Selected System Redesign and Analysis

The Pennsylvania State University

Architectural Engineering

Senior Thesis

Bucks County Justice Center

Doylestown, PA

Joshua Lange

Lighting/Electrical

Thesis Adviser: Dr. Richard Mistrick

Electrical Adviser: Gary Golaszewski

4/8/2015

Analysis and models are located at Y:\Lange_Thesis\Report_Files

Bucks County Justice Center

Doylestown, PA

Image 1 — Exterior rendering of the front apex

Project Statistics

Occupancy: Assembly, Business, Institutional, Storage
Size: 273,000 GSF
Levels: 7 levels above grade (with penthouse)
2 levels below grade
Dates of construction: July 2011-Early 2015
Overall Project Cost: approximately $84 million

Project Team

Owner: County of Bucks
General Contractor: Ernest Bock & Sons, Inc.
Architect: HOK
Civil: Carroll Engineering Corporation
MEP: H. F. Lenz
Structural: Harman Group
Security and Code Consulting: Brinjac Engineers
Telecom, A-V, and Acoustics: Acentech Incorporated
Elevators: John Van Deusen
Lighting: Tigue Lighting
Fall Protection: Lerch Bates Incorporated

Image 2 — Exterior rendering of the south wing

Architecture

This building is in the shape of a 'V' with the main entrance located at the apex facing east. (see Image 1 to the left) and is occupied by courtrooms, offices, holding cells, secure parking, and other supporting spaces. Part of a historic building on the site will be incorporated into the new structure. (see the bottom left of Image 2 below) The exterior façade is curtain wall with precast concrete panels faced with brick and terracotta. Vision, translucent, spandrel, and fritted glass are utilized based on the orientation of the window and the use of the space.

Lighting and Electrical

A 3200A 480/277V unit substation, located in the penthouse, is supplied by a 2000kVA transformer with a 34.5kV primary. Four 480/277V vertical bus ducts distribute normal power from the penthouse to the dimmer panels, lighting and distribution transformers. 120/208V is used for receptacles and small equipment. A 1000KW/1250kVA diesel generator provides emergency power. Interior lighting is predominantly linear fluorescent fixtures with LED accent lighting. The courtroom lighting is controlled through central dimming panels located on each floor.

Mechanical

The chilled water and hot water plants are located in the penthouse. There are seven water based variable volume air units. Pressurization fans are provided for each stair tower. Dedicated heat pumps with a water/ glycol loop are provided for telecom/data closets and server rooms. CO monitoring is provided for the garage with exhaust fan control.

Structural

The building is a steel framed structure supported by spread footings and strip footings. The columns, beams, and girders are primarily wide flange. A braced frame lateral system is utilized. The floor system is a concrete slab with welded wire reinforcing on metal deck with composite beam framing.

Joshua Lange Lighting/Electrical Option
Adviser: Dr. Richard Mistrick

Table of Contents

Disclaimer

While great efforts have been taken to provide accurate and complete information in this report, please be aware that this report is strictly an academic exercise. Modifications and changes related to the original building designs and construction methodologies for this senior thesis project are solely the interpretation of Joshua Lange. Changes and discrepancies in no way imply that the original design contained errors or was flawed. Differing assumptions, code references, requirements, and methodologies have been incorporated into this thesis project; therefore, investigation results may vary from the original design.

Executive Summary

The following report presents several analyses of various systems of the Bucks County Justice Center (BCJC) which is a 273,000 SF courthouse located in eastern Pennsylvania. This report has five major sections: a lighting depth, an electrical depth, an acoustical breadth, an MAE acoustical breadth, and a mechanical breadth.

The lighting depth of this report details the lighting redesign for four unique spaces in the BCJC. The criteria for these designs included qualitative criteria as well as illuminance values and ratios from the IES Handbook and control and LPD requirements from ASHRAE. All of the spaces met the control requirements, all of the spaces have LPD's that are significantly below the maximum, and all of the spaces are within reasonable conformance with the illuminance value and ratio targets.

The electrical depth analyzed the effects of the lighting depth on the electrical distribution system, studied the fault current available at various locations throughout the building, and gives an analysis of the feasibility of a DC distribution system being used to increase electrical efficiency.

The acoustical breadth of this report gives an analysis of the RT of Ceremonial Courtroom 4100, establishes a target RT, and makes recommendations to bring the RT into closer conformity with the target.

The MAE acoustical breadth gives an analysis of the influence of the sound reinforcement system in Ceremonial Courtroom 4100 on speech intelligibility. This analysis looks at both SPL and STI to determine the effects of the system. The system greatly improves the SPL distribution as well as greatly increasing STI, but STI still only has a value that is on the low end of "good".

Finally, the mechanical breadth examines the practicality of a CHP system being used for this building. This analysis revealed that the building does not have a high enough consistent thermal load to make a CHP system feasible. Because of this the payback period is much longer than is acceptable to most investors.

Acknowledgements

I would like to thank Mr. Gerald Anderson for allowing me to use the Bucks County Justice Center as my thesis building.

I would like to thank Mr. Scott Mack and the team at H.F. Lenz for their help in selecting the BCJC as my thesis building, providing me with project documentation, and for providing consultation at various times throughout this project.

I would like to thank the following for their guidance on this project:

Dr. Richard Mistrick

Mr. Gary Golaszewski

Dr. Michelle Vigeant

Dr. James Freihaut

Thank you all for your assistance in making this report a reality!

Introduction

General Information

Project Name: Bucks County Justice Center
Location: Doylestown, PA
Owner: Bucks County
Occupancy: Assembly, Business, Institutional, Storage
Size: 272,856 SF Gross Square Footage IBC 2006
Levels: 7 stories above grade (including the penthouse)
2 stories below grade

Project Team

Owner/tenant: County of Bucks
General Contractor: Ernest Bock & Sons, Inc.
CM: N/A
Architect: HOK
Civil: Carroll Engineering Corporation
MEP: H. F. Lenz
Structural: The Harman Group
Security and Code Consulting: Brinjac Engineers
Telecommunications, Data, Audio Visual, and Acoustic: Acentech Incorporated
Elevators: John Van Deusen
Lighting: Tigue Lighting
Fall Protection: Lerch Bates Incorporated

Construction Information

Construction Start: Ground Breaking July 2011
Grand Opening: January 10, 2015
Cost: $84 million total project cost
Project Delivery: Design-Bid-Build

Architecture

This project is the location for the county courthouse including courtrooms, offices, holding cells, and other supporting spaces. Part of an existing historic building on the site was incorporated into the new structure (please see the historical requirements section below). The building is in the shape of a ‘V’ with the main entrance located at the apex. The building is across the street from the existing courthouse with the main entrance facing the existing building. Two sides of the building border streets with the remaining sides being adjacent to parking. See Figure 1 and Figure 2 below.

Figure 1 - Site Plan

Figure 2 - Exterior Render of the Main Entrance

Codes:
International Building Code 2006
ICC Electrical Code 2006
International Energy Conservation Code 2006
International Fire Code 2006
International Fuel Gas Code 2006
International Mechanical Code 2006
International Plumbing Code 2006
ADA Accessibility Guidelines for Buildings and Facilities
ANSI/ASME A17.1 Safety Code for elevators and Escalators, as adopted by the Commonwealth of Pennsylvania's, Department of Labor and industry, Division of Elevators

Zoning
Doylestown Borough O District zoning (O District is designated for Office use)

Historical
A portion of an armory that was built on the site in 1909 was incorporated into the building. The portion is located along Shewell Avenue and consists of two exterior walls and an interior fireplace. Figure 3 below details the portion of the existing building that was incorporated into the new building.

Figure 3 - Existing Structure to Remain

Building Enclosure

Exterior Wall Materials

For the first two above grade exterior walls, the primary finish material is brick (with a running bond) clad precast concrete panels with decorative profiled precast concrete below the windows and acid etched precast concrete panels for the window sills. See Figure 4 below. The rest of the above grade exterior walls use terracotta clad precast panels as the primary finish material and continue the typical use of decorative profiled precast concrete below the windows. On some of the walls with smaller windows a single course of soldier bricks on precast concrete is added at each floor.

Figure 4 – Exterior Render

Windows

The windows are a curtainwall system with several types of exterior glazing in order to achieve a uniform exterior façade while not impeding on the interior uses of the building. The glazing types include vision glass, translucent glass, spandrel glass, and fritted glass. All of the glazing types have a low-E coating on one of the surfaces.

Roofing

The main roofing type for this project is an inverted roof membrane assembly (IRMA) with a stone ballast and four inches of rigid insulation as shown in Figure 5 on the next page.

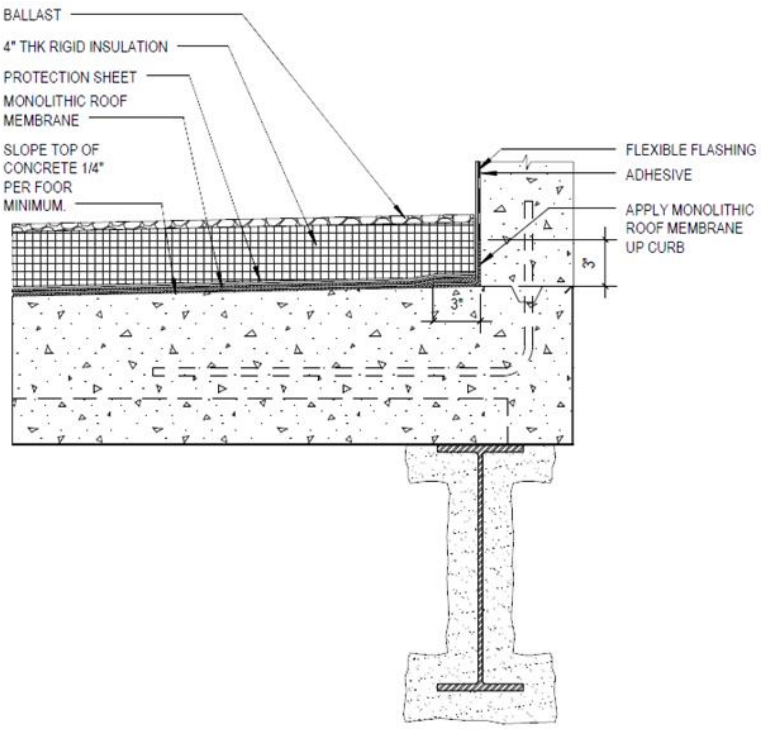


Figure 5 – Roof Detail

Sustainability

The project did not pursue LEED certification. However, the design still incorporates various features to increase efficiency. The design includes networked automated control of the mechanical systems and selected lighting systems in order to maximize efficiency. In order to minimize solar gains while still allowing for daylighting glazing with a low E coating, low SHGC and a fairly high VLT were used. Additionally, high efficiency plumbing fixtures were used throughout the building. Including dual flush water closets, ultra-low flow (1 pint per flush) urinals, 0.5 GPM sinks with aerators, and 2.0 GPM showerheads.

Primary Engineering Systems

Construction Management

The delivery method for the project was design-bid-build. The primary designer and general contractor are HOK and Ernest Bock & Sons, Inc. respectively. The project has a cost of approximately $84 million and a construction duration of about 3.5 years. Access to the site is somewhat constrained by surrounding buildings, but there is substantial frontage for access to the site. The main site entrance was from Union Street with alternate entrances from North Main Street and North Broad Street. After the existing parking garage was demolished in the early stages of construction there was a large amount of future parking lot that provided space for construction staging. The integration of the wall from the existing building was a significant logistical challenge.

Electrical/Lighting

The main electrical system utilizes a 3200 A unit substation that is fed by a 2000 KVA building transformer with a 34.5 KV primary and a 277/480 secondary. Four 800 A 277/480 V vertical busses distribute normal power throughout the building. In general, each floor has two electrical rooms with a 277/480 V and a 120/208 V panel. The 277/480 V panel feeds the 120/208 V panel through a transformer.

A 1000 KW generator provides the emergency and backup power. There are four sets of loads on the generator; fire pump, life safety, emergency, and critical. The fire pump, life safety, and emergency are all code required loads. The critical loads are optional backup loads. The generator directly feeds the ATS for the fire pump and the remaining ATS's are fed from a 1600 A 480/277 V distribution switchboard. All of the optional backup loads except for the heat pumps are fed from a 160 KVA/144 KW UPS.

Interior lighting is predominantly linear fluorescent luminaires with LED accent lighting. Recessed indirect linear florescent luminaires are used for the private offices, conference rooms, and corridors. Direct/indirect linear florescent pendants are used in the open office areas. Various luminaires including CFL downlights and linear florescent wall washers and strip lights are utilized in the courtrooms. For lighting control, there are various types of low voltage push button stations, occupancy sensors, and daylight sensors that are networked with control units. For the courtrooms there are central dimming panels located on every other floor. For the conference rooms, offices, and other spaces control packs with four zones are utilized. All of the lighting controls are tied into the central lighting management system.

Mechanical

There are nine water based AHU's for the building. Seven are located in the penthouse and two are located on level B2. Two of the AHU's are fixed volume dedicated outdoor air units and the rest are variable volume. The AHU's range in size from 5,500 CFM to 40,000 CFM. Five of the AHU's include energy recovery wheels. Chilled water is supplied by two 330 ton air cooled chillers that interface with two 615 GPM cooling towers. Hot water is supplied by five gas boilers each with a 2000 MBH input.

18 water source heat pumps intended for 24/7 cooling are provided for the telecom/data closets, server rooms, and some mechanical rooms. These units are served by a dedicated water/glycol loop.

A CO monitoring system with exhaust fan control is provided for the parking area on level B2. Makeup air is provided by a 16,000 CFM makeup air unit with hot water heating.

Pressurization fans are provided for each stair tower and the elevators. The fans are all around 19,000 CFM.

Variable volume boxes are utilized for the various heating and cooling zones

Structural

The building is a steel framed structure supported by spread footings and strip footings. The spread footings range in size from 4'-0" x 4'-0" x 2'-0" to 9'-0" x 9'-0" x 3'-6" with the most common size for interior supports being 7'-6" x 7'-6" x 3'-1" and the most common size for exterior supports being 4'-0" x 4'-0" x 2'-0". The strip footings are typically 3'-0" deep.

The vast majority of the columns are wide flange, but there are also some hollow structural section columns and standard steel pipe columns. The wide flange steel columns range in size from W14x43 to W14x455. The hollow structural section columns range in size from HSS8.625x0.375 to HSS14x0.625. The standard steel pipe columns are PIPE8"STD.

The floor framing is wide flange beams and wide flange girders. A typical floor bay utilizes 40'-0" W18x40 beams with 24 shear studs and a 1 ½" camber and 30'-0" W21x62 girders with 38 shear studs. However, there are numerous non typical bays that utilize a wide range of beam sizes.

The floor system is 3" composite deck with composite beam framing. The typical floor thickness is 6 ¼" and utilizes welded wire reinforcing. A 7 ½" slab is used to support the equipment in the penthouse. A 5" thick slab on grade is used for B2.

Lateral loads are resisted by braced frames and moment frames. There are eight braced frames distributed throughout the building. Wide flange beams are used in both diagonal and chevron bracing. The bases of the braced frames are anchored by either 74" or 78" deep mat foundations.

Additional Engineering and Engineering Support Services

Fire Protection

The fire protection system includes a fire command center, full building sprinklering, motor operated dampers, pressurized stair towers, and a fire pump. Stand pipes are provided in every stairwell. An automatic wet sprinkler system is used everywhere accept the parking garage and sally port which use a dry system.

Transportation

Vertical circulation is handled by four stair cases and nine elevators. The elevators are dedicated for the following uses: four for general purpose circulation are located in the main elevator lobby, three for prisoner transport are distributed throughout the building, one is dedicated for the judges to use, and one is for service.

Telecommunications

There is sufficient telecommunications equipment to meet the VOIP and data needs of the various offices throughout the building. There are telecommunications rooms centrally located on each floor which are used as hubs for each floor. The backbone cabling is typically 25 strand CAT 3 cable, 12 strand single mode fiber cable and 6 strand multimode fiber cable.

Audio/Visual
All of the courtrooms have an A/V system that includes cameras, microphones, speakers, amplifiers, input stations, touch panel control stations, an assistive listening system, and a projector.

Security

Access control
Both exterior and interior doors utilize electronic locks and card swipes to limit access to secure areas. In general, each door has a 120 V circuit supplied to the control pack which feeds the equipment 24 V, but for doors in close proximity a central power pack is used.

Surveillance
A thorough surveillance system is utilized throughout the building. There are glass break sensors for the windows that are accessible from the outside, door contacts on doors for sensitive areas, and video cameras for the majority of the building. The surveillance devices are fed to security servers located in the telecom rooms. There are various displays and controls for the security system located in the control rooms on level B2. For the internal and external building mounted surveillance cameras CAT 6 UTP cable is used for video and CL3 cable is used to provide low voltage power. Fiber optic cable is used for exterior surveillance cameras that are mounted away from the building.

1. Part 1 – Lighting Depth

1.1 Introduction

The lighting of four unique spaces in the BCJC was redesigned. The designs were based on the criteria that were developed in Tech Report 2. These criteria include qualitative functional aspects such as way finding and security and quantitative aspects such as illuminance levels from the IES Handbook and power density requirements from ASHRAE 90.1 2013. The completed designs are documented with lighting plans, lighting schedules, illuminance calculations, and rendered images. The four spaces are as follows:

Outdoor Space: Main Plaza
Circulation Space: Main Lobby 1000
Large Workspace: Open Office 2520
Special Purpose Space: Ceremonial Courtroom 4100

Figure 6 through Figure 9 on the following pages show the locations of the spaces.

Figure 6 – Main Plaza Location

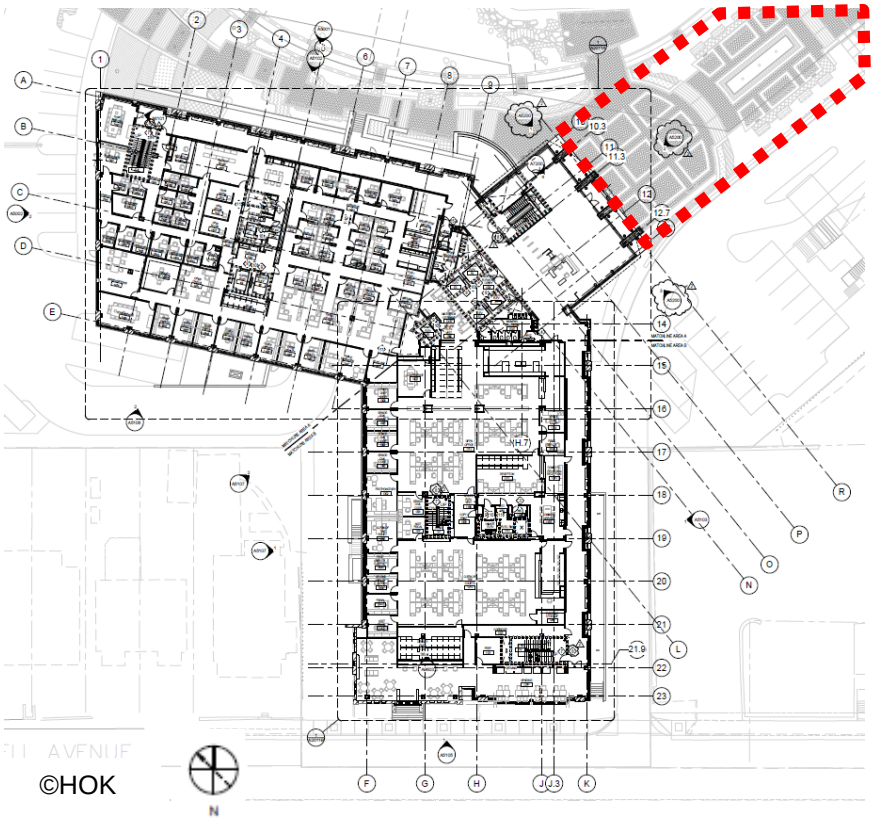


Figure 7 – Main Lobby 1000 Location

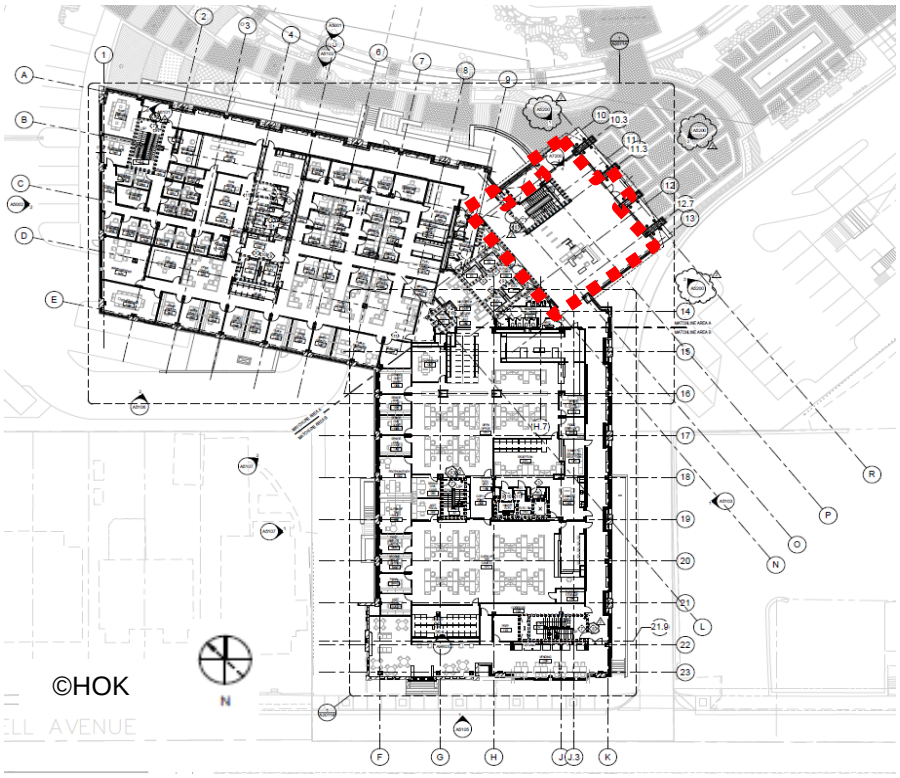


Figure 8 – Open Office 2520 Location

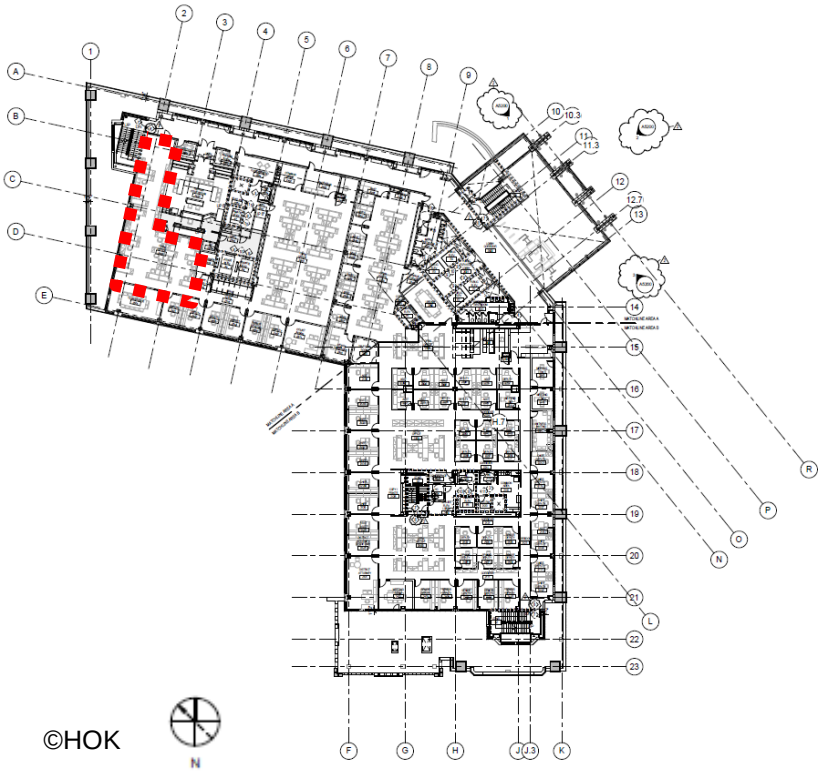
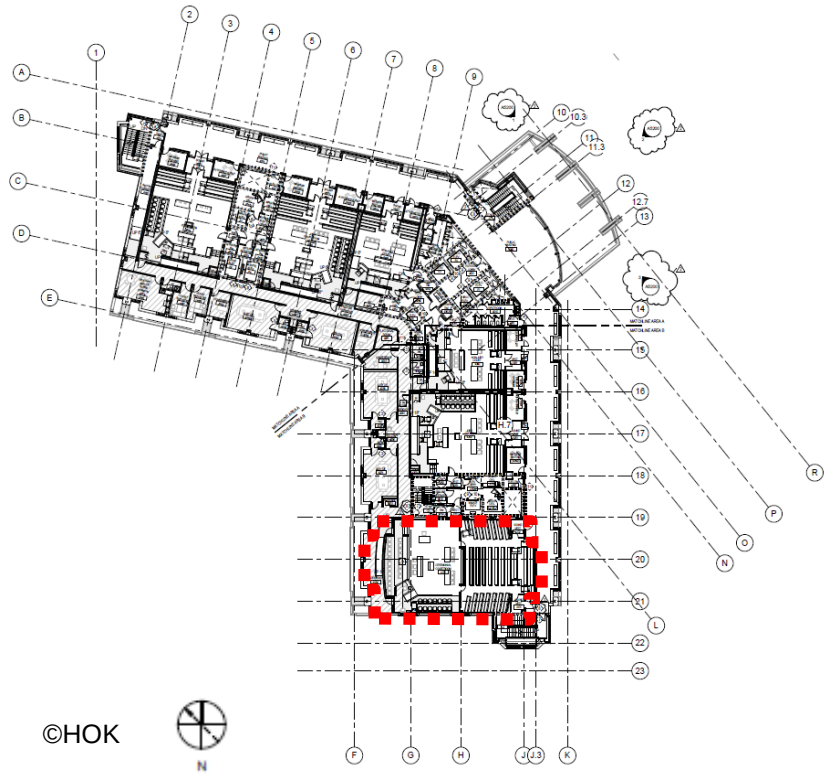


Figure 9 – Ceremonial Courtroom 4100 Location



In addition to the individual criteria that are used for each space the following are criteria for all of the spaces.

CCT of 3500K: A CCT of 3500K was chosen to help with daylight mixing because of the significant amount of daylight that will penetrate many of the spaces. This CCT was used in all of the spaces to help bring uniformity to the building.

20% reduction from ASHRAE LPD requirements: In order to create an efficient design a target reduction was set.

All luminaires have LED light sources. A light loss factor of 0.70 was used for all maintained illuminance calculations. All of the LED's have a minimum L_{70} of 50,000 hours and some have an L_{80} of 50,000 hours. This means that with an average luminaire use of 10 hours per day 5 days a week the 0.7 LLD would not occur for over 19 years. Even with a LLF of 0.7 the illuminance will most likely be significantly higher than the target for at least 10 years. However, for the completeness of this report full LLF calculations for each luminaire type are given in Appendix A-1 – Light Loss Factor Calculations.

All illuminance calculations were performed in AGI32 with a 2'-0" X 2'-0" grid unless noted otherwise.

1.2 Main Plaza

1.2.1 Introduction

The main plaza located outside of Main Lobby 1000 connects the main entrance of the BCJC with the administration building that is located across the street. The majority of this space is hardscape.

1.2.2 Criteria

Way finding: This space leads up to the main entrance of the building and therefore providing a clear path to the entrance is important.

Safety: Ample light must be provided to discourage criminal activity and provide a sense of safety.

Both the illuminance level and illuminance ratio targets shown in Table 1 below are based on recommendations in the IES Handbook.

Table 1 – Main Plaza Illuminance Recommendations

Eh (lux)	Elevation Eh	Ev (lux)	Elevation Ev	Max:Avg	Avg:Min
4	0'-0"	2	5'-0"	4:1	5:1

Control and LPD requirements are based on ASHRAE 90.1 2013 and are as follows:

- The allowed lighting power for Main Plaza (including the plaza area and ADA ramp) was calculated to be **976 watts**. See Table 2 below for calculation.

Table 2 – Allowed Watts Calculation for Plaza and Ramp

Plaza Areas			**Walkway <10 FT wide**		
Allowance (W/SF)	**Area (SF)**	**Total (W)**	**Allowance (W/lin FT)**	**Length (FT)**	**Total (W)**
0.14	6171	864	0.7	160	112

- Photosensor control

- Façade and landscape lighting shutoff between midnight or business closing (whichever is later) and 6 a.m. or business opening (whichever comes first)

- Non façade and landscape lighting shall have automatic control to reduce power by 30% for either the period from midnight or within 1 hour of closing (whichever comes later) and 6 a.m. or opening (whichever comes first) or during any period when no activity has been detected for a time no longer than 15 minutes

In order to limit light trespass and sky glow the requirements given in the Model Lighting Ordinance (MLO) will be considered. Lighting Zone 2 was selected for this project. The MLO requirements include a total site lumen limit of 22,428, a maximum of 15% of the site lumens making it to the property line, and a maximum single point illuminance at the property line of 3.0 Lux. See Table 3 below for the site lumen calculation.

Table 3 – MLO Site Lumen Calculation

Site area (SF):	6171	
Allowed Lumens Per SF	2.5	15428
Allowed Base Lumens		7000
Total Allowed Lumens:		**22428**

1.2.3 Design

Table 4 – Main Plaza Luminaire Schedule

Type	Description	Manufacturer	Model	Lamp	CCT (K)	CRI	Life (Hours)	Ballast	Input (Watts)	Voltage	Fixture Image
X1	EXTERIOR POLE MOUNTED TYPE 3 DOWN LIGHT TWELVE FOOT POLE, 1635 LUMEN	COOPER LIGHTING	MSA-C01-LED-E1-T3-GM	INTEGRAL	4000	70	60,000+ >90%	INTEGRAL	27	277	
X2	EXTERIOR IN RAIL LIGHT THREE FOOT, 83 LMS/FT	COOPER LIGHTING	0.06.SSS.1.PMC.NR.ASYM.35K.GB3.4	INTEGRAL	3500	80	50,000 L70	INTEGRAL	4.14	277	

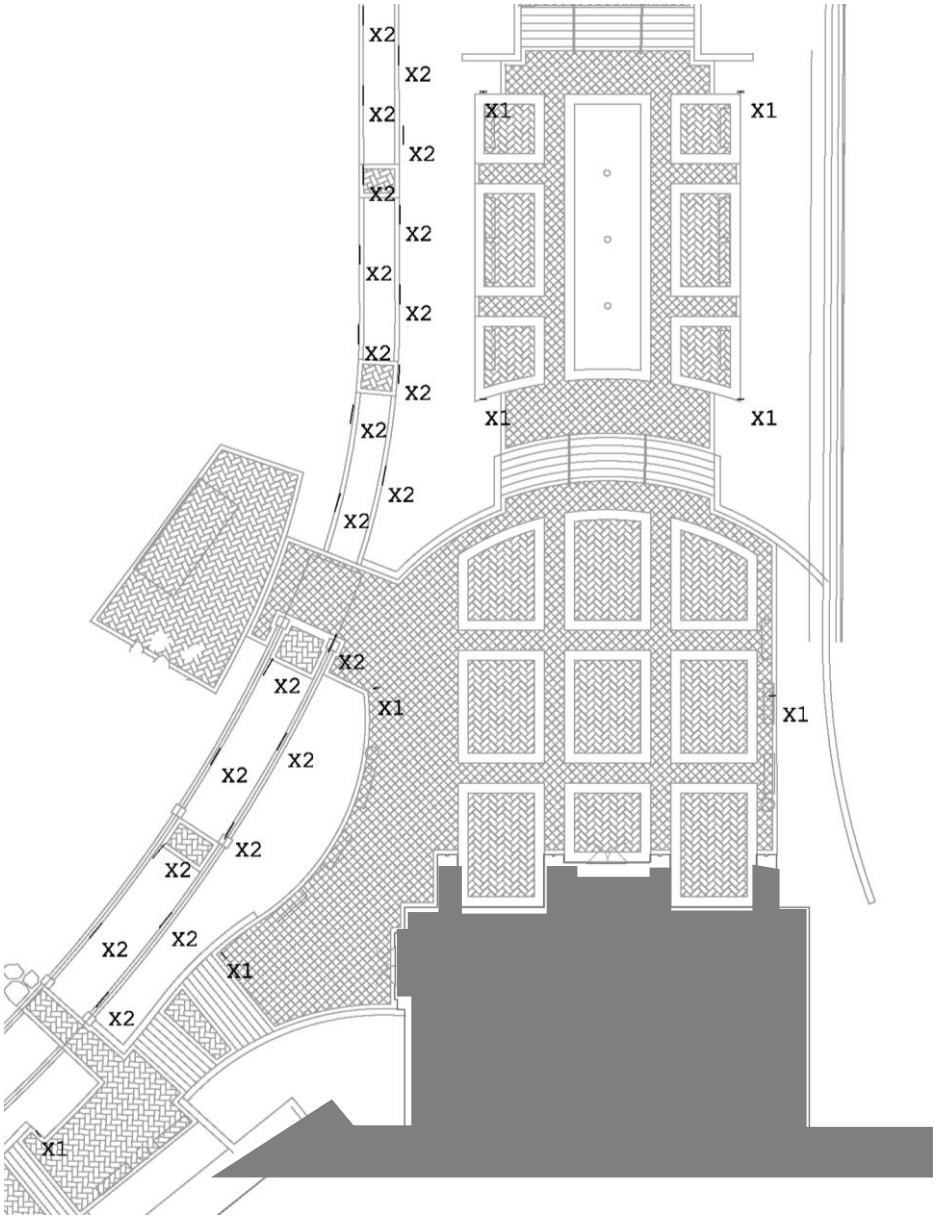


Figure 10 – Main Plaza Lighting Plan

Luminaire X1 is mounted 12 feet above the ground. Luminaire X2 is a 3’-0” long section that is incorporated into the handrail spaced 9’-0” O.C. with the luminaires in the opposite handrail offset as to be in the center of the space that does not have a luminaire.

Table 5 – Main Plaza Target Vs Design Illuminance

Location		Eh (lux)	Height Eh	Max:Avg	Avg:Min
Outdoor Plaza and Ramp	Target	4	0'-0"	4:1	5:1
	Ramp	12	0'-0"	5.5:1	12.4:1
	Plaza	7	0'-0"	2.1:1	7.3:1

The design average illuminance and illuminance ratios are not very close to the target values, but the design provides ample illuminance for the tasks that must be performed. The majority of the plaza area is very uniform; it is just some outlying points that are causing the average to minimum ratio to be so high.

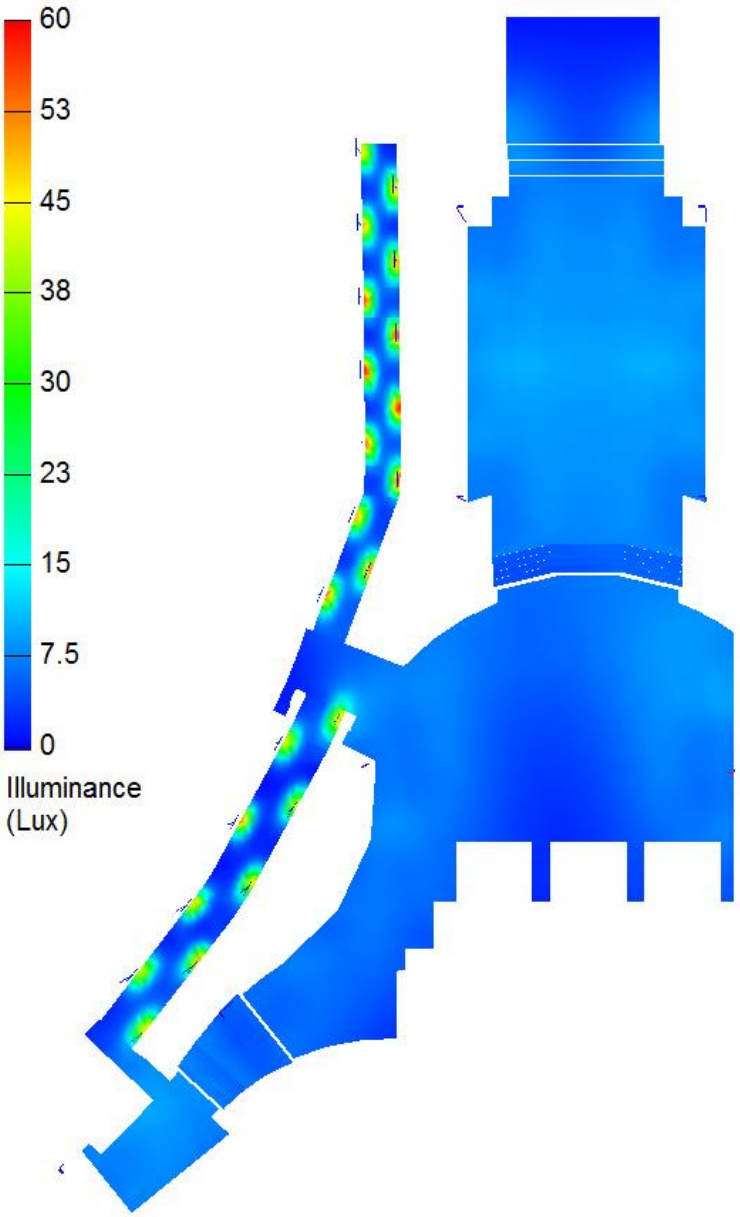


Figure 11 – Main Plaza Pseudo Color

ASHRAE control requirements were addressed as follows:

- A photosensor is used to turn off the site lighting when daylight is present
- There is no façade of landscape lighting present in the design
- A portion of the exterior site lighting accounting for more than 30% of the power is programmed to turn off between midnight and 6 a.m.

The LPD for the site is 68% below the max allowed by ASHRAE. See Appendix A-2 – Lighting Power Density Calculations for the calculations.

MLO Considerations

The total installed lumens is 32% below the max allowed lumens. See Table 6 below for the total site lumen calculation. The total lumens hitting the bounding box is below 12% of the site lumens. The design exceeds the max allowed single point illuminance at a point on the property line. This occurs because the task plane goes right up to the property line so it is impossible to light the task plane and not the property line.

Table 6 – Installed Site Lumens

Luminaire	Lumens per fixture	Quantity	Total Lumens
Pole Light (C1 T3)	1635	8	13080
Rail Light	98	22	2156
	Total Installed Lumens:		**15236**

1.3 Main Lobby 1000

1.3.1 Introduction

Main Lobby 1000 is approximately 3000 SF and is located on the east side of the building at the intersection of the two wings. It is double height with a second floor balcony overlooking it. The east façade is primarily glass which provides extensive daylight exposure. below shows the layout ad dimensions of Main Lobby 1000

Figure 12 – Main Lobby 1000 Layout and Dimensions

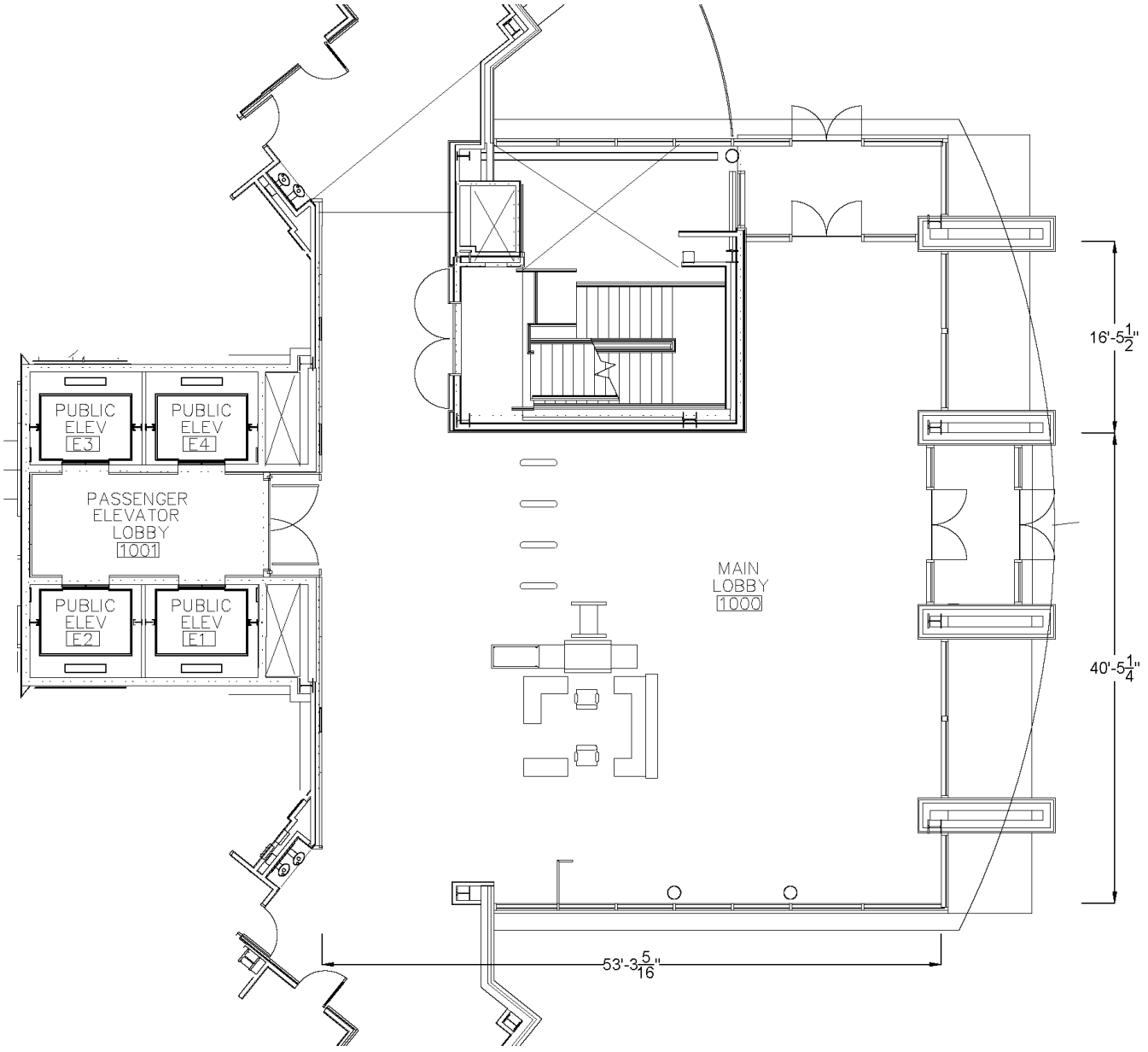


Table 7 and Table 8 below give the finish materials for Main Lobby 1000

Table 7 – Main Lobby 1000 Finish Schedule

Surface	Description	Color	Reflectance
Ceiling	Acoustical Metal ceiling 24" x 24"	-	>0.60
	Acoustical Metal ceiling 6" wide	-	>0.60
Floor	Handset Granite	Mountain Green	0.22*
Wall	Paint	White	0.85
	Terracotta Wall Tile	-	-

*denotes reflectances that were calculated by AGI32 based on the manufacturers image

Table 8 – Main Lobby 1000 Glazing Types

Surface	Description	ρ_{EXT}	ρ_{INT}	ρ_{SOL}	VLT
Windows	Vision glass	0.12	0.12	0.24	.78

1.3.2 Design Criteria

Spaciousness: This space is the main entrance of the building and should be designed in such a way as to instill a sense of awe and grandeur

Safety: This space houses the main security screening for the building and therefore the lighting must be designed to not hinder the screening process

Both the illuminance level and ratio targets given in Table 9 below are based on the recommendations in the IES Handbook.

Table 9 – Main Lobby 1000 Illuminance Recommendations

Location	Eh (lux)	Elevation Eh	Ev (lux)	Elevation Ev	Avg:Min
Security Screening	200	3'-0"	200	5'-0"	2:1
Lobbies near entries (day)	100	Floor	30	5'-0"	4:1

The control and LPD requirements given in are based on ASHRAE 90.1 2013

Table 10 – Main Lobby 1000 LPD and Control Requirements

LPD (W/SF)	Local Control	Automatic Daylight Responsive Controls for Sidelighting	Automatic Full OFF	Scheduled Shutoff
0.9	REQ	REQ	ADD2	ADD2

Note: "ADD2" designates a requirement that has an option. i.e. one of the "ADD2" options must be selected.

1.3.3 Final Design

Table 11 – Main Lobby 1000 Luminaire Schedule

Type	Description	Manufacturer	Model	Lamp	CCT (K)	CRI	Life (Hours)	Ballast	Input (Watts)	Voltage	Fixture Image
R3	RECESSED CIRCULAR 6 INCH WIDE BEAM DOWNLIGHT 1500 LUMEN	COOPER LIGHTING	LD6A15DL3 ERW6A15835 6LW1LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	22.4	277	
R4	RECESSED CIRCULAR 6 INCH WIDE BEAM WALL WASH 1000 LUMEN	COOPER LIGHTING	LD6A10DL3 ERM6A10835 6LM111LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	14.1	277	
R7	RECESSED CIRCULAR 8 INCH MEDIUM BEAM DOWNLIGHT 5000 LUMEN	COOPER LIGHTING	LD8A502DL3 ER8A50835 8LMOLI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	62	277	
R8	RECESSED CIRCULAR 8 INCH MEDIUM BEAM DOWNLIGHT 3000 LUMEN	COOPER LIGHTING	LD8A302DL3 ER8A30835 8LW110LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	42	277	
R9	RECESSED CIRCULAR 8 INCH WIDE BEAM DOWNLIGHT 3000 LUMEN	COOPER LIGHTING	LD8A302DL3 ER8A30835 8LW0LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	42	277	
W1	WALL MOUNTED LINEAR UPLIGHT TWO FOOT, 2000 LUMENS	COOPER LIGHTING	A02-SI-A-2-LED-35K-277-S-AK12-D	INTEGRAL	3500	80	50,000 L70	INTEGRAL	22.6	277	

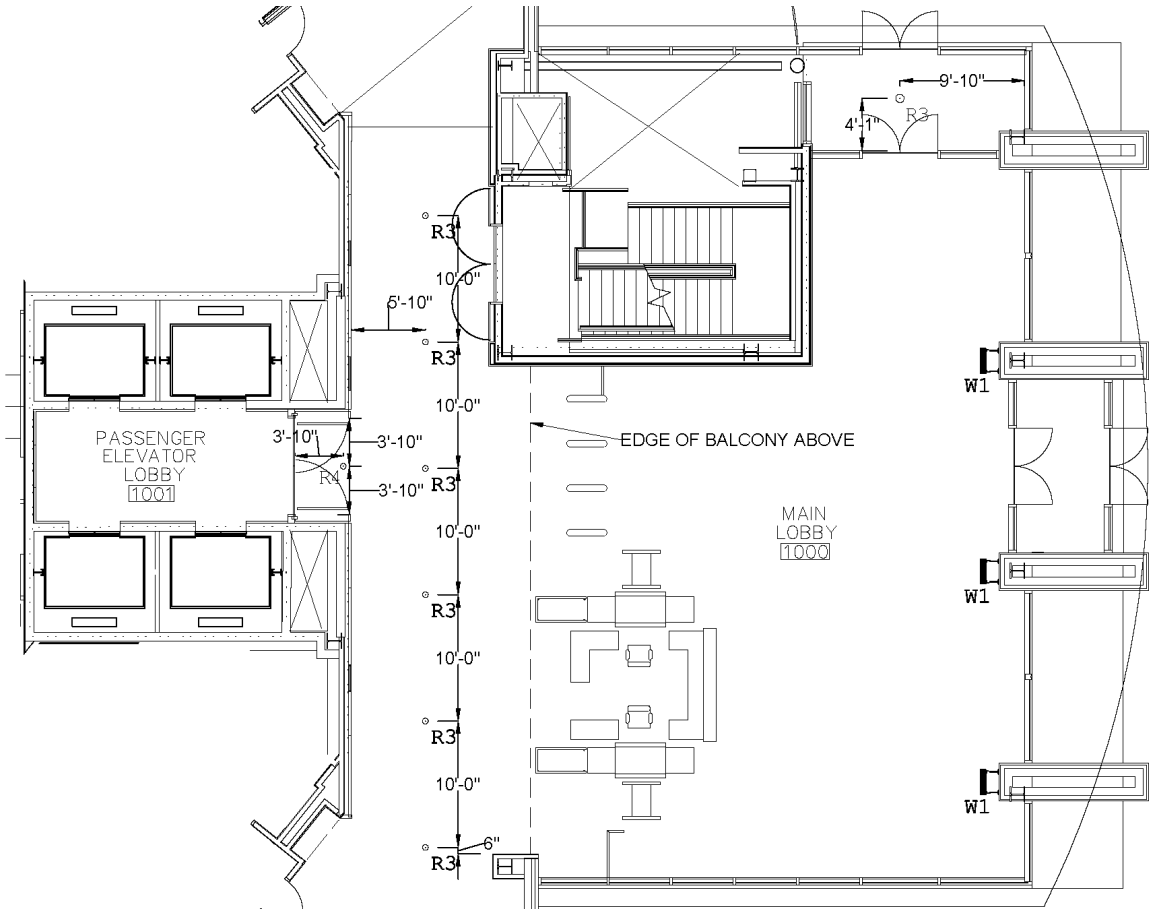


Figure 13 – Main Lobby 1000 Lower Level Reflected Ceiling Plan

Figure 13 on the previous page and Figure 14 below show the luminaire layout for Lobby 1000. All ceiling mounted luminaires are recessed into the drop ceiling. Coordinate the height with the architect. Wall mounted luminaire W1 is to be mounted at the center of the columns 7’-0” AFF.

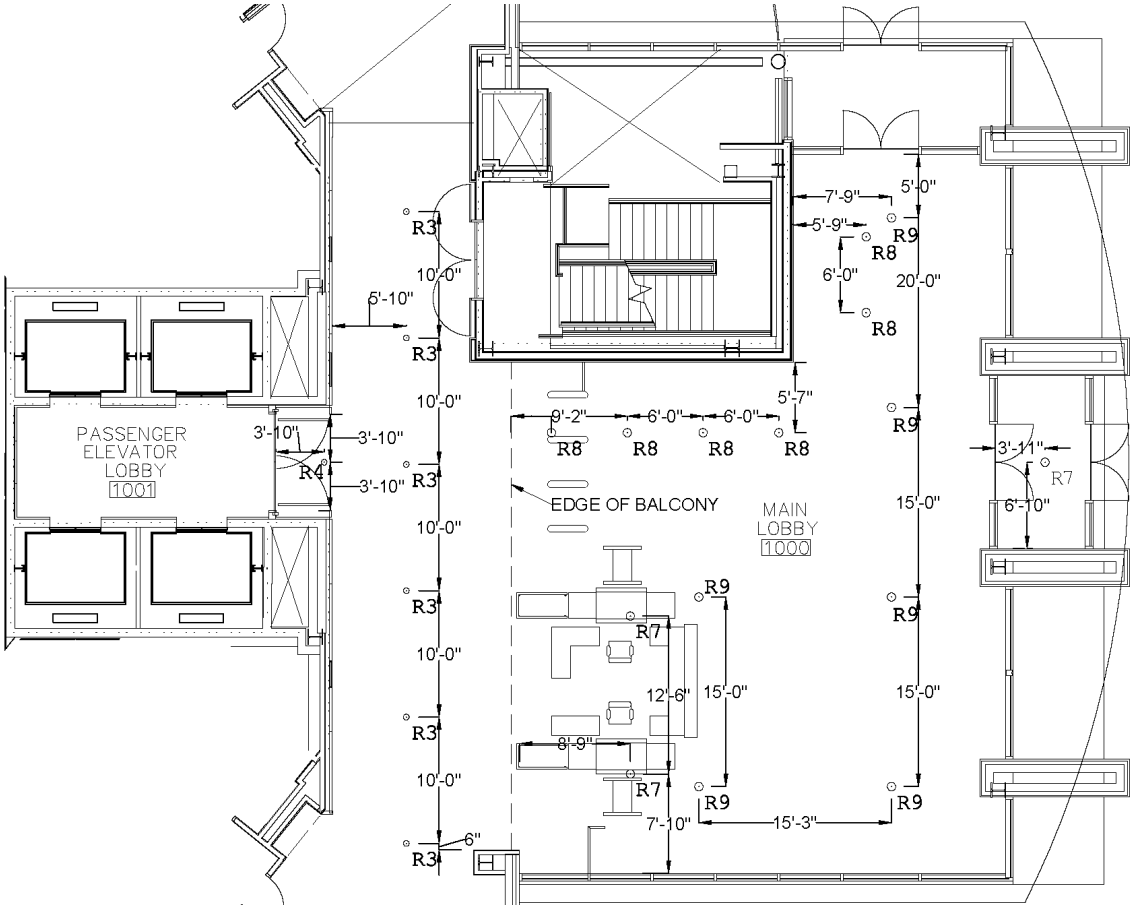


Figure 14 – Main Lobby 1000 Upper Level Reflected Ceiling Plan

Table 12 – Main Lobby 1000 Target Vs Design Illuminance

Location		Eh (lux)	Height Eh	Avg:Min
Security Screening	Target	200	3'0"	2:1
	Design	186	3'-0"	1.7:1
Lobbies near entries (day)	Target	100	Floor	4:1
	Design	139	Floor	3.2:1

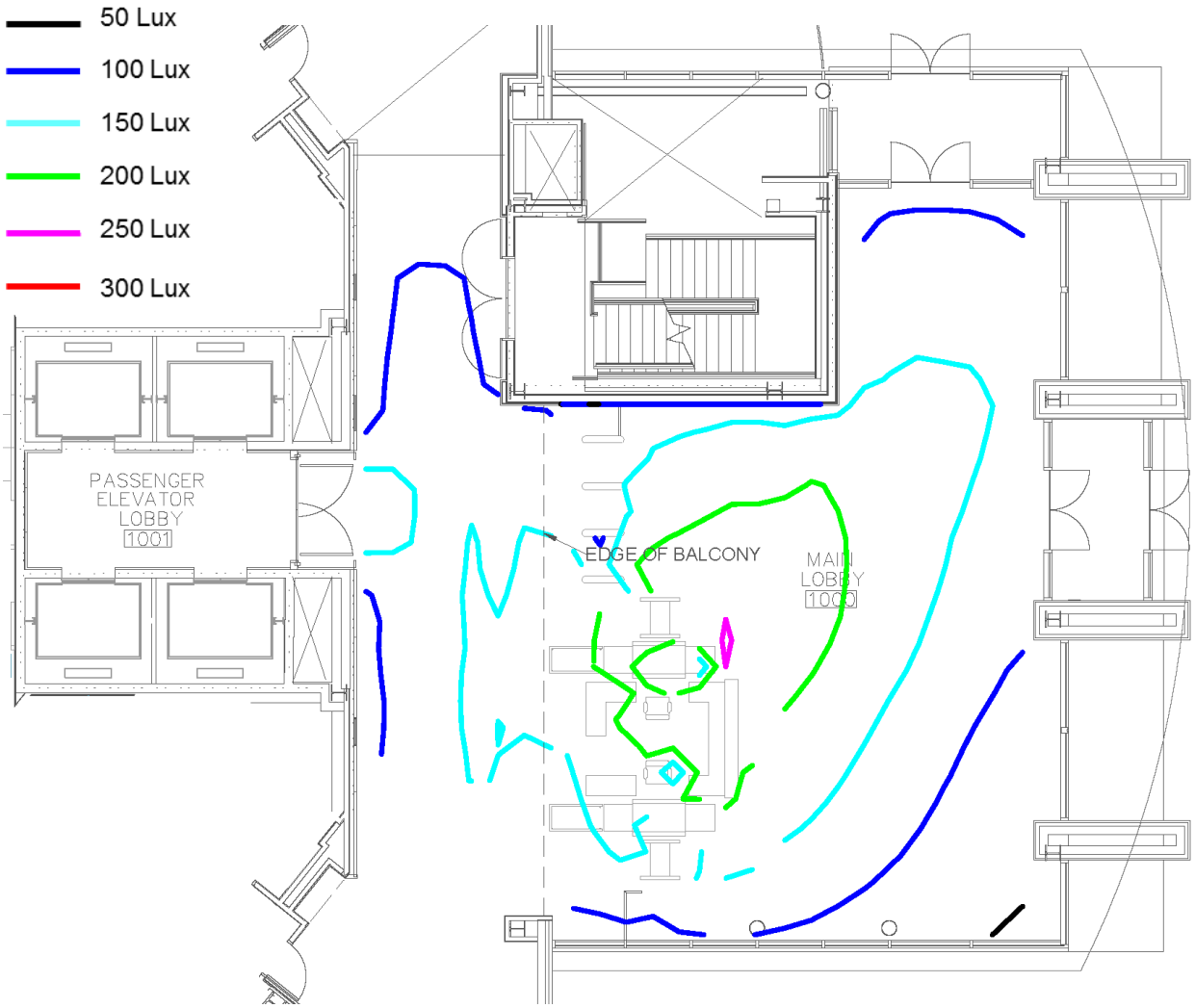


Figure 15 – Main Lobby 1000 Lower Level Isoline

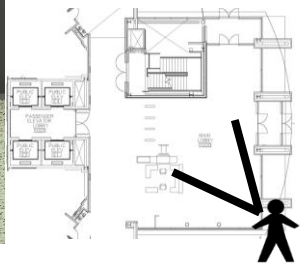
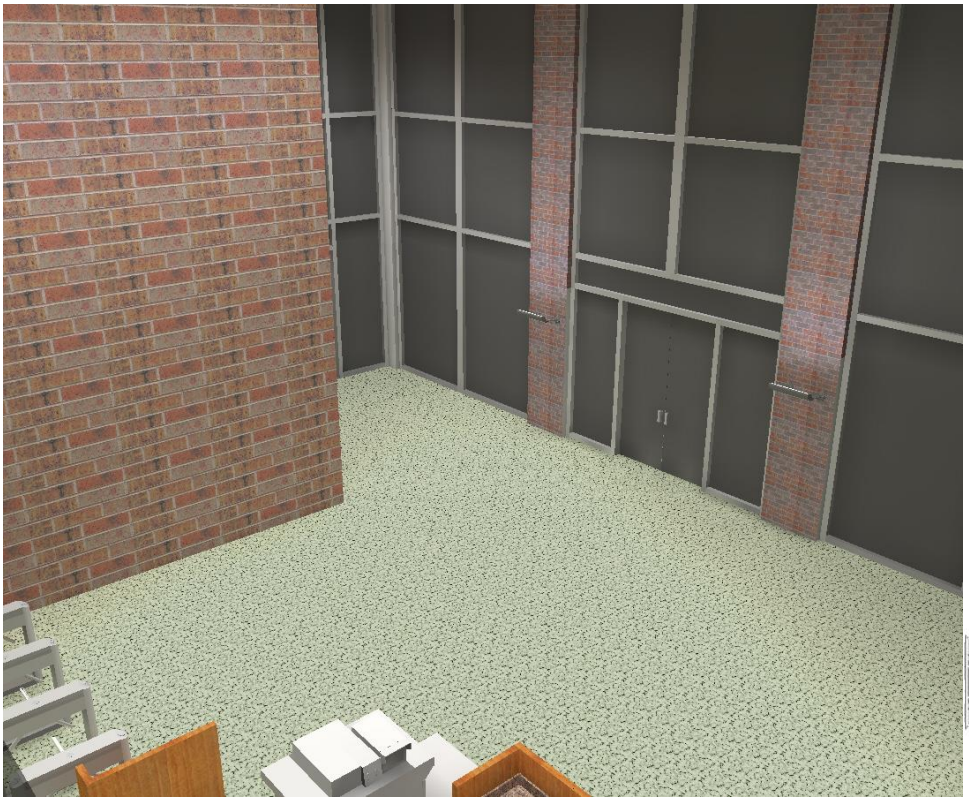


Figure 16 – Main Lobby 1000 Perspective 1



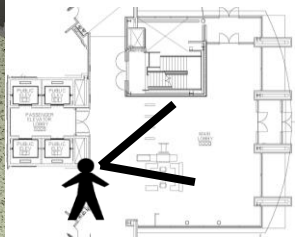


Figure 17 – Main Lobby 1000 Perspective from Balcony

The LPD for this design is 0.33 W/SF which is a 63% reduction from the maximum allowed LPD. See Appendix A-2 – Lighting Power Density Calculations for the calculations.

The ASHRAE controls requirements for this space were addressed as follows:

*Local Control***:** The control station is located at the security station.

Automatic Daylight Responsive Controls for Sidelighting: Nearly the entire room is a primary sidelighted area. As a result photosensor control is provided for all of the general lighting. Continuous dimming will be used for these luminaires. The luminaires for the security screening area are not general lighting and therefore will not be photocontrolled.

Automatic Full OFF: Because this is the main security screening area for the building automatic full off would endanger the safety of the occupants so exception 2 for this requirement will be taken.

Scheduled Shutoff: Because this is the main security screening area for the building scheduled shutoff would endanger the security of the building occupants so exception 3 of this requirement will be taken.

See Figure 18 and Figure 19 on the next page for the lighting controls details.

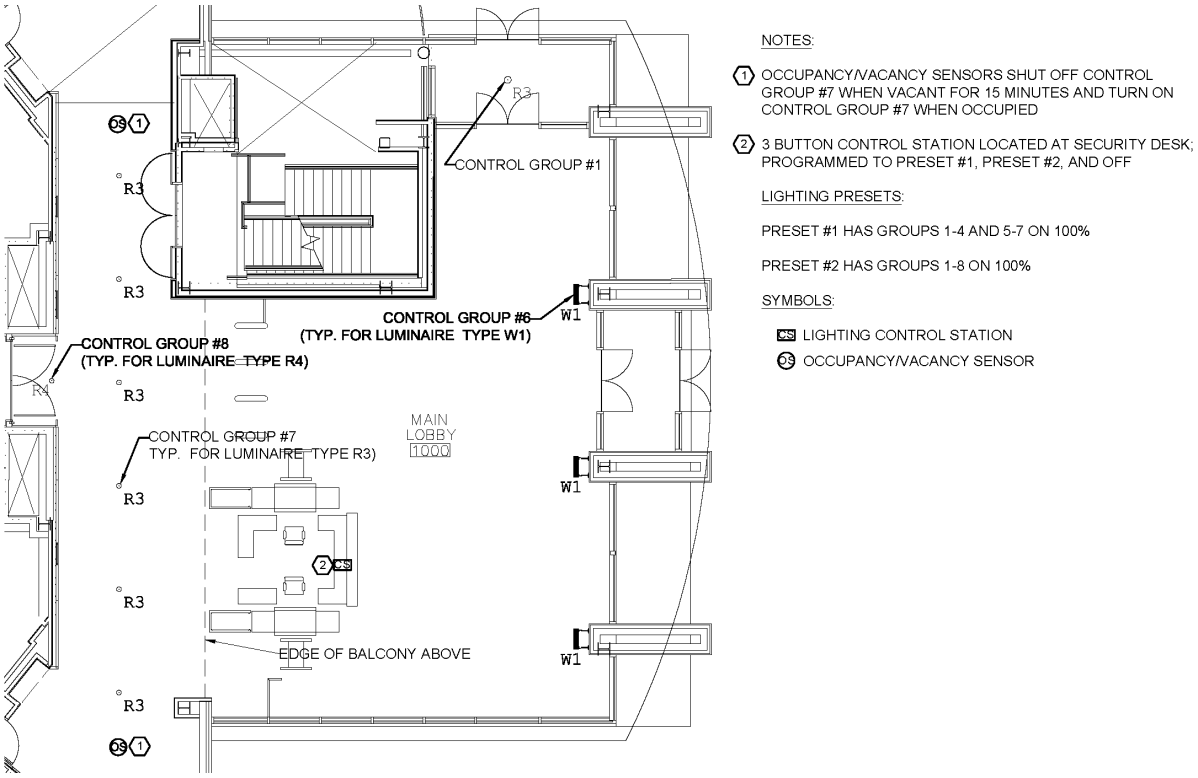


Figure 18 – Main Lobby 1000 Lower Level Lighting Controls

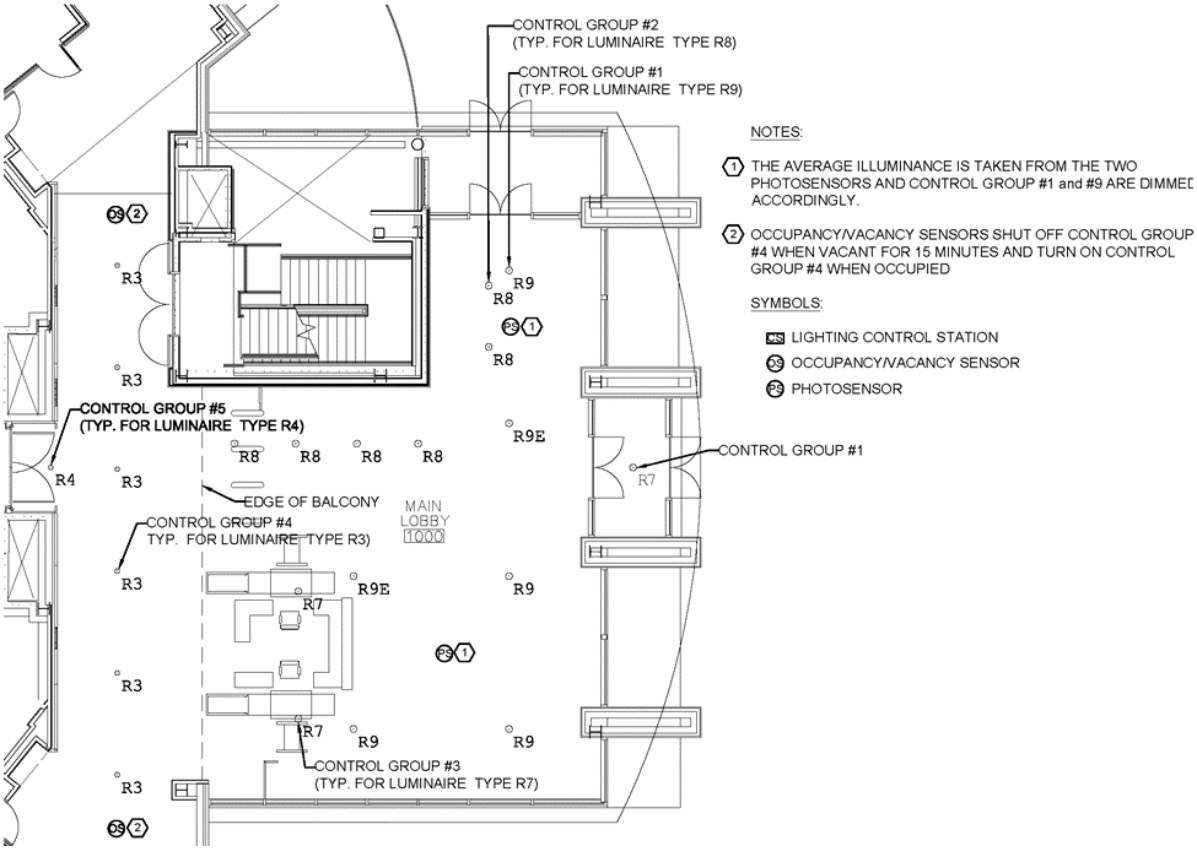


Figure 19 – Main Lobby 1000 Upper Level Lighting Controls

1.4 Open Office 2520

1.4.1 Introduction

Open Office 2520 is a 1600 SF “L” shaped open office located in the southwest corner of the building. This office is typical of the open offices located throughout the building, but has significant exterior exposure on the northwest side. See Figure 20 below for the layout and dimensions of Open Office 2520

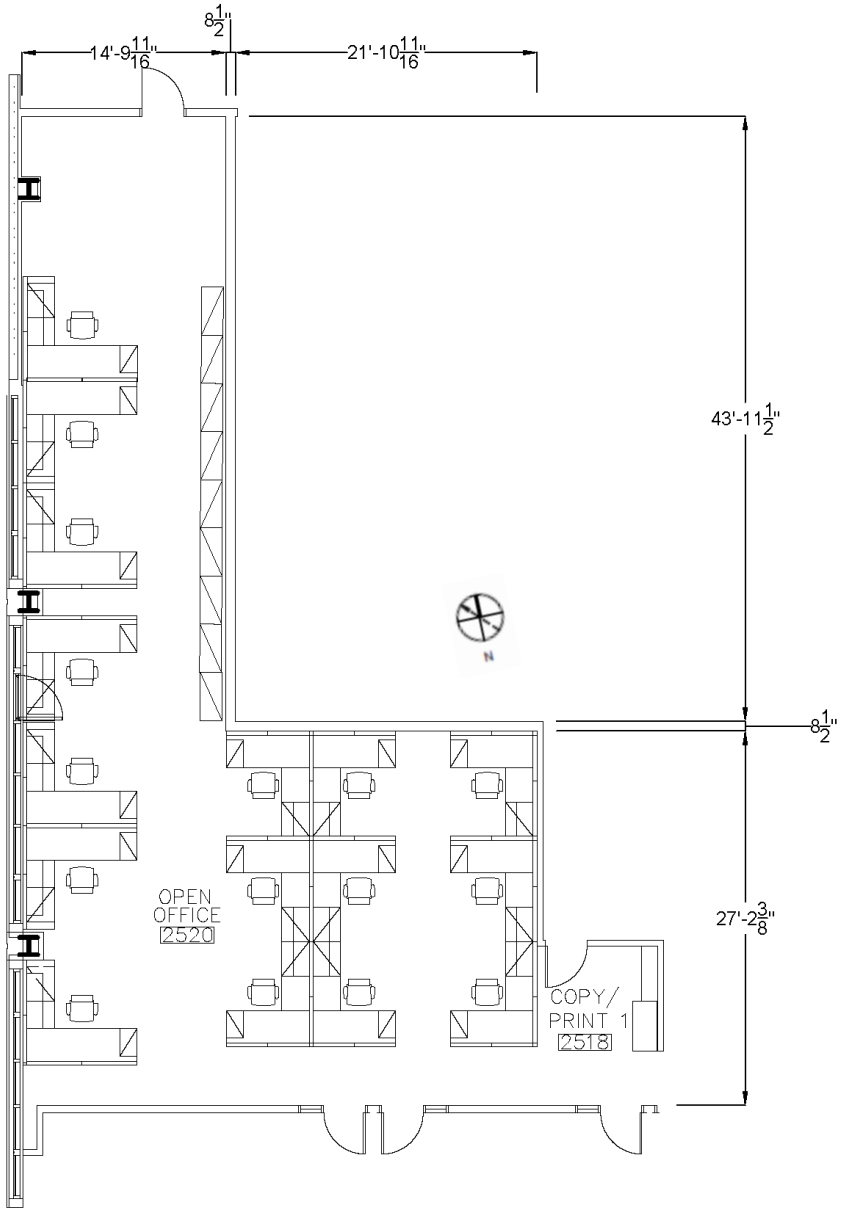


Figure 20 – Open Office 2520 Layout and Dimensions

The finish and glazing properties for Open Office 2520 are given in Table 13 and Table 14 below.

Table 13 – Open Office 2520 Finish Schedule

Surface	Description	Color	Reflectance
Ceiling	Acoustical panel ceiling 24” x 24”	White	0.90
Floor	Carpet Tile 24” x 24”	Opening Night (403674)	0.04*
Wall	Paint	Pure White (7005)	0.85

*denotes reflectances that were calculated by AGI32 based on the manufacturers image

Table 14 – Open Office 2520 Glazing Types

Surface	Description	ρ_{EXT}	ρ_{INT}	ρ_{SOL}	VLT
Windows	Vision glass	0.11	0.11	0.26	0.49

1.4.2 Design Criteria

Views/Daylight: In order to create a friendly working environment, views and daylighting should be utilized as much as possible while keeping glare to a minimum.

Community/Unity: The lighting design of this space should create a sense of community and not cause the space to feel segmented.

Both the illuminance level and illuminance ratios are based on the recommendations in the IES Handbook and are listed in Table 15 below.

Table 15 – Open Office 2520 Illuminance Recommendations

Eh (lux)	Elevation Eh	Ev (lux)	Elevation Ev	Avg:Min
300	2’-6”	50	4’-0”	1.5:1*

*From Table 12.6

The control and LPD requirements from ASHRAE 90.1 2013 are given in Table 16 below.

Table 16 – Open Office 2520 LPD and Control Requirements

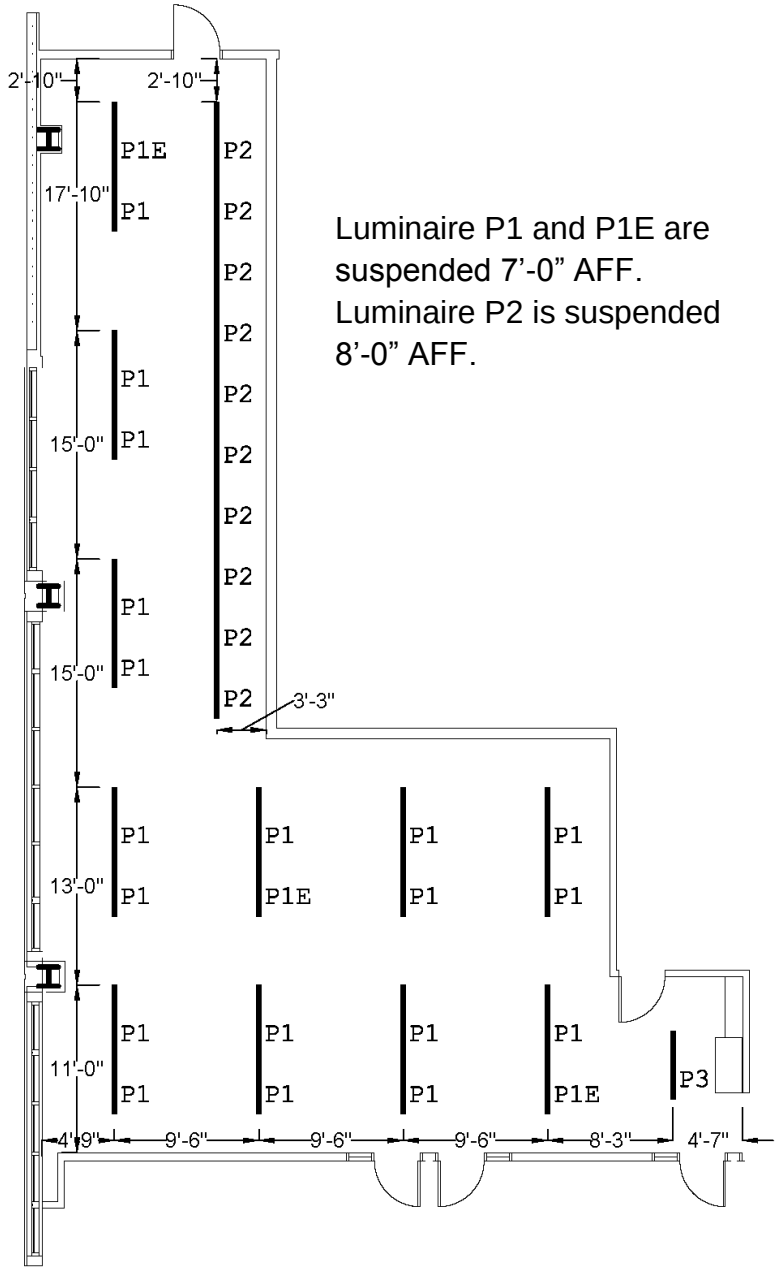
LPD (W/SF)	Local Control	Manual ON	Restricted to Partial Automatic ON	Bilevel Lighting Control	Automatic Daylight Responsive Controls for Sidelighting	Automatic Full OFF	Scheduled Shutoff
0.98	REQ	ADD1	ADD1	REQ	REQ	ADD2	ADD2

Note: “ADD1” and “ADD2” designates requirements that have an option. i.e. one of the “ADD1” options and one of the “ADD2” options must be selected.

1.4.3 Final Design

Table 17 – Open Office 2520 Luminaire Schedule

Type	Description	Manufacturer	Model	Lamp	Input Watts	Voltage	Fixture Image
P1	CYLINDRICAL LED DIRECT/INDIRECT PENDANT	PEERLESS	RD4M4 W20/20 8FT R8 277 EZB SCT LP835 F1/24 C110	INTEGRAL	40	277	
P1E	EMERGENCY CYLINDRICAL LED DIRECT/INDIRECT PENDANT	PEERLESS	RD4M4 W20/20 8FT R8 277 EZB 1 EC SCT LP835 F1/24 C110	INTEGRAL	40	277	
P2	CYLINDRICAL LED WALL WASHER PENDANT	PEERLESS	RD4MW W20 40FT R8 277 EZB SCT LP835 F1/24 C110	INTEGRAL	20	277	
P3	CYLINDRICAL LED DIRECT/INDIRECT PENDANT	PEERLESS	RD4M4 W40/20 4FT R4 277 EZB SCT LP835 F1/24 C110	INTEGRAL	60	277	



Luminaire P1 and P1E are suspended 7’-0” AFF. Luminaire P2 is suspended 8’-0” AFF.

Figure 21 – Open Office 2520 RCP

Table 18 – Open Office 2520 Target Vs Design Illuminance

	Eh (lux)	Height Eh	Avg:Min
Target	300	2'6"	1.5:1
Design	329	2'6"	1.98:1

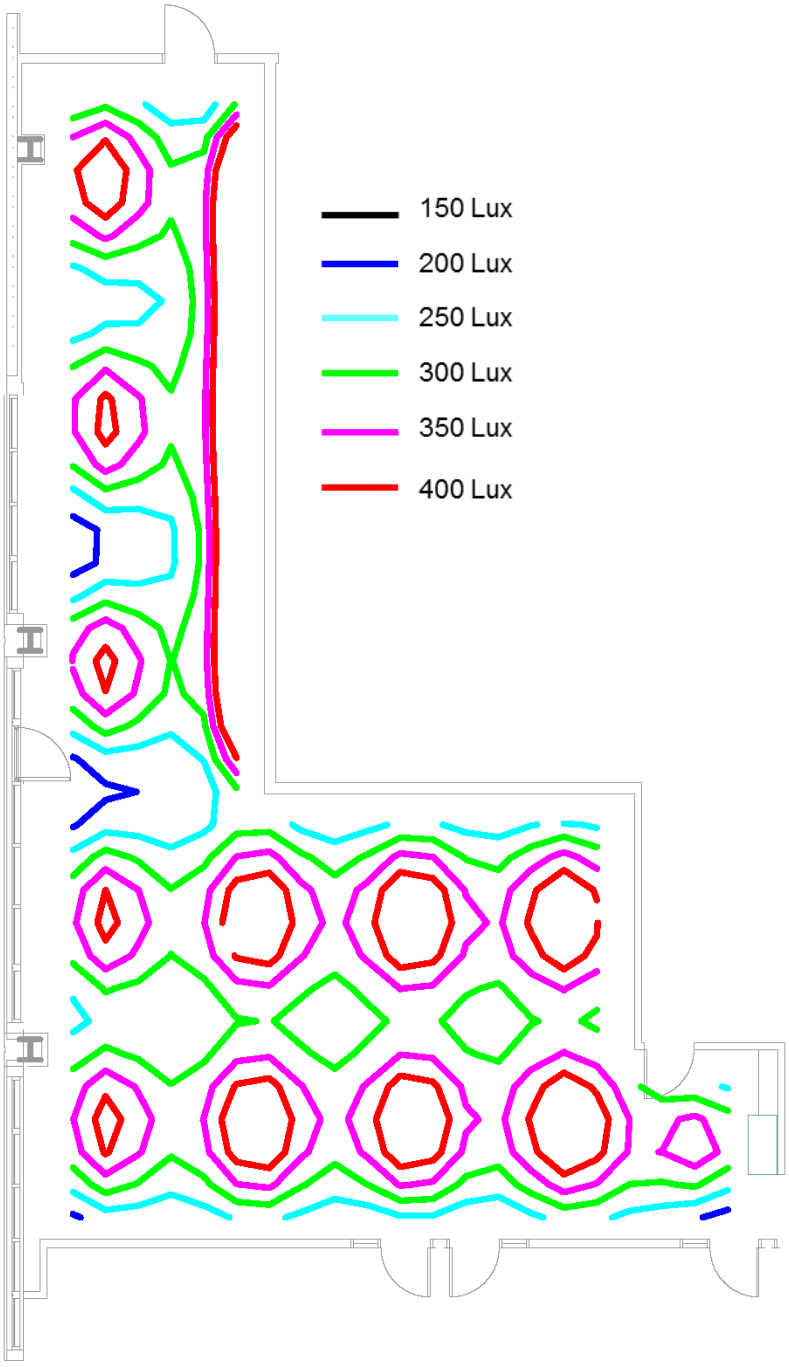


Figure 22 – Open Office 2520 Isolines

Figure 23 – Open Office 2520 Perspective

Figure 24 – Open Office 2520 Perspective

The LPD for this design is 0.71 W/SF which is a 28% reduction from the maximum allowed LPD. See Appendix A-2 – Lighting Power Density Calculations for the calculations.

The ASHRAE control requirements were addressed as follows:

Local Control: There are control stations located at each door.

Manual ON: This is not required because the lighting is restricted to partial automatic on.

Restricted to Partial Automatic ON: The occupancy sensors are only able to turn on a portion of the lighting for this space.

*Bilevel Lighting Control***:** The lighting control stations allow for various luminaire combinations to be turned on including a setting that is between 30% and 70% of the total lighting power.

Automatic Daylight Responsive Controls for Sidelighting: A large portion of the room is a primary sidelighted area. As a result photo sensor control is provided for all of the luminaires in this area. Continuous dimming will be used for these luminaires.

Automatic Full OFF: The lighting control system is equipped with vacancy sensors that will turn off all of the lighting for the space.

Scheduled Shutoff: This is not required because automatic full off is being utilized.

See Figure 25 on the next page for lighting control details.

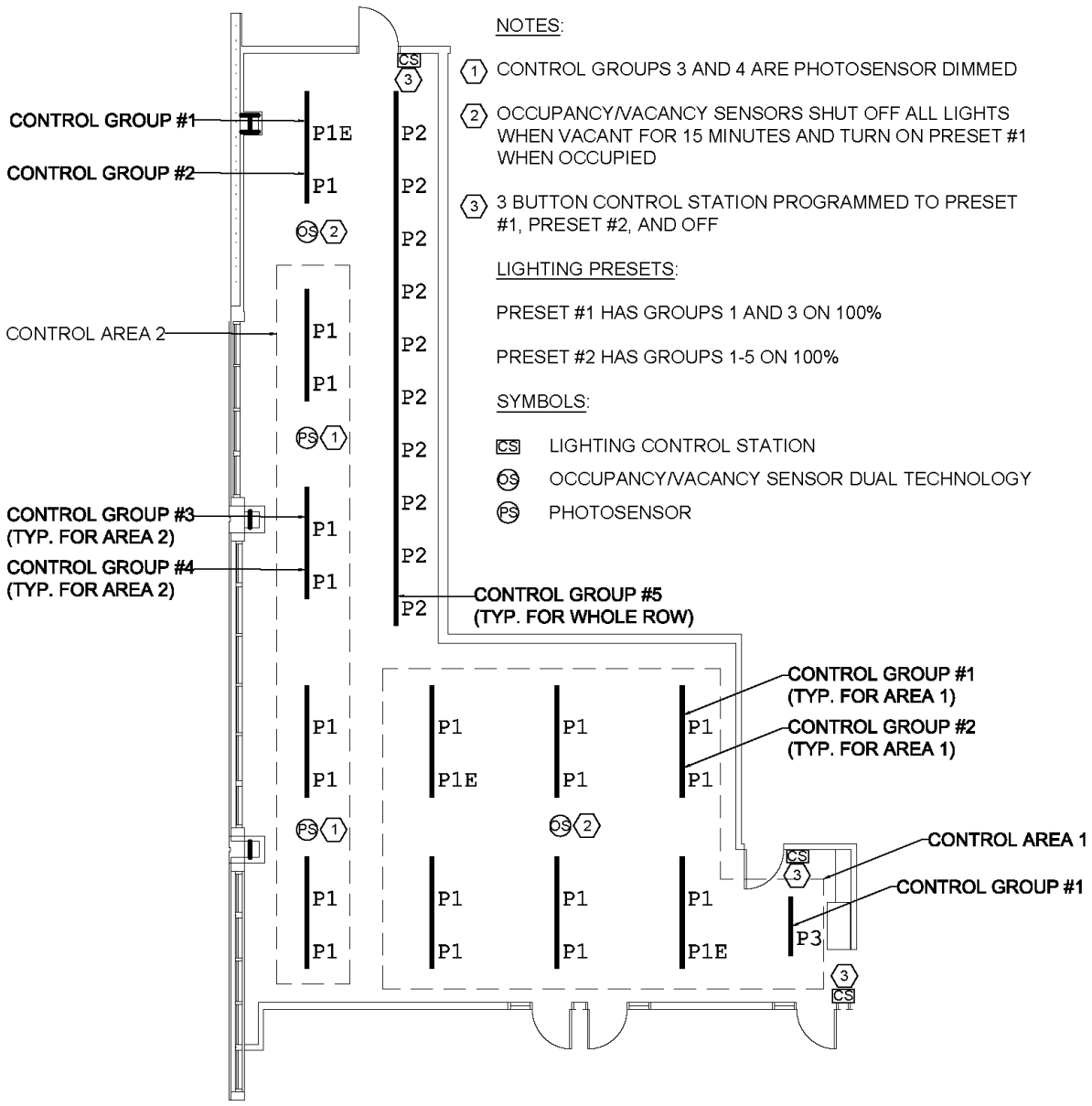


Figure 25 – Open Office 2520 Lighting Control

1.5 Ceremonial Courtroom 4100

1.5.1 Introduction

Ceremonial Courtroom 4100 is located in the southeast end of the building and is the largest of the courtrooms. This courtroom has an area of 2900 SF with 222 public seats and a large area for proceedings that includes the typical items (attorney's tables, evidence table, jury seating, etc.) and seating for a panel of judges. There are various activities that take place in the courtroom that require very different illuminance levels. Figure 26 below gives the layout and dimensions of Ceremonial Courtroom 4100.

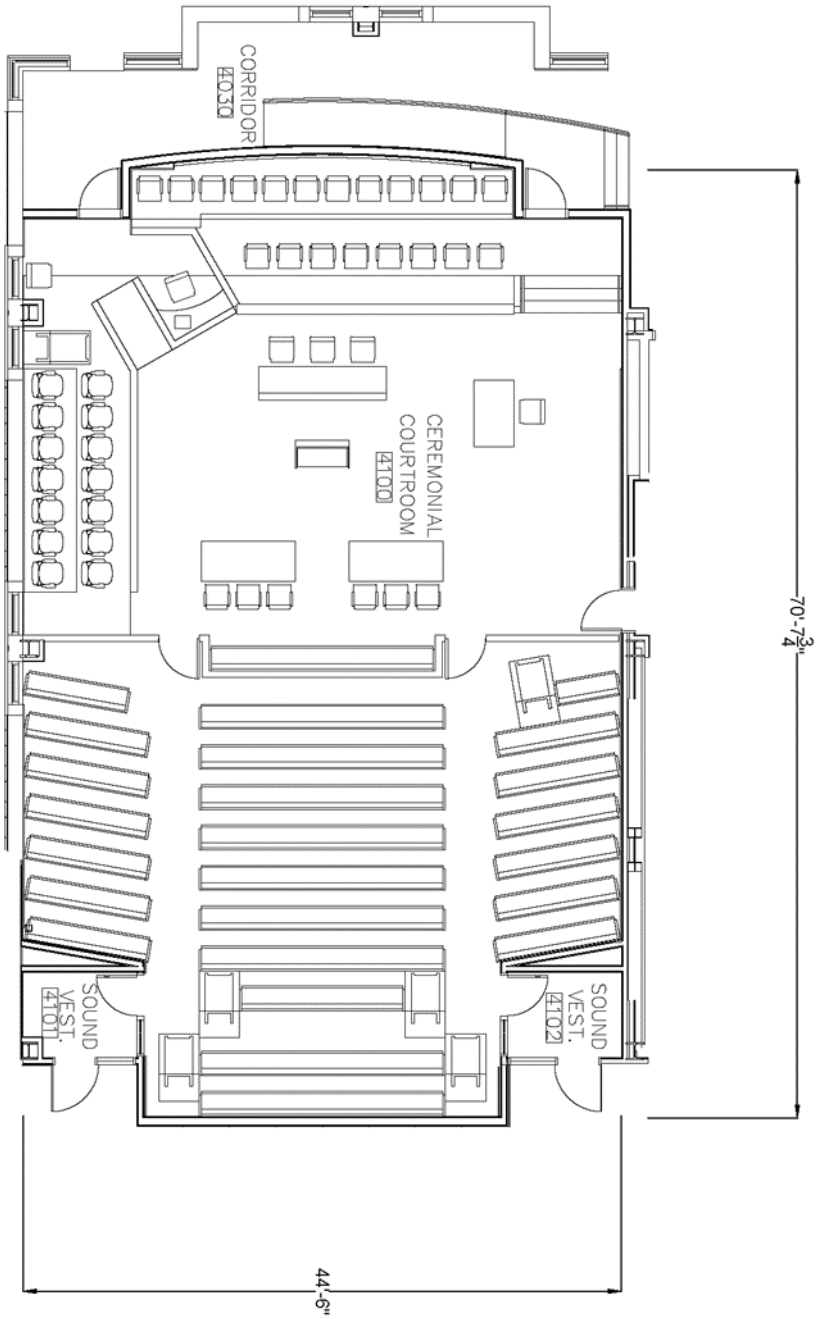


Figure 26 – Ceremonial Courtroom 4100 Layout and Dimensions

The finish materials and their properties for Ceremonial Courtroom 4100 are listed in Table 19 and Table 20 below.

Table 19 - Ceremonial Courtroom 4100 Finish Schedule

Surface	Description	Color	Reflectance
Ceiling	Acoustical panel ceiling 24” x 48”	White	0.83
	Painted gypsum	Pure White (7005)	0.85
Wall	Acoustic Fabric Panel	Designtex 4139 102 Clay	0.72*
	Handset Stone	Mountain Green	0.22*
	Paint	Natural Choice (7011)	0.73
	Hardwood veneer	Black Walnut	0.30*
Floor	Broadloom Carpet	Dusk (921)	0.03*

*denotes reflectances that were calculated by AGI32 based on the manufacturers image

Table 20 - Ceremonial Courtroom 4100 Glazing Types

Surface	Description	ρ_{EXT}	ρ_{INT}	ρ_{SOL}	VLT
Exterior windows	Vision glass	0.11	0.11	0.26	.49
Interior windows	Acoustic Glazing	0.11*	0.11*		.49

*denotes assumed value

1.5.2 Design Criteria

Flexibility: in order to accommodate the various activities that will take place in the courtroom the lighting solution must have various scenes

Respect: the lighting design of this space should convey a sense of honor and respect

Both the illuminance level and illuminance ratios are based on the recommendations in the IES Handbook and are listed in Table 21 below.

Table 21 – Ceremonial Courtroom 4100 Illuminance Recommendations

Location	Eh (lux)	Height Eh	Ev (lux)	Height Ev	Max:Avg	Avg:Min	Notes
Attorneys' Tables	500	2'-6"	200	4'-0"		2:1	
AV Presentation Screen			50		2:1		Max value
Bench and Clerks	500	2'-6"	200	4'-0"		2:1	
Jury Box	300	2'-6"	150	4'-0"		2:1	
Public Seating	100	2'-6"	50	4'-0"		2:1	
Witness Stand	300	2'-6"	150	4'-0"		2:1	

The control and LPD requirements from ASHRAE 90.1 2013 are given in Table 22 below.

Table 22 – Ceremonial Courtroom 4100 LPD and Control Requirements

LPD (W/SF)	Local Control	Manual ON	Restricted to Partial Automatic ON	Bilevel Lighting Control	Automatic Daylight Responsive Controls for Sidelighting	Automatic Full OFF	Scheduled Shutoff
1.72	REQ	ADD1	ADD1	REQ	REQ	ADD2	ADD2

Note: "ADD1" and "ADD2" designates requirements that have an option. i.e. one of the "ADD1" options and one of the "ADD2" options must be selected.

1.5.3 Final Design

Table 23 – Ceremonial Courtroom 4100 Luminaire Schedule

Type	Description	Manufacturer	Model	Lamp	CCT (K)	CRI	Life (Hours)	Ballast	Input (Watts)	Voltage	Fixture Image
R1	RECESSED CIRCULAR 6 INCH NARROW BEAM DOWNLIGHT 1500 LUMEN	COOPER LIGHTING	LD6A15DL3 ERN6A10835 6LN1LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	22.4	277	
R2	RECESSED CIRCULAR 6 INCH WIDE BEAM DOWNLIGHT 1000 LUMEN	COOPER LIGHTING	LD6A10DL3 ERW6A10835 6LW1LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	14.1	277	
R4	RECESSED CIRCULAR 6 INCH WIDE BEAM WALL WASH 1000 LUMEN	COOPER LIGHTING	LD6A10DL3 ERM6A10835 6LM111LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	14.1	277	
R10	RECESSED CIRCULAR 6 INCH WIDE BEAM DOWNLIGHT 3000 LUMEN	COOPER LIGHTING	LD6A30DL3 ERW6A30835 6LW1LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	43.6	277	
R11	RECESSED CIRCULAR 6 INCH MEDIUM BEAM DOWNLIGHT 2000 LUMEN	COOPER LIGHTING	LD6A20DL3 ERN6A20835 6LM1LI	INTEGRAL	3500	80	50,000 L70	INTEGRAL	31.5	277	
S1E	SURFACE MOUNTED LINEAR CEILING WASH	IO LIGHITNG	0 -08-35KV2HO-1-72-L	INTEGRAL	3500	80+	50,000 L70	INTEGRAL	63.4	277	

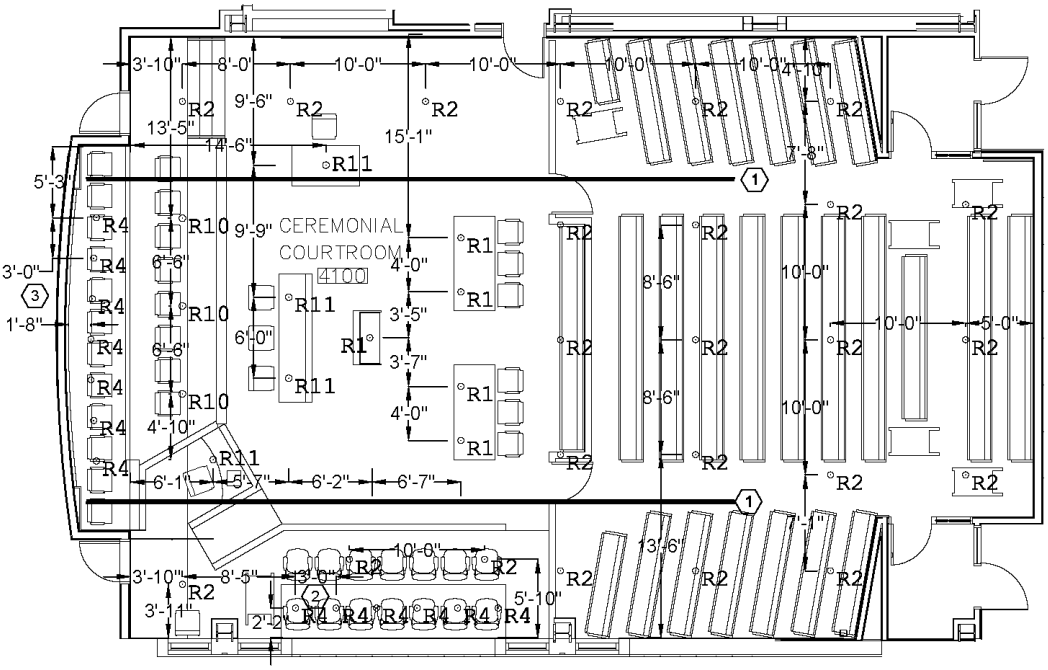


Figure 27 – Ceremonial Courtroom 4100 Reflected Ceiling Plan

All luminaires except S1 are recessed in the ceiling. Coordinate the mounting heights with the architect. See Figure 28 on the next page for the cove dimensions.

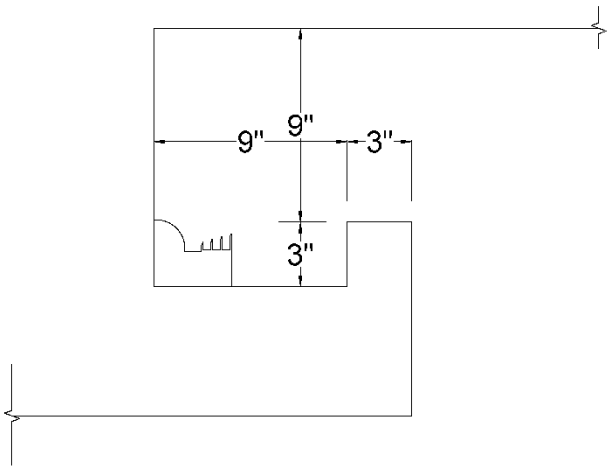


Figure 28 – Cove Detail

Table 24 – Ceremonial Courtroom 4100 Target Vs Design Illuminance

Location		Eh (lux)	Height Eh	Avg:Min
Attorneys' Tables	Target	500	2'-6"	2:1
	Table 1	454	2'-6"	1.1:1
	Table 2	457	2'-6"	1.1:1
Bench and Clerks	Target	500	2'-6"	2:1
	Design (Bench Upper)	434	2'-6"	1.9:1
	Design (Bench Lower)	460	2'-6"	1.7:1
	Design (Clerks)	500	2'-6"	1.2:1
Jury Box	Target	300	2'-6"	2:1
	Design	325	2'-6"	2.0:1
Podium	Target	500	2'-6"	2:1
	Design	456	2'-6"	1.1:1
Public Seating	Target	100	2'-6"	2:1
	Design	123	2'-6"	2.1:1
Witness Stand	Target	300	2'-6"	2:1
	Design	384	2'-6"	1.1:1

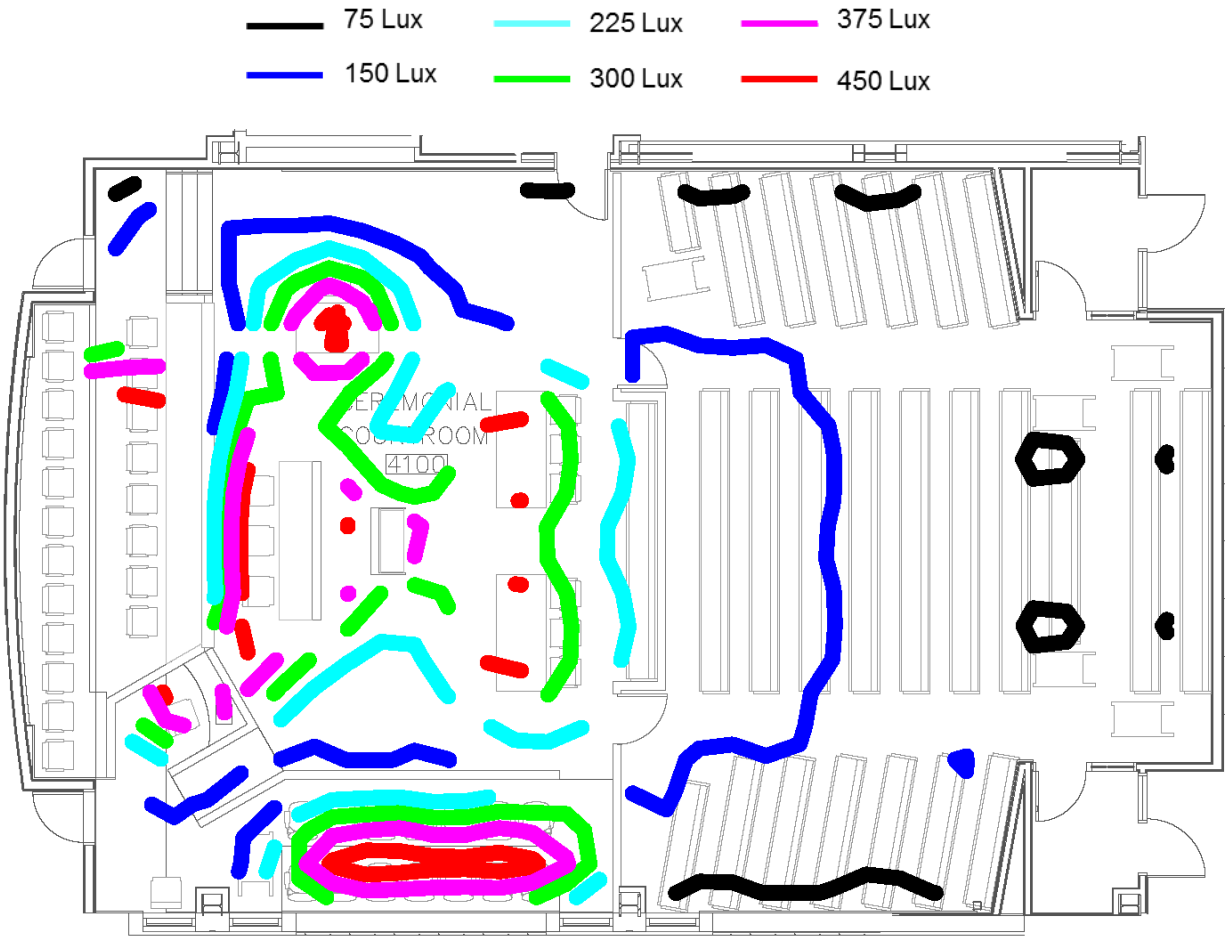


Figure 29 – Ceremonial Courtroom 4100 Isoline

Figure 30 – Ceremonial Courtroom 4100 Perspective from Public Seating

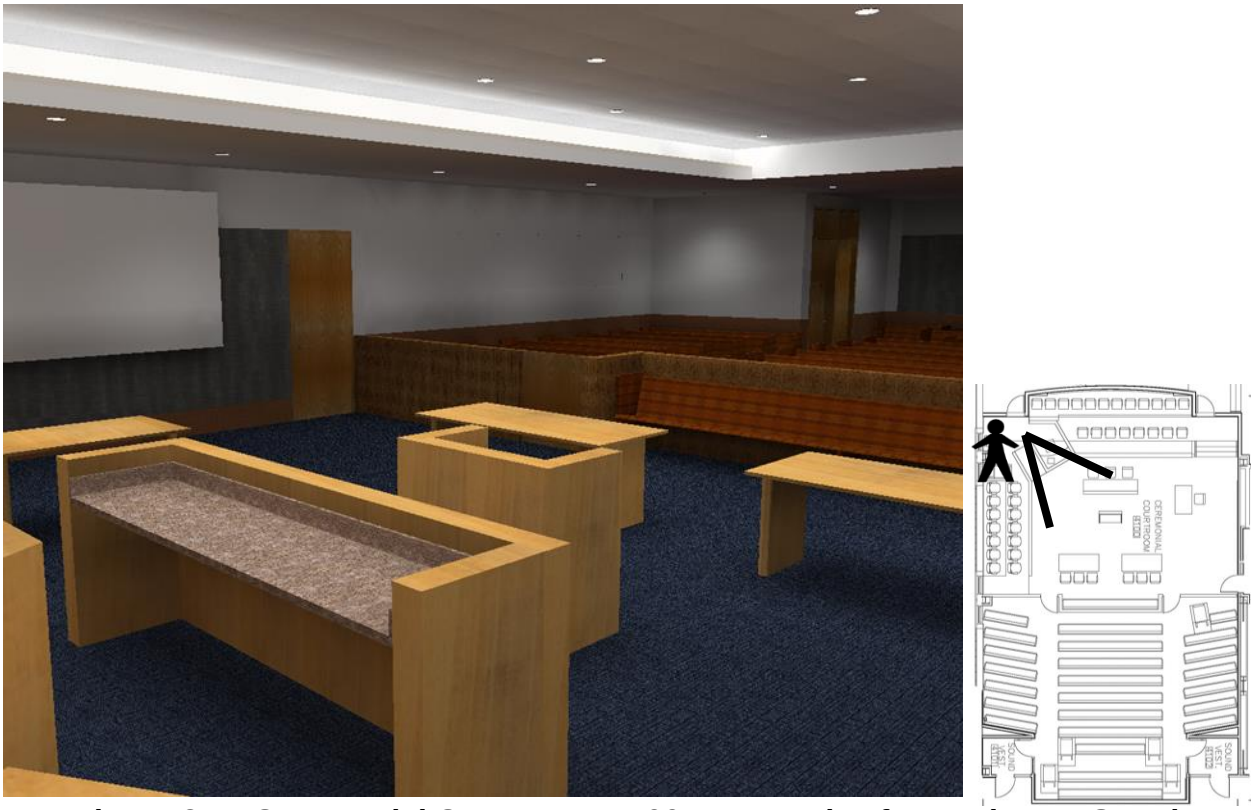


Figure 31 – Ceremonial Courtroom 4100 Perspective from Witness Stand

The LPD for this design is 0.66 W/SF which is a 64% reduction from the maximum allowed LPD. See Appendix A-2 – Lighting Power Density Calculations for the calculations.

The ASHRAE control requirements were addressed as follows:

Local Control: There are control stations located at the two doors at the front of the room and at the bench.

Manual ON: The lighting system is restricted to manual on.

Restricted to Partial Automatic ON: This is not required because the system is restricted to manual on.

*Bilevel Lighting Control***:** The lighting control stations allow for various Luminaire combinations to be turned on including a setting that is between 30% and 70% of the total lighting power.

Automatic Daylight Responsive Controls for Sidelighting: A small portion of the room is primary sidelighted area, but this portion and the associated installed lighting power is enough to make dimming a code requirement. As a result photosensor control is provided for all of the luminaires in this area. Continuous dimming will be used for these luminaires.

Automatic Full OFF: The lighting control system is equipped with vacancy sensors that will turn off all of the lighting for the space.

Scheduled Shutoff: This is not required because automatic full off is being utilized.

See Figure 32 on the next page for lighting control details.

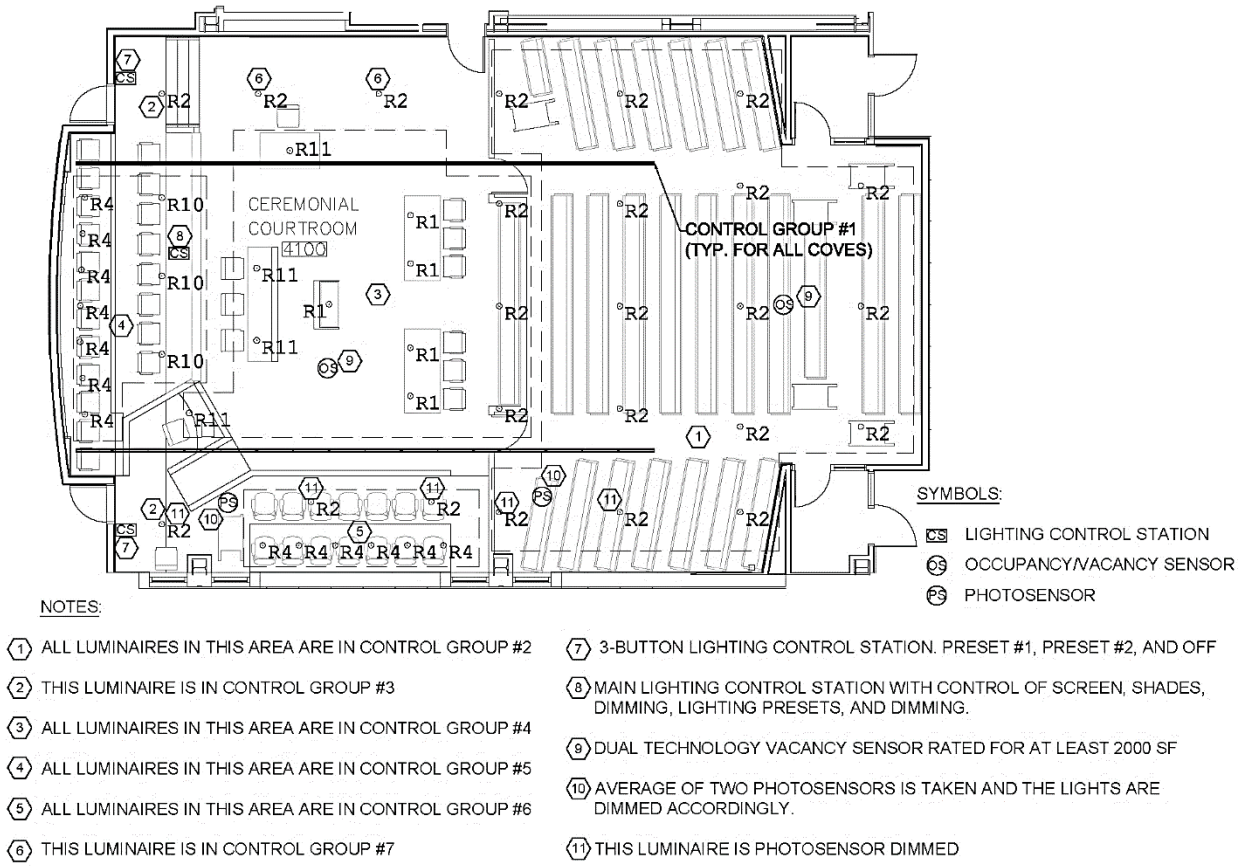


Figure 32 – Ceremonial Courtroom 4100 Lighting Control

The presets will be as follows:

Preset #1 (Entry): control group #1 at 100%

Preset #2 (General Proceedings): control group #1 – control group #7 at 100%

Preset #3 (Projection Screen Use): control group #1 – control group #6 and control group #8 at 100% and control group #7 at 25%

Preset #4 (No Jury): control group #1 – control group #5 and control group #7-control group #8 at 100%

Table 25 below gives the illuminance on the screen for two different presets. Preset #2 and preset #3. For preset #3 the average illuminance at the clerk is 383 Lux which is significantly below the target, but this scene should only be used in rare situations that demand the highest image quality.

Table 25 – Presentation Screen Illuminance Values

Location		Ev (lux)	Max:Avg	Notes
AV Presentation Screen	Target	50	2:01	Max value
	Design (normal)	66	1.6:1	
	Design (A/V mode)	40	1.2:1	

The luminaire drivers for this space have two different types of control. The drivers for the cove lights use Lutron Hi-Lume and the drivers for the recessed luminaires use Lutron Ecosystem. One option for a control system for this space is a Lutron GRAFIK Eye QS with EcoSystem. This system would be able to accommodate the seven lighting control zones and the two other zones (one for shades and one for the screen).

A Sivoia QS could be used for shade control and is capable of controlling up to ten shades from one control box. This room only has four shades so this box could provide control for another adjacent room as well.

Sensors

Occupancy/vacancy sensing could be handled by two ceiling mount LOS-CDT-2000-WH Dual tech which are rated for 2000 SF.

A daylight sensor that is compatible with the EcoSystem ballasts is the C-SR-M1-WH

A QS Contact closure interface QSE-IO could be used to interface the lighting control system with the projection screen.

User Controls

There are 3 user control stations located within this space. The main unit is located at the bench and two 3-button seeTouch QS keypads are located at the front doors. The main control allows for control of multiple lighting scenes as well as control of the window shades and projection screen. The 3-button control stations allow for preset #1 or preset #2 to be turned on and for all the lights to be turned off.

2. Part 2 – Electrical Depth

2.1 Introduction

The BCJC's electrical system utilizes a 3200 A unit substation that is fed by a 2000 KVA building transformer with a 34.5 KV primary and a 277/480 secondary. The building utilizes a dual voltage AC distribution system of 277/480 V and 120/208 V. A 1000 KW generator and a 100 KW UPS serve the emergency power distribution system. There are various low voltage systems throughout the building including audio visual, telecommunications, fire alarm, and an expansive security system. For this report the changes made in the lighting equipment were reflected in the electrical distribution system, a breaker coordination study was performed, a short circuit study was performed and finally research was performed into the feasibility of a DC distribution system.

2.2 Distribution System Analysis/Redesign

In order to accommodate the changes made in the Lighting Depth all of the circuits were updated to reflect the changes in the luminaire type, quantity, and layout for the four spaces that were redesigned. The conductors, conduit, circuit breakers, and panelboards were resized as required.

The changes in the lighting load for Lobby 1000 and Open Office 2520 did not have a significant impact on the panel loads because the amount of load from these two spaces is just a small fraction of the load that is on the entire panel.

The original design for Courtroom 4100 had all of the luminaires run through a single 84 circuit dimmer panel that served a total of six courtrooms. With the redesign dimming is handled by the luminaire ballasts so the dimming panel is no longer required. The total original lighting load for Ceremonial Courtroom 4100 is shown in Table 26 below and the lighting load for the redesigned system is shown in Table 27 below.

Table 26 - Original Lighting Loads for Ceremonial Courtroom 4100

DIMMING PANEL SCHEDULE		**DIM4**			
MAINS:	100A MCB	**SERVING :** FOURTH FLOOR		**AIC**: 25,000	
VOLTAGE	480/277	**MOUNTING:**	SURFACE		
CIRCUIT	AREA/ROOM	CIRCUIT BREAKER	VOLTAGE	REMARKS	LOAD (W)
26	JURY COURTROOM 4100	20/1	277	DIMMED	676
27	JURY COURTROOM 4100	20/1	277	DIMMED	232
28	JURY COURTROOM 4100	20/1	277	DIMMED	174
29	JURY COURTROOM 4100	20/1	277	DIMMED	232
30	JURY COURTROOM 4100	20/1	277	DIMMED	690
59	JURY COURTROOM 4100	20/1	277	DIMMED / EMERGENCY	840
60	JURY COURTROOM 4100	20/1	277	DIMMED / EMERGENCY	116
81	JURY COURTROOM 4100	20/1	277	DIMMED	58
82	JURY COURTROOM 4100	20/1	277	DIMMED	116
83	JURY COURTROOM 4100	20/1	277	DIMMED	29
84	JURY COURTROOM 4100	20/1	277	DIMMED	29
				Total:	**3192**

Table 27 – Revised Lighting Loads for Ceremonial Courtroom 4100

CIRCUIT	AREA	CIRCUIT BREAKER	VOLTAGE	REMARKS	LOAD (W)
1	Public Seating, Area of Proceedings (includes witness)	20/1	277	Normal Power	491.8
2	Jury and Judges	20/1	277	Normal Power	342.3
3	Cove	20/1	277	Emergency Power	1014.4
4	Screen, Stairs, and ramp	20/1	277	Normal Power	56.4
				Total:	**1904.9**

The revised load is about 2/3 of the original load. Assuming that each of the six courtrooms served by Dim 4 would have the same load as Ceremonial Courtroom 4100 (which is a conservative estimate because 4100 is much larger than most of the courtrooms) the total lighting load would be approximately 11,400 watts with approximately 6,000 watts of this load being emergency/backup lighting. 6000 watts gives a load of about 6 KVA. This is a very small load and requires a very small panelboard. However, to accommodate any future needs the new panel to replace DIM 4 could be a 30 circuit panelboard with a 50 amp main breaker.

2.3 Short Circuit Analysis

A short circuit analysis is an important step in electrical system design in order to make sure that equipment with an appropriate AIC rating is selected. The maximum current let through for each transformer in the building was calculated by assuming infinite current available at the primary. Table 28 below gives the specifications and calculations for transformers that are representative of all the transformers in the BCJC. The associated equations are also given.

Table 28 – Calculated Maximum Transformer Let Through Current

Designation	KVA	Primary Voltage	Secondary Voltage	Phase	Type	%Z*	Mounting	I_{FLA}	I_{SC}
T1	2000	34,500	480Y/277	3	Dry	5.75	Floor	7,217	125,511
T2	30	480	208Y/120	3	Dry	1.8	Hung	250	13,879
T4	45	480	208Y/120	3	Dry	1.8	Hung	375	20,818
T29	15	480	208Y/120	3	Dry	1.9	Hung	125	6,574
T31	75	480	208Y/120	3	Dry	1.7	Hung	625	36,738

*for T1 %Z was taken from Eaton pad mounted transformer typical design impedance for all others %Z was taken from Eaton Type EPT minimum impedance

Equation 1 – Maximum Secondary Full Load Amps

$$I_{FLA} = \frac{(kVA)(1000)}{(V_{LL})\sqrt{3}}$$

Equation 2 – Secondary Short Circuit Current

$$I_{SC} = (I_{FLA})\left(\frac{100}{\%Z}\right)$$

The maximum fault current available at each floor was calculated taking into account the let through of the main transformer (assuming infinite current from the utility) and the impedance from the main cable and busway. The calculations are based on the Bussmann Short Circuit Calculation Guide. Table 29 on the next page shows the details of each calculation. The associated equations are also given.

Table 29 – Calculated Available Fault Current for Each Busway at Each Floor

Location	Conductor Type	Length (Feet)	Table 5 C	$I_{3\emptyset}$	Conductors per phase	V_{LL}	f 3Ø	M	I_{SC}	Notes
Bus #1	3 Sets 300 KCMIL	125	18177	125,511	3	480	1.04	0.49	61,580	Approximate length of conductor from main panel to bus
Level 6	800A Bus	16	49300	61,580	1	480	0.07	0.93	57,438	Length of bus to electrical room based on floor to floor height
Level 5	800A Bus	32	49300	61,580	1	480	0.14	0.87	53,818	
Level 4	800A Bus	48	49300	61,580	1	480	0.22	0.82	50,627	
Level 3	800A Bus	64	49300	61,580	1	480	0.29	0.78	47,793	
Level 2	800A Bus	80	49300	61,580	1	480	0.36	0.73	45,260	
Level 1	800A Bus	96	49300	61,580	1	480	0.43	0.70	42,982	
Bus #2	3 Sets 300 KCMIL	30	18177	125,511	3	480	0.25	0.80	100,476	Approximate length of conductor from main panel to bus
Level 6	800A Bus	16	49300	100,476	1	480	0.12	0.89	89,898	Length of bus to electrical room based on floor to floor height
Level 5	800A Bus	32	49300	100,476	1	480	0.24	0.81	81,335	
Level 4	800A Bus	48	49300	100,476	1	480	0.35	0.74	74,262	
Level 3	800A Bus	64	49300	100,476	1	480	0.47	0.68	68,320	
Level 2	800A Bus	80	49300	100,476	1	480	0.59	0.63	63,259	
Level 1	800A Bus	96	49300	100,476	1	480	0.71	0.59	58,896	
Bus #3	3 Sets 300 KCMIL	35	18177	125,511	3	480	0.29	0.77	97,244	Approximate length of conductor from main panel to bus
Level 6	800A Bus	16	49300	97,244	1	480	0.11	0.90	87,301	Length of bus to electrical room based on floor to floor height
Level 5	800A Bus	32	49300	97,244	1	480	0.23	0.81	79,204	
Level 4	800A Bus	48	49300	97,244	1	480	0.34	0.75	72,481	
Level 3	800A Bus	64	49300	97,244	1	480	0.46	0.69	66,810	
Level 2	800A Bus	80	49300	97,244	1	480	0.57	0.64	61,962	
Level 1	800A Bus	96	49300	97,244	1	480	0.68	0.59	57,770	
Bus #4	3 Sets 300 KCMIL	55	18177	125,511	3	480	0.46	0.69	86,156	Approximate length of conductor from main panel to bus
Level 6	800A Bus	16	49300	86,156	1	480	0.10	0.91	78,259	Length of bus to electrical room based on floor to floor height
Level 5	800A Bus	32	49300	86,156	1	480	0.20	0.83	71,689	
Level 4	800A Bus	48	49300	86,156	1	480	0.30	0.77	66,137	
Level 3	800A Bus	64	49300	86,156	1	480	0.40	0.71	61,382	
Level 2	800A Bus	80	49300	86,156	1	480	0.50	0.66	57,266	
Level 1	800A Bus	96	49300	86,156	1	480	0.61	0.62	53,667	

Equation 3 – f Calculation for 3 Phase Faults

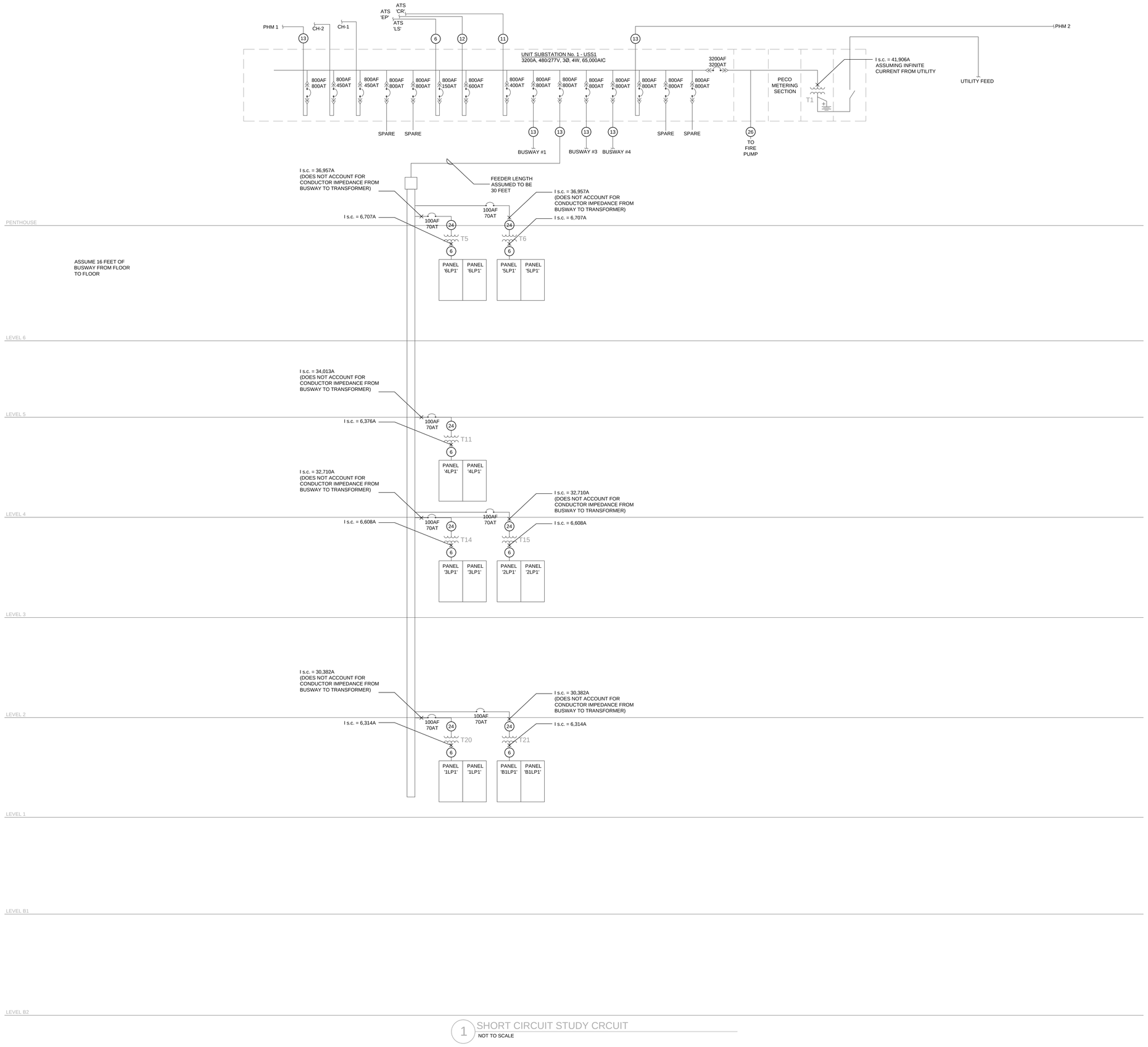
$$3\emptyset\ faults: f = \frac{\sqrt{3}(L)(I_{3\emptyset})}{(C)(n)(V_{LL})}$$

Equation 4 – M Calculation

$$M = \frac{1}{1+f}$$

A single circuit was selected to calculate the available fault current available at each panelboard. The results of this calculation are shown on the next page.

An AIC rating of 10,000 is sufficient for all of the sub panels, but the sub transformers and breakers that protect them need AIC ratings of up to 40,000.



1 SHORT CIRCUIT STUDY CRCUIT

NOT TO SCALE

2.4 DC Distribution

Throughout my time at Penn State I have heard it mentioned several times by several different sources that there is significant potential for increasing electrical efficiency by utilizing a DC distribution system for equipment that can utilize DC power. This equipment includes motors, servers, UPS systems, and LED lighting. The increase in efficiency would come from reducing the use of inverters ad rectifiers. I felt that this would be an excellent topic for the electrical depth of my thesis. My initial research into this topic found reports that claimed a significant savings potential of nearly 25%. If these claims were true it seemed that surely the industry would quickly adopt this new method of electrical distribution, but there seems to be no large scale adoption of this method. Upon further research I found a report[1] that compared the results of several of the previous studies and discussed the errors in the methodology of the studies and misconceptions of the data in the reports that were spread by mainstream media. The main misconception comes from the reports comparing the efficiency of a new DC distribution system to the efficiency of existing AC systems that were installed around the 1980's. This is a fair comparison if this is what is actually going to occur, but is pretty much useless when designing a system for a new building using new equipment because it neglects the fact that the efficiency of AC distribution systems and equipment has greatly improved over the last 30 years. The largest discrepancy between the reports was in the efficiency of the UPS. The reports that claimed the highest increase in efficiency by utilizing DC distribution used 10% loss for AC based UPS systems. These values were accurate for the equipment they used, but they used equipment that was a couple of generations old or that operated at a lower voltage. Currently there are currently UPS systems available that operate in bypass mode when power quality is acceptable. This leads to an efficiency of about 98.6%. Another area where there was a large discrepancy was in the area of transformer efficiency. The reports with large efficiency improvements for DC systems also utilized low efficiency transformers for the AC distribution systems.

In conclusion, DC distribution and AC distribution systems have very similar efficiencies; there is not an appreciable difference between the two. In general, it is not practical to use a DC distribution system due to the utility providing AC and the prevalence of AC loads in the building. However, one area where DC distribution could yield savings is for situations where there is onsite DC generation like photovoltaic or wind. In these cases the DC generated by the sources could be distributed directly to DC loads and thus avoiding any inverter or rectifier losses.

(Rasmussen, 2012)[1]

3. Part 3 – Acoustical Breadth/MAE Depth

3.1 Introduction

Speech intelligibility is an important part of court proceedings and Ceremonial Courtroom 4100 is of a size where conditions that are unfavorable for speech intelligibility could easily exist. The large size of this space also makes the application of a sound reinforcement system potentially very beneficial to speech intelligibility. The original design for Ceremonial Courtroom 4100 includes acoustical treatment and a sound reinforcement system. The influence of these systems on speech intelligibility was evaluated through a reverberation time (RT) analysis and a sound distribution analysis.

3.2 Acoustical Breadth: Reverberation Time (RT) Analysis

3.2.1 Introduction

For the acoustical breadth, an analysis was performed of the RT of the space. This analysis involved deciding what range of RT is acceptable for a courtroom, modeling the space as currently designed (including geometry and materials), calculating the RT of the space, and making recommendations to bring the RT into closer agreement with the criteria that were developed.

3.2.2 Original Design

The original design included acoustical panel ceiling for almost the entire ceiling, large sections of seamless acoustical system, and large sections of fabric wrapped acoustical panels. A “worst case scenario” was assumed for the RT calculation by assuming that there would be no jury, only one judge, and only 10% of the public seating area occupied. See the next page for the details of the RT calculation for the original design. The resulting RT’s for the 125 Hz to 4000 Hz octave bands are shown in Figure 6Figure 33 below.

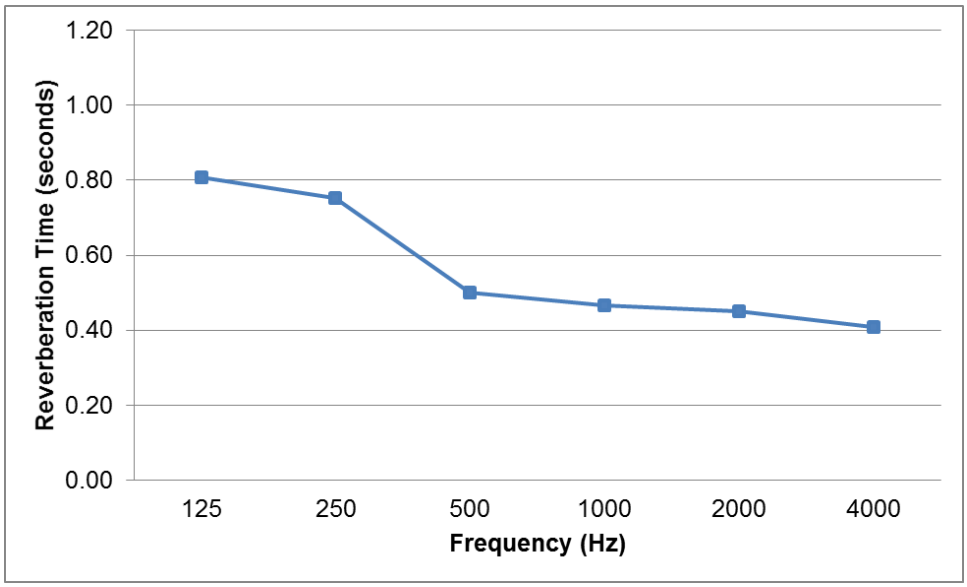


Figure 33 – Ceremonial Courtroom 4100 Original Design RT

Original Reverberation Time Calculations
(English Units)

Volume: (ft^3) V = 31,394

Total Surface Area: (ft^2) S_{tot}= 8,062

Floor Area (ft^2)	2,854.0
Avg. Height (ft)	11.0

Surface Description	Surface Area, S (ft^2)	Material/ Partition Type	Material Description	Sound Absorption Coefficient, α Frequency (Hz)						S*α (sabins) Frequency (Hz)					
				125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
North Wall															
Door	48		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	12	7	5	4	4	4
Fabric Panel 1 Non-acoustical	127	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	6	3	4	4	8	5
Fabric Panel 1 Acoustical	76	FP-1	Fabric Wrapped FG Panel, 1'', over 400mm air space (Decoustics Tests)	0.67	0.97	0.76	0.99	0.99	0.99	51	74	58	76	76	76
Gypsum	201	G4C	Gypsum board, 2 layers 5/8'' on studs 16''oc w/batt (Egan)	0.28	0.12	0.10	0.07	0.13	0.09	56	24	20	14	26	18
Wood Paneling	128	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	13	14	13	10	10	14
Glass	28		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	10	7	5	3	2	1
West Wall															
Stone	209	ST-1	Marble or glazed tile (Mehta Pg. 407)	0.01	0.01	0.01	0.01	0.02	0.02	2	2	2	2	4	4
Doors	48		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	12	7	5	4	4	4
Wood Paneling	144	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	14	16	14	12	12	16
East Wall															
Seamless Acoustical Finish	131	SAF	BASWA acoustic BASWAphon 30mm Classic Fine Finish (BASWA Data Sheet)	0.32	0.34	0.86	0.98	0.89	0.72	42	45	113	128	117	94
Wood Paneling	157	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	16	17	16	13	13	17
Fabric Panel 1 Acoustical	120	FP-1	Fabric Wrapped FG Panel, 1'', over 400mm air space (Decoustics Tests)	0.67	0.97	0.76	0.99	0.99	0.99	80	116	91	119	119	119
Glazing	54	GL-12	Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	19	13	10	6	4	2
Gypsum	10	N4DY	Two 5/8'' gyp. Bd. On each side of 3-5/8'' studs + Fiberglass (Mehta pg. 407)	0.10	0.07	0.05	0.05	0.04	0.04	1	1	1	1	0	0
South Wall															
Window	112		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	39	28	20	13	8	4
Fabric Panel 1 Non-acoustical	127	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	6	3	4	4	8	5
Fabric Panel 1 Acoustical	76	FP-1	Fabric Wrapped FG Panel, 1'', over 400mm air space (Decoustics Tests)	0.67	0.97	0.76	0.99	0.99	0.99	51	74	58	76	76	76
Glass	28		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	10	7	5	3	2	1
Gypsum	204	GYP-1	Gypsum board, 2 layers 5/8'' on studs 16''oc w/batt (Egan)	0.28	0.12	0.10	0.07	0.13	0.09	57	24	20	14	27	18
Wood Paneling	130	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	13	14	13	10	10	14
Door	24		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	6	4	2	2	2	2
Floor															
Public Seating (occupied)	105		Pews, wood occupied (Mehta Pg. 408)	0.57	0.61	0.75	0.86	0.91	0.86	60	64	79	90	96	90
Public Seating (unoccupied)	945		Unoccupied pews, wood (Mehta Pg. 408)	0.10	0.10	0.09	0.08	0.08	0.08	95	95	85	76	76	76
Circulation	300		Carpet glued to floor (Mehta Pg. 407)	0.02	0.03	0.06	0.10	0.26	0.47	6	9	18	30	78	141
Jury (Unoccupied)	128		Unoccupied medium upholstered seats (Mehta Pg. 408)	0.56	0.64	0.70	0.72	0.68	0.62	72	82	90	92	87	79
Judges (Unoccupied)	246		Unoccupied medium upholstered seats (Mehta Pg. 408)	0.56	0.64	0.70	0.72	0.68	0.62	138	157	172	177	167	153
Area of Proceedings	1,130		Carpet glued to floor (Mehta Pg. 407)	0.02	0.03	0.06	0.10	0.26	0.47	23	34	68	113	294	531
Ceilling															
Acoustical Panel Ceiling	844	APC-4	Armstrong Ultima (Armstrong Data Sheet)	0.32	0.34	0.76	0.87	0.86	0.84	270	287	641	734	726	709
Acoustical Panel Ceiling	1,208	APC-7	Armstrong Dune Second Look (Armstrong Data Sheet)	0.34	0.39	0.71	0.66	0.52	0.40	411	471	858	798	628	483
Gypsum Ceiling	973	GYP-1	1/2'' gyp. Bd. Ceiling (Mehta Pg. 407)	0.11	0.11	0.05	0.06	0.04	0.05	107	107	49	58	39	49
									∑Sα	1,698	1,807	2,538	2,687	2,720	2,807
									Avg. α	0.21	0.22	0.31	0.33	0.34	0.35
									Air absorption constant for 20 °C and 40% RH, m (ft^{-1})	0	0	1.83E-04	3.26E-04	7.86E-04	2.56E-03
									Sabine Reverb Time: (s) RT =	0.91	0.85	0.60	0.56	0.55	0.49
									Norris-Eyring Reverb Time: (s) RT =	0.81	0.75	0.50	0.46	0.45	0.41
									Calculated RT (s)	0.81	0.75	0.50	0.46	0.45	0.41
									Target RT (s)	0.98	0.86	0.75	0.75	0.75	0.75

$$\bar{\alpha} = \frac{\sum_{i=1}^{n} S\alpha}{S_{tot}}$$

$\bar{\alpha} < 0.2$ $$RT_{Sabine} = \frac{0.049V}{S_{tot}\bar{\alpha} + 4mV}$$

$\bar{\alpha} \geq 0.2$ $$RT_{Norris-Eyring} = \frac{0.049V}{-S_{tot}\ln(1-\bar{\alpha}) + 4mV}$$

3.2.3 Design Criteria

A target reverberation time was set based on the volume of Ceremonial Courtroom 4100 and the type of activity that was expected to occur in it. The volume was calculated to be approximately 31,000 cubic feet and the anticipated activity is speech. Based on this information the target RT for the 500 Hz octave band was found by using Figure 17.10 from an architectural acoustics text book[2]. See Figure 34 below. To determine the RT targets for the other octave bands the recommendations in another architectural acoustics text book[3] were used; increasing the RT at 125 Hz by 30% and the RT at 250 Hz by 15%. See Table 30 below for the target RT's.

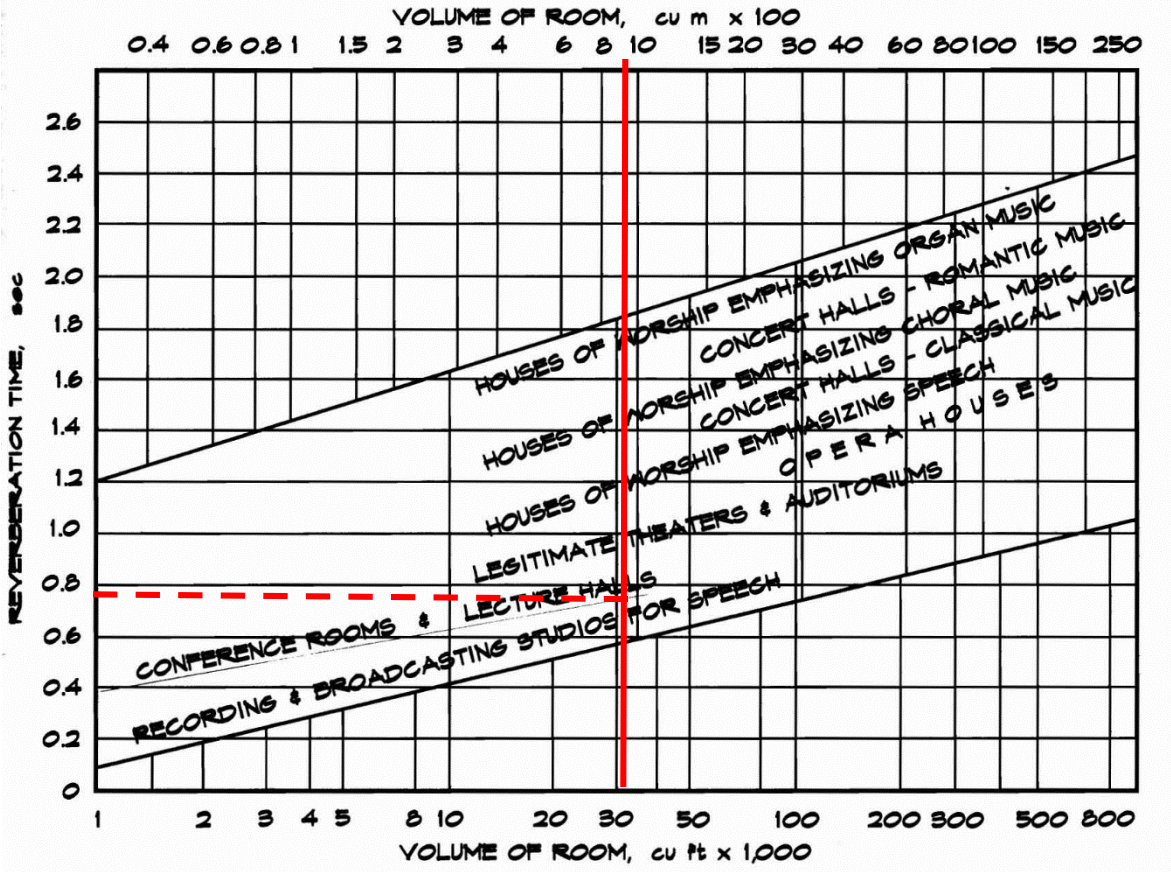


Figure 34 – Figure 17.10 With Annotations to Find the Target RT for Ceremonial Courtroom 4100

Table 30 – Target RT for Ceremonial Courtroom 4100

	Frequency (Hz)					
	125	**250**	**500**	**1000**	**2000**	**4000**
Target RT (s)	0.98	0.86	0.75	0.75	0.75	0.75

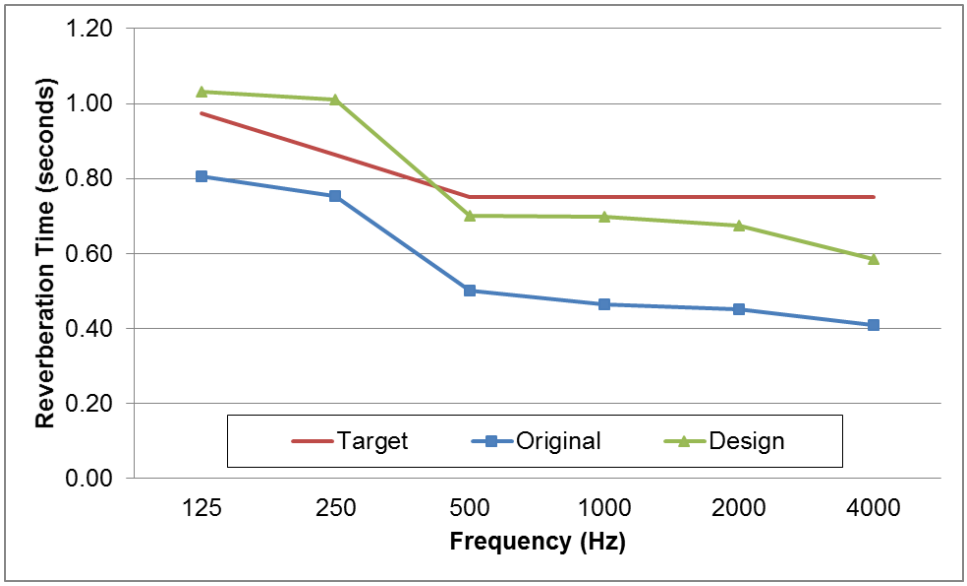
[2] (Long, 2014)

[3] (Mehta, Johnson, & Rocafort, 1999)

3.2.4 Final Design

The original RT was significantly lower than the target RT for all octave bands and particularly for the high frequencies. This was with the assumption that the public seating area was only at 10% occupancy. A higher occupancy would further reduce the RT time. In order to bring the RT into closer alignment with the target RT many modifications were made to the finish materials of the room including changing large sections of the acoustical panel ceiling to gypsum, changing fabric wrapped acoustical panels to fabric wrapped non-acoustical panels, and removing all of the seamless acoustical treatment. See Appendix B – Supporting Material for Acoustical Breadth for elevations detailing the locations of materials that were changed. The detailed calculations for the new design are given on the next page. Figure 35 below compares the target, original, and design RT's. The design RT is much closer to the target, but is still low at the 4000 Hz octave band and is a bit high at the 250 Hz band. The curve could be brought into closer alignment if specialized materials were used. However, this addition would add considerable cost and complexity to the project with only minimal benefit.

Figure 35 – Target, Original, and Design RT for Ceremonial Courtroom 4100



Final Reverberation Time Calculations
(English Units)

Volume: (ft^3) V = 31,394

Total Surface Area: (ft^2) S_{tot}= 8,053

Floor Area (ft^2)	2,854.0
Avg. Height (ft)	11.0

Surface Description	Surface Area, S (ft^2)	Material/ Partition Type	Material Description	Sound Absorption Coefficient, α Frequency (Hz)						S*α (sabins) Frequency (Hz)					
				125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
North Wall															
Door	48		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	12	7	5	4	4	4
Fabric Panel 1 Non-acoustical	70	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	4	1	2	2	4	3
Fabric Panel 1 Acoustical	43	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	2	1	1	1	3	2
Gypsum	291	G4C	Gypsum board, 2 layers 5/8" on studs 16"oc w/batt (Egan)	0.28	0.12	0.10	0.07	0.13	0.09	81	35	29	20	38	26
Wood Paneling	128	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	13	14	13	10	10	14
Glass	28		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	10	7	5	3	2	1
West Wall															
Stone	209	ST-1	Marble or glazed tile (Mehta Pg. 407)	0.01	0.01	0.01	0.01	0.02	0.02	2	2	2	2	4	4
Doors	48		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	12	7	5	4	4	4
Wood Paneling	144	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	14	16	14	12	12	16
East Wall															
Gypsum	131	N4DY	Two 5/8" gyp. Bd. On each side of 3-5/8" studs + Fiberglass (Mehta pg. 407)	0.10	0.07	0.05	0.05	0.04	0.04	13	9	7	7	5	5
Wood Paneling	157	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	16	17	16	13	13	17
Fabric Panel 1 Acoustical	120	FP-1	Fabric Wrapped FG Panel, 1", over 400mm air space (Decoustics Tests)	0.67	0.97	0.76	0.99	0.99	0.99	80	116	91	119	119	119
Glazing	54	GL-12	Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	19	13	10	6	4	2
Gypsum	10	N4DY	Two 5/8" gyp. Bd. On each side of 3-5/8" studs + Fiberglass (Mehta pg. 407)	0.10	0.07	0.05	0.05	0.04	0.04	1	1	1	1	0	0
South Wall															
Window	112		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	39	28	20	13	8	4
Fabric Panel 1 Non-acoustical	96	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	5	2	3	3	6	4
Fabric Panel 1 Acoustical	34	FP-1	StretchWall Prefabricated MagniRoc (StretchWall Data Sheet)	0.05	0.02	0.03	0.03	0.06	0.04	2	1	1	1	2	1
Glass	28		Glass Window (Mehta Pg. 408)	0.35	0.25	0.18	0.12	0.07	0.04	10	7	5	3	2	1
Gypsum	268	GYP-1	Gypsum board, 2 layers 5/8" on studs 16"oc w/batt (Egan)	0.28	0.12	0.10	0.07	0.13	0.09	75	32	27	19	35	24
Wood Paneling	130	WD-1	Wood (pine) sheathing (Mehta Pg. 407)	0.10	0.11	0.10	0.08	0.08	0.11	13	14	13	10	10	14
Door	24		Fenestration 700: 701: 44mm flush door (Absorption Data - University of Hartford)	0.25	0.15	0.10	0.08	0.08	0.08	6	4	2	2	2	2
Floor															
Public Seating (occupied)	105		Pews, wood occupied (Mehta Pg. 408)	0.57	0.61	0.75	0.86	0.91	0.86	60	64	79	90	96	90
Public Seating (unoccupied)	945		Unoccupied pews, wood (Mehta Pg. 408)	0.10	0.10	0.09	0.08	0.08	0.08	95	95	85	76	76	76
Circulation	300	CP-1	Carpet glued to floor (Mehta Pg. 407)	0.02	0.03	0.06	0.10	0.26	0.47	6	9	18	30	78	141
Jury (Unoccupied)	128		Unoccupied medium upholstered seats (Mehta Pg. 408)	0.56	0.64	0.70	0.72	0.68	0.62	72	82	90	92	87	79
Judges (Unoccupied)	246		Unoccupied medium upholstered seats (Mehta Pg. 408)	0.56	0.64	0.70	0.72	0.68	0.62	138	157	172	177	167	153
Area of Proceedings	1,130	CP-1	Carpet glued to floor (Mehta Pg. 407)	0.02	0.03	0.06	0.10	0.26	0.47	23	34	68	113	294	531
Ceilling															
Gypsum Ceiling	580	GYP-1	1/2" gyp. Bd. Ceiling (Mehta Pg. 407)	0.11	0.11	0.05	0.06	0.04	0.05	64	64	29	35	23	29
Acoustical Panel Ceiling	264	APC-7	Armstrong Dune Second Look (Armstrong Data Sheet)	0.34	0.39	0.71	0.66	0.52	0.40	90	103	187	174	137	106
Acoustical Panel Ceiling**	1,208	APC-7	Armstrong Dune Second Look (Armstrong Data Sheet)	0.34	0.39	0.71	0.66	0.52	0.40	411	471	858	798	628	483
Gypsum Ceiling	973	GYP-1	1/2" gyp. Bd. Ceiling (Mehta Pg. 407)	0.11	0.11	0.05	0.06	0.04	0.05	107	107	49	58	39	49
									∑Sα	1,493	1,521	1,906	1,899	1,911	2,005
									Avg. α	0.19	0.19	0.24	0.24	0.24	0.25
									Air absorption constant for 20 °C and 40% RH, m (ft^{-1})	0	0	1.83E-04	3.26E-04	7.86E-04	2.56E-03
									Sabine Reverb Time: (s) RT =	1.03	1.01	0.80	0.79	0.77	0.66
									Norris-Eyring Reverb Time: (s) RT =	0.93	0.91	0.70	0.70	0.67	0.59
									Calculated RT (s)	1.03	1.01	0.70	0.70	0.67	0.59
									Target RT (s)	0.98	0.86	0.75	0.75	0.75	0.75

$$\bar{\alpha} = \frac{\sum_{i=1}^{n} S\alpha}{S_{tot}}$$

$\bar{\alpha} < 0.2$ $\quad RT_{Sabine} = \frac{0.049V}{S_{tot}\bar{\alpha} + 4mV}$

$\bar{\alpha} \geq 0.2$ $\quad RT_{Norris-Eyring} = \frac{0.049V}{-S_{tot}\ln(1-\bar{\alpha}) + 4mV}$

*Replace BASWAphon with gypsum
**Replace APC-7 with APC-4

3.3 Acoustical MAE Depth: Sound Reinforcement System Analysis

3.3.1 Introduction

The design for Ceremonial Courtroom 4100 has a distributed audio amplification system. The influence that this system has on speech intelligibility and distribution was studied using EASE. This study involved creating a geometric model of the space, assigning material properties, selecting appropriate files for the sources, and receivers, and running simulations. The metrics selected to measure system performance were sound pressure level (SPL) and speech transmission index (STI). Auralizations were created to simulate what would be heard from two different locations in the audience when the sound reinforcement system was and was not in use.

3.3.2 Model

Figure 36 below shows the layout for the model. There are 21 recessed ceiling mounted speakers. For this analysis, 6 audience areas were used: Audience 1, Audience 2, and Audience 3 comprise the public seating area, Jury is the jury box, and Judge 1 and Judge 2 make up the judge's box. Two seat locations were used for auralizations one at the front right and one at the back center of the audience area. Figure 37 below is a 3D perspective of the space.

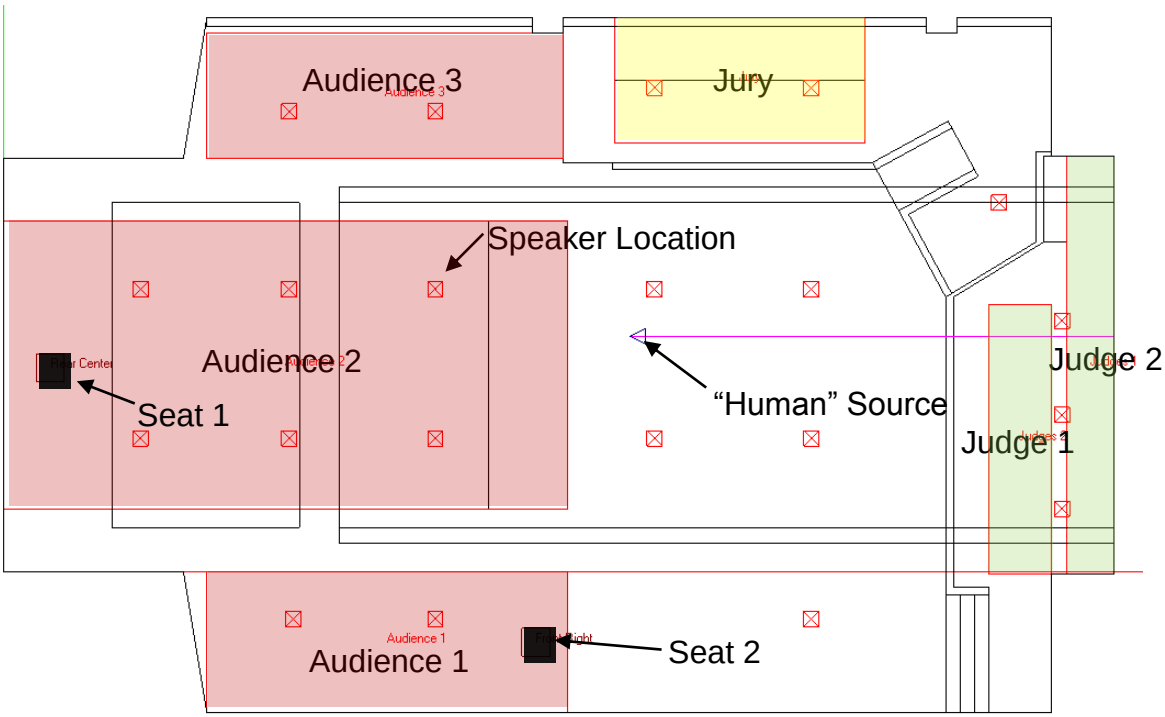


Figure 36 – Ceremonial Courtroom 4100 Plan

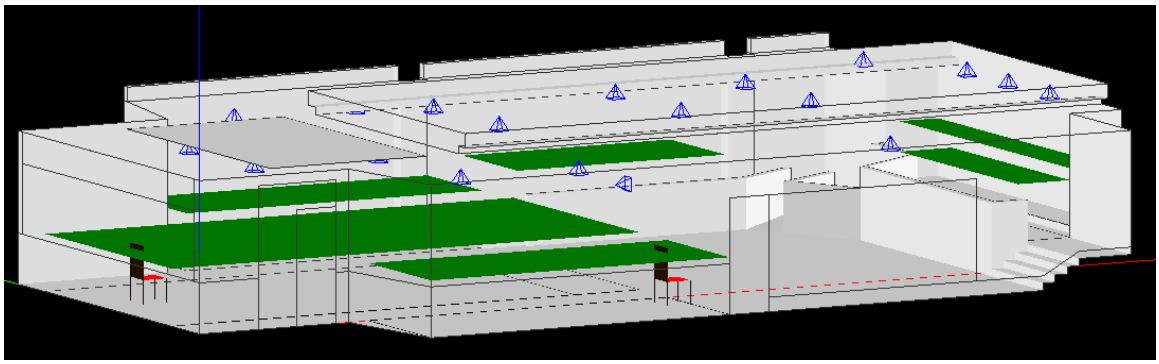


Figure 37 – Ceremonial Courtroom 4100 Perspective

3.3.3 Results

Figure 38 below shows the SPL distribution without sound reinforcement and Figure 39 below shows the SPL distribution with sound reinforcement. The sound distribution with the sound reinforcement system is at a higher level and is much more consistent than the unamplified speech distribution. This would help to improve speech intelligibility.

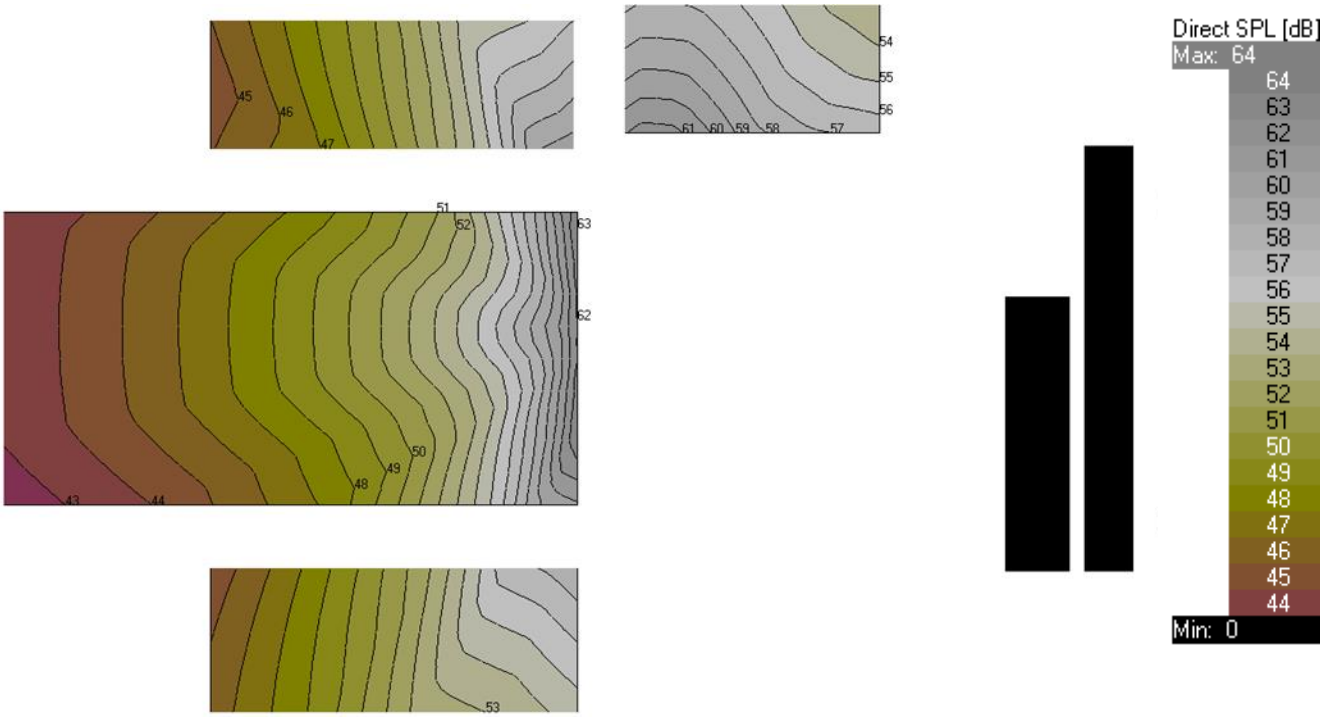


Figure 38 – Direct SPL Without Sound Reinforcement

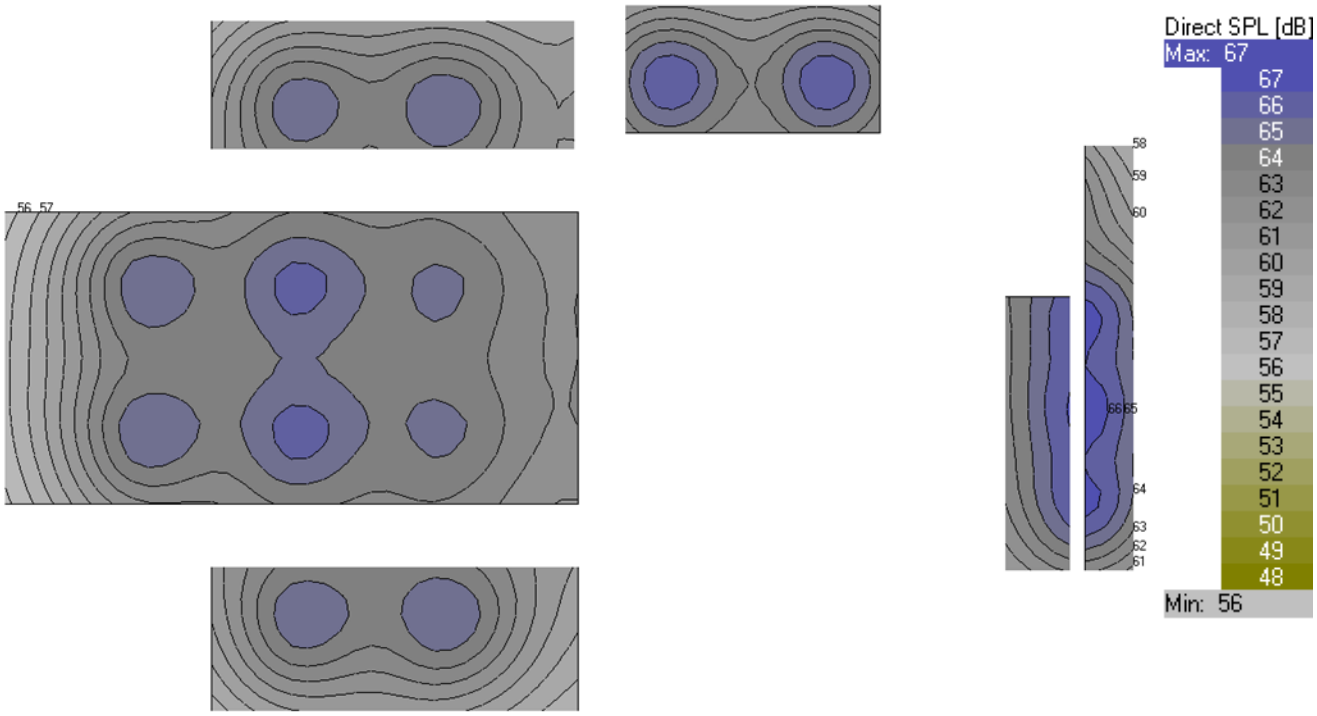


Figure 39 – Direct SPL With Audio Reinforcement

Figure 40 below shows the STI map without sound reinforcement and Figure 41 below shows the STI map with sound reinforcement. The STI with sound reinforcement is much higher and more consistent especially in the public seating areas than that of the unreinforced system.

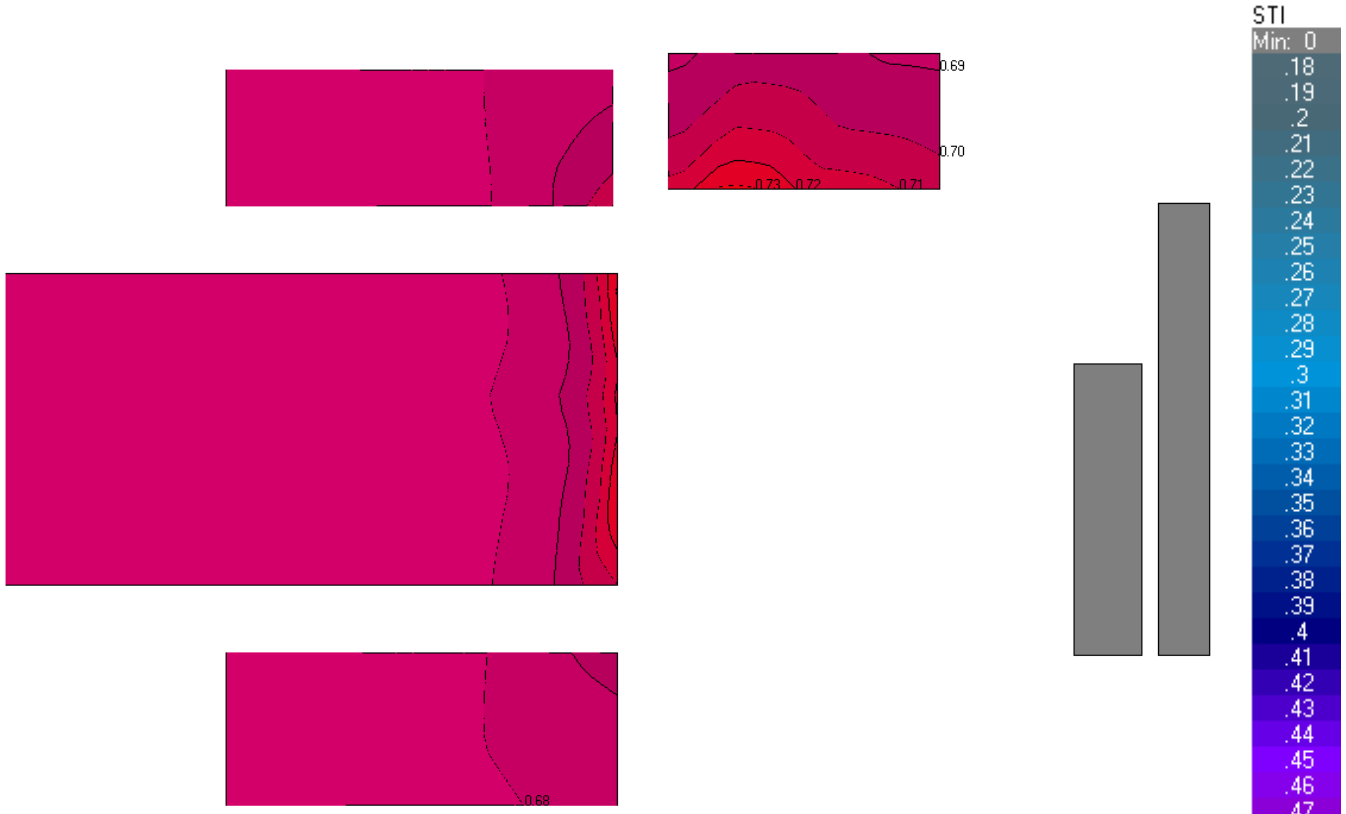


Figure 40 – STI Without Sound Reinforcement

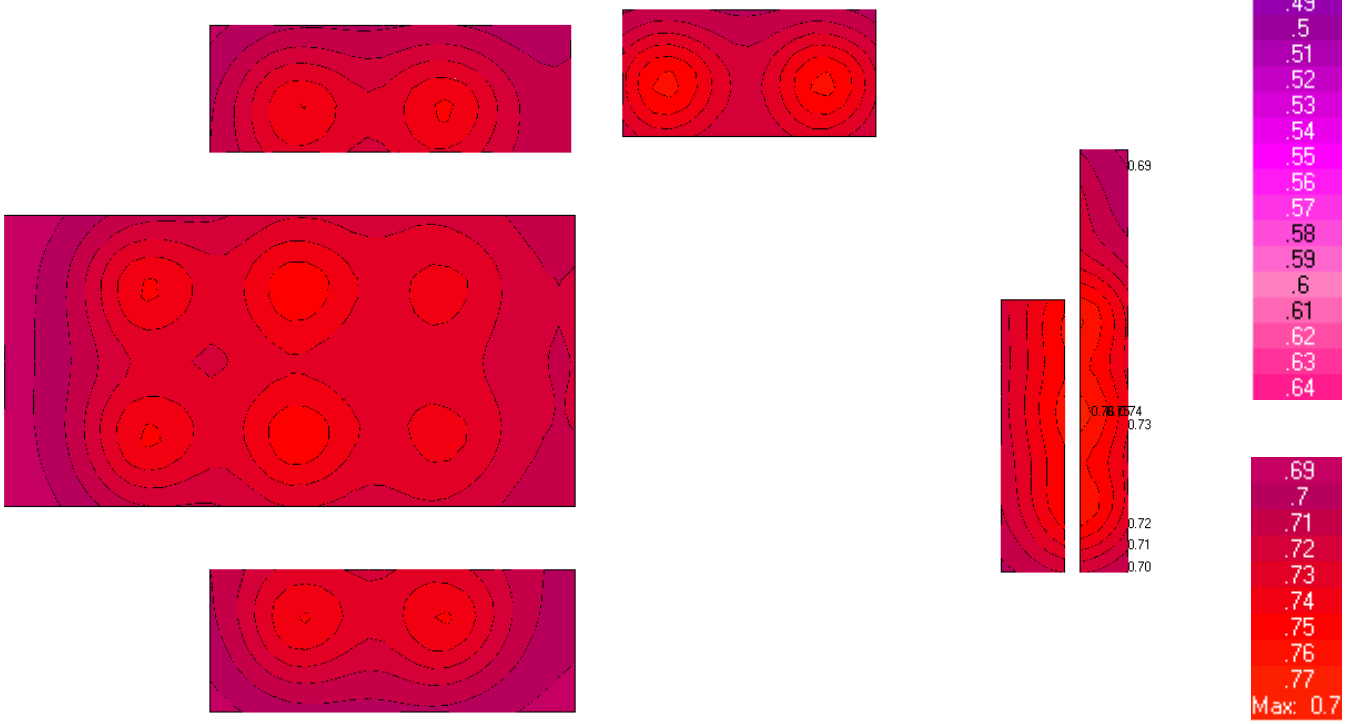


Figure 41 – STI With Sound Reinforcement

A background noise level (BNL) of 30 dB was used in the STI calculations.
The speaker used in the simulations was an Atlas FAP62T at an output level that was about 20dB below its output at 1W. For the simulation of unreinforced speech the “Man Loud” file provided in EASE was used at an unadjusted level.

Four auralizations were created to demonstrate how the room would sound with and without the sound reinforcement system. These auralizations were created by convolving the impulse response generated by the Aura module of EASE. The auralizations are described in Table 31 below and can be found at Y:\Lange_Thesis\Report_Files\Auralizations.

Table 31 - Auralizations

Source:	Receiver Locations	
Lawyer	Seat 1	Seat 2
Sound Reinforcement System	Seat 1	Seat 2

3.3.4 Conclusion

The analysis demonstrated that the sound reinforcement system greatly increased the level and uniformity of SPL throughout the listener areas. The analysis also showed a large improvement in STI for the listener areas when the sound reinforcement system was used. However, a value of 0.7 is considered a ‘good’ STI, but even with the sound reinforcement system the max STI is only 0.7. Further still, this value is achieved only directly below the speakers and for listeners further from the speaker STI is significantly lower. The STI could be improved by selecting a speaker with a wider distribution pattern.

4. Part 4 – Mechanical Breadth: Combined Heat and Power (CHP) Analysis

4.1 Introduction

A CHP system has the potential to greatly improve the primary energy efficiency of a building, reduce energy costs, and significantly reduce emissions associated with generation. An analysis was performed to evaluate the suitability of the BCJC for a CHP system. There was limited project specific data available so many design decisions were made based on existing data from similar projects and average values from similar buildings. The analysis included finding appropriate thermal and electric demands for the BCJC, checking the suitability of the loads for CHP, and calculating the simple payback period of a CHP system.

4.2 Analysis

The heating and cooling loads were extracted from a Trane Trace model. The model provided average hourly loads for Saturday, Sunday, Monday, and the average weekday for each month. The monthly loads were calculated by assuming there are 4.345 of each day per month. See Equation 5 below.

Equation 5 – Heating and Cooling Loads

$$Total\ monthly\ load = 4.345(Saturday + Sunday + Monday + 4 \times Average\ Weekday)$$

The electric demand was calculated based on data from the United States Energy Information Administration (EIA). EIA provided system separated annual electric use data for 25 office buildings that are in the Mid-Atlantic region, were constructed from 1990-1999, are between 200,001 and 500,000 SF, and use non-electric heat. The total annual electric usage for each subsystem was reported in mBTU. This consumption was averaged over the entire year and converted to watts and used to find the average electric demand per square foot. The average electric demand for the 25 buildings was found to be 2.41W/SF. By using the electric cooling subsystem data from EIA the average percentage of electricity used for cooling was found to be 11%. See Table 32 below for the electric demand data used in the analysis.

Table 32 – Annual Electric Use

Annual Electric Usage					
Annual Avg. (W/SF)	**Hours per year**	**Building Area (SF)**	**Total Usage (KWh)**	**Cooling (KWh)**	**Other (KWh)**
2.41	8,760	275,000	5,805,690	638,626	5,167,064

The electric used for cooling was distributed by month proportionally to the cooling loads for that month. The remaining electric use was distributed evenly across the months. See Table 33 below.

Table 33 – Monthly Loads

Month	Thermal Load (MMBTU)	Cooling Load (Tons)	Percentage of Cooling	Electric (KWh)
Jan	2,966	0	0%	430,589
Feb	2,936	0	0%	430,589
Mar	2,656	124	0%	430,753
Apr	2,396	5,758	1%	438,202
May	1,907	52,884	11%	500,513
Jun	1,568	92,296	19%	552,624
Jul	1,224	137,726	29%	612,692
Aug	1,573	121,058	25%	590,653
Sep	1,856	56,014	12%	504,651
Oct	2,288	12,761	3%	447,461
Nov	2,488	4,375	1%	436,374
Dec	2,758	0	0%	430,589
Total	**26,615**	**482,996**		**5,805,690**

The base electric load was found by taking the average electric use for the winter (December, January, and February) and the base thermal load was found by taking the average thermal demand for the summer months (June, July, and August). See Table 34 below.

Table 34 – Summer and Winter Average Demand and Seasonal Based Loads

Summer Average (June, July, August)	
Thermal (MMBTU/hr)	1.99
Electric (KW)	802

Winter Average (December, January, February)	
Electric (KW)	590
Thermal (MMBTU/hr)	3.95

Average Weather Demand	
Cooling Electric (KW)	212
Heating Thermal (MMBTU/hr)	1.96

A typical boiler efficiency of 80% was assumed for the calculations.

The 2013 average electric and natural gas costs for commercial customers in Pennsylvania were used to calculate spark spread and simple payback see Table 35 on the next page for fuel costs.

Table 35 – 2013 Average Fuel Costs

Fuel Cost	
Gas $/1000CF	10.15
Gas $/MMBTU	9.90
Electric $/KWh	0.11
Electric $/MMBTU	31.88

The difference between the cost of one MMBTU of electricity and one MMBTU of gas (known as spark spread) was calculated to be 21.98. The ratio of annual thermal energy demand to annual electric energy demand for the site (known as $\lambda_{D)}$ was calculated to be 1.34. Figure 42 and Table 36 on the next page show the monthly thermal and electric demand of the site as well as the monthly $\lambda_{D.}$

The United States Department of Energy (DOE) CHP Qualification Tool was used to calculate the simple payback period for an appropriately sized CHP system. The result of this calculation was 16.3 years. Which is significantly longer than most clients are willing to accept.

Figure 42 – Average Monthly Thermal and Electric Demand and Lambda D

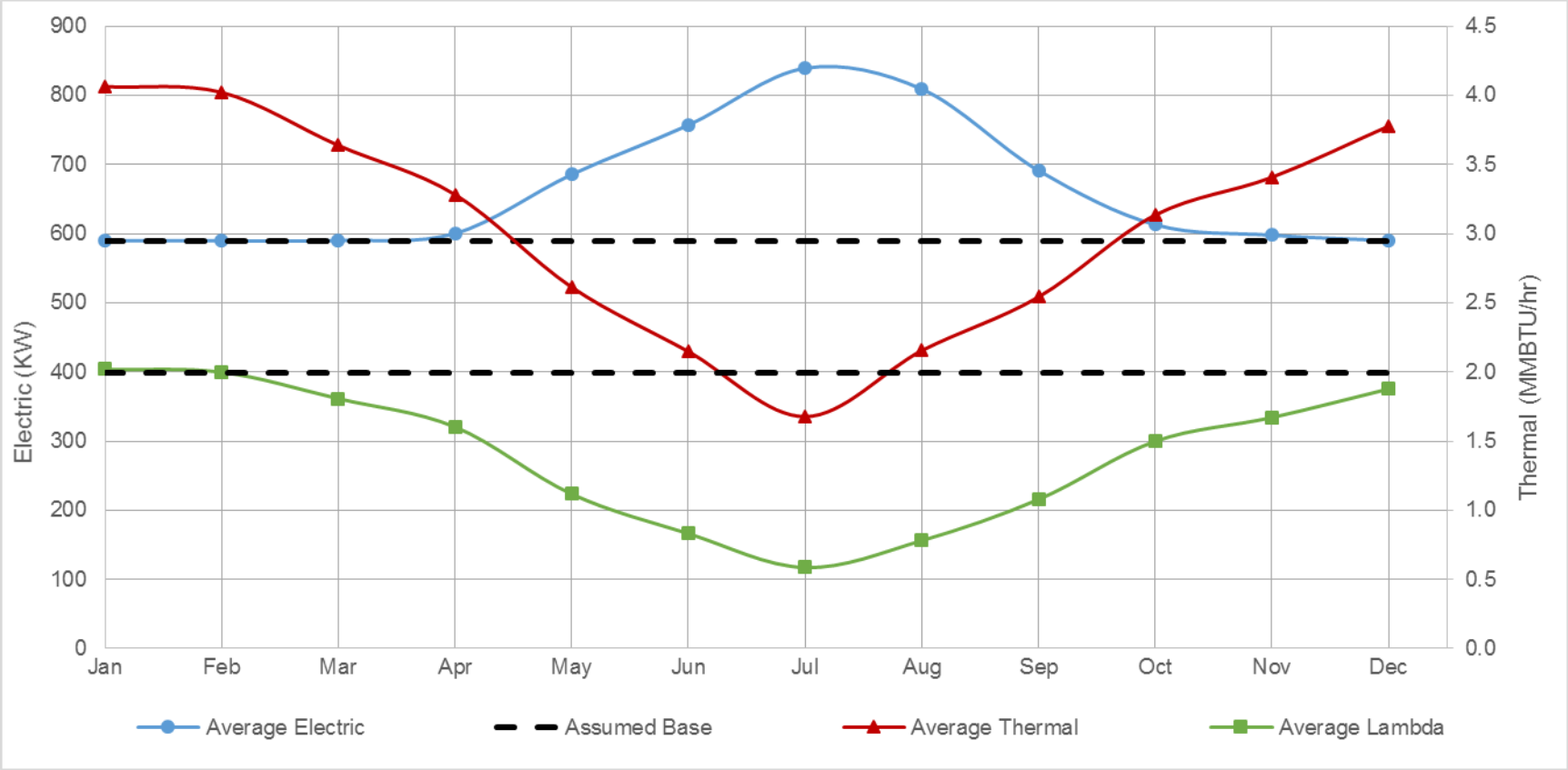


Table 36 –Thermal and Electric Demand and Lambda D

Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
Heating Load	2,966	2,936	2,656	2,396	1,907	1,568	1,224	1,573	1,856	2,288	2,488	2,758	**26,615**
Monthly Electric	430,589	430,589	430,753	438,202	500,513	552,624	612,692	590,653	504,651	447,461	436,374	430,589	**5,805,690**
Days per month (Days)	30	30	30	30	30	30	30	30	30	30	30	30	**365**
Monthly Hourly average electric demand (KW)	589.85	589.85	590.07	600.28	685.64	757.02	839.31	809.12	691.30	612.96	597.77	589.85	**7,953**
Monthly Hourly average thermal demand (MMBTU/hr)	4.06	4.02	3.64	3.28	2.61	2.15	1.68	2.15	2.54	3.13	3.41	3.78	**36**
Monthly Hourly average λD	2.02	2.00	1.81	1.60	1.12	0.83	0.59	0.78	1.08	1.50	1.67	1.88	**0**
Electrical 'baseload' (KW)	590	590	590	590	590	590	590	590	590	590	590	590	**7,078**
Thermal 'baseload' (MMBTU/hr)	2	2	2	2	2	2	2	2	2	2	2	2	**24**

4.3 Conclusion

Despite the relatively high spark spread, which should have resulted in a short payback period, the payback period of a CHP system for this project was found to be 16.3 years. This is well beyond the range that most owners consider acceptable for an energy saving investment. A CHP system is not appropriate for this project due to the very low λ_D which is a result of there not being any system that requires thermal energy other than the heating system. If the site had a higher thermal demand then a larger system could be selected which would mean that the savings from a reduction in purchasing electric rom he utility company would be greater and thus there would be a shorter payback period.

Summary and Conclusion

The lighting depth of this report detailed the lighting redesign for four unique spaces in the BCJC. The goal of the designs was to meet the criteria that were established. The criteria included qualitative criteria as well as illuminance values and ratios from the IES Handbook and control and LPD requirements from ASHRAE. All of the spaces met the control requirements. All of the spaces had LPD's that were significantly below the maximum as shown in Table 37 below.

Table 37 – LPD Reduction from Maximum

Space	% LPD Reduction
Main Plaza	68
Main Lobby 1000	63
Open Office 2520	28
Ceremonial Courtroom 4100	64

The design illuminance values and ratios are generally in compliance with the targets, but there are some spaces that are not as close to the targets as was desired. This is mostly due to outlying analysis points being in locations that do not conform to the majority of the space. The illuminance targets not being exactly met was accepted because of the other design factors such as luminaire spacing/arrangement that would have been compromised by further adjustment.

The electrical depth of this report looked at the effects of the lighting breadth on the electrical distribution system and made the required changes. A short circuit study was performed to check that appropriately rated electrical equipment was selected. Finally, an investigation was performed into the potential of an increase in efficiency from the use of a DC distribution system. This revealed that there are not significant savings from a DC distribution system and that the added complexity of having a dual distribution system is not worth it.

For the acoustical breadth an analysis of the RT of Ceremonial Courtroom 4100 was performed. This analysis revealed that the RT of the original design was significantly below the target that was set for this project. As a result many material changes were made until the RT was in closer alignment with the criteria. However, the design RT was not in perfect agreement with the target especially in the 250 Hz octave and the 4000 Hz octave bands. This could have been resolved through the use of specialized construction materials, but this would have added significant cost and complexity to the project.

For the MAE breadth an analysis was performed on the influence of the sound reinforcement system in Ceremonial Courtroom 4100 on speech intelligibility. This analysis was performed using EASE. It was found that the sound reinforcement system

greatly increases the SPL of the room and makes the SPL significantly more even as compared to an unamplified speaker. Additionally, the system also greatly improved STI, but was still in the low end of “good” values. This could be improved by using loudspeakers with a wider distribution.

The mechanical breadth of this report looked at the applicability of using a CHP system at the BCJC. Because data for this project was not available this analysis used average data from past similar projects for calculations. This analysis revealed that this project does not have a high enough thermal demand to make a CHP system economical and thus the payback period of the system was well beyond what is acceptable to most owners.

Overall, this project provided a wide range of opportunities for analysis and enabled me to sharpen a wide range of skills that will hopefully be used throughout my career in the construction industry.

Appendix A – Supporting Material for Lighting Depth

Appendix A-1 – Light Loss Factor Calculations

Fixtures P1, P1E		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.91	Clean, Other, General Diffuse: W 24 month cleaning interval
LLF =	**0.637**	

Fixtures P2		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.91	Clean, Other, Direct: W 24 month cleaning interval
LLF =	**0.637**	

Fixtures P3		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.85	Clean, Other, Semi Indirect: X 24 month cleaning interval
LLF =	**0.595**	

Fixtures S1E		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.85	Clean, Other, Indirect: X 24 month cleaning interval
LLF =	**0.595**	

Fixtures R1, R2, R3, R4, R5, R6, R7, R8, R9		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.91	Clean, Open/Unventilated, Direct: W 24 month cleaning interval
LLF =	**0.637**	

Fixture W1		
Nonrecoverable		
Luminaire ambient temperature	1	
Voltage to luminaire	1	
Ballast factor	1	
Luminaire surface depreciation	1	
Recoverable		
Lamp lumen depreciation (LLD)	0.7	LED
Lamp burnouts factor (LBO)	1	
Luminaire dirt depreciation (LDD)	0.85	Clean, Other, Indirect: X 24 month cleaning interval
LLF =	**0.595**	

Appendix A-2 – Lighting Power Density Calculations

Space	Fixture	Quantity	Lamps per fixture	Watts per lamp	Watts per fixture	Total watts	Space Type	Allowed Watts
Main Plaza						307	Lighting Zone 2	976
	X1	8	N/A	N/A	27	216		
	X2	22	N/A	N/A	4.14	91		

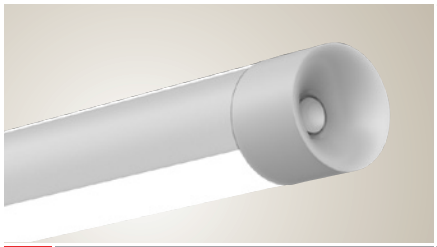
Space	Fixture	Quantity	Watts per fixture	Total watts	Room Area	LPD (W/SF)	Space Type	Allowed LPD	Allowed Watts
Main Lobby 1000				1077	3300	0.33	Lobby, all others	0.9	2970
	R3	13	22.4	291.2					
	R4	2	14.1	28.2					
	R7	3	62	186					
	R8	6	42	252					
	R9	6	42	252					
	W1	3	22.6	67.8					

Space	Fixture	Quantity	Watts per fixture	Total watts	Room Area	LPD (W/SF)	Space Type	Allowed LPD	Allowed Watts
Open Office 2520				1140	1600	0.71	Open Office	0.98	1568
	P1	22	40	880					
	P2	10	20	200					
	P3	1	60	60					

Space	Fixture	Quantity	Watts per fixture	Total watts	Room Area	LPD (W/SF)	Space Type	Allowed LPD	Allowed Watts
Ceremonial Courtroom 4100				1905	2900	0.66	Courtroom	1.72	4988
	R1	5	22.4	112					
	R2	24	14.1	338.4					
	R4	13	14.1	183.3					
	R10	3	43.6	130.8					
	R11	4	31.5	126					
	S1	16	63.4	1014					

Appendix A-3 – Luminaire Specification Sheets

Peerless



Round 4 LED
Indirect/Direct

Type: P1

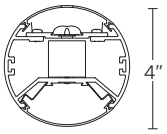
Project:

SPECIFICATIONS | Suspended — 4″ Round | **RD4M4**

RD4M4 W20/20 8FT R8 277 EZB SCT LP835 F1/ 24 C110

DIMENSIONS

☐ **RD4M4**



Lumen Packages:

Specify by Lamp Wattage	W20/20	W20/40	W40/20	W40/40
Indirect	Low	Low	High	High
Direct	Low	High	Low	High
Total Delivered Lumens*	3100	4550	4550	6000
Distribution Percentage $^{up}/_{down}$	50/50	30/70	70/30	50/50
Total Watts*	40	60	60	80

Low lumen package = 1550 deliverd lumens*, 20W
High lumen package = 3000 delivered lumens*, 40W
* nominal per 4′

SPECIFICATIONS

Construction
Extruded aluminum housing has diameter of 4″. Die-cast aluminum end caps mechanically attach with no exposed fasteners.

Source
Four LED lumen packages (see chart above). Three available color temperature options (3000K, 3500K and 4000K). All within 2.5 MacAdam ellipses.

Optics
Optical system consists of injection-molded primary optics, co-extruded acrylic lenses and metal reflectors. Lenses connect end to end to form a continuous line of light.

Dimming
Dimming down to black standard with eldoLED driver. Dual circuit (DCT) option for independent indirect and direct dimming.

Finish
Standard finish for housing and end caps is painted aluminum or gloss white. Consult factory for custom colors.

Controls
Optional nLight-embedded controls allow for constant lumen management (N80) and facilitate simple "plug-and-play" networking and control via CAT-5e cable.

Electrical
eldoLED light engine consists of modular LED boards and 0-10V dimming driver that dims to black rated for 50,000 hours (L_{80}) at 25° C ambient temperature. Driver input wattage is 40W for 3100 delivered-lumen package, 60W for 4550 delivered-lumen package and 80W for 6000 delivered-lumen package per 4′ section.

Specify 120V or 277V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment
Damp location label option. Ambient operating temperature O° C to 25° C.

Fixture Length
4′ and 8′ lengths in a single section for exact suspension spacing of 4′ and 8′. For total luminaire length, add 3″ for each end cap. Using internal joiners, 4′ and 8′ sections can be joined to form longer rows.

Validation
CSA/CUS listed. FCC part 15 certified. LM-79 tested. Lighting Facts partner.

Warranty
Five-year limited warranty coverage includes luminaire construction, LED light engine, driver and nLight control device. Terms and conditions apply.

Packaging
100% post-consumer recycled cardboard box. Biodegradable foam inserts and protective luminaire bag. Recycled kraft paper tape.

CATALOG NUMBER

Example: RD4M4 W40/20 48FT R8 120 EZB SCT LP835 F1/24 C032 PDT1

RD4M4	W20/20	8FT	R8	277	EZB		

Fixture
RD4M4

Lamp Wattage
W20/20 1550 nominal delivered-lumens up, 1550 nominal delivered-lumens down
W20/40 1550 nominal delivered-lumens up, 3000 nominal delivered-lumens down
W40/20 3000 nominal delivered-lumens up, 1550 nominal delivered-lumens down
W40/40 3000 nominal delivered-lumens up, 3000 nominal delivered-lumens down

Fixture Row Length
X FT (4′ increments)

Maximum Section Length
R4 4′ section(s)
R8 8′ section(s)

Voltage
120
277

Driver Type
EZB eldoLED dims to black

# of Emergency Modules
(Blank) None
1SE 1 section
2SE 2 sections
XSE X sections

Emergency Type[1]
(Blank) None
EC Emergency circuit

SCT	LP835	F1/	24	C110	

Switching
SCT Single circuit
DCT Dual circuit

LED Color Temperature
LP830 3000K 80+ CRI 17-20+ R9
LP835 3500K 80+ CRI 17-20+ R9
LP840 4000K 80+ CRI 17-20+ R9

Mounting Type /
F1/ T-bar ceiling (universal mounting bracket)
F1A/ T-bar ceiling (UMB with integrated J-box)
F2/ Hard ceiling (horizontal J-box)

Overall Suspension[2]
24 24″
36 36″
48 48″
72 72″
XX XX″
Overall suspension is measured from ceiling to bottom of fixture

Finish
C032 White white (high gloss)
C110 Painted aluminum
C099 Custom finish

Options
CFG Configuration, consult factory for drawings
CP Chicago plenum (available with F1A only)
DL Damp location label
GLR Fusing (fast blow)
GMF Fusing (slow blow)
LM 80% lumen management without networking
MCS Matching feed canopy at support
N80 nLight nIO with 80% lumen management per row/zone
N100 nLight nIO without lumen management per row/zone
OJB Offset junction box
SLP Sloped ceiling adapter (for 10-45°; must be specified along with F2 and OJB options)
XXXX Integrated sensor; choose options and obtain code on page 2

Notes:
1 Emergency type is installed in last 4′ of luminaire sections. Separate feed required
2 Adjustable cable gripper comes standard

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Peerless

Round 4 LED
Indirect/Direct

Type: P1

Project:

Suspended — 4″ Round **RD4M4**

INTEGRATED NLIGHT MICRO SENSOR

Determine the appropriate sensor type, network type and sensor power source for your application. Enter the code in the Options section of the Catalog Number.

EXAMPLE: **PDT1**

Sensor Type (choose one)	
ADC nLight model nES ADCX	**Daylight Dimming** Specify 0-10V dimming ballast No occupancy sensing
PDT nLight model nES PDT7 ADCX	**Daylight Dimming and/or Occupancy Detection** Specify 0-10v dimming ballast for daylight dimming Specify fixed-output ballast for occupancy detection only (daylight dimming disabled)

Network Type & Sensor Power Source (choose one)	
1*	**nLight-Enabled (Network-Ready) with Luminaire-Integrated Power Pack** 10′ Cat-5e cable and splitter provided
2	**Standalone Operation (No Networking) with Luminaire Integrated Power Pack** No Cat-5e cable provided
3*	**nLight-Enabled (Network-Ready) with Remote nLight Power Pack or nPanel** 10′ Cat-5e cable and splitter provided Order required remote nLight Power Pack or nPanel separately through nLight (Acuity Brands Controls)

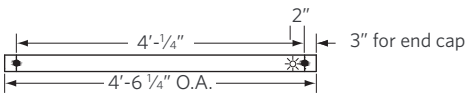
For more information about the Integrated nLight Micro Sensor, its capabilities and options, download the PDF guide at: *PeerlessLighting.com/nLight-Sensor-Guide*
*nLight-Enabled (network-ready) options include one RJ-45 connector on the luminaire, 10 feet of Cat-5e cable to control the entire luminaire row (depending on wattage/voltage limitations), and splitter. The Cat-5e cable drop is located in the same section as the sensor. For multiple zones, please contact techsupport@peerlesslighting.com.

WEIGHTS & SUPPORT SPACING

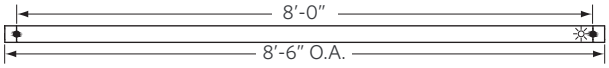
Suspension spacing equals section length.

STANDARD SECTIONS

18 LBS



34 LBS



PLAN VIEW

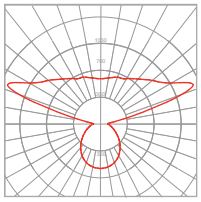
Key:
● Support or feed location
✲ Sensor

CONFIGURATIONS

Round 4 can be configured with special mitered sections to provide seamless corner illumination where two luminaires join together. Reference *Pattern Connector Guide* for additional details.

PHOTOMETRICS

Actual performance may differ as a result of end-user environment and application.



W40/20 LP835
75 lumens per watt
4493 delivered lumens

66% up / 34% down

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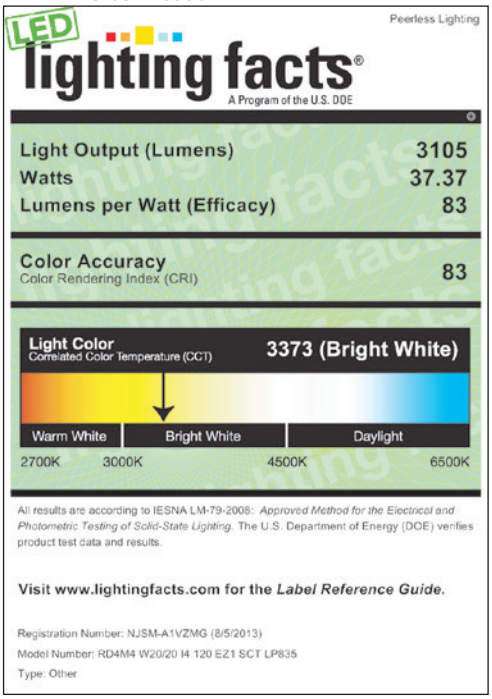
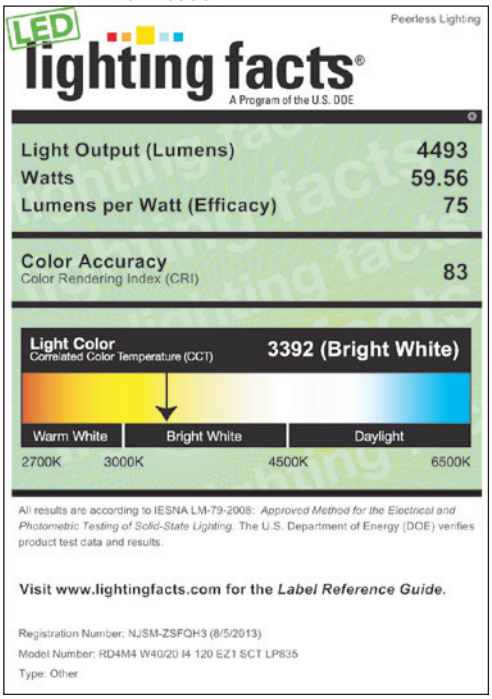
LIGHTING FACTS LABELS

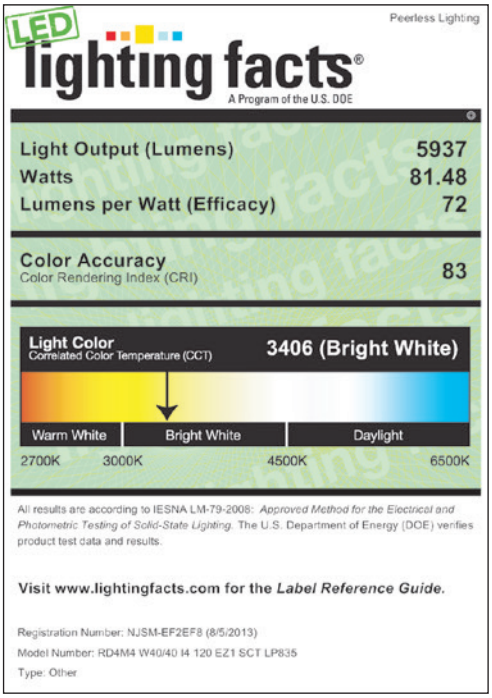
RD4M4 3105L 3500K



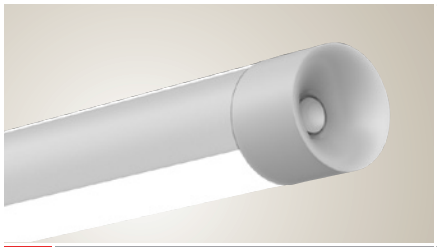
RD4M4 4493L 3500K



RD4M4 5937L 3500K



Peerless



Round 4 LED
Indirect/Direct

Type: P1E

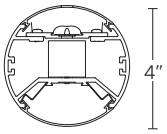
Project:

SPECIFICATIONS | Suspended — 4″ Round | **RD4M4**

RD4M4 W20/20 8FT R8 277 EZB 1 EC SCT LP835 F1/ 24 C110

DIMENSIONS

☐ **RD4M4**



Lumen Packages:

Specify by Lamp Wattage	W20/20	W20/40	W40/20	W40/40
Indirect	Low	Low	High	High
Direct	Low	High	Low	High
Total Delivered Lumens*	3100	4550	4550	6000
Distribution Percentage $^{up}/_{down}$	50/50	30/70	70/30	50/50
Total Watts*	40	60	60	80

Low lumen package = 1550 deliverd lumens*, 20W
High lumen package = 3000 delivered lumens*, 40W
* nominal per 4′

SPECIFICATIONS

Construction
Extruded aluminum housing has diameter of 4″. Die-cast aluminum end caps mechanically attach with no exposed fasteners.

Source
Four LED lumen packages (see chart above). Three available color temperature options (3000K, 3500K and 4000K). All within 2.5 MacAdam ellipses.

Optics
Optical system consists of injection-molded primary optics, co-extruded acrylic lenses and metal reflectors. Lenses connect end to end to form a continuous line of light.

Dimming
Dimming down to black standard with eldoLED driver. Dual circuit (DCT) option for independent indirect and direct dimming.

Finish
Standard finish for housing and end caps is painted aluminum or gloss white. Consult factory for custom colors.

Controls
Optional nLight-embedded controls allow for constant lumen management (N80) and facilitate simple "plug-and-play" networking and control via CAT-5e cable.

Electrical
eldoLED light engine consists of modular LED boards and 0-10V dimming driver that dims to black rated for 50,000 hours (L_{80}) at 25° C ambient temperature. Driver input wattage is 40W for 3100 delivered-lumen package, 60W for 4550 delivered-lumen package and 80W for 6000 delivered-lumen package per 4′ section.

Specify 120V or 277V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment
Damp location label option. Ambient operating temperature O° C to 25° C.

Fixture Length
4′ and 8′ lengths in a single section for exact suspension spacing of 4′ and 8′. For total luminaire length, add 3″ for each end cap. Using internal joiners, 4′ and 8′ sections can be joined to form longer rows.

Validation
CSA/CUS listed. FCC part 15 certified. LM-79 tested. Lighting Facts partner.

Warranty
Five-year limited warranty coverage includes luminaire construction, LED light engine, driver and nLight control device. Terms and conditions apply.

Packaging
100% post-consumer recycled cardboard box. Biodegradable foam inserts and protective luminaire bag. Recycled kraft paper tape.

CATALOG NUMBER

Example: RD4M4 W40/20 48FT R8 120 EZB SCT LP835 F1/24 C032 PDT1

RD4M4	W20/20	8FT	R8	277	EZB	1	EC

Fixture
RD4M4

Lamp Wattage
- **W20/20** 1550 nominal delivered-lumens up, 1550 nominal delivered-lumens down
- **W20/40** 1550 nominal delivered-lumens up, 3000 nominal delivered-lumens down
- **W40/20** 3000 nominal delivered-lumens up, 1550 nominal delivered-lumens down
- **W40/40** 3000 nominal delivered-lumens up, 3000 nominal delivered-lumens down

Fixture Row Length
X FT (4′ increments)

Maximum Section Length
- **R4** 4′ section(s)
- **R8** 8′ section(s)

Voltage
- **120**
- **277**

Driver Type
- **EZB** eldoLED dims to black

# of Emergency Modules
- **(Blank)** None
- **1SE** 1 section
- **2SE** 2 sections
- **XSE** X sections

Emergency Type[1]
- **(Blank)** None
- **EC** Emergency circuit

SCT	LP835	F1/	24	C110	

Switching
- **SCT** Single circuit
- **DCT** Dual circuit

LED Color Temperature
- **LP830** 3000K 80+ CRI 17-20+ R9
- **LP835** 3500K 80+ CRI 17-20+ R9
- **LP840** 4000K 80+ CRI 17-20+ R9

Mounting Type /
- **F1/** T-bar ceiling (universal mounting bracket)
- **F1A/** T-bar ceiling (UMB with integrated J-box)
- **F2/** Hard ceiling (horizontal J-box)

Overall Suspension[2]
- **24** 24″
- **36** 36″
- **48** 48″
- **72** 72″
- **XX** XX″

Overall suspension is measured from ceiling to bottom of fixture

Finish
- **C032** White white (high gloss)
- **C110** Painted aluminum
- **C099** Custom finish

Options
- **CFG** Configuration, consult factory for drawings
- **CP** Chicago plenum (available with F1A only)
- **DL** Damp location label
- **GLR** Fusing (fast blow)
- **GMF** Fusing (slow blow)
- **LM** 80% lumen management without networking
- **MCS** Matching feed canopy at support
- **N80** nLight nIO with 80% lumen management per row/zone
- **N100** nLight nIO without lumen management per row/zone
- **OJB** Offset junction box
- **SLP** Sloped ceiling adapter (for 10-45°; must be specified along with F2 and OJB options)
- **XXXX** Integrated sensor; choose options and obtain code on page 2

Notes:
1 Emergency type is installed in last 4′ of luminaire sections. Separate feed required
2 Adjustable cable gripper comes standard

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Round 4 LED
Indirect/Direct

Type: P1E

Project:

Suspended — 4″ Round **RD4M4**

INTEGRATED NLIGHT MICRO SENSOR

Determine the appropriate sensor type, network type and sensor power source for your application. Enter the code in the Options section of the Catalog Number.

EXAMPLE: **PDT1**

Sensor Type (choose one)	
ADC nLight model nES ADCX	**Daylight Dimming** Specify 0-10V dimming ballast No occupancy sensing
PDT nLight model nES PDT7 ADCX	**Daylight Dimming and/or Occupancy Detection** Specify 0-10v dimming ballast for daylight dimming Specify fixed-output ballast for occupancy detection only (daylight dimming disabled)

Network Type & Sensor Power Source (choose one)	
1*	**nLight-Enabled (Network-Ready) with Luminaire-Integrated Power Pack** 10′ Cat-5e cable and splitter provided
2	**Standalone Operation (No Networking) with Luminaire Integrated Power Pack** No Cat-5e cable provided
3*	**nLight-Enabled (Network-Ready) with Remote nLight Power Pack or nPanel** 10′ Cat-5e cable and splitter provided Order required remote nLight Power Pack or nPanel separately through nLight (Acuity Brands Controls)

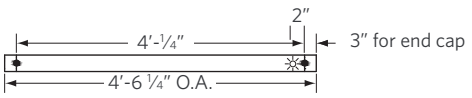
For more information about the Integrated nLight Micro Sensor, its capabilities and options, download the PDF guide at: *PeerlessLighting.com/nLight-Sensor-Guide*
*nLight-Enabled (network-ready) options include one RJ-45 connector on the luminaire, 10 feet of Cat-5e cable to control the entire luminaire row (depending on wattage/voltage limitations), and splitter. The Cat-5e cable drop is located in the same section as the sensor. For multiple zones, please contact techsupport@peerlesslighting.com.

WEIGHTS & SUPPORT SPACING

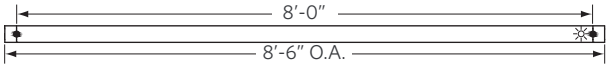
Suspension spacing equals section length.

STANDARD SECTIONS

18 LBS



34 LBS



PLAN VIEW

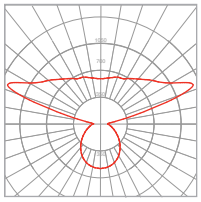
Key:
● Support or feed location
✲ Sensor

CONFIGURATIONS

Round 4 can be configured with special mitered sections to provide seamless corner illumination where two luminaires join together. Reference *Pattern Connector Guide* for additional details.

PHOTOMETRICS

Actual performance may differ as a result of end-user environment and application.



W40/20 LP835
75 lumens per watt
4493 delivered lumens

66% up / 34% down

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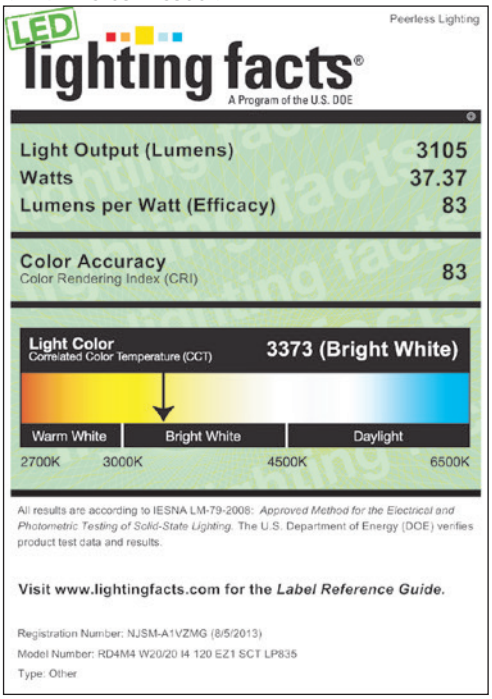
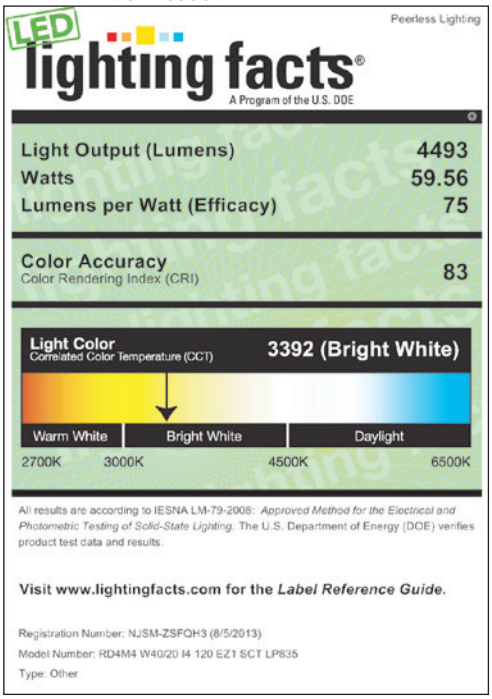
LIGHTING FACTS LABELS

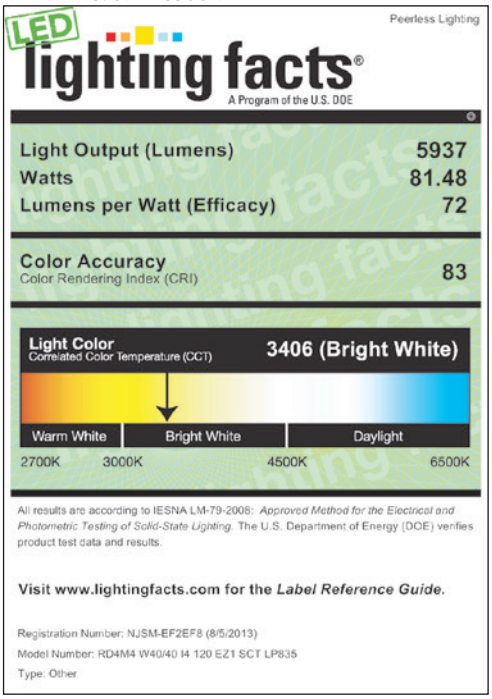
RD4M4 3105L 3500K



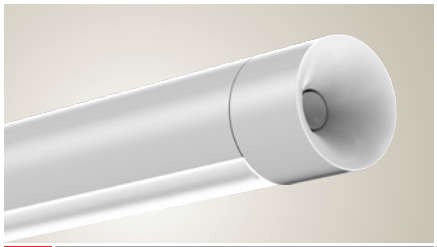
RD4M4 4493L 3500K



RD4M4 5937L 3500K



Peerless



Round 4 LED
Wall-Wash

Type: P2

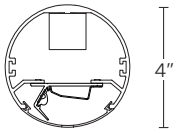
Project:

SPECIFICATIONS | Suspended — 4″ Round | **RD4MW**

RD4MW W20 40FT R8 277 EZB SCT LP835 F1/ 24 C110

DIMENSIONS

☐ **RD4MW**



Two LED Lumen Packages:

Specify by Lamp Wattage	W20	W40
Indirect	Low	High
Total Delivered Lumens*	1400	2600
Total Watts*	20	40

* nominal per 4′

SPECIFICATIONS

Construction
Extruded aluminum housing has diameter of 4″. Die-cast aluminum end caps mechanically attach with no exposed fasteners.

Source
Two LED lumen packages (High and Low). Three available color temperature options (3000K, 3500K and 4000K). All within 2.5 MacAdam ellipses.

Optics
Optical system consists of injection-molded primary optics, co-extruded acrylic lenses and metal reflectors. Lenses connect end to end to form a continuous line of light.

Dimming
Dimming down to black standard with eldoLED driver.

Finish
Standard finish for housing and end caps is painted aluminum or gloss white. Consult factory for custom colors.

Controls
Optional nLight-embedded controls allow for constant lumen management (N80) and facilitate simple "plug-and-play" networking and control via CAT-5e cable.

Electrical
eldoLED light engine consists of modular LED boards and 0-10V dimming driver that dims to black rated for 50,000 hours (L_{80}) at 25° C ambient temperature. Driver input wattage is 20W for 1400 delivered-lumen package and 40W for 2000 delivered-lumen package per 4′ section.

Specify 120V or 277V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment
Damp location label option. Ambient operating temperature O° C to 25° C.

Fixture Length
4′ and 8′ lengths in a single section for exact suspension spacing of 4′ and 8′. For total luminaire length, add 3″ for each end cap. Using internal joiners, 4′ and 8′ sections can be joined to form longer rows.

Validation
CSA/CUS listed. FCC part 15 certified. LM-79 tested. Lighting Facts partner.

Warranty
Five-year limited warranty coverage includes luminaire construction, LED light engine, driver and nLight control device. Terms and conditions apply.

Packaging
100% post-consumer recycled cardboard box. Biodegradable foam inserts and protective luminaire bag. Recycled kraft paper tape.

CATALOG NUMBER

Example: RD4MW W40 48FT R8 277 EZB SCT LP835 F1/24 C032 N80

RD4MW	W20	40FT	R8	277	EZB			▸▸▸
Fixture	**Lamp Wattage**	**Fixture Row Length**	**Maximum Section Length**	**Voltage**	**Driver Type**	**# of Emergency Modules**	**Emergency Type[1]**	
RD4MW	**W20** 1400 nominal delivered-lumens **W40** 2600 nominal delivered-lumens	**X FT** (4′ increments)	**R4** 4′ section(s) **R8** 8′ section(s)	**120** **277**	**EZB** eldoLED dims to black	**(Blank)** None **1SE** 1 section **2SE** 2 sections **XSE** X sections	**(Blank)** None **EC** Emergency circuit	

▸▸ SCT	LP835	F1/	24	C110	
Switching	**LED Color Temperature**	**Mounting Type /**	**Overall Suspension[2]**	**Finish**	**Options**
SCT Single circuit	**LP830** 3000K 80+ CRI 17-20+ R9 **LP835** 3500K 80+ CRI 17-20+ R9 **LP840** 4000K 80+ CRI 17-20+ R9	**F1/** T-bar ceiling (universal mounting bracket) **F1A/** T-bar ceiling (UMB with integrated J-box) **F2/** Hard ceiling (horizontal J-box)	**24** 24″ **36** 36″ **48** 48″ **72** 72″ **XX** XX″ *Overall suspension is measured from ceiling to bottom of fixture*	**C032** White white (high gloss) **C110** Painted aluminum **C099** Custom finish	**CP** Chicago plenum (available with F1A only) **DL** Damp location label **GLR** Fusing (fast blow) **GMF** Fusing (slow blow) **LM** 80% lumen management without networking **MCS** Matching feed canopy at support **N80** nLight nIO with 80% lumen management per row/zone **N100** nLight nIO without lumen management per row/zone **OJB** Offset junction box **SLP** Sloped ceiling adapter (for 10-45°; must be specified along with F2 and OJB options)

Notes:
1 Emergency type is installed in last 4′ of luminaire sections. Separate feed required
2 Adjustable cable gripper comes standard

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Peerless

Round 4 LED
Wall-Wash

Type: P2

Project:

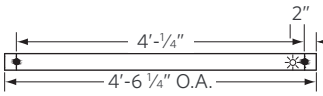
Suspended — 4″ Round **RD4MW**

WEIGHTS & SUPPORT SPACING

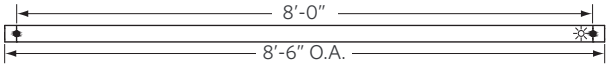
Suspension spacing equals section length.

STANDARD SECTIONS

18 LBS



34 LBS

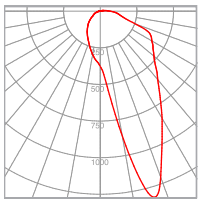


PLAN VIEW

Key:
● Support or feed location
☼ Sensor

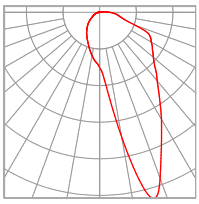
PHOTOMETRICS

Actual performance may differ as a result of end-user environment and application.



W20 LP835
68 lumens per watt
1385 delivered lumens

2% up / 98% down



W40 LP835
63 lumens per watt
2567 delivered lumens

2% up / 98% down

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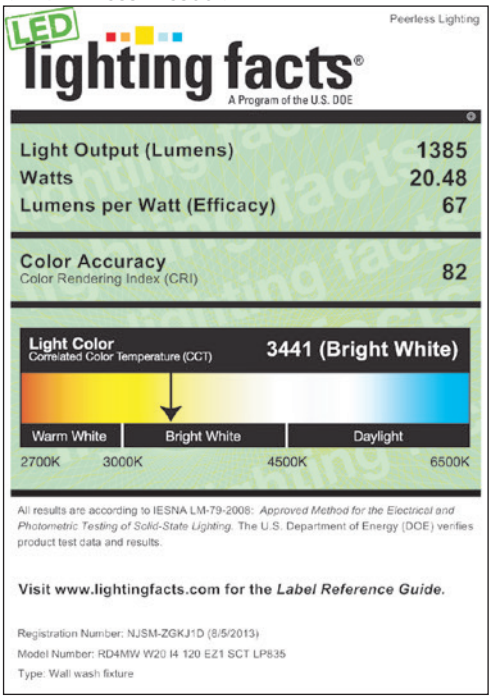
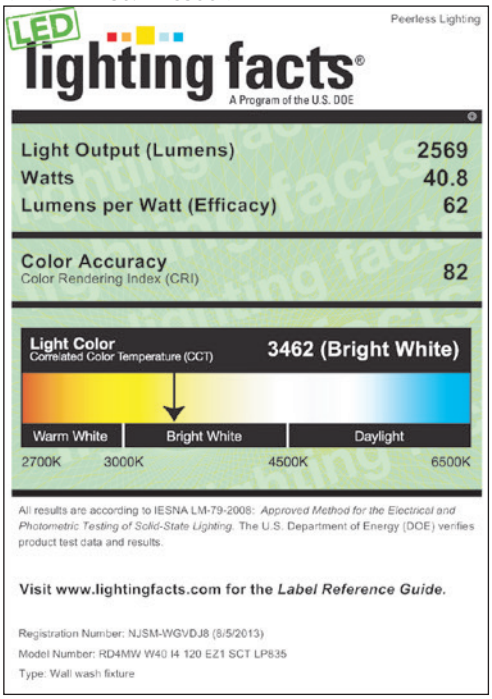
LIGHTING FACTS LABELS

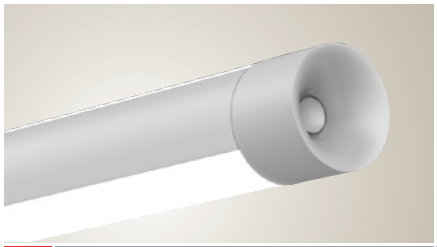
RD4MW 1385L 3500K



RD4MW 2569L 3500K



Peerless



Round 4 LED
Indirect/Direct

Type: P3

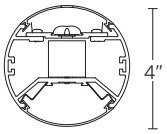
Project:

SPECIFICATIONS | Suspended — 4″ Round | **RD4M4**

RD4M4 W40/20 8FT R8 277 EZB SCT LP835 F1/ 24 C110

DIMENSIONS

☐ **RD4M4**



Lumen Packages:

Specify by Lamp Wattage	W20/20	W20/40	W40/20	W40/40
Indirect	Low	Low	High	High
Direct	Low	High	Low	High
Total Delivered Lumens*	3100	4550	4550	6000
Distribution Percentage $^{up}/_{down}$	50/50	30/70	70/30	50/50
Total Watts*	40	60	60	80

Low lumen package = 1550 deliverd lumens*, 20W
High lumen package = 3000 delivered lumens*, 40W
* nominal per 4′

SPECIFICATIONS

Construction
Extruded aluminum housing has diameter of 4″. Die-cast aluminum end caps mechanically attach with no exposed fasteners.

Source
Four LED lumen packages (see chart above). Three available color temperature options (3000K, 3500K and 4000K). All within 2.5 MacAdam ellipses.

Optics
Optical system consists of injection-molded primary optics, co-extruded acrylic lenses and metal reflectors. Lenses connect end to end to form a continuous line of light.

Dimming
Dimming down to black standard with eldoLED driver. Dual circuit (DCT) option for independent indirect and direct dimming.

Finish
Standard finish for housing and end caps is painted aluminum or gloss white. Consult factory for custom colors.

Controls
Optional nLight-embedded controls allow for constant lumen management (N80) and facilitate simple "plug-and-play" networking and control via CAT-5e cable.

Electrical
eldoLED light engine consists of modular LED boards and 0-10V dimming driver that dims to black rated for 50,000 hours (L_{80}) at 25° C ambient temperature. Driver input wattage is 40W for 3100 delivered-lumen package, 60W for 4550 delivered-lumen package and 80W for 6000 delivered-lumen package per 4′ section.

Specify 120V or 277V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment
Damp location label option. Ambient operating temperature O° C to 25° C.

Fixture Length
4′ and 8′ lengths in a single section for exact suspension spacing of 4′ and 8′. For total luminaire length, add 3″ for each end cap. Using internal joiners, 4′ and 8′ sections can be joined to form longer rows.

Validation
CSA/CUS listed. FCC part 15 certified. LM-79 tested. Lighting Facts partner.

Warranty
Five-year limited warranty coverage includes luminaire construction, LED light engine, driver and nLight control device. Terms and conditions apply.

Packaging
100% post-consumer recycled cardboard box. Biodegradable foam inserts and protective luminaire bag. Recycled kraft paper tape.

CATALOG NUMBER

Example: RD4M4 W40/20 48FT R8 120 EZB SCT LP835 F1/24 C032 PDT1

RD4M4	W40/20	8FT	R8	277	EZB		

Fixture
RD4M4

Lamp Wattage
W20/20 1550 nominal delivered-lumens up, 1550 nominal delivered-lumens down
W20/40 1550 nominal delivered-lumens up, 3000 nominal delivered-lumens down
W40/20 3000 nominal delivered-lumens up, 1550 nominal delivered-lumens down
W40/40 3000 nominal delivered-lumens up, 3000 nominal delivered-lumens down

Fixture Row Length
X FT (4′ increments)

Maximum Section Length
R4 4′ section(s)
R8 8′ section(s)

Voltage
120
277

Driver Type
EZB eldoLED dims to black

# of Emergency Modules
(Blank) None
1SE 1 section
2SE 2 sections
XSE X sections

Emergency Type[1]
(Blank) None
EC Emergency circuit

SCT	LP835	F1/	24	C110	

Switching
SCT Single circuit
DCT Dual circuit

LED Color Temperature
LP830 3000K 80+ CRI 17-20+ R9
LP835 3500K 80+ CRI 17-20+ R9
LP840 4000K 80+ CRI 17-20+ R9

Mounting Type /
F1/ T-bar ceiling (universal mounting bracket)
F1A/ T-bar ceiling (UMB with integrated J-box)
F2/ Hard ceiling (horizontal J-box)

Overall Suspension[2]
24 24″
36 36″
48 48″
72 72″
XX XX″
Overall suspension is measured from ceiling to bottom of fixture

Finish
C032 White white (high gloss)
C110 Painted aluminum
C099 Custom finish

Options
CFG Configuration, consult factory for drawings
CP Chicago plenum (available with F1A only)
DL Damp location label
GLR Fusing (fast blow)
GMF Fusing (slow blow)
LM 80% lumen management without networking
MCS Matching feed canopy at support
N80 nLight nIO with 80% lumen management per row/zone
N100 nLight nIO without lumen management per row/zone
OJB Offset junction box
SLP Sloped ceiling adapter (for 10-45°; must be specified along with F2 and OJB options)
XXXX Integrated sensor; choose options and obtain code on page 2

Notes:
1 Emergency type is installed in last 4′ of luminaire sections. Separate feed required
2 Adjustable cable gripper comes standard

2246 5th Street, Berkeley, CA 94710 • Tel: 510.845.2760 • Fax: 510.845.2776 • Email: techsupport@peerlesslighting.com • PeerlessLighting.com

Peerless

Round 4 LED
Indirect/Direct

Type: P3

Project:

Suspended — 4″ Round **RD4M4**

INTEGRATED NLIGHT MICRO SENSOR

Determine the appropriate sensor type, network type and sensor power source for your application. Enter the code in the Options section of the Catalog Number.

EXAMPLE: **PDT1**

Sensor Type (choose one)	
ADC nLight model nES ADCX	**Daylight Dimming** Specify 0-10V dimming ballast No occupancy sensing
PDT nLight model nES PDT7 ADCX	**Daylight Dimming and/or Occupancy Detection** Specify 0-10v dimming ballast for daylight dimming Specify fixed-output ballast for occupancy detection only (daylight dimming disabled)

Network Type & Sensor Power Source (choose one)	
1*	**nLight-Enabled (Network-Ready) with Luminaire-Integrated Power Pack** 10′ Cat-5e cable and splitter provided
2	**Standalone Operation (No Networking) with Luminaire Integrated Power Pack** No Cat-5e cable provided
3*	**nLight-Enabled (Network-Ready) with Remote nLight Power Pack or nPanel** 10′ Cat-5e cable and splitter provided Order required remote nLight Power Pack or nPanel separately through nLight (Acuity Brands Controls)

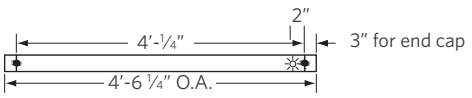
For more information about the Integrated nLight Micro Sensor, its capabilities and options, download the PDF guide at: *PeerlessLighting.com/nLight-Sensor-Guide*
*nLight-Enabled (network-ready) options include one RJ-45 connector on the luminaire, 10 feet of Cat-5e cable to control the entire luminaire row (depending on wattage/voltage limitations), and splitter. The Cat-5e cable drop is located in the same section as the sensor. For multiple zones, please contact techsupport@peerlesslighting.com.

WEIGHTS & SUPPORT SPACING

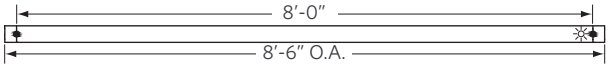
Suspension spacing equals section length.

STANDARD SECTIONS

18 LBS



34 LBS



PLAN VIEW

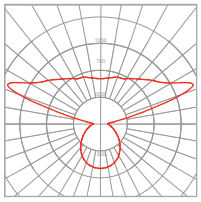
Key:
● Support or feed location
✲ Sensor

CONFIGURATIONS

Round 4 can be configured with special mitered sections to provide seamless corner illumination where two luminaires join together. Reference *Pattern Connector Guide* for additional details.

PHOTOMETRICS

Actual performance may differ as a result of end-user environment and application.



W40/20 LP835
75 lumens per watt
4493 delivered lumens

66% up / 34% down

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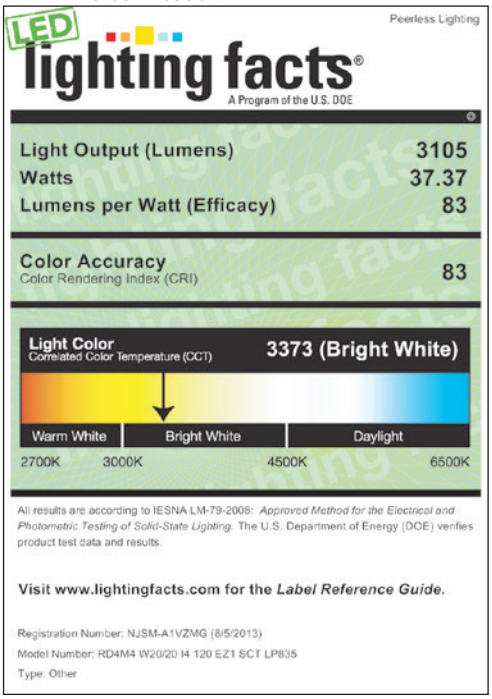
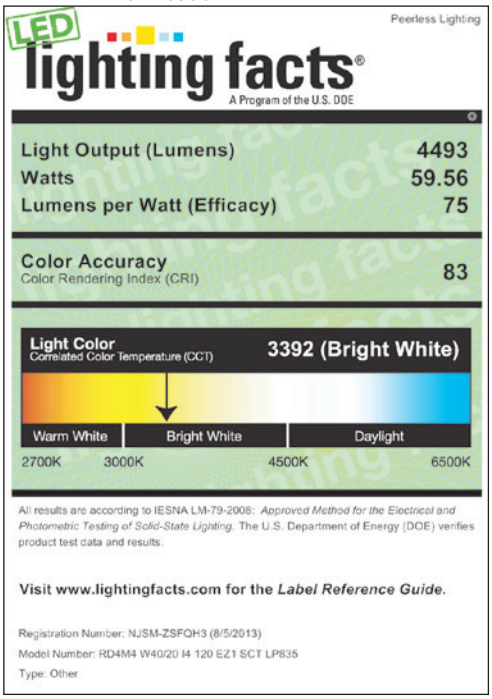
LIGHTING FACTS LABELS

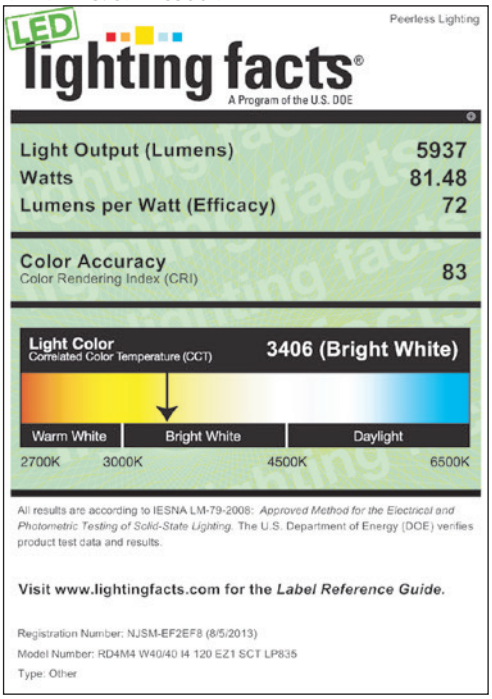
RD4M4 3105L 3500K



RD4M4 4493L 3500K



RD4M4 5937L 3500K



PORTFOLIO™

DESCRIPTION

6 inch LED recessed narrow beam downlight specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 1000, 1500, 2000 and 3000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A15DL3 ERN6A10835 6LN1LI	**Type**
Project		R1
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

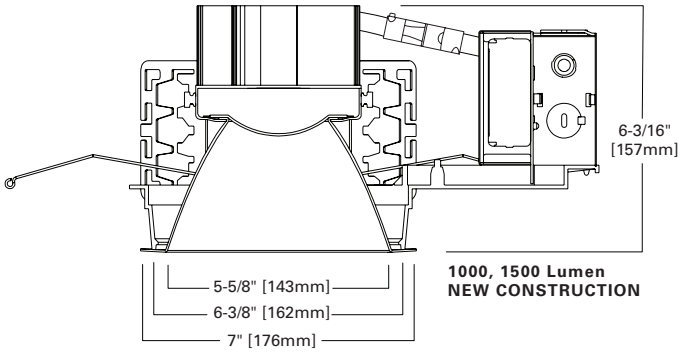
Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

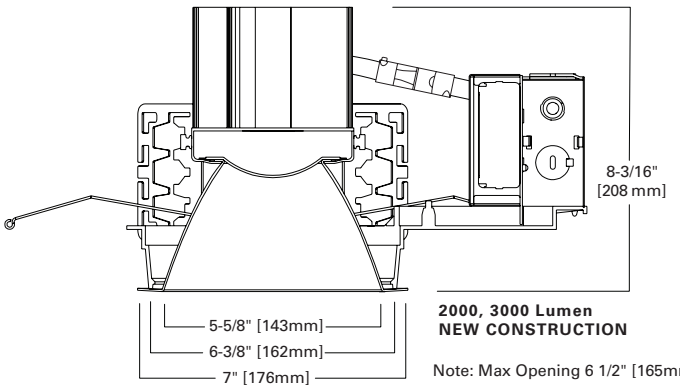
Driver
Combination 120-277V 0-10V or120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. IP66 rated when used with IP66 gasket kit accessory. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

Warranty
5 year warranty.



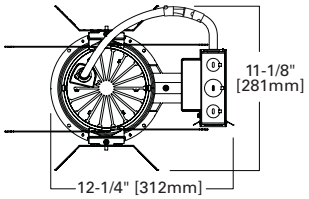
1000, 1500 Lumen NEW CONSTRUCTION



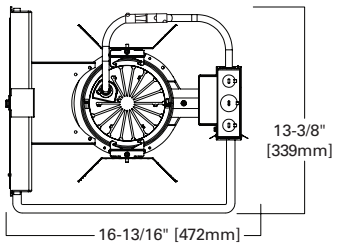
2000, 3000 Lumen NEW CONSTRUCTION

Note: Max Opening 6 1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LN

1000, 1500 Lumen LED

2000, 3000 Lumen LED

6-Inch

Narrow Beam Downlight

New Construction

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

powered by fifthlight technology

Cooper Lighting by EATON

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

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ORDERING INFORMATION

EXAMPLE: LD6A15D010TE ERN6A15835 6LN0LI=6" LED Narrow Beam Reflector, 1500 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing

LD6A=6"Aperture,
LD6ACP=6"Aperture, Remodel Chicago

Lumens[1]

10=1000 Lumens
15=1500 Lumens
20=2000 Lumens
30=3000 Lumens

Driver

1000, 1500, 2000 and 3000 Lumen
D010TE=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming
D5LT=Fifth Light® (DALI) Dimming 1-100%
DE010=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V
DL3=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire
DLT=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming
DMX=DMX Dimming 1-100%

1000, 1500 and 2000 Lumen
D010TR=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming

Options

EMBOD=Bodine® Emergency Module with Remote Test Switch
IEMBOD=Bodine® Emergency Module with Integral Test Switch

Power Module

ERN6A10=6", 1000 Lumen Module for Narrow Beam Reflector
ERN6A15=6", 1500 Lumen Module for Narrow Beam Reflector
ERN6A20=6", 2000 Lumen Module for Narrow Beam Reflector
ERN6A30=6", 3000 Lumen Module for Narrow Beam Reflector

CRI

8=80 CRI
9=90 CRI

Color

27=2700° K
30=3000° K
35=3500° K
40=4000° K
27CP=2700° K, Chicago Plenum
30CP=3000° K, Chicago Plenum
35CP=3500° K, Chicago Plenum
40CP=4000° K, Chicago Plenum

Reflector

6LN0=6" Narrow Reflector, Polymer Trim Ring
6LN1=6" Narrow Reflector, Self-flanged
6LN0E=6" Narrow Reflector, Polymer Trim Ring for use with IEM Integral Emergency Option
6LN1E=6" Narrow Reflector, Self-flanged for use with IEM Integral Emergency Option

Finish

LI=Specular Clear
H=Semi-Specular Clear
WMH=Warm Haze
G=Specular Gold
WH=Wheat
WHH=Wheat Haze
GP=Graphite
GPH=Graphite Haze
B=Specular Black
W=Gloss White

Options

Self-Flanged Only
WF=White Painted Flange

Accessories

HB26=C-channel Bar Hanger, 26" Long, Pair
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair
H347=347 to 120V Step Down Transformer, 75VA
H347200=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope
HSA6=Slope Adapter for 6" Aperture Housings, Specify Slope
TRM6=Metal Trim Ring, Specify Color[2]
TRR6=Rimless Trim Ring[2]
DT6=Deco Trim[2]
LGSKT6IP66=IP66 Gasket Kit

Notes: **1** Nominal Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.

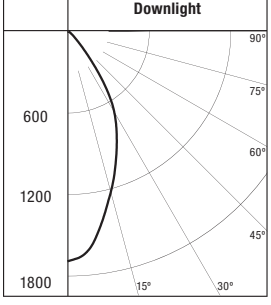
ENERGY

ENERGY DATA			
Sound Rating: Class A standards			
(Values at non-dimming line voltage)			
Minimum Starting Temperature: -30°C (-22°F)			
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)			
Input Voltage: UNV (120V - 277V)			
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)			
3000 Lumen D010TE		**2000 Lumen D010TE**	
Input Power: 43.6W	THD: <17%	Input Power: 31.5W	THD: <20%
120V Input Current: .37A	277V Input Current: .16A	120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz		Input Frequency: 50/60Hz	
1500 Lumen D010TE		**1000 Lumen D010TE**	
Input Power: 22.4W	THD: <20%	Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A	120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz		Input Frequency: 50-60Hz	

	120V		277V	
Lumens	Inrush (A)	Duration (ms)	Inrush (A)	Duration (ms)
900/1000	0.486	0.4	0.848	0.182
1300/1500	0.717	1.58	0.531	1.24
1800/2000	0.832	0.405	1.25	0.788
2800/3000	1.09	0.3	1.23	0.294

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98195
LD6A15D010TE ERN6A835 6LN1H	
Lumens	1277
Efficacy	57 Lm/W
Watts	22.4
CCT	3500K
SC	0.74

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	55	4.0
7'	34	5.0
8'	26	5.8
9'	20	6.6
10'	16	7.2
12'	11	8.8

CANDELA TABLE

Degrees Vertical	Candela
0	1684
5	1623
15	1223
25	853
35	454
45	97
55	22
65	8
75	3
85	0
90	0

ZONAL LUMEN SUMMARY

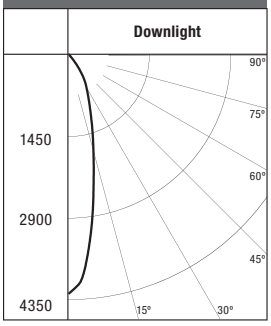
Zone	Lumens	%Fixture
0-30	881	69.0
0-40	1160	90.8
0-60	1266	99.1
0-90	1277	100
90-180	0	0
0-180	1277	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	8959
55	2548
65	1158
75	756
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P97939
LD6A15D010TE ERN6A835 6LN1LI	
Lumens	1450
Efficacy	64.7 Lm/W
Watts	22.4
CCT	3500K
SC	0.41

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	139	2.2
7'	86	2.8
8'	66	3.2
9'	52	3.6
10'	42	4.0
12'	29	4.8

CANDELA TABLE

Degrees Vertical	Candela
0	4226
5	3654
15	1689
25	823
35	374
45	45
55	3
65	1
75	0
85	0
90	0

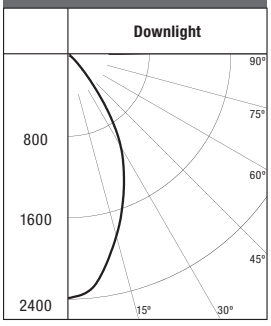
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1171	80.8
0-40	1401	96.6
0-60	1449	99.9
0-90	1450	100
90-180	0	0
0-180	1450	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	4133
55	353
65	154
75	0
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P98503
LD6A20D010TE ERN6A835 6LN1H	
Lumens	1914
Efficacy	60.8 Lm/W
Watts	31.5
CCT	3500K
SC	0.79

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	78	4.2
7'	48	5.4
8'	37	6.2
9'	29	7.0
10'	23	7.8
12'	16	9.4

CANDELA TABLE

Degrees Vertical	Candela
0	2376
5	2314
15	1826
25	1287
35	676
45	157
55	33
65	12
75	3
85	1
90	0

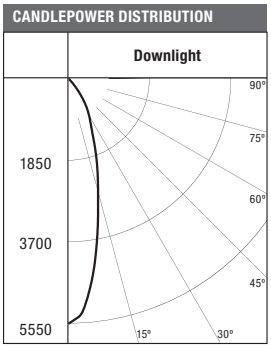
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1312	68.5
0-40	1730	90.4
0-60	1898	99.1
0-90	1914	100
90-180	0	0
0-180	1914	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	14495
55	3742
65	1806
75	807
85	823

CANDLEPOWER DISTRIBUTION



Test Number	P97555
LD6A20D010TE ERN6A835 6LN1LI	
Lumens	2209
Efficacy	70.1 Lm/W
Watts	31.5
CCT	3500K
SC	0.46

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	182	2.4
7'	112	3.2
8'	86	3.6
9'	68	4.0
10'	55	4.6
12'	38	5.4

CANDELA TABLE

Degrees Vertical	Candela
0	5515
5	4944
15	2581
25	1236
35	593
45	103
55	5
65	2
75	0
85	0
90	0

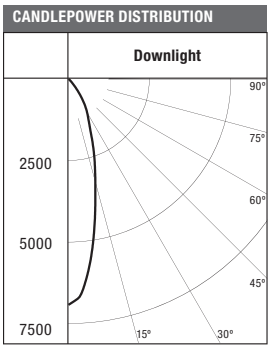
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1740	78.8
0-40	2106	95.4
0-60	2207	99.9
0-90	2209	100
90-180	0	0
0-180	2209	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	6784
55	423
65	188
75	0
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97571
LD6A30DE010 ERN6A30835 6LN1LI	
Lumens	2685 Lm
Efficacy	61.5 Lm/W
Watts	43.6 W
CCT	3500K
SC	0.46

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
10'	67	5
15'	30	7
20'	17	9.5
25'	11	12
30'	7	14

CANDELA TABLE

Degrees Vertical	Candela
0	6704
5	6010
15	3137
25	1502
35	721
45	125
55	6
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

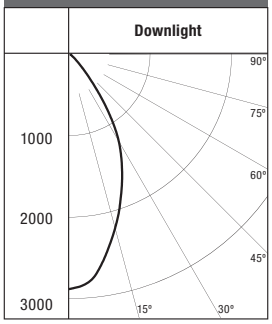
Zone	Lumens	%Fixture
0-30	2116	79
0-40	2560	95.5
0-60	2683	100
0-90	2685	100
90-180	0	0
0-180	2685	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	8244
55	513
65	221
75	0
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98519
LD6A30DE010 ERN6A30835 6LN1H	
Lumens	2327 Lm
Efficacy	53 Lm/W
Watts	43.6 W
CCT	3500K
SC	0.8

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
10'	51	6
15'	29	8
20'	13	12
25'	9	14
30'	7	16

CANDELA TABLE

Degrees Vertical	Candela
0	2888
5	2814
15	2220
25	1564
35	822
45	191
55	40
65	14
75	4
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1595	68.5
0-40	2103	90.5
0-60	2307	99
0-90	2327	100
90-180	0	0
0-180	2327	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	17622
55	4550
65	2192
75	983
85	973

EMBOD MULTIPLIER

900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

CCT Multiplication Factors		CCT [K]	Multiplier from 3500K	80 -> 90 CRI
80 CRI	1000 Lumen	2700	0.93	
		3000	0.99	
		3500	1.00	
		4000	1.01	
	1500 Lumen	2700	0.93	
		3000	0.99	
		3500	1.00	
		4000	1.01	
90 CRI	1000 Lumen	2700	0.88	0.79
		3000	0.95	0.80
		3500	1.00	0.84
		4000	1.03	0.86
	1500 Lumen	2700	0.88	0.79
		3000	0.94	0.79
		3500	1.00	0.84
		4000	1.03	0.86

PORTFOLIO™

DESCRIPTION

6 inch LED recessed wide beam downlight specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 1000, 1500, 2000, and 3000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A30DL3 ERW6A30835 6LW1LI	**Type**
Project		R10
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

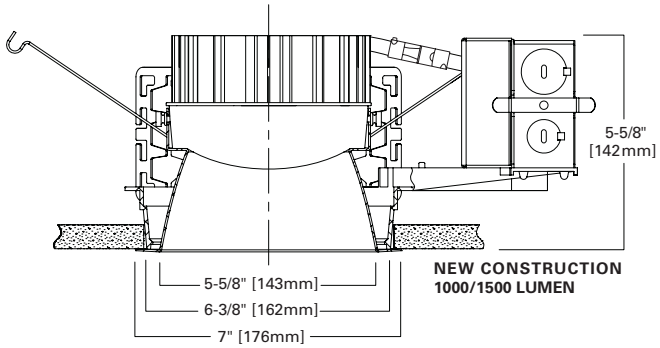
Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

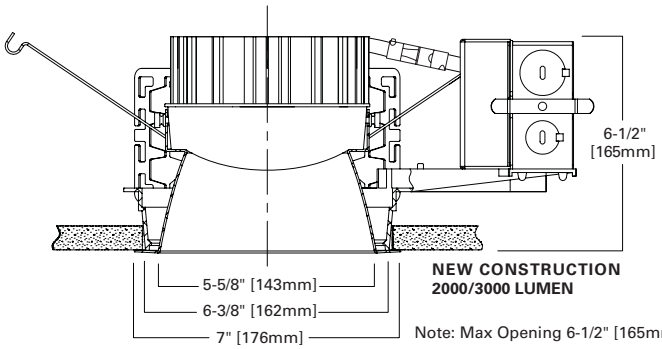
LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 120-277V 0-10V or 120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. IP66 rated when used with IP66 gasket kit accessory. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Title 24 Compliant with designated trims. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

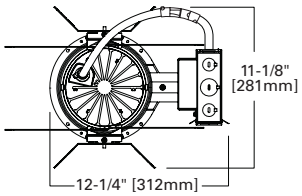
Warranty
5 year warranty.



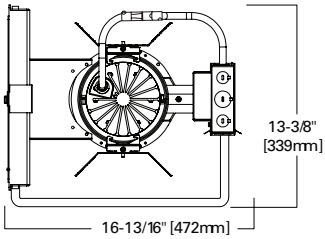


Note: Max Opening 6-1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LW

1000, 1500 Lumen LED

2000, 3000 Lumen LED

6-Inch

Wide Beam Downlight

New Construction

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -30°C (-22°F)	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Voltage: UNV (120V - 277V)	
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)	
3000 Lumen D010TE	
Input Power: 43.6W	THD: <17%
120V Input Current: .37A	277V Input Current: .16A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
2000 Lumen D010TE	
Input Power: 31.5W	THD: <20%
120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
1500 Lumen D010TE	
Input Power: 22.4W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	
1000 Lumen D010TE	
Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	

ENERGY STAR

Can be used to comply with T24 California Non-Residential Lighting Controls requirements

RoHS Compliant

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

CE

powered by fifthlight technology

Cooper Lighting by EATON

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

ORDERING INFORMATION

EXAMPLE: LD6A15D010TE ERW6A15835 6LW1LI=6" LED Wide Reflector Lens, 1500 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

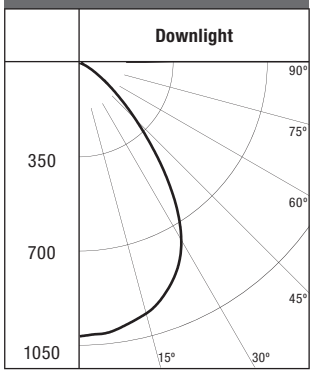
Housing	Lumens[1]	Driver	Options	Power Module	CRI	Color
LD6A=6" Aperture **LD6ACP**=6" Aperture, Chicago Plenum	**10**=1000 Lumens **15**=1500 Lumens **20**=2000 Lumens **30**=3000 Lumens	**1000, 1500, 2000 and 3000 Lumen** **D010TE**=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming **D5LT**=Fifth Light® (DALI) Dimming 1-100% **DE010**=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V **DL3**=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire **DLT**=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming **DMX**=DMX Dimming 1-100% **1000, 1500 and 2000 Lumen** **D010TR**=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming	**EMBOD**=Bodine® Emergency Module with Remote Test Switch[3,4]	**ERW6A10**=6", 1000 Lumen Module for Wide Beam Reflector **ERW6A15**=6", 1500 Lumen Module for Wide Beam Reflector **ERW6A20**=6", 2000 Lumen Module for Wide Beam Reflector **ERW6A30**=6", 3000 Lumen Module for Wide Beam Reflector	**8**=80 CRI **9**=90 CRI	**27**=2700° K **30**=3000° K **35**=3500° K **40**=4000° K **27CP**=2700° K, Chicago Plenum **30CP**=3000° K, Chicago Plenum **35CP**=3500° K, Chicago Plenum **40CP**=4000° K, Chicago Plenum

Reflector	Finish		Options	Accessories
6LW0=6" Wide Beam Reflector, Polymer Trim Ring **6LW1**=6" Wide Beam Reflector, Self-flanged	**LI**=Specular Clear **H**=Semi-Specular Clear **WMH**=Warm Haze **G**=Specular Gold **WH**=Wheat **WHH**=Wheat Haze **GP**=Graphite **GPH**=Graphite Haze	**B**=Specular Black **W**=Gloss White **6LW0 Only** **BB**=Black Baffle **WB**=White Baffle	**Self-flanged Only** **WF**=White Painted Flange	**HB26**=C-channel Bar Hanger, 26" Long, Pair **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair **H347**=347 to 120V Step Down Transformer, 75VA **H347200**=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope **HSA6**=Slope Adapter for 6" Aperture Housings, Specify Slope **TRM6**=Metal Trim Ring, Specify Color[2] **TRR6**=Rimless Trim Ring[2] **DT6**=Deco Trim[2] **LGSKT6IP66**=IP66 Gasket Kit

Notes: **1** Nominal delivered Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.
4 Not CSA approved.

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98323
ERW6A835	6LW1H
Lumens	1463
Efficacy	65.3 Lm/W
Watts	22.4
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	33	6.0
7'	20	7.8
8'	16	9.0
9'	12	10.0
10'	10	11.2
12'	7	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1008
5	1002
15	956
25	845
35	602
45	281
55	98
65	19
75	5
85	0
90	0

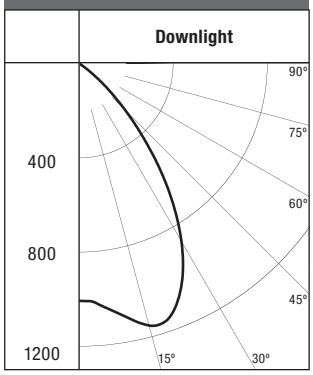
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	750	51.3
0-40	1122	76.7
0-60	1434	98
0-90	1463	100
90-180	0	0
0-180	1463	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	25954
55	11090
65	2964
75	1210
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97443
ERW6A835	6LW1LI
Lumens	1552
Efficacy	69.2 Lm/W
Watts	22.4
CCT	3500K
SC	1.22

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	34.0	6.5
7'	21.0	8.5
8'	16.0	9.5
9'	13.0	11.0
10'	10.5	12.0
12'	7.0	14.5

CANDELA TABLE

Degrees Vertical	Candela
0	1000
5	1021
15	1142
25	1022
35	663
45	267
55	39
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

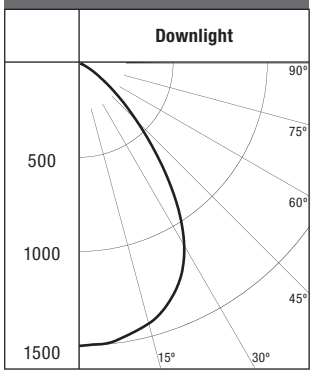
Zone	Lumens	%Fixture
0-30	885	57
0-40	1294	83.4
0-60	1548	99.7
0-90	1552	100
90-180	0	0
0-180	1552	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	24598
55	4425
65	340
75	277
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98615
LD6A20D010TE	ERW6A835 6LW1H
Lumens	2179
Efficacy	69.2 Lm/W
Watts	31.5
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	49	6.0
7'	30	7.8
8'	23	9.0
9'	18	10.0
10'	14	11.2
12'	10	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1491
5	1486
15	1421
25	1258
35	891
45	424
55	147
65	30
75	6
85	1
90	0

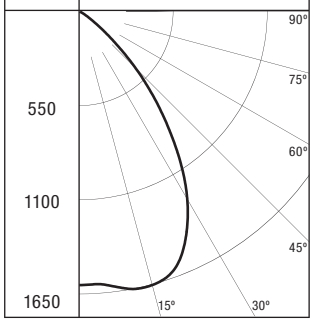
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1114	51.1
0-40	1664	76.4
0-60	2134	98.0
0-90	2179	100
90-180	0	0
0-180	2179	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	39074
55	16709
65	4662
75	1638
85	823

CANDLEPOWER DISTRIBUTION



Test Number	P97715
LD6A20D010TE	ERW6A835 6LW1LI
Lumens	2349
Efficacy	74.6 Lm/W
Watts	31.5
CCT	3500K
SC	1.17

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	52	6.4
7'	32	8.0
8'	24	9.2
9'	19	10.4
10'	15	11.6
12'	11	14.0

CANDELA TABLE

Degrees Vertical	Candela
0	1587
5	1588
15	1641
25	1458
35	989
45	453
55	93
65	5
75	2
85	0
90	0

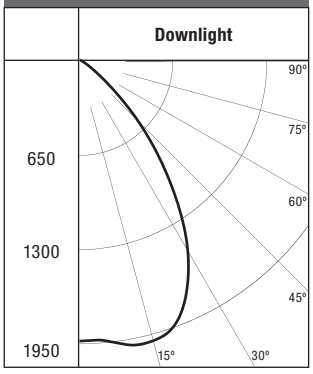
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1280	54.5
0-40	1893	80.6
0-60	2337	99.5
0-90	2349	100
90-180	0	0
0-180	2349	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	35128
55	8927
65	687
75	381
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97731
LD6A30DE010	ERW6A30835 6LW1LI
Lumens	2838 Lm
Efficacy	65 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	39	8
8'	30	9
9'	24	10.5
10'	19	11.5
12'	13	14
15'	8.5	17.5

CANDELA TABLE

Degrees Vertical	Candela
0	1917
5	1919
15	1983
25	1761
35	1195
45	547
55	113
65	6
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

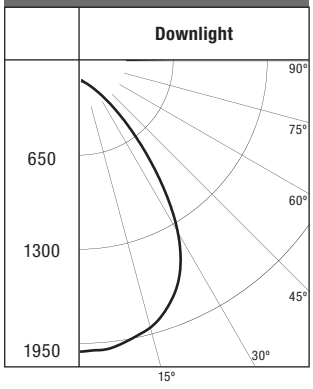
Zone	Lumens	%Fixture
0-30	1546	54.5
0-40	2287	80.5
0-60	2824	99.5
0-90	2838	100
90-180	0	0
0-180	2838	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	42439
55	10791
65	830
75	445
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98631
LD6A30DE010 ERW6A30835 6LW1H	
Lumens	2633 Lm
Efficacy	60.3 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	37	9
8'	28	9
9'	22	10
10'	18	10
12'	12.5	13.5
15'	8	17

CANDELA TABLE

Degrees Vertical	Candela
0	1802
5	1795
15	1717
25	1520
35	1077
45	512
55	178
65	37
75	8
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1347	51
0-40	2011	76.5
0-60	2579	98
0-90	2633	100
90-180	0	0
0-180	2633	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	47212
55	20189
65	5650
75	1966
85	973

EMBOD MULTIPLIER

900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

PORTFOLIO™

DESCRIPTION

6 inch LED recessed medium beam downlight with 50° cut off specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 1000, 1500, 2000 and 3000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A20DL3 ERN6A20835 6LM1LI	**Type**
Project		R11
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

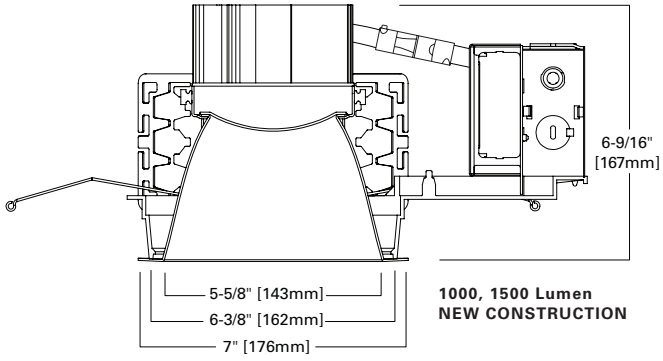
Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

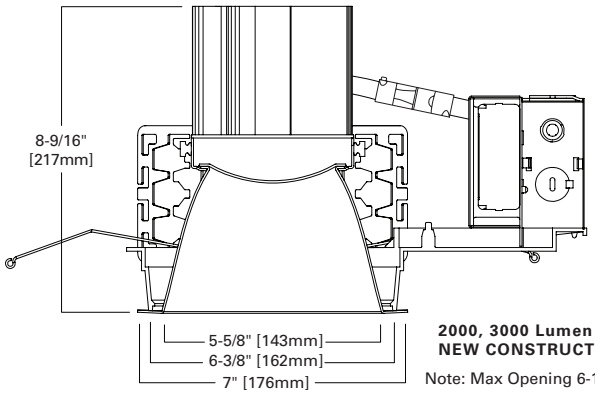
Driver
Combination 120-277V 0-10V or 120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. IP66 rated when used with IP66 gasket kit accessory. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

Warranty
5 year warranty on LED housings, LED Modules and LED Trims.



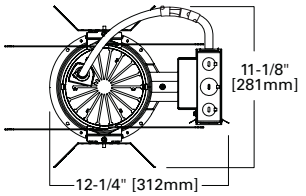
1000, 1500 Lumen NEW CONSTRUCTION



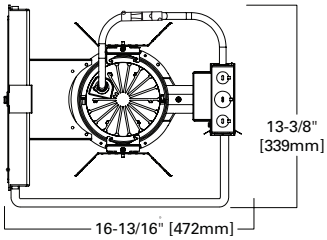
2000, 3000 Lumen NEW CONSTRUCTION

Note: Max Opening 6-1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LM

1000, 1500 Lumen LED
2000, 3000 Lumen LED

6-Inch
Medium Beam Downlight
New Construction

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

powered by fifthlight technology

Cooper Lighting by EATON

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

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ORDERING INFORMATION

EXAMPLE: LD6A15D010TE ERM6A15835 6LM0LI=6" LED Medium Beam Reflector, 1500 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing

LD6A=6" Aperture,
LD6ACP=6" Aperture

Lumens[1]

10=1000 Lumens
15=1500 Lumens
20=2000 Lumens
30=3000 Lumens

Driver

1000, 1500, 2000 and 3000 Lumen
D010TE=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming
D5LT=Fifth Light® (DALI) Dimming 1-100%
DE010=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V
DL3=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire
DLT=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming
DMX=DMX Dimming 1-100%

1000, 1500 and 2000 Lumen
D010TR=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming

Options

EMBOD=Bodine® Emergency Module with Remote Test Switch
IEMBOD=Bodine® Emergency Module with Integral test Switch[3]

Power Module

ERM6A10=6", 1000 Lumen Module for Medium Beam Reflector
ERM6A15=6", 1500 Lumen Module for Medium Beam Reflector
ERM6A20=6", 2000 Lumen Module for Medium Beam Reflector
ERM6A30=6", 3000 Lumen Module for Medium Beam Reflector

CRI

8=80 CRI
9=90 CRI

Color

27=2700° K
30=3000° K
35=3500° K
40=4000° K
27CP=2700° K, Chicago Plenum
30CP=3000° K, Chicago plenum
35CP=3500° K, Chicago Plenum
40CP=4000° K, Chiago Plenum

Reflector

6LM0=6" Medium Reflector, Polymer Trim Ring
6LM1=6" Medium Reflector, Self-flanged
6LM0E=6" Medium Reflector, Polymer Trim Ring for use with IEM Integral Emergency Option
6LM1E=6" Medium Reflector, Self-flanged for use with IEM Integral Emergency Option

Finish

LI=Specular Clear
H=Semi-Specular Clear
WMH=Warm Haze
G=Specular Gold
WH=Wheat
WHH=Wheat Haze
GP=Graphite
GPH=Graphite Haze
B=Specular Black
W=Gloss White

6LM0, 6LM0E Only
BB=Black Baffle
WB=White Baffle

Options

Self-flanged Only
WF=White Painted Flange

Accessories

HB26=C-channel Bar Hanger, 26" Long, Pair
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair
H347=347 To 120V Step Down Transformer, 75VA
H347200=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope
HSA6=Slope Adapter for 6" Aperture Housings, Specify Slope
TRM6=Metal Trim Ring, Specify Color[2]
TRR6=Rimless Trim Ring[2]
DT6=Deco Trim[2]
LGSKT6IP66= P66 Gasket Kit

Notes: **1** Nominal Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.

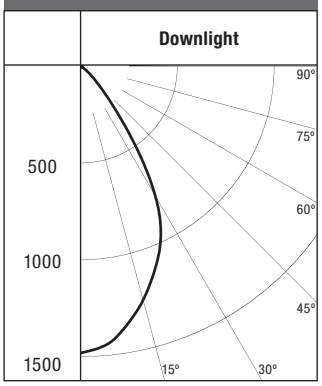
ENERGY

ENERGY DATA			
Sound Rating: Class A standards			
(Values at non-dimming line voltage)			
Minimum Starting Temperature: -30°C (-22°F)			
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)			
Input Voltage: UNV (120V - 277V)			
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)			
3000 Lumen D010TE		**2000 Lumen D010TE**	
Input Power: 43.6W	THD: <17%	Input Power: 31.5W	THD: <20%
120V Input Current: .37A	277V Input Current: .16A	120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz		Input Frequency: 50/60Hz	
1500 Lumen D010TE		**1000 Lumen D010TE**	
Input Power: 22.4W	THD: <20%	Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A	120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz		Input Frequency: 50-60Hz	

	120V		277V	
Lumens	Inrush (A)	Duration (ms)	Inrush (A)	Duration (ms)
900/1000	0.486	0.4	0.848	0.182
1300/1500	0.717	1.58	0.531	1.24
1800/2000	0.832	0.405	1.25	0.788
2800/3000	1.09	0.3	1.23	0.294

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98227
LD6A15D010TE ERM6A835 6LM1H	
Lumens	1347
Efficacy	60.1 Lm/W
Watts	22.4
CCT	3500K
SC	0.92

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	48	5.0
7'	30	6.5
8'	22	7.0
9'	18	8.0
10'	14	9.0
12'	10	11.0

CANDELA TABLE

Degrees Vertical	Candela
0	1468
5	1436
15	1238
25	969
35	468
45	116
55	25
65	8
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

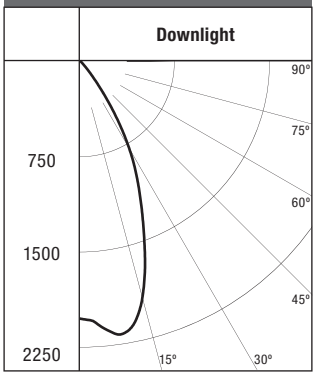
Zone	Lumens	%Fixture
0-30	919	68.2
0-40	1213	90.1
0-60	1336	99.2
0-90	1347	100
90-180	0	0
0-180	1347	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	10749
55	2889
65	1158
75	378
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P97379
LD6A15D010TE ERM6A835 6LM1LI	
Lumens	1509
Efficacy	67.4 Lm/W
Watts	22.4
CCT	3500K
SC	0.83

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	69	4.0
7'	42	5.6
8'	32	6.0
9'	25	7.0
10'	21	8.0
12'	14	9.5

CANDELA TABLE

Degrees Vertical	Candela
0	2018
5	2098
15	1908
25	1097
35	381
45	29
55	4
65	1
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

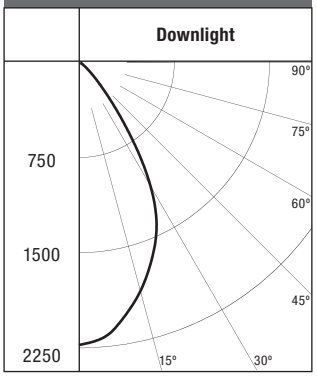
Zone	Lumens	%Fixture
0-30	1225	81.2
0-40	1471	97.5
0-60	1507	99.9
0-90	1509	100
90-180	0	0
0-180	1509	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	2676
55	455
65	154
75	0
85	0

Lumen Output Bodine:...Emergency .45

CANDLEPOWER DISTRIBUTION



Test Number	P98531
LD6A20D010TE ERM6A835 6LM1H	
Lumens	2018
Efficacy	64.1 Lm/W
Watts	31.5
CCT	3500K
SC	0.91

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	73	4.8
7'	45	6.2
8'	34	7.2
9'	27	8.0
10'	22	9.0
12'	15	10.8

CANDELA TABLE

Degrees Vertical	Candela
0	2212
5	2164
15	1855
25	1435
35	698
45	180
55	40
65	12
75	3
85	1
90	0

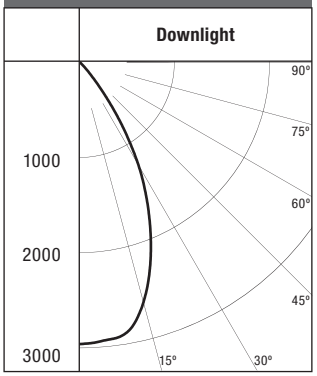
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1370	67.9
0-40	1810	89.7
0-60	2001	99.2
0-90	2018	100
90-180	0	0
0-180	2018	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	16654
55	4504
65	1775
75	781
85	749

CANDLEPOWER DISTRIBUTION



Test Number	P97631
LD6A20D010TE ERM6A835 6LM1LI	
Lumens	2301
Efficacy	73 Lm/W
Watts	31.5
CCT	3500K
SC	0.85

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	97	4.6
7'	60	5.8
8'	45	6.8
9'	36	7.6
10'	29	8.4
12'	20	10.2

CANDELA TABLE

Degrees Vertical	Candela
0	2940
5	2913
15	2588
25	1706
35	694
45	85
55	9
65	4
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

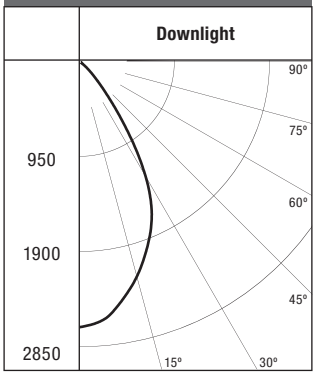
Zone	Lumens	%Fixture
0-30	1768	76.9
0-40	2204	95.8
0-60	2296	99.8
0-90	2301	100
90-180	0	0
0-180	2301	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	6865
55	887
65	487
75	376
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P97647
LD6A30DE010 ERM6A30835 6LM1LI	
Lumens	2809 Lm
Efficacy	64.4 Lm/W
Watts	43.6 W
CCT	3500K
SC	0.8

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	73	6
8'	56	7
9'	44	7.5
10'	36	8.5
12'	25	10
15'	16	12.5

CANDELA TABLE

Degrees Vertical	Candela
0	3589
5	3557
15	3159
25	2082
35	848
45	104
55	11
65	4
75	2
85	0
90	0

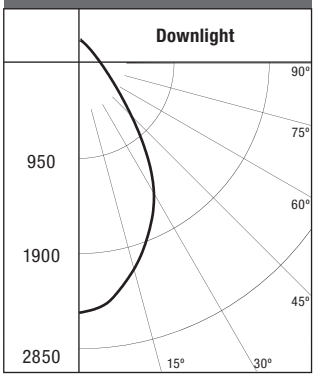
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	2159	77
0-40	2691	96
0-60	2803	100
0-90	2809	100
90-180	0	0
0-180	2809	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	8385
55	1087
65	595
75	464
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P98547
LD6A30DE010 ERM6A30835 6LM1H	
Lumens	2464 Lm
Efficacy	56.5 Lm/W
Watts	43.6 W
CCT	3500K
SC	0.9

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	55	6
8'	42	7
9'	33.5	8
10'	27	9
12'	19	11
15'	12	13.5

CANDELA TABLE

Degrees Vertical	Candela
0	2702
5	2643
15	2266
25	1753
35	853
45	220
55	48
65	14
75	4
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1672	68
0-40	2210	90
0-60	2444	99
0-90	2464	100
90-180	0	0
0-180	2464	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	20335
55	5505
65	2161
75	958
85	973

EMBOD MULTIPLIER

900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

CCT Multiplication Factors		CCT [K]	Multiplier from 3500K	80 -> 90 CRI
80 CRI	1000 Lumen	2700	0.93	
		3000	0.99	
		3500	1.00	
		4000	1.01	
	1500 Lumen	2700	0.93	
		3000	0.99	
		3500	1.00	
		4000	1.01	
90 CRI	1000 Lumen	2700	0.88	0.79
		3000	0.95	0.80
		3500	1.00	0.84
		4000	1.03	0.86
	1500 Lumen	2700	0.88	0.79
		3000	0.94	0.79
		3500	1.00	0.84
		4000	1.03	0.86

PORTFOLIO™

DESCRIPTION

6 inch LED recessed wide beam downlight specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 1000, 1500, 2000, and 3000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A10DL3 ERW6A10835 6LW1LI	**Type** R2
Project		
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

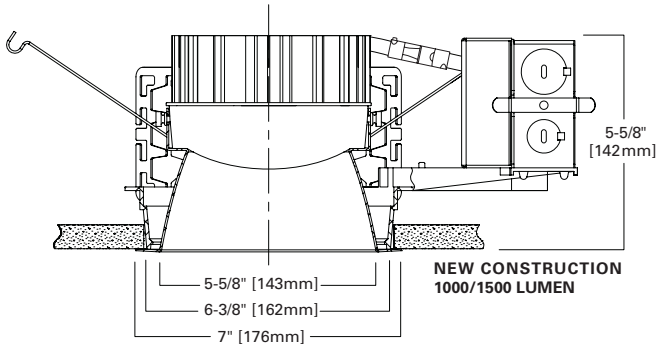
Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

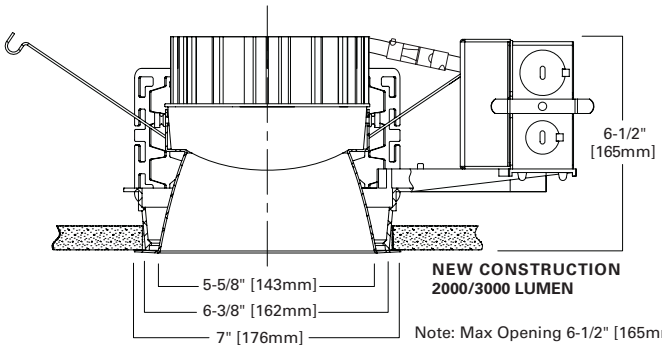
LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 120-277V 0-10V or 120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. IP66 rated when used with IP66 gasket kit accessory. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Title 24 Compliant with designated trims. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

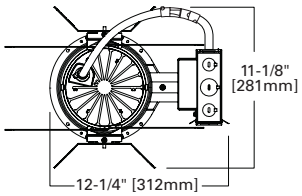
Warranty
5 year warranty.



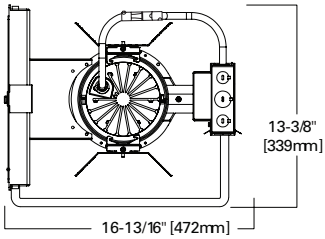


Note: Max Opening 6-1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LW

1000, 1500 Lumen LED

2000, 3000 Lumen LED

6-Inch

Wide Beam Downlight

New Construction

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -30°C (-22°F)	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Voltage: UNV (120V - 277V)	
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)	
3000 Lumen D010TE	
Input Power: 43.6W	THD: <17%
120V Input Current: .37A	277V Input Current: .16A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
2000 Lumen D010TE	
Input Power: 31.5W	THD: <20%
120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
1500 Lumen D010TE	
Input Power: 22.4W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	
1000 Lumen D010TE	
Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	

ENERGY STAR

Can be used to comply with T24 California Non-Residential Lighting Controls requirements

RoHS Compliant

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

CE

powered by fifthlight technology

Cooper Lighting by EATON

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

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ORDERING INFORMATION

EXAMPLE: LD6A15D010TE ERW6A15835 6LW1LI=6" LED Wide Reflector Lens, 1500 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

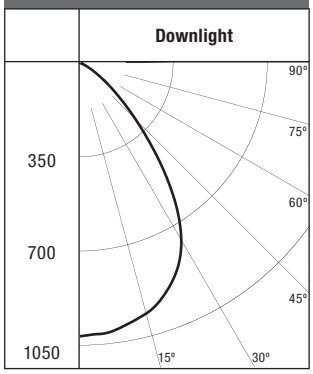
Housing	Lumens[1]	Driver	Options	Power Module	CRI	Color
LD6A=6" Aperture **LD6ACP**=6" Aperture, Chicago Plenum	**10**=1000 Lumens **15**=1500 Lumens **20**=2000 Lumens **30**=3000 Lumens	**1000, 1500, 2000 and 3000 Lumen** **D010TE**=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming **D5LT**=Fifth Light® (DALI) Dimming 1-100% **DE010**=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V **DL3**=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire **DLT**=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming **DMX**=DMX Dimming 1-100% **1000, 1500 and 2000 Lumen** **D010TR**=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming	**EMBOD**=Bodine® Emergency Module with Remote Test Switch[3,4]	**ERW6A10**=6", 1000 Lumen Module for Wide Beam Reflector **ERW6A15**=6", 1500 Lumen Module for Wide Beam Reflector **ERW6A20**=6", 2000 Lumen Module for Wide Beam Reflector **ERW6A30**=6", 3000 Lumen Module for Wide Beam Reflector	**8**=80 CRI **9**=90 CRI	**27**=2700° K **30**=3000° K **35**=3500° K **40**=4000° K **27CP**=2700° K, Chicago Plenum **30CP**=3000° K, Chicago Plenum **35CP**=3500° K, Chicago Plenum **40CP**=4000° K, Chicago Plenum

Reflector	Finish	Options	Accessories
6LW0=6" Wide Beam Reflector, Polymer Trim Ring **6LW1**=6" Wide Beam Reflector, Self-flanged	**LI**=Specular Clear **H**=Semi-Specular Clear **WMH**=Warm Haze **G**=Specular Gold **WH**=Wheat **WHH**=Wheat Haze **GP**=Graphite **GPH**=Graphite Haze **B**=Specular Black **W**=Gloss White **6LW0 Only** **BB**=Black Baffle **WB**=White Baffle	**Self-flanged Only** **WF**=White Painted Flange	**HB26**=C-channel Bar Hanger, 26" Long, Pair **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair **H347**=347 to 120V Step Down Transformer, 75VA **H347200**=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope **HSA6**=Slope Adapter for 6" Aperture Housings, Specify Slope **TRM6**=Metal Trim Ring, Specify Color[2] **TRR6**=Rimless Trim Ring[2] **DT6**=Deco Trim[2] **LGSKT6IP66**=IP66 Gasket Kit

Notes: **1** Nominal delivered Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.
4 Not CSA approved.

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98323
ERW6A835	6LW1H
Lumens	1463
Efficacy	65.3 Lm/W
Watts	22.4
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	33	6.0
7'	20	7.8
8'	16	9.0
9'	12	10.0
10'	10	11.2
12'	7	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1008
5	1002
15	956
25	845
35	602
45	281
55	98
65	19
75	5
85	0
90	0

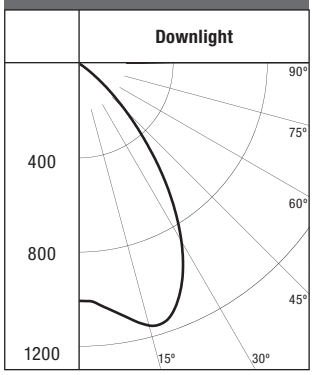
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	750	51.3
0-40	1122	76.7
0-60	1434	98
0-90	1463	100
90-180	0	0
0-180	1463	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	25954
55	11090
65	2964
75	1210
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97443
ERW6A835	6LW1LI
Lumens	1552
Efficacy	69.2 Lm/W
Watts	22.4
CCT	3500K
SC	1.22

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	34.0	6.5
7'	21.0	8.5
8'	16.0	9.5
9'	13.0	11.0
10'	10.5	12.0
12'	7.0	14.5

CANDELA TABLE

Degrees Vertical	Candela
0	1000
5	1021
15	1142
25	1022
35	663
45	267
55	39
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

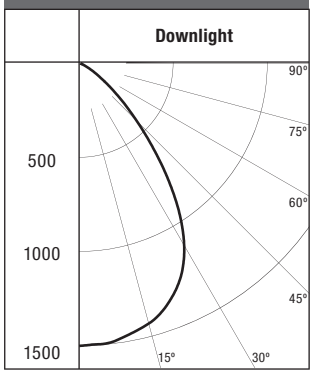
Zone	Lumens	%Fixture
0-30	885	57
0-40	1294	83.4
0-60	1548	99.7
0-90	1552	100
90-180	0	0
0-180	1552	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	24598
55	4425
65	340
75	277
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98615
LD6A20D010TE	ERW6A835 6LW1H
Lumens	2179
Efficacy	69.2 Lm/W
Watts	31.5
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	49	6.0
7'	30	7.8
8'	23	9.0
9'	18	10.0
10'	14	11.2
12'	10	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1491
5	1486
15	1421
25	1258
35	891
45	424
55	147
65	30
75	6
85	1
90	0

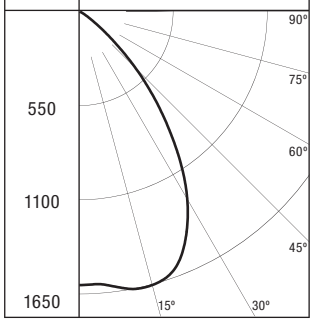
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1114	51.1
0-40	1664	76.4
0-60	2134	98.0
0-90	2179	100
90-180	0	0
0-180	2179	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	39074
55	16709
65	4662
75	1638
85	823

CANDLEPOWER DISTRIBUTION



Test Number	P97715
LD6A20D010TE	ERW6A835 6LW1LI
Lumens	2349
Efficacy	74.6 Lm/W
Watts	31.5
CCT	3500K
SC	1.17

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	52	6.4
7'	32	8.0
8'	24	9.2
9'	19	10.4
10'	15	11.6
12'	11	14.0

CANDELA TABLE

Degrees Vertical	Candela
0	1587
5	1588
15	1641
25	1458
35	989
45	453
55	93
65	5
75	2
85	0
90	0

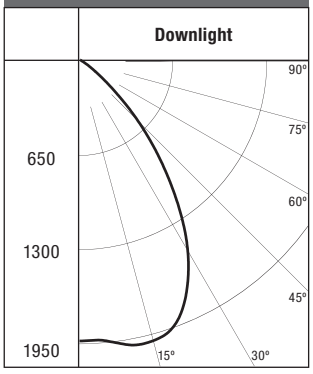
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1280	54.5
0-40	1893	80.6
0-60	2337	99.5
0-90	2349	100
90-180	0	0
0-180	2349	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	35128
55	8927
65	687
75	381
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97731
LD6A30DE010	ERW6A30835 6LW1LI
Lumens	2838 Lm
Efficacy	65 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	39	8
8'	30	9
9'	24	10.5
10'	19	11.5
12'	13	14
15'	8.5	17.5

CANDELA TABLE

Degrees Vertical	Candela
0	1917
5	1919
15	1983
25	1761
35	1195
45	547
55	113
65	6
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

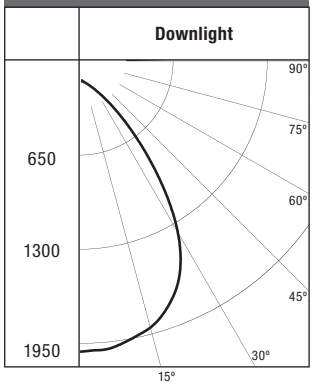
Zone	Lumens	%Fixture
0-30	1546	54.5
0-40	2287	80.5
0-60	2824	99.5
0-90	2838	100
90-180	0	0
0-180	2838	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	42439
55	10791
65	830
75	445
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98631
LD6A30DE010 ERW6A30835 6LW1H	
Lumens	2633 Lm
Efficacy	60.3 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	37	9
8'	28	9
9'	22	10
10'	18	10
12'	12.5	13.5
15'	8	17

CANDELA TABLE

Degrees Vertical	Candela
0	1802
5	1795
15	1717
25	1520
35	1077
45	512
55	178
65	37
75	8
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1347	51
0-40	2011	76.5
0-60	2579	98
0-90	2633	100
90-180	0	0
0-180	2633	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	47212
55	20189
65	5650
75	1966
85	973

EMBOD MULTIPLIER

900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

PORTFOLIO™

DESCRIPTION

6 inch LED recessed wide beam downlight specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 1000, 1500, 2000, and 3000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A15DL3 ERW6A15835 6LW1LI	**Type**
Project		R3
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

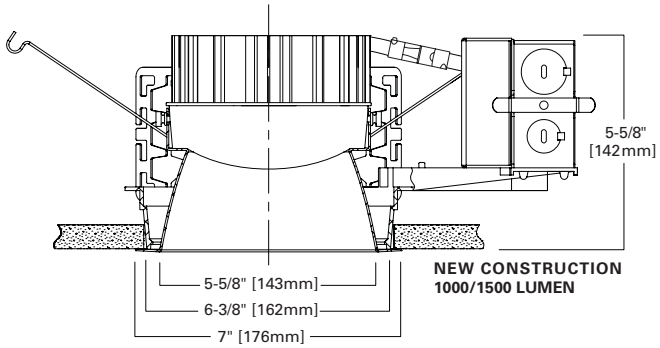
Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

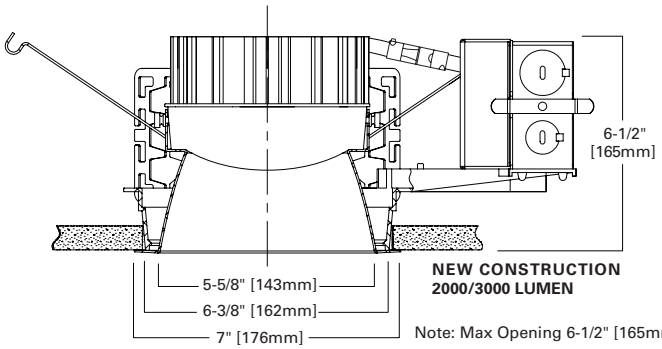
LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 120-277V 0-10V or 120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. IP66 rated when used with IP66 gasket kit accessory. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Title 24 Compliant with designated trims. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

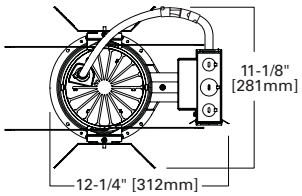
Warranty
5 year warranty.



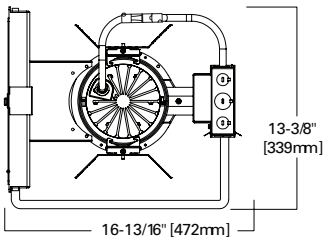


Note: Max Opening 6-1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LW

1000, 1500 Lumen LED

2000, 3000 Lumen LED

6-Inch

Wide Beam Downlight

New Construction

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -30°C (-22°F)	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Voltage: UNV (120V - 277V)	
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)	
3000 Lumen D010TE	
Input Power: 43.6W	THD: <17%
120V Input Current: .37A	277V Input Current: .16A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
2000 Lumen D010TE	
Input Power: 31.5W	THD: <20%
120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz	
1500 Lumen D010TE	
Input Power: 22.4W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	
1000 Lumen D010TE	
Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz	

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

powered by fifthlight technology

ADP100519
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Cooper Lighting by EATON

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

ORDERING INFORMATION

EXAMPLE: LD6A15D010TE ERW6A15835 6LW1LI=6" LED Wide Reflector Lens, 1500 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing

LD6A=6" Aperture
LD6ACP=6" Aperture, Chicago Plenum

Lumens[1]

10=1000 Lumens
15=1500 Lumens
20=2000 Lumens
30=3000 Lumens

Driver

1000, 1500, 2000 and 3000 Lumen
D010TE=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming
D5LT=Fifth Light® (DALI) Dimming 1-100%
DE010=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V
DL3=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire
DLT=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming
DMX=DMX Dimming 1-100%

1000, 1500 and 2000 Lumen
D010TR=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming

Options

EMBOD=Bodine® Emergency Module with Remote Test Switch[3,4]

Power Module

ERW6A10=6", 1000 Lumen Module for Wide Beam Reflector
ERW6A15=6", 1500 Lumen Module for Wide Beam Reflector
ERW6A20=6", 2000 Lumen Module for Wide Beam Reflector
ERW6A30=6", 3000 Lumen Module for Wide Beam Reflector

CRI

8=80 CRI
9=90 CRI

Color

27=2700° K
30=3000° K
35=3500° K
40=4000° K
27CP=2700° K, Chicago Plenum
30CP=3000° K, Chicago Plenum
35CP=3500° K, Chicago Plenum
40CP=4000° K, Chicago Plenum

Reflector

6LW0=6" Wide Beam Reflector, Polymer Trim Ring
6LW1=6" Wide Beam Reflector, Self-flanged

Finish

LI=Specular Clear
H=Semi-Specular Clear
WMH=Warm Haze
G=Specular Gold
WH=Wheat
WHH=Wheat Haze
GP=Graphite
GPH=Graphite Haze
B=Specular Black
W=Gloss White

6LW0 Only
BB=Black Baffle
WB=White Baffle

Options

Self-flanged Only
WF=White Painted Flange

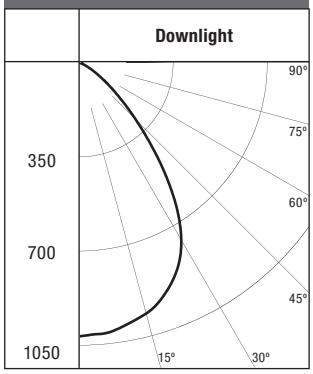
Accessories

HB26=C-channel Bar Hanger, 26" Long, Pair
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair
H347=347 to 120V Step Down Transformer, 75VA
H347200=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope
HSA6=Slope Adapter for 6" Aperture Housings, Specify Slope
TRM6=Metal Trim Ring, Specify Color[2]
TRR6=Rimless Trim Ring[2]
DT6=Deco Trim[2]
LGSKT6IP66=IP66 Gasket Kit

Notes: **1** Nominal delivered Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.
4 Not CSA approved.

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98323
ERW6A835	6LW1H
Lumens	1463
Efficacy	65.3 Lm/W
Watts	22.4
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	33	6.0
7'	20	7.8
8'	16	9.0
9'	12	10.0
10'	10	11.2
12'	7	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1008
5	1002
15	956
25	845
35	602
45	281
55	98
65	19
75	5
85	0
90	0

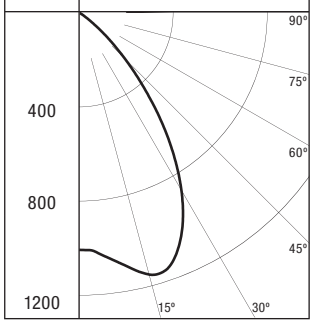
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	750	51.3
0-40	1122	76.7
0-60	1434	98
0-90	1463	100
90-180	0	0
0-180	1463	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	25954
55	11090
65	2964
75	1210
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97443
ERW6A835	6LW1LI
Lumens	1552
Efficacy	69.2 Lm/W
Watts	22.4
CCT	3500K
SC	1.22

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	34.0	6.5
7'	21.0	8.5
8'	16.0	9.5
9'	13.0	11.0
10'	10.5	12.0
12'	7.0	14.5

CANDELA TABLE

Degrees Vertical	Candela
0	1000
5	1021
15	1142
25	1022
35	663
45	267
55	39
65	2
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

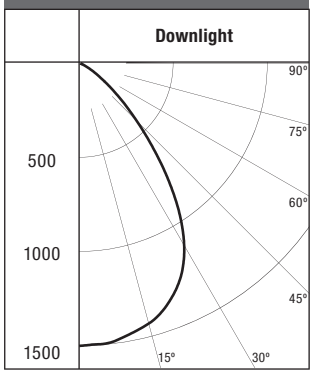
Zone	Lumens	%Fixture
0-30	885	57
0-40	1294	83.4
0-60	1548	99.7
0-90	1552	100
90-180	0	0
0-180	1552	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	24598
55	4425
65	340
75	277
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98615
LD6A20D010TE	ERW6A835 6LW1H
Lumens	2179
Efficacy	69.2 Lm/W
Watts	31.5
CCT	3500K
SC	1.13

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	49	6.0
7'	30	7.8
8'	23	9.0
9'	18	10.0
10'	14	11.2
12'	10	13.4

CANDELA TABLE

Degrees Vertical	Candela
0	1491
5	1486
15	1421
25	1258
35	891
45	424
55	147
65	30
75	6
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1114	51.1
0-40	1664	76.4
0-60	2134	98.0
0-90	2179	100
90-180	0	0
0-180	2179	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	39074
55	16709
65	4662
75	1638
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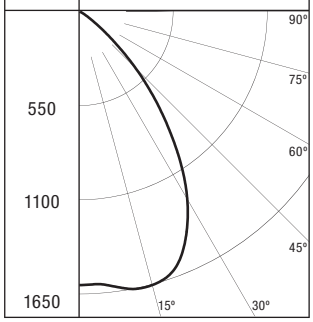
CANDLEPOWER DISTRIBUTION



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LD6A20D010TE	ERW6A835 6LW1LI
Lumens	2349
Efficacy	74.6 Lm/W
Watts	31.5
CCT	3500K
SC	1.17

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
5'5"	52	6.4
7'	32	8.0
8'	24	9.2
9'	19	10.4
10'	15	11.6
12'	11	14.0

CANDELA TABLE

Degrees Vertical	Candela
0	1587
5	1588
15	1641
25	1458
35	989
45	453
55	93
65	5
75	2
85	0
90	0

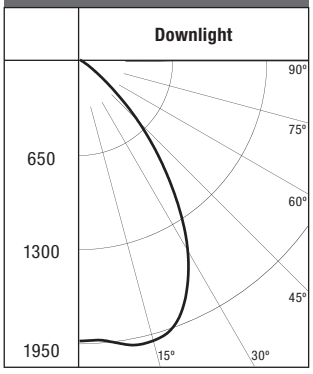
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1280	54.5
0-40	1893	80.6
0-60	2337	99.5
0-90	2349	100
90-180	0	0
0-180	2349	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	35128
55	8927
65	687
75	381
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P97731
LD6A30DE010	ERW6A30835 6LW1LI
Lumens	2838 Lm
Efficacy	65 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	39	8
8'	30	9
9'	24	10.5
10'	19	11.5
12'	13	14
15'	8.5	17.5

CANDELA TABLE

Degrees Vertical	Candela
0	1917
5	1919
15	1983
25	1761
35	1195
45	547
55	113
65	6
75	2
85	0
90	0

ZONAL LUMEN SUMMARY

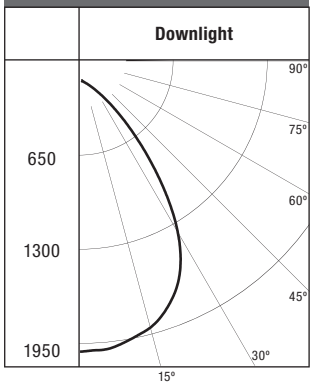
Zone	Lumens	%Fixture
0-30	1546	54.5
0-40	2287	80.5
0-60	2824	99.5
0-90	2838	100
90-180	0	0
0-180	2838	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	42439
55	10791
65	830
75	445
85	0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P98631
LD6A30DE010 ERW6A30835 6LW1H	
Lumens	2633 Lm
Efficacy	60.3 Lm/W
Watts	43.6 W
CCT	3500K
SC	1.1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
7'	37	9
8'	28	9
9'	22	10
10'	18	10
12'	12.5	13.5
15'	8	17

CANDELA TABLE

Degrees Vertical	Candela
0	1802
5	1795
15	1717
25	1520
35	1077
45	512
55	178
65	37
75	8
85	1
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	1347	51
0-40	2011	76.5
0-60	2579	98
0-90	2633	100
90-180	0	0
0-180	2633	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	47212
55	20189
65	5650
75	1966
85	973

EMBOD MULTIPLIER

900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

PORTFOLIO™

DESCRIPTION

6 inch LED recessed wall wash specially designed for LED technology. Two-stage reflector system combined with a Gradient Kicker, produces high levels of uniform vertical illumination on the wall with no flashback or glare. Color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD6A10DL3 ERM6A10835 6LM111LI	**Type**
Project		R4
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Wall Wash Reflector
Self-flanged, spun .050" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
New Construction Housing: Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

Thermal
Extruded aluminum heat sink conducts heat away from the LED module for optimal performance and long life.

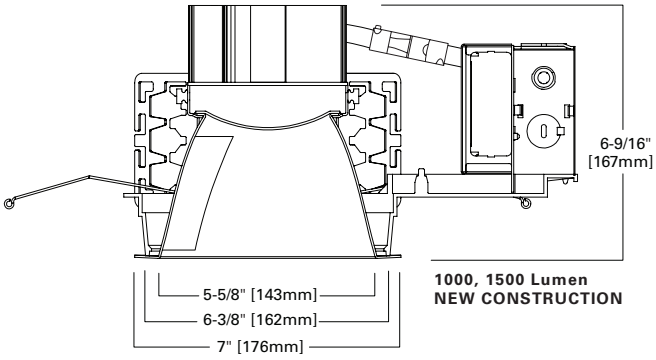
LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Auto resetting, thermally protected, LED's are turned off when safe operating temperatures are exceeded. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

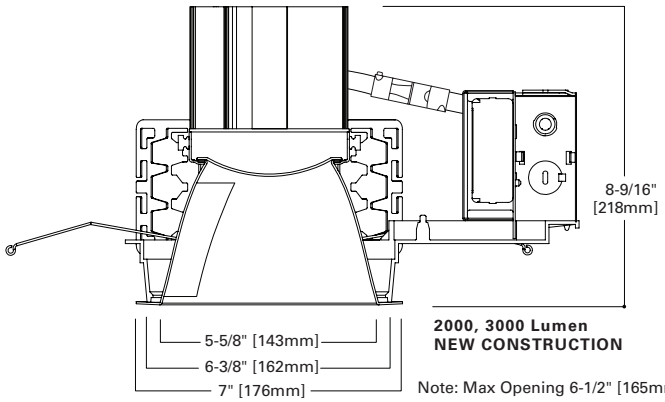
Driver
Combination 120-277V 0-10V or 120V trailing edge phase cut driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Environmental
Fixture should not be operated in ambient temperatures above 40° C.

Code Compliance
Thermally protected and cULus listed for protected damp locations. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Title 24 Compliant with designated trims. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

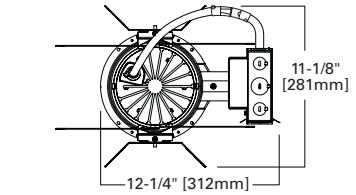
Warranty
5 year warranty.



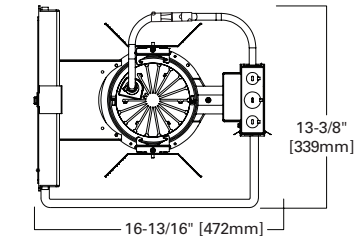


Note: Max Opening 6-1/2" [165mm]

TOP VIEW - NEW CONSTRUCTION



TOP VIEW - NEW CONSTRUCTION WITH BATTERY



LD6A10 LD6A15 LD6A20 LD6A30 6LM111

1000, 1500 Lumen LED

2000, 3000 Lumen LED

6-Inch

Medium Beam Wall Wash

New Construction

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements. Certified to California Title 20 Appliance Efficiency Database.

powered by fifthlight technology

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Cooper Lighting by EATON

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

ORDERING INFORMATION

EXAMPLE: LD6A20D010TE ERM6A20835 6LM111LI=6" LED Medium Beam Wall Wash, 2000 Lumen 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing

LD6A=6" Aperture
LD6ACP=6" Aperture, Chicago Plenum

Lumens[1]

10=1000 Lumens
15=1500 Lumens
20=2000 Lumens
30=3000 Lumens

Driver

1000, 1500, 2000 and 3000 Lumen
D010TE=120-277V 0-10V 10% Dimming or Trailing Edge 120V Dimming
D5LT=Fifth Light® (DALI) Dimming 1-100%
DE010=1 to 100% Dimming, 120-277V 50/60Hz, 0-10V
DL3=1 to 100% Dimming, 120-277V Lutron® Hi-Lume, Ecosystem or 3 Wire
DLT=1 to 100% Dimming, 120V Lutron® Hi-Lume Forward Phase Dimming
DMX=DMX Dimming 1-100%

1000, 1500 and 2000 Lumen
D010TR=120-277V 0-10V 10% Dimming or Leading Edge 120V Dimming

Options

EMBOD=Bodine® Emergency Module with Remote Test Switch[3]

Power Module

ERM6A10=6", 1000 Lumen Module for Medium Beam Reflector
ERM6A15=6", 1500 Lumen Module for Medium Beam Reflector
ERM6A20=6", 2000 Lumen Module for Medium Beam Reflector
ERM6A30=6", 3000 Lumen Module for Medium Beam Reflector

CRI

8=80 CRI
9=90 CRI

Color

27=2700° K
30=3000° K
35=3500° K
40=4000° K
27CP=2700° K, Chicago Plenum
30CP=3000° K, Chicago Plenum
35CP=3500° K, Chicago Plenum
40CP=4000° K, Chicago Plenum

Reflector

6LM111= 6" Medium Reflector, Single Wall Wash, Self-flanged
6LM121=6" Medium Reflector, Double Wall Wash, Self-flanged
6LM110=6" Medium Reflector, Single Wall Wash, Polymer Trim Ring
6LM120=6" Medium Reflector, Double Wall Wash, Polymer Trim Ring

Finish

LI=Specular Clear
H=Semi-Specular Clear
WMH=Warm Haze
G=Specular Gold
WH=Wheat
WHH=Wheat Haze
GP=Graphite
GPH=Graphite Haze
B=Specular Black
W=Gloss White

Options

Self-flanged Only
WF=White Painted Flange

Accessories

HB26=C-channel Bar Hanger, 26" Long, Pair
HB50=C-channel Bar Hanger, 50" Long, Pair
RMB22=Wood Joist Bar Hanger, 22" Long, Pair
H347=347 to 120V Step Down Transformer, 75VA
H347200=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope
TRM6=Metal Trim Ring, Specify Color[2]
TRR6=Rimless Trim Ring[2]
DT6=Deco Trim[2]
LGSKT6IP66=IP66 Gasket Kit

Notes: **1** Nominal Lumens will vary depending on selected color, driver and reflector finish.
2 Order trim with polymer trim ring (Consult specification sheet for color ordering information and options).
3 Not available with Chicago Plenum.

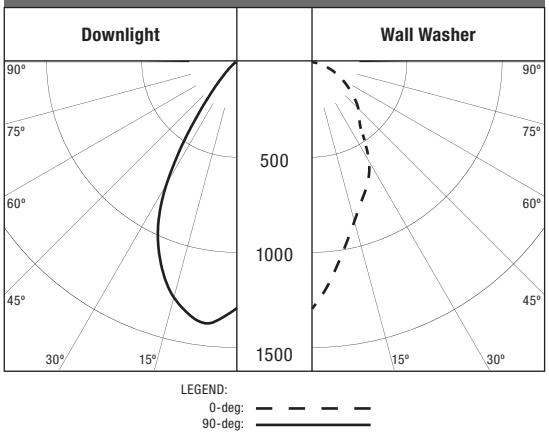
ENERGY

ENERGY DATA			
Sound Rating: Class A standards			
(Values at non-dimming line voltage)			
Minimum Starting Temperature: -30°C (-22°F)			
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)			
Input Voltage: UNV (120V - 277V)			
Power Factor: >0.90 (at nominal input 120-277 VAC & 100% of Rated Output Power)			
3000 Lumen D010TE		**2000 Lumen D010TE**	
Input Power: 43.6W	THD: <17%	Input Power: 31.5W	THD: <20%
120V Input Current: .37A	277V Input Current: .16A	120V Input Current: .27A	277V Input Current: .12A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50/60Hz		Input Frequency: 50/60Hz	
1500 Lumen D010TE		**1000 Lumen D010TE**	
Input Power: 22.4W	THD: <20%	Input Power: 14.1W	THD: <20%
120V Input Current: .12A	277V Input Current: .09A	120V Input Current: .12A	277V Input Current: .06A
Maximum Non-IC Ambient Continuous		Maximum Non-IC Ambient Continuous	
Input Frequency: 50-60Hz		Input Frequency: 50-60Hz	

	120V		277V	
Lumens	Inrush (A)	Duration (ms)	Inrush (A)	Duration (ms)
900/1000	0.486	0.4	0.848	0.182
1300/1500	0.717	1.58	0.531	1.24
1800/2000	0.832	0.405	1.25	0.788
2800/3000	1.09	0.3	1.23	0.294

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION

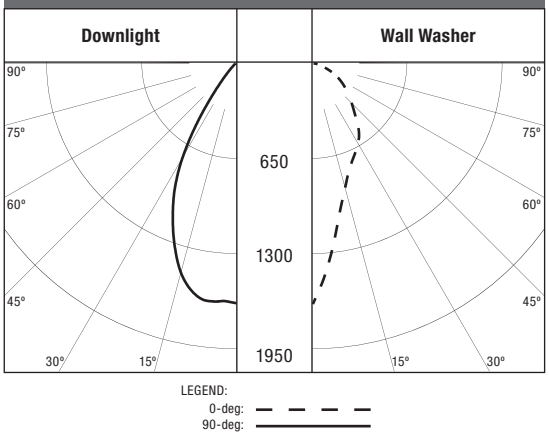


Test Number	P98259
Platform	LD6A15D010TE
Element	ERM6A835 6LM111H
Lumens	1386
Efficacy	61.8 Lm/W
Watts	21.8
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD	●	1'	2'	3'	●	2'	●	●	3'	●	●	2'	●	●	3'	●
1'	7.2	5.2	2.5	1.0	18.1	19.5	18.1	15.5	12.9	15.5	9.7	10.5	9.7	8.2	7.3	8.2
2'	13.9	11.9	7.5	4.0	29.8	33.4	29.8	24.8	25.6	24.8	21.4	23.9	21.4	18.0	19.4	18.0
3'	13.4	11.9	8.2	4.7	25.4	28.7	25.4	20.7	24.0	20.7	21.6	23.9	21.6	18.1	20.5	18.1
4'	10.1	9.4	7.1	4.6	20.5	22.6	20.5	17.1	19.1	17.1	17.3	18.7	17.3	14.7	16.8	14.7
5'	8.6	7.9	6.0	4.0	16.1	17.5	16.1	13.4	15.8	13.4	14.6	15.8	14.6	12.6	14.1	12.6
6'	6.6	6.2	5.2	3.7	11.9	12.6	11.9	10.3	11.8	10.3	11.8	12.5	11.8	10.3	11.6	10.3
7'	4.9	4.7	4.2	3.3	8.7	9.0	8.7	7.9	8.7	7.9	9.0	9.4	9.0	8.2	9.0	8.2
8'	3.6	3.5	3.2	2.8	6.5	6.7	6.5	6.1	6.4	6.1	6.9	7.1	6.9	6.4	6.9	6.4
9'	2.8	2.7	2.5	2.3	5.0	5.1	5.0	4.7	4.9	4.7	5.3	5.4	5.3	5.0	5.3	5.0
10'	2.2	2.1	2.0	1.8	3.9	3.9	3.9	3.7	3.8	3.7	4.2	4.3	4.2	4.0	4.2	4.0

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION

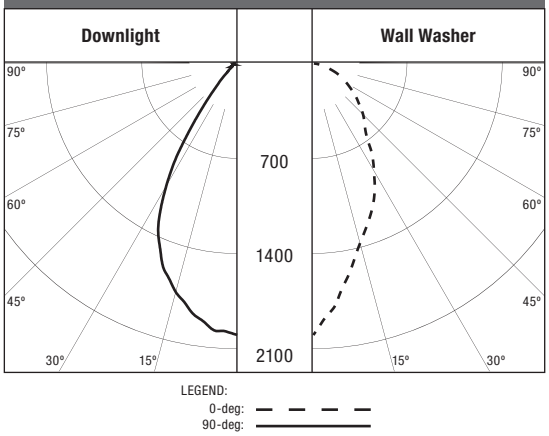


LEGEND:
0-deg: — — — —
90-deg: ————

Test Number	P97411
Platform	LD6A15D010TE
Element	ERM6A835 6LM111LI
Lumens	1479
Efficacy	66.0 Lm/W
Watts	21.8
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD	●	1'	2'	3'	●	2'	●	●	3'	●	●	2'	●	●	3'	●
1'	5.8	4.9	2.4	0.9	16.5	19.3	16.5	13.9	12.9	13.9	8.3	9.8	8.3	6.8	7.3	6.8
2'	15.0	12.4	7.5	4.0	31.3	35.0	31.3	26.2	26.4	26.2	22.4	24.8	22.4	19.0	19.9	19.0
3'	14.3	12.7	8.5	4.8	27.9	31.1	27.9	23.1	25.1	23.1	22.8	25.4	22.8	19.1	21.5	19.1
4'	11.9	10.7	7.5	4.5	22.1	25.1	22.1	18.1	21.2	18.1	19.4	21.3	19.4	16.4	18.4	16.4
5'	9.1	8.6	6.6	4.1	16.6	17.9	16.6	13.3	16.7	13.3	15.7	17.3	15.7	13.2	15.7	13.2
6'	6.5	6.3	5.6	3.9	12.0	12.5	12.0	10.3	12.1	10.3	12.1	12.6	12.1	10.4	12.1	10.4
7'	4.7	4.7	4.3	3.5	8.7	9.0	8.7	7.9	8.8	7.9	9.0	9.3	9.0	8.2	9.1	8.2
8'	3.5	3.5	3.3	2.9	6.6	6.7	6.6	6.2	6.6	6.2	6.9	7.0	6.9	6.4	6.9	6.4
9'	2.7	2.7	2.6	2.4	5.1	5.2	5.1	4.8	5.2	4.8	5.3	5.4	5.3	5.1	5.4	5.1
10'	2.1	2.1	2.1	2.0	4.0	4.1	4.0	3.9	4.1	3.9	4.2	4.3	4.2	4.1	4.3	4.1

CANDLEPOWER DISTRIBUTION

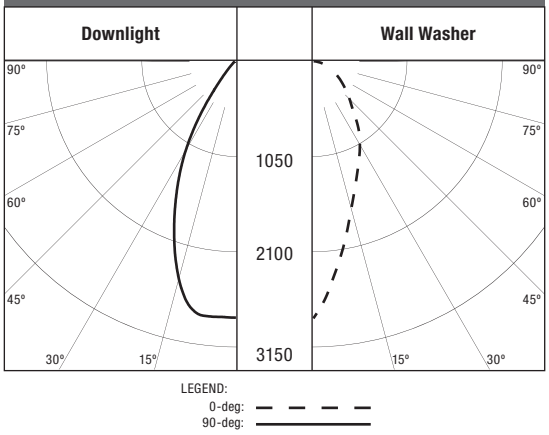


LEGEND:
0-deg: — — — —
90-deg: ————

Test Number	P98559
LD6A20D010TE	ERM6A835 6LM111H
Lumens	2160
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD		1'	2'	3'		2'			3'			2'			3'	
1'	11	9	5	1	129	32	29	25	23	25	16	18	16	13	13	13
2'	21	17	11	5	44	49	44	36	37	36	32	35	32	26	28	26
3'	19	17	12	6	38	43	38	31	35	31	32	34	32	26	30	26
4'	15	14	10	6	31	34	31	26	29	26	26	28	26	21	25	21
5'	12	12	9	6	24	26	24	20	23	20	22	24	22	18	21	18
6'	9	9	8	5	18	19	18	15	18	15	17	18	17	15	17	15
7'	7	7	6	5	13	14	13	12	13	12	14	14	14	12	13	12
8'	5	5	5	4	10	10	10	9	10	9	10	11	10	9	10	9
9'	4	4	4	3	7	8	7	7	7	7	8	8	8	7	8	7
10'	3	3	3	2	6	6	6	5	6	5	6	6	6	6	6	6

CANDLEPOWER DISTRIBUTION



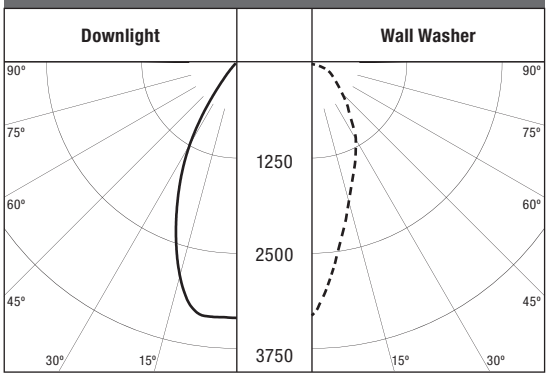
LEGEND:
0-deg: — — — —
90-deg: ————

Test Number	P97659
LD6A20D010TE	ERM6A835 6LM111LI
Lumens	2330
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD		1'	2'	3'		2'			3'			2'			3'	
1'	11	8	4	1	27	29	27	23	19	23	15	16	15	12	11	12
2'	21	18	11	5	46	51	46	38	39	38	33	36	33	27	29	27
3'	21	18	12	6	41	46	41	34	37	34	33	37	33	28	31	28
4'	18	16	11	6	35	39	35	28	33	28	29	32	29	24	27	24
5'	15	13	10	6	27	29	27	22	27	22	25	27	25	21	24	21
6'	11	10	9	6	20	21	20	17	20	17	20	21	20	17	19	17
7'	8	8	7	5	15	16	15	13	15	13	15	16	15	14	15	14
8'	6	6	5	4	11	12	11	10	11	10	12	12	12	11	12	11
9'	5	5	4	3	9	9	9	8	9	8	9	9	9	9	9	9
10'	4	4	3	3	7	7	7	7	7	7	7	8	7	7	7	7

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



LEGEND:
0-deg: — — — —
90-deg: ——————

Test Number	P97675
LD6A30DE010 ERM6A30835 6LM111LI	
Lumens	2795 Lm
Watts	39.6 W
CCT	3500K

SINGLE UNIT FOOTCANDLES				
	3' FROM WALL (Distance From Fixture Along Wall)			
DD		1'	2'	3'
1'	13	9.5	5	2
2'	26	22	13	7
3'	26	22	15	8
4'	22	19.5	13	7
5'	18	16.5	12	7
6'	13.5	12	10	7
7'	10	9	8.5	6
8'	8	7.5	7	5.5
9'	6	6	5.5	4
10'	5	5	4.5	4

MULTIPLE UNIT FOOTCANDLES												
	2' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
	2'			3'			2'			3'		
1'	61	63.9	61.7	53	39	53	18	19	18	15	14	15
2'	76.5	84.5	76.5	64	58	64	40	44	39.9	33	36	33
3'	62	71	62	51.5	51	51.5	40.5	44	40.5	34	37.5	33.9
4'	46	53.5	46	36.5	45	36.5	35.5	39	35.5	29	33	29
5'	34	37	34	27	33	27	30.5	33	30.5	25	29	25
6'	24	26	24	21	24	21	24	25.5	24	21	24	21
7'	18	19	18	16	18	16	18	19.5	18	17	18.5	17
8'	13.5	14	13.5	12	13.5	12	14.5	15	14.5	13.5	14.5	13.5
9'	10.5	11	10.5	9.5	10.5	9.5	11.6	11.9	11.5	11	11.5	11
10'	8	8.5	8	7	8	7	9	9.5	9	9	9	9

EMBOD MULTIPLIER
900/1000 Lumen= .50
1300/1500 Lumen= .31
1800/2000 Lumen= .22
2800/3000 Lumen= .16

CCT Multiplication Factors		CCT [K]	Multiplier from 3500K	80 -> 90 CRI
80 CRI	2000 Lumen	2700	0.93	
		3000	0.99	
		3500	1.00	
		4000	1.01	
90 CRI	2000 Lumen	2700	0.88	0.79
		3000	0.94	0.80
		3500	1.00	0.84
		4000	1.03	0.85

PORTFOLIO™

DESCRIPTION

8-inch LED recessed medium beam downlight with 50° cut off specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Offered with 3000-10,000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K available in 80 or 90 CRI.

Catalog #	LD8A502DL3 ER8A50835 8LMOLI	**Type** R7
Project		
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .060" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

Thermal
Forged aluminum heat sink conducts heat away from the LED module for improved performance and longer life.

LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 0-10V/trailing edge driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. cCSAus certified. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/ RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

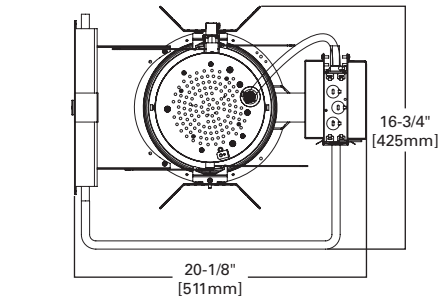
Warranty
5 year warranty.

LD8A ER8A 8LM

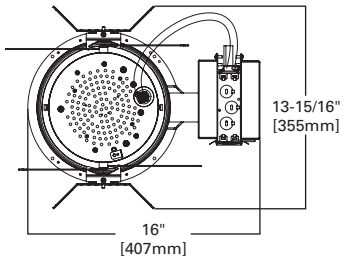
3000-10,000 Lumen LED

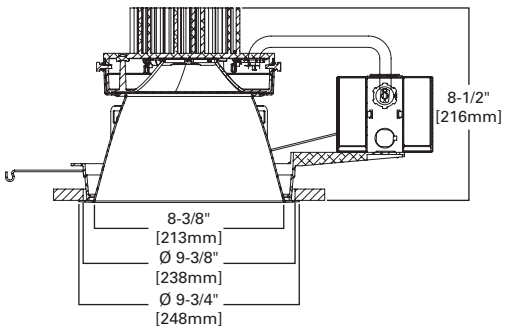
8-Inch Medium Downlight

New Construction

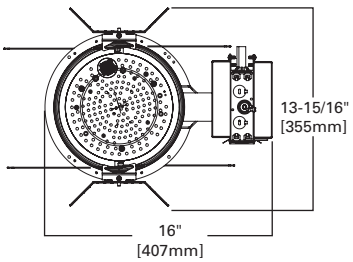


3000-6500 Lumen





8000-10,000 Lumen



ENERGY STAR

Can be used to comply with T24 California Non-Residential Lighting Controls requirements

RoHS Compliant

Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements.

powered by fifthlight technology

Cooper Lighting by EATON

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

ORDERING INFORMATION

EXAMPLE: LD8A501DE010 ER8A50835 8LW111LI= 8" LED Wide Beam Reflector, 5000 Lumen, 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing	Lumens[1]	Voltage	Driver	Options	Power Module	Lumens	CRI	Color
LD8A=8" Aperture **LD8ACP**=8" Aperture, Chicago Plenum	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens **90**=9000 Lumens **100**=10000 Lumens	**1**=120V **2**=277V	**3000, 4000, 5000, 6000, 8000, 9000 AND 10000 LUMEN** **D010TE**=0-10V 10% Dimming or Trailing Edge Dimming **3000, 4000, 5000, 6000 AND 8000 LUMEN** **D5LT**=Fifth Light® DALI 1% Dimming **DMX**=DMX Dimming **DE010**=0-10V 1% Dimming **3000, 4000, 5000 AND 6000 LUMEN** **DL3**=1% Lutron® Hi-Lume 3-Wire or Ecosystem **D010TR**=0-10V 10% Dimming or Leading Edge **6500 LUMEN** **D010**=0-10V 10% Dimming **DE010**=0-10V 1% Dimming	**EMBOD**=Bodine® Emergency Module with Remote Test Switch **IEMBOD**=Bodine® Emergency Module with Integral Test Switch [2]	**ER8A**=8" Module	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens **90**=9000 Lumens **100**=10000 Lumens	**8**=80 CRI **9**=90 CRI	**27**=2700° K **30**=3000° K **35**=3500° K **40**=4000° K

Reflector	Finish		Options	Accessories	
8LM0=8" Medium Reflector, Polymer Trim Ring **8LM1**=8" Medium Reflector, Self-flanged **8LM0E**=8" Medium Reflector, Polymer Trim Ring for use with IEM Integral Emergency option **8LM1E**=8" Medium Reflector, Self-flanged Trim Ring for use with IEM Integral Emergency option	**LI**=Specular Clear **H**=Semi-Specular Clear **WMH**=Warm Haze **G**=Specular Gold **WH**=Wheat **WHH**=Wheat Haze **GP**=Graphite **GPH**=Graphite Haze	**B**=Specular Black **W**=Gloss White **8LM0 Only** **BB**=Black Baffle **WB**=White Baffle	**Self-flanged Only** **WF**=White Painted Flange	**HB26**=C-channel Bar Hanger, 26" Long, Pair **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair **H347**=347 to 120V Step Down Transformer, 75VA	**H347200**=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope **HSA8**=Slope Adapter for 8" Aperture Housings, Specify Slope **LGSKT8IP65**=IP65 Gasket Kit

Notes: **1.** Nominal Lumens will vary depending on selected color, driver and reflector finish.
2. Not available with Chicago Plenum.
3. Not CSA approved.
4. Trailing edge and leading edge 120V only.

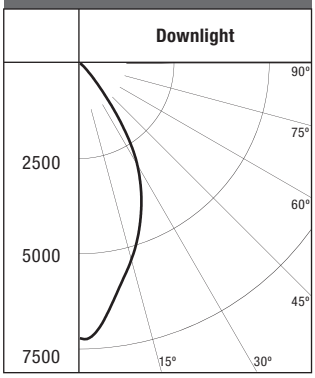
ENERGY DATA

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	
3000 Lumen	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 42W	THD: <20%
120V Input Current: .35A	277V Input Current: .16A
Input Frequency: 50-60Hz	
4000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 58W	THD: <20%
120V Input Current: .48A	277V Input Current: .21A
Input Frequency: 50-60Hz	
5000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 62W	THD: <17%
120V Input Current: .52A	277V Input Current: .22A
Input Frequency: 50-60Hz	
6000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 77W	THD: <17%
120V Input Current: .64A	277V Input Current: .28A
Input Frequency: 50-60Hz	

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	
6500 Lumen D010	
Input Power: 84W	THD: <17%
120V Input Current: .70A	277V Input Current: .30A
Input Frequency: 50-60Hz	
8000 Lumen D010TE	
120V Input Power: 96W	277V Input Power: 96W
120V Input Current: .79A	277V Input Current: .36A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	
9000 Lumen D010TE	
120V Input Power: 108W	277V Input Power: 107W
120V Input Current: .89A	277V Input Current: .39A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	
10,000 Lumen D010TE	
120V Input Power: 126W	277V Input Power: 123W
120V Input Current: 1.05A	277V Input Current: .47A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P112343
LD8A50D010TE ER8A50835 8LM0LI	
Lumens	4962 Lm
Efficacy	80 Lm/W
CCT	3500K
SC	0.8

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
12.5'	42	10
15'	29	12
20'	16	16
24'	11	19
28'	8	22

CANDELA TABLE

Degrees Vertical	Candela
0	6445
5	6573
15	5323
25	3488
35	1582
45	316
55	26
65	0
75	1
85	0
90	0

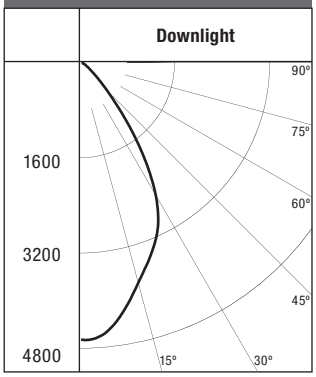
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	3598	72
0-40	4641	93
0-60	4952	99
0-90	4962	100
90-180	0	0
0-180	4962	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	13773
55	1421
65	0
75	166
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P112599
LD8A50D010TE ER8A50835 8LM0H	
Lumens	4461 Lm
Efficacy	71.9 Lm/W
CCT	3500K
SC	1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
12.5'	21	13
15'	15	16
20'	8	22
24'	6	26
28'	4	30

CANDELA TABLE

Degrees Vertical	Candela
0	2977
5	3234
15	3611
25	3268
35	2011
45	822
55	173
65	19
75	0
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	2455	48
0-40	3741	74
0-60	4872	96
0-90	5035	100
90-180	0	0
0-180	5035	100

LUMINANCE

Average Candella Degrees	Average 0° Luminance
45	35859
55	9275
65	1421
75	0
85	0

PORTFOLIO™

DESCRIPTION

8-inch LED recessed wide wall wash specially designed for LED technology. Two-stage reflector system combined with a Gradient Kicker, produces high levels of uniform vertical illumination on the wall with minimal source brightness. Color temperatures of 2700K, 3000K, 3500K, 4000K.

Catalog #	LD8A302DL3 ER8A30835 8LW110LI	**Type**
Project		R8
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Lower Wall Wash Reflector
Spun .060" thick aluminum lower reflector with gradient kicker in comblnation with a lensed upper optical chamber provides superior lumen output, high level vertical illumination with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling (new construction housing only).

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

Thermal
Forged aluminum heat sink conducts heat away from the LED module for improved performance and longer life.

LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 0-10V/trailing edge driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected damp locations. cCSAus certified. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/ RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards. 8000 lumen and above are marked spacing and must follow spacing requirements.

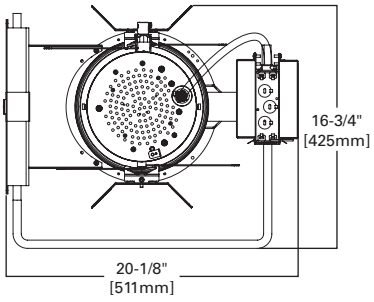
Warranty
5 year warranty.

LD8A ER8A 8LW111

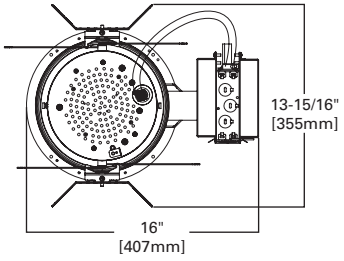
3000-10,000 Lumen LED

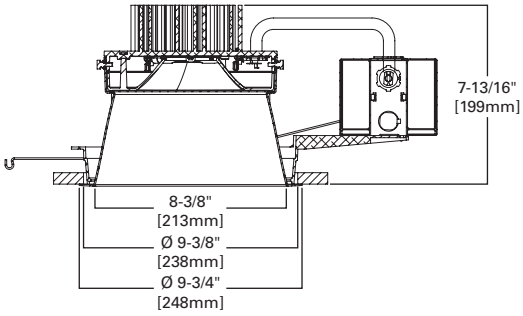
8-Inch Wide Beam Wall Wash

New Construction

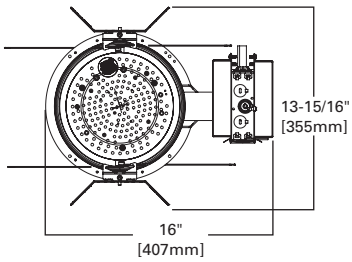


3000-6500 Lumen





8000-10,000 Lumen



Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements.

powered by fifthlight technology

ORDERING INFORMATION

EXAMPLE: LD8A501DE010 ER8A50835 8LW111LI= 8" LED Wide Beam Reflector Lens, 5000 Lumen, 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing	Lumens[1]	Voltage	Driver	Options	Power Module	Lumens	CRI	Color
LD8A=8" Aperture **LD8ACP**=8" Aperture, Chicago Plenum	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens [5] **90**=9000 Lumens [5] **100**=10000 Lumens [5]	**1**=120V **2**=277V	**3000, 4000, 5000, 6000, 8000, 9000 AND 10000 LUMEN** **D010TE**=0-10V 10% Dimming or Trailing Edge Dimming **3000, 4000, 5000, 6000 AND 8000 LUMEN** **D5LT**=Fifth Light® DALI 1% Dimming **DMX**=DMX Dimming **DE010**=0-10V 1% Dimming **3000, 4000, 5000 AND 6000 LUMEN** **DL3**=1% Lutron® Hi-Lume 3-Wire or Ecosystem **D010TR**=0-10V 10% Dimming or Leading Edge **6500 LUMEN** **D010**=0-10V 1% Dimming **DE010**=0-10V 1% Dimming	**EMBOD**=Bodine® Emergency Module with Remote Test Switch [2,3]	**ER8A**=8" Module	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens [5] **90**=9000 Lumens [5] **100**=10000 Lumens [5]	**8**=80 CRI **9**=90 CRI	**27**=2700° K **30**=3000° K **35**=3500° K **40**=4000° K

Reflector	Finish		Options	Accessories	
8LW111=8" Wide Reflector, Single Wall Wash, Self-flanged **8LW121**=8" Wide Reflector, Double Wall Wash, Self-flanged **8LW110**=8" Wide Reflector, Single Wall Wash, Polymer Trim Ring **8LW120**=8" Wide Reflector, Double Wall Wash, Polymer Trim Ring	**LI**=Specular Clear **H**=Semi-Specular Clear **WMH**=Warm Haze **G**=Specular Gold **WH**=Wheat **WHH**=Wheat Haze **GP**=Graphite **GPH**=Graphite Haze	**B**=Specular Black **W**=Gloss White	**Self-flanged Only** **WF**=White Painted Flange	**HB26**=C-channel Bar Hanger, 26" Long, Pair **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair	**H347**=347 to 120V Step Down Transformer, 75VA **H347200**=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope

Notes:
1. Nominal Lumens will vary depending on selected color, driver and reflector finish.
2. Not available with Chicago Plenum.
3. Not CSA approved.
4. Trailing edge and leading edge 120V only.
5. Product is marked spacing and must be installed with the following minimum spacing:
   Center to Center of adjacent luminaires : 36"
   Center of Luminaire to Side of Building Member : 18"
   Minimum Overhead Clearance: 9"

ENERGY DATA

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	

3000 Lumen	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 42W	THD: <20%
120V Input Current: .35A	277V Input Current: .16A
Input Frequency: 50-60Hz	

4000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 58W	THD: <20%
120V Input Current: .48A	277V Input Current: .21A
Input Frequency: 50-60Hz	

5000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 62W	THD: <17%
120V Input Current: .52A	277V Input Current: .22A
Input Frequency: 50-60Hz	

6000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 77W	THD: <17%
120V Input Current: .64A	277V Input Current: .28A
Input Frequency: 50-60Hz	

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	

6500 Lumen D010	
Input Power: 84W	THD: <17%
120V Input Current: .70A	277V Input Current: .30A
Input Frequency: 50-60Hz	

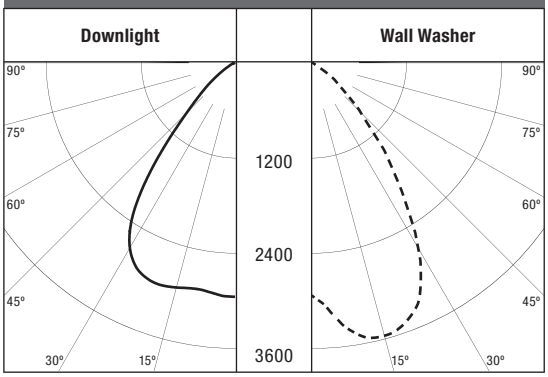
8000 Lumen D010TE	
120V Input Power: 96W	277V Input Power: 96W
120V Input Current: .79A	277V Input Current: .36A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

9000 Lumen D010TE	
120V Input Power: 108W	277V Input Power: 107W
120V Input Current: .89A	277V Input Current: .39A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

10,000 Lumen D010TE	
120V Input Power: 126W	277V Input Power: 123W
120V Input Current: 1.05A	277V Input Current: .47A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

PHOTOMETRICS

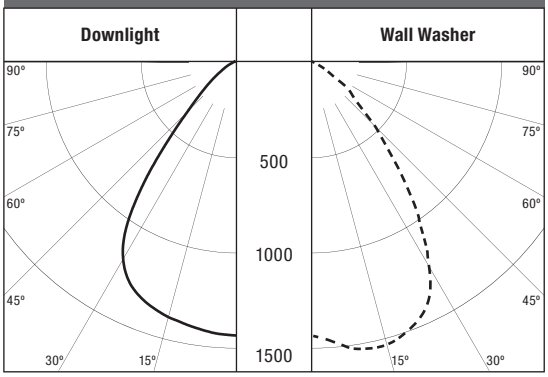
CANDLEPOWER DISTRIBUTION



Test Number	P112727
LD8A50D010TE ER8A50835 8LM0LI	
Lumens	5035 Lm
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD		1'	2'	3'	2'			3'			2'			3'		
1'	1	1	0	0	2	2	2	1	1	1	1	1	1	1	1	1
2'	8	5	2	1	30	32	30	27	18	27	10	11	10	9	7	9
3'	32	25	12	4	79	88	79	66	61	66	44	50	44	36	36	36
4'	43	36	22	10	87	97	87	70	78	70	64	72	64	53	59	53
5'	39	35	25	14	73	80	73	61	70	61	64	69	64	53	60	53
6'	31	29	23	15	54	58	54	47	53	47	54	57	54	46	52	46
7'	23	22	19	14	39	41	39	35	38	35	42	43	42	37	41	37
8'	17	16	14	12	28	29	28	26	28	26	31	32	31	29	31	29
9'	13	12	11	10	21	21	21	20	20	20	24	24	24	22	23	22
10'	10	9	8	8	16	16	16	15	15	15	18	18	18	17	18	17

CANDLEPOWER DISTRIBUTION



Test Number	P113111
LD8A50D010TE ER8A50835 8L110H	
Lumens	4800 Lm
CCT	3500K

SINGLE UNIT FOOTCANDLES					MULTIPLE UNIT FOOTCANDLES											
	3' FROM WALL (Distance From Fixture Along Wall)				2.5' FROM WALL (Spacing Between Fixtures)						3' FROM WALL (Spacing Between Fixtures)					
DD		1'	2'	3'	2'			3'			2'			3'		
1'	3	2	1	0	8	8	8	7	5	7	4	4	4	3	3	3
2'	16	12	6	2	42	45	42	36	30	36	22	23	22	18	18	18
3'	33	26	14	6	77	86	77	65	61	65	47	51	47	39	39	39
4'	40	34	21	10	80	90	81	65	73	65	61	68	61	50	56	50
5'	35	32	24	14	64	71	66	54	62	55	58	64	59	49	56	49
6'	27	25	21	15	47	50	47	41	46	42	47	51	48	41	46	42
7'	20	19	16	13	33	35	33	30	33	30	36	38	36	32	35	33
8'	14	14	12	11	24	25	24	22	24	22	27	28	27	25	26	25
9'	11	10	9	8	18	18	18	17	17	17	20	21	20	19	20	19
10'	8	8	7	7	13	14	13	13	13	13	15	16	15	15	15	15

PORTFOLIO™

DESCRIPTION

8-inch LED recessed wide downlight specially designed for LED technology. Two-stage reflector system produces smooth distribution with excellent light control and low aperture brightness. Lumen packages include 3000-10,000 lumens with color temperatures of 2700K, 3000K, 3500K, 4000K. Suitable for commercial construction and can be used to comply with California Title 24 non-residential requirements (with designated trims).

Catalog #	LD8A302DL3 ER8A30835 8LW0LI	Type
Project		R9
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Lower Shielding Reflector
Self-flanged, spun .060" thick aluminum lower reflector in combination with a lensed upper optical chamber provides superior lumen output with minimal source brightness. Available in all Portfolio Alzak® finishes.

Trim Retention
Lower reflector is retained with two torsion springs holding the flange tightly to the finished ceiling surface.

Plaster Frame / Collar
Die cast aluminum 1-1/2" deep collar accommodates ceiling materials up to 2".

Universal Mounting Bracket
Accepts 1/2" EMT, C channel and bar hangers and adjusts 5" vertically from above and below the ceiling.

Junction Box
(4) 1/2" and (2) 3/4" trade size pry outs positioned to allow straight conduit runs. Listed for (8) #12 AWG (four in, four out) 90°C conductors and feed thru branch wiring.

Thermal
Forged aluminum heat sink conducts heat away from the LED module for improved performance and longer life.

LED
LED system contains a plurality of high brightness white LED's combined with a high reflectance upper reflector and convex transitional lens producing even distribution with no pixilation. Rated for 50,000 hours at 70% lumen maintenance. Color variation within 3-step MacAdam ellipses. Flexible disconnect allows for tool-less replacement of LED engine from below ceiling. Available in 80 or 90 CRI.

Driver
Combination 0-10V/trailing edge driver provides flicker free dimming from 100% to 10%. Optional 1% 0-10V, Fifth Light, DMX or Lutron® Ecosystem. Driver can be serviced from above or through the aperture.

Code Compliance
Thermally protected and cULus listed for protected wet locations. cCSAus certified. Optional City of Chicago environmental air (CCEA) marking for plenum applications. EMI/ RFI emissions per FCC 47CFR Part 18 Class B consumer limits. Non-IC rated - Insulation must be kept 3" from top and sides of housing. RoHS Compliant. Photometric testing completed in accordance with IES LM 79 standards. LED life testing completed in accordance with LM 80 standards.

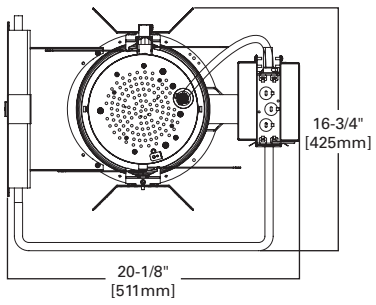
Warranty
5 year warranty.

LD8A ER8A 8LW

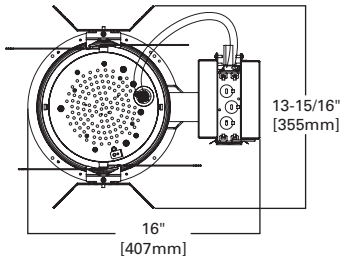
3000-10,000 Lumen LED

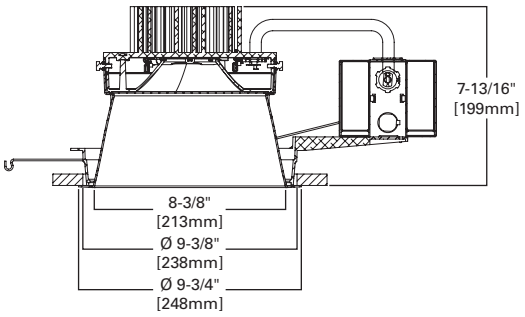
8-Inch Wide Beam Downlight

New Construction

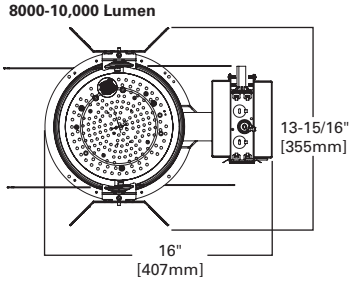


3000-6500 Lumen





8000-10,000 Lumen



Refer to ENERGY STAR® Qualified Products List. Can be used to comply with California Title 24 High Efficacy requirements.

powered by fifthlight technology

Cooper Lighting by EATON

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

ORDERING INFORMATION

EXAMPLE: LD8A501DE010 ER8A50835 8LW1LI= 8" LED Wide Beam Reflector Lens, 5000 Lumen, 3,500 K Color with Universal 120 - 277V, 0 - 10 Driver

Housing	Lumens[1]	Voltage	Driver	Options	Power Module	Lumens	CRI	Color
LD8A=8" Aperture **LD8ACP**=8" Aperture, Chicago Plenum	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens **90**=9000 Lumens **100**=10000 Lumens	**1**=120V **2**=277V	**3000, 4000, 5000, 6000, 8000, 9000 AND 10000 LUMEN** **D010TE**=0-10V 10% Dimming or Trailing Edge Dimming **3000, 4000, 5000, 6000 AND 8000 LUMEN** **D5LT**=Fifth Light® DALI 1% Dimming **DMX**=DMX Dimming **DE010**=0-10V 1% Dimming **3000, 4000, 5000 AND 6000 LUMEN** **DL3**=1% Lutron® Hi-Lume 3-Wire or Ecosystem **D010TR**=0-10V 10% Dimming or Leading Edge **6500 LUMEN** **D010**=0-10V 10% Dimming **DE010**=0-10V 1% Dimming	**EMBOD**=Bodine® Emergency Module with Remote Test Switch [2] **IEMBOD**=Bodine® Emergency Module with Integral Test Switch [2]	**ER8A**=8" Module	**30**=3000 Lumens **40**=4000 Lumens **50**=5000 Lumens **60**=6000 Lumens **65**=6500 Lumens **80**=8000 Lumens **90**=9000 Lumens **100**=10000 Lumens	**8**=80 CRI **9**=90 CRI	**27**=2700° K **30**=3000° K **35**=3500° K **40**=4000° K

Reflector	Finish		Options	Accessories	
8LW0=8" Wide Reflector, Polymer Trim Ring **8LW1**=8" Wide Reflector, Self-flanged **8LW0E**=8" Wide Reflector, Polymer Trim Ring for use with IEM Integral Emergency option **8LW1E**=8" Wide Reflector, Self-flanged Trim Ring for use with IEM Integral Emergency option	**LI**=Specular Clear **H**=Semi-Specular Clear **WMH**=Warm Haze **G**=Specular Gold **WH**=Wheat **WHH**=Wheat Haze **GP**=Graphite **GPH**=Graphite Haze	**B**=Specular Black **W**=Gloss White	**Self-flanged Only** **WF**=White Painted Flange	**HB26**=C-channel Bar Hanger, 26" Long, Pair **HB50**=C-channel Bar Hanger, 50" Long, Pair **RMB22**=Wood Joist Bar Hanger, 22" Long, Pair **H347**=347 to 120V Step Down Transformer, 75VA	**H347200**=347 to 120V Step Down Transformer, 200VA Housings, Specify Slope **HSA8**=Slope Adapter for 8" Aperture Housings, Specify Slope **LGSKT8IP65**=IP65 Gasket Kit

Notes: **1.** Nominal Lumens will vary depending on selected color, driver and reflector finish.
2. Not available with Chicago Plenum.
3. Trailing edge and leading edge 120V only.

ENERGY DATA

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	

3000 Lumen	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 42W	THD: <20%
120V Input Current: .35A	277V Input Current: .16A
Input Frequency: 50-60Hz	

4000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 58W	THD: <20%
120V Input Current: .48A	277V Input Current: .21A
Input Frequency: 50-60Hz	

5000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 62W	THD: <17%
120V Input Current: .52A	277V Input Current: .22A
Input Frequency: 50-60Hz	

6000 Lumen D010TE	
EMI/RFI: FCC Title 47 CFR, Part 15, Class B (Consumer)	
Input Power: 77W	THD: <17%
120V Input Current: .64A	277V Input Current: .28A
Input Frequency: 50-60Hz	

ENERGY DATA	
Sound Rating: Class A standards	
(Values at non-dimming line voltage)	
Minimum Starting Temperature: -20°C (-4°F)	
Power Factor: >0.90	

6500 Lumen D010	
Input Power: 84W	THD: <17%
120V Input Current: .70A	277V Input Current: .30A
Input Frequency: 50-60Hz	

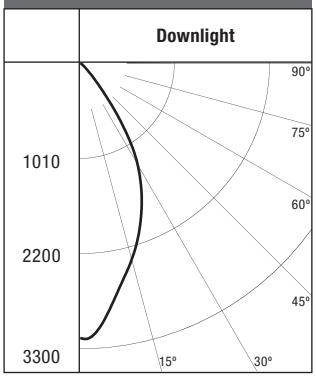
8000 Lumen D010TE	
120V Input Power: 96W	277V Input Power: 96W
120V Input Current: .79A	277V Input Current: .36A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

9000 Lumen D010TE	
120V Input Power: 108W	277V Input Power: 107W
120V Input Current: .89A	277V Input Current: .39A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

10,000 Lumen D010TE	
120V Input Power: 126W	277V Input Power: 123W
120V Input Current: 1.05A	277V Input Current: .47A
THDi 120V: <13%	THDi 277V: <20%
Input Frequency: 50-60Hz	

PHOTOMETRICS

CANDLEPOWER DISTRIBUTION



Test Number	P110167
LD8A50D010TE ER8A50835 8LW0LI	
Lumens	5083 Lm
Efficacy	81.9 Lm/W
CCT	3500K
SC	1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
12.5'	22	15
15'	15	18
20'	8	24
24'	6	29
28'	4	34

CANDELA TABLE

Degrees Vertical	Candela
0	3304
5	3395
15	3658
25	3398
35	2268
45	967
55	203
65	18
75	1
85	0
90	0

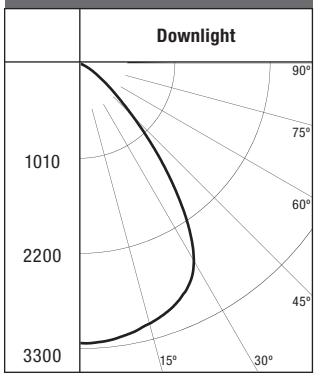
ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	2740	54
0-40	4147	81
0-60	5052	99
0-90	5083	100
90-180	0	0
0-180	5083	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
45	42170
55	10921
65	1320
75	166
85	0

CANDLEPOWER DISTRIBUTION



Test Number	P110039
LD8A50D010TE ER8A50835 8LW0H	
Lumens	4790 Lm
Efficacy	77.2 Lm/W
CCT	3500K
SC	1

CONE OF LIGHT

Distance Fixture to Lighted Plane	Initial Footcandles at Nadir	Beam Diameter
12.5'	21	15
15'	14	18
20'	8	24
24'	5	29
28'	4	34

CANDELA TABLE

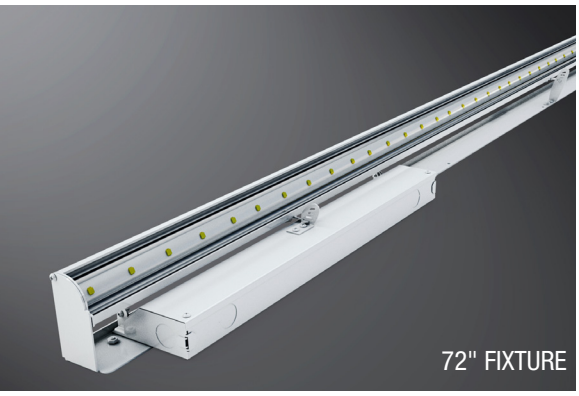
Degrees Vertical	Candela
0	3200
5	3288
15	3542
25	3291
35	2196
45	936
55	197
65	18
75	1
85	0
90	0

ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixture
0-30	2478	51
0-40	3754	78
0-60	4696	98
0-90	4790	100
90-180	0	0
0-180	4790	100

LUMINANCE

Average Candela Degrees	Average 0° Luminance
45	40840
55	10577
65	1278
75	161
85	0



5-year warranty

raye G2

3"H X 3.6"W

0 . 08 .35KV2HO . 1 . 72 . L

Application

raye Generation 2 (G2) is today's answer to high performance cove applications. Available in a 3" x 3" housing (2" x 6" housing also available), much of the extruded aluminum heat sinking (required for Raye Gen 1) has been removed enabling a cost reduction while maintaining superior thermal management. **io** utilizes the highest efficacy LEDs and tightest Binning (2-step MacAdam). **raye** Gen 2 is the high-performance, affordable answer to new and retrofit cove applications. While exceeding T8 & T5 high performance alternatives, **raye**'s optical assembly has been designed to uniformly illuminate the interior surfaces of the cove while offering a very precise asymmetric beam projection. Now field adjustable, the fixture can be tilted up to illuminate various types of ceiling conditions (i.e. barrel vaults). An LED tray can removed in the field via a quick disconnect for future maintenance without disrupting the permanent installation. The driver is also easily accessible for future maintenance. Projected average rated life is 50,000 hours at 70% of lamp lumen output. **io** utilizes LEDs that are compliant with LM 80 standards. Ambient temperature surrounding the fixture shall not exceed 122˚F (50˚C).

Light Output

raye is available with four lumen outputs for white light only. All values listed below represent initial lumens. LM79 IES format files are available on the Cooper website. **io** only delivers high quality white light solutions with 2-step Binning. 80+CRI is standard. For 90+ CRI, please consult factory for pricing and lead-time.

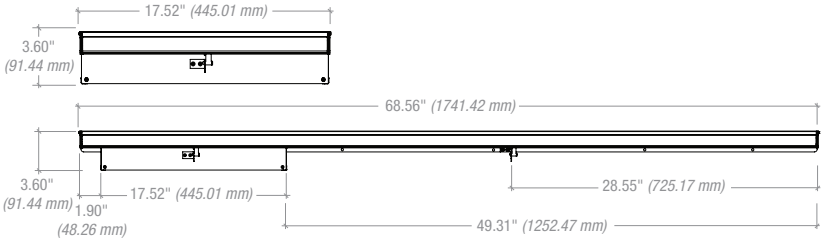
>> *2-step MacAdam Binning.*

	Standard Output	Mid Output	Very High Output	V2HO
INITIAL LUMENS				
2700K White:	**342 lms/ft**	**456 lms/ft**	**661 lms/ft**	**684 lms/ft**
3000K White:	**384 lms/ft**	**512 lms/ft**	**742 lms/ft**	**768 lms/ft**
3500K White:	**390 lms/ft**	**520 lms/ft**	**754 lms/ft**	**780 lms/ft**
4000K White:	**414 lms/ft**	**552 lms/ft**	**800 lms/ft**	**828 lms/ft**
POWER CONSUMPTION*				
	4.80 w/ft	**6.40 w/ft**	**9.60 w/ft**	**10.56 w/ft**

Non-standard color temperatures available as a custom offering for a modest additional cost and lead-time.
** Power Consumption dos not include power supply losses.*

Construction

raye's wireway housing is die formed 20 gauge prime cold rolled steel. The wireway is 17.15" in length for both the 18"& 72" fixtures. Knockouts are provided for ½" conduit fittings. Wiring components and Drivers are mounted to a one piece back housing, permitting removal of the cover for ease of maintenance. An anodized aluminum channel which houses the LED tray and optic is mechanically fastened to a metal channel that runs the length of the fixture.



Mounting Options

raye is designed to be surface mounted within an architectural cove for indirect illumination. For a uniform distribution (with no socket shadows) of light fixtures should be mounted end-to-end.

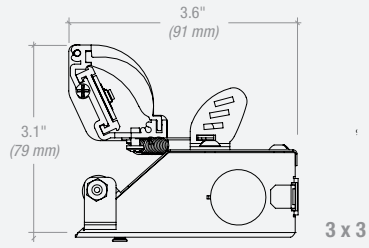
Electrical

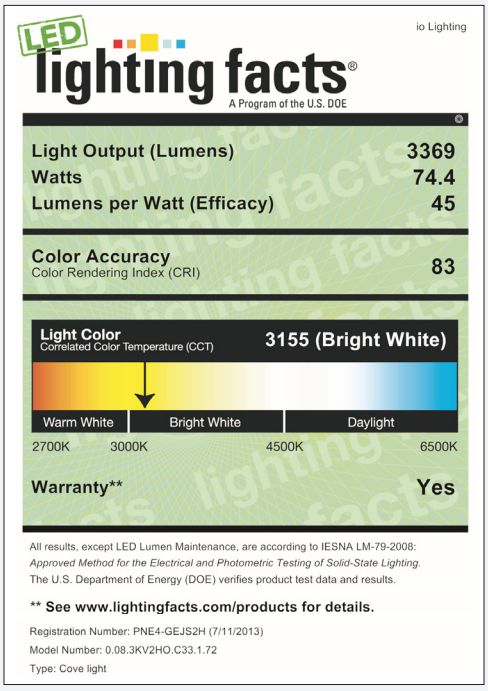
All fixtures are pre-wired and pre-assembled for easy installation. Electronic drivers (universal power supplies, 120-277v) are integral within the sheet metal wire way housing for both the 18" and 72" units.

Finish

White powder coat paint finish is standard.

Dimensions

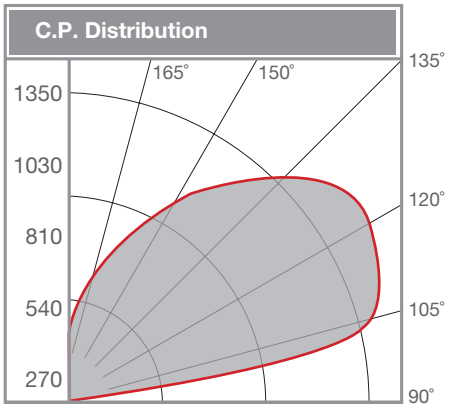


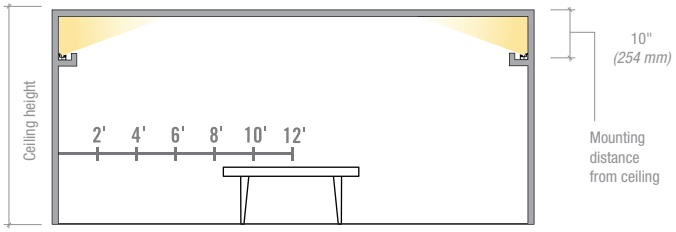


Label references 72" **raye** fixture in V2HO 3000K. Lighting Facts for additional beam spreads and light output levels may be obtained from **io** Lighting.

COVE LIGHTING

3KV2HO – 72" Length





LIGHT OUTPUT CONVERSION TABLE

	Standard Output	High Output	Very High Output	V2HO
2700K White	**0.44**(1)	**0.72**(1)	**0.95**(1)	**1.40**(1)
3000K White	**0.47**(1)	**0.75**(1)	**1.00**(1)	**1.47**(1)
3500K White	**0.48**(1)	**0.77**(1)	**1.03**(1)	**1.51**(1)
4000K White	**0.47**(1)	**0.75**(1)	**1.00**(1)	**1.47**(1)

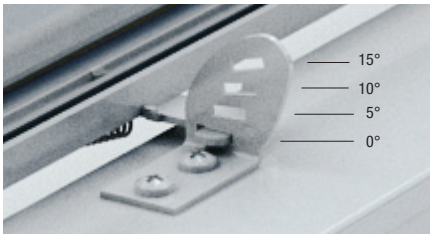
*Visit **www.iolighting.com** or contact an **io** representative for IES format photometrics.*

10" MOUNTING DISTANCE

Ceiling Height	2'	4'	6'	8'	10'	12'
11'-6" *(3.51m)*	25.5fc	26.3fc	25.5fc	23.5fc	22.4fc	22.2fc
10'-6" *(3.20m)*	26.8fc	27.3fc	25.4fc	22.9fc	20.9fc	20.4fc
9'-6" *(2.90m)*	28.5fc	28.3fc	24.8fc	21.5fc	19.1fc	18.5fc
8'-6" *(2.59m)*	32.5fc	32.2fc	27.2fc	21.9fc	18.0fc	17.3fc

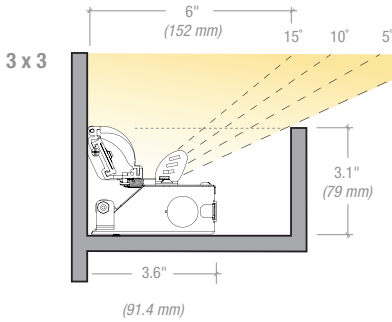
**Calculations based on 3KV2HO LEDs.*

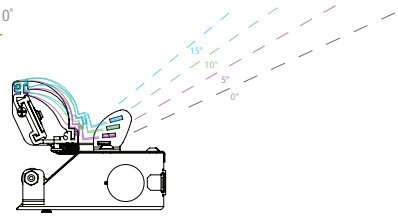
NEW: FIELD ADJUSTABLE ILLUMINATION ANGLES



Application Notes

- For cove applications, there should not be less than 6" of lampless (fixtureless) space at the end of all run lengths.
- For cove applications, **raye** luminaires shall be butted end to end to eliminate any opportunity for socket shadows.
- For ease of maintenance, the Printed Circuit Board (PCB) Assembly may be removed from the all **raye** housings via a quick disconnect and a removable extruded aluminum sliding tray (which contains the PCB). This can be accomplished without removing the wireway which is connected to line voltage.





Note: Adjustable tab rotates fixture in 5 degree increments.

Order Code

0	.	08	.	35KV2HO	.	C33	.	1	.	72	.	L
io		1		2		3		4		5		6

1. SERIES

08 raye Gen 2

2. COLOR

27K	White 2700K SO(1)
27KHO	White 2700K HO(1)
27KVHO	White 2700K VHO(1)
27KV2HO	White 2700K V2HO(1)
3K	White 3000K SO(1)
3KHO	White 3000K HO(1)
3KVHO	White 3000K VHO(1)
3KV2HO	White 3000K V2HO(1)
35K	White 3500K SO(1)
35KHO	White 3500K HO(1)
35KVHO	White 3500K VHO(1)
35KV2HO	White 3500K V2HO(1)
4K	White 4000K SO(1)
4KHO	White 4000K HO(1)
4KVHO	White 4000K VHO(1)
4KV2HO	White 4000K V2HO(1)
CC	Custom Color(2)

3. MOUNTING

C33 Cove 3" x 3"

Note: 2" x 6" profile also available

4. FINISH

1 White

5. LENGTH

UNITS (ACTUAL)

18 18" (17.52"/445.01mm)

72 72" (68.56"/68.56mm)

FOR CONTINUOUS ROW
Specify length (e.g., 51'-0")
Note: Overall length must be multiples of 72" and 18" lengths.

6. VOLTAGE / DIMMING

ND	Non-Dimming (120-277v)
D	0-10V (Osram)(3)
DALI	DALI (Osram)(3)
DMX	DMX (Osram)(3)
L	Lutron Hi-lume A-Series

Footnotes

1. White light variance between LEDs is equal to or better than 3-step MacAdam Binning.
2. Non-standard color temperature and CRI are available. Consult factory for availability.
3. Consult factory for other dimming driver options.

YouTube
raye applications
youtube.com/iolighting

DESCRIPTION

- LED asymmetric distribution
- Extruded aluminum housing
- Die-cast aluminum end-caps
- Die-cast adjustable mounting arms
- Alanod® MIRO® 4 aluminum reflector
- Extruded, lightly diffused acrylic lens standard
- Electrostatically applied polyester powder coat paint finish

Catalog #	A02-SI-A-2-LED-35K-277-S-AK12-D	Type
Project		W1
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction
Housing is corrosion-resistent Type 6063-T6 aluminum extrusion with die-cast aluminum end caps. End caps are secured by concealed stainless steel fasteners. Housing, end caps and lens are sealed with single, closed cell slicone gaskets. Stainless steel hardware is standard.

Reflector
Reflector is constructed from highly specular Alanod® MIRO® 4 aluminum with minimum 95% reflectance.

Aiming
Fixture includes the PointGrab2 TM lockable aiming system, providing minimum 180 degree vertical adjustment of the fixture housing in 5 degree increments. The aiming feature locks securely in place by means of a stainless steel locking mechanism.

Lens
A lightly diffused acrylic lens is standard, constructed of impact-resistent, U.V. stabilized virgin acrylic to prevent discoloration.

Electrical
LED fixtures use .92 power factor UL 1310 Class 2 AC to DC driver with built-in dimming. Integral LED lamp modules are easily replacable in the field.

Mounting
Fixture includes Slide-N-Mount TM adjustable, lockable mounting arms (patent pending), constructed from Type 383 die-cast aluminum. Support structure by others.

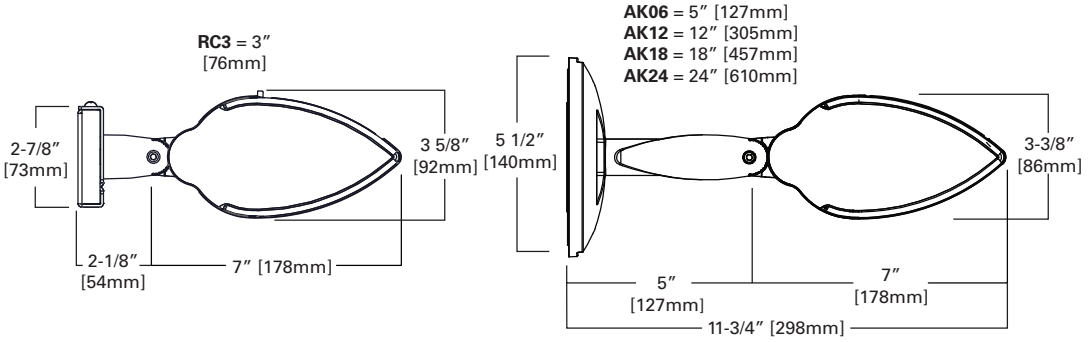
Finish
Fixture housing is finished using electrostactically applied polyester powdercoat paint. Consult factory for custom colors.

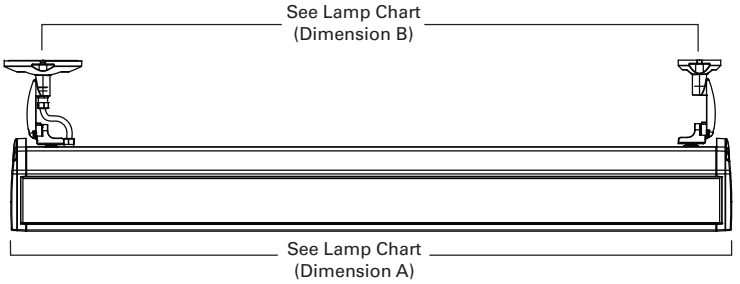
Labels
UL / cUL listed for use in damp locations.

ARROWLINEAR LED

Extra Small Integral
Individual Linear

WALL





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

Lamp Chart

Lamp Source	* Light Level 2: Absolute Lumens	Nominal Fixture Length	Actual Fixture Length	**** Recommended Mounting Centers
LED	1000	1'	13-1/2" (343mm)	** See note below
LED	2000	2'	27-3/8" (695mm)	22-13/16" (580mm)
LED	3000	3'	39-3/16" (995mm)	34-5/8" (880mm)
LED	4000	4'	51" (1295mm)	46-7/16" (1180mm)
LED	6000	6'	77-7/16" (1967mm)	72-29/32" (1852mm)
LED	8000	8'	101-1/16" (2567mm)	96-17/32" (2452mm)
LED	12,000	12'	151-3/16" (3839mm)	*** 146-7/16 (3719mm)

* Based on 3500K CCT. See photometric files at www.ametrixlighting.com for delivered lumen levels.
** 1' fixtures utilize a single, centered RC3 mounting arm.
*** 12' fixtures require three mounting points.
**** Slide-N-Mount™ adjustable, lockable mounting arms are standard.

ORDERING INFORMATION

Sample Number: A04-SI-A-2-LED-30K-120-W-AK6-LMC

A02	SI	A	2	LED	35K	277	S	AK12	D

Product
A01=Arrowlinear 1' Unit[1, 2]
A02=Arrowlinear 2' Unit
A03=Arrowlinear 3' Unit
A04=Arrowlinear 4' Unit
A06=Arrowlinear 6' Unit
A08=Arrowlinear 8' Unit
A12=Arrowlinear 12' Unit

Size - In/Outdoor
SI=Extra Small - Indoor

Lens
A=Acrylic

Light Level
2=See Lamp Chart above

Lamp Type
LED=LED

Color Temperature
30K=3000K
35K=3500K
40K=4000K

Voltage
120=120V
277=277V
347=347V
UNV=Universal

Finish
B=Bronze
C=Custom (specify)
K=Black
S=Silver
W=White

Mounting
RC3=Rectangular Canopy, 3" Arm / Integral [1, 2]
AK6=6" Adjustable Knuckle / Integral
AK12=12" Adjustable Knuckle / Integral
AK18=18" Adjustable Knuckle / Integral
AK24=24" Adjustable Knuckle / Integral

Options [3]
B=Battery Pack
D=Dimming
E=Emergency
LMC=Large AK Mounting Canopies (in lieu of standard)

Notes: 1 A single RC3 mounting arm is standard for model A01.
2 2" x 4" horizonal J-box (by others) required for mounting.
3 All options may not be available with all models.

INVUE® energy solutions

DESCRIPTION

The geometric form of MESA LED luminaire allows it to adapt to either contemporary or traditional architectural settings. Available in single or twin pole mount configurations with optional wall mounting capability, the MESA LED luminaire's mounting options allow for harmonized site design whether at the entryway or in the parking lot. UL/cUL listed for use in wet locations.

Catalog #	MSA-C01-LED-E1-T3-GM	**Type**
Project		X1
Comments		**Date**
Prepared by		

SPECIFICATION FEATURES

Construction

HOUSING: Die-cast aluminum main housing and spider mount base maintain a minimum 0.125 wall thickness. Integral aluminum heat sink provides superior thermal heat transfer in +40°C ambient environments. DOOR ASSEMBLY: Top mounted, heavy wall, die-cast aluminum door maintains a nominal 0.125 thickness. Door includes a self-retaining interior hinge. GASKET: Continuous silicone gasket provided to seal housing door assembly and optic tray. LENS: Downlight lens is LED board integrated acrylic over-optics, each individually sealed for IP66 rating. HARDWARE: Four iinset fasteners on underside of housing provide access to luminaire interior. Concealed, stainless steel four bar hinge lock allows door to lock in the open position.

Optics

DISTRIBUTION: Choice of twelve patented, high-efficiency AccuLED Optics™, featuring designs that maximize light collection and directional distribution onto the application region. Each optical lens is precision manufactured via injection-molding then precisely arranged and sealed on the board media. LEDs: High output LEDs, 60,000+ hours life at >90% lumen maintenance, offered standard in 4000°K (+/- 275K) CCT and nominal 70 CRI. Mesa LightBAR optic tray is removable and able to rotate 360° in 90° increments for specific placement of the distribution relative to fixture.

Electrical

DRIVER: LED drivers are potted and heat sunk for optimal performance and prolonged life. Standard drivers feature electronic universal voltage (120-277V/50-60Hz), greater than 0.9 power factor, less than 20% harmonic distortion and feature ambient temperature range of +40°C (104°F) down to minimum starting temperature of -30°C (-22°F). Shipped standard with Cooper Lighting proprietary circuit module designed to withstand 10kV of transient line surge. All LED LightBARs™ and drivers are mounted to dedicated mounting trays and are easily replaced by use of quick disconnects for ease of wiring. Driver tray is removable without the use of tools. Options to control light levels, energy savings and egress capabilities (battery pack and separate circuit) are available.

Mounting

Fitter assembly mounts over 3" O.D. tenon and is secured via three concealed stainless steel set screws. Design of fitter provides seamless transition to 4" round poles. Additional mounting accessories include a dual fixture post top mounting arm and wall mount arm.

Finish

Housing is finished in five-stage super TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. LightBAR™ cover plates are standard white and may be specified to match finish of luminaire housing. Standard colors include black, bronze, grey, white, dark platinum and graphite metallic. RAL and custom color matches available. Consult Outdoor Architectural Colors brochure for a complete selection.

Warranty

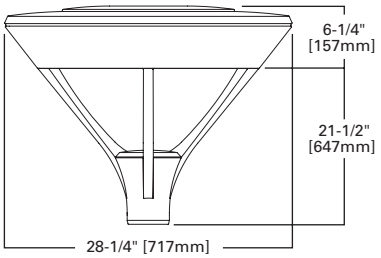
Five-year warranty.

MSA MESA LED

1-6 LightBARs
Solid State LED

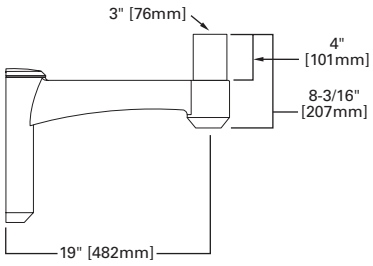
DECORATIVE LUMINAIRE

DIMENSIONS

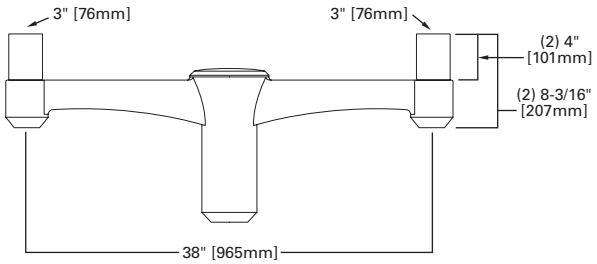


MOUNTING ACCESSORIES

WALL MOUNT ARM



DUAL MOUNT ARM (EPA 1.36)



CERTIFICATION DATA

UL/cUL Listed
ISO 9001
IP66 LightBARs
LM79 / LM80 Compliant
2G Vibration Tested
DesignLights Consortium® Qualified*

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V/50 & 60Hz, 347V/60Hz, 480V/60Hz
-30°C Minimum Temperature
40°C Ambient Temperature Rating

EPA

Effected Projected Area
1.1 Sq. Ft.

SHIPPING DATA

Approximate Net Weight:
50 lbs. (22.7 kgs.)

Cooper Lighting by EATON

*www.designlights.org

POWER AND LUMENS BY BAR COUNT

Number of LightBARs	Distribution													
	Power (Watts)	Current @ 120V (A)	Current @ 277V (A)	T2	T3	T4	SL2	SL3	SL4	5MQ	5WQ	5XQ	RW	SLR/SLL
	7 LED LIGHTBAR													
C01	27	0.23	0.13	1,708	1,709	1,668	1,718	1,668	1,675	1,845	1,770	1,791	1,701	1,609
C02	54	0.46	0.21	3,291	3,294	3,215	3,311	3,214	3,228	3,556	3,412	3,451	3,277	3,102
C03	77	0.65	0.29	4,751	4,755	4,641	4,779	4,640	4,660	5,133	4,925	4,982	4,731	4,478
C04	101	0.86	0.37	6,270	6,276	6,125	6,308	6,124	6,151	6,775	6,500	6,575	6,244	5,910
C05	131	1.11	0.50	7,508	7,515	7,334	7,553	7,333	7,365	8,112	7,783	7,873	7,477	7,076
C06	154	1.30	0.58	9,086	9,094	8,875	9,140	8,874	8,913	9,817	9,419	9,528	9,048	8,563
	21 LED LIGHTBAR													
B01	27	0.23	0.13	2,101	2,102	2,052	2,113	2,052	2,061	2,269	2,177	2,203	2,092	1,980
B02	51	0.43	0.20	4,048	4,052	3,954	4,072	3,954	3,971	4,374	4,196	4,245	4,031	3,815
B03	73	0.62	0.28	5,844	5,849	5,708	5,879	5,707	5,732	6,314	6,058	6,128	5,820	5,507
B04	95	0.81	0.35	7,712	7,720	7,534	7,759	7,533	7,566	8,333	7,995	8,087	7,681	7,269
B05	124	1.05	0.48	9,235	9,243	9,021	9,290	9,020	9,059	9,978	9,573	9,684	9,197	8,703
B06	146	1.24	0.56	11,176	11,186	10,917	11,243	10,915	10,963	12,075	11,585	11,719	11,130	10,533

LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
10°C	1.04
15°C	1.03
25°C	1.00
40°C	0.96

LUMEN MAINTENANCE

Ambient Temperature	TM-21 Lumen Maintenance (60,000 Hours)	Theoretical L70 (Hours)
25°C	> 94%	> 350,000
40°C	> 93%	> 250,000
50°C	> 90%	> 170,000

ORDERING INFORMATION

Sample Number: MSA-A06-LED-E1-T3-GM

Product Family [1]	Number of LightBARs [2, 3]	Lamp Type	Voltage	Distribution	Color [4]
MSA=Mesa	**B01**=(1) 21 LED LightBAR **B02**=(2) 21 LED LightBARs **B03**=(3) 21 LED LightBARs **B04**=(4) 21 LED LightBARs **B05**=(5) 21 LED LightBARs **B06**=(6) 21 LED LightBARs **C01**=(1) 7 LED LightBAR **C02**=(2) 7 LED LightBARs **C03**=(3) 7 LED LightBARs **C04**=(4) 7 LED LightBARs **C05**=(5) 7 LED LightBARs **C06**=(6) 7 LED LightBARs	**LED**=Solid State Light Emitting Diodes	**E1**=Electronic (120-277V) **347**=347V **480**=480V	**T2**=Type II Area **T3**=Type III Area **T4**=Type IV Short **SL2**=Type II w/Spill Control **SL3**=Type III w/Spill Control **SL4**=Type IV w/Spill Control **RW**=Rectangular Wide **5MQ**=Type V Square Medium **5WQ**=Type V Square Wide **5XQ**=Type V Square Extra Wide **SLL**=90° Spill Light Eliminator Left **SLR**=90° Spill Light Eliminator Right	**AP**=Grey **BZ**=Bronze **BK**=Black **DP**=Dark Platinum **GM**=Graphite Metallic **WH**=White

Options (Add as Suffix)	**Accessories** (Order Separately) [9]
PC=Button Type Photocontrol (Specify Voltage) **R**=NEMA Twistlock Photocontrol Recepetacle **2L**=Two Circuits [5] **LCF**=LightBAR Cover Plate Matches Housing Finish **7060**=70 CRI / 6000K CCT [6] **8030**=80 CRI / 3000K CCT [6] **ICB**=Integral Cold Weather Battery Pack (Specify 120 or 277V) [7] **DIMRF-LW**=LumaWatt Wireless Sensor, Wide Lens for 8' - 16' Mounting Height [8] **DIMRF-LN**=LumaWatt Wireless Sensor, Narrow Lens for 16' - 40' Mounting Height [8]	**VA6028-XX**=Dual Mount Arm (EPA 1.38) **VA6029-XX**=Wall Mount Arm **OA/RA1016**=NEMA Photocontrol - Multi-Tap **OA/RA1027**=NEMA Photocontrol - 480V **OA/RA1201**=NEMA Photocontrol - 347V **MA1253**=10kV Circuit Module Replacement

Notes:
1. DesignLights Consortium® Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details.
2. Standard 4000K CCT and nominal 70 CRI.
3. 21 LED LightBAR powered at 350mA, 7 LED LightBAR powered at 1A.
4. Cutsom and RAL color matching available upon request. Consult your Eaton's Cooper Lighting business representative for more information.
5. Low-level output varies by bar count. Consult factory. Not availalbe with 347V or 480V. Requires quantity two or more LightBARs.
6. Consult factory for lead times and lumen multiplier.
7. Available with B01-B04 or C01-C04 configurations only. Specify 120V or 277V. LED cold weather integral battery pack is rated for minimum operating temperature -40°F (-20°C). Operates one LightBAR for 90-minutes. Not available in all configuration, consult factory. Rated for use in 25°C ambient.
8. LumaWatt wireless sensors are factory installed and require network components RF-EM1-, RF-GW1 and RF-ROUT1 in appropriate quantities. See www.cooperlighting.com for LumaWatt application information.
9. Replace XX with color designation.

Cooper Lighting by EATON

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Lighting Business
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

1-year warranty

TYPE X2

luxrail™

INTERIOR/EXTERIOR APPLICATIONS

0.06.SSS.1.PMC.NR.ASYM.35K.GB3.4

Application

ANSI and ADA compliant, **luxrail** is an indoor/outdoor LED-based handrail that delivers functional illumination. Three intensities may be specified: standard output, mid output, and high output. The standard light output version delivers illuminance levels appropriate for exterior applications (2 footcandles at grade) as well as for dark interior environments with low ambient illumination levels (e.g., themed environments, theatres and residential areas). The high output version delivers illuminance levels applicable to interior environments – providing in excess of 10 footcandles along the path of egress (ANSI required for stair treads). Independent photometric test reports and IES Format data are available at **www.iolighting.com**.

luxrail's standard handrail gripping surfaces are circular in cross section and meet 2004 ADAAG (Americans with Disability Act Accessibility Guidelines). Patented optical assemblies deliver 10˚, 25˚, and 55˚ beam spreads, as well as an asymmetric option. The 25˚ and 55˚ beam patterns are most suitable for illuminating pathways, while the 10˚ beam spread offers accent lighting for optional glass or stainless steel cable railing infills. Reference page 54 of this catalog for information regarding infill options. Projected average rated life is 50,000 hours at 70% of lamp lumen output. Contact factory for IES LM-80 compliance. To ensure proper performance, architectural details should allow for ventilation and air flow around the fixture. Ambient temperature surrounding the fixture shall not exceed 122˚F *(50˚C)*.

Light Output

Three luminous intensities are available for white light. All values below represent the initial raw lumens of the LED. IES format photometry of Lighting Facts labels represent actual light output measured in lumens and candle power. Light output losses include optical, thermal and power supply inefficiencies. IES LM-79 format files may be obtained from the factory or downloaded from **www.iolighting.com.** Results are typical measurements. For 90+ CRI, please consult factory for pricing and availability.

Initial Lumens

	Standard Output	Mid Output	High Output
2700K White:	72 lms/ft	181 lms/ft	253 lms/ft
3000K White:	81 lms/ft	203 lms/ft	284 lms/ft
3500K White:	83 lms/ft	206 lms/ft	289 lms/ft

Non-standard color temperatures available as a custom offering for a modest additional cost and lead-time.

Construction

luxrail may be post mounted or wall mounted. **io** recommends installation be completed by a qualified handrail installer. Mounting hardware (post or wall) is typically required up to 5' O.C., depending on the handrail alloy. Final post and wall bracket spacing must be determined by a licensed architect or structural engineer. **luxrail** is available in stainless steel and aluminum. Vandal resistant access chamber allows units to be removed for maintenance purposes. The LED light fixture inside the caprail is UL Listed for wet locations. Handrail alloy options include stainless steel and aluminum. Contact factory for maintenance guidelines.

All handrail component parts are engineered for quick installation. Field welding or cutting is typically not required. All parts are prefabricated to field dimensions and are assembled in the field with mechanical connection or epoxy. Contact **io** Lighting for recommended handrail installers.

Electrical

luxrail houses a low voltage LED-based light fixture that is integrated into the underside of the handrail. 24 volt 100 watt power supplies are provided as a standard. For detailed information regarding daisy chain limitations, remote distance limitations, power supply options, and dimming options consult the **io** website **(www.iolighting.com)** or an **io** representative.

Driver Remote Distance

7'-0" (2.1m) w/22 AWG
18'-0" (5.5m) w/18 AWG
46'-0" (14.0m) w/14 AWG
71'-0" (21.6m) w/12 AWG

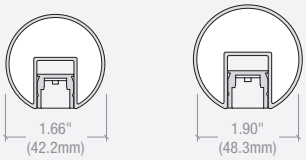
Dimming modules must be specified separately. For detailed information download the power supply specification sheet from **www.iolighting.com**.

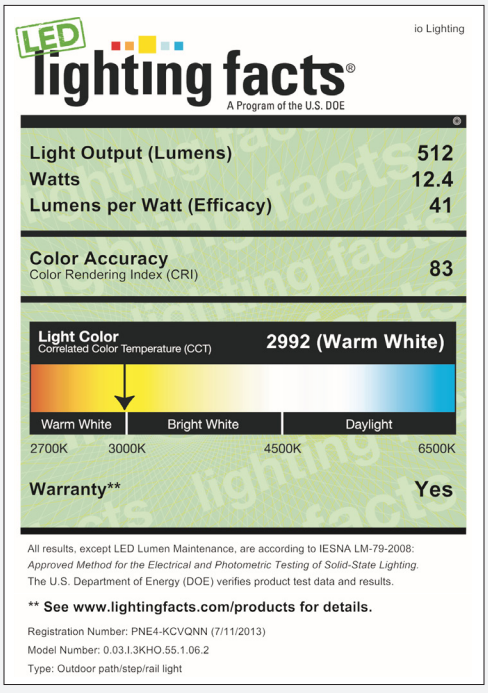
Power Consumption

Power consumption does not include power supply losses.

Standard Output	Mid Output	High Output
1.02 w/ft	2.54 w/ft	3.81 w/ft

Dimensions

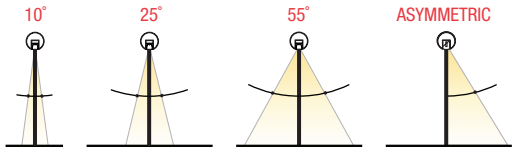




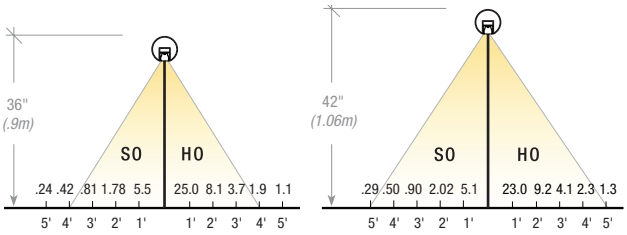
Label references 36" **luxrail** fixture with a 55˚ beam spread in High Output 3000K. Lighting Facts for additional beam spreads and light output levels may be obtained from **io** Lighting.

Light Output / Distributions

BEAM SPREAD OPTIONS

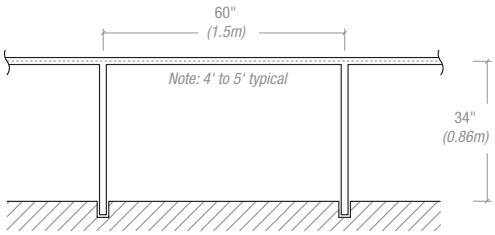


LIGHT OUTPUT - 55 DEGREE WARM WHITE



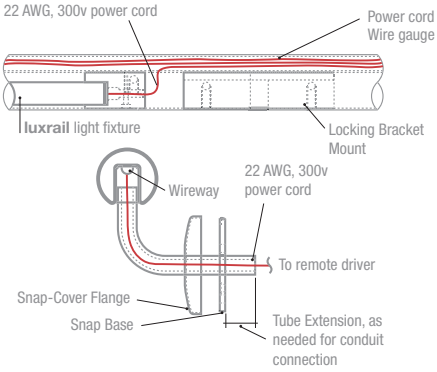
Calculation assumes 12'0" run length. All footcandle values are initial.

POST MOUNT APPLICATION



Note: Will depend on alloy and diameter specifications.

WALL MOUNT DETAILS*



* Wall mounted **luxrail** may be mounted to new or existing guardrail (by others).

Post and wall bracket spacing must be determined by a licensed architect or structural engineer.

io Lighting recommends a qualified handrail installer be on site during install.

LIGHT OUTPUT CONVERSION TABLE

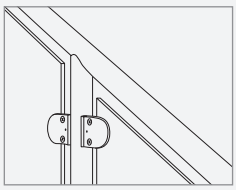
	Standard Output	Mid Output	High Output
2700K White	**0.25**(1)	**0.69**(1)	**0.94**(1)
3000K White	**0.27**(1)	**0.73**(1)	**1.00**(1)
3500K White	**0.29**(1)	**0.78**(1)	**1.06**(1)

*Note: Visit **www.iolighting.com** or contact an **io** representative for IES format photometrics.*

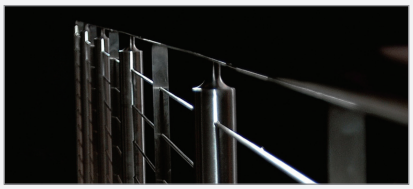
Mounting / Infill Options

PM *(POST MOUNTED)*

WM *(WALL MOUNT INTERMEDIATE)*



GLASS INFILL
(glass provided by others)



STAINLESS STEEL CABLE INFILL
(only available on flat surfaces)

Order Code

0	. 06	. SSS	. 1	. PMC	. NR	. ASYM	. 35K	. GB3	. 4	.	.
io	1	2	3	4	5	6	7	8	9	10	11

1. PRODUCT FAMILY
- 06 luxrail

2. ALLOY / FINISH
- SSS Stainless steel satin
- SSP Stainless steel polished
- CAA Clear anodized aluminum

3. SIZE
- 1 1.66" O.D. (1¼" pipe size) (available in SS only)
- 2 1.90" O.D. (1½" pipe size) (available for SS & CAA)

4. MOUNTING
- PMC Post mount concrete
- PMW Post mount wood
- PMS Post mount stone
- WM Wall or guard rail mounted

5. INFILL
- AC Stainless steel cable (4)
- GL Glass (provided by others)
- C Custom
- NR Not required

6. LIGHT DISTRIBUTION
- 10 10 Degree
- 25 25 Degree
- 55 55 Degree
- ASYM Asymmetric
- NI Handrail only (not illuminated)

7. LIGHT COLOR
- 27K Warm White
- 27KMO Warm White
- 27KHO Warm White
- 3K Warm White (3)
- 3KMO Warm White (3)
- 3KHO Warm White (3)
- 35K Warm White
- 35KMO Warm White
- 35KHO Warm White
- CC Custom Color(6)

8. LENGTH
- GB2 Grab Bar 2' nominal(6)
- GB3 Grab Bar 3' nominal(6)
- GB4 Grab Bar 4' nominal(6)
- GB5 Grab Bar 5' nominal(6)
- HR Hand Rail length in Feet / Inches (provide overall length of each handrail section)(2)(5)
- HRC Hand Rail Curved length in Feet / Inches (provide overall length of each handrail section)(2)(5)

9. VOLTAGE / DIMMING
- 1 120v
- 2 277v
- 3 120v w/dim
- 4 277v w/dim
- 5 Other (International voltage)

10. SPECIFY DRIVER / DIMMING(1)

*Note: If not specified otherwise, **io** will supply 100 watt drivers. Download Power Supply specification sheet from **www.iolighting.com**.*

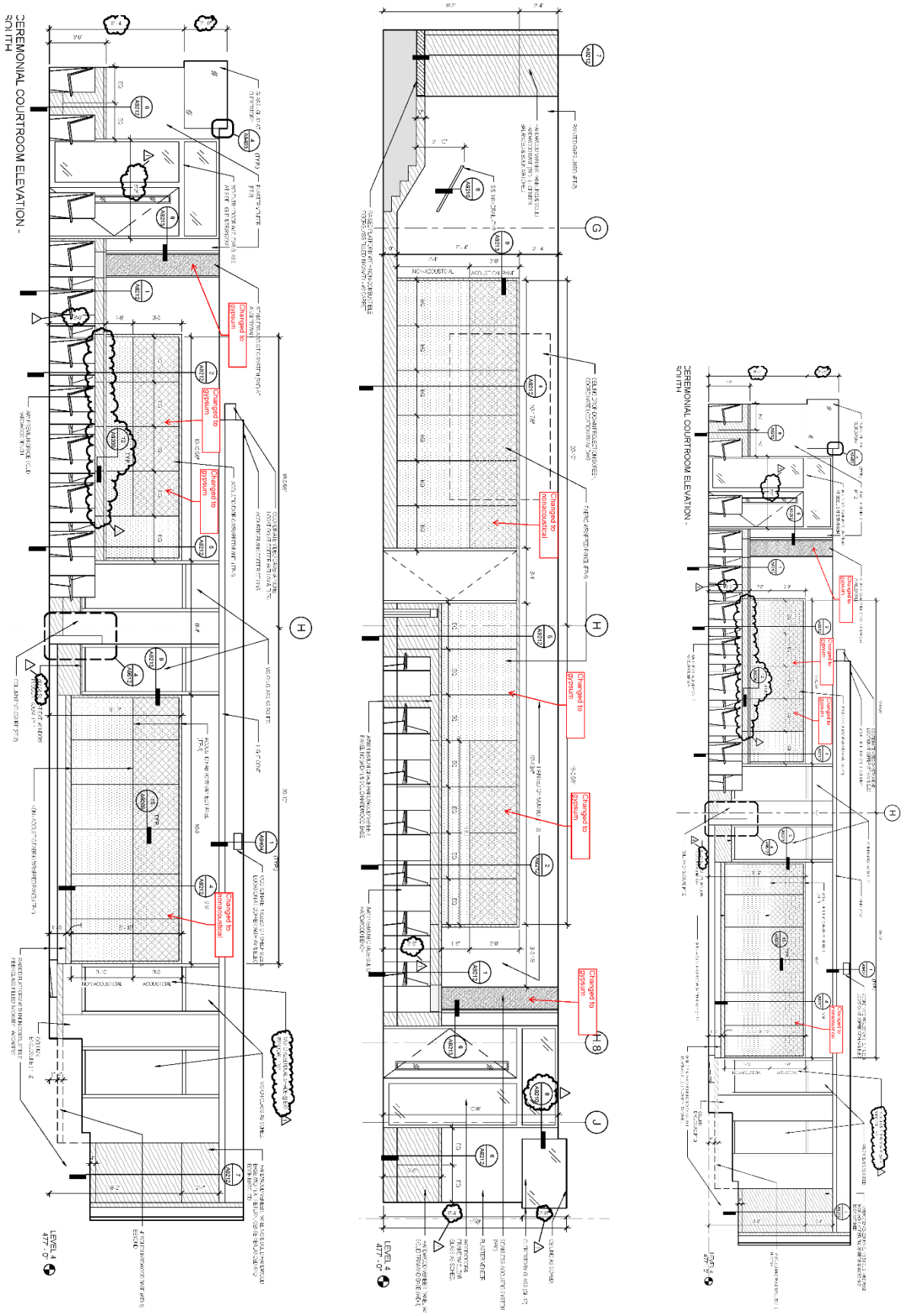
11.
- CE Available upon request.

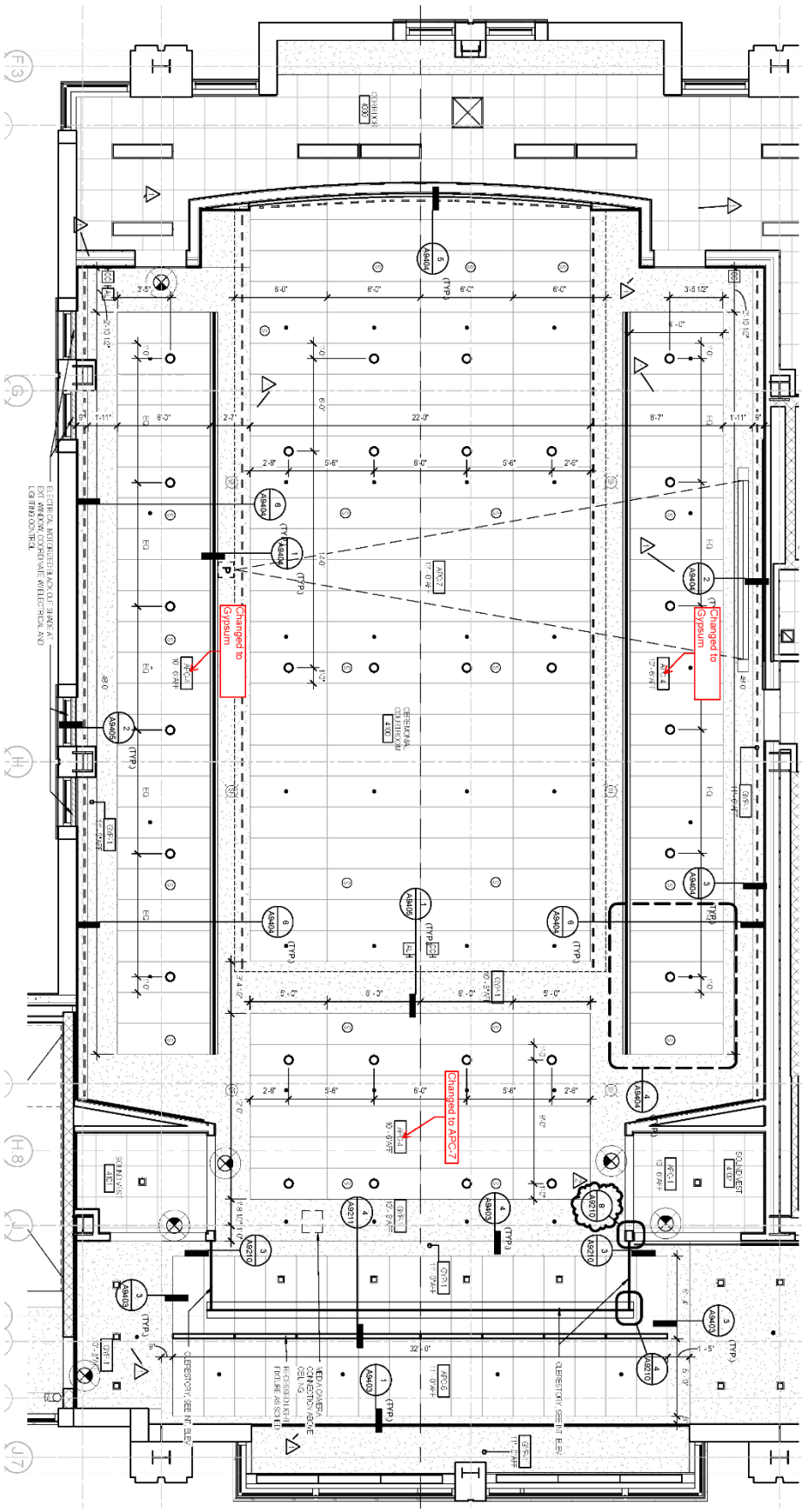
Footnotes

1. ***Power Supply Specification Sheet** may be downloaded from **www.iolighting.com**.*
2. *Each handrail application will be custom to accommodate varying field conditions and design requirements. Shop drawings will be required to manage specifics of each handrail section.*
3. *White light variance between LEDs is equal to or better than 3-step MacAdam Binning.*
4. *Stainless Steel cable available for flat surfaces only.*
5. *Detailed elevation drawings of handrail section are required for quote.*
6. *Non-standard color temperature and CRI are available. Consult factory for availability.*

luxrail applications
youtube.com/iolighting

Appendix B – Supporting Material for Acoustical Breadth


CEREMONIAL COURTROOM ELEVATION - SOUTH
Changed to gypsum
Changed to nonacoustical
LEVEL 4
477' - 0"
CEREMONIAL COURTROOM ELEVATION - SOUTH
LEVEL 4
477' - 0"


Changed to Gypsum
Changed to Gypsum
Changed to ACT-7

References

ASHRAE. (2013). *Standard 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.*

DiLaura, D. L., Mistrick, R. G., Houser, K. W., & Steffy, G. R. (2011). *Illuminating Engineering Society The Lighting Handbook: Reference and Application Tenth Edition.* New York, NY: Illuminating Engineering Society of North America.

IDA-IES. (2011). *Model Lighting Ordinance.* Illuminating Engineering Society and International Deark Sky Association.

Long, M. (2014). *Architectural Acoustics Second Edition.* Amsterdam: Elsevier/Academic.

Mehta, M., Johnson, J., & Rocafort, J. (1999). *Architectural Acoustics: Principles and Design.* Upper Saddle River, NJ: Prentice Hall.

Rasmussen, N. (2012). Review of Four Studies Comparing Efficiency of AC and DC Distribution for Data Centers. *White Paper 151.* Schneider Electric.