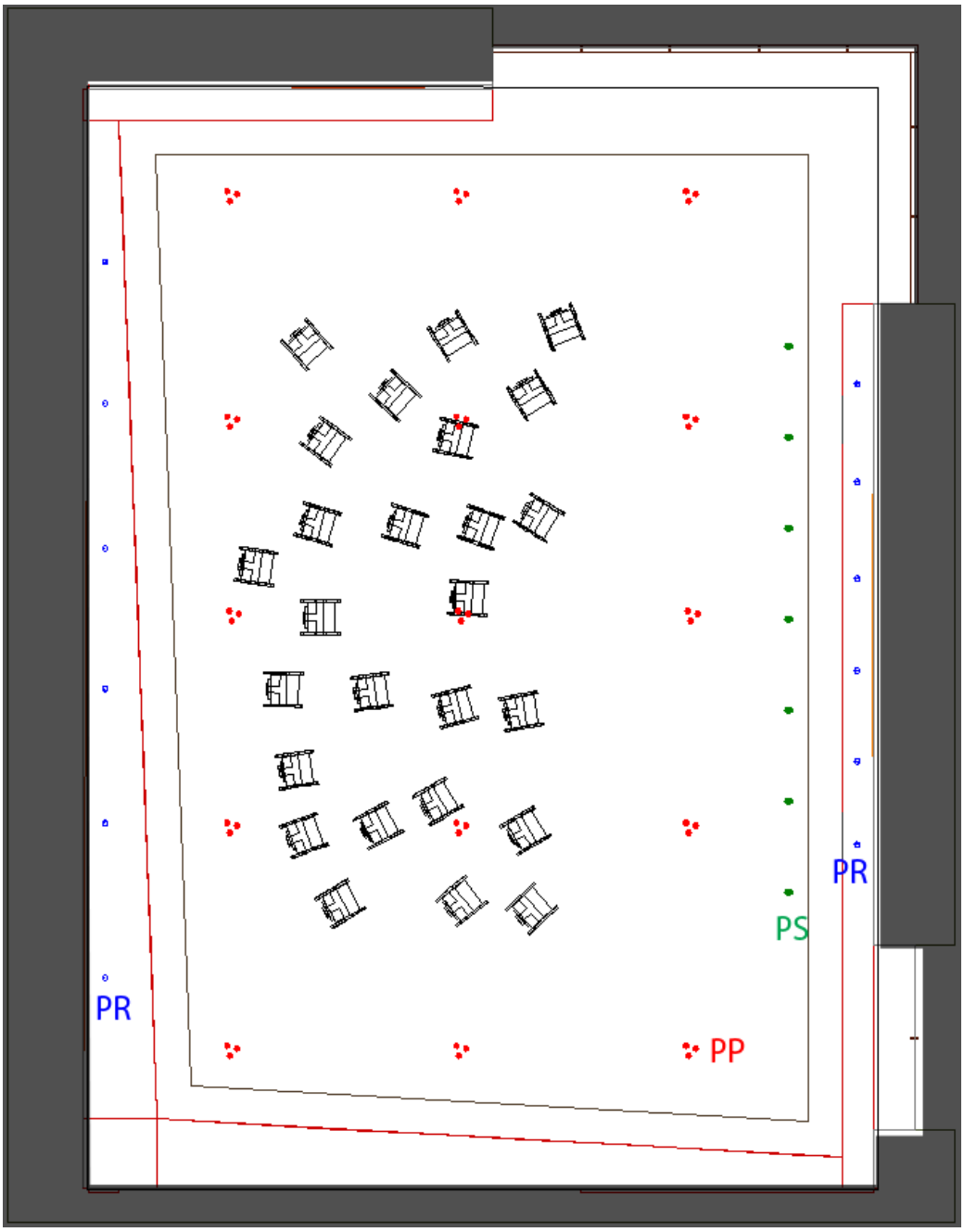


Figure 21 | **Lighting Plan of Performance Penthouse**

PP | Pendent fixture with LED (2) for down (1) for up
PS | LED Spot fixture
PR | 3" Recessed LED downlight

Calculation Data

	Description	Eh (Lux)	Avg:Min
IES Design Criteria		300	1.5:1
Scene 1	All lights On	338.26	1.6:1
Scene 2	50% Output of Zone 1, 2 and 3	191.68	1.5:1
Scene 3	Lights off of Zone 1, 2 and 3	32.53	-
Scene 4	During Daytime @ 7:30 on June,21	-	-
Scene 5	During Daytime with shade @ 7:30 on June, 21	87.26	5.16:1
Scene 6	100% Output of Zone 1, 50% Output of Zone 2, and only uplights of Zone 3 with Recessed downlights	254.52	3.1:1

	Power Density (W/ft^2)
ASHRAE 90.1 (2010)	1.4
Performance Penthouse	1.07

Performance Summary

Overall, the flexible lighting system was supported by giving different lighting zones with control systems. There are five different lighting zones to provide different illuminance values for the different performance or activities. As you see the Scene 1, this is used when the space houses classes, and dance such as when it needed 'bright' in the space, and It gave 338.26 lux that sufficient illuminance to support those activities. Also, other activities such as banquet or social activities could be supported by dimming of zone 1, 2, and 3.

As you see the floor plan of the performance penthouse, there are full-height windows located on the east and north side. Those windows are installed with a shade system to block the strong direct sunlight and to make a space darker during the morning. The average illuminance on the space drops to 87.26 lux with shading on June, 21 at 7 am. And the average illuminance could be increased up to 250 lux by controlling lighting zone 1, 2, and 3. However, the ratio of the average to minimum for the illuminance is very larger than other scenes due to the daylights near the window.

=

Circulation Space | Main Lobby

Space Description

The main lobby is primary access to the building. The stair near the entrance, allows the people to the tower directly. Also, it is connected to the *GIDWITZ Lobby* where is the daylight feature space with a stairway leading up to terraces both indoor and outdoor audience overflow. The corridor on the lobby is used for gallery, and exhibition.

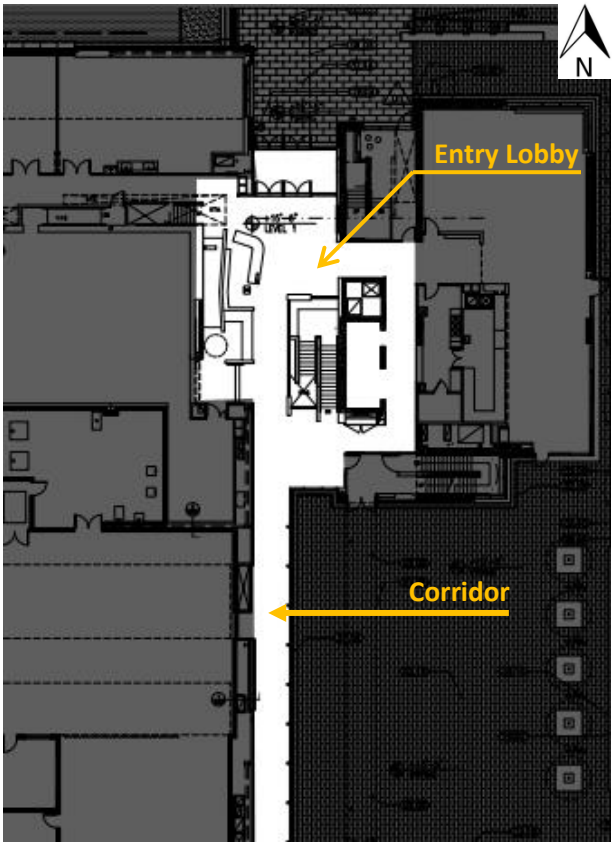


Figure 22 | Floor Plan of Main Lobby

Dimension

Entry Lobby: Approx. W 37’ x L 77’ x H 10’ AFF

Corridor: Approx. W 8’ x L 180’ x H 10’ AFF

Interior Finish

The entire floor of the main lobby is finished with 18" x 36" Stone tile, and the most wall of the main lobby is finished by white painted gypsum board. Additionally, the ceramic tile and felt wall carpeting are used for entry lobby, and GIDWITZ lobby. The table 3.1 describes the detail interior finishes for the entry lobby, corridor, and GIDWITZ lobby.

Space	Surface	Description	Reflectance
Main Entry	Floor	18” x 36” Stone Type 1 with 6” metal base	0.47
	Wall	Painted metal wall panel	0.45
		Ceramic Tile Type 3	0.6
		Painted Gypsum wall board	0.7
	Ceiling	Painted Type 1 – Gypsum wall board	0.75
Corridor	Floor	18” x 36” Stone Type 1 with 6” metal base	0.47
	Wall	Painted Gypsum Wall Board	0.7
	Ceiling	Painted Type 1 – Gypsum wall board	0.75

Table 7 | Interior Finshes of Main Lobby

Design Consideration

As the entry lobby is a main entrance to the building and delivers people to the stair that access to the tower and lower level, the transition will be important with proper lights amount. The illuminance criteria and accents are an important aspect of making comfortable and safe transitions. The lamp types and color qualities should be matched for purpose of visual consistency. The daylight feature will be considered to make a space more enjoyable for the people.

Design Criteria

Application Type	E_h (lux)	E_v (lux)	Avg:Min	Note
Lobby - Day	100	30	4:1	E_h@floor, E_v@5' AFF
Lobby-Night	50	20	4:1	E_h@floor, E_v@5' AFF
Reception Desk	150	50	4:1	E_h@2.5' AFF, E_v@3.5' AFF
Adjacency Passageways	Avg ≥ 0.2 x E_h of adjacent space	Avg ≥ 0.2 x E_v of adjacent space	3:1	E_h@floor, E_v@5' AFF
Independent Passageways	50	30	2:1	E_h@floor, E_v@5' AFF

Table 8 | **Illuminance Recommendation [IES Lighting Handbook 10th Edition]**

Application Type	Power Density (W/ft²)
Lobby	1.3
Corridor/Transition	0.5

Table 9 | **Energy Allowance [ASHRAE Standard 90.1]**

Design Approach & Concept

The main lobby is the first space that people meets in the building. Therefore, the welcoming environment with powerful atmosphere will be considered in this space. The main idea of the lighting design concept is from the architect's thought which is "flat prairies of the Midwest". Since the Midway Plaisance Park has been a landmark for the University of Chicago, two horizontal lines from the Midway Park and applied with cove lighting fixtures to the ceiling of main lobby to connect the inside and outside of the building and to provide powerful atmosphere. Also, it will be navigated for the people to find a way easily. Downlight fixture is used to give additional lights in information desk and stair. Also, the architectural wall is emphasized with glazed lighting fixture by providing deep shadow on the surface.

Figure 23 | **Midway Plaisance Park**

Computer Rendering

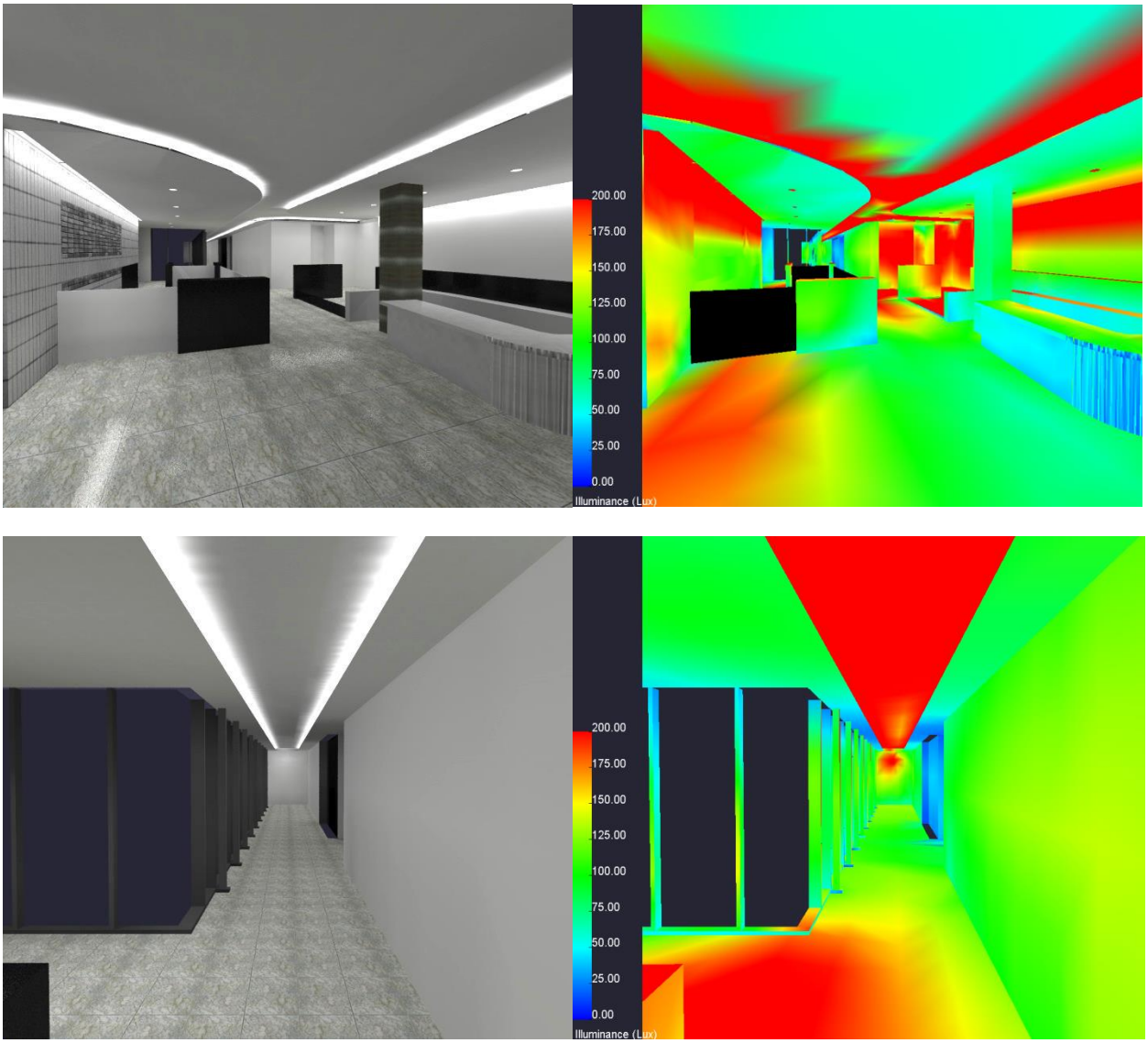


Figure 24 | **Rendering images of Main Lobby**

Figure 25 | **Rendering image of Architectural wall in Main Lobby**

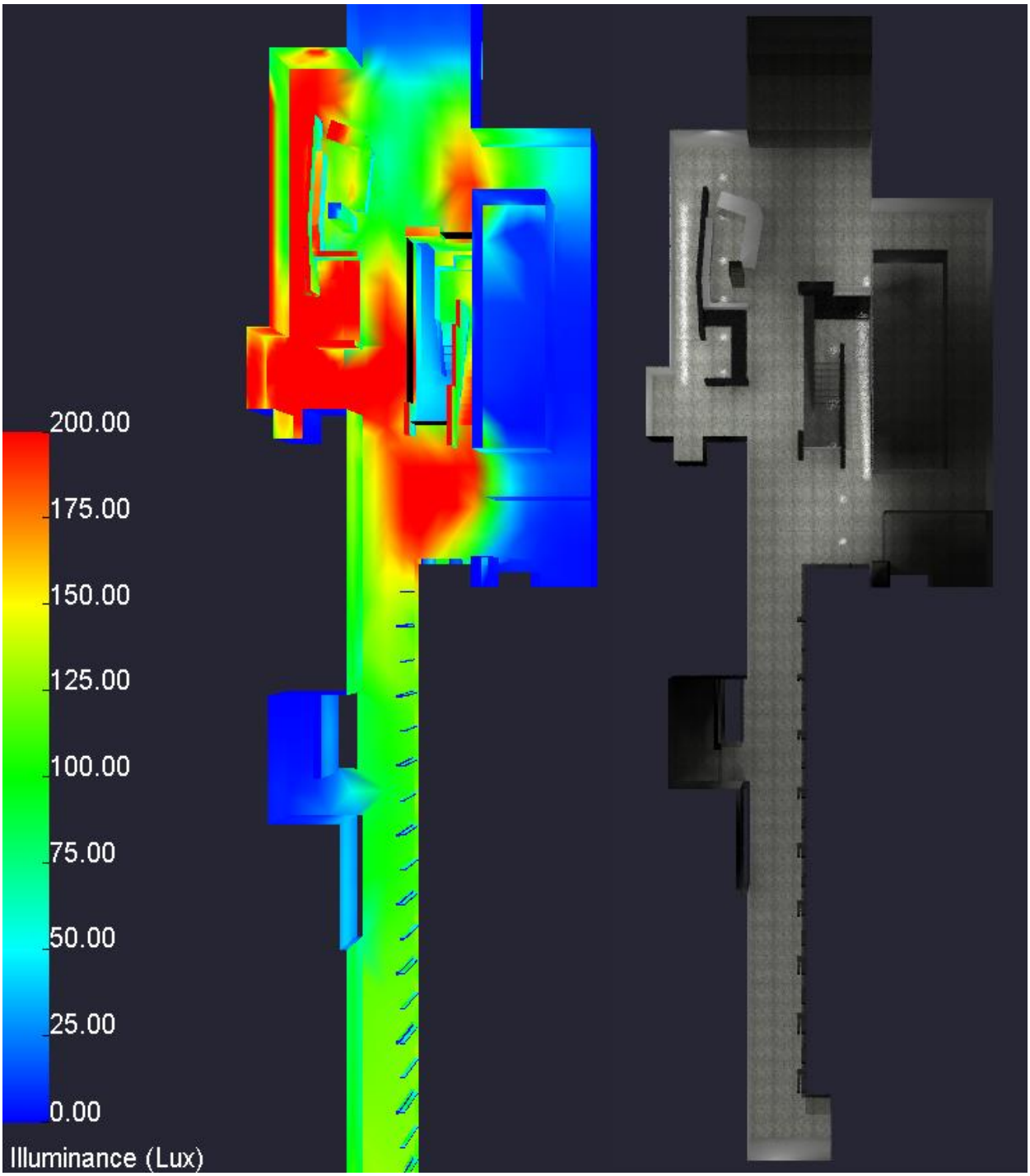
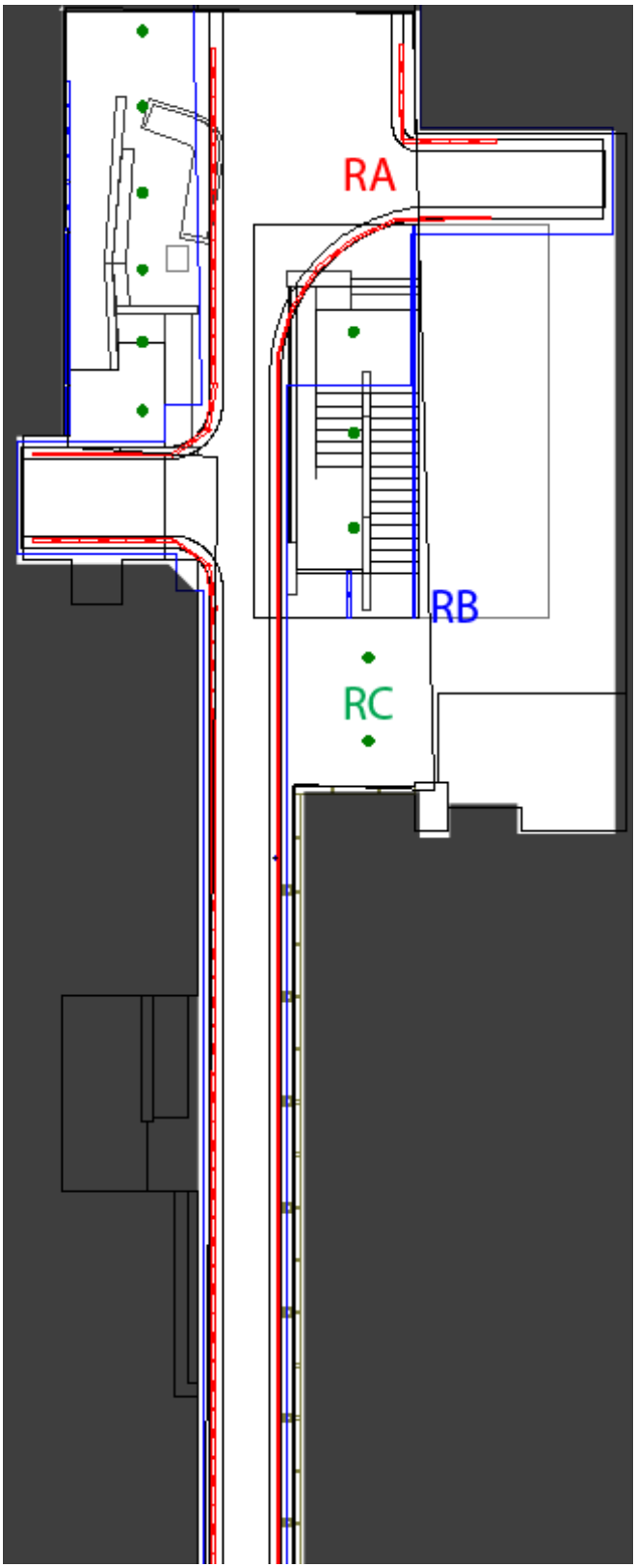


Figure 26 | **Main Lobby and Corridor**



RA | LED 4’ Cove lighting
RB | LED 4’ Wall grazing
RC | 6” Recessed downlight with Compact Fluorescent

Figure 27 | **Lighting Plan of Main Lobby**

Calculation Data

	E_h (lux)	Avg:Min
Design Criteria: Lobby	50	4:1
Design Proposed: Lobby	95.19	1.92:1
Design Criteria: Reception Desk	150	4:1
Design Proposed: Reception Desk	164.6	2.2:1
Design Criteria: Corridor	50	2:1
Design Proposed: Corridor	95.8	1.85:1

	Power Density (W/ft^2)
ASHRAE 90.1 (2010):Lobby	1.3
Design Proposed: Lobby	0.64
ASHRAE 90.1 (2010): Corridor	0.5
Design Proposed: Corridor	0.87

Performance Summary

The Cove lighting was used to provide powerful and welcoming atmosphere in the Main lobby for the occupants. Also, it navigates the people to other transition spaces easily. To give more lights on the reception desk, and grab attentions from the people, the recessed downlight with compact fluorescent was used. There is one architectural wall near the stair, and it is highlighted with wall-glazing lights to create unique light patterns with deep-shadow on the materials. The overall lighting design of the Main lobby satisfied the design considerations, but the average illuminance of the corridor is higher than design criteria recommended from IES Lighting Handbook 10th Edition. However, this value met with 10 fc which is a recommend illuminance value from the *Interior Lighting of Facilities Services Facility Standards – Electrical System* for the University of Chicago.

One problem issue on the main lobby is that the power density of the corridor is 0.87 watts per square feet which is almost double of 0.5 recommend power density from ASHRAE 90.1. The reason is that many cove lightings are used on the two parallel lines of the ceiling. So, I would like to suggest one line of the ceiling with cove lighting fixtures to decrease power density on the corridor.

Outdoor Space | Courtyard

Space Description

The Courtyard is placed at outdoor, and surrounded by Logan Center building and Midway Studio building. It allows people to access to tower and performance hall directly. This space is provided as a rest area and café for the students; and used for class, exhibition, and outdoor performance sometimes.

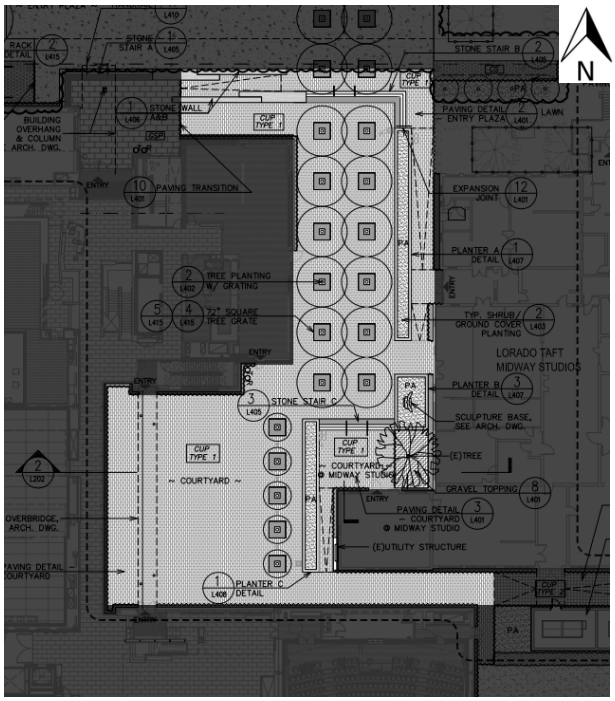


Figure 28 | **Floor Plan of Courtyard**

Dimension

Approx. W 60’ (Widest) x L 144’ (Longest)
Area: Approx. 10,700 ft^2

Interior Finish

As the courtyard is located at the outside, the floor is the only interior finish, and consists of concrete unit paver type 1

Space	Surface	Description	Reflectance
Courtyard	Floor	Concrete Unit Paver Type 1	0.5

Table 10 | **Exterior Finishes of Courtyard**

Design Consideration

For the outdoor lighting zone, the courtyard should be defined as LZ3 which is moderate ambient lighting since the courtyard could be used for the outdoor performance, and banquets. Accent light should be important to provide visual relief and visual attraction for wayfinding. The entry lighting should transition between the indoor and outdoor lighting condition. The safety also should be considered, but it is not necessarily uniform or continuous. The Illumination ratio in table 4.4 is the ratio average illuminance on focal point typically of vertical orientation to average illuminance on primary task plane typically of horizontal orientation. The recommendations lighting level for the Courtyard will be 5 fc by International Dark-Sky Association.

Design Criteria

Application Type	Attraction	Role	Illumination Ratio	Note
Performance Area	Moderate	Feature	~5:1 focal-point-to-task	Eh@pavement, and Ev @5' AFG
Perimeter (on wall plane or trees)	Soft	Visual Edge	~2:1 focal-point-to-task	Eh@pavement, and Ev @5' AFG

Table 11 | **Illuminance Recommendation [IES Lighting Handbook 10th Edition]**

Application Type	Power Density (W/ft^2)
Walkway 10ft wide or greater	0.2

Table 12 | Energy Allowance [ASHRAE Standard 90.1]

Computer Rendering

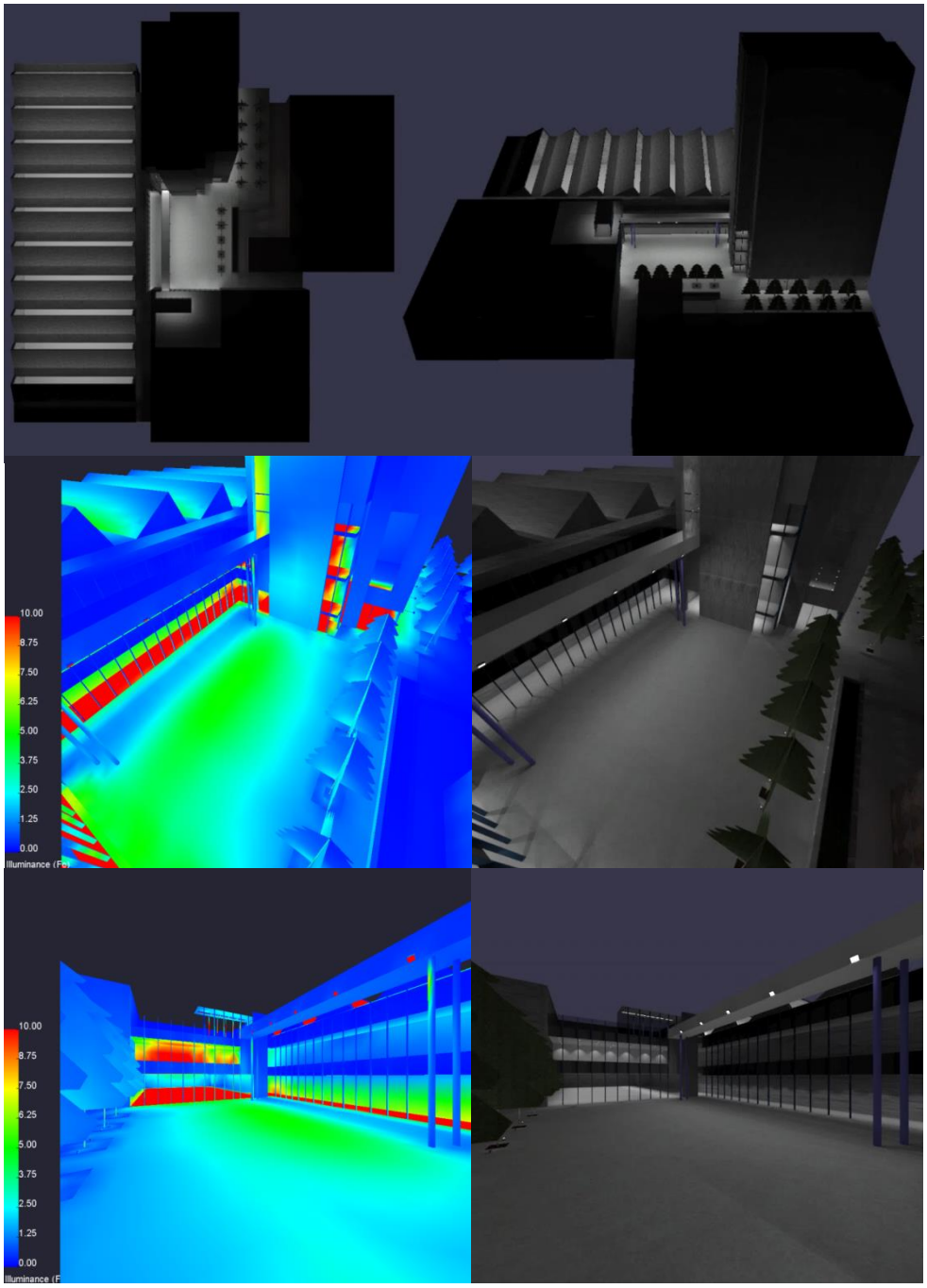


Figure 29 | Rendering images of Courtyard

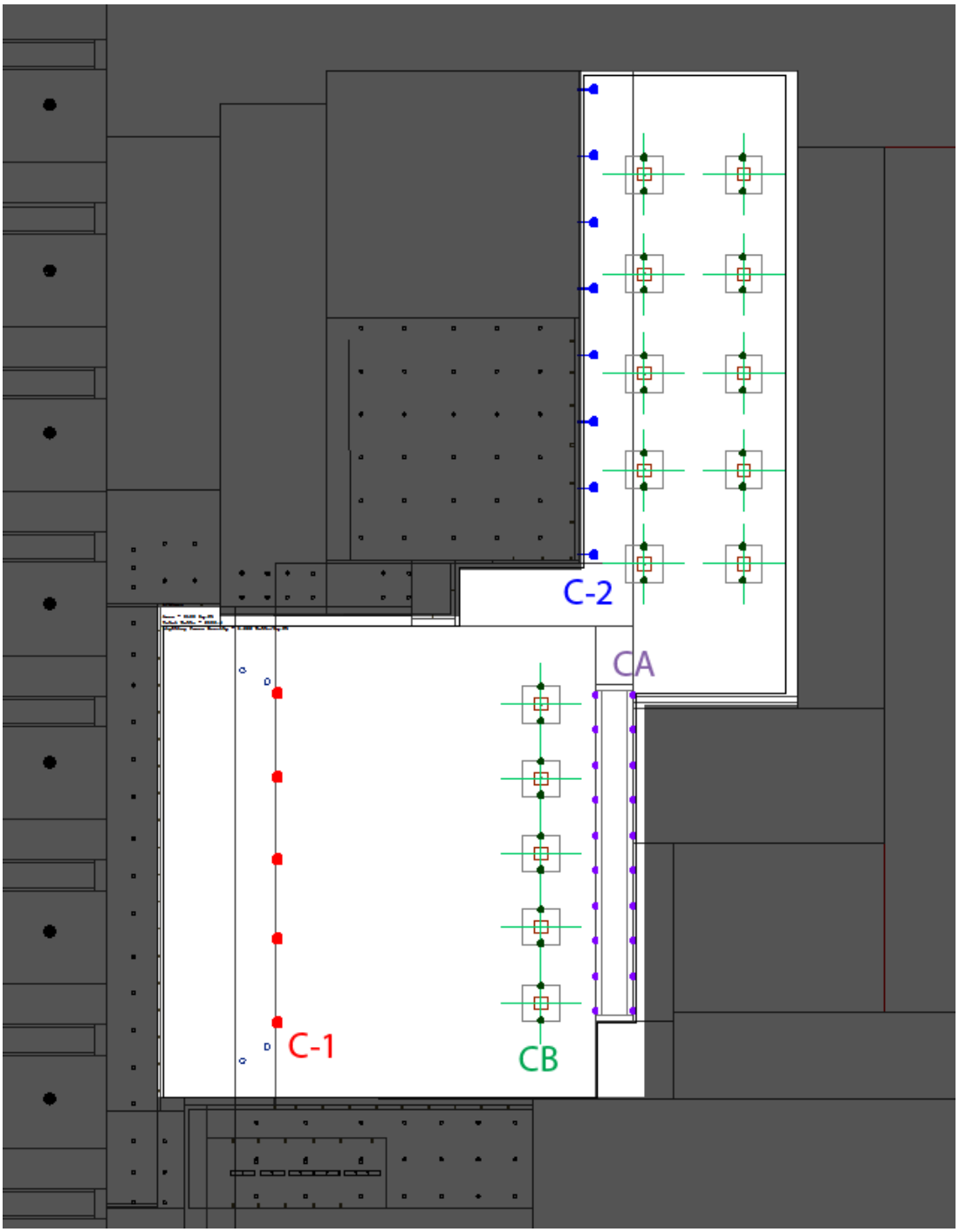


Figure 30 | **Lighting Plan of Courtyard**

C-1 | Outdoor wall surface flood light with Metal Halide
C-2 | Outdoor wall arm fixture with Compact fluorescent
CA | Recessed step LED light
CB | Outdoor landscape fixture with PAR30

Calculation Data

	E_h (fc)
Design Criteria	5
Design Proposed	3.2

	Power Density (W/ft^2)
ASHRAE 90.1 (2010)	0.2
Design Proposed	0.22

Performance Summary

Due to the space is surrounded by Logan Center building and Midway Studio building, the light trespass was considered carefully to avoid light travel into the inside of the building. So, I used the outdoor flood lights with wall-arm, and made their facing away from the building. Those fixtures provided 3.2 fc of average illuminance on Courtyard. Also, I used outdoor landscape spot lights with halogen lamps to highlight the exterior trees. The recessed step LED fixtures are used on the surface of the rectangular stone garden podium to give lights on the walkway.

The power density is 0.22 watts per square feet that is acceptable with a recommended power density from ASHRAE, but little higher. So, the outdoor landscape spot light should be used as one for each tree instead of using two.

ELECTRICAL DEPTH

Overview

The electrical depth will involve the electrical systems to save energy and cost for the Logan center. Following studies on the below will be analyzed and conducted.

- High - Efficiency Transformer
- Main Circuit Breaker for distribution switchboard
- Emergency Generator size

Those studies will be analyzed and modified if they are not violated the *Illinois Chicago Electrical Code*, and the *Facilities Services Facility Standards – Electrical System* from the University of Chicago.

Study of High - Efficiency Transformer

The *Facilities Services Facility Standards (FS) – Electrical System* from the University of Chicago, it provides standard information for the low-voltage transformer for the building of the University of Chicago. Following lists on the below are the requirements for the low-voltage, dry-type transformers rated 600V and less, with capacities up to 1000 KVA.

- All Transformers must have copper winding. Aluminum windings are not acceptable
- All Transformers must be delta-wye configuration.
- Transformers 15 kVA or smaller shall have (2) 5% FCBN (full capacity below normal) primary taps and transformers larger than 15 kVA shall have (2) 2.5% FCAN (full capacity above normal and) and (4) 2.5% FCBN primary taps
- Enclosures
    - Indoor – Ventilated, NEMA 250, Type 2
    - Outdoor – Ventilated, rain-tight, NEMA 250, Type 3R
    - Other Wet or Damp Indoor – Ventilated, drip-proof, NEMA 250, Type 2
- All Transformers shall have insulation class of 220 deg C with a maximum of 80 deg C rise under full load above 40 deg C ambient temperature.
- K-Rated transformers shall be used when serving loads with a high degree of harmonics.

Schedule of Existing Transformers in Logan Center for the Arts						
No.	**Rating of Unit**	**Primary V**	**Secondary V**	**Location**	**Feeding to**	**Note**
T-1	150 kVA	277/480	120/208	Lower Level	to LV-EM-LL	Switchboard
T-2	57 kVA	277/480	120/208	Lower Level	to EM-PP-LL	Panelboard
T-3	45 kVA	277/480	120/208	First Floor	to PP-TH-1	Panelboard
T-4*	30 kVA	277/480	120/208	Lower Level	to LP-AV-LL	Panelboard
T-5*	30 kVA	277/480	120/208	First Floor	to LP-AV-1	Panelboard
T-6	76 kVA	277/480	120/208	Eleventh Floor	to TLP-7-11	Panelboard
T-7	300 kVA	277/480	120/208	Lower Level	to LV-DP-LL-N	Switchboard
T-8	112.5 kVA	277/480	120/208	Second Floor	to TLP-3-6	Panelboard
T-9	75 kVA	277/480	120/208	Second Floor	to PNL-#1	THEATRICAL BRK at 245
T-10	45 kVA	277/480	120/208	Second Floor	to PP-TH-2B	Panelboard
T-11	225 kVA	277/480	120/208	Lower Level	to SP-201, Dimmer Racks 201,202	at 245
T-12	150 kVA	277/480	120/208	First Floor	to SP-101, Dimmer Racks 101,102	at 245
T-13	75 kVA	277/480	120/208	Second Floor	to PNL-#2	THEATRICAL BRK at 245
T-14	45 kVA	277/480	120/208	Second Floor	to PP-TH-2A	Panelboard
T-15	not shown in Single-Line Diagram					
T-16	45 kVA	277/480	120/208	Third Floor	to PP-SR	Panelboard
T-17	75 kVA	277/480	120/208	Second Floor	to PNL-#1	THEATRICAL BRK at 210B
T-18	75 kVA	277/480	120/208	Second Floor	to PNL-#2	THEATRICAL BRK at 210B
T-19	225 kVA	277/480	120/208	Second Floor	to Dimmer Racks 1,2,3	at 210B
T-20	500 kVA	277/480	120/208	Lower Level	to LV-SB-SS-S	Switchboard
T-21	45 kVA	277/480	120/208	Lower Level	to Courtyard Projection	
T-22	30 kVA	277/480	120/208	Eleventh Floor	to Dimmer Racks 301	at 301
T-23	45 kVA	277/480	120/208	Lower Level	to LP-LL-NA	Panelboard
note:	T-15 could not be found from single-line diagram					
	* ISO XFMR					

Table 13 | Schedule of Existing Dry-type Transformer

Due the characteristic of the building, the workshop studios in this building are equipped with many work tools machines such as plasma cutter, vertical band saw, drill press, bench grinder, and cutoff saw bench. So, all existing transformers are designed as K-rated transformer to handle the heat generated by harmonic currents from non-linear loads such as fluorescent lamps, electric welding machines. As you see the table above, T-4 and T-5 are designed as Isolation transformer, and T-20 with 500 KVA is designed with K factor of 13. All existing transformers are designed as NEMA TP-1 for energy efficiency.

Proposed Solution

Even though existing transformers are meets for NEMA TP-1 for the energy efficiency, there is possible change to lower energy loss, and operating costs. The EATON provides a NEMA Premium efficiency transformer. This transformer provides 30 percent less losses than similar-sized NEMA TP-1 efficiency models while lowering energy consumption, resulting in reduced operating costs and harmful emissions.

Figure 31 | NEMA Premium Efficient Transfromer [from EATON]

- Recognized efficiency of NEMA Premium efficient transformers is measured at 75 degrees C and with a linear load of 35 percent of full load rating
- Available as general purpose, K Factor or harmonic mitigating
- Designed, manufacture and tested per applicable standards, including ULT 1561, NEMA ST 20, NEMA TP-1, DOE 10 CFR Part 431 and the NEMA Premium efficiency transformers program
- Manufactured in an ANSI 61 gray polyester powder-coat-painted NEMA type 2 enclosure which is easily converted to NEMA 3R when fitted with a weathershield kit

Energy Saving Calculation

Quantity	KVA	Material	Type	
3	30.0	Aluminum / Copper	K-Rated*	X
6	45.0	Aluminum / Copper	K-Rated*	X
5	75.0	Aluminum / Copper	K-Rated*	X
2	112.5	Aluminum / Copper	K-Rated*	X
2	150.0	Aluminum / Copper	K-Rated*	X
2	225.0	Aluminum / Copper	K-Rated*	X
1	300.0	Aluminum / Copper	K-Rated*	X
1	500.0	Aluminum / Copper	K-Rated*	X

Figure 32 | Schedule of New Dry-type Transformer

To calculate the energy saving per year, the type of building is assumed as education. The electricity rate of the Illinois state is set as 0.1057 per KWH by EATON transformer energy savings calculator. Since they don't provide transformers rating 57KVA and 76 KVA, they are assumed as 75KVA and 112.5 KVA.

Total Loss Per Year

Selected BOM				NEMA-TP1		NEMA Premium	
Qty	KVA	Mat'l	Type	Total Loss		Total Loss	
3	30	Copper	K-Rated*	5.83	MWH	3.54	MWH
6	45	Copper	K-Rated*	14.84	MWH	8.68	MWH
5	75	Copper	K-Rated*	19.15	MWH	12.57	MWH
2	112.5	Copper	K-Rated*	9.57	MWH	5.98	MWH
2	150	Copper	K-Rated*	12.87	MWH	8.19	MWH
2	225	Copper	K-Rated*	16.34	MWH	11.68	MWH
1	300	Copper	K-Rated*	10.85	MWH	7.49	MWH
1	500	Copper	K-Rated*	18.31	MWH	10.68	MWH
			Total Energy Lost by Transformers	**107.76**	**MW**	**68.8**	**MW**
			Energy Lost to Heat	**367.7**	**MBTU**	**234.75**	**MBTU**

Energy Life Cycle Costs

Per Year	$11,390	$7,271
Over 1 Year and 2.5% Inflation	$11,389	$7,270
Over 1 Year and 1% Inflation	$11,390	$7,271

Summary

Savings Comparison

Energy Cost Savings Per Year	$4,119	
Energy Cost Savings Over 1 Year with 2.5% Inflation	$4,119	
Energy Cost Savings Over 1 Year with 1% Inflation	$4,119	
Reduction in Power Lost by Transformers Per Year	38.96	MW
HVAC Savings Per Year**	19.48	MBT

By replacing existing NEMA-TP1 with NEMA Premium high efficiency transformer, the energy saving cost could be up to $4,119 per year, and the reduction in power lost by transformers is 38.96 Mega Watts per year.

Study of Main Circuit Breaker for distribution switchboard

Due to the High fault current and arc flash issues, it is not recommended to replace the fuses with Main Circuit Breaker for the distribution switchboard.

Study of Emergency Generator size

The as-designed emergency power system meets the IBC emergency requirements, NFPA, and City of Chicago Code. The 600kW diesel-engine generator serves the fire pump, and high-voltage and low-voltage distribution switchboards. However, the generator serves too many loads such as fire pump, and LV-EM-LL that are served by the power company additionally. Therefore, decreasing of the size of generator will be suggested to decrease extra costs if it is not violated the *Illinois Chicago Electrical Code*, and the *Facilities Services Facility Standards – Electrical System* from the University of Chicago.

The *Facilities Services Facility Standards – Electrical System* from the University of Chicago provides the recommendations about the engine generators. The following lists will be considered for the re-sized engine generator.

- Natural Gas Generators are preferred for University projects
- Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 4 hours operation at 100 percent of rated power output of engine generator system without being refilled.
- Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.

Existing emergency power system

A 600KW diesel-powered engine generator is located on the lower level. The generator set fully automatic on transfer and re-transfer and suitable for continuous operation for the duration of any interruption of the normal electric power source. The generator serves three loads which are emergency service switchboard HV-EM-LL, LV-EM-LL, and Fire PUMP. The detail loads are described below.

- HV-EM-LL: 277/480V, 3ϕ, 4-wires, 800A Bus, 75K AIC
- LV-EM-LL: 120/208V, 3-phases, 4-wires, 600A, 20K AIC
- Fire Pump: 100 horsepower

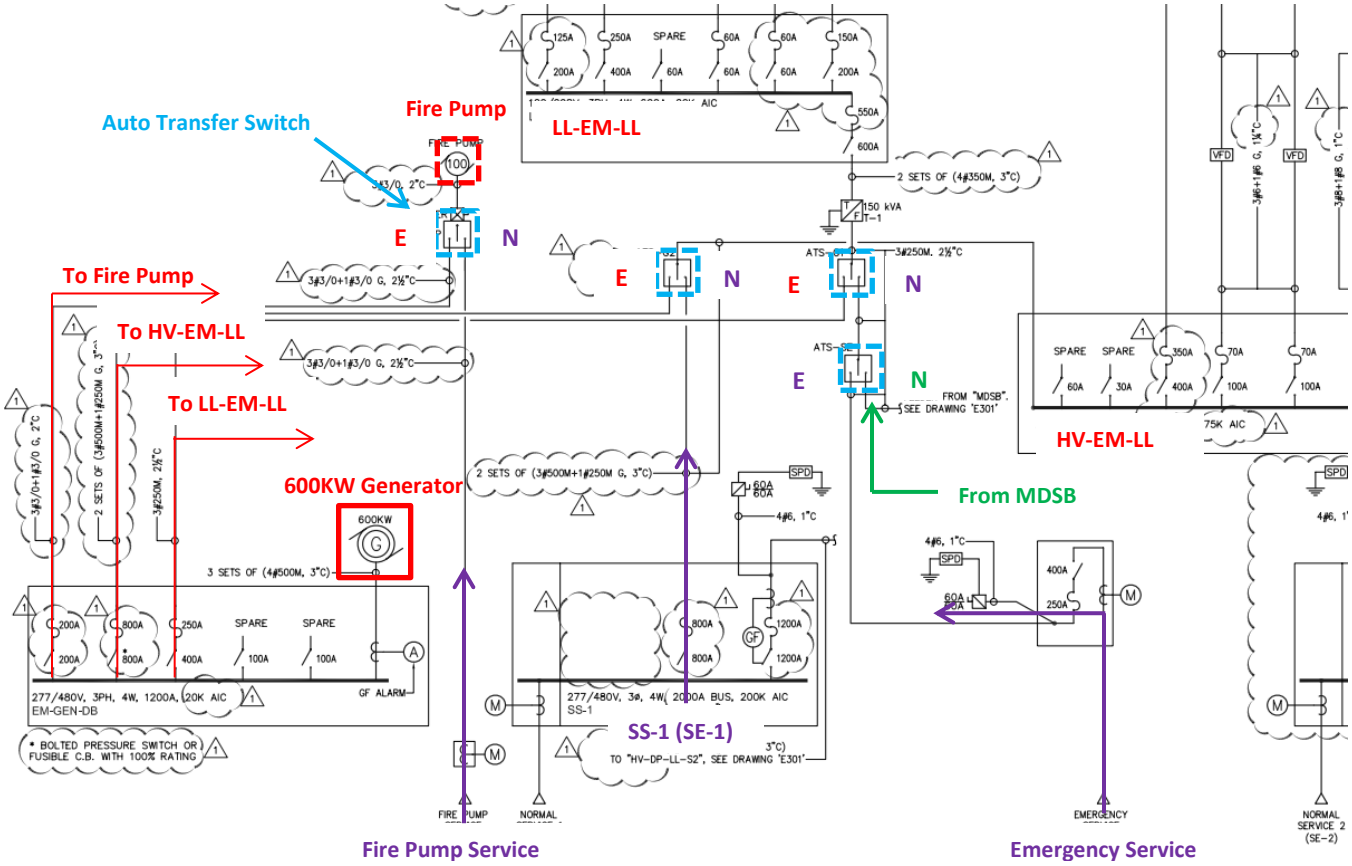


Figure 33 | **Single line diagram of Emergency Service**

Summary

The enlarged emergency single line diagram above shows the detail of emergency system. A fire pump is served by the power company (fire pump service) as normal, and served by generator as emergency. The switchboard of HV-EM-LL is served by SS-1 (Normal Service) as normal, and served by generator as emergency. However, the switchboard of LL-EM-LL is served by MDSB (Normal Service) as normal, and served by two emergency powers which from emergency service, and a generator. Since there are two emergency power systems for the switchboard of LL-EM-LL, the size of generator could be decreased.

Power factor = 1

600KW (generator) / 1 = 600kVA

600kVA – 150kVA (LL-EM-LL) = 450 kVA

By simple calculation above, the size of generator could be 450KW. However it is not recommended to decrease the size of generator due to the Illinois Chicago Electrical Code.

ACOUSTICAL BREADTH

Overview

The Reverberation Time (RT) for the performance hall located at first floor will be analyzed to determine how the space dose functions acoustically well with surface materials since this space is critical acoustically for various performances. In addition, the Bass Ratio will be calculated to measure of the "warmth" in music which a balance of sound throughout the various frequencies in the space.

Analysis

The performance hall is used for various performances such as concert, music, and film. The shape of the space is a rectangular box with slightly narrow shape at the front. Since the ceiling is suspended from structure, the height of the space is measured from the floor to the ceiling. The surfaces of the space are separated into the three parts which are ceiling, wall, and floor. Additionally, the case of the fully occupied hall and an air which is a volume of the space is added into the surface to determine the reverberation time. After the sound absorption coefficients of each material are determined, the reverberation time is calculated for various frequencies from 125 hertz to 4000 hertz.

Material

Color	Materials
	Sound Control Window Glass
	Perforated Wood Sliding Panels
	Acoustically Transparent Fabric Wall

Table 14 | Schedule of Interior finishe of Performance Hall

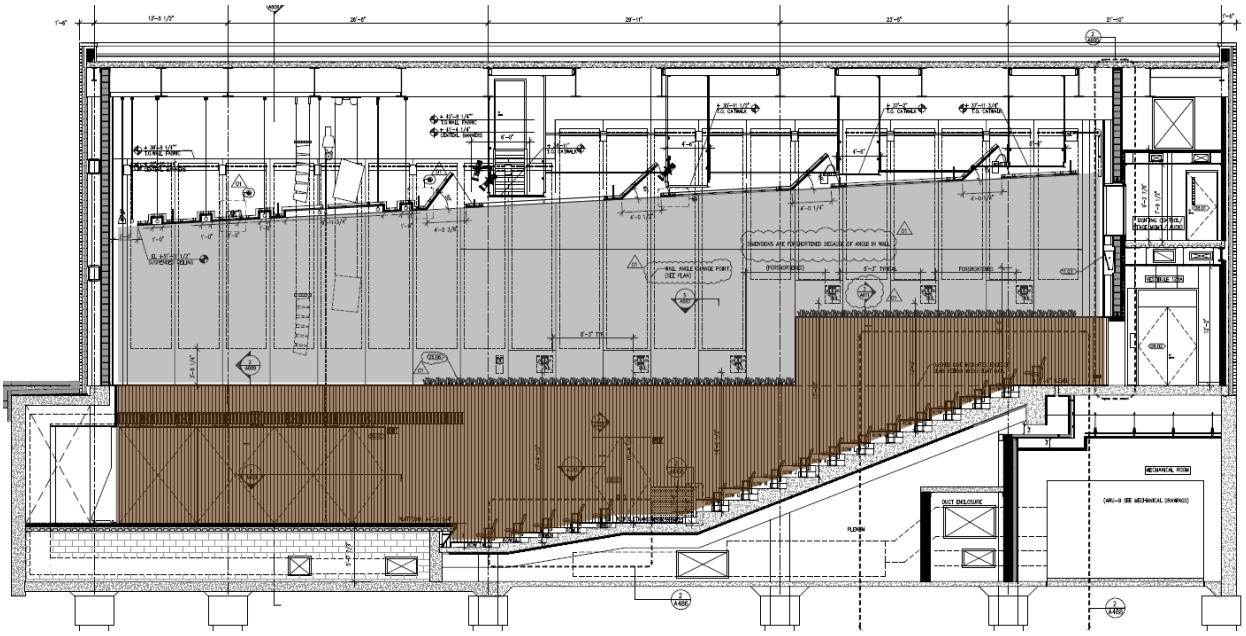


Figure 34 | Section view of Performance Hall

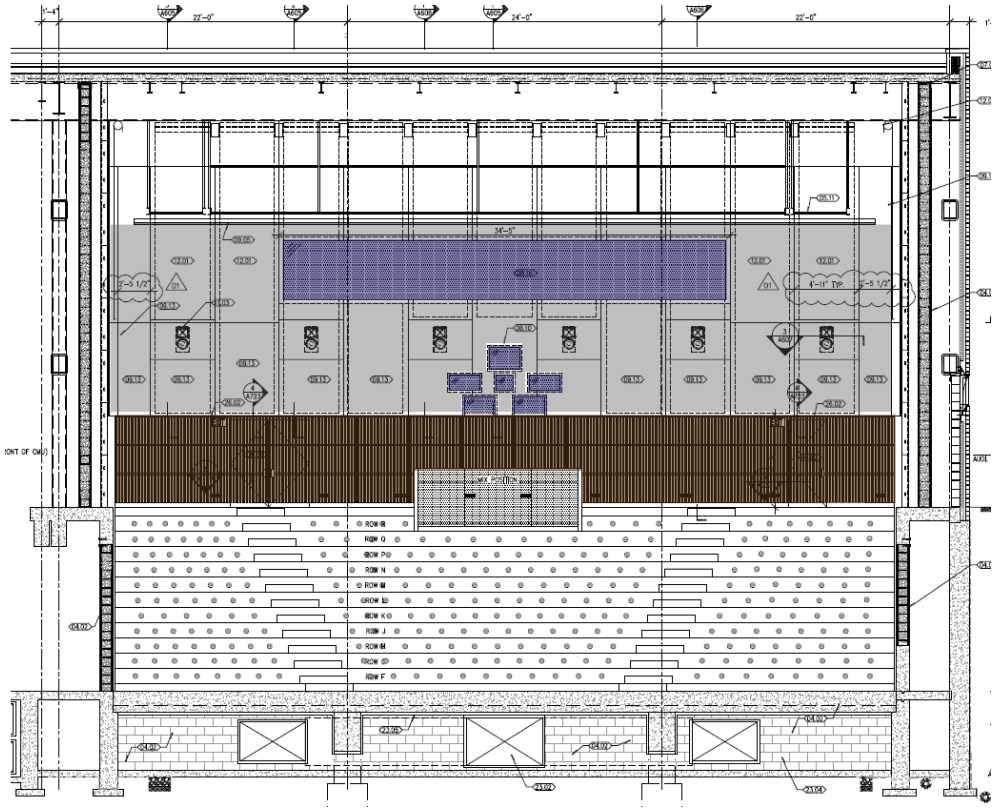


Figure 35 | **Rear view of Performance Hall**

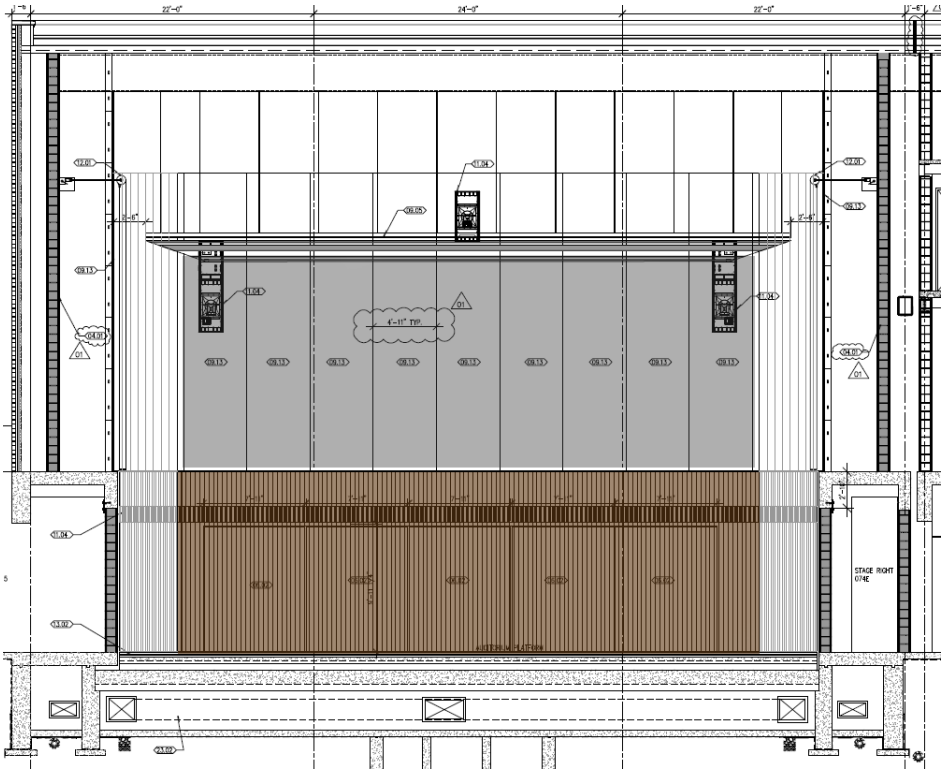


Figure 36 | **Front view of Performance Hall**

Calculation Method

The proper sound absorption coefficients are determined based on each material, and the sound absorption which is a s*abin* is calculated with following equation.

$$A = S\alpha$$

Where, S = surface area of a material
α is the sound absorption coefficient.

Then, the reverberation time is calculated for each frequency with following equation.

$$T = \frac{0.05 \times V}{\sum A}$$

Where, T = reverberation time which is taken by a sound to decrease 60 dB from its value at termination (seconds)
V = room volume in ft^2
∑A = total absorption in the room (sabins)

To calculate the bass ratio, the reverberation time with 125, 250, 500, and 1000 frequency are used with following equations. Preferred bass ratio values are 1.1 to 1.25 for halls with a high reverberation time, and 1.1 to 1.45 for halls with reverberation time of 1.8 sec of less. A hall in which bass ratio is less than 1.0 appears to lack warmth.

$$BR = \frac{[T_{125} + T_{250}]}{[T_{500} + T_{1,000}]}$$

Where, BR = bass ratio
T_{125} = reverberation time at 125 frequency
T_{250} = reverberation time at 250 frequency
T_{500} = reverberation time at 500 frequency
$T_{1,000}$ = reverberation time at 1,000 frequency

Surface	Element	Total Area (sf)	Frequency (Hz)											
			125Hz		250Hz		500Hz		1000Hz		2000Hz		4000Hz	
			α	Sα	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα
Ceiling	Acoustical Reflector Fabric Type 1	5010.8	0.05	250.54	0.22	1102.38	0.44	2204.75	0.56	2806.05	0.45	2254.86	0.32	1603.46
Front Wall	Acoustically Transparent Fabric Type 2	717.4	0.04	28.70	0.15	107.61	0.32	229.57	0.47	337.18	0.56	401.74	0.60	430.44
	Wood Panels	644.5325	0.28	180.47	0.22	141.80	0.17	109.57	0.09	58.01	0.10	64.45	0.11	70.90
Side Wall	Acoustically Transparent Fabric Type 2	3310.695	0.04	132.43	0.15	496.60	0.32	1059.42	0.47	1556.03	0.56	1853.99	0.60	1986.42
	Wood Panels	2455	0.28	687.40	0.22	540.10	0.17	417.35	0.09	220.95	0.10	245.50	0.11	270.05
Rear Wall	Acoustically Transparent Fabric Type 2	708.4575	0.04	28.34	0.15	106.27	0.32	226.71	0.47	332.98	0.56	396.74	0.60	425.07
	Wood Panels	390	0.28	109.20	0.22	85.80	0.17	66.30	0.09	35.10	0.10	39.00	0.11	42.90
	Glass	169.165	0.18	30.45	0.06	10.15	0.04	6.77	0.03	5.07	0.02	3.38	0.02	3.38
Floor - Stage	Resilient Wood	1634.08	0.04	65.36	0.04	65.36	0.07	114.39	0.07	114.39	0.06	98.04	0.07	114.39
Audience	Fully occupid hall	3490.54	0.68	2373.57	0.74	2583.00	0.82	2862.24	0.85	2966.96	0.86	3001.86	0.85	2966.96
Air	-	179296	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0009	161.37
Total absorption, ∑A				3886.45		5239.07		7297.06		8432.71		8359.58		8075.33
Reverberation Time (RT)				2.31		1.71		1.23		1.06		1.07		1.11

Figure 37 | **Table of Calculation for Reverberation Time**

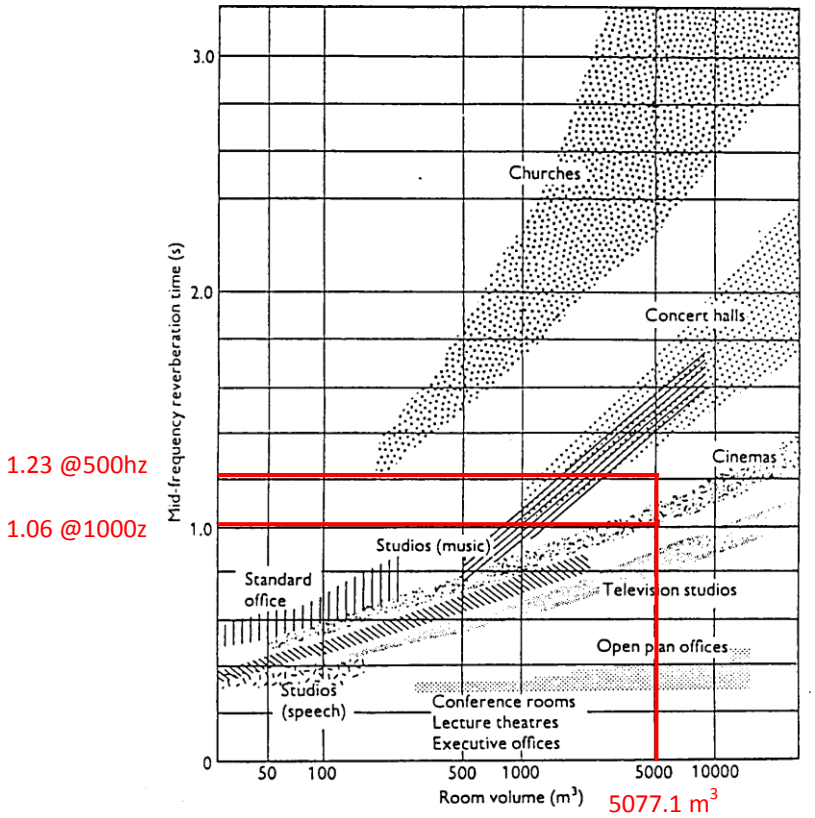


Figure 38 | **Graph of Acceptance range of Reverberation Time on Mid-frequency**

Summary

The reverberation times for the Performance hall are variable with different frequencies. The longest reverberation time is 2.31 at 125 Hz, and the shortest reverberation time is 1.06 at 1000 Hz. However, reverberation time of Mid-frequency, 500 Hz is 1.23, and it is within the range of the 1.2-1.8 which is criteria of reverberation time for the performance space. As you see the figure 38, reverberation time of 500 Hz is located in the middle of between the Concert halls and Cinema. Due to the characteristic of the performance hall that holds various performance activities, this value is acceptable.

$$\mathrm{BR} = \frac{[T_{125} + T_{250}]}{[T_{500} + T_{1,000}]} = \frac{[2.31 + 1.71]}{[1.23 + 1.06]} = 1.75$$

With following calculation above, the Bass Ratio is 1.75 which a too high by comparing to the criteria. However, it is good enough to give “warmth” which a balance of sound throughout the various frequencies in the space.

MECHANICAL BREADTH

Overview

Since good estimates of the corresponding heat transfer rates are necessary to design an acceptable air-conditioning system, the heating loads thru the glass of the corridor on the first floor will be analyzed because this space are applied with large amount of windows. This space will be conducted for the amount solar heat gains and cooling loads with existing glazing type and it will be compared with proposed different glazing types.

Analysis

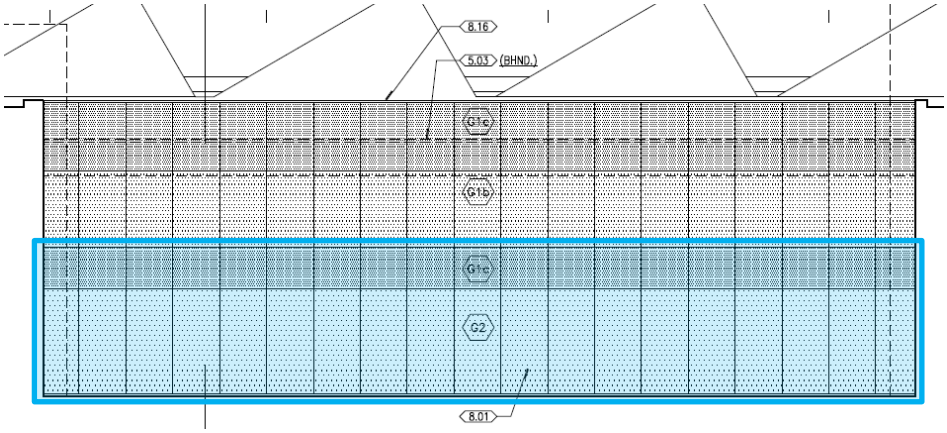


Figure 39 | Elevation view of the Corridor

Since the corridor on the first floor is a transition area with occupants, the large amount of windows (90.88'L x 10' H) is applied on the east side to provide bright and dynamic atmosphere into the space at the early morning. The glazing type is a vision glass with 1-1/4" thick insulated unit consisting of a 5/16" thick heat strengthened *PPG Starphire* outer lite, an 11/16" air space, and a 1/4" thick heat strengthened *PPG Starphire* inner lite with a neutral low E coating.

The image on the right side shows a simple glazing construction of the corridor. To get a data of window specification, the thickness of the air space is assumed as 5/8" because PPG Industries does not provide 11/16" thickness for the air. The solar heat gain coefficient is 0.41, U-value is 0.30 Btu/(hr-ft^2-F), and visible light transmittance is 74%. Shade IAC (interior Attenuation Coefficient) is assumed as 0.5 in this study because some of direct and diffuse radiation incidents on the widow surface enter the space, and some of them are blocked. The table on the below shows a detail specification of the existing glazing type of the corridor.

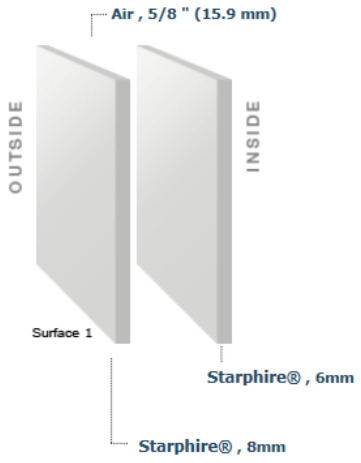


Figure 40 - Existing Glazing Type

COLOR	PRODUCT & IGU	THICKNESS	VLT (%)	EXT. REFL. (%)	SHGC	WINTER U-VALUE ENGLISH Btu/(Hr X Sqft X °F)	WINTER U-VALUE METRIC W/(M² X K)	THERMAL STRESS RISK
Visualize Details Gallery	OUTDOOR LITE: 8mm Solarban® 60 (2) on Starphire® AIRSPACE: 5/8 " (15.9 mm) Air INDOOR LITE: 6mm Starphire®	1 3/16 "	74	11	0.41	0.30	1.69	Low

Figure 41 | **Specification of existing glazing type**

Method

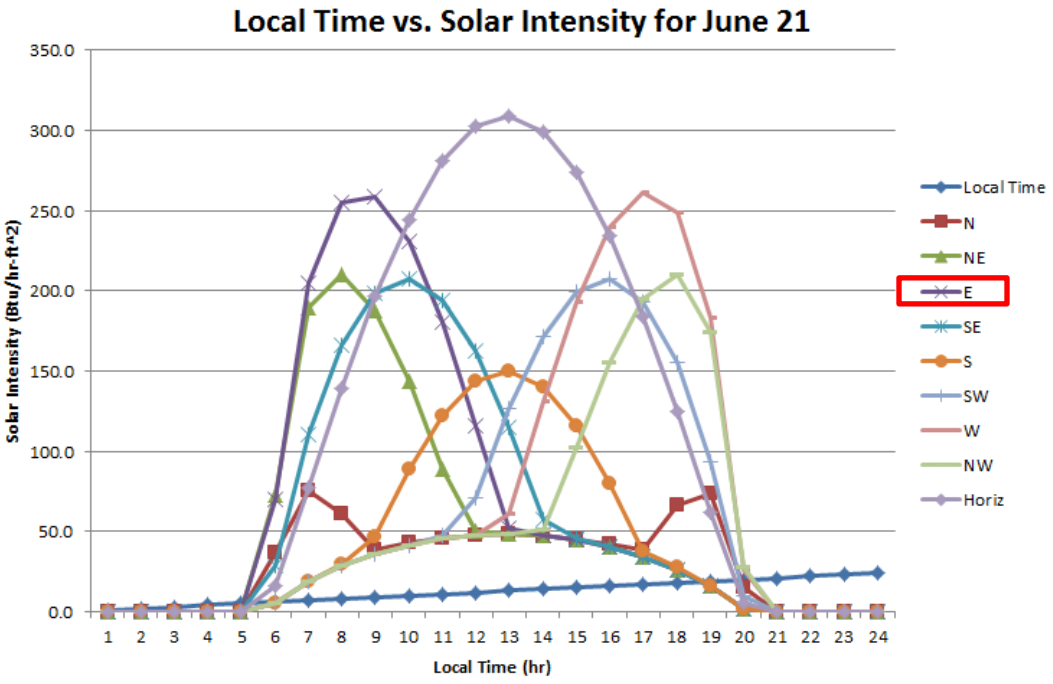
The solar intensity for the summer (June) and winter (December) will be determined by using RSTM calculation Excel spreadsheet on the location of the building. Then, the window heat gain and cooling load thru the existing glazing system with product date from PPG Industries on the corridor located on the first floor will be generated by table and graph.

And, the existing glazing system will be compared with different proposed glazing types by the window heat gain and cooling load for the summer and winter. The detail of two proposed glazing types are shown in the table below.

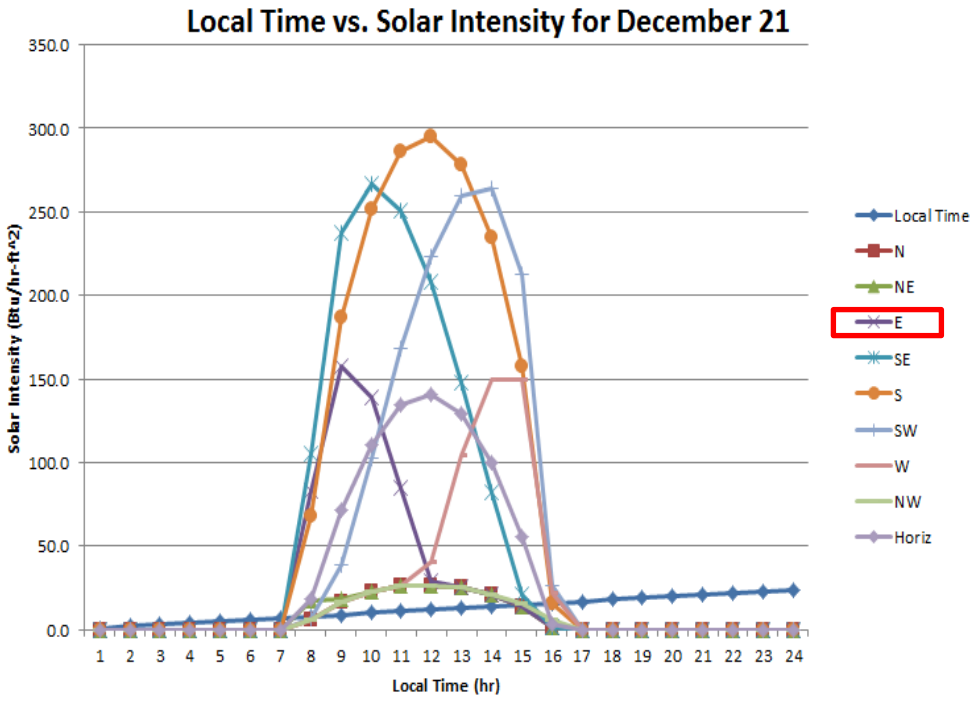
COLOR	PRODUCT & IGU	THICKNESS	VLT (%)	EXT. REFL. (%)	SHGC	WINTER U-VALUE ENGLISH Btu/(Hr X Sqft X °F)	WINTER U-VALUE METRIC W/(M² X K)	THERMAL STRESS RISK
Visualize Details Gallery	OUTDOOR LITE: 5mm Starphire® - 0.060" PVB - 5mm Solarban® 70XL (4) on Clear OUTDOOR AIRSPACE: 1/2 " (12.7 mm) Argon MIDDLE LITE: 5mm Solarban® 60 (4) on Clear INDOOR AIRSPACE: 1/2 " (12.7 mm) Argon INDOOR LITE: 5mm Clear	1 13/16 "	50	13	0.23	0.12	0.68	Med
	Proposed type 1 – Triple							
Visualize Details Gallery	GLASS LITE: 13.52mm Laminate: 6mm Solarban® z50 (2) on Optiblue® - 0.060" PVB - 6mm Solarblue®	1/2 "	33	6	0.36	0.95	5.41	High
	Proposed type 2 - Single							

Figure 42 | **Specification of Proposed glazing types**

Solar Intensity (Btu/hr-ft²) for June 21, 42N Latitude, 87.88W Longitude, Time Zone: Central Daylight Savings Time									
Clearness Index: CN = 1, Ground Reflectance: rhog = 0.2									
Local Time	N	NE	E	SE	S	SW	W	NW	Horiz
1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	36.8	73.1	69.6	28.8	5.6	5.6	5.6	5.6	15.9
7.0	75.4	189.6	204.6	110.2	18.9	18.9	18.9	18.9	77.1
8.0	60.8	209.9	255.3	166.5	29.9	28.2	28.2	28.2	139.2
9.0	38.6	187.5	258.7	198.5	46.5	35.5	35.5	35.5	196.3
10.0	42.7	143.5	230.6	207.3	88.8	41.2	41.2	41.2	244.5
11.0	45.3	89.1	180.2	194.3	122.5	47.1	45.3	45.3	280.8
12.0	47.8	50.6	115.5	162.2	143.5	71.2	47.8	47.8	302.8
13.0	48.5	48.5	51.9	114.8	149.6	126.9	60.8	48.5	309.0
14.0	47.4	47.4	47.4	57.1	139.9	171.2	131.4	50.9	299.1
15.0	44.5	44.5	44.5	45.7	115.7	199.2	193.5	102.2	273.6
16.0	41.9	40.0	40.0	40.0	79.5	207.3	239.4	155.0	234.2
17.0	38.8	34.0	34.0	34.0	37.3	193.1	261.2	195.2	183.7
18.0	66.3	26.3	26.3	26.3	27.5	155.6	248.5	210.2	125.1
19.0	73.5	16.3	16.3	16.3	16.3	93.4	182.8	174.3	62.4
20.0	14.9	2.0	2.0	2.0	2.0	9.9	26.0	28.2	5.1
21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Solar Intensity (Btu/hr-ft²) for December 21, 42N Latitude, 87.88W Longitude, Time Zone: Central Standard Time									
Clearness Index: CN = 1, Ground Reflectance: rhog = 0.2									
Local Time	N	NE	E	SE	S	SW	W	NW	Horiz
1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8.0	6.1	17.4	83.5	105.3	68.4	6.7	6.1	6.1	18.6
9.0	16.8	18.2	158.0	237.7	186.7	38.6	16.8	16.8	71.1
10.0	22.8	22.8	138.7	267.0	251.8	103.0	22.8	22.8	111.0
11.0	25.9	25.9	85.2	250.9	286.4	168.3	25.9	25.9	134.8
12.0	26.7	26.7	29.0	207.8	295.0	223.7	40.3	26.7	140.9
13.0	25.2	25.2	25.2	148.3	278.3	259.6	104.3	25.2	129.1
14.0	21.2	21.2	21.2	81.9	235.0	264.0	150.0	21.2	100.0
15.0	14.2	14.2	14.2	21.0	157.2	212.2	149.9	15.9	55.5
16.0	1.4	1.4	1.4	1.5	15.9	26.1	21.7	5.6	3.5
17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

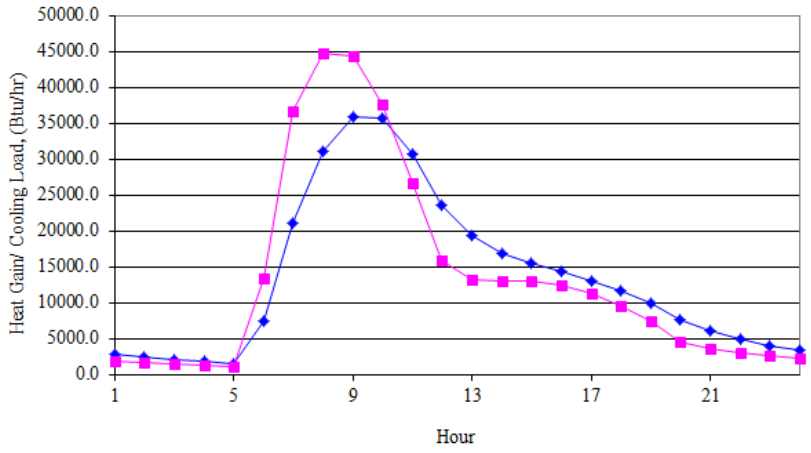
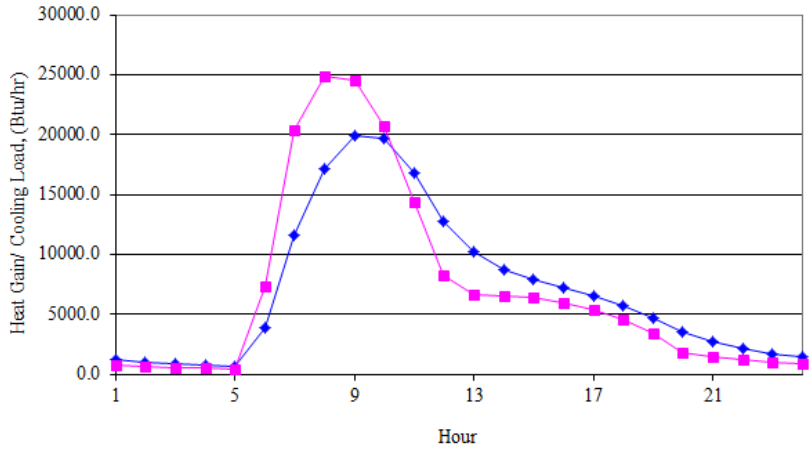
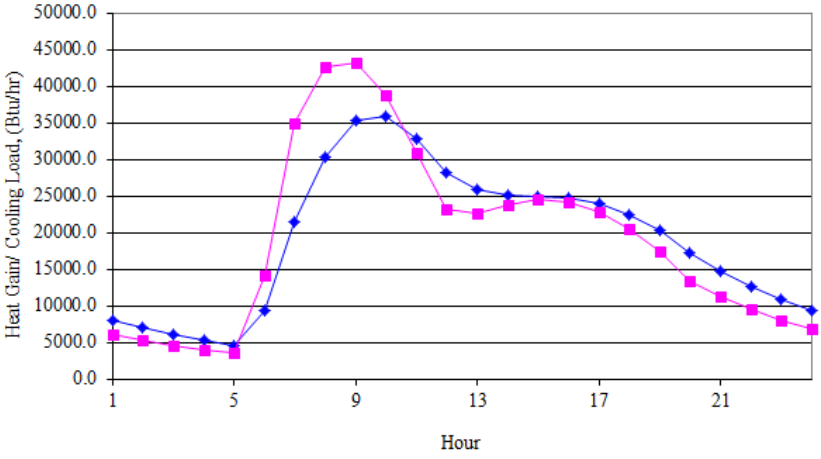


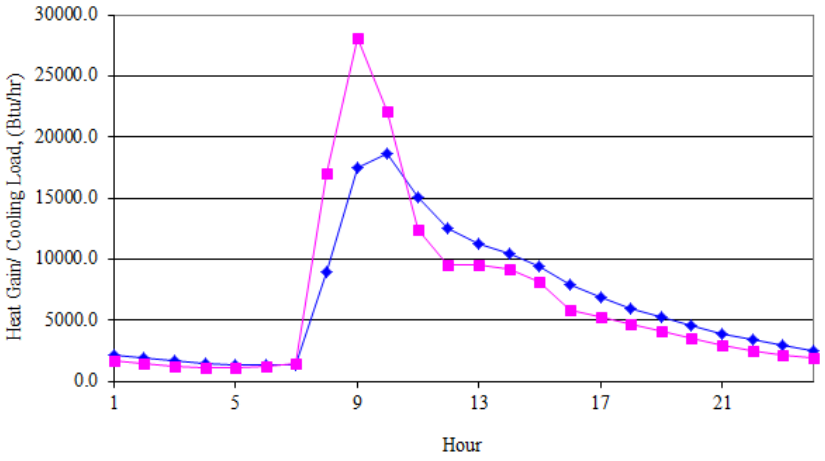
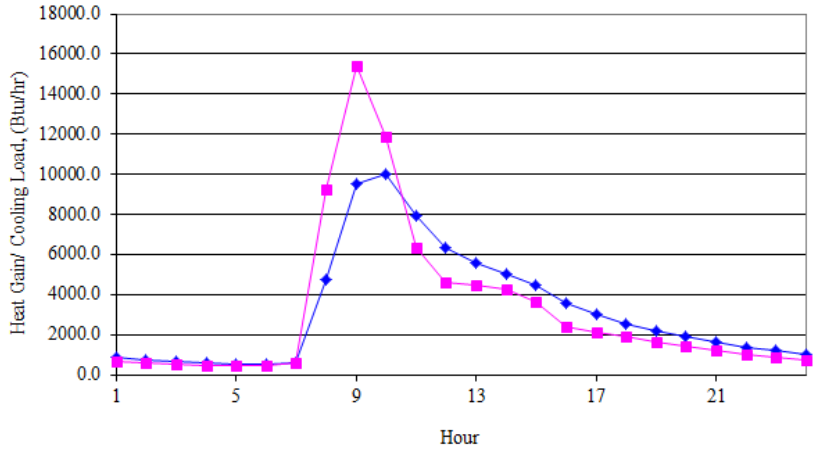
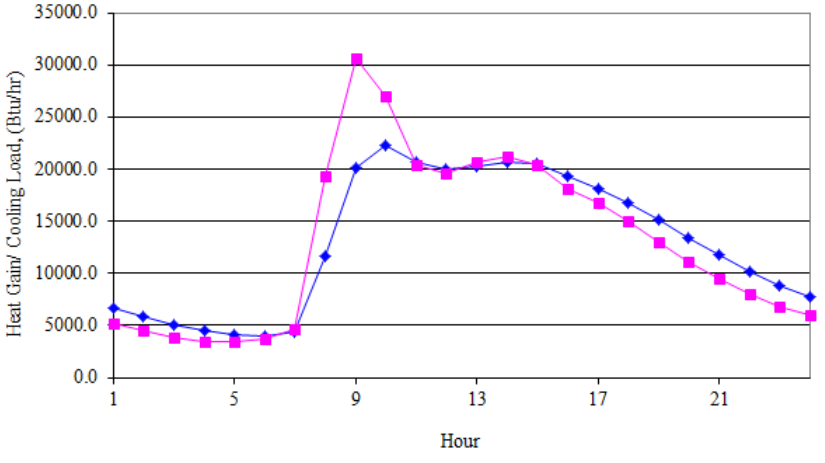
Cooling Load Summary			June, 21		
Local Time	**Beam (Btu/hr)**	**Diffuse + conduction (Btu/hr)**		**Cooling Load**	**Solar & Conduction Heat Gain**
1	82.7	2718.6		2801.3	1894.2
2	62.2	2327.0		2389.2	1653.2
3	47.2	1993.3		2040.5	1420.6
4	36.2	1715.2		1751.4	1233.0
5	28.0	1494.0		1522.0	1100.3
6	5083.2	2272.5		7355.7	13412.2
7	16434.0	4619.9		21053.9	36727.1
8	24128.2	6860.0		30988.2	44702.4
9	27187.7	8707.9		35895.7	44316.6
10	25449.2	10133.3		35582.5	37610.5
11	19520.3	11173.6		30693.9	26584.5
12	11730.8	11916.2		23646.9	15846.2
13	6885.5	12398.6		19284.1	13272.5
14	4316.8	12597.7		16914.5	13078.3
15	2783.8	12691.1		15474.9	12975.9
16	1834.7	12471.6		14306.2	12345.4
17	1231.5	11853.5		13085.0	11192.7
18	839.9	10819.4		11659.3	9581.3
19	581.1	9308.8		9889.9	7411.2
20	407.4	7186.3		7593.7	4456.6
21	289.2	5691.3		5980.5	3526.2
22	207.9	4639.5		4847.4	3006.5
23	151.1	3832.7		3983.9	2539.9
24	111.2	3204.1		3315.3	2168.4
			Total (Btu)	322055.9	322055.9

Table 15 | Cooling Load Summary of Existing glazing type for June, 21

Cooling Load Summary			December, 21		
Local Time	**Beam (Btu/hr)**	**Diffuse + conduction (Btu/hr)**		**Cooling Load**	**Solar & Conduction Heat Gain**
1	31.1	2148.4		2179.4	1639.3
2	23.3	1863.0		1886.3	1408.0
3	17.7	1619.1		1636.8	1223.9
4	13.6	1422.7		1436.3	1094.6
5	10.5	1299.0		1309.5	1068.1
6	8.2	1282.0		1290.2	1192.0
7	6.4	1383.8		1390.3	1455.7
8	6384.7	2597.5		8982.2	17038.9
9	12918.7	4597.8		17516.5	28151.1
10	12372.1	6224.3		18596.5	22090.7
11	7609.0	7439.0		15048.0	12462.1
12	4212.0	8262.6		12474.6	9580.9
13	2570.6	8686.7		11257.3	9485.0
14	1622.5	8811.3		10433.9	9184.5
15	1049.7	8412.9		9462.7	8105.7
16	693.2	7200.5		7893.7	5839.6
17	465.8	6372.6		6838.3	5275.1
18	317.8	5684.4		6002.2	4728.2
19	219.8	5024.5		5244.3	4096.8
20	154.0	4394.3		4548.3	3493.6
21	109.3	3819.2		3928.5	2978.0
22	78.4	3294.7		3373.2	2515.0
23	57.0	2841.6		2898.6	2150.4
24	41.8	2467.8		2509.6	1879.7
			Total (Btu)	158137.0	158137.0

Table 16 | Cooling Load Summary of Existing glazing type for December, 21

June 21	Window Heat Gain and Cooling Load
Existing Glazing System – Double	
Proposed type1 - Triple	
Proposed type2 - Single	

December 21	**Window Heat Gain and Cooling Load**
Existing Glazing System – Double	
Proposed type1 - Triple	
Proposed type2 - Single	

Summary

According to Kotey, Nathan A, ASHRAE Transaction: Solar gain through windows with shading devices : simulation versus measurement (2009), the significant cooling loads solar gain is especially troublesome in the building because it is generally the largest and most variable heat gain the building will experience. Therefore, several different glazing types are compared with existing glazing window of the first floor corridor by cooling loads and solar heat gains for the summer and winter. The existing glazing window is composed by double pane with thick heat strengthened with neutral low E coating. The first proposed type is composed by triple pane with 5mm clear with ½" airspace filled by Argon. The second proposed type is composed by single pane with 13.52mm laminate, and 0.06" PVB with 6mm Solarblue.

June, 21	***Total Cooling Load & Heat Gain***
Existing	322055.9 Btu
Proposed 1	168500.8 Btu
Proposed 2	455729.3 Btu

Based on the calculation results for each glazing types, the proposed type 1 has lowest value of total cooling load and solar heat gains for the summer (June, 21). It means that small amount of heat is needs to be removed from a structure in order to keep the temperature inside of the building consistent.

December, 21	***Total Cooling Load & Heat Gain***
Existing	158137.0 Btu
Proposed 1	102726.3 Btu
Proposed 2	311800.5 Btu

On the winter (December, 21), the proposed type 1 has also lowest value of total cooling load and solar heat gains and the proposed type 2 has highest number of total cooling load and solar heat gains.

In conclusion, the proposed type 1 has good performances for the cooling load and heat gains because it consists of triple panes. However, it requires high cost for the installation. The proposed type 2 is not good for the Cooling load because it gains much solar heat due to the single pane. However, It might be proper for the saving of heating energy during the winter because it keeps heat gains until late of the day by compare to other glazing types.

CONCLUSION

Many great aspects of engineering systems were applied to provide energy savings, system efficiency, and aesthetics for the Reva and David Logan Center for the Arts. The Lighting designs concept for each of the four spaces were accomplished with their design criteria. The lighting designs of the performance hall successfully expressed the abstract concepts with color output and light distribution. The performance penthouse was designed with flexible lighting system to provide different scenes with collaborating daylight. The lighting design of the main lobby provides very powerful and welcoming environments for the occupants. The lighting design of the courtyard was designed well to avoid light trespass into the inside of the building.

The electrical systems were re-designed for the energy savings. By replacing existing NEMA-TP1 with NEMA Premium high efficiency transformer, the energy saving cost could be up to $4,119 per year, and the reduction in power lost by transformers is 38.96 Mega Watts per year. Also, the size of the emergency generator was re-designed efficiently by subtracting the load of switchboard of LL-EM-LL that is served by extra emergency power from the local power utilities.

In the Acoustical breadth, the reverberation time for the performance hall is studied to see how the sound is delivered efficiently. The reverberation time of the performance hall was very variable with different frequencies; however those values are acceptable because the characteristics of the performance hall that holds various performance activities.

In the Mechanical breadth, the different glazing types of the corridor were conducted with solar heat gain and cooling loads. The single pane type was not appropriated for the corridor because it gained much solar heats, but potentially it might be good during winter because it keeps heats until late of the day. The triple pane type was good for gaining less solar heats other than glazing type, however it required high initial costs for installation.

Overall, the proposed engineering systems brought energy efficiency to Logan Center for the Arts, and integrated with functional and aesthetics view successfully.

REFERENCES

DiLaura DL, Houser KW, Mistrick RG, Steff GR. Illuminating Engineering Society The Lighting HandBook 10th Edition.

ASHRAE Standard 90.1, 2007 – Energy Standard for Building Except Low-Rise Residential Buildings.

National fire Protection Association 101, 2009: Life Safety Code – 7.8 Illumination of Means of Egress.

International Building Code, 2012 – Section 2701 Emergency and Standby Power systems

National Electrical Code, 2011

Facilities Services Facility Standards (FS) 2 of the Univeristy of Chicago, Volume III, M-Electrical Systems.

Kotey, Nathan A.; Wright, John L.; Collins, Michael R.; Barnaby, Charles S. "Solar gain through windows with shading devices: simulation versus measurement" The Free Library 01 July 2009. 09 April 2014 , Retrieved from http://www.thefreelibrary.com/Solar gain through windows with shading devices: simulation versus...-a0217848187.

“Energy Savings Calculator for Eaton Transformers”, 2013, Eaton Corporation, Retrieved from <http://es.eaton.com/transformercalc/index.php#calc>

“Glass Configuration tools”, 2014, PPG Industries, Retrieved from http://construct.ppg.com.

LIGHTING APPENDIX

Luminaire Schedule

Type	Fixture Description	Mounting	Manuf.	Catalog #	Lamps	Watts
TM-1	Slot 6" Wide LED Recessed Luminaire, 4' long, with 3500K High output LEDs and Regressed 1/4" P95 Opal Acrylic Lens	Recessed	Mark Architectural Lighting	S6LR-4FT-FL-N35HI-277-SW-35-WH	LEDs	50
TM-2	6200 4' long, Straight LED recessed Linear, Opal Acrylic Regressed, Semi-Gloss White Finish	Recessed	Winona Lighting	6200-ST-4L-LED-277-OAR-SGW	LEDs	45
TC-1	Cast gray enamel aluminum housing, Clear glass enclosure with lower cutoff shield, 7 Red, 6 Green, and 6 Blue LEDs with Clear Plastic Optics	Surface	Philips Color Kinetics	123-000015-07	LEDs	30
TC-2	8" open downlight with clear diffuse reflector and wallwash kicker, (1) 100W coated ED17 protected metal halide, vertical base up position	Recessed	Lithonia Lighting	LP8HN-100M-8W1A	Metal Halide	100
TS-1	6" Recessed downlight with prismatic lens, (1) CDM70,T6, 830with Nais and EMHB, M7012-20CK-5EU-F-AROMAT Ballast	Recessed	Prescolite	RHD670T6EB120VFL-ST6T4-6	Metal Halide	70
TS-2	Extruded unfinished metal heat sink/housing, one black circuit board with 12 LEDs and Optical assemblies, Molded clear plastic lens with "Holographic" plastic interior overlay and formed semi-specular metal end caps.	Recessed	Philips Color Kinetics	523-000053-04	LEDs	22.6

Type	Fixture Description	Mounting	Manuf.	Catalog #	Lamps	Watts
E-1	LED EXIT panel illumination with red letters and attractive UV stable thermo-plastic housing. UL listed LED run-time of 120 minutes with 10 year life, and sealed nickel cadmium battery	Wall surface	Dual-Lite	LX-U-R-W	LEDs	2.64
E-2	4-13/16" long set light with yellow/cool, white/yellow piranha superflux LED	Surface	Tivoli Lighting	USL-C-YWY-06	LEDs	0.721
RA	138 LEDs (4 Boards) 4' Indirect luminaire with clear acrylic lens white reflector laying flat with light bar tilted 60 degrees, Advance LED driver 3XI054C150V054DNT1 .746K OHM Resistor	Surface	Focal Point Lighting	FCOL-HS-LL1-L35-1C-120-LD1-CV-4'-60	LEDs	15
RB	220 LEDs (55 LED per Board) 4' perimeter mount luminaire extruded frosted acrylic flat lens with 600mA resistor. Advance Driver #XI025C100V036XPL1	Wall grazing	Focal Point Lighting	FTR-AC-4LED-L30-1C-120-G-WH	LEDs	23
RC	Recessed compact fluorescent downlight with (1) 18W triple-tube 4-pin, Base-up lamp position, 6" aperture Even Tone.	Recessed	Edison Price Lighting	TRIPLES 18/6 COL	Compact Fluorescent	22
PP	Matte Chrome finish with LED source, two circuit line voltage track. 2700K with 80 CRI, 20 degrees reflector	Pendant	Bruck Lighting Systems	340435-wh-2-m-s2-geobk	LEDs	32.4
PS	Pendant Cylinder LED source	Track	Bruck Lighting Systems	112-250-mc-2a-m-zonmc	LEDs	15

Type	Fixture Description	Mounting	Manuf.	Catalog #	Lamps	Watts
PR	Recessed 12.4 watt LED fixture in a 3" aperture with clear glass lens and 40 degree specular reflector with >80 CRI	Recessed	Bruck Lighting Systems	128-055-wh-m-3	LEDs	16
C-1	NightLine B, Low copper alloy cast aluminum body, axially symmetrical specular reflector, clear prismatic tempered glass lens with (1) double ended ceramic metal halide, with M85 ballast	Wall surface	DesignPlan Lighting	BN3-9-L5-1	Metal Halide	70
C-2	NightLine A with wall arm, low copper alloy cast aluminum body, axially symmetrical specular reflector, clear prismatic tempered glass lens with (1) 4 pin double biax compact fluorescent with 18W CF ballast	Wall Arm	DesignPlan Lighting	NA2-8-57-1	Compact Fluorescent	22
CA	Recessed step LED light with frosted tempered glass lens 4 3/4 " long with LD12W-12 ballast	Recessed	Cole Lighting	L503	LEDs	1.5
CB	Outdoor landscape fixture with tamper proof, sealed optical compartment, and all aluminum construction with stainless steel hardware, with (1) PAR 30 halogen lamp	Surface	B-K lighting	LA-413-SAP-9-11-C	Halogen	50

Fixture Cut Sheets

MARK ARCHITECTURAL LIGHTING

The Slot 6 LED Series

Type: **TM-1**

Project:

Catalog Number:
DO NOT TYPE HERE. Autopopulated field.

Slot 6 LED, the most versatile member of the Slot family, offers endless creative possibilities. It also boasts higher efficiencies and layout flexibility, and it's a perfect fit for Armstrong TechZone™ ceiling systems.

Through an optional Xicato® LED downlight component, Slot 6 LED integrates point-source lighting with general illumination, and a regressed lens option provides added dimension to the sleek, slender design. Slot 6 LED is a natural choice for spaces that emphasize basic lines and clean design.

Specification Features

Housing
Nominal 6" x 2', 3', 4', 5', 6', 7' or 8' units fabricated from cold-rolled steel 20ga. Ceiling trim is extruded aluminum. Downlight component (where applicable) is die-cast aluminum.

Finish
Matte white. MR16 trim is matte black (standard) or white.

Reflector
Precision-formed steel; high reflectance white.

Shielding
Nominal 1/4"-thick P95 Opal acrylic with rabbeted ends to prevent light leaks against downlight components. Optional 90% transmissive poly carbonate lens with a textured surface provides diffuse illumination and a uniform appearance.

LED Components
Linear:
Nichia® • 757A -V1 LED chips (>80 CRI)
Normal Output: 6 W/LF, 70 LM/W**
Hi Output: 12 W/LF, 70 LM/W**

Downlight Module:
Xicato® • XSM 80 1 x 2 step MacAdam ellipse (>80 CRI)
L10: 14W, 1000 lumens*
L7: 10W, 700 lumens*
* Initial Lumens
** Delivered Lumens

Driver
AccuDrive LED Driver allows for 0 10V dimming, flicker-free from 2 to 100%. Universal input voltage 120 277VAC, 50/60Hz. Integrated thermal fold-back management to prevent over heating.

Color Consistency
The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

The Xicato XSM 80 LED Series have a color consistency of no greater than a 1 x 2 step MacAdam ellipse along the black body locus from module to module.

Integrated Controls
Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Option: N100)

Lumen Management
An optional lumen management system provides onboard intelligence that actively manages the LED light source so that constant lumen output is maintained over the system's life, creating a consistently illuminated environment while preventing energy waste. (Option: N80)

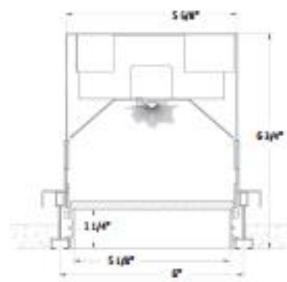
Mounting
Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee. For Hunter Douglas Techstyle® or other ceiling types, consult factory.

Certification
CSA Certified to meet U.S. and Canadian standards, rated for Chicago Plenum, and IBEW (Local 3) Union-made in the USA.

Warranty
5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResorurces/Terms and conditions.aspx

Notes
1. *Specifications subject to change without notice*
2. *Actual performance may differ as a result of end-user environment and application*

Technical Drawing



Regressed Lens

LED lighting facts

Ordering

Example: S6LR 4FT FL N35HI 277 HT L135 WHT N80 CP

Series	Length	Ceiling Trim	Linear LED[5] Output	Linear LED Color Temp	Driver	Voltage	Shielding	Downlights[6,7]	LED Downlight Color Temp	LED Downlight Trim Color	Integrated Controls	Options
S6LR Regressed Lens	2FT 2'	FL 5/8" Flange (sheetrock)	N 6W/LF 70 LM/W	30 3000K	AD 100% constant Current Driver, 0-10V 2% Dimming	120	SW 1/4" P95 opal acrylic	(Blank) Linear LED ONLY	27 2700K	WHT White Trim	N100 N100 nLight without Lumen mgt	CP Chicago Plenum[8]
S6LF Flush Lens	3FT 3'	TG 9/16" Flat or Inverted Tee	H 12 W/LF 70 LM/W	35 3500K	HI[10] 100% constant Current Driver, 0-10V 100% Dimming to Off	277	HT 90% transmissive textured poly carbonate	L10 14W LED Module (1000lm)	30 3000K	BLK Black Trim	N80 N80 nLight with 80% Lumen mgt	
	4FT 4'	GR Trimless[2] (sheetrock)		40 4000K		347[9]		L7 10W LED Module (700lm)	35 3500K		N80EMG N80 nLight with 80% Lumen mgt for use with generator supply EM power	
	5FT 5'							LR Retro-fit LED MR16[1]	41 4100K		N100EMG N100 nLight without Lumen mgt for use with generator supply EM power	
	6FT 6'										NX Dimming, NX Light	
	7FT 7'										ECO Lutron EcoSystem Interface Module	
	8FT 8'										OCS[4] Integrated occupancy/photocell	

DOWNLIGHT OPTIONS:
Only select these options for fixtures with integrated downlight components

Notes
1 MR16 modules are supplied at each end of individual unit. For other configurations, consult factory.
2 Not intended for [illegible] sheetrock installation.
3 Consult Factory
4 Occupancy/Photocell sensors are supplied at one end of individual unit. Fixtures with downlights require a remote sensor locations by others.
5 Delivered lumens are variable and contingent on LED color temperature and fixture configuration.
6 2'–3' fixtures are not available with downlights, 3'–8' fixtures with downlights require a remote driver.
7 Downlights are not adjustable and are provided with a solite lens.
8 Chicago Plenum not available for fixtures with integrated downlights.
9 Not available with 277V. Retro-fit lamps by others.
10 HI Driver is not available with N100, N100EMG, N80 or N80EMG control options.

nLIGHT XICATO

TM Quickship Program also available.

marklighting.com 3 Kilmer Rd, Edison NJ 08817 T (732) 985 2600 F (732) 985 8441

©Acuity Brands Lighting, Inc. All Rights Reserved. We reserve the right to change design, materials and finish in any way that will not alter installed appearance or reduce function and performance.

072013

MARK ARCHITECTURAL LIGHTING

The **Slot 6 LED** Series

Ceiling Trim

GB
(Flangeless sheetrock)

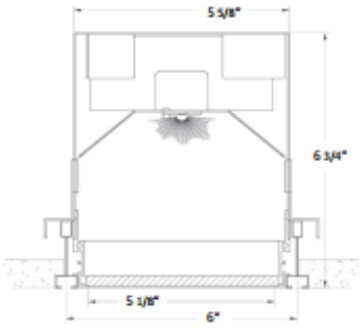
FL
(Flangeled sheetrock)

TG
(15/16" Grid)

TG
(9/16" Slot Grid)

TG
(9/16" Grid)

Technical Drawing



TG
(9/16" Slot Grid)
Flush Lens

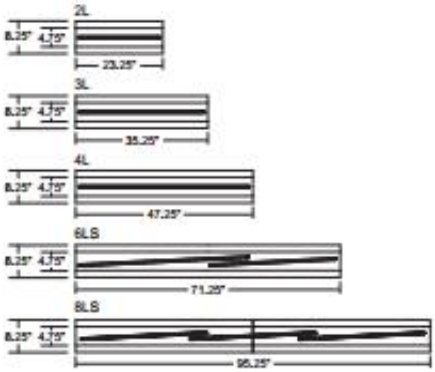
marklighting.com 3 Kilmer Rd, Edison NJ 08817 T (732) 985 2600 F (732) 985 8441
©Acuity Brands Lighting, Inc. All Rights Reserved. We reserve the right to change design, materials and finish in any way that will not alter installed appearance or reduce function and performance.

TM-2

decorative Project: _____ Qty: _____

Full Circle Series • Straight • 6200-ST

Recessed Ceiling



Drawings below depict lay-in and hard ceiling flange sizes
Note: Mud-in fixtures have flexible bead detail.

Flush Lens | Regressed Lens

6200-ST-lay-in ceiling w/Opal Acrylic Flush
6200-ST-lay-in ceiling w/Opal Acrylic Regressed

6200-ST-hard ceiling w/Opal Acrylic Flush
6200-ST-hard ceiling w/Opal Acrylic Regressed

1. **6200** CATALOG #
   - 6200
2. **ST** FIXTURE TYPE
   - ST = STRAIGHT
3. CEILING TYPE
   - LC = LAY-IN CEILING
   - HC = HARD CEILING
   - HCMD = HARD CEILING MUD-IN
4. * SIZE
   - 2L = 2 FOOT (23.25") STRAIGHT SECTION
   - 3L = 3 FOOT (35.25") STRAIGHT SECTION
   - 4L = 4 FOOT (47.25") STRAIGHT SECTION
   - 6LS = 6 FOOT (71.25") STRAIGHT SECTION (staggered lamps)
   - 8LS = (2) 4 FOOT (95.25") STRAIGHT SECTIONS (staggered lamps)
5. **LED** LAMPING
   - F = (1) F24WT5HOMINI BI-PIN (for 2L)
   - F = (1) F21WT5/MINI BI-PIN (for 3L)
   - F = (1) F28WT5/MINI BI-PIN (for 4L)
   - F = (1) F21WT5/MINI BI-PIN & (1) F28WT5/MINI BI-PIN (for 6LS)
   - F = (3) F21WT5/MINI BI-PIN (for 8LS)
   - T5HO lamp image info (consult factory)
   - LED = LED (consult factory)
6. VOLTAGE
   - 120V = 120 VOLT
   - 277V = 277 VOLT
7. LENS OPTION
   - OAF = OPAL ACRYLIC FLUSH
   - OAR = OPAL ACRYLIC REGRESSED (N/A with HCMD)
8. FINISH
   - STANDARD
   - SGW = SEMI-GLOSS WHITE
   - CUSTOM
   - CPF = CUSTOM PAINT FINISH (consult factory)
9. OPTIONS
   - X = ELECTRONIC BALLAST
   - DIM = DIMMING BALLAST (Lutron ECO-10 standard)
10. SPECIAL
    - STD = STANDARD
    - MOD = MODIFIED STANDARD

Modification Descriptions: (if needed)

General Notes:
- UL listed and cUL approved
- Winona Lighting products are union made.
- Custom Sizes and Finishes available upon request.
- All Fluorescent fixtures available in 120V and 277V.
- Winona Lighting reserves the right to make design changes without prior notice.
- Lamps not included.
- Ballast information: Electronic, Standard Dimming Ballast is Lutron ECO-10 (consult factory for other).

Weight Hanging (lbs.)

2L	10 lbs.
3L	13 lbs.
4L	16 lbs.
6LS	19 lbs.
8LS	25 lbs.

WINONA solutions | forms | light
AcuityBrands

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

Version 2/2014 1 of 1

TC-1

Date: _____ Type: _____

Firm Name: _____

Project: _____

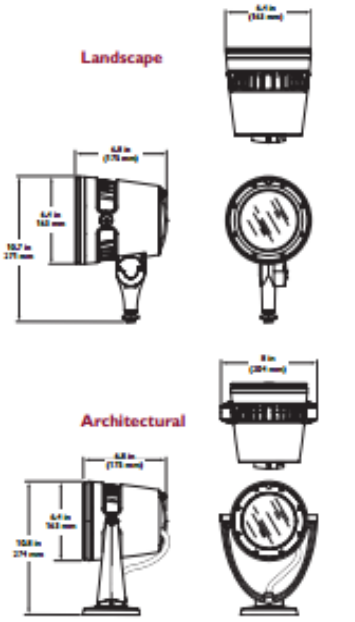
ColorBurst Powercore

8° native (no spread lens)

Architectural and landscape LED spotlight with intelligent color light

ColorBurst Powercore is a high-output, exterior-rated LED lighting fixture designed for accent and site lighting. Standard format Architectural and Landscape fixtures deliver full-color light output of up to 647 lumens to support a range of dynamic uplighting, floodlighting, and decorative lighting applications.

- Integrates patented Powercore technology — Powercore technology rapidly, efficiently, and accurately controls power output to fixtures directly from line voltage. The Philips Color Kinetics Data Enabler Pro merges line voltage and control data and delivers them to the fixture over a single standard cable, dramatically simplifying installation and lowering total system cost.
- Flexible mounting options in architectural applications — ColorBurst Powercore Architectural fixtures feature an integrated yoke with canopy base for mounting to standard US junction boxes or directly to a flat surface or substrate as local codes permit.
- Support for a wide range of landscape applications — ColorBurst Powercore Landscape fixtures feature a 1/2 in NPT threaded post for mounting to standard junction boxes and third-party mounting accessories for use in softscape and hardscape applications.
- Outdoor rated — With a rugged, die-cast aluminum housing fully sealed for maximum fixture life and IP66-rated for outdoor applications, ColorBurst Powercore is ideal for use in damp or wet locations.
- Exchangeable optics and accessories — Available 14°, 23°, 41°, and asymmetric 10° x 41° spread lenses project a soft-edge beam to support a wide range of lighting applications. Native 8° beam angle offers extended light projection.
- Versatile light positioning — ColorBurst Powercore fixtures can tilt through a full 180°. ColorBurst Powercore Architectural fixtures can also rotate through a full 360° for precise aiming. Locking nuts accept standard hex wrenches to secure fixtures firmly in position.



- Universal power input range — ColorBurst Powercore accepts a universal power input range of 100 to 240 VAC, allowing long fixture runs and consistent installation in any location around the world.
- Industry-leading controls — ColorBurst Powercore works seamlessly with the complete line of Philips Color Kinetics controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, as well as third-party controllers.

For detailed product information, please refer to the ColorBurst Powercore Product Guide at www.philipscolorkinetics.com/ls/rgb/colorburstpc/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	Details
	Lumens*	647
	LED Channels	Red / Green / Blue
	Lumen Maintenance†	120,000 hours L_{50} @ 25° C 70,000 hours L_{50} @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz via Data Enabler Pro
	Power Consumption	30 W maximum at full output, steady state
Control	Interface	Data Enabler Pro (DMX / Ethernet)
	Control System	Philips full range of controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, or third-party controllers
Physical	Dimensions (Height x Width x Depth)	10.8 x 8.0 x 6.8 in (274 x 204 x 175 mm) Architectural 10.7 x 6.4 x 6.8 in (271 x 163 x 175 mm) Landscape
	Weight	11 lb (5 kg) Architectural 7.4 lb (3.4 kg) Landscape
	Housing	Die-cast aluminium, powder-coated finish
	Lens	Tempered glass
	Fixture Connections	6 ft (1.8 m) unified power / data cable with flying leads Architectural 6 in (152 mm) flying leads Landscape
	Temperature Ranges	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage
	Vibration Resistance	ANSI C136.31 (Architectural only)
	Humidity	0 – 95%, non-condensing
	Fixture Run Lengths	To calculate fixture run lengths and total power consumption for your specific installation, download the Configuration Calculator from www.philipscolorkinetics.com/support/install_tool/
Certification and Safety	Certification	UL / cUL, FCC Class A, CE, PSE, C-Tick, CQC, SAA
	Environment	Dry / Damp / Wet Location, IP66

* Lumen measurement complies with IES LM-79-08 testing procedures.

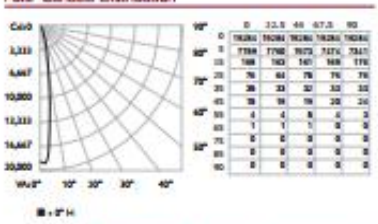
† L_{50} = 50% lumen maintenance (when light output drops below 50% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

Photometrics

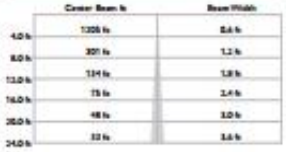
ColorBurst Powercore

8" native (no spread lens)

Polar Candela Distribution



Illuminance at Distance



139 ft (42.4 m) Beam Spread/Edge

1 fc maximum distance

LED	Lumens	Efficacy
RGB	647	24.6

For lux multiply fc by 10.7

CHROMACORE CK TECHNOLOGY | OPTIBIN CK TECHNOLOGY | POWERCORE CK TECHNOLOGY

Fixtures and Data Enabler Pro

Item	Type	Item Number	Philips 12NC
ColorBurst Powercore Landscape UL / cUL / CE	Gray	123-000015-00	910503700578
	Black	123-000015-03	910503701703
	White	123-000015-06	910503701706
ColorBurst Powercore Architectural UL / cUL / CE	Gray	123-000015-01	910503700639
	Black	123-000015-04	910503701704
	White	123-000015-07	910503701707
ColorBurst Powercore Architectural CQC	Gray	123-000015-02	910503701702
	Black	123-000015-05	910503701705
	White	123-000015-08	910503701708
Data Enabler Pro	3/4 in / 1/2 in NPT (US trade size conduit)	106-000004-00	910503701210
	PG21 / PG13 (metric size conduit)	106-000004-01	910503701211

Use Item Number when ordering in North America.

Accessories

Item	Type	Item Number	Philips 12NC
Trim Ring	Gray	120-000103-00	910503701212
	Black	120-000103-06	910503701734
	White	120-000103-12	910503701737
45° Glare Shield	Gray	120-000103-01	910503701213
	Black	120-000103-07	910503701735
	White	120-000103-13	910503701738
Full Height Glare Shield	Gray	120-000103-02	910503701214
	Black	120-000103-08	910503701736
	White	120-000103-14	910503701739
Honeycomb Louver	Black	120-000104-00	910503701215
Spread Lenses	14°	120-000080-00	910503700609
	23°	120-000080-01	910503700610
	41°	120-000080-02	910503700611
	10° x 41° asymmetric	120-000080-03	910503700612

Use Item Number when ordering in North America.

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.philipscolorkinetics.com

Copyright © 2010 – 2012 Philips Solid-State Lighting Solutions, Inc. All rights reserved. Chromacore, Chromusic, CK, the CK logo, Color Kinetics, the Color Kinetics logo, ColorBlast, ColorBlaze, ColorBurst, ColorGroup, ColorPlay, ColorReach, iW Reach, eW Reach, eW Fuse, DMtand, EssentialWhite, eW, iColor, iColor Cove, IntelliWhite, iW, iPlayer, Optibin, and Powercore are either registered trademarks or trademarks of Philips Solid-State Lighting Solutions, Inc. in the United States and / or other countries. All other brand or product names are trademarks or registered trademarks of their respective owners. Due to continuous improvements and innovations, specifications may change without notice. DAS-000029-01 R04 07-12

TC-2

LITHONIA LIGHTING®

Catalog Number

Notes

Type

FEATURES & SPECIFICATIONS

INTENDED USE

Ideal for a wide variety of low- to medium-height ceiling applications including commercial, retail and hospitality spaces where a wallwash fixture is required.

OPTICS

Aluminum full reflectors are optically designed to maximize lumen output and to provide superior glare control. Anodized finishes for wallwash reflectors are semi-specular or diffuse in a variety of colors. Polyester powder coat finishes also are available in white.

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

MECHANICAL

Utilizes an extruded socket housing that attaches to the reflector via key hole mount, which provides superior heat dissipation and extended lamp life. Socket housing also adjusts to accommodate varying lamp lengths.

Heavy gauge die formed galvanized steel mounting frame. Attached to frame are vertically adjustable mounting brackets for use with C channels, ½" steel conduit or 16 gauge flat bar hangers included, standard. Frames equipped with galvanized junction box UL Listed for through wire applications. Junction boxes equipped with (2) ¾" and (4) ½" conduit knockouts with pryout slots and removable access doors.

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

Maximum 1-1/2" ceiling thickness.

ELECTRICAL

120V/277V electronic ballast is standard.

Thermally protected against improper contact with insulation.

Durable, pulse rated medium base porcelain socket with nickel-plated alloy screw shell and contact. Protected lamps ship standard.

Rated for #12 AWG conductor thru-branch wiring. Minimum 90° supply wire. Ground wire provided.

LISTINGS

Fixtures are UL Listed for thru-branch wiring, Non-IC recessed mounting, damp location, and to U.S. and Canadian Safety Standards.

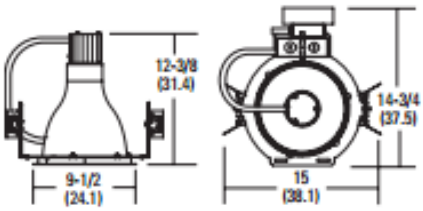
NOTE: Specifications subject to change without notice.

HID Downlighting

8" LP8HN

WALLWASH

Vertical Metal Halide ED-17 Lamp



Specifications

Max. height: 12-3/8 (31.4)

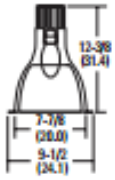
Ceiling opening: 8-3/4 (22.2)

Overlap trim: 9-1/2 (24.1)

Length: 15 (38.1)

Width: 14-3/4 (37.5)

All dimensions are inches (centimeters) unless otherwise indicated.



ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**

Example: LP8HN 100M 8W1AZ 120/277

LP8HN

Series	Wattage/lamp	Reflector/color	Voltage	Options
LP8HN	Metal halide	8W1 White open	**120/277**	SF Single fuse, must specify voltage.
	50M 50W MP50/C/U	**8W1A Clear diffuse wallwash**	120	QRS Quartz restrike system (uses maximum 100W DC-base quartz lamp).[2]
	70M 70W MP70/C/U	**8W1AZ Clear semi-specular wallwash**	277	QRSTD Quartz restrike system with time delay. Operates like QRS, except quartz lamp remains on for two minutes after HID lamp restrikes.[3]
	100M 100W MP100/C/U	8W1G Gold diffuse wallwash		WLP Lamp (shipped separately).
	Color-corrected metal halide[1]	8W1GZ Gold semi-specular wallwash		TRW White flange.
	50MPC MPC50/C/MED	8W1PR Pewter diffuse wallwash		LBH Less barhangers.
	70MPC MPC70/C/MED	8W1WTZ Wheat semi-specular wallwash		
	100MPC MPC100/C/MED			

NOTES:

1 Ceramic arc tube consistent-color lamp. Philips MasterColor or GE ConstantColor.

2 Not available with QRSTD.

3 Not available with QRS.

Accessories

Order as separate catalog number

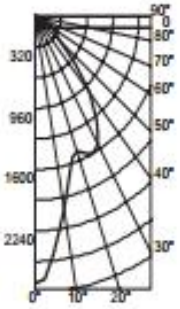
SCA8 Sloped ceiling adapter. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Ex: SCA8 10D.

CTE8 Ceiling thickness extender is used when ceiling thickness is greater than 1-1/2 (3.8). Maximum thickness 2 (5.1).

Downlighting and Track **Sheet #: LP8HN-WALLWASH**

8" LP8HN Vertical Metal Halide, ED-17 Lamp, Wallwash

LP8N 70M 8W1AZ MVOLT, (1) 70W MH lamp, .92 s/mh, 4800 rated lumens, Test no. LTL12500



Intensity Distribution

Vertical Angle	Horizontal Angle 0
0	2791
5	2495
15	1671
25	1584
35	1322
45	683
55	310
65	147
75	59
85	12
90	0

Zonal Lumen Summary

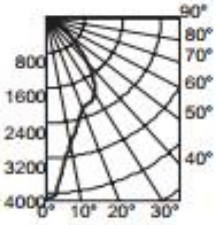
Zone	Lumens	% Lamp
0° - 30°	1696.5	35.3
0° - 40°	2363.3	49.2
0° - 60°	2749.0	57.3
0° - 90°	2828.7	58.9
90° - 180°	0.0	0.0
0° - 180°	2828.7	*58.9

*Total Efficiency

Coefficients of Utilization

RCR	pf 20% p 80 50%	30	70 50%	30	50% 50%	30%
0	70	70	69	69	65	65
1	65	63	63	62	61	60
2	60	57	58	56	57	55
3	55	52	54	51	52	50
4	51	47	50	47	49	46
5	47	43	47	43	45	42
6	44	40	43	40	42	39
7	41	37	41	37	40	36
8	38	35	38	34	37	34
9	36	32	36	32	35	32
10	34	30	34	30	33	30

LP8HN 100M 8W1A, (1) 100W MP100/c/u/MED lamp, .85 s/mh, 7900 rated lumens, Test no. LTL18319



Intensity Distribution

Vertical Angle	Horizontal Angle 0°
0°	4087
5°	3545
15°	2515
25°	2128
35°	1721
45°	936
55°	509
65°	265
75°	120
85°	31
90°	0

Zonal Lumen Summary

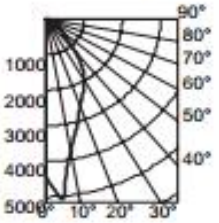
Zone	Lumens	% Lamp
0° - 30°	2236.1	28.3
0° - 40°	3154.3	39.9
0° - 60°	3776.6	47.8
0° - 90°	3956.8	50.1
90° - 180°	0.0	0.0
0° - 180°	3956.8	*50.1

*Total Efficiency

Coefficients of Utilization

RCR	pf 20% pc 80% 50%	30%	70% 50%	30%	50% 50%	30%
0	60	60	58	58	56	56
1	55	53	54	52	51	50
2	50	48	49	47	47	46
3	46	43	45	43	44	42
4	42	39	42	39	41	38
5	39	36	39	36	38	35
6	36	33	36	33	35	32
7	34	30	34	30	33	30
8	32	28	31	28	31	28
9	30	26	29	26	29	26
10	28	25	28	25	27	24

LP8HN 100M 8W1AZ, (1) 100W MP100/c/u/MED lamp, .94 s/mh, 7900 rated lumens, Test no. LTL18320



Intensity Distribution

Vertical Angle	Horizontal Angle 0°
0°	4448
5°	5081
15°	3127
25°	2297
35°	1646
45°	790
55°	420
65°	217
75°	90
85°	26
90°	0

Zonal Lumen Summary

Zone	Lumens	% Lamp
0° - 30°	2669.4	33.8
0° - 40°	3672.7	46.5
0° - 60°	4230.9	53.6
0° - 90°	4380.6	55.5
90° - 180°	0.0	0.0
0° - 180°	4380.6	*55.5

*Total Efficiency

Coefficients of Utilization

RCR	pf 20% pc 80% 50%	30%	70% 50%	30%	50% 50%	30%
0	66	66	64	64	62	62
1	61	59	60	58	57	56
2	56	53	55	53	53	51
3	52	49	51	48	49	47
4	48	44	47	44	46	43
5	44	41	44	41	43	40
6	41	38	41	37	40	37
7	39	35	38	35	38	34
8	36	33	36	32	35	32
9	34	30	34	30	33	30
10	32	29	32	28	31	28

LITHONIA LIGHTING®
An AcuityBrands Company

Sheet #: LP8HN-WALLWASH

© 2005-2011 Acuity Brands Lighting, Inc. All rights reserved. Rev. 11/09/11

Lithonia Lighting
Recessed Downlighting and Track
One Lithonia Way, Conyers, GA 30012
Phone: 800-315-4835 Fax: 770-918-1209
www.lithonia.com

TS-1

DATE:

FIRM NAME:

PROJECT:

Featuring VirtualSource VS Reflectors

6" Vertical T6 MH Downlights

RHD6

One 39W, 70W or 150W T6 MH Lamp

Architektūr

Ceiling Cutout: 6 5/16"
Maximum Ceiling Thickness: 1"
For conversion to millimeters, multiply inches by 25.4
Not to Scale

APPLICATIONS:
The Architektūr RHD6, T6 Series offers a lensed metal halide downlight fixture that provides superior brightness and glare control. Available in three different wattages, this luminaire is ideal for a wide variety of high ceiling applications including commercial, retail, hospitality and atrium areas.

HOUSING:
One piece 18 Ga. painted galvaneal steel plaster flange standard with regressed tempered glass lens. Prewired J-box. Thermal protector.

REFLECTOR:
High purity aluminum Alzak reflector. Self-trim standard. Painted white self-trim available.

BALLAST:
Electronic ballast standard. Accessible from below ceiling. See reverse side for ballast data.

LAMP:
One (1) 39W, 70W or 150W T6 MH, G12 Base lamp. Lamp furnished by others or as option. Optical performance will be dramatically compromised if a lamp other than a Philips CMD is used.

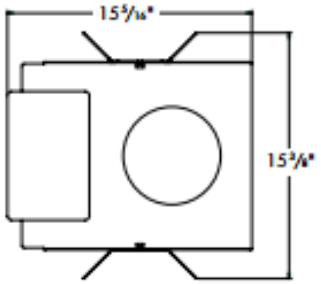
SOCKET:
Ceramic Bi-Pin G12 Base metal halide lamp shipped in a predetermined socket position for precise optical control.

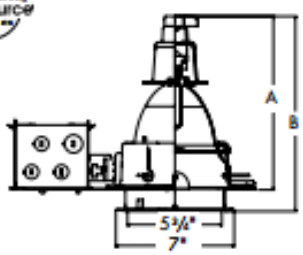
INSTALLATION:
Universal adjustable mounting brackets accommodate 1 1/2" or 3/4" lathing channel or 1/2" EMT (by others), or Prescolite 24" bar hangers (B24 or B6).

LABELS:
UL, CSA listed for wet locations
Approved for through branch wiring, 4 in/4 out #12, 90° C.
Thermally protected
Non-IC rated

EISA compliant (150W)

OVERALL FIXTURE HEIGHT:	A	B
6" 150W Spot	13 3/16"	14 3/16"
6" 150W Medium/Flood	12 3/16"	13 3/16"
6" 70W/39W Spot	11 1/4"	12 1/4"
6" 70W/39W Medium/Flood	10 1/4"	11 1/4"





CATALOG NUMBER: EXAMPLE: RHD670T6EB120VSP-ST6T4/6

HOUSING	VOLTAGE	HOUSING DISTRIB.	HOUSING OPTIONS	REFLECTOR	REFLECTOR COLOR	REFLECTOR OPTIONS	ACCESSORIES
❑ **RHD639T6EB** 6", (1) 39W T6 MH enclosed fixture, electronic ballast	❑ **120V** ❑ **277V**	❑ **SP** Spot (10°) ❑ **MD** Medium (25°) ❑ **FL** Flood (40°)	❑ **DCB** Auxiliary socket (see note on back page) ❑ **FSDFA** Fuse kit installed at factory ❑ **QR** Quartz restrike ❑ **LP** Philips lamp included ❑ **CP** Chicago Plenum	❑ **ST6T4/6** VS 6° Specular Alzak	❑ **Blank** Clear Alzak ❑ **CG** Champagne Gold ❑ **BL*** Black Alzak ❑ **WE** Wheat ❑ **LW** Light Wheat ❑ **PW** Pewter ❑ **BC*** Painted Black Cone ❑ **WC** Painted White Cone	❑ **TRG** Trim Ring gasket (factory installed) ❑ **WT** Painted white trim	❑ **B24** Set of (2) 24" bar hangers for T-bar ceilings ❑ **B6** Set of (2) bar hangers for ceiling joists up to 24" centers ❑ **FSDFI** Fuse kit for field installation ❑ **SCA6** Sloped ceiling adaptor for 6" housing (Specify slope and type of ceiling)
(E) ❑ **RHD670T6EB** 6", (1) 70W T6 MH enclosed fixture, electronic ballast				REFLECTOR FINISH ❑ **BLANK** Specular Clear Alzak ❑ **SS** Semi-specular Alzak ❑ **MFC** American Matte™ Alzak			
(E) ❑ **RHD6150T6EB** 6", (1) 150W T6 MH enclosed fixture, electronic ballast							

(E) EISA Compliant

*Not to be used with flood distributions

prescolite
A Division of Hubbell Lighting, Inc.

In a continuing effort to offer the best product possible we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product.
Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**

ARCH-HID-025

PHOTOMETRIC DATA

Architektūr - 6" Lensed Vertical MH Downlights - RHD6, T6

BALLAST DATA

		39W		70W		150W	
		120V	277V	120V	277V	120V	277V
Power Factor		>90%	>90%	>90%	>90%	>90%	>90%
Regulation:	Line Voltage	± -5%	± -5%	± -5%	± -5%	± -5%	± -5%
	Output Wattage	± -10%	± -10%	± -10%	± -10%	± -10%	± -10%
Min. Ambient Starting Temp.		-30°C	-30°C	-30°C	-30°C	-30°C	-30°C
Input Watts		45W	44W	82W	81W	169W	166W
Input Amps		.4 amp	.2 amp	.67 amp	.29 amp	1.4 amp	0.6 amp

LAMP DATA

	39W	70W
Rated Watts	3,300	6,600
Rated Lum	85	94
Efficacy (LPW)	12,000	12,000
Rated Life	81	81
CRI		

AVERAGE INITIAL FOOTCANDLES

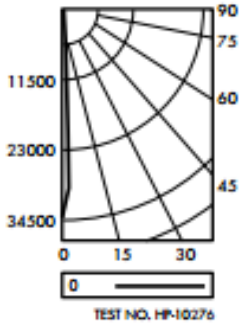
Multiple Units (Square Array)
Ceiling 80% Wall 50% Floor 20%

Assumptions:
1. Multiple Units (Square Array)
2. Ceiling 80% Wall 50% Floor 20%
3. 4 Fixtures evenly spaced in the center of the room.
4. The room is square and has a width and length equal to twice the lamp spacing.
5. The lumen depreciation factor is 0.8.
6. The dirt depreciation factor is 0.98.

70W T6

SPACING	RCR1	RCR3	RCR7
7.0	66	62	57
8.0	51	47	43
9.0	40	37	34
10.0	32	30	28
11.0	27	25	23
12.0	23	21	19
13.0	19	18	16
14.0	17	15	14
15.0	14	13	12

RHD70T6EB120VSP-ST6T4/6
1-CDM70/T6/830-PHILIPS
Spacing Criteria: 0.4
Efficiency: 54.1%



TEST NO. HP-10276

CANDLEPOWER SUMMARY

Angle	0°
0	76722
5	26129
10	10537
15	3215
20	1240
25	348
30	93
35	49
40	16
45	11
50	8
55	2
60	1
65	0
70	0
75	0
80	0
85	0
90	0

LUMINANCE DATA IN CANDELA/SQ. METER

Angle in Vertical	0°
45°	947
55°	196
65°	68
75°	66
85°	65

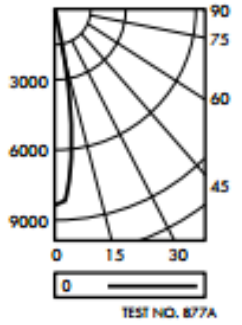
COEFFICIENTS OF UTILIZATION

Zonal Cavity Method

Room Cavity Ratio	% Effective Ceiling Cavity Reflectance: 80%				70%				50%				30%				10%			
	20% Effective Floor Cavity Reflectance																			
	% Wall Reflectance																			
	70	50	30	10	70	50	30	10	50	30	10		50	30	10		50	30	10	
1	.64	.63	.62	.61	.63	.62	.61	.60	.59	.59	.58		.57	.57	.57		.56	.55	.55	
2	.62	.60	.59	.58	.61	.60	.58	.57	.58	.57	.56		.56	.56	.55		.55	.56	.54	
3	.61	.59	.57	.56	.60	.58	.57	.56	.57	.56	.55		.56	.55	.54		.54	.54	.53	
4	.59	.57	.56	.54	.59	.57	.55	.54	.56	.54	.54		.54	.54	.53		.54	.53	.52	
5	.58	.56	.54	.53	.58	.56	.54	.53	.55	.53	.53		.54	.53	.52		.53	.52	.52	
6	.57	.55	.53	.52	.57	.55	.53	.52	.54	.53	.52		.53	.52	.51		.53	.52	.51	
7	.57	.54	.52	.51	.56	.54	.52	.51	.53	.52	.51		.53	.52	.51		.52	.51	.51	
8	.56	.53	.52	.50	.55	.53	.51	.50	.53	.51	.50		.52	.51	.50		.52	.51	.50	
9	.55	.53	.51	.50	.55	.52	.51	.50	.52	.50	.50		.51	.50	.49		.51	.50	.49	
10	.54	.51	.50	.49	.54	.51	.50	.49	.51	.50	.49		.51	.49	.49		.50	.49	.49	

RHD70T6EB120VSP-ST6T4/6 Test No. HP-10276

RHD670T6EB120VMD-ST6T4/6
1-CDM70/T6/830-PHILIPS
Spacing Criteria: 0.6
Efficiency: 70.6%

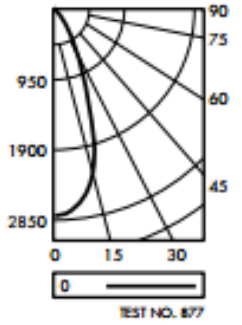


TEST NO. 877A

CANDLEPOWER SUMMARY

Angle	0°
0	10619
5	10482
10	9167
15	6582
20	4148
25	2432
30	1337
35	756
40	456
45	256
50	135
55	26
60	3
65	1
70	2
75	2
80	1
85	1
90	0

RHD670T6EB120VFL-ST6T4/6
1-CDM70/T6/830-PHILIPS
Spacing Criteria: 0.8
Efficiency: 64.2%



TEST NO. 877

CANDLEPOWER SUMMARY

Angle	0°
0	4781
5	4783
10	4782
15	4558
20	3850
25	2887
30	1936
35	1129
40	659
45	412
50	304
55	99
60	3
65	1
70	0
75	0
80	0
85	0
90	0

NOTES

(VS) Denotes a Virtual Source reflector.

The DCB option uses a quartz T6 lamp to provide emergency light during power outages. The DCB socket must be field wired into an auxiliary emergency power supply circuit for emergency use.

The QR option uses a quartz T6 lamp to provide light continuously during cold start or hot restrike until the HID lamp is at approximately 25-50% or more of its rated light output.

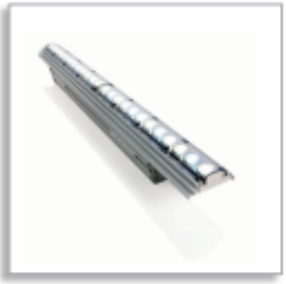
When ordering a sloped ceiling adapter, specify the degree of slope in 5° increments (max of 35°). For a more precise degree or wet ceiling application, please contact factory. The SCA must be installed during housing installation.

prescolite

Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**
701 Millennium Boulevard • Greenville, SC 29607 U.S.A. • Phone (864) 678-1000
Copyright ©2011 Prescolite, Inc., a division of Hubbell Lighting, Inc. All Rights Reserved
Specifications subject to change without notice. • Printed in U.S.A. • ARCHHD-025 - 5/10/11

HUBBELL
Hubbell Lighting, Inc.

TS-2



Date: _____ Type: _____

Firm Name: _____

Project: _____

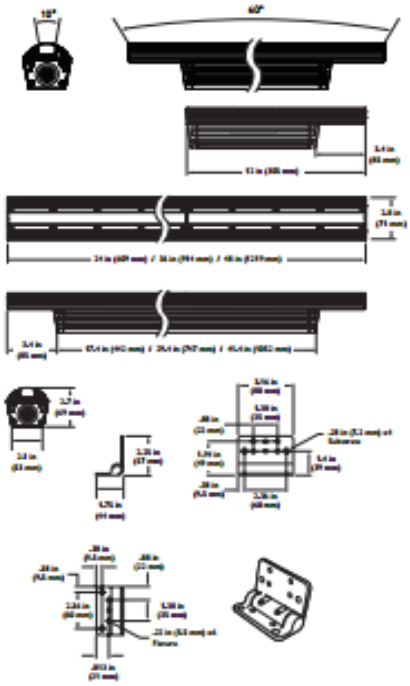
iW Graze Powercore

10° x 60° beam angle

Linear exterior LED wall grazing fixture with intelligent white light

iW Graze Powercore linear LED fixtures are optimized for surface grazing, wash lighting, and efficient signage illumination. iW Graze Powercore fixtures combine channels of cool and warm white LEDs to offer color temperatures ranging from 2700 K – 6500 K. With the operational efficiency and cost-effectiveness of Powercore technology, and a low-profile multi-positional housing, iW Graze Powercore offers both superior performance and simple installation.

- Integrates patented Powercore technology — Powercore technology rapidly, efficiently, and accurately controls power output to iW Graze Powercore fixtures directly from line voltage. The Philips Color Kinetics Data Enabler Pro merges line voltage and control data and delivers them to the fixture over a single standard cable, dramatically simplifying installation and lowering total system cost.
- Tailor light output to specific applications — Available in 1 ft (305 mm), 2 ft (610 mm), 3 ft (914 mm), and 4 ft (1219 mm) lengths, with 10° x 60° and 30° x 60° beam angle options. Superior beam quality offers uniform beam saturation as close as 6 in (152 mm), and a wide horizontal beam angle allows a range of fixture spacing options.
- Versatile installation options — Constant-torque locking hinges offer simple and consistent position control from various angles. The space-efficient, low-profile aluminum housing accommodates placement within most architectural niches.
- Industry-leading controls — iW Graze Powercore works seamlessly with the complete line of Philips Color Kinetics controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, as well as third-party controllers.
- Universal power input range — iW Graze Powercore accepts power input of 100 to 240 VAC, allowing consistent installation in any location around the world. A single Data Enabler Pro can support long runs of iW Graze Powercore fixtures.
- Outdoor rated — With an extruded, anodized aluminum housing fully sealed for maximum fixture life and IP66-rated for outdoor applications, iW Graze Powercore is ideal for use in damp or wet locations.



For detailed product information, please refer to the iW Blast Powercore Product Guide at www.philipscolorkinetics.com/ls/intelliwhite/iwgrazepc/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	1 ft (305 mm)	2 ft (610 mm)	3 ft (914 mm)	4 ft (1219 mm)
Output	Color Temperature*	2700 K – 6500 K			
	Lumens†	557 (1 ft length)			
	Efficacy (lm / W)	24.6 (1 ft length)			
	Lumen Maintenance‡	50,000 hours L_{50} @ 25° C (typical application)			
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz			
	Power Consumption max. at full output, steady state	17.5 W	35 W	52.5 W	70 W
Control	Interface	Data Enabler Pro (DMX / Ethernet) Fixture firmware addressable 8- or 16-bit control			
Physical	Dimensions (Height x Width x Depth)	2.7 x 12 x 2.8 in (69 x 305 x 71 mm)	2.7 x 24 x 2.8 in (69 x 610 x 71 mm)	2.7 x 36 x 2.8 in (69 x 914 x 71 mm)	2.7 x 48 x 2.8 in (69 x 1219 x 71 mm)
	Weight	1.99 lb (0.9 kg)	4.9 lb (2.2 kg)	8.1 lb (3.6 kg)	10.8 lb (4.9 kg)
	Housing	Extruded anodized aluminum			
	Lens	Clear polycarbonate with holographic film diffuser			
	Fixture Connectors	Integral male / female waterproof connectors			
	Mounting	Multi-positional, constant torque locking hinges			
	Temperature Ranges	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage			
	Humidity	0 – 95%, non-condensing			
	Fixture Run Lengths	To calculate fixture run lengths and total power consumption for your specific installation, download the Configuration Calculator from www.philipscolorkinetics.com/support/install_tool/			
Certification and Safety	Certification	UL / cUL, FCC Class A, CE, C-Tick			
	Environment	Dry / Damp / Wet Location, IP66			

* Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.

† Lumen measurement complies with IES LM-79-08 testing procedures.

‡ L_{50} = 50% lumen maintenance (when light output drops below 50% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

Fixtures and Accessories

Use Item Number when ordering in North America.

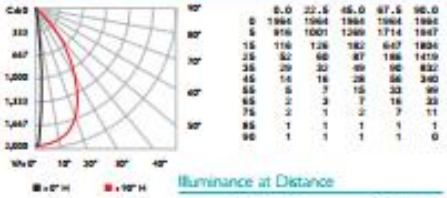
Item	Type		Item Number	Philips 12NC
iW Graze Powercore	10° x 60° beam angle	1 ft (305 mm)	523-000053-04	910503700956
		2 ft (610 mm)	523-000053-05	910503700957
		3 ft (914 mm)	523-000053-06	910503700958
		4 ft (1219 mm)	523-000053-07	910503700959
Leader Cable	UL / cUL	50 ft (15.2 m)	108-000042-00	910503700322
	CE		108-000042-01	910503700323
Jumper Cable	UL / cUL	End-to-end	108-000039-00	910503700314
		1 ft (305 mm)	108-000039-01	910503700315
		5 ft (1.5 m)	108-000039-02	910503700316
	CE	End-to-end	108-000040-00	910503700317
		1 ft (305 mm)	108-000040-01	910503700318
		5 ft (1.5 m)	108-000040-02	910503700319
Glare Shield		1 ft (305 mm)	120-000081-00	910503700745
		2 ft (610 mm)	120-000081-01	910503700746
		3 ft (914 mm)	120-000081-02	910503700747
		4 ft (1.2 m)	120-000081-03	910503700748
Additional Terminators		Quantity 10	120-000074-00	910503700580
Additional Hinge		Quantity 1	120-000098-00	910503700772
Data Enabler Pro	3/4 in / 1/2 in NPT (U.S. trade size conduit)		106-000004-00	910503701210
	PG21 / PG13 (metric size conduit)		106-000004-01	910503701211

CHROMACORE® CK TECHNOLOGY | OPTIBIN™ CK TECHNOLOGY | POWERCORE® CK TECHNOLOGY

Photometrics

1 ft (305 mm) length, 10° x 60° beam angle

Polar Candela Distribution



	0.0	22.5	45.0	67.5	90.0
0°	1984	1984	1984	1984	1984
10°	916	1001	1269	1714	1847
20°	116	126	182	647	1834
30°	52	60	87	186	1419
40°	29	32	49	90	832
50°	14	16	28	56	340
60°	6	7	15	33	99
70°	2	3	7	16	33
80°	1	1	2	7	11
90°	1	1	1	1	0

Illuminance at Distance

44.3 ft (13.5 m)
1 fc maximum distance

For lux multiply fc by 10.7

Lumens	557
Efficacy	24.6 lm / W

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.philipscolorkinetics.com

Copyright © 2010 – 2012 Philips Solid-State Lighting Solutions, Inc. All rights reserved. Chromacore, Chromusic, CK, the CK logo, Color Kinetics, the Color Kinetics logo, ColorBlast, ColorBlaze, ColorBurst, ColorGraze, ColorPlay, ColorReach, iW Reach, eW Reach, eW Fuse, DiMand, EssentialWhite, eW, iColor, iColor Cove, IntelliWhite, iW, iPlayer, Optibin, and Powercore are either registered trademarks or trademarks of Philips Solid-State Lighting Solutions, Inc. in the United States and / or other countries. All other brand or product names are trademarks or registered trademarks of their respective owners. Due to continuous improvements and innovations, specifications may change without notice. DAS-000016-01 R03 07-12

E-1

DUAL LITE

LX Series
Designer LED Exit Sign

Catalog Number	
Comments	Type

FEATURES

Application
The LX Series offers bright and even LED EXIT panel illumination with Green or Red letters and attractive UV stable thermo-plastic housing. Features include AC or Emergency operation with optional Spectron® self-test/self diagnostic circuitry. Housing designed for quick and easy installation with low energy consumption. Damp location listed. Accepts 120 or 277 VAC input.

Construction
The precision-molded thermoplastic housing is impact resistant and scratch resistant, corrosion proof and UL stabilized to resist discoloration. Available in white or black finish. Innovative snap-together design. Includes additional face-plate for single or double face applications. Snap-in directional chevrons. Exit stencil with 6" letters and ¾" stroke. Includes push-in wire connectors for easy installation.

Installation
Universal mounting (ceiling, end, wall) to standard 3 ½" or 4" octagon or square electrical box by use of easily removed, template configured knockouts. Canopy and universal mounting plate included. All mounting hardware is fully concealed.

Illumination
Exit face illumination is provided by energy saving, long-life red or green LED's. Exceeds UL 924 requirements for brightness and uniformity. UL listed LED run-time of 120 minutes. 10 year LED life.

Compliances
UL 924 Listed (Meets1998 brightness and uniformity requirments)
UL Damp Location Listed
NFPA-70
NFPA-101
US Patent No. D402,316, and D406,863.

Warranty
Unit and electronics: 5 years full

ORDERING GUIDE

LX U - ____

Model	Faces	Letter Color	Housing Finish	Operation	Self-Diagnostic	Options
LX	U Universal Single/ Double Face	R Red G Green	W White B Black	Blank AC Only E Emergency	Blank None I Spectron® Self-Testing / Self-Diagnostic Electronics	-2C 2-Circuit Operation [2, 5] -FAP Fire Alarm Panel Interface [1, 3, 5, 6] -FM Flasher Module [1, 6] -AF Audible/Flasher Module [1, 6] -DC Remote DC Operation [2, 4, 5] -24/K 220-240 VAC, 60Hz Operation

ACCESSORIES *(order separately)*

VRS-3	Vandal Resistant Shield
FCM-R	Kit Converts AC red letter models to emergency operation
FCM-G	Kit Converts AC green letter models to emergency operation
PMLXW	12 ½" Pendant Mounting Kit (white)
PMLXB	12 ½" Pendant Mounting Kit (black)
WGLX	Wire Guard (wall mount)
WGLXC	Wire Guard (ceiling mount)
WGLXE	Wire Guard (end mount)

FEATURES

(1) For use with Spectron® self-diagnostic models only.
(2) For use with AC models only.
(3) Operates with 24-volt AC or DC fire alarm panels.
(4) For emergency illumination of sign from remote 6-24 VDC power sources.
(5) -DC option may not be specified with -2C or -FAP options.
(6) -AF, -FM and -FAP options may not be specified together.

HUBBELL
Hubbell Lighting, Inc.

DUAL LITE

LX Series
Designer LED Exit Sign

SPECIFICATIONS

Electronics
Available with AC, emergency and Spectron® self-diagnostic/self-testing electronics option. Emergency and self-diagnostic models equipped with isolation transformer and fully automatic constant current solid-state charger with sealed maintenance-free nickel-cadmium battery. All components mounted inside housing. Includes test switch and AC-on indicator. Transient/surge protection, low-voltage disconnect and AC lock –out features included. Battery re-charge within UL time standards. Includes pre-stripped AC input pigtail leads.UL listed LED run-time of 120 minutes.

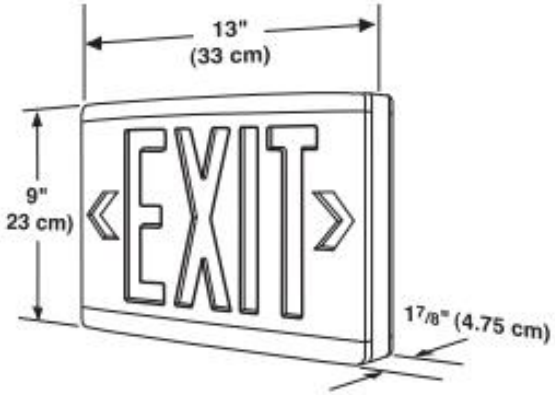
Power Consumption

	120VAC	277VAC
Red AC Only Models:	2.84 watts	2.70 watts
Green AC Only Models:	2.24 watts	2.24 watts
Red Emergency Models:	3.81 watts	3.80 watts
Green Emergency Models:	3.50 watts	3.50 watts

** Wattage figures include LED lamps, transformer and electronics power requirements. LED lamp assemblies (red or green) consume less than 1 watt.*

Power Factor, Average: .8 (lagging)
Battery Type: Maintenance-free sealed nickel cadmium battery
AC Input: 120/277VAC, 60 Hz. (all models)
Operating Temperature Range: 0°C to 40°C (32°F to 104°F)

DIMENSIONS



Dual-Lite • www.dual-lite.com

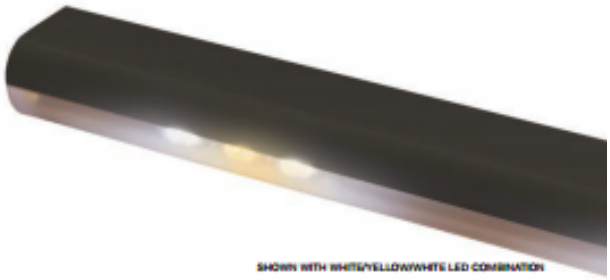
HUBBELL
Hubbell Lighting, Inc.

E-2

CAT:	FEET:
TYPE:	PROJECT:

USHER™
PLATINUM SERIES SEAT LIGHT

A stylish, seat-mounted, tamper resistant linear LED lighting system with an optically clear directional lens.



SHOWN WITH WHITE/YELLOW/WHITE LED COMBINATION

FEATURES

- Compact (8" x 1⅛" x ⅞"), hidden light source tamper-resistant seat mounted LED lighting system
- Optically clear polycarbonate co-extruded directional lens features 110° lighting cut-off with no glare intrusive to patrons view
- Seat light is adaptable for stationary or pivot arms, hard or fabric surface-mount
- Individually replaceable 3 LED PCB module design operates at efficient 0.72W (6 LED fixture) and 1.08W (9 LED fixture) 12V DC. LED PCBs easily snap into platinum series modules for easy and economical maintenance (50,000 hour average lifespan)
- 48" super-flex conduit standard for wireway connection
- Use with Tivoli's patented two-tone bullnose stair nosing with reflective edge to step delineation to maximize voltage drop
- Smooth full range dimming capability with commercially available analog dimmers for magnetic low voltage transformers

SPECIFICATIONS

USHER SEAT LIGHT	EFFICACY LM/WATT	LM/ FIXTURE	LM/ MODULE	WT/ FIXTURE	WT/ MODULE
White Piranha - 9 LED Fixture	21.92	23.67	7.89	1.08	0.36
White Piranha - 6 LED Fixture	21.92	15.78	7.89	0.72	0.36
Ye/Wht/Yel Piranha - 9 LED Fixture	20.33	21.96	7.32	1.08	0.36
Ye/Wht/Yel Piranha - 6 LED Fixture	20.33	14.64	7.32	0.72	0.36

Measurements are based on 12V DC power design calculations will vary based on power supply and run lengths.

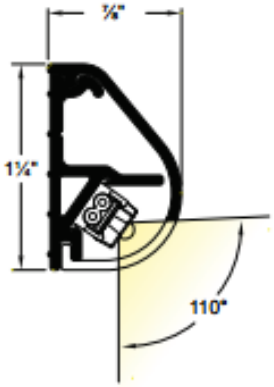
LED DATA RATED TO L90B STANDARDS	WATTAGE	LED LIFE* / COLOR TEMP	VIEWING ANGLE
Piranha Superflux LED	0.36W per LED	40,000 hrs. White (5500°K), Warm White (2800°K), Blue, Green 100,000 hrs. Yellow, Red	90°

*Lamps operate at 90% of design voltage.

1. LEDs - 0.36W High Brightness LED PCBs
2. Colors - Available in the following color arrangements:
   Red/White/Yellow Yellow/White/Yellow
   White/Yellow/White White/White/White
3. LEDs per fixture - 6 or 9 LEDs (2 or 3 PCBs) per fixture
4. Installation - Suggested mounting height above floor 10-15"
5. Power Supply - Listed Class II 12V DC power supply required
6. Safety - Meets ADA requirements and NFPA (National Fire Protection Agency) guidlines for aisle/step illumination and emergency egress standards (if mounted under 12")
7. Safety - Meets Life Safety Code when mounted 12"-15" above floor
8. Listing - ETL listed for Class II applications
9. Warranty - 3 Year Warranty

ADA

PROFILES



Visible light source for slope delineation while illuminating step and aisle surfaces.

PROFILE OF PLATINUM LED MODULE

USHER SEAT LIGHT ORDER SPECIFICATION GUIDE

Example: USL-C-YWY-09

PRODUCT CODE	FEEDPOINT	LED BOTTOM	# OF LEDS	REQUIRED POWER SUPPLY
	–	–	–	+ PSU
USL = Usher Seat Light	C = Center R = Right L = Left	RRR = Red/Red/Red YYY = Yellow/Yellow/Yellow YWY = Yellow/White/Yellow WYW = White/Yellow/White WWW = White/White/White	06 = 6 LED 09 = 9 LED	See power supply specifications

* Fixture length refers to manufacturing range of length. Architectural Step is manufactured to specified lengths to within ⅛"

REQUIRED POWER SUPPLY OPTIONS

- ☐ JT-240-4-5-12-D
- ☐ JTH-240-4-5-12-D
- ☐ JT-60-1-5-12-D
- ☐ JTH-60-1-5-12-D

See power supply specifications for more information

OPTIONAL DIMMERS

- ☐ N-600
- ☐ N-1000
- ☐ NH-600
- ☐ NH-1000
- ☐ DIM-12V-8A

Copyright © 2013 Tivoli 10.07.13 - Page 1 of 4

Tivoli, LLC • 15602 Mosher Ave Tustin, CA 92780 • ph 714 957-6101 fx 714 427-3458 • www.tivollighting.com / sales@tivollighting.com

USHER™
PLATINUM SERIES SEAT LIGHT

RECOMMENDED POWER SUPPLIES

PART #	PRIMARY AND SECONDARY	TOTAL WATTAGE / AMPERAGE PER BREAKER	LISTING	DIMENSIONS	ELECTRONIC OR AC MAGNETIC	DIMMABLE (Y OR N)
JT-60-1-S-12-D	120V AC / 12V DC	60 / 1.15A	ETL	4.25"W X 6.50"L X 3.25"D	Magnetic	Y: A, B, C
JTH-60-1-S-12-D	277V AC / 12V DC	60 / 1.15A	ETL	4.25"W X 6.50"L X 3.25"D	Magnetic	Y: C, D, E
JT-96D-1-S-12-D	120V AC / 12V DC	96D / 4.15A	ETL	8.50"W X 16.05"L X 4.50"D	Magnetic	Y: A, B, C
JTH-96D-1-S-12-D	277V AC / 12V DC	96D / 4.15A	ETL	8.50"W X 16.05"L X 4.50"D	Magnetic	Y: C, D, E

DIMMERS

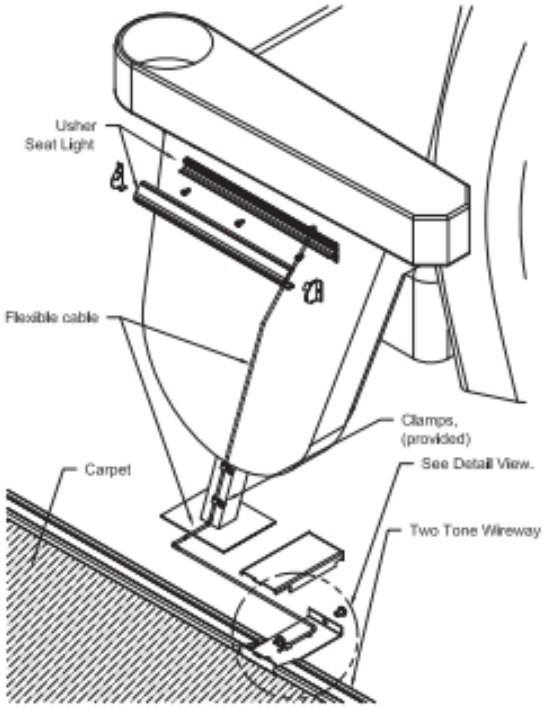
SELECTOR	DIMMER	TYPE	CONTROL SIGNAL	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX LOAD	BREAKER RATING	DIMENSIONS
A	N-600	AC Magnetic	N/A	120V AC	120V AC	450W Max.	N/A	Recessed Single gang box
B	N-1000	AC Magnetic	N/A	120V AC	120V AC	900W Max.	N/A	Recessed Dual gang box
C	DM-12V-8A	DC Digital	N/A	12V DC	12V DC	96W	8A*	Single gang box
D	NH-600	AC Magnetic	N/A	277V AC	277V AC	450W	N/A	Recessed Single gang box
E	NH-1000	AC Magnetic	N/A	277V AC	277V AC	900W	N/A	Recessed Dual gang box

* JT Series secondary outputs would be limited to 8 amps.

PRODUCT SPECIFICATION GUIDE

MAX. LEDS PER FEED

TYPE	WATTS PER FIXTURE	# OF FIXTURES PER BREAKER
6 LED	0.72W	75EA
9 LED	1.08W	50EA



Page 4 of 4 - Copyright © 2013 Tivoli 10.07.13

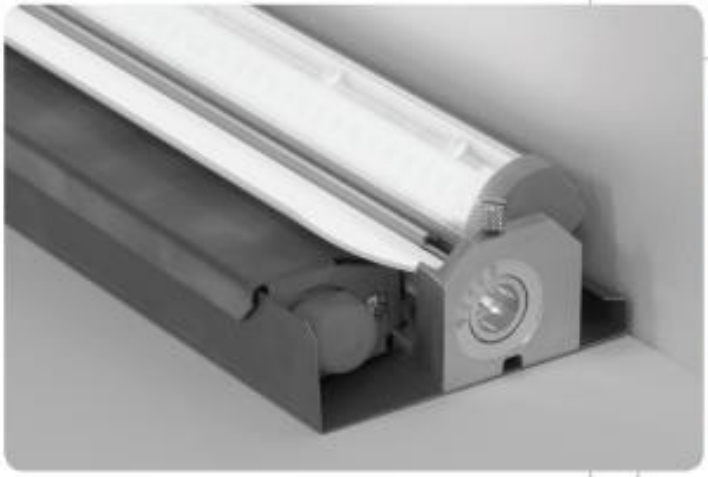
Tivoli, LLC • 15602 Mosher Ave Tustin, CA 92780 • ph 714 957-6101 fx 714 427-3458 • www.tivolilighting.com / sales@tivolilighting.com

RA

FOCAL POINT

covert™

led



features

Small profile indirect LED luminaire designed for concealed cove applications.

Adjustable Light Bar and Light Scoop aim and lock to optimize distribution in any cove application.

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

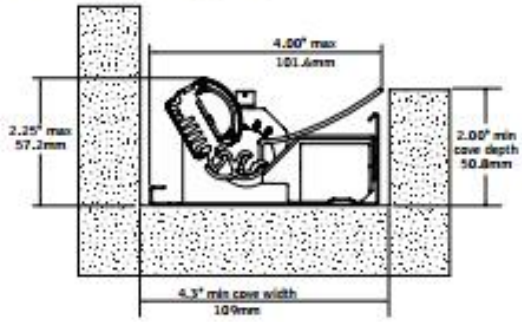
Continuous runs may be specified in 1" increments.

Covert™ provides pleasing and shadow-free illumination that highlights architectural details.

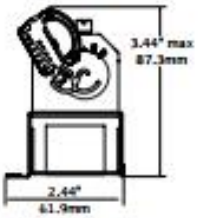
detail

dimensional data

horizontal base with adjustable light scoop
also available without light scoop



vertical base

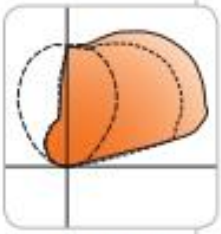


2.81" min cove width
3.25" min cove depth

performance

horizontal base with light scoop
light bar set at position 6
4' length, High Output (LL4)
Delivered lumens: 4905lm
Total system watts: 55.5W
205@135°

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



Visit focalpointlights.com for complete photometric data.

march 2014 E

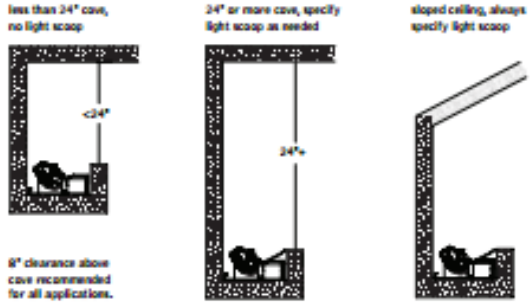
fixture:

project:

details

wiring compartment for power feed at start of run

profile recommendations



8" clearance above cove recommended for all applications.

ordering

luminaire series		FCOL
Covert - Adjustable LED Cove Light	FCOL	
profile		
Horizontal base	HN	
Horizontal base with light scoop	HS	
Vertical base	VN	
led system		
Low Output (L3D only)	LL1	
Standard Output	LL2	
Medium Output	LL3	
High Output	LL4	
color temperature		
3000K	L30	
3500K	L35	
4000K	L40	
circuits		1C
Single Circuit	1C	
voltage		
120 Volt	120	
277 Volt	277	
driver		
0-10V Dimming	LD1	
Lutron A-Series - EcoSystem	L3D	
mounting		CV
Cove	CV	
nominal luminaire length		
Specify in 1" increments (2' min. LD1: LL3 - 4' min, LL3 - 3' min. Wiring compartment adds 5.75" to each run)	XX"	

specifications

led system

Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K or 4000K with CRI:>80, 3SDCM. 0-10V dimming driver standard. LED modules and drivers are replaceable.

construction

.07" thick extruded aluminum LED module housing.
20 Ga. steel driver compartment and outer housing.
Optional adjustable light scoop of .07" thick extruded aluminum.

4' unit weight: 9.5lbs

optic

Continuous illumination enabled by linear LED modules shielded by extruded acrylic lens.Light Bar and Light Scoop adjust and lock to aim peak candela and/or shape overall distribution.

electrical

Standard 120-277V driver includes 0-10V analog dimming. Dimming range 100% - 10%. Power factor > .9.

Optional EcoSystem® dimming drivers from Lutron available.

External wiring compartment provided with each run for power feed.

4' profile	output	adjustment settings: light scoop	adjustment settings: light bar	delivered lumens	total system watts	peak candela
HS	LL1	0	0	1612	15.4	539 @ 170°
		0	6	1415	15.4	594 @ 135°
	LL2	0	0	2868	27.1	958 @ 170°
		0	6	2628	27.1	1103 @ 135°
	LL3	0	0	4220	40.7	1410 @ 170°
		0	6	3837	40.6	1611 @ 135°
	LL4	0	0	5322	55.0	1778 @ 170°
		0	6	4905	55.0	2059 @ 135°
HN	LL3		0	3894	40.6	1363 @ 170°
			6	3436	40.6	1467 @ 120°
VN	LL3		0	4235	40.8	1464 @ 170°
			6	4246	40.8	1523 @ 120°
			8	4240	40.8	1499 @ 100°

labels

ETL listed in accordance with UL standards.

lifetime and warranty

LED system rated for 50,000 hours at 70% lumen output (L70). Rated life and lumen output based on maximum ambient temperature of 25°C. 5 year limited warranty.

perimeter

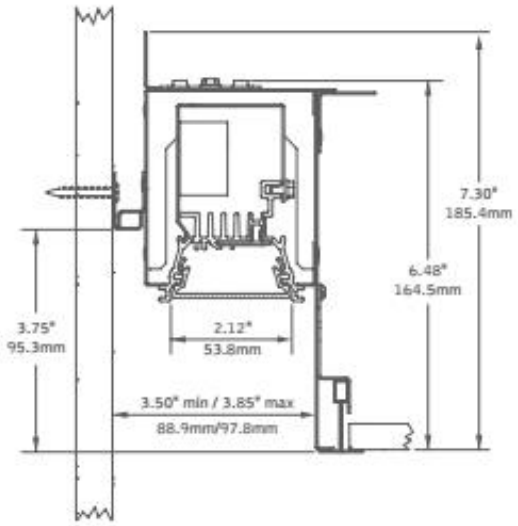
RB

OUTLINE AND OUTSHINE.

Trace your designs and define the transition from wall to ceiling with a glow.

FEATURES

- Narrow 3.5" aperture
- Creates floating ceiling effect without building a cove
- Shadow-free continuous illumination and pleasant perimeter glow
- 90 degree corners and sliding sleeves for wall-to-wall installation
- A frosted lens with linear rib pattern obscures LEDs and allows comfortable viewing at any angle



LED DETAILS

- 3000K or 3500K, CRI>80
- 5.7 watts and 300 delivered lumens per foot
- 0-10V dimming standard
- L70 at 50,000 hours, 5 year warranty
- Replaceable LED modules and drivers

led

INSTALLATION DETAILS

GRID CEILING

15/16" or 9/16" Flat Tee
main runner required.

DRYWALL/HARD CEILING

Ceiling mounts below housing,
finish by others.

CORNERS

3" min / 6" max
Inside corner shown.

ORDERING

luminaire series		FTRL
Trace	FTRL	
shielding		AC
Frosted Acrylic Diffuser	AC	
led system		LL1
Standard Output	LL1	
color temperature		_____
3000K	L30	
3500K	L35	
circuits		1C
Single Circuit	1C	
voltage		_____
120 Volt	120	
277 Volt	277	
driver		LD1
0-10V Dimming	LD1	
mounting		_____
Grid	G	
Drywall	XF	
factory options		
Air Return	AK	_____
Chicago Plenum	CP	_____
Emergency Circuit	EC	_____
Flanged Ends (specify when ends do not terminate at a wall)	FL	_____
HLR/GLR Fuse	FU	_____
Sliding Sleeve	SS	_____
Sliding Sleeve Pair (recommended to finish incremental lengths 6" or more. Ex. 12'-8" opening)	SSB	
finish		WH
Matte White Housing	WH	
luminaire length		_____
Specify luminaire/row length in 1" increments (3" minimum)	XX'	
corner options		_____
90-degree Inside Corner	FTRL-IC90	
90-degree Outside Corner	FTRL-OC90	

THE ART OF LIGHT®

Follow @focalpointlight

©2012 Focal Point LLC.
4141 S. Pulaski Road, Chicago, IL 60632
T 773.247.9494 | www.focalpointlights.com

All rights reserved. "Focal Point", "The Art of Light", "Trace" and the light-ray graphic are trademarks or registered trademarks of Focal Point, LLC. Visit focalpointlights.com for specification and other details on our entire Focal Point catalog.

8/12 #MKT1097

Spec Sheet **RC**

FLUORESCENT
1-125

TRIPLES-V 18/6

recessed compact fluorescent downlight/wallwasher

FEATURES

Triples-V 18/6 is an efficient 6" aperture low brightness downlight designed for use with one 18-watt triple-tube compact fluorescent lamp of the 4-pin types made by GE, Sylvania or Philips. Triples-V 18/6 provides a shielding angle of 40°.

One housing allows interchangeable use of downlight and wallwash reflectors, permitting housings to be installed first and reflectors to be installed or changed at any time.

Triples-V 18/6 uses one 18-watt lamp providing 1200 lumens (more than a 75-watt incandescent), a 10,000-hour life, a color rendering index (CRI) of 82, and color temperatures as warm as 2700°K (nearly duplicating the color qualities of incandescent).

Reflectors are available in clear, natural aluminum in two finishes: **EvenTone**, our standard clear finish, partially diffuse, anti-iridescent and gently luminous in appearance; and **EasyTone**, diffuse and luminous. Additionally, reflectors are available in champagne gold, wheat, pewter and bronze. Wallwash (120°), corner wallwash (210°) and double wallwash (2x120°) reflectors are also available.

Triples-V 18/6 includes a pair of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are also available.

APPLICATIONS

Fixture is suitable for downlighting or wallwashing in nearly all architectural environments, especially those spaces where non-directional luminaires are preferred over rectangular troffers. These include offices, stores, lobbies, corridors, restrooms and public areas.

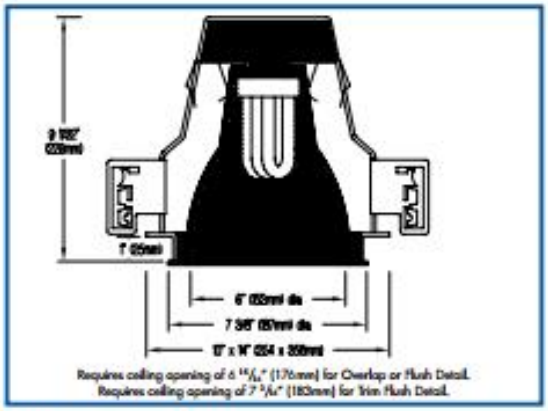
Fixture is "UL" listed for Damp Location (may not be suitable for some outdoor environments). Fixture is prewired with high power factor Class P electronic ballast, suitable for use in a fire rated ceiling, and approved for ten #12 wire 75°C branch circuit pull-through wiring. Removal of the reflector allows access to the ballast and junction box.

NOTE: Under certain conditions, such as installations where there is a pressure differential between the room and ceiling cavity, amalgam based fluorescent lamps may experience reduced lumen output.

MODIFICATIONS AVAILABLE

Contact factory with quantity for pricing; orders may require shop drawing approval.

- **CHP-:** fixture suitable for **Chicago Plenum**; add CHP- as prefix to Product Code.
- **CONC-:** fixture suitable for poured-in-place concrete; add CONC- as prefix to Product Code.
- **EXP-:** 'European-style' **install-from-below** fixture; add EXP- as prefix to Product Code.
- **+2"CLG:** fixture suitable for installation in **2" thick ceiling** material; add +2"CLG to Product Code.
- **+DOD-:** fixture suitable for **high humidity** environments.
- **+MAR-:** reflector suitable for **marine** environments.



PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit	TRPV 18/6

Reflector Type

Downlight	no suffix	Corner Wallwash	CWW
Wallwash	WW	Double Wallwash	DWW

Voltage

120 volt service	120	277 volt service	277

Reflector Color and Detail

	Overlap Flange	*Flush*	*Trim Flush**
EvenTone Clear	VOL	VFL	VTF
EasyTone Clear	ECOL	ECFL	ECTF
Champagne Gold	GOL	GFL	GTF
Wheat	WHOL	WHFL	WHTF
Pewter	POL	PFL	PTF
Bronze	ZOL	ZFL	ZTF

Other reflector finishes available on special order.

Overlap flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CF (custom color flange).

**Trim Flush reflector trim requires the use of a plaster ring Accessory (see below).*

OPTIONS *Specify by adding to the basic unit.*

Dimmable 3-wire ballast. Not for outdoor application ..... – DM

Emergency battery pack operates lamp in event of power outage. Fixture footprint increases to 10 x 17½" (254 x 444mm). Not available with CWW reflector. Not for outdoor application ..... – EM

¼" (3mm) thick clear acrylic shield, spring-mounted in reflector. Available with downlight or WW reflector only..... – PS

ACCESSORIES *Specify as a separate line item.*

Plaster ring allows use of 6 7/8" OD Trim Flush (-TF) reflector in sheetrock ceiling; 7 3/16" dia hole required..... TF RING/6

- For combinations of the Options above, contact factory or Edison Price Lighting representative.
- A modified fixture suitable for 347-volt service is available on special order. Contact factory.
- Decorative reflector rings are available on special order. Contact factory.

EDISON PRICE LIGHTING

41-50 22ND STREET, LIC NY 11101 tel 718.685.0700 fax 718.786.8530 www.epl.com

©Copyright, Edison Price Lighting 2009

06/10

TRIPLES-V 18/6

EDISON PRICE LIGHTING

PHOTOMETRIC REPORT

Report No. 44758. Original Independent Testing Laboratories, Inc. (ITL) test report furnished upon request.

Luminaire ..... recessed compact fluorescent downlight with spun aluminum reflector, semi-specular finish
Lamp ..... Philips 18-watt triple-tube compact fluorescent, 4-pin GX24q-2 base, 1200 lumens
Efficiency 64.3%
Spacing Criteria ..... 0°-1.2, 90°-1.1

BALLAST INFORMATION

Voltage	120	277
Input Watts	22	22
Line Current (A)	.19	.08
Power Factor (%)	>98	>98
THD (%)	<10	<10
Min. Starting Temp* (°F)	0	0

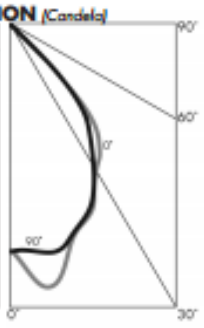
*Consult lamp manufacturers for specific temperatures.

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixture
0 - 30°	436	36.3	56.5
0 - 40°	661	55.1	85.7
0 - 60°	772	64.3	100.0
0 - 90°	772	64.3	100.0
90 -180°	0	0.0	0.0
0 -180°	772	64.3	100.0

CANDLEPOWER DISTRIBUTION (Candela)

Vertical Angle	Horizontal Angle 0.0	45.0	90.0
0	557	557	557
5	627	589	561
15	575	580	553
25	489	456	482
35	385	354	349
45	143	158	162
55	1	0	0
65	0	0	0
75	0	0	0
85	0	0	0
90	0	0	0



LUMINANCE DATA

(Candela/m²)

Vertical Angle	Average 0° Longitude	Average 90° Longitude
45	10215	11572
55	88	0
65	0	0
75	0	0
85	0	0

To convert cd/m² to footlamberts, multiply by 0.2919.

COLOR MULTIPLIERS

EvenTone (V)	.95
EasyTone (EC)	.88
Champagne Gold (G)	.97
Wheat (WH)	.79
Pewter (P)	.81
Bronze (Z)	.58

COEFFICIENTS OF UTILIZATION – ZONAL CAVITY METHOD

Effective Floor Cavity Reflectance 20%

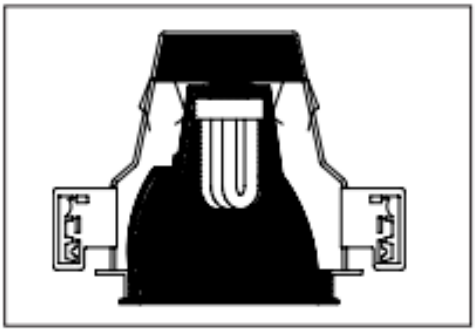
Ceiling Reflectance (%)	80				70				50			30			10			0
Wall Reflectance (%)	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
Room Cavity Ratio																		
0	76	76	76	76	75	75	75	75	71	71	71	68	68	68	65	65	65	64
1	73	71	69	67	71	69	68	66	67	65	64	64	63	62	62	61	61	59
2	69	65	62	60	67	64	62	59	62	60	58	60	58	57	58	57	56	55
3	65	60	57	54	63	59	56	54	58	55	53	56	54	52	55	53	51	50
4	61	56	52	49	60	55	51	49	54	51	48	52	50	47	51	49	47	46
5	57	52	48	45	56	51	47	44	50	46	44	49	46	44	48	45	43	42
6	54	48	44	41	53	47	43	41	46	43	40	45	42	40	45	42	40	39
7	51	45	40	37	50	44	40	37	43	40	37	42	39	37	42	39	37	36
8	48	42	37	34	47	41	37	34	40	37	34	40	36	34	39	36	34	33
9	46	39	35	32	45	38	35	32	38	34	32	37	34	32	37	34	31	31
10	43	36	32	30	42	36	32	30	35	32	29	35	32	29	34	31	29	28

TRIPLES-V 18/6 WW

WALLWASH INFORMATION

Distance From Ceiling (Feet)	2'6" From Wall; 2'6" O.C.		3' From Wall; 3' O.C.	
	Below Fixture	Between Fixtures	Below Fixture	Between Fixtures
1	5	5	3	3
2	8	7	5	4
3	13	13	7	6
4	15	15	10	10
5	13	13	10	10
6	10	11	9	9
7	9	8	8	8
8	7	7	6	6
9	6	6	5	5

All vertical footcandles are initial values with no contribution from ceiling or floor reflectances. Computation performed with at least five wallwashers.



PP

Job Name: Contact:

Ordering Code: Fixture Type:

LEDRA BRUCK

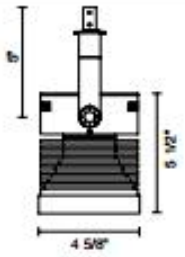
Fixture Heads

Chroma Z35 Track Spot

Chroma

Additional Info:

mc 10	ph	ac 1	ls 1
mounting options	photometric data	accessories	LED info



shown with flared snoot

Description

The Chroma Z35 is a purpose made, fully adjustable, Lockable, high performance LED spot for Bruck's GEO two circuit line voltage track.The precision machined aluminum housing seconds as its heat sink providing exceptional thermal management ensuring efficient long life operation. It utilizes the powerful Xicato® XSM 2200 lumen module for performance as well as perfect color from fixture-to-fixture. Multiple snoot options are offered.

Industry best color quality and consistency is achieved through the use of single source LED module with patented cold remote phosphor technology; SDCM of 2 for 2 step Macadam ellipses. Single source eliminates multi-shadows caused by multi-emmiter LED spots. A remote dimming driver is in a low profile side car attachment within the adapter for GEO track.

Like all Chroma products that use Xicato, Z35 carries a 5 YEAR WARRANTY which includes NO COLOR SHIFT.

Technical Specs

- 120Vac input, 50/60Hz
- 32.4W, 32.5VA
- Lumens: 2200lm.
- CCT: 2700K, 3000K, 3500K, 4000K
- CRI: 80 and 97
- SDCM: 2x, 1y, 2 step MacAdam Ellipse
- Duv +/- .001
- Max +/- 50 Kelvin
- Rated life, based on IESNA-LM-80-2008: 85% of initial lumens after 50,000 hrs
- Dimming capability: electronic low voltage (ELV), Reverse Phase
- Track mounting: Global Trac Systems, GEO track
- Made in the USA - meets the requirements of the Buy American provision within the ARRA.
- ETLus Listed to UL1574 (suitable for dry locations only)
- cETL Listed to CSA C22.2 #9.0
- 5 year limited fixture warranty
- 5 year no color shift warranty

Ordering Code:

example: **350435 • wh • 2 • m • s3 • geowh**

Light Source	Finish	Color Temperature	Reflector	Snoot	Adaptor Option
350435 LED	bk black	2 >80 CRI, 2700k	fl flood, 60°	s1 flush	geobk GEO black
	mc matte chrome	2a >95 CRI, 2700k	m medium, 40°	s2 flare	geosv GEO matte silver
	wh white	3 >80 CRI, 3000k	s spot, 20°	s3 extended	geowh GEO white
		3a >95 CRI, 3000k		bd barn doors	
		9 >80 CRI, 3500k			
		9a >95 CRI, 3500k			
		4 >80 CRI, 4000k			
		4a >95 CRI, 4000k			

Notes:

Bruck Lighting Systems, Inc. 15774 Gateway Circle Tustin, CA 92780 p:714.259.9959 f:714.259.9969 v.10.3.10

Job Name:

Contact:

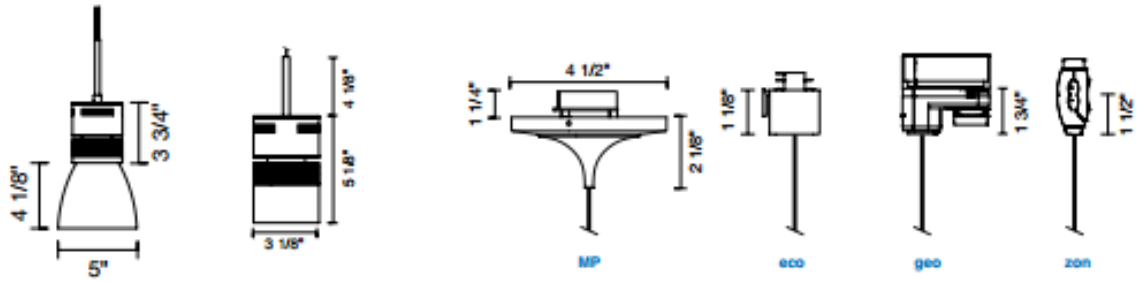
PS

Ordering Code:

Fixture Type:

Z15 LED Pendant Cylinder

BRUCK
LEDRA brands



Applications

The Z15 Pendant Cylinder with Chroma technology provides energy efficient light using a cold remote phosphor module by XICATO® with an industry best SDCM of 1 x 2 Macadam ellipses. The housing is machined aluminum and seconds as its heat sink and driver housing. It is offered in matte chrome, white and black with either snoot aperture or white or blue frosted glass shade optic. The Z15 Pendant Cylinder is fully dimmable and offered in 4 color temperatures. The 3" Z15 Pendant Cylinder carries a 5 year NO COLOR SHIFT AND FIXTURE WARRANTY.

LED Performance

LED: Patented Cold Remote Phosphor, XICATO®
SDCM: 1 x 2 MacAdam Ellipse, +/- 50 Kelvin
CCT: 2700k, 3000k, 3500k, or 4000k
CRI: >80, >95
LIFE: 85% at 50k hrs based on LM-80 testing
5 year "no color shift" warranty

lumens	+80 CRI	+95 CRI
700lm		15W
1000 lm	15W	

Chroma made in the USA Qship LM-79

Housing

Machined aluminum housing with white, matte chrome, or black finish. Optional cast glass shade.

Mounting

Pendant provided with a cable length of 60". Canopy over a 3" - 4" recessed round junction box. Optional Track mounting: Global Trac Systems, GEO track and ECO track, Halo® Power Trac track, and Zonyx track.

Reflector

Reflectors are provided with computer designed, lamp specific, post Alzak anodized reflectors of pure aluminum (99.98%). Available in Specular aluminum (SA) to provide glare and iridescence free performance.

LiteOptics / Accessories

Optical attachments allow for tool-less access to LED components and reflector. Ease of maintenance with field interchangeable optics when performance variations and lighting requirements of the space change. Optional dust protective lens provided on snoot aperture.

Electrical / LED Driver

120Vac input, 50/60Hz, 15W, 16VA. Electronic 120V driver. Trailing Edge (ELV) dimming. *Consult factory for other voltage options.

Listings

ETLus Listed to UL1598 (suitable for dry and damp locations),
UL1574 (track suitable for dry locations only)
cETL Listed to CSA C22.2 #250.0 and #9.0
Made in the USA - meets the requirements of the Buy American provision within the ARRA.

Ordering Codes

Follow the steps to specify your luminaire.

example: 112 - 250 - mc - 2a - m - zonmc

① Light Source	② Shade	③ Finish	④ Color Temperature	⑤ Reflector / Glass*	⑥ Mounting Option
112 LED	250 252 with glass	bk black mc matte chrome wh white	2 >80 CRI, 2700k, 1000lm 2a >95 CRI, 2700k, 700lm 3 >80 CRI, 3000k, 1000lm 3a >95 CRI, 3000k, 700lm 9 >80 CRI, 3500k, 1000lm 9a >95 CRI, 3500k, 700lm 4 >80 CRI, 4000k, 1000lm 4a >95 CRI, 4000k, 700lm	fl flood, 60° m medium, 40° s spot, 20° bl blue wh white	MP 4" Kiss Canopy ecobk ECOHalo black ecosv ECOHalo matte silver ecowh ECOHalo white geobk GEO black geosv GEO matte silver geowh GEO white zonmc Zonyx matte chrome

NOTES:
****specify reflector degree for 250 only***
****specify glass color for 252 glass only***

PR

BRUCK

LEDRA

Job Name: Contact:

Fixture Type: Part Number:

CHROMA R

Chroma

The Ledra® Chroma R is a recessed 6.5 or 12.4 Watt LED fixture in a 3" aperture. It has a clear glass lens and can be specified with a 20°, 40° or 60° specular reflector. Standard with specular reflector. Add /DA for diffuse matte reflector. The Chroma R is IC rated using the 6.5 watt only. It features a patented Cold remote phosphor single source module which offers industry leading color consistency with a + / - 50 Kelvin fixture to fixture variance. The Chroma R is offered in MC, BZ and WHT. For compatible drivers refer to our driver section.

Ordering Code

Choose the desired wattage, finish, reflector, and color temperature from the options below. Diffuse matte reflector optional.

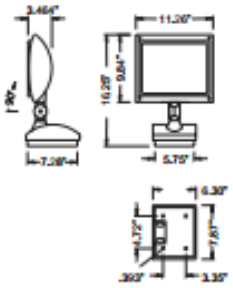
example: 138 - 050 - mc - s - 3

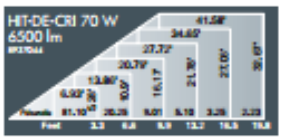
Light Source	Finish	Reflector	Color Temperature	Reflector Option
138050* LED 6.5W **138055** LED 12.4W *6.5W available only in 3000k color temperature only	**bz** bronze **ch** chrome **wh** white	**fl** flood 60° **m** med 40° **s** spot 20°	**2** >80 CRI, 2700k **3*** >80 CRI, 3000k **4** >80 CRI, 4000k	**DA** diffuse matte

C-1

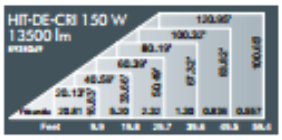
Nightline B BN3

- low copper alloy cast Aluminum body
- UL, cUL listed wet label IP65
- axially symmetrical specular reflector
- available in 70W ceramic MH ballast in canopy and 150W ceramic MH ballast in recessed box behind the canopy
- electronic ballast for HID with cold weather start
  -30C for HID
- 70W and 150W double ended ceramic metal halide have a CRI of 85, 3000k color temperature and a rated life of 15,000 hours
- clear prismatic tempered glass lens





Nightline B BN3				
Lamp	Lampholder	Weight	Beam angle Y	
			C 0-180	C 90-270
70W CERAMIC MH DE	Rx7s	14.5lbs	93	79°



Nightline B BN3				
Lamp	Lampholder	Weight	Beam angle Y	
			C 0-180	C 90-270
150 W CERAMIC MH DE	Rx7s	14.5lbs	93°	81°

Lamp
D/E MH

ORDERING CHART

SERIES	PROD. ID XXX	LAMP TYPE X	WATTAGE XX	BODY X	FINISH XX	GRILL X	BALLAST X	LENS X	OPTIONS XX
NIGHTLINE B	BN3	9-HID	L5-70W CERAMIC MH D/E 85 CRI 3000K R7s U1-150W CERAMIC MH D/E 85 CRI 3000K R7s	1- SURF. MT. NO CONDUIT ENTRIES	78- TEXT BLACK EW- EURO WHITE 10- MATTE SILVER 99- CUSTOM	0- NONE	C- 120-277 V ELECT.	3- CLEAR PATTERNED TEMP. GL.	0- NONE 4- ONE CIRCUIT FUSING 8- SPEC. SCREWS

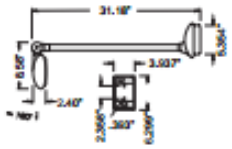
NOTE: 150W MH VERSION REQUIRES RECESSED BALLAST BOX

designplan

7

designplan MEYER LIGHTING

C-2

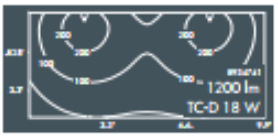


Nightline A
with wall arm NA2

- low copper alloy cast Aluminum body
- UL, cUL listed wet label IP65
- axially symmetrical specular reflector
- available in compact fluorescent (120V-277V) and ceramic metal halide (120V only)
- electronic ballast for either compact fluorescent or HID with cold weather start
  -25F for fluorescent
  -30C for HID
- 39W single ended ceramic metal halide has a CRI of 81, 3000k color temperature and a rated life of 12,000 hours
- clear prismatic tempered glass lens

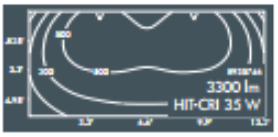
Nightline A NA2

Lamp	Lampholder	Weight	Beam angle °	
			C 0-180	C 90-270
18W QUAD 4 PIN	G24q-2	6.6 lbs	107°	91°



Nightline A NA1

Lamp	Lampholder	Weight	Beam angle °	
			C 0-180	C 90-270
39W CERAMIC MH	G12	6.6 lbs	64°	87°



This compact luminaire is suitable for the illumination of smaller signs.

Lamp

Quad lamp 4 pin

T6 single ended MH

ORDERING CHART

SERIES	PROD. ID XXX	LAMP TYPE X	WATTAGE XX	BODY X	FINISH XX	GRILL X	BALLAST X	LENS X	OPTIONS XX
NIGHTLINE A	NA2	8- FLUORESCENT 9- HID	56- 1X 18W QUAD 4 PIN 2700K G24Q3 57- 1X 18W QUAD 4 PIN 3000K G24Q3 58- 1X 18W QUAD 4 PIN 3500K G24Q3 59- 1X 18W QUAD 4 PIN 4100K G24Q3 T8- 39W T6 CERAMIC MH CRI 81 G12	1- SURF. MT. NO CONDUIT ENTRIES	78- TEXT BLACK EW- EURO WHITE 10- MATTE SILVER 99- CUSTOM	0- NONE	C- 120-277 V ELECT. 0- 120V ELECT.	T- CLEAR PATTERNED TEMP. GL.	0- NONE 4- ONE CIRCUIT FUSING 8- SPEC. SCREWS

NOTE: FLUORESCENT IS ALWAYS C,
HID IS ALWAYS 0. ON THIS FIXTURE
HID IS AVAILABLE IN 120V ONLY

designplan

designplan MEYER LIGHTING

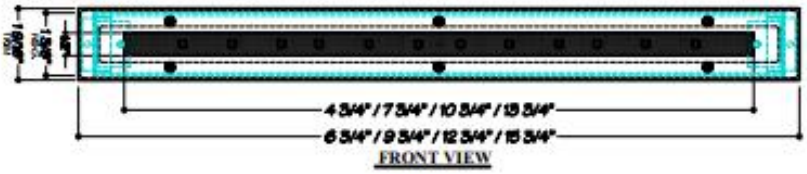
4

CA

COLE LIGHTING

CATALOG NUMBER

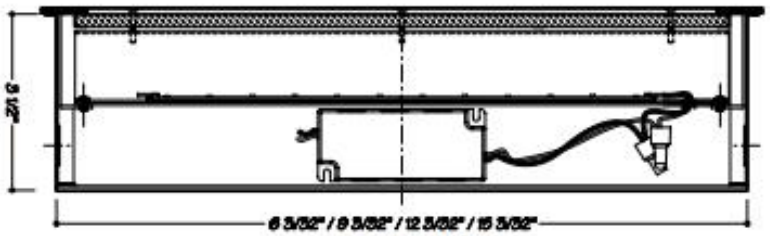
LED	L503	1.5W 3000°K
	L506	3.0W 3000°K
	L509	4.5W 3000°K
	L512	6.0W 3000°K



FRONT VIEW

DESCRIPTION:

1.) FACEPLATE = 11 GA. #4 SATIN STAINLESS STEEL
2.) HOUSING = 16 GA. STAINLESS STEEL
3.) 16 GA. STEEL CHANNEL - PTD. WHITE
4.) ELECTRONIC LED DRIVER
5.) 1/4" FLASHED OPAL TEMPERED GLASS OR CLEAR FROSTED TEMPERED GLASS
6.) OUTPUT VOLTAGE = 12VDC
7.) INPUT VOLTAGE = 120V / 277V
8.) SUITABLE FOR CONCRETE POUR
9.) SUITABLE FOR WET LOCATION



SECTION VIEW

L512 shown

K2908-SERIES | COLE LIGHTING SINCE 1911 | C.W. COLE & CO., INC. 2560 N. ROSEMEAD BLVD., SOUTH EL MONTE, CA 91733-1593 • www.colelighting.com • (626) 443-2473 • FAX (626) 443-9253

LOW PROFILE LED STEPLITE

LED / 3000K / Flashed Opal Diffuser

DRAWN BY	DATE	CHECKED BY	DATE	SCALE	DRAWING No
T. PHAN	5-3-11	D.W.	5-3-11	NTS	K2908-SERIES

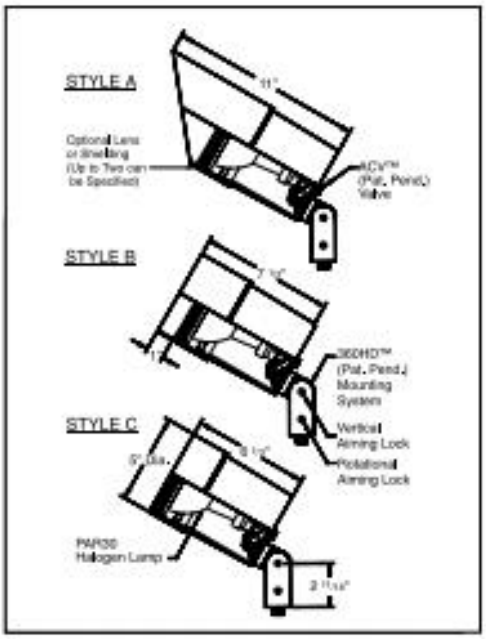
Lassen Series™

CB

The **Lassen Series™** is designed for use with the PAR30 50 watt or 75 watt halogen lamp. The combination of the fully-sealed Lassen Series and the 120V PAR30 halogen lamp makes a very economical outdoor lighting instrument. No compromises in quality are taken in its construction, however. The Lassen Series is an all aluminum construction design and is finished in your choice of one of eight polyester powder coat finishes. The Lassen Series includes our ACV™ (Pat. Pend.) Valve System and our 360HD™ Mounting System (Pat. Pend.) as standard features.

Features

- Tamper proof design.
- Completely sealed optical compartment.
- Clear, tempered glass lens, factory sealed.
- Machined aluminum construction with stainless steel hardware.
- ACV™ (Pat. Pend.) Valve System. See page 33.
- 360HD™ (Pat. Pend.) Mounting System allows vertical to horizontal and rotational aiming with positive 'aim-and-lock technology', provides integral wireway. See page 33.
- Medium base lamp holder with 250° C, 18 ga., wire leads.
- & Listed with PAR30 lamps to 75 watts.
- For use with 120V, no transformer required.



CATALOG NUMBER LOGIC

Example: LA - 56 - SAP - 10 - 11 - C

Series

Lamp Type
0 - By others
50 - 50 PAR30L/H/NSP9(50W), 9° N. Spot
51 - 50 PAR30L/H/SP16(50W), 16° Spot
52 - 50 PAR30L/H/FL30(50W), 30° Flood
53 - 50 PAR30L/H/WFL40(50W), 40° W. Flood
54 - 75 PAR30L/H/NSP9(75W), 9° N. Spot
55 - 75 PAR30L/H/SP16(75W), 16° Spot
56 - 75 PAR30L/H/FL30(75W), 30° Flood
57 - 75 PAR30L/H/WFL40(75W), 40° W. Flood

Finish

Powder Coat Color	Satin	Wrinkle
Bronze	BZP	BZW
Black	BLP	BLW
White(Gloss)	WHP	WHW
Aluminum	SAP	—
Verde	—	VER

Lens Type
9 - Clear (Standard), 10 - Spread, 13 - Rectilinear

Shielding
11 - Honeycomb Baffle

Cap Style
A - 45°, B - 90°, C - Flush

B-K LIGHTING

20

LASSEN™ SERIES FLOODLIGHT

Par 30 Halogen

PROJECT:	
TYPE:	
CATALOG NUMBER:	
SOURCE:	
NOTES:	

CATALOG NUMBER LOGIC

	LA											
Example:	LA	-	408	-	SAP	-	9	-	11	-	C

Series

LA - Lassen Series™ Floodlight

Lamp Type

408 - 39PAR30LN/SP10 (39W), 10° Spot
409 - 39PAR30LN/NFL25 (39W), 25° Narrow Flood
410 - 39PAR30LN/WFL50 (39W), 50° Wide Flood
411 - 60PAR30LN/SP10 (60W), 10° Spot
412 - 60PAR30LN/NFL25 (60W), 25° Narrow Flood
413 - 60PAR30LN/WFL50 (60W), 50° Wide Flood

Finish

Standard Finish

Powder Coat Color	Satin	Wrinkle
Bronze	BZP	BZW
Black	BLP	BLW
White (Gloss)	WHP	WHW
Aluminum	SAP	—
Verde	—	VER

Premium Finish

ABP	Antique Brass Powder	CMG	Cascade Mountain Granite	RMG	Rocky Mountain Granite
AMG	Aleutian Mountain Granite	CRI	Cracked Ice	SDS	Sonoran Desert Sandstone
AQW	Antique White	CRM	Cream	SMG	Sierra Mountain Granite
BCM	Black Chrome	HUG	Hunter Green	TXF	Textured Forest
BGE	Beige	MDS	Mojave Desert Sandstone	WCP	Weathered Copper
BPP	Brown Patina Powder	NBP	Natural Brass Powder	WIR	Weathered Iron
CAP	Clear Anodized Powder	OCP	Old Copper	Also available in RAL Finishes See submittal SUB-1439-00	

Lens Type

9 - Clear (Standard) 10 - Spread Lens* 13 - Rectilinear Lens*

Shielding

11 - Honeycomb Baffle*

Cap Style

A - 45° B - 90° C - Flush D - 45° without Weep Hole (Interior Use Only) E - 90° without Weep Hole (Interior Use Only)

*Accommodates up to 2 Lens/Shielding media

LAMP DATA

BK No.	Lamp Watts	Description	Rated Life	Center Beam Candlepower	Beam Angle	Beam Type
408	39	39PAR30LN/H/SP10	1,500	6,100	10°	Spot
409	39	39PAR30LN/H/NFL25	1,500	1,700	25°	Narrow Flood
410	39	39PAR30LN/H/WFL50	1,500	600	50°	Wide Flood
411	60	60PAR30LN/H/SP10	1,500	12,000	10°	Spot
412	60	60PAR30LN/H/NFL25	1,500	3,300	25°	Narrow Flood
413	60	60PAR30LN/H/WFL50	1,500	1,300	50°	Wide Flood

B-K LIGHTING

40429 Brickyard Drive • Madera, CA 93636 • USA
559.438.5800 • FAX 559.438.5900
www.bklighting.com • info@bklighting.com

SUBMITTAL DATE	DRAWING NUMBER
2-20-14	SUB-1133-08

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF B-K LIGHTING, INC. AND ITS RECEIPT OR POSSESSION DOES NOT CONVEY ANY RIGHTS TO REPRODUCE, DISCLOSE ITS CONTENTS, OR TO MANUFACTURE, USE OR SELL ANYTHING IT MAY DESCRIBE. REPRODUCTION, DISCLOSURE OR USE WITHOUT SPECIFIC WRITTEN AUTHORIZATION OF B-K LIGHTING, INC. IS STRICTLY FORBIDDEN.

ELECTRICAL APPENDIX

Reduces energy consumption, resulting in decreased operating costs and lower harmful emissions

Eaton's family of NEMA Premium® efficiency transformers provides **30 percent less losses** than similarly sized NEMA® TP-1 efficiency models. In the United States, Department of Energy regulation 10 CFR Part 431 requires low voltage dry-type distribution transformers to meet NEMA TP-1 efficiency levels. Installing lower-loss NEMA Premium transformers **reduces energy consumption, resulting in lower operating costs while reducing harmful emissions**. Eaton® is one of the original manufacturers who supported and joined NEMA's Premium efficiency transformers program.

Like NEMA TP-1 efficient transformers, the recognized efficiency of NEMA Premium efficient transformers is measured at 75°C and with a linear load of 35 percent of full load rating. The table below shows the difference between the various transformer efficiency levels that have become common over the past few years.

Low voltage dry-type distribution transformer efficiency levels for three-phase transformers

kVA	NEMA TP-1 efficiency	NEMA Premium efficiency	NEMA TP-1 losses (at 35% load and 75°C) (watts)	NEMA Premium losses (at 35% load and 75°C) (watts)	NEMA Premium improvement in losses
15.0	97.0%	97.90%	162.4	112.6	30.7%
30.0	97.5%	98.25%	269.2	187.0	30.5%
45.0	97.7%	98.39%	370.8	257.7	30.5%
75.0	98.0%	98.60%	535.7	372.7	30.4%
112.5	98.2%	98.74%	721.7	502.5	30.4%
150.0	98.3%	98.81%	907.9	632.2	30.4%
225.0	98.5%	98.95%	1199.2	835.6	30.3%
300.0	98.6%	99.02%	1490.9	1039.2	30.3%
500.0	98.7%	99.09%	2305.0	1607.1	30.3%

For additional information on NEMA's Premium efficiency transformers program, visit NEMA at: www.nema.org/prod/pwr/trans/transformersprogram.cfm.

All NEMA Premium efficient transformers manufactured by Eaton are designed, manufactured and tested per applicable standards, including UL® 1561, NEMA ST20, NEMA TP-1, DOE 10 CFR Part 431 and the NEMA Premium efficiency transformers program. The results of all industry-standard production tests are electronically stored so the results can be retrieved at a later date. Along with other data, Eaton also records the no-load losses of every transformer that is shipped.

EATON
Powering Business Worldwide

Eaton's NEMA Premium product family

Eaton's NEMA Premium efficiency transformers are manufactured in an ANSI 61 gray polyester powder-coat-painted NEMA Type 2 enclosure, which is easily converted to NEMA 3R when fitted with a weathershield kit.

General purpose

- Three-phase 15–500 kVA
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- 200°C insulation system and 130°C rise (115°C or 80°C optional)

K-Factor

- Three-phase 15–300 kVA
- K-4, K-9 or K-13 ratings
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- Single electrostatic shield between primary and secondary winding
- 200 percent rated neutral

Harmonic mitigating

- Three-phase 15–300 kVA
- 0°, -15°, +15° or 30° phase shift
- Aluminum windings (copper optional)
- 220°C insulation system and 150°C rise (115°C or 80°C rise optional)
- Single electrostatic shield between primary and secondary winding
- 200 percent rated neutral

Additional factory-installed options

- Surge protective device installed on primary or secondary (120 kA or 160 kA)
- Infrared viewing window (3", 4" or 5")
- Stainless steel enclosure (grade 304 or 316)
- Core-coil only
- CE mark
- Custom paint colors

Catalog number configuration—product selection

V 48 M 28 T 75 N3

Type
- V = DT-3 (three-phase ventilated)
- X = Harmonic mitigating (three-phase ventilated)

Nonlinear
- H = KT-4 (three-phase ventilated)
- B = KT-9 (three-phase ventilated)
- N = KT-13 (three-phase ventilated)
- G = KT-20 (three-phase ventilated)
- J = KT-30 (three-phase ventilated)

Primary voltage
- 29 = 208
- 72 = 200
- 25 = 220
- 23 = 230
- 24 = 240
- 27 = 277
- 38 = 380
- 39 = 400
- 43 = 416
- 44 = 440
- 45 = 450
- 48 = 480
- 57 = 575
- 60 = 600

Taps
- D = 2 at +2.5%, 2 at -2.5%
- E = 1 at +5%, 1 at -5%
- G = 2 at -5%
- M = 2 at +2.5%, 4 at -2.5%
- N = None
- R = 1 at +5%, 2 at -5%

Secondary voltage
- 19 = 190Y/110
- 28 = 208Y/120
- 29 = 208
- 25 = 220 delta
- 31 = 220Y/127
- 26 = 220 delta/110 midtap
- 22 = 240 delta/120 midtap
- 64 = 240Y/139
- 24 = 240 delta
- 27 = 277
- 38 = 380 delta
- 37 = 380Y/220
- 34 = 400Y/231
- 51 = 416Y/240
- 35 = 440Y/254
- 62 = 460Y/266
- 47 = 480Y/277
- 48 = 480 delta
- 60 = 600 delta
- 61 = 600Y/346

Temp rise
- B = 80°C rise
- F = 115°C rise
- E = Electrostatic shield
- T = 150°C rise

kVA
- 15 = 15
- 25 = 25
- 30 = 30
- 45 = 45
- 50 = 50
- 75 = 75
- 99 = 100
- 12 = 112.5
- 49 = 150
- 22 = 225
- 33 = 300
- 55 = 500
- 77 = 750

Suffix options
- CU = Copper windings.
- SS = Grade 304 stainless steel enclosure (does not imply a NEMA 4X rating).
- ZZ = Open-type core and coil assembly.
- NV = Totally enclosed non-ventilated DS-3 or DT-3.
- X = 50/60 Hz.
- LS_ _ = Low sound design. LS47 indicates low sound equal to 47 dB; LS42 indicates 42 dB.
- AF = Fungus-proof.
- TR = Certified test report of standard production tests for the specific serial number to be shipped.
- SR = Certified sound level report.
- CE = CE marked.
- T = Thermal indicator embedded in center coil. Suffix "TT" indicates two thermal indicators of different temperature ratings are installed.
- EE = NEMA TP-1 efficient.
- NON = 0° phase-shift (used with HMTs).
- POS = +15° phase-shift (used with HMTs).
- NEG = -15° phase-shift (used with HMTs).
- THR = -30° phase-shift (used with HMTs).
- E3 = CSL3 DOE 2007 energy-efficient.
- Z = Easy install base.
- S6 = Grade 316 stainless steel enclosure (does not imply NEMA 4X rating).
- I2 = Integral 2-inch infrared viewing window.
- I3 = Integral 3-inch infrared viewing window.
- I4 = Integral 4-inch infrared viewing window.
- N3 = NEMA Premium efficiency.

Contact your local Eaton sales office for voltage combinations not shown. Use table for catalog number breakdown only. Do not use to create catalog numbers because all combinations may not be valid.

Eaton Corporation
Electrical Sector
1111 Superior Ave.
Cleveland, OH 44114
United States
877-ETN-CARE (877-386-2273)
Eaton.com

© 2012 Eaton Corporation
All Rights Reserved
Printed in USA
Publication No. PA00904011E / BC-118
December 2012

As a partner in the NEMA Premium transformer program, Eaton has determined that this product meets the NEMA Premium efficiency specifications for premium energy efficiency.

NEMA Premium is a trademark of the National Electrical Manufacturers Association.

Eaton is a registered trademark of Eaton Corporation.

All other trademarks are property of their respective owners.

Powering Business Worldwide

EATON
Powering Business Worldwide

Your estimated energy savings*

Save by replacing your existing Non NEMA-TP1 transformer with a NEMA-TP1 or NEMA Premium® high efficiency transformer from Eaton.

Total Loss Per Year (Based on Commercial Building Loading Profile)

Selected BOM				Non NEMA-TP1		NEMA-TP1		NEMA Premium	
Qty	KVA	Mat'l	Type	Total Loss		Total Loss		Total Loss	
3	30	Copper	K-Rated*	10.15	MWH	5.83	MWH	3.54	MWH
6	45	Copper	K-Rated*	24.10	MWH	14.84	MWH	8.68	MWH
5	75	Copper	K-Rated*	30.68	MWH	19.15	MWH	12.57	MWH
2	112.5	Copper	K-Rated*	15.78	MWH	9.57	MWH	5.98	MWH
2	150	Copper	K-Rated*	12.24	MWH	12.87	MWH	8.19	MWH
2	225	Copper	K-Rated*	27.96	MWH	16.34	MWH	11.68	MWH
1	300	Copper	K-Rated*	7.62	MWH	10.85	MWH	7.49	MWH
1	500	Copper	K-Rated*	25.82	MWH	18.31	MWH	10.68	MWH
Total Energy Lost by Transformers				**154.35**	**MW**	**107.76**	**MW**	**68.80**	**MW**
Energy Lost to Heat				**526.66**	**MBTU**	**367.70**	**MBTU**	**234.75**	**MBTU**

Energy Life Cycle Costs (Based on Electricity Rate of $0.1057/KWH)

Per Year	$16,314	$11,390	$7,271
Over 1 Year and 2.5% Inflation	$16,313	$11,389	$7,270

Over 1 Year and 1% Inflation	$16,314	$11,390	$7,271

Savings Comparison: NEMA-TP1 vs. Non NEMA-TP1

Energy Cost Savings Per Year	$4,924
Energy Cost Savings Over 1 Year with 2.5% Inflation	$4,924
Energy Cost Savings Over 1 Year with 1% Inflation	$4,924
Reduction in Power Lost by Transformers Per Year	46.59 MW
HVAC Savings Per Year**	23.29 MBTU

Savings Comparison: NEMA Premium vs. NEMA-TP1

Energy Cost Savings Per Year	$4,119
Energy Cost Savings Over 1 Year with 2.5% Inflation	$4,119
Energy Cost Savings Over 1 Year with 1% Inflation	$4,119
Reduction in Power Lost by Transformers Per Year	38.96 MW
HVAC Savings Per Year**	19.48 MBTU

Savings Comparison: NEMA Premium vs. Non NEMA-TP1

Energy Cost Savings Per Year	$9,043
Energy Cost Savings Over 1 Year with 2.5% Inflation	$9,043
Energy Cost Savings Over 1 Year with 1% Inflation	$9,043
Reduction in Power Lost by Transformers Per Year	85.55 MW
HVAC Savings Per Year**	42.78 MBTU

**Energy savings are estimates. Your actual energy savings may vary depending on your specific situation. This calculator is not intended*

to provide product, engineering, or electrical advice or warranties. Eaton does not guarantee the accuracy of this calculator with regard to your individual circumstances.

***50% of KW used.*
Typical values are 35%-50% (ie. for every 100 KW of losses, 35-50 KW of HVAC is required to eliminate the additional heat)

Learn more

- Eaton NEMA Premium® high efficiency transformers
- Eaton Harmonic mitigating transformers (HMT)

© 2013 Eaton Corporation All Rights Reserved

MECHANICAL APPENDIX

Vision Glazings

Starphire® Ultra-Clear Glass By PPG

Ordinary glass is green with envy.

Vision Glazings

Starphire® Ultra-Clear Glass by PPG provides commercial designers with a new and unprecedented option for all their vision glass applications. For entire building facades or retail showroom windows, to maximize light transmission and bring an uncommon brightness and clarity to the interior, no commercially available glazing product comes close to the pristine personality of ***Starphire*** glass.

Starphire vision glass is clearly remarkable:

- Maximum transparency – 5% higher Visible Light Transmittance than ordinary clear glass (in a 1-inch IG unit)
- High fidelity color transmission – undistorted view of exterior
- New level of visual brightness and clarity
- Jewel-like brilliance and character
- Easily fabricated to required specifications

For vision glazings in which enhanced energy performance is required, ***Starphire*** glass can be combined with solar control, low-e coatings to satisfy energy requirements while maintaining the unique ultra-clear visual character of ***Starphire*** glass.

Starphire glass is available in thicknesses from 2.5 mm to 19 mm and is stocked regionally to assure consistent supply reliability. For ***Starphire*** glass samples or a list of distributors, contact our Solutions Hotline at 1-888-PPG-IDEA, or visit www.ppgstarphire.com.

All PPG architectural glass is ***Cradle to Cradle Certified***™

PPG *IdeaScapes*® Integrated products, people and services to inspire your design and color vision.

Ultra-Clear Glass

Tokyo Kasai Rinkai Park View Visitors Center
Chiba Prefecture, Japan
(Complete project details on our web site)

The ultra-clear character of Starphire glass is exemplified in this Tokyo visitor center project. The difference between the unglazed lower-level breezeway and the Starphire-glazed areas is nearly imperceptible. Contrast that to the green appearance of the glass hand rails which are glazed with conventional clear glass.

Alcoa Corporate Center
Pittsburgh, PA
(Complete project details on our web site)

Starphire glass was the choice of both owner and architect to bring the brightness and color fidelity of the outdoors into this magnificent new structure. For energy efficiency, Starphire glass is combined with a solar control, low-e coating to clad the entire exterior facade.

© 2013 PPG Industries, Inc. All rights reserved. *Atlantica, Azuria, Azurlite, Graylite, IdeaScapes, Oceans of Color, Optiblue, Pacifica, Solarban, Solarblue, Solarbronze, Solarcool, Solargray, Sales, Solexia, Starphire, Sungate, Vistacool*, the PPG logo and the PPG Certified Fabricator Network and the PPG Certified Programs are registered trademarks of PPG Industries Ohio, Inc. *Cradle to Cradle Certified* is a certification mark licensed by the Cradle to Cradle Products Innovation Institute.

Printed in U.S.A.
7073 07/13 5M

cradle to cradle SILVER

PPG IdeaScapes® Glass • Coatings • Paint

PPG Industries, Inc. Glass Business & Discovery Center 400 Guys Run Road Cheswick, PA 15024 1-888-PPG-IDEA www.ppgideascapes.com

PPG IdeaScapes
Glass • Coatings • Paint

Product Detail Sheet:

13.52mm Laminate: 6mm Solarban® z50 (2) on Optiblue® - 0.060" PVB - 6mm Solarblue®

6mm Solarban® z50 (2) on Optiblue® - 0.060" PVB - 6mm Solarblue®, 13.52mm

Solarblue® tinted glass delivers a light blue appearance.

Solarban® z50 glass is a steel blue/gray tinted MSVD solar control low-e glass in which the coating and Optiblue® glass substrate are uniquely tuned together to provide excellent solar control and glare reduction.

Optiblue® tinted glass is specifically designed as a substrate for Solarban® z50 glass, but can also be used in an insulating glass unit in conjunction with another PPG coated or tinted glass.

Outdoor Lite: 6mm Solarban® z50 (2) on Optiblue® - 0.060" PVB - 6mm Solarblue®

Note: Be aware that laminated glazing constructions may have increased optical distortion and/or strain iridescence from stacked multiple individual layers especially when the glass lites are heat treated. In addition transmitted and reflective color differences can occur when a low-e or reflective coating is located adjacent to the interlayer material. A coating facing an airspace in an IG unit may appear a different color than the same coating in a laminate.

Thermal Glass Specifications

Shading Coefficient	SHGC	U-Value Winter Nighttime		U-Value Summer Daytime		Relative Heat Gain		LSG
		($W/m^2 \cdot C$)	($BTU/hr \cdot ft^2 \cdot F$)	($W/m^2 \cdot C$)	($BTU/hr \cdot ft^2 \cdot F$)	(W/m^2)	($BTU/hr \cdot ft^2$)	
0.42	0.36	5.41	0.95	4.91	0.87	301.93	95.72	0.91

Optical Glass Specifications

Transmittance			Reflectance			Fading Factor	Color Properties					
							Transmittance			Reflectance		
UV %	Visible %	Total Solar Energy (%)	Visible (out %)	Visible (in %)	Total Solar Energy (Out %)	Tdw-ISO	L*	a*	b*	L*	a*	b*
0	33	16.35	6	6	22.07	0.26	64.59	-6.29	-11.26	29.86	0.02	-12.02

Specifications

Thermal Stress % Risk: High Risk

Approved Manufacturers/Where to Buy PPG Authorized Fabricator

Certification: Both lites to be Cradle to Cradle certified, minimum Silver Level, by McDonough Braungart Design Chemistry, LLC (MBDC www.mbdc.com (http://www.mbdc.com))

Outdoor Appearance: Light blue

Monolithic Construction: 13.52mm Laminate: 6mm Solarban® z50 (2) on Optiblue® - 0.060" PVB - 6mm Solarblue®

The results represent Center-of-Glass performance data based on NFRC 100 Environmental Design Conditions utilizing the LBNL Window 6.3 software program. Performance data is based on representative samples of factory production. Actual values may vary slightly due to variations in the production process. This data is to be used for comparison purposes and should not be considered a contract. It is the recipient's responsibility to ensure the manufacturability of the above glazing configurations as well as evaluating appropriate design considerations such as wind and snow load analysis, thermal stress analysis, and local building code compliance. PPG recommends that a full size mock-up be reviewed under the specific job-site conditions and retain the mock-up as a basis of acceptable product.

PPG Industries | Headquarters - One PPG Place Pittsburgh, PA 15272 USA | ©2001-2014 PPG Industries - All Rights Reserved |

Atlantica, Azuria, Azurlite, Caribia, Graylite, Optigray, Pacifica, Solarban, Solarblue, Solarbronze, Solarcool, Solargray, Solargreen, Solex, Solexia, Starphire, Sungate, Vistacool are trademarks.

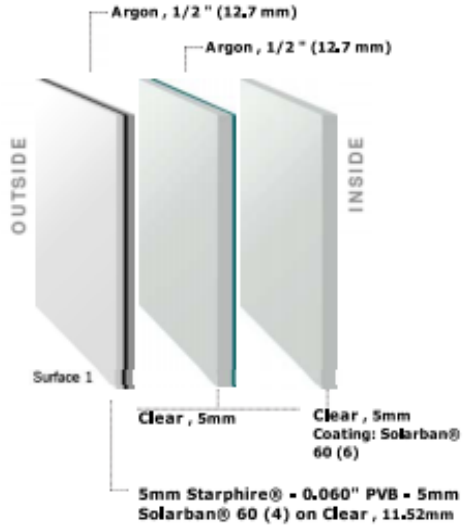
Glass colors represented are approximate.

While PPG has made a good faith effort to verify the reliability of this computer based tool, it may contain unknown programming errors that may result in incorrect results. The user is encouraged to use good judgment and report any questionable results to PPG for evaluation. The applicability and subsequent results of analysis performed by this tool will be compromised if the user fails to input the correct information. PPG makes no warranty or guarantee as to the results obtained by the user of this tool.

PPG IdeaScapes
Glass • Coatings • Paint

Product Detail Sheet:

5mm Starphire® - 0.060" PVB - 5mm Solarban® 60 (4) on Clear + 1/2 " (12.7 mm) Argon + 5mm Solarban® 60 (4) on Clear + 1/2 " (12.7 mm) Argon + 5mm Clear



Solarban® 60 glass is a mid-range MSVD solar control low-e glass. Though the coating is transparent (on clear or Starphire® Ultra-Clear glass), it can also be paired with, or applied directly on most PPG tinted glasses in an insulating glass unit.

Starphire® Ultra-Clear glass is a unique low-iron glass, the clearest float glass available, delivering high light transmittance and true-color fidelity.

Outdoor Lite: 5mm Starphire® - 0.060" PVB - 5mm Solarban® 60 (4) on Clear

Middle Lite: Clear with a second surface Solarban® 60

Indoor Lite: Clear

Note: Be aware that laminated glazing constructions may have increased optical distortion and/or strain iridescence from stacked multiple individual layers especially when the glass lites are heat treated. In addition transmitted and reflective color differences can occur when a low-e or reflective coating is located adjacent to the interlayer material. A coating facing an airspace in an IG unit may appear a different color than the same coating in a laminate.

Thermal Glass Specifications

Shading Coefficient	SHGC	U-Value Winter Nighttime		U-Value Summer Daytime		Relative Heat Gain		LSG
		(W/m²- C)	(BTU/hr - ft²- F)	(W/m²- C)	(BTU/hr - ft²- F)	(W/m²)	(BTU/hr - ft²)	
0.35	0.30	0.69	0.12	0.70	0.12	224.25	71.09	1.88

Optical Glass Specifications

Transmittance			Reflectance			Fading Factor	Color Properties					
							Transmittance			Reflectance		
UV %	Visible %	Total Solar Energy (%)	Visible (out %)	Visible (in %)	Total Solar Energy (Out %)	Tdw-ISO	L*	a*	b*	L*	a*	b*
0	57	22.81	13	15	25.94	0.35	79.97	-6.41	4.75	42.06	-3.15	-2.53

Specifications

Thermal Stress % Risk: Medium Risk

Approved Manufacturers/Where to Buy PPG Authorized Fabricator

Certification: Both lites to be Cradle to Cradle certified, minimum Silver Level by McDonough Braungart Design Chemistry, LLC (MBDC www.mbdc.com (http://www.mbdc.com))

Outdoor Appearance:

Insulating Unit Construction: 5mm Starphire® - 0.060" PVB - 5mm Solarban® 60 (4) on Clear + 1/2 " (12.7 mm) Argon + 5mm Solarban® 60 (4) on Clear + 1/2 " (12.7 mm) Argon + 5mm Clear

The results represent Center-of-Glass performance data based on NFRC 100 Environmental Design Conditions utilizing the LBNL Window 6.3 software program. Performance data is based on representative samples of factory production. Actual values may vary slightly due to variations in the production process. This data is to be used for comparison purposes and should not be considered a contract. It is the recipient's responsibility to ensure the manufacturability of the above glazing configurations as well as evaluating appropriate design considerations such as wind and snow load analysis, thermal stress analysis, and local building code compliance. PPG recommends that a full size mock-up be reviewed under the specific job-site conditions and retain the mock-up as a basis of acceptable product.

PPG Industries | Headquarters - One PPG Place Pittsburgh, PA 15272 USA | ©2001-2014 PPG Industries - All Rights Reserved |

Atlantica, Azuria, Azurlite, Caribia, Graylite, Optigray, Pacifica, Solarban, Solarblue, Solarbronze, Solarcool, Solargray, Solargreen, Solex, Solexia, Starphire, Sungate, Vistacool are trademarks.

Glass colors represented are approximate.

While PPG has made a good faith effort to verify the reliability of this computer based tool, it may contain unknown programming errors that may result in incorrect results. The user is encouraged to use good judgment and report any questionable results to PPG for evaluation. The applicability and subsequent results of analysis performed by this tool will be compromised if the user fails to input the correct information. PPG makes no warranty or guarantee as to the results obtained by the user of this tool.