North Instructional Building
Bronx Community College
Bronx, NY

Senior Thesis Final Report

Jarret J. Clark Lighting/Electrical Advisor: Dr. Kevin Houser 4/09/14

Thesis Abstract

NORTH INSTRUCTIONAL BUILDING

JARRET J. CLARK | LIGHTING/ELECTRICAL

View from University Avenue

GENERAL INFORMATION

Location and Site

- University Avenue West 181 Street
  Bronx Community College, Bronx, New York

Building Occupant Name

- Bronx Community College

Size

- 98,600 square feet

Number of Stories Above Grade

- 3 stories

Dates of Construction

- Completed in September 2012

Actual Building Cost

- $74 million

Delivery Method

- Design-Bid-Build

PROJECT TEAM

Architect - Robert A.M. Stern Architects, LLP
Associate Architect - Ismael Leyva Architects
Civil - Gedeon GRC Consulting
Structural - Robert Silman Associates, P.C.
M.E.P - Joseph R. Loring and Associates, Inc.
Lighting Designer - Cline Bettridge Bernstein
Contractor - TDX Construction Corporation

ARCHITECTURE

- Classrooms, a library with a double story reading room, and faculty offices
- Classical exterior with industrial inspired interior
- Pre-formed brick veneer on concrete panel exterior construction

STRUCTURAL

- 6' x 6' (max) concrete footings
- 5" thick reinforced slab on grade
- Steel framing integrated into the architecture provides the building's structural support

MECHANICAL

- Six (6) VAV air handling units and (1) CV unit serve the various spaces with the largest 20k CFM VAV unit servicing the 3rd floor reading room
- Mechanical systems are integrated into the ground floor corridor and reading room using slot diffusers and custom return air grilles

LIGHTING/ELECTRICAL

- 4.16 KV double ended service from campus substation turned down by indoor transformer to 480Y/277V to supply the building
- 3000A rated Main Switchboard
- 480-208Y/120V Step-down transformer for receptacle loads

http://www.engr.psu.edu/ae/thesis/archive_2014.shtml

Executive Summary

The following thesis report provides comprehensive research and analyses performed during the yearlong Penn State Architectural Engineering Senior Thesis Capstone project. This project focuses on the building systems within the Bronx Community Colleges' North Instructional Building. The analyses include a lighting systems depth, an electrical distribution systems depth, an architectural breadth, and a solar energy conversion systems breadth.

The lighting depth proposes alternative lighting solutions for six spaces which observe an overall design concept. These spaces include an exterior canopy, an information lobby, main lobby, connecting corridors, a library, and a multi-purpose classroom containing library stacks. An architectural breath will be performed on the multi-purpose law classroom to investigate a more integrative and adaptable design.

The electrical breadth will include three topics. First, will be a branch circuit analysis consisting of new load calculations, panelboard circuit adjustments, and breaker resizing in response to the modified lighting systems installed in the lighting depth. Second, will be short circuit analysis to acquire short circuit ratings at five locations on a branch circuit. Third, will be an addition to the building's one-line diagram illustrating a photo-voltaic roof system's equipment, layout and integration into the existing electrical system. The photo-voltaic roof system is a breadth investigation into the PV system's design characteristics, implementation strategies, and return on investment feasibility.

Table of Contents

Building Introduction

Building Name: North Instructional Building

Location and Site: Bronx Community College, Bronx, New York

Building Occupant Name: Bronx Community College (BCC)

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Number of Stories Above Grade: 3 stories

Primary Project Team:

- **Architect of Record**: Robert A. M. Stern
- **Associate Architect**: Ismael Leyva Architects
- **Civil Engineer**: Gedeon GRC Consulting
- **Structural Engineer:** Robert Silman Associates, P.C.
- **M.E.P Engineer**: Joseph R. Loring and Associates, Inc.
- **Contractor**: TDX Construction Corporation

Dates of Construction:

- **Start:** 2009
- **Finish:** September 2012

Actual Building Cost: $74 million

Project Delivery Method: Design-Bid-Build

Major National Model Codes: IBC 2007

Zoning: Bronx Community College campus

Historical District: The BCC campus is a designated National Historic Landmark

Architectural Information

The Bronx Community College's North Instructional Building, also known as the North Hall and Library, complements surrounding historical landmarks such as the Gould Memorial Library and the Hall of Fame. Its design pays tribute to the classical style of campus while providing state of the art classrooms, a double story reading room, library, and faculty offices. The building is very easily navigated. Classrooms are located on the first floor and contain wall mounted projectors, white boards, and flexible furniture to support various layouts. The large double story reading room is found on the second floor which is easily accessible from a central staircase at the building entry. At the base of the reading room are long study tables mixed with computer carrels. Wrapping around the double height space is a walkway with study tables and book stacks on the east and west ends. Light shines through the very large windows to provide a considerable amount of natural daylighting to the space. The faculty offices can be found in the extension off of the west wing which was design in proportion to the Gould Memorial Library.

Sustainability Features

- Solar shades in classrooms and reading room
- Large windows allowing natural daylight penetration in reading room, library and elevator lobbies
- Rain collection system with internal leader and downspout connecting to two underground collection tanks.
- Occupancy sensors in classrooms

Lighting

Overall, the North Instructional Building's (NIB) lighting system uses primarily fluorescent sources both linear fluorescents and compact fluorescents (CFLs) in its design. A few metal halide sources have also been used in lighting the large vaulted ceiling of the Library. Linear fluorescent pendants are typical in every classroom on the ground floor. These fixtures are integrated into the main building automation system (BAS) which controls the lighting with a time clock and occupancy sensor. A lighting controls box is also placed in each room for manual control over designed lighting zones. All other ground floor spaces, including the monumental stair, are illuminated using mixture of decorative pendants/ceiling mounted fixtures, downlights, and wall sconces with CFL light sources. The double story library begins on the second level. It is illuminated with 1500W metal halide fixtures mounted to the walls and adjusted to wash the vaulted ceiling from each side. Additional task lighting is incorporated using CFL table lamps built into the large study tables and carrels in the reading area. The

library stacks, located on the 3rd floor, utilize linear fluorescent fixtures mounted onto each individual stack. Power is provided to the stacks by floor receptacles. A shading system is provided for the large windows on the 3rd floor of the library. A Lutron Graphic Eye controls panel is located behind the circulation desk. This panel contains (1) shade control keypad and (5) toggle switches for the lighting. The toggle switches control zones as follows:

Switch 1 – All Library Lights

Switch 2 – 2nd Floor Library Lights Only

Switch 3 – 3rd Floor Library Lights Only

Switch 4 – 2nd Floor Carrel Lights

Switch 5 – 2nd Floor Table Lights

The library's law collection is located in a separate multi-purpose classroom on the 3rd floor. This space is lit using a lay-light with linear fluorescents housed above, CFL downlights, and linear fluorescent pendants.

Electrical

NIB receives 4.16KV double ended electrical service from a campus substation. The service enters into the main switchboard located the basement mechanical room where the 4.16KV service is turned down to 480Y/277V to supply the building. The 3000A rated main switchboard serves (4) mechanical chiller pumps, (2) distribution panelboards, an emergency distribution panelboard (EDP), a fire alarm system, a sprinkler system, a branch circuit panelboard to power the basement and another to power the roof mechanical room. The two normal distribution panel boards are designed so that one serves the east wing and the other the west wing of the building. Each distribution panelboard supplies power to lighting panelboards and receptacle panelboards located in electrical closets on each level. All lighting loads receive 277V power. Located at each lighting panelboard is a step-down transformer to supply the receptacle panelboards at 120V.

A 250KW, 3 phase, 4 wire, diesel generator provides emergency power to the EDP, fire alarm system, and sprinkler system which are each connected to the emergency generator with their own automatic transfer switches (ATS). The EDP provides power to elevators and emergency lighting, receptacle, mechanical, telecom, and security loads.

Mechanical

Conditioned air is provided to NIB by (7) air handling units (AHU) located in the roof mechanical room. Six out of the seven total AHU's are variable air volume (VAV) units with only one control volume unit (CV) servicing the ground floor corridor. Each VAV unit has a dedicated service area. The ground and second floor AHU's service either the east or west wing of that floor individually. The largest AHU (20,000 cfm) delivers air to the entire 3rd Floor. The mechanical system is also integrated into the BAS system and also communicates with occupancy sensors.

Structural

The foundation is made up by a 5" slab on grade (SOG) with concrete footings ranging from 4'x4' to 6'x6' to a depth of 20" and 28" respectively. The superstructure is formed of steel framing integrated into the architecture. The largest spans are supported with W27x114 steel girders on the upper mechanical floor. Lightweight concrete on metal deck provides the general floor structure.

Fire Protection

An active fire protection system utilizes an alarm system and sprinkler system on an ATS and integrated into the BAS system. A 10gpm jockey maintains the minimum pressure in the sprinkler system and a 500gpm booster pump covering any drops in pressure. All work conforms to NFPA-13/89.

Transportation

NIB contains one passenger elevator and one freight elevator located adjacent to the monumental stair. The elevators provide access from the ground floor through the 3rd Floor.

Telecommunications

The building is equipped with an integrated security management system consisting of Access Control and Alarm Monitoring System (ACAMS), Closed Circuit Television (CCTV) System, emergency phone system, and an uninterruptable power system to support security systems.

Lighting Depth

The Bronx Community College's North Instructional Building, also known as the North Hall and Library, complements surrounding historical landmarks such as the Gould Memorial Library and the Hall of Fame Terrace. Its design pays tribute to the classical style of campus while providing state of the art classrooms, a double-story library, and faculty offices.

Spaces studied:

- Exterior Canopy
- Information Lobby
- Main Lobby
- Corridor
- Library
- Law Classroom and Stacks

The North Hall and Library is the new face of the college campus and the heart of learning. It aims to inspire everyone who enters or passes by. The lighting should be conducive to this excitement to learn and grow. The classical style provides many architectural features to be brought to life, to excite and inspire by displaying depth and dimension. These two words, Depth and Dimension, will be influential throughout all of the proposed designs by showcasing the architecture to create inspiring spaces.

Embracing the concept of displaying depth and dimension within the design, one major change was to alter the original ceiling by constructing architectural coves in the information lobby, main lobby, and connecting corridors. Each of these spaces interconnects with one another and creates the pathway for occupants to progress into all branches of the building. The addition of the coves enhances the visual experience and ambience of the three spaces while transitioning the occupants to their destinations.

By selecting and redesigning the lighting for the exterior canopy, information lobby, main lobby, and corridors, the new lighting design can completely controls the visual path of the occupant as they enter into the building and utilize the modified ceiling heighten this experience.

Exterior Canopy

The North Instructional Building's (NIB) north entry is denoted by a colonnade at the base of the structure with a regressed canopy. The canopy features an arched ceiling constructed of brick laid in a decorative pattern. Out front is a large open plaza connecting the campus sidewalk and the entrance of the building. Important tasks include circulation, public safety, and security.

Figure 1: Exterior Canopy Location

Materials & Reflectance

Floor

- Concrete – 0.3
- Ceramic Tile – 0.2

Wall

- Brick Veneer – 0.25

Ceiling

- Brick – 0.3

Dimensions

Area – 1112 sq. ft.

Ceiling Height – 12'

Approximate Width – 56’ 7”

Approximate Length – 12’ 4”

Design Criteria

Qualitative

Security | *Very Important* |

Proper Illuminance levels should be met both horizontal and vertical to deter criminal activity and allow surveillance equipment to operate effectively.

Color Rendering | *Important* |

The lighting should demonstrate adequate rendering of color for security purposes.

Accent | *Important* |

The entrance of the building should distinguish itself and draw attention.

Quantitative

Illuminance Levels | *Very Important* |

IESNA Lighting Handbook, 10th Edition

Recommended Illuminance for Ages 25 and Under

- Building Entries | Canopied Entries/Exits | Low Activity | LZ1
    - Horizontal Illuminance @grade – 2 lux
    - Vertical Illuminance @5’ AFG – 0.5 lux
    - Uniformity Ratio, Avg:Min – 2:1 (4:1 E_v)

Energy Code | *Very Important* |

ANSI/ASHRAE/IES Standard 90.1-2010

Table 9.4.3B Individual Lighting Power Allowances for Building Exteriors – Zone 3

- Building Entrances and Exits
    - Entry Canopies
        - Maximum Allowable LPD – 0.4 W/ft^2

Equipment

Lighting Equipment				
Type		**Description**	**Lamp Code**	**Manufacturer/Catalog**
L1		Exterior decorative pendant with LED lamping	(1) A19/DM/ 800/GU24/LED 13W 3000K 85+CRI	Kicler Salisbury Collection 11006RZ
L2		Exterior in-grade LED uplight	5W LED 3000K 85+CRI	BEGA 7018LED

Lighting Plan

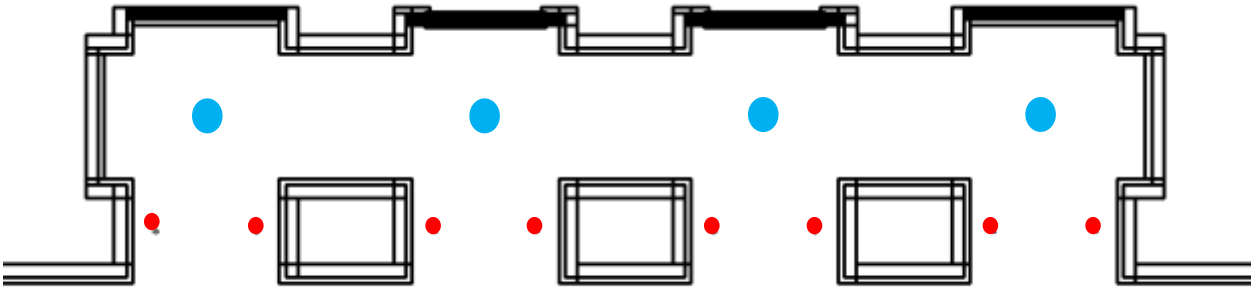

Figure 2: Exterior Canopy Lighting Plan

Light Loss Factors						
Type	**Lamp Lumens**		**LLD**	**LDD**	**BF**	**Total**
	Initial	**Mean**				
L1	-	-	0.7	0.85	-	0.595
L2	-	-	0.7	0.85	-	0.595

Renderings

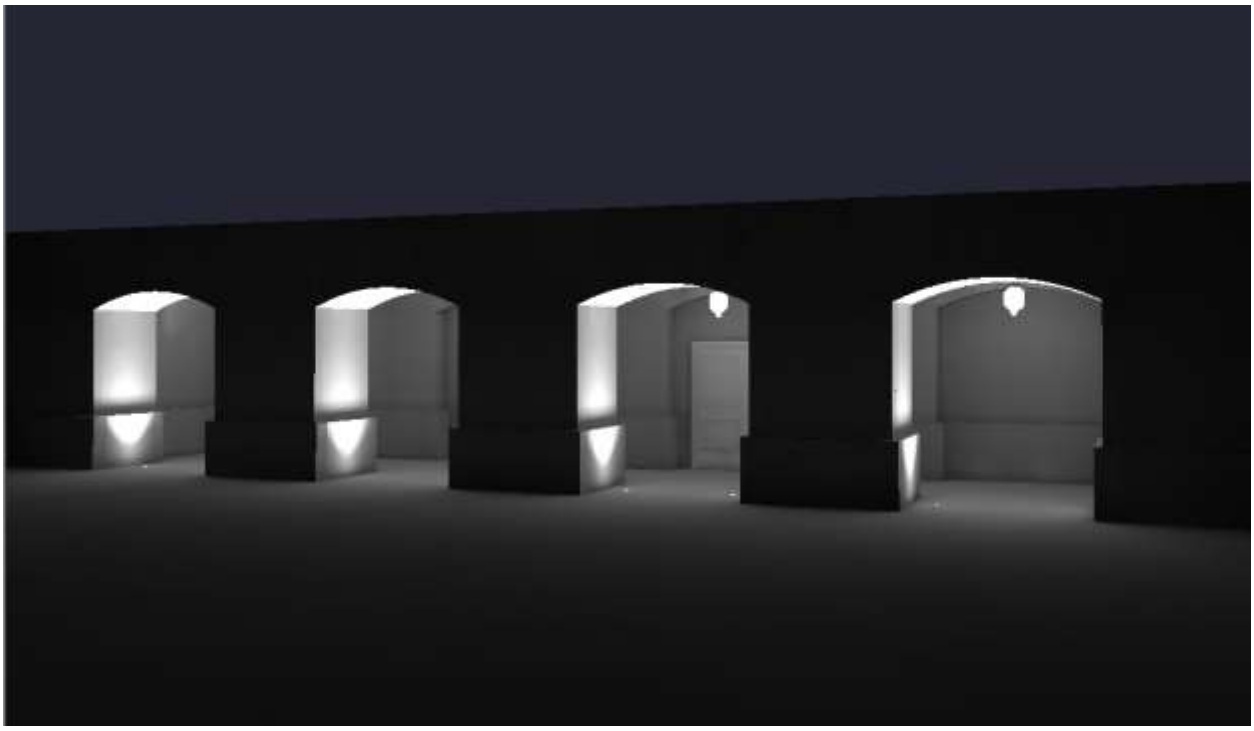

Figure 3: Exterior Canopy Illuminance Render

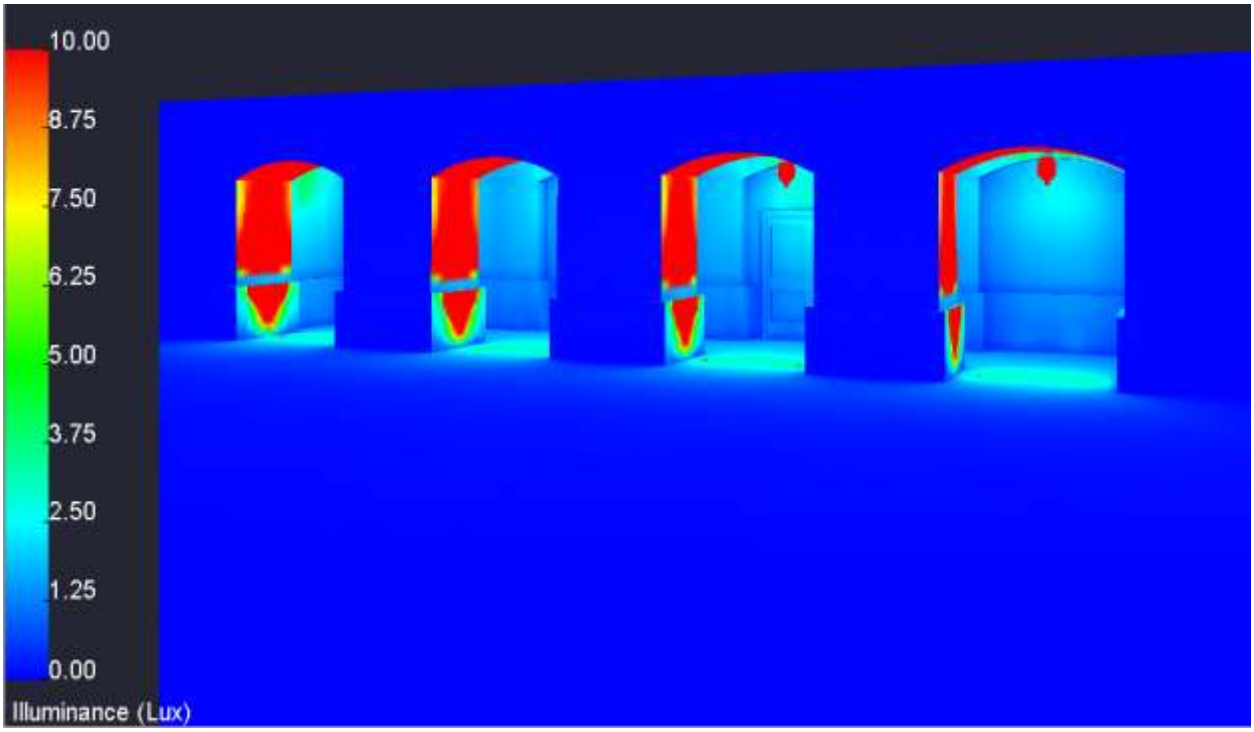

Figure 4: Exterior Canopy Pseudo Render

Performance

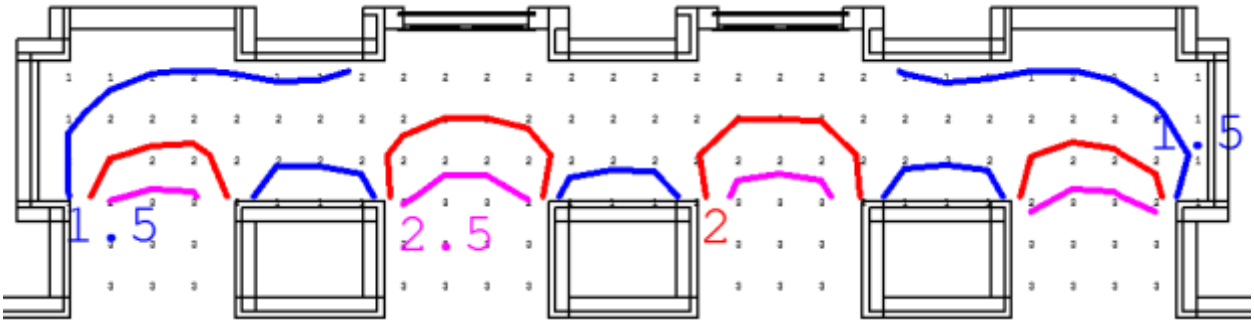

Figure 5: Exterior Canopy Isoline Calculation

Performance Data		
Calculation	**Target (lux)**	**Horizontal @ 0' (lux)**
Average Illuminance	2	2.07
Maximum Illuminance	-	3
Miniumum Illuminance	-	1
Average/Minimum	2	2.07

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L1	LED Pendant	4	13	52
L2	LED In-grade	8	5	40

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (sqft)	-	626
Input Watts (W)	-	52
Power Density (W/sqft)	0.4	**0.15**

Evaluation

The exterior canopy is the first visual the occupants will have upon entering the BCC library. The in grade uplights set the arches apart from the rest of the structure and define a clear entrance to the building. General illumination is provided with a decorative brushed bronze acorn pendant centered within the canopy at the each archway. These pendants blend nicely with the architecture and surrounding walkway lighting adjacent to the canopy area to maintain a cohesive campus image. The lighting design's quantitative performance exceeds basic

standards by providing proper illuminance levels with a highly energy efficient design that surpasses ASHRAE power density standards.

Information Lobby

After entering the BCC through the exterior canopy, you briefly pass through a small vestibule and into the Information Lobby. This is the first social space the occupant enters which serves as an information commons supported by computer carrels centered within the room dividing the space into two suggestive walkways. A small directory is centered on the far wall with a brief synopsis of each floor's content. Television screens are located on the east and west walls providing news and important campus information. This space serves many way-finding tasks and provides circulation into the main lobby.

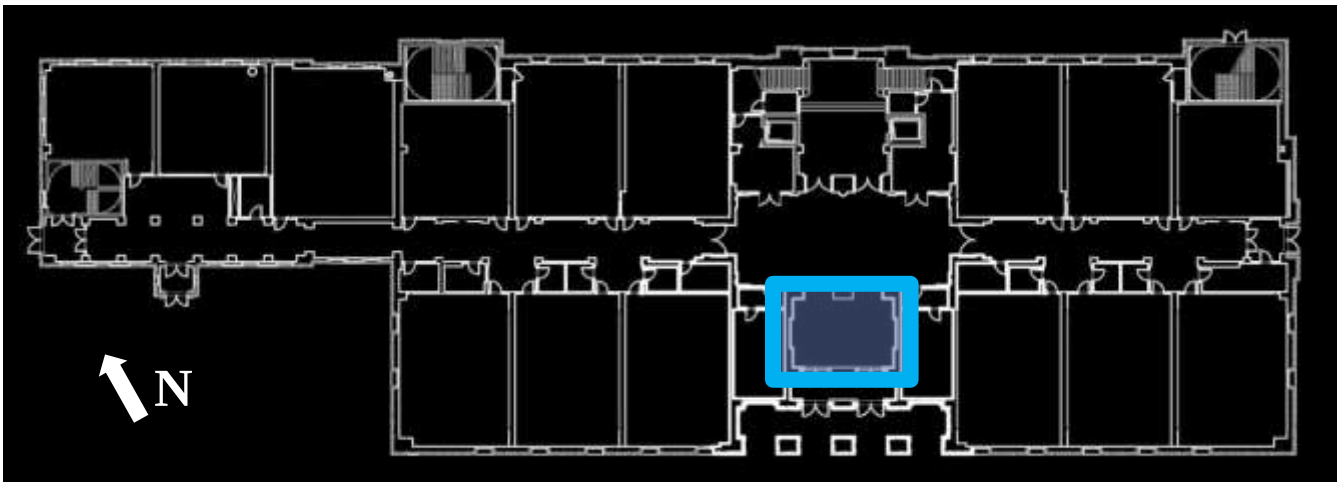

Figure 6: Information Lobby Location

Materials & Reflectance

Ceiling

- PTD GWB (cream) – 0.7
- Decorative GWB Panels – 0.7

Walls

- PTD GWB (green) – 0.5

Floor

- Ceramic Tile (Red) – 0.2

- Marble Tile (Cream) – 0.4

Furniture

- Wood Desk and Bench – 0.3

Dimensions

- Area – 531 sq. ft.
- Ceiling Height – 11’
- Approximate Width – 28’ 7”
- Approximate Length – 18’ 7”

Design Criteria

Qualitative

Way-finding | *Important* |

The information lobby contains directories, computers, and television screens to provide the occupants with guidance throughout the building. The lighting must support these tasks and provide and intuitive path to the main lobby.

Glare | *Important* |

Luminaires should be pleasant to view under normal viewing conditions so that discomfort glare is avoided.

Color Rendering | *Important* |

A light source with a high CRI value (80+) should be selected to properly render the color of skin tone, clothing, and the architectural materials.

Quantitative

Illuminance Levels | *Very Important* |

IESNA Lighting Handbook, 10th Edition

Recommended Illuminance for Ages 25 and Under

- Educational Facilities | Transition Spaces | Lobbies | Distant from entries

- Horizontal Illuminance @floor – 50 lux
- Vertical Illuminance @5' AFF – 25 lux
- Uniformity Ratio, Avg:Min – 3:1

Energy Code | *Very Important* |

ANSI/ASHRAE/IES Standard 90.1-2010

Lighting Power Density - Space by Space Method

- Lobby
  - Maximum Allowable LPD – 0.9 W/ft^2

Equipment

Lighting Equipment				
Type		**Description**	**Lamp**	**Manufacturer/Catalog**
L3		2" Recessed Linear LED	27W LED 3500K 80+CRI	Lumenpulse LLI2P-120-4-dRO35K
L4		Decorative LED Wall Sconce	16W LED 3500K 80+CRI	Beta Calco Windsor 591110
L5		4" LED Downlight Wide Distribution Specular Reflector	16W LED 3500K 83 CRI	Gotham EVO 35/06 4AR LD WD 120
L6		LED Linear Ribbon	1.5 W/Ft 3500K 80+CRI	Acolyte RBNL121535

Lighting Plan

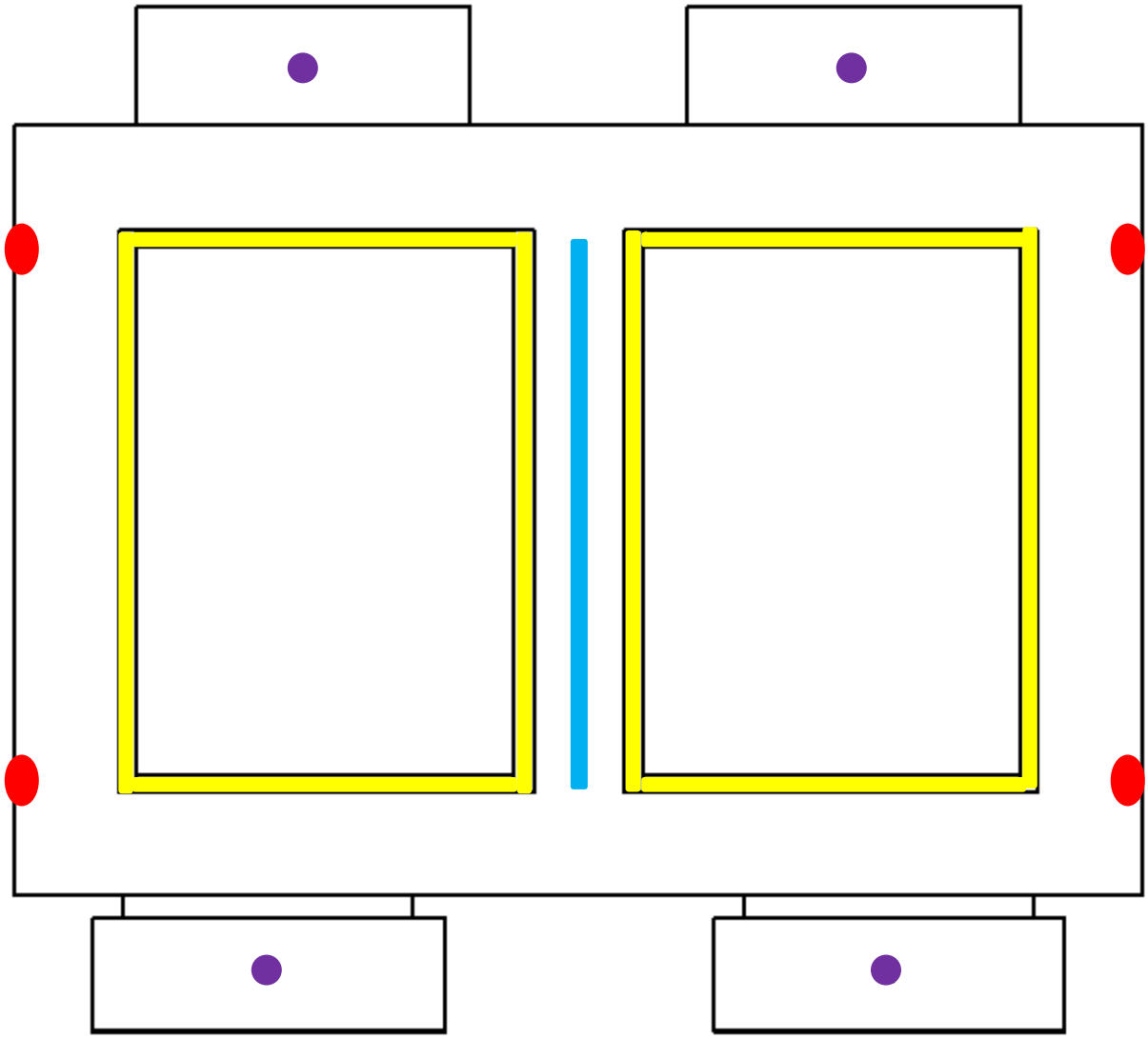

Figure 7: Information Lobby Lighting Plan

Light Loss Factors						
Type	Lamp Lumens		LLD	LDD	BF	Total
	Initial	Mean				
L3	-	-	0.7	0.95	-	0.665
L4	-	-	0.7	0.95	-	0.665
L5	-	-	0.7	0.95	-	0.665
L6	-	-	0.7	0.85	-	0.595

Controls

Cove lighting is circuited for emergency lighting.

Renderings

Figure 8: Information Lobby Illuminance Render

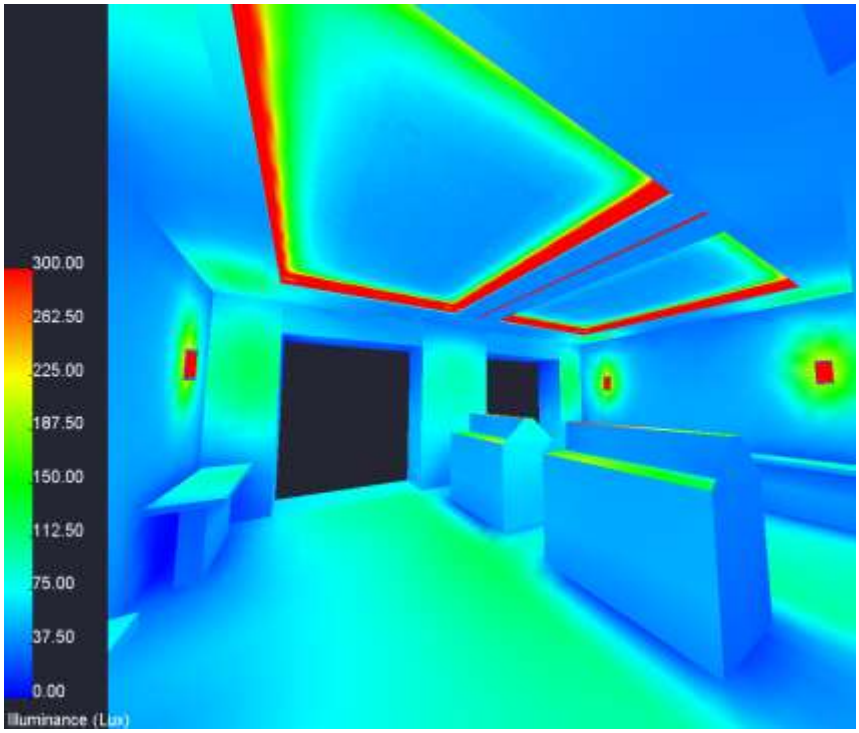

Figure 9: Information Lobby Pseudo Render

Performance

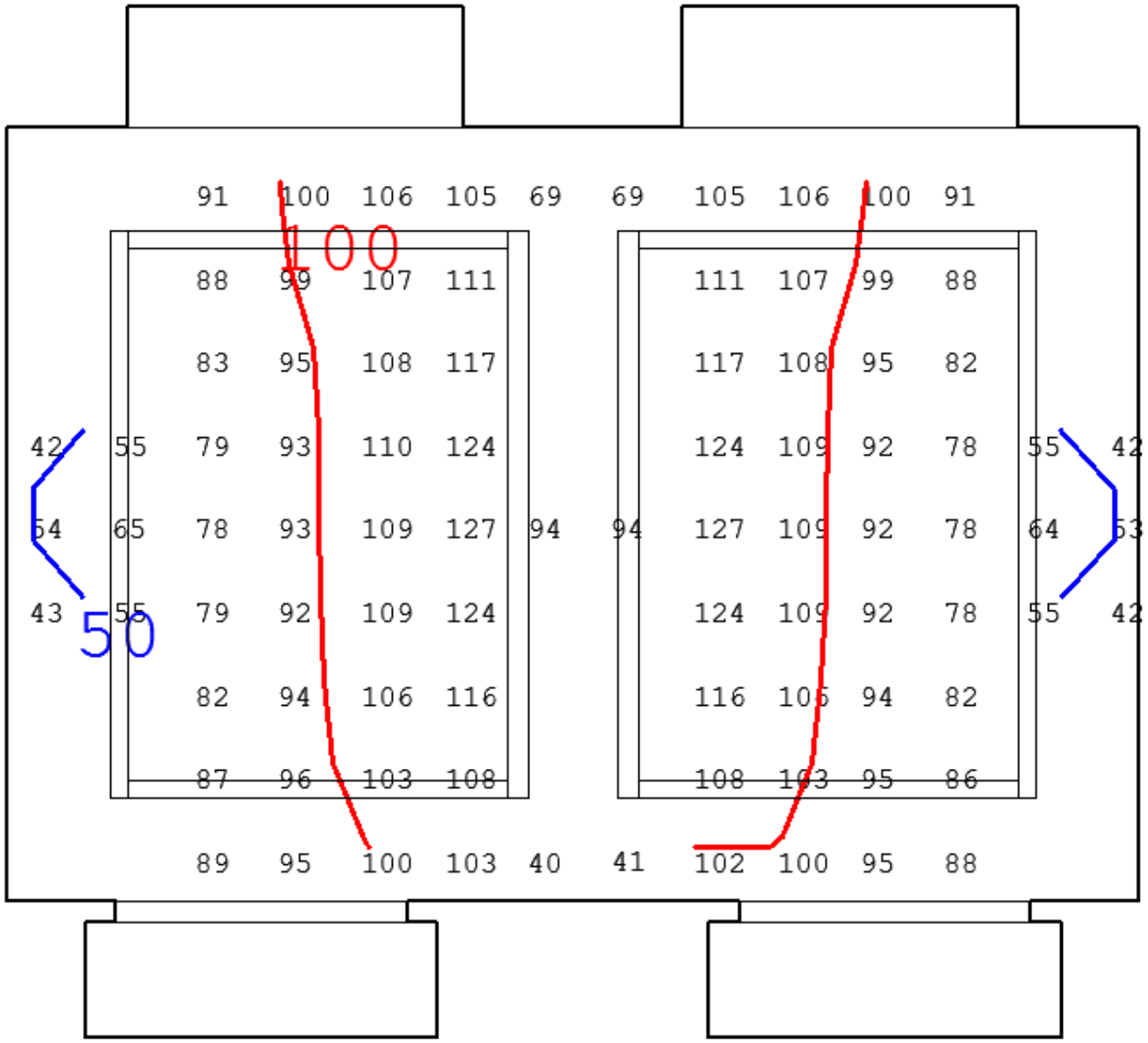

Figure 10: Information Lobby Isoline Calculation

Performance Data		
Calculation	**Target (lux)**	**Horizontal @ 0' (lux)**
Average Illuminance	50	102
Maximum Illuminance	-	140
Miniumum Illuminance	-	46
Average/Minimum	3	2.22

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L3	LED Rec. Linear	13 ft	7 W/ft	91
L4	LED Wall Sconce	4	16	64
L5	LED Downlight	4	16	64
L6	LED Ribbon	88 ft	1.5 W/ft	132

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (ft^2)	-	608
Input Watts (W)	-	351
Power Density (W/ ft^2)	0.9	**0.58**

Evaluation

The lighting in the information lobby successfully creates an inviting space by lighting the walls and ceiling while maintaining visual clarity with the linear recessed fixtures placing the focus on the information desks in the center of the room. The coves add to the ambience of the space while creating suggestive corridors into the main lobby. The high illuminance levels in the space are justified by the near adjacency to the exterior and the fact that the information lobby is the very first socially interactive space upon entering the building. These light levels are not overbearing and will promote reading and writing within the space in case occupants need to quickly record information they have just received. Even with the higher illuminance levels the highly energy efficient fixtures still perform under the ASHRAE power density allowance.

Main Lobby

The main lobby is the pivotal point within the building. It connects the information lobby, the east/west corridors and provides access to the elevator lobby on the south side. The large rectangular space is decorated with classical columns and small adornments. There are small café tables in each corner of the room for people relaxed, socialize, or study. Its scale and openness gives the space a plaza-like feel for occupants to interact in or meander through.

Figure 11: Main Lobby Location

Materials & Reflectance

Ceiling

- PTD GWB (cream) – 0.7
- Decorative GWB Panels – 0.7

Walls

- PTD GWB (green) – 0.5

Floor

- Ceramic Tile (Red) – 0.2
- Marble Tile (Cream) – 0.4

Furniture

- Wood Table and Chairs – 0.3

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Illuminance Levels | *Very Important* |

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Recommended Illuminance for Ages 25 and Under

- Educational Facilities | Transition Spaces | Lobbies | Distant from entries
    - Horizontal Illuminance @floor – 50 lux
    - Vertical Illuminance @5’ AFF – 25 lux
    - Uniformity Ratio, Avg:Min – 3:1
- Common Applications | Reading and Writing | Print Media | 12pt Font | Matte Paper
    - Horizontal Illuminance @ 2’6” – 100 lux
    - Vertical Illuminance @4’ AFF – 50 lux
    - Maximum Illuminance Ratio, Avg:Min – 2:1

Energy Code | *Very Important* |

ANSI/ASHRAE/IES Standard 90.1-2010

Lighting Power Density - Space by Space Method

- Lobby
    - Maximum Allowable LPD – 0.9 W/ft^2

Equipment

Lighting Equipment				
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L6		LED Linear Ribbon	1.5 W/Ft 3500K	Acolyte RBNL121535

Lighting Plan

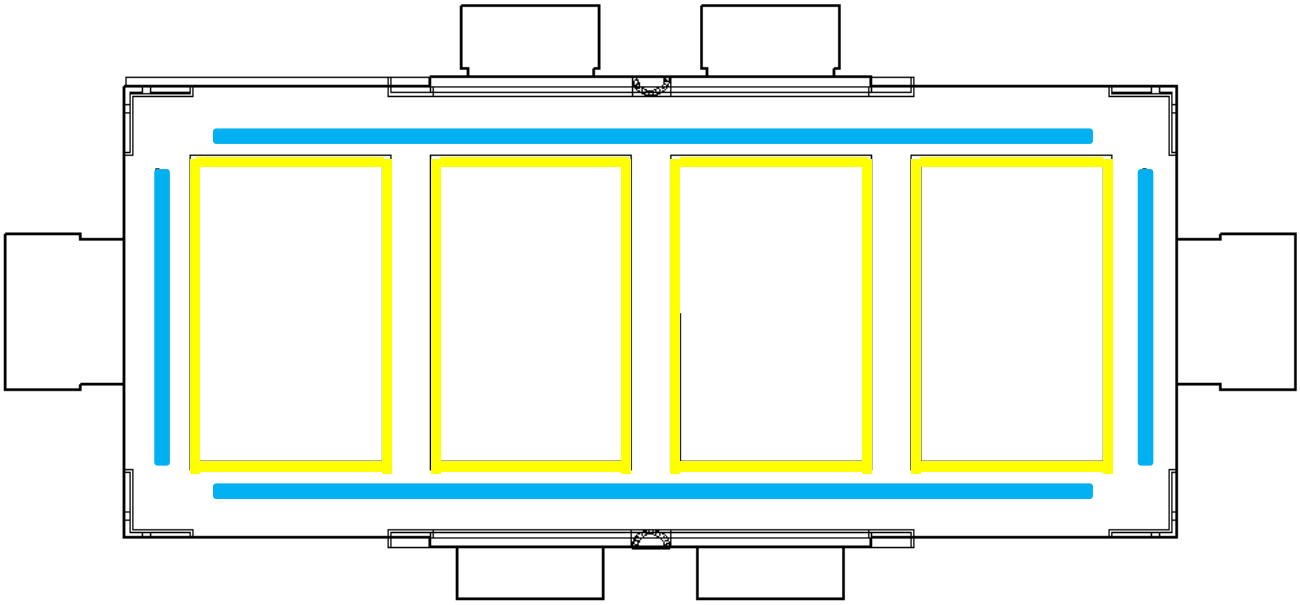


Figure 12: Main Lobby Lighting Plan

Light Loss Factors						
Type	**Lamp Lumens**		**LLD**	**LDD**	**BF**	**Total**
	Initial	**Mean**				
L3	-	-	0.7	0.95	-	0.665
L6	-	-	0.7	0.85	-	0.595

Controls

Cove lighting is circuited for emergency lighting.

Renderings

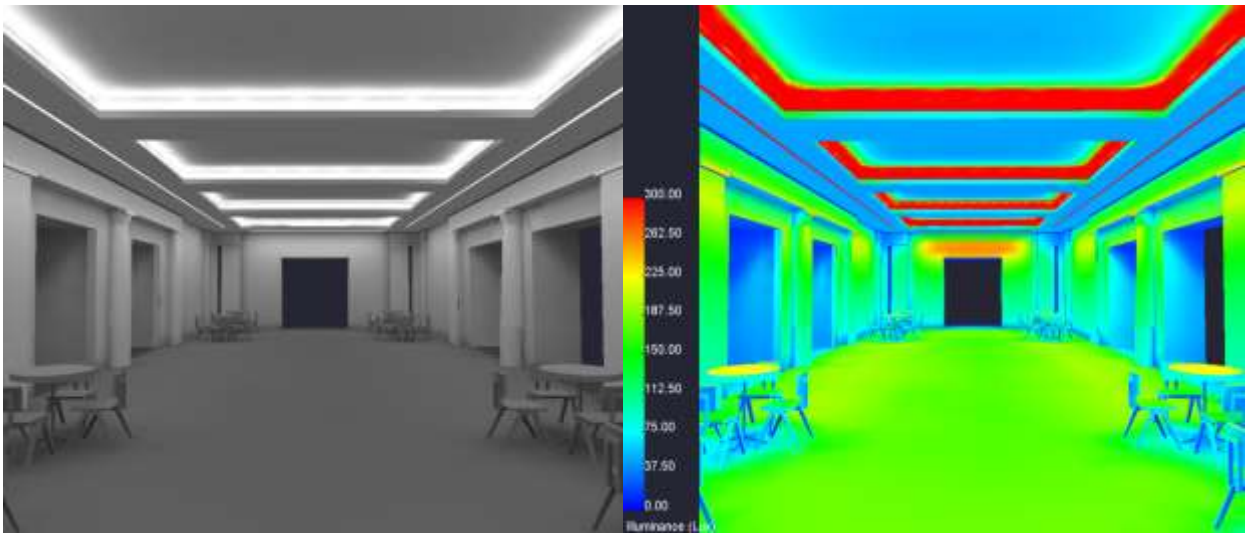


Figure 13: Main Lobby Illuminance and Pseudo Render

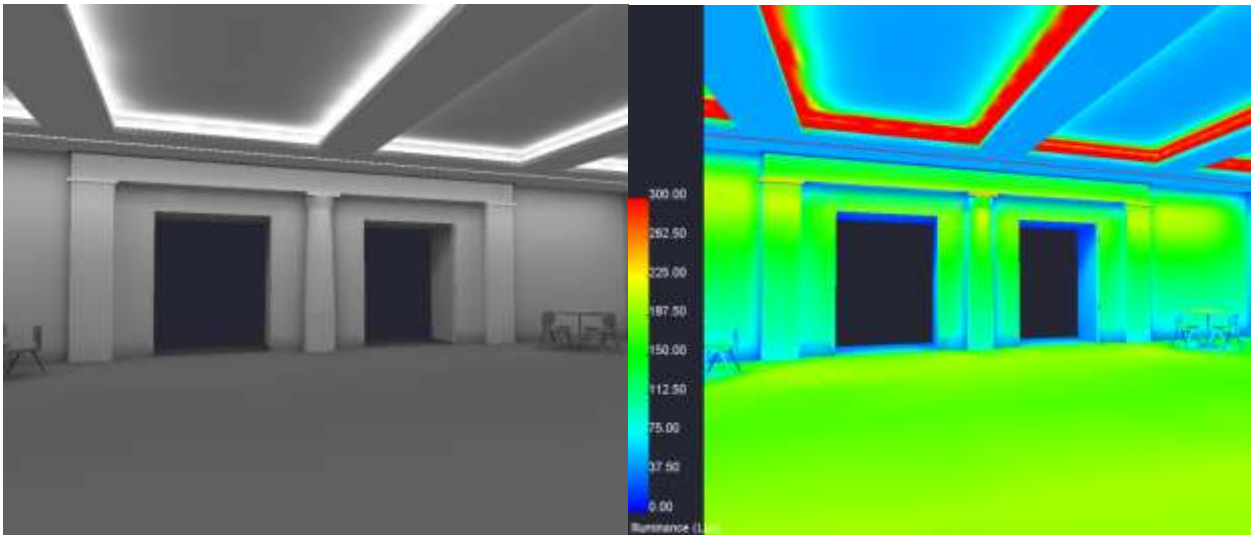


Figure 14: Main Lobby Entrance from Information Lobby

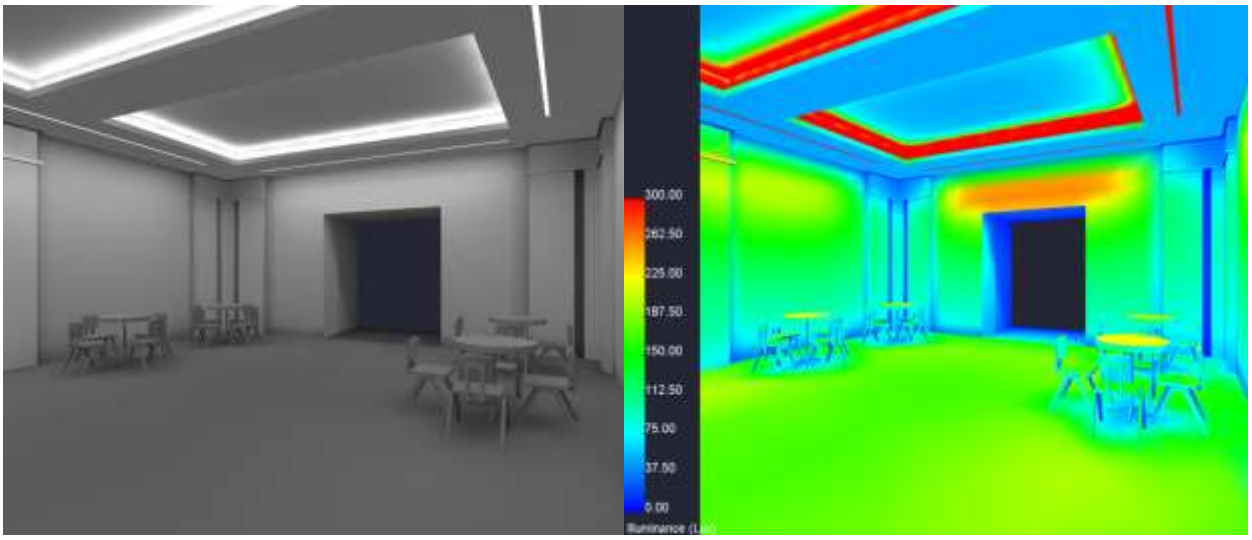


Figure 15: Main Lobby Seating Area

Performance

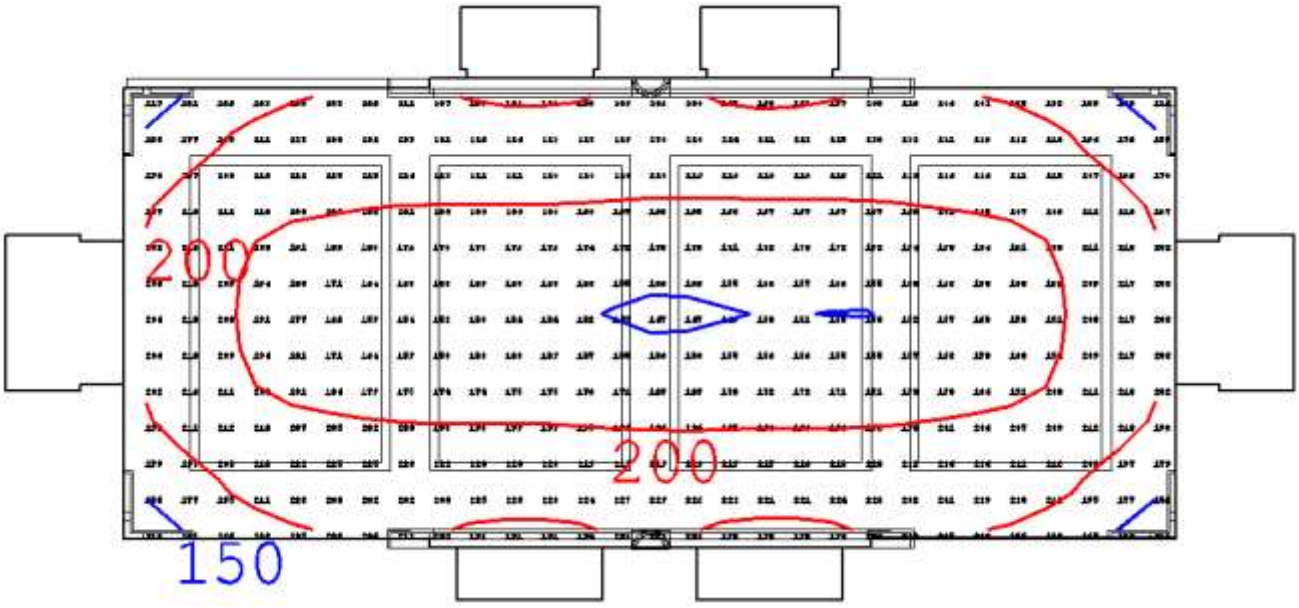


Figure 16: Main Lobby Isoline Calculation

Illuminance Data		
Calculation	**Target (lux)**	**Horizontal @ 2.5' (lux)**
Average Illuminance	100	194
Maximum Illuminance	-	233
Miniumum Illuminance	-	116
Average/Minimum	1.5	1.67

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L3	LED Rec. Linear	128 ft	7 W/ft	896
L6	Cove Ribbon	208 ft	1.5 W/ft	312

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (ft^2)	-	1533
Input Watts (W)	-	1208
Power Density (W/ ft^2)	0.9	**0.79**

Evaluation

The coves once again provide a great visual with their strong accent and are fluid with the coves in the surrounding spaces. The 2" low profile recessed linear fixtures graze the walls with their wide angle distribution and highlight the doorways at each of the four surrounding walls. The uniform light distribution throughout the space and along the walls fashions the open plaza-like impression and provides a pleasant social environment. The illuminance level in the main lobby is higher than the recommended value. This is acceptable due to the hierarchy of the space and the potential for occupants to work at the seating areas. The lighting design also performs within the ASHRAE power density allowance. Dimming could be incorporated into the linear fixtures to reduce the light levels and save more energy.

Corridor

The corridor runs east to west off of the main lobby guiding occupants to the state of the art classrooms on the ground floor. It also serves as the main exit path in case of emergency evacuations. Classically styled architectural columns line the walls appearing to support the pattern of rectangular soffits continuing through the corridor. The ceiling between these columns adorns even smaller rectangular soffits to complete the classical style. The flooring pattern mirrors the ceiling with a combination of porcelain and terracotta tile. At the entrance of each classroom, the corridor extends towards the south wall creating a secondary rectangular area which provides access to electrical, data, and storage spaces adjacent to the corridor.

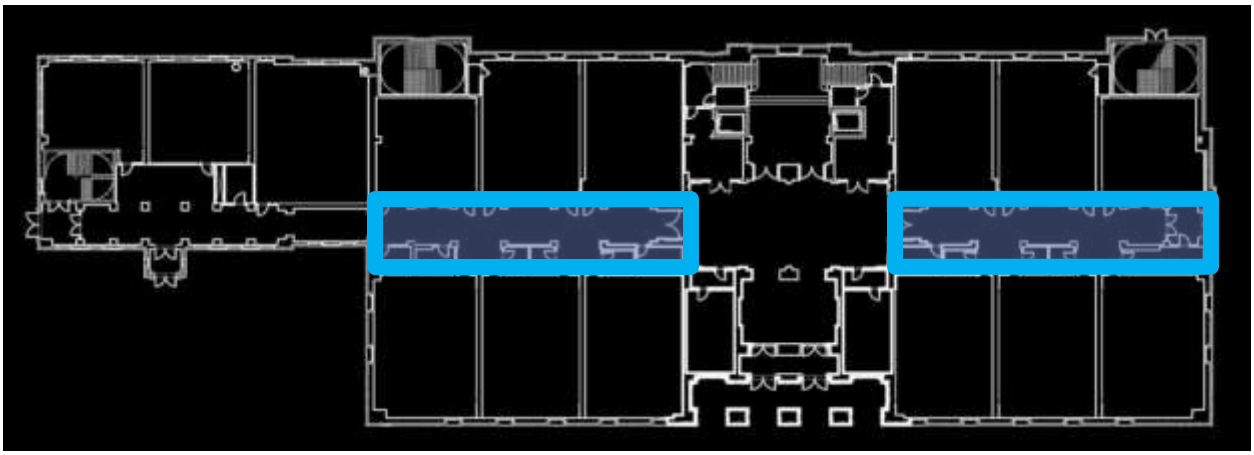


Figure 17: Corridor Location

Materials & Reflectance

Ceiling

- PTD GWB (cream) – 0.7
- Decorative GWB Panels – 0.7

Walls

- PTD GWB (green) – 0.4
- PTD GWB (cream) – 0.6

Floor

- Ceramic Tile (Red) – 0.2

- Marble Tile (Cream) – 0.3

Dimensions

- Area – 2500 sq. ft.
- Ceiling Height – 11’ 6”
- Approximate Width – 11’ 6”
- Approximate Length – 170’

Design Criteria

Qualitative

Psychological Impact | *Important* |

The lighting should create an appealing and intuitive passageway to guide the user to their destination. By properly placing light the design can evoke a sense of spaciousness and comfort.

Glare | *Important* |

Luminaires should be pleasant to view under normal viewing conditions so that discomfort glare is avoided.

Color Rendering | *Important* |

A light source with a high CRI value (80+) should be selected to properly render the color of skin tone, clothing, and the architectural materials.

Psychological Impact

The lighting in the corridor must create an appealing and intuitive passageway to guide the user to their destination. A corridor should be appealing in its physical appearance as well as psychological impression. The lighting must synchronize with the elegance of the architecture and provide a sense of spaciousness and fluency in the understanding its design with The architectural color palette is a mix of light color tones which the lighting should complement in providing a soft glowing, glare free environment with exceptional rendition of colors.

Quantitative

Illuminance Levels | *Very Important* |

IESNA Lighting Handbook, 10th Edition

Recommended Illuminance for Ages 25 and Under

- Transition Spaces | Circulation Corridor | Public | Independent Passageway
  - Horizontal Illuminance @floor – 25 lux
  - Vertical Illuminance @5' AFF – 15 lux
  - Uniformity Ratio, Avg:Min – 2:1

Energy Code | *Very Important* |

ANSI/ASHRAE/IES Standard 90.1-2010

Lighting Power Density - Space by Space Method

- Corridor/Transition
  - Maximum Allowable LPD – 0.66 W/ft^2

Equipment

Lighting Equipment				
Type		**Description**	**Lamp**	**Manufacturer/Catalog**
L4		Decorative LED Wall Sconce	16W LED 3500K 80+CRI	Beta Calco Windsor 591110
L5		4" LED Downlight Wide Distribution Specular Reflector	16W LED 3500K 83 CRI	Gotham EVO 35/06 4AR LD WD 120
L6		LED Linear Ribbon	1.5 W/Ft 3500K 80+CRI	Acolyte RBNL121535

Lighting Plan

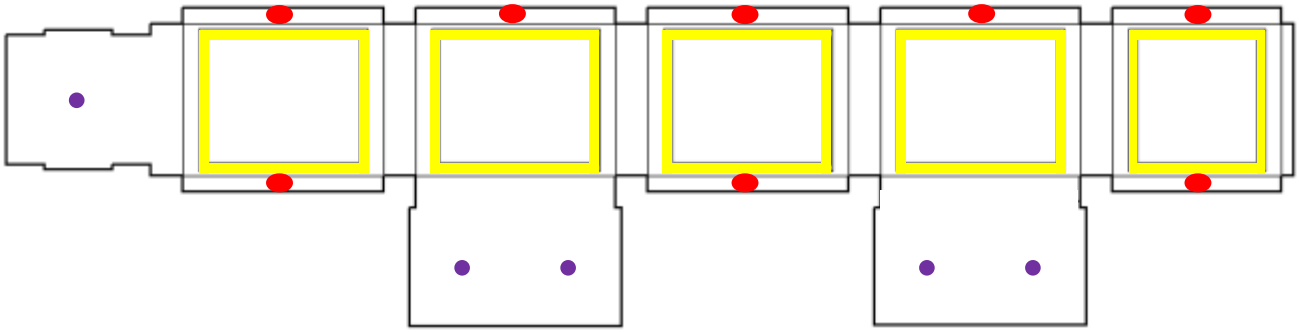


Figure 18: Corridor Lighting Plan

Light Loss Factors						
Type	Lamp Lumens		LLD	LDD	BF	Total
	Initial	Mean				
L4	-	-	0.7	0.95	-	0.665
L5	-	-	0.7	0.95	-	0.665
L6	-	-	0.7	0.85	-	0.595

Controls

Cove lighting is circuited for emergency lighting.

Renderings

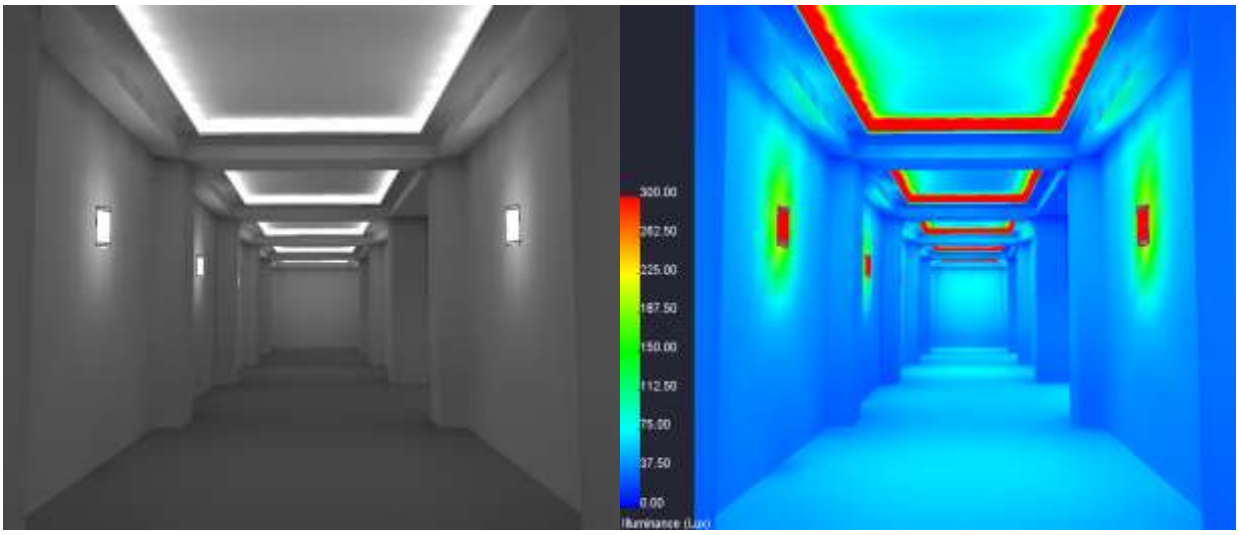


Figure 19: Corridor Illuminance and Pseudo Render

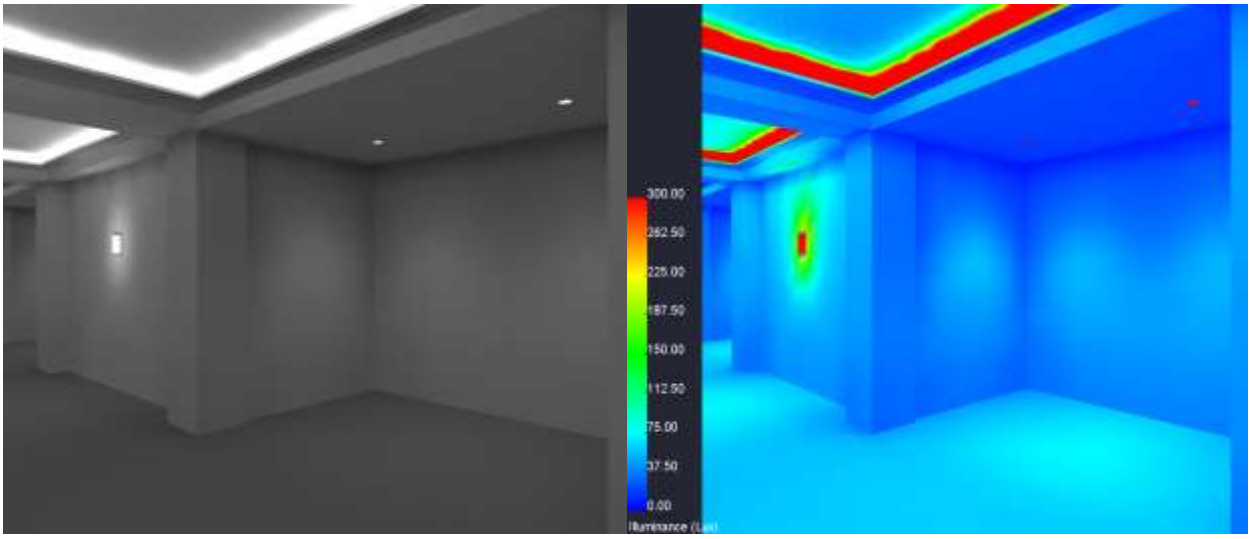


Figure 20: Corridor Classroom Entrance

Performance

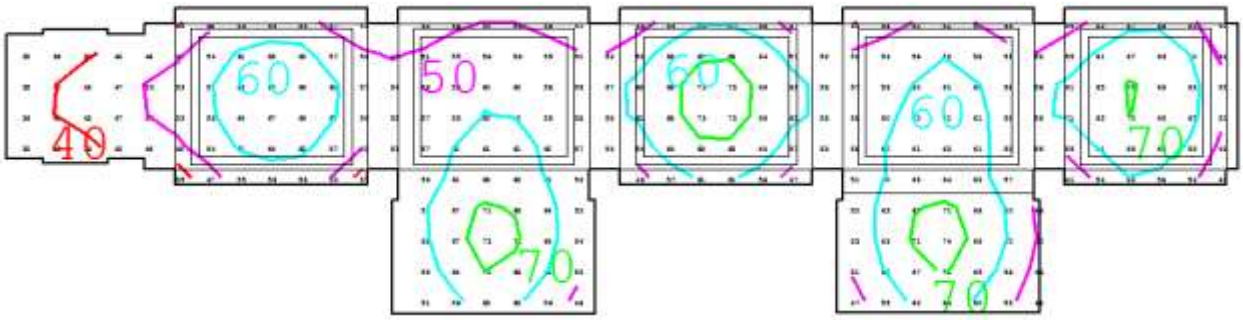


Figure 21: Corridor Isoline Calculation

Illuminance Data		
Calculation	**Target (lux)**	**Horizontal @ 0' (lux)**
Average Illuminance	25	56.75
Maximum Illuminance	-	74
Miniumum Illuminance	-	32
Average/Minimum	2	1.77

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L4	LED Wall Sconce	8	16	128
L5	LED Downlight	5	16	80
L6	LED Ribbon	176 ft	1.5 W/ft	264

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (sqft)	-	1178
Input Watts (W)	-	472
Power Density (W/sqft)	0.66	**0.4**

Evaluation

The strong accent of the cove lighting creates a guiding rhythm of light as you view down the corridor. The wall sconces compliment this pattern and spread light throughout the space and onto the walls. The low power density limited the design intent of creating a psychologically spacious environment by creating high intensity uniform light along the walls. Linear wall grazers as used in the lobby were removed from the original design and supplemented with wall sconces to achieve an energy compliant design. The final design does not fully fulfill the original psychological intent. However, the design is visually interesting and a cohesive design that fits the architectural context and performs within the ASHRAE power density allowance.

Library

Atop the monumental staircase lies the building's feature space, the library, which showcases an enormous double height reading room. The library is rectangular in shape and has a two adjacent barrel vaults for its ceiling which are supported by centralized columns between the arches. The reading room lies in the center of the library and is open to the third floor above. Study carrels, computer stations, and long study tables cover the open floor. Along the wooden banner around the reading room's opening to above are paintings done by a local artist. Large windows on the south wall provide the space with a generous amount of daylight. The amount of daylight is controlled with motorized shades under the control of the library's management staff.

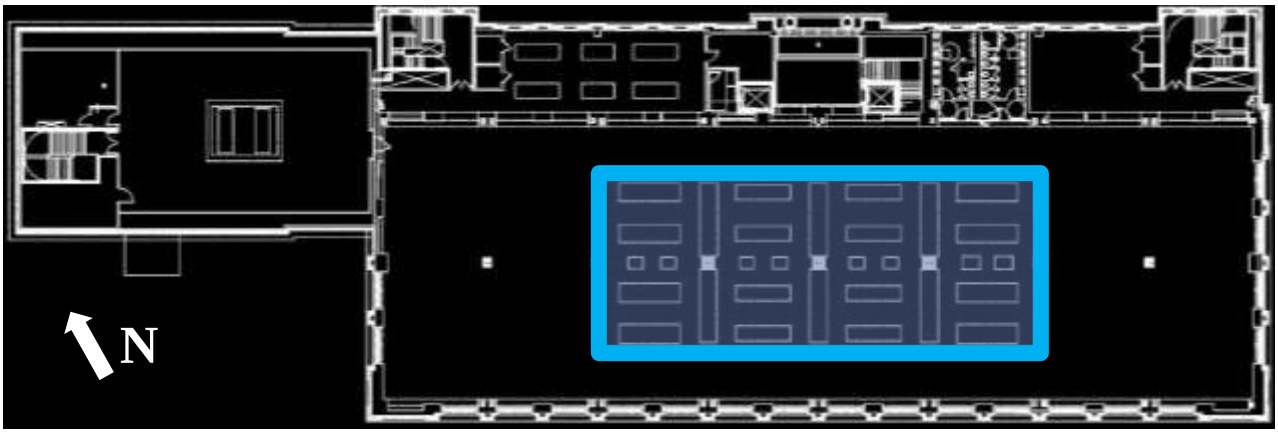


Figure 22: Library 2nd Floor Reading Room

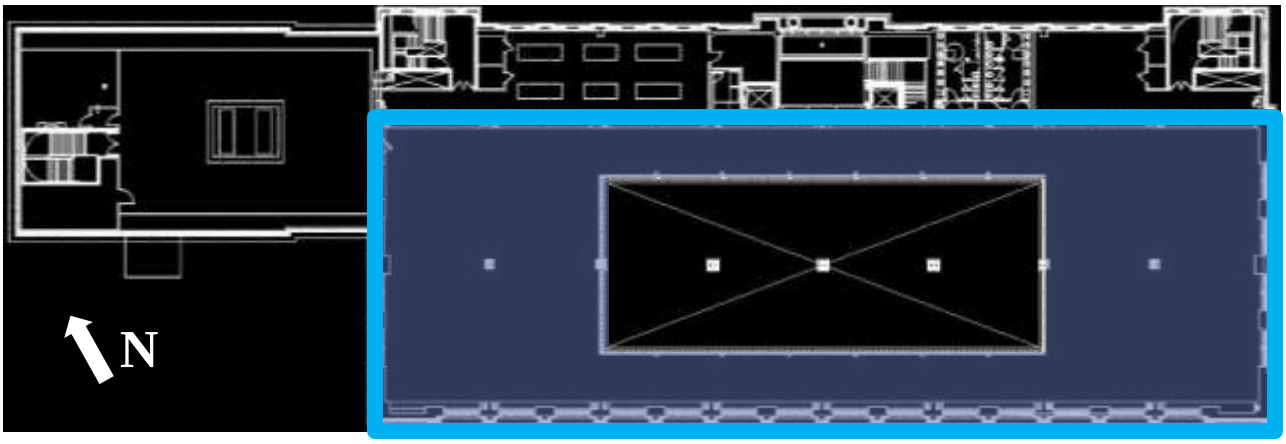


Figure 23: Library 3rd Floor Workspace and Stacks

Materials and Reflectance

Ceiling

- Barrel Vaulted GWB – 0.7
- Acoustical Plaster – 0.7
- Architectural Arches – 0.2

Walls

- PTD GWB (tan) – 0.5

Floor

- Cork Floor (Lower Level) – 0.2
- Carpet (Upper Level) – 0.2

Furniture

- Wood Tables and Chairs (Lower Level) – 0.3
- Wood, Fabric (Upper Level) – 0.3

Dimensions

Reading Room – Lower Level

Area – 9450 sq. ft.

Ceiling Height High Point – 26’ 3”

Ceiling Height Low Point – 20’ 3”

Approximate Width – 101’ 11”

Approximate Length – 136’ 8”

Reading Room – Upper Level

Area – 2565 sq. ft.

Approximate Width – 16’ 3”

Approximate Length – 136’ 8”

Design Criteria

Qualitative

Glare |*Very Important* |

Direct Glare from the lighting fixtures and daylight entering through the windows must be addressed so it does not cause discomfort and disrupt students in their studies.

Controls |*Important* |

The level of control designed into the illumination system will have a major role in addressing daylight illuminance levels and overall design flexibility.

Accent Lighting |*Somewhat Important* |

The artwork on the banner around the reading room should have proper vertical illuminance to be viewed.

Quantitative

Illuminance Levels |*Very Important*

IESNA Lighting Handbook, 10th Edition

Recommended Illuminance *for Ages 25 and Under*

- Library Facilities | Library Proper | Reading Area | Study Carrels & Tables and Chairs
    - Horizontal Illuminance @2.5' AFF – 250 lux
    - Vertical Illuminance @4' AFF – 100 lux
    - Uniformity Ratio, Avg:Min – 2:1

- Library Facilities | Reading and Writing | VDT Screen | CSA/ISO Type I | Positive Polarity
    - Horizontal Illuminance @2.5' AFF – 150 lux
    - Vertical Illuminance @3.5' AFF – 75 lux

- Common Applications | Reading and Writing | Print Media | 12pt Font | Matte Paper
    - Horizontal Illuminance @ 2'6" – 100 lux
    - Vertical Illuminance @4' AFF – 50 lux
    - Maximum Illuminance Ratio, Avg:Min – 2:1

*Maximum Illuminance ratio to maintain concentration should be 5:1 at task area to minimum throughout work space

Energy Code |*Very Important*

ANSI/ASHRAE/IES Standard 90.1-2010

Lighting Power Density - Space by Space Method

- Library | Reading Area
    - Maximum Allowable LPD – 0.93 W/ft2

Equipment

Lighting Equipment				
Type		**Description**	**Lamp**	**Manufacturer/Catalog**
L7		46” Decorative LED Pendant	360W LED 3500K 80+CRI	Beta Calco 60 7041
L8		30” Decorative LED Wall Sconce Upper Level	190 W 3500K	Beta Calco 60 7021
L8A		30” Decorative LED Wall Sconce Lower Level	190 W 3500K	Beta Calco 60 7021

Lighting Plan

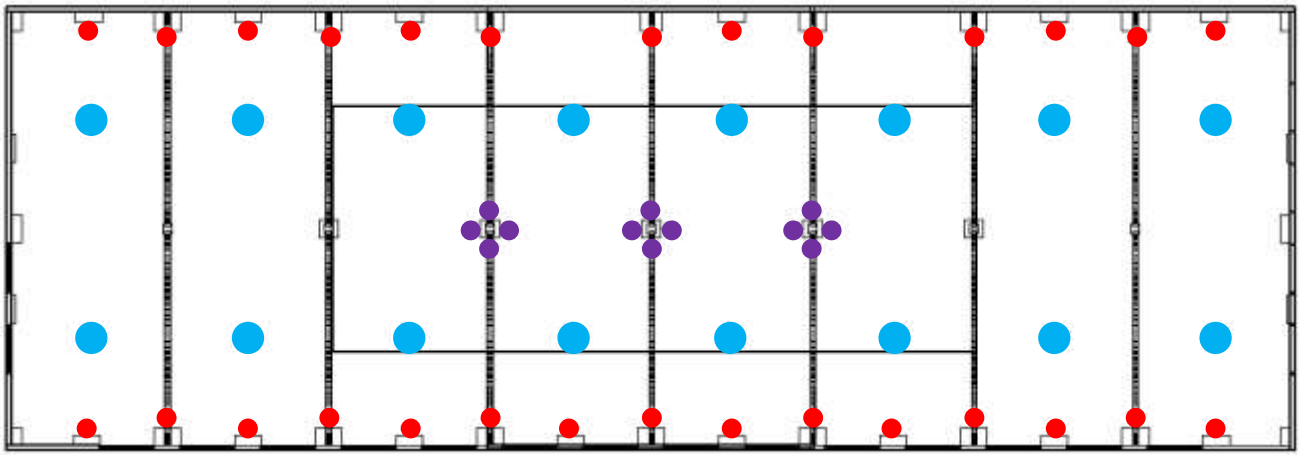


Figure 24: Library Lighting Plan

Light Loss Factors						
Type	**Lamp Lumens**		**LLD**	**LDD**	**BF**	**Total**
	Initial	**Mean**				
L7	-	-	0.7	0.8	-	0.56
L8	-	-	0.7	0.8	-	0.56
L8A	-	-	0.7	0.8	-	0.56

Controls

New library lighting is to be integrated into existing Lutron Graphic Eye system for staff control only.

Renderings

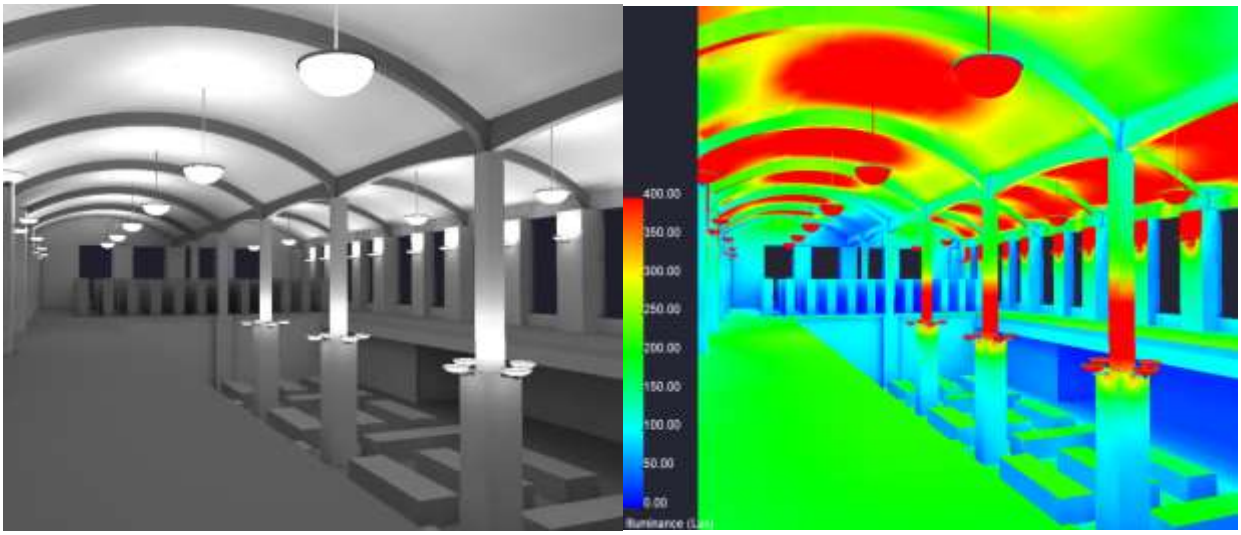


Figure 25: Library 3rd Floor Illuminance and Pseudo Render

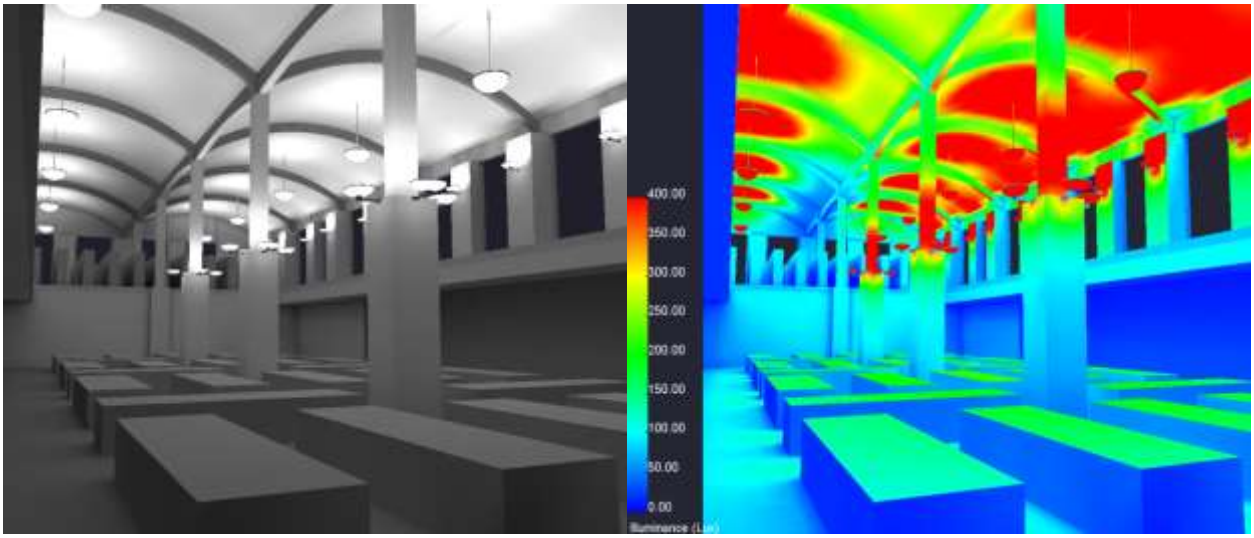


Figure 26: Library 2nd Floor Illuminance and Psuedo Render

Performance

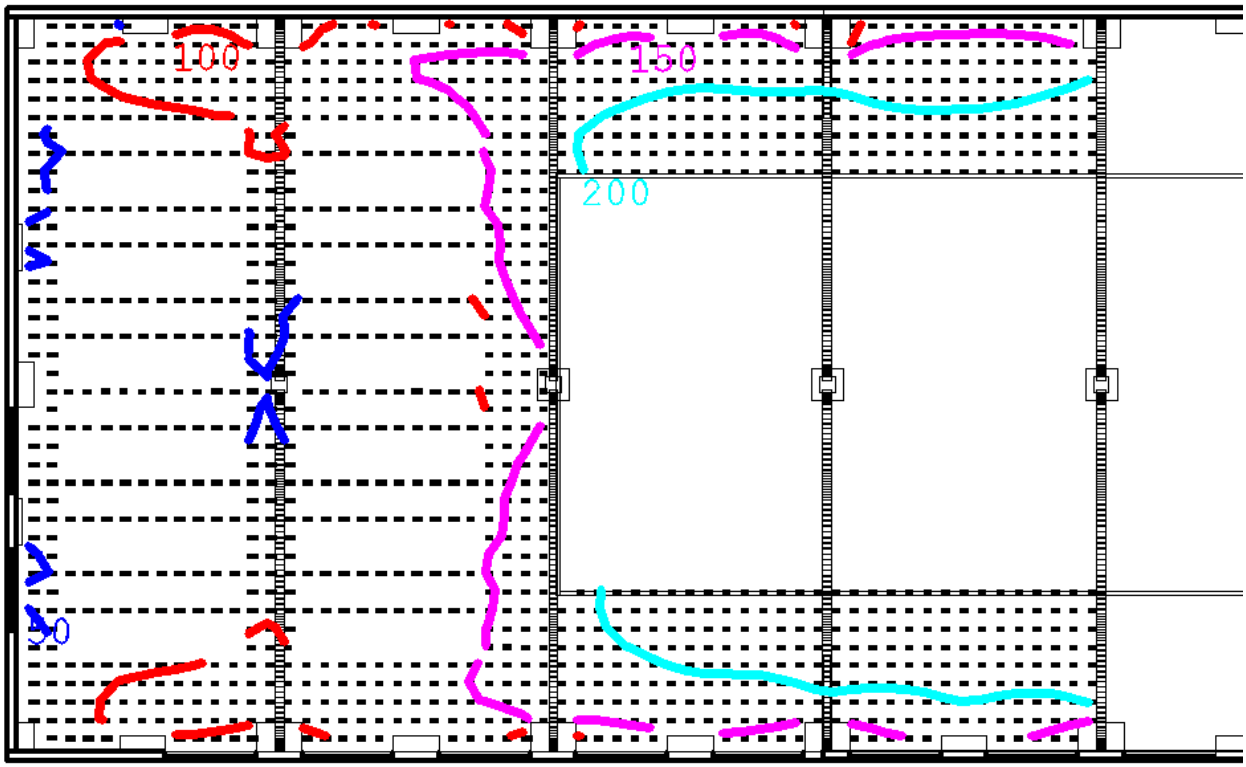


Figure 27: Library 3rd Floor West Isoline Calculation (Symetrical)

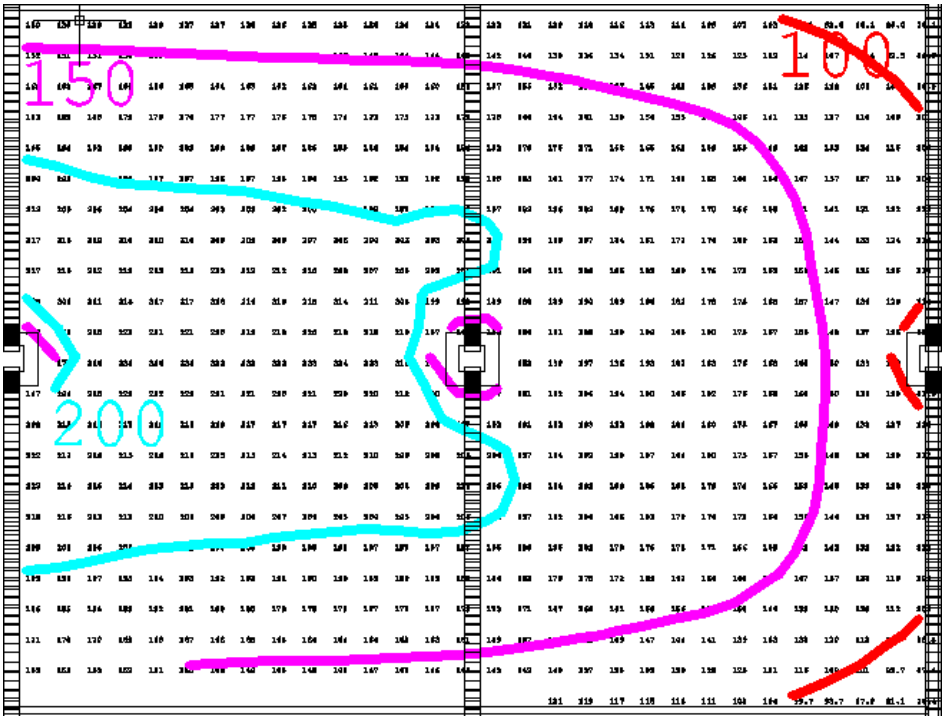


Figure 28: : Library 2nd Floor West Isoline Calculation (Symetrical)

Illuminance Data		
Calculation	**Target (lux)**	**Horizontal @ 2.5' (lux)**
Lower Study Carrel and Table		
Average Illuminance	250	181
Maximum Illuminance	-	226
Miniumum Illuminance	-	107
Average/Minimum	2	1.69
Upper Level		
Average Illuminance	150	166
Maximum Illuminance	-	241
Miniumum Illuminance	-	65.1
Average/Minimum	2	2.55

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L7	LED Pendant	16	360	5760
L8	LED Wall Sconce	28	190	5320
L8A	LED Wall Sconce	12	190	2280

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (sqft)	-	19683
Input Watts (W)	-	13360
Power Density (W/sqft)	0.93	**0.68**

Evaluation

The new library lighting design illuminates the entire volume of the Library with primarily indirect lighting fixture. The library is designed with classical French industrial style with which the high powered LED pendants and wall sconces fit the decorative context and provide illumination to all of the area not covered with book stacks. The wall sconces up-light the central columns, provide additional light to the lower reading room, and tie the two levels together visually. These fixtures contain custom cutoff baffles to ensure glare control when viewed from the upper level. The overall design spreads light across the vaulted ceiling creating grand environment to experience. The illuminance levels in the carrel area were slightly under the recommended values yet are still acceptable. The current light levels are still above the 100 lux level for reading and writing. If the owner would decide that achieving the 250 lux recommended at the carrels and tables was critical to the design, it would be possible to

include integrated furniture lighting into the tables and still abide to the ASHRAE power density allowance.

Law Classroom and Stacks

Architectural Breadth

The law classroom located on the third floor adjacent to the library provides additional work space for students and accommodates the law book stacks. It is intended to be used for multiple purposes such as a classroom, mock-up courtroom, or simply a space to study. I chose to redesign this space in order to enhance its functionality and provide integrated lighting systems by harmonizing the room's functional and spatial aspects with the lighting, furniture layout, and new stacks.

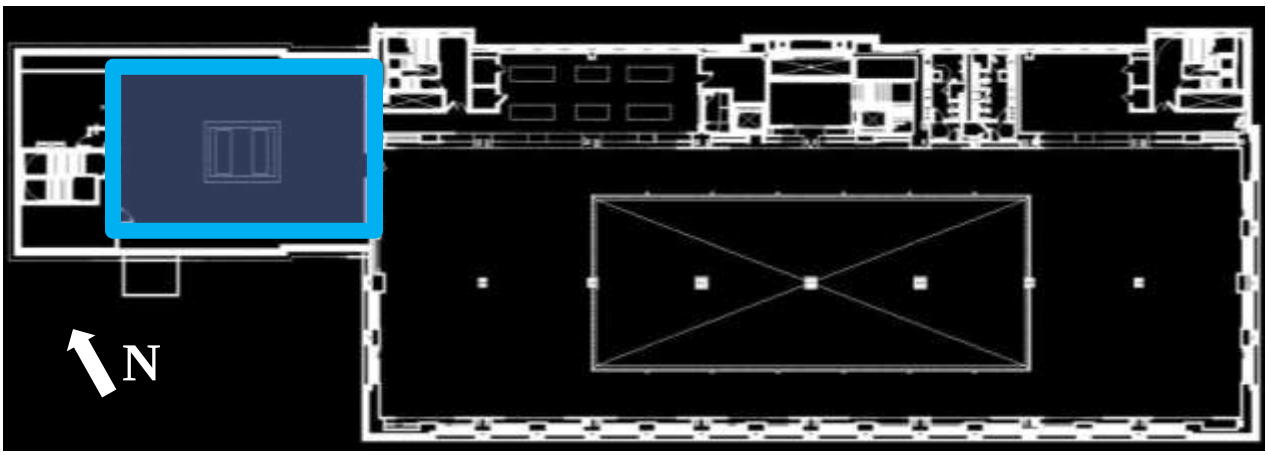


Figure 29: Law Classroom and Stacks Location

Inspirational Quotes from Design Literature

"Natural motivation to learn can be rekindled by supportive environments, meaningful activities, by being freed of anxiety, fear, and other negative mental states."

"Intrinsic motivation… is assisted by a level of familiarity and absence of distraction."

"Social interactions, discussion, debate, and teamwork encourage learning and prompt a design requirement for rooms that can be reconfigured quickly"

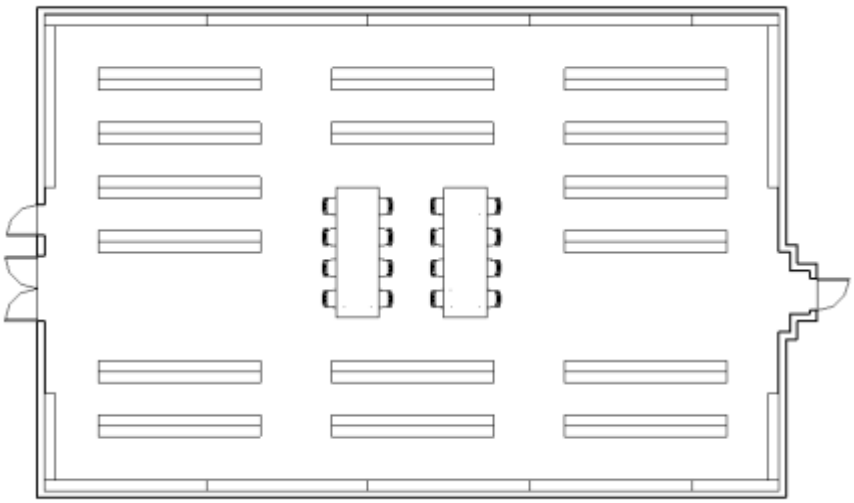


Figure 30: Original Law Classroom Design

Original Stack Design Data		
Area	**sq. ft.**	**% of Area**
Total	3042	-
Stacks	2443	81 %
Workspace	564	**19 %**

Room Dimensions

Area – 3042 sq. ft.
Ceiling Height – 15’
Approximate Width – 44’
Approximate Length – 68’

As you can see in Figure 30 above, the original design of the law classroom has fixed stacks along the walls as well as rows of stacks which converge towards the center of the room. The stacks open up at the center of the room to two large desks for occupants to work. A suggestive corridor created by the layout of the stacks to connect the two off-center doors at each wall. The original ceiling is a partial mansard style ceiling with a 30 degree slope starting 8 feet up the wall along the length of the room. The sloped ceiling connects to the flat of the ceiling plane maxing out at 15 feet above the floor. You can see from the data that there is very little percentage of actual area of workspace compared to the percentage of area that the stacks consume. Since the stacks consumed the majority of the space, I first looked into ideas for how to improve their design, layout and spatial relationship with the furniture within the confines of the room. The solution I decided on was high density mobile shelving. This shelving allowed me to keep the existing volume of storage space while freeing up valuable area within the room that can now be used more productively.

I continued to look into how I could utilize the compact mobile shelving within the space to maximize the usable work area while creating a functional, integrative and enjoyable environment for the occupants. Spatial diagrams were created to brainstorm potential layouts.

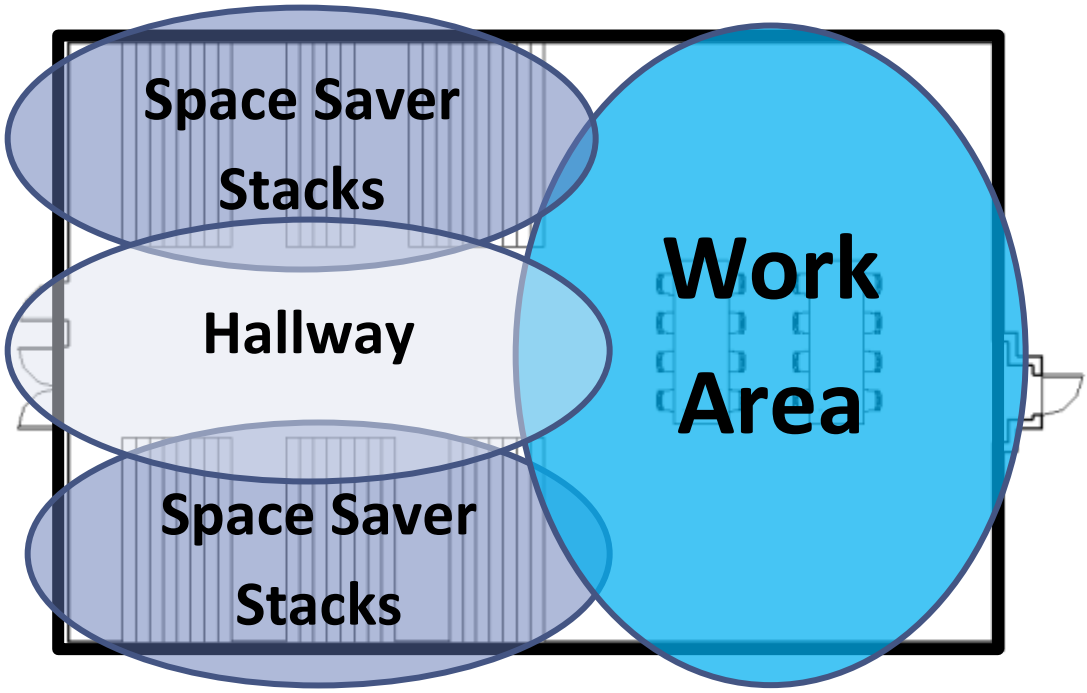


Figure 31: Diagram 1

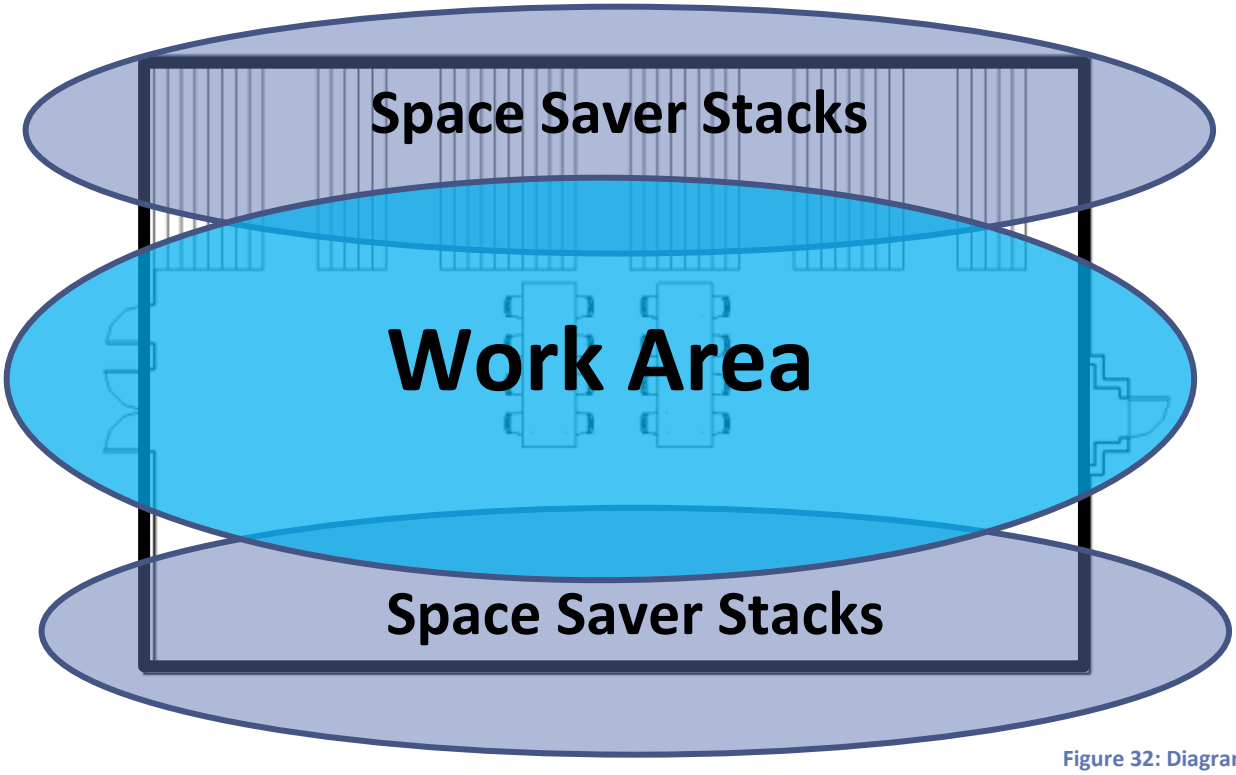


Figure 32: Diagram 2

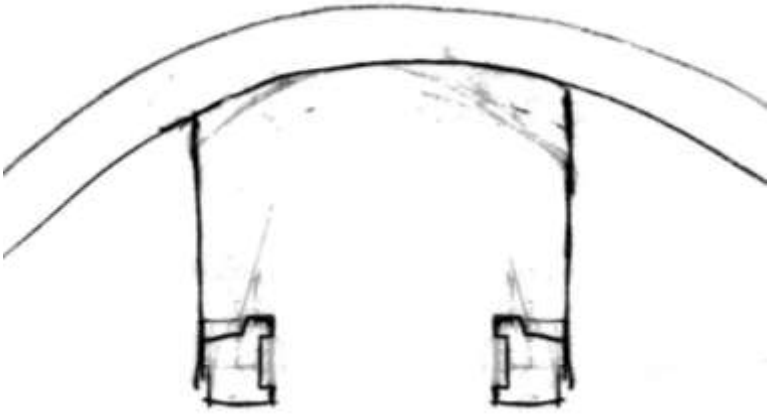
Reciting the prior quotations, the new classroom should encourage learning, social interactions and alleviate distractions and anxiety. The design criteria are as follows…

- The design provides an open social environment to promote learning.
- The design unifies the educational resources and learning environment.
- The design coheres with the classical style of the building.

After analyzing the two selected spatial diagrams against the design criteria and constructability within the spatial extents so as not to disrupt other building equipment, the latter of the two spatial diagrams was selected for the following reasons. By laying out the high density shelving along each length of the room, they create a dynamic wall system that defines the boundary of an open and adaptable study hall while allowing proper ceiling height for an arched ceiling to enclose the central hall and illuminate the workspace. The arched ceiling gives the space a sense of openness and spaciousness while creating a familiar yet unique environment from the adjacent library.

To address the lack of symmetry created by the skewed position of the doors at each end of the room, the rectangular extrusion at the primary entrance was extended to create the perception of symmetry of the space as a whole by drawing the eye away from the off centered doorway.

Sketches



Proposed arched ceiling design replicating the adjacent library with architectural coves to support illumination techniques

Primary entry cut-out and architectural cove designed for perception of symmetry within the space and draw attention away from the off centered door.

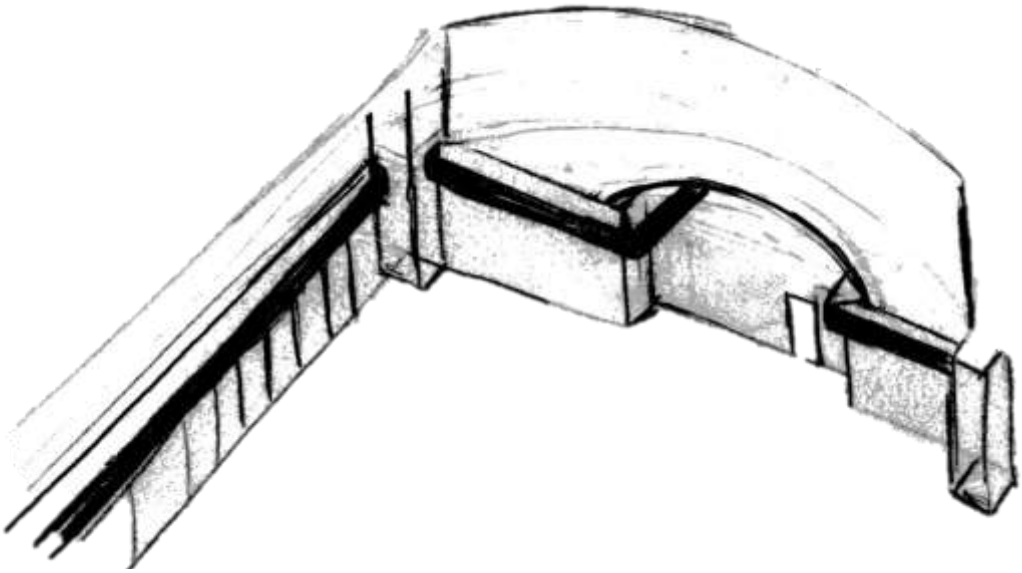


Figure 33: Comprehensive Perspective Sketch

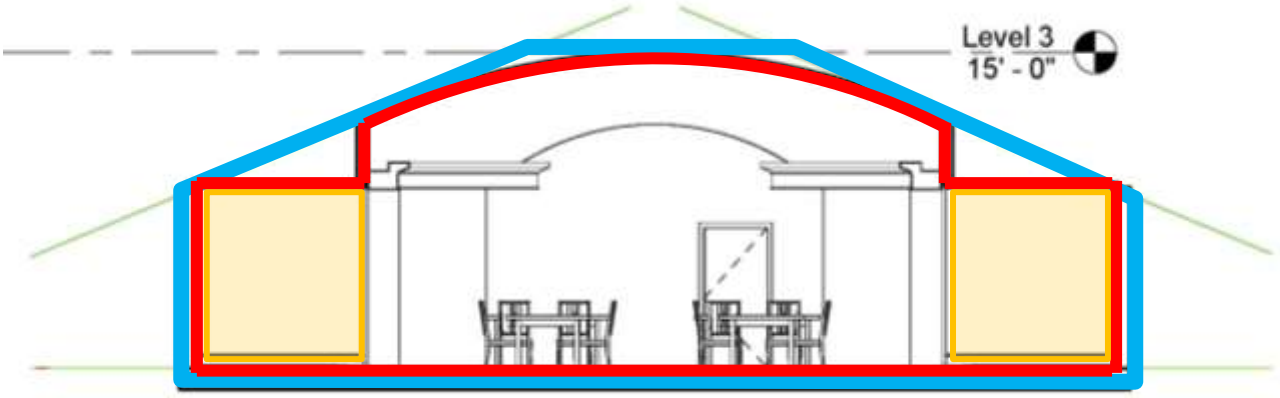


Figure 34: New Section View and Original Ceiling Profile

Original Room Profile
Redesigned Room Profile
Space Saver Mobile Stacks

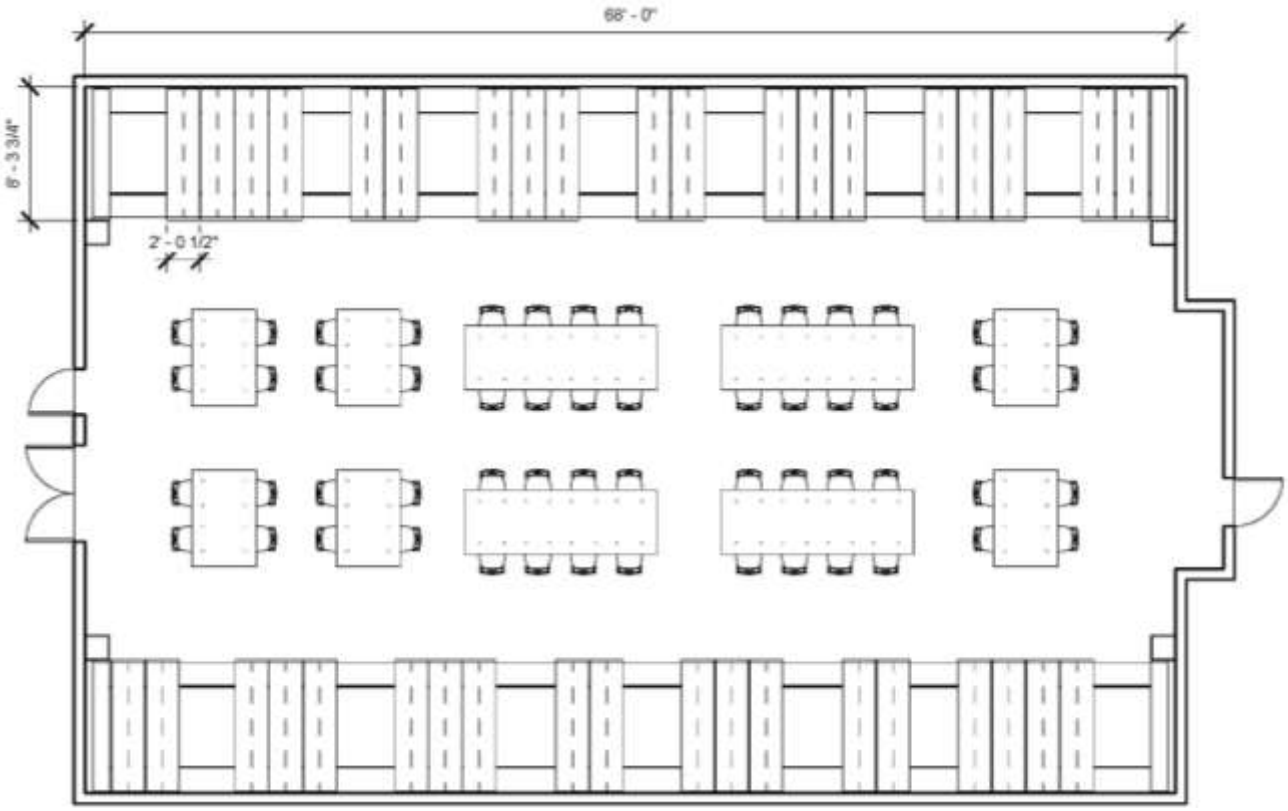


Figure 35: New Floor Plan

Original Design vs. Space Saver Design Data				
Original Design			Space Saver Design	
Area	**Ft^2**	**% of Area**	**Ft^2**	**% of Area**
Total	3042	-	3042	-
Stacks	2443	81 %	1130	38 %
Workspace	564	**19 %**	1862	**62 %***
				*** 43% more workspace**

Render

Figure 36: Redesigned Law Classroom and Stack Render

Breadth Conclusion

The design unifies the educational resources and learning environment by integrating the Space Saver mobile shelving into the wall system and providing the new law classroom 43% more workspace which promotes an enhanced social learning environment. The arched ceiling adds depth to the space and provides great indirect lighting opportunities with the cove features surrounding the room. Overall the architectural redesign of the law classroom successfully created a spatially integrative, functionally adaptable and architecturally unique learning environment within the volume of the existing conditions.

Redesigned Law Classroom Lighting

Materials & Reflectance

Ceiling

- PTD GWB – 0.7

Walls

- PTD GWB – 0.5
- Mobile Shelving Wood Panels – 0.3

Floor

- Carpet – 0.2

Furniture

- Wood Tables , Chairs, Stacks – 0.3

Dimensions

- Area – 3042 sq. ft.
- Ceiling Height – 15’
- Approximate Width – 68’
- Approximate Length – 44’

Design Criteria

Qualitative

Glare | *Important* |

Luminaires should be pleasant to view under normal viewing conditions so that discomfort glare is avoided.

Color Rendering | *Important* |

A light source with a high CRI value (80+) should be selected to properly render the color of skin tone, clothing, and the architectural materials.

Quantitative

Illuminance Levels | *Very Important*

IESNA Lighting Handbook, 10th Edition

Recommended Illuminance for Ages 25 and Under

- Educational Facilities | Classrooms | Study Halls
  - Horizontal Illuminance @2.5' AFF – 150 lux
  - Vertical Illuminance @4' AFF – 100 lux
  - Uniformity Ratio, Avg:Min – 2:1
- Library Facilities | Library Proper | Reading Area | Study Carrels & Tables and Chairs
  - Horizontal Illuminance @2.5' AFF – 250 lux
  - Vertical Illuminance @4' AFF – 100 lux
  - Uniformity Ratio, Avg:Min – 2:1

Energy Code | *Very Important*

ANSI/ASHRAE/IES Standard 90.1-2010

Lighting Power Density - Space by Space Method

- Classroom/Lecture/Training
  - Maximum Allowable LPD – 1.23 W/ft^2

Equipment

Lighting Equipment				
Type		**Description**	**Lamp**	**Manufacturer/Catalog**
L3		4' Recessed Linear LED	27W LED 3500K 80+CRI	Lumenpulse LLI2P-120-4-dRO35K
L3A		3' Recessed Linear LED	21W LED 3500K 80+CRI	Lumenpulse LLI2P-120-4-dRO35K
L4		Decorative LED Wall Sconce	16W LED 3500K 80+CRI	Beta Calco Windsor 591110
L9		4' LED linear HO Cove	45W LED 3500K 80+CRI	Lumenpulse LCS HO-277-48-30K-CL

L10		4’ Integral Fluorescent Stack Light	(2) 32W Fluorescent 3500K 80+ CRI	SpaceSaver

Lighting Plan

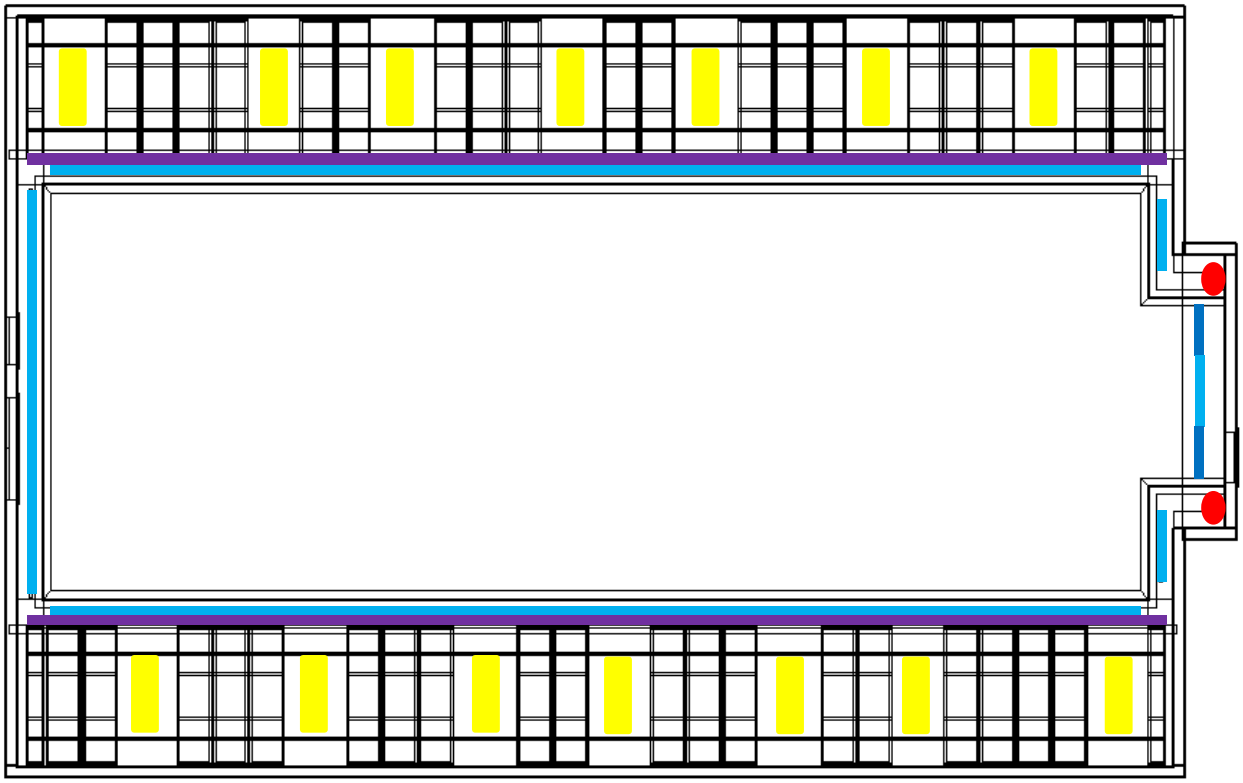


Figure 37: Law Classroom Lighting Plan

Light Loss Factors							
Type	Lamp Lumens		LLD	LDD	BF	UDF	Total
	Initial	Mean					
L3	-	-	0.7	0.95	-	-	0.665
L3A	-	-	0.7	0.95	-	0.75	0.500
L4	-	-	0.7	0.95	-	-	0.665
L9	-	-	0.7	0.85	-	1.16	0.690
L10	-	-	0.7	0.85	-	-	0.595

*UDF (0.75) was used to de-rate lumen out from 4’ fixture to 3’.

*UDF (1.16) was used to pro-rate 3000K CCT to 3500K CCT.

Renderings

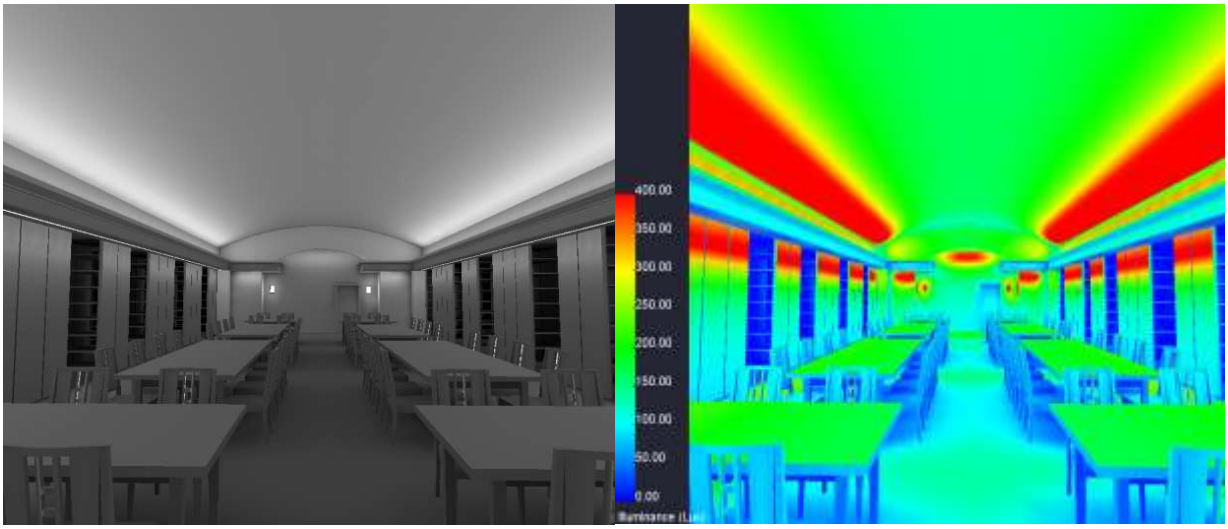


Figure 38: Law Classroom Illuminance Render and Pseudo Render

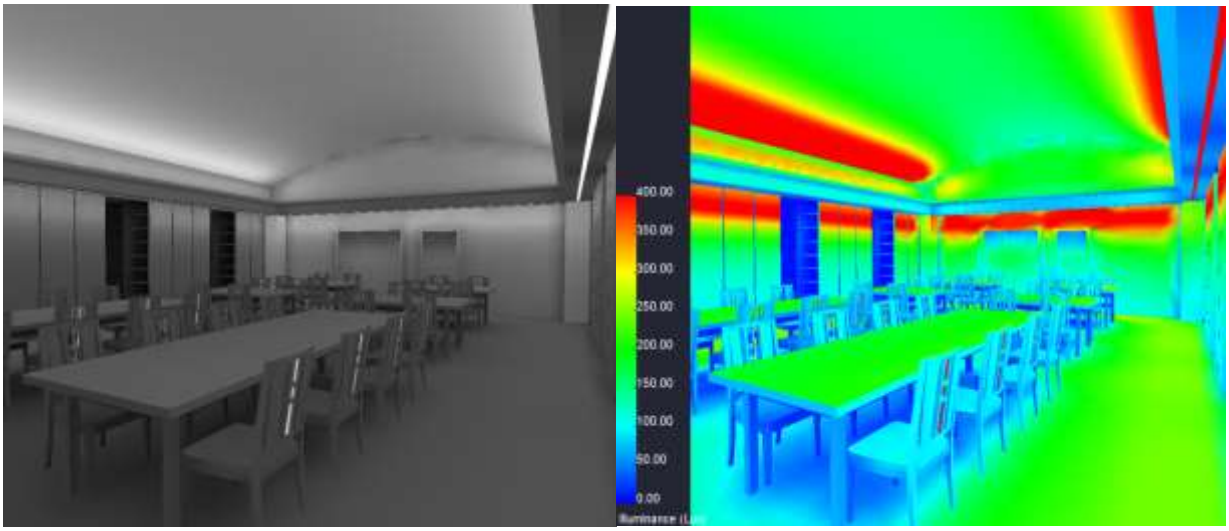


Figure 39: Law Classroom Alternate View

Performance

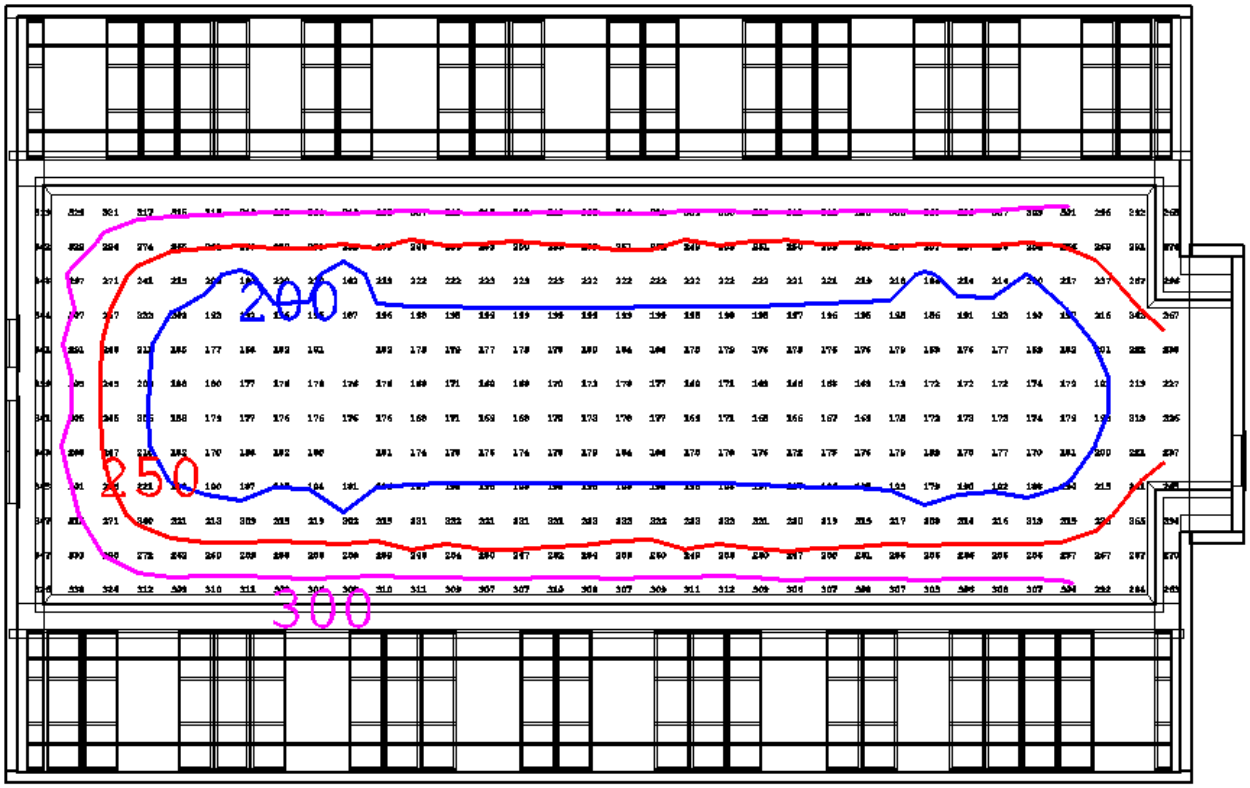


Figure 40: Law Classroom Isoline Calculation

Illuminance Data		
Calculation	**Target (lux)**	**Horizontal @ 2' 6" (lux)**
Average Illuminance	150-250	232
Maximum Illuminance	-	348
Miniumum Illuminance	-	158
Average/Minimum	2	1.47

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L3	LED Rec. Linear	41	28	1148
L3A	LED Rec. Linear	2	21	42
L4	LED Wall Sconce	2	16	32
L9	LED Linear Cove	32	45	1440
L10	FL. Stack Light	14 (of 40)	74	1036

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	**Allowable**	**Actual**
Area (sqft)	-	3042
Input Watts (W)	-	3698
Power Density (W/sqft)	1.23	**1.21**

Evaluation

Low profile 2" linear continuous runs wash the wood trim walls created by the mobile stack shelving with their wide angle distribution which also adds to the task illumination. High output linear surface washing fixtures are hidden above the same large decorative cove extrusion and are used to smoothly wash the arched ceiling with light and blanket indirect lighting onto the work area. The design has many similar aspects to various other spaces but keeps its own unique quality. The uniform perimeter light combined with the clean wash of the ceiling coves creates a pleasant and spacious environment to study. The integrated stack lighting in the mobile shelving aisles will also be illuminated adding another visually interesting and potentially dynamic element to the design. The new architecture with integrative lighting features was able to enhance the occupants' visual comfort and supply a larger working environment all while staying within the ASHRAE power density allowance and supplying the proper illumination levels for the tasks it serves.

Photo-voltaic Breadth

Solar energy is a great renewable energy source available everywhere. Solar energy conversion systems harvest this free energy which can offset demand from the buildings utility service. The goal of solar design is to maximize the solar utility for a client in a given locale. To achieve this goal for the North Instructional Building, a photo-voltaic (PV) roof system was explored. The three story building sits atop University Heights in Bronx, NY. Its location and height provide excellent exposure to the sun with no potential threat for shading of the PV panels from surrounding structures. The buildings south façade faces inward towards the center of the campus. The pitched roof on the south side is an excellent location to place a PV system because of its south-southwest orientation and 31.5 degree tilt which should provide optimal results in the New York area. Aesthetics were extremely important in this design since the solar panels will be in clear sight. Mono-crystalline PV panels were selected to be used over poly-crystalline and thin filmed technology because of their aesthetics and higher efficiency. Mono-crystalline panels are dark black in color which will have greater aesthetic appeal on the zinc roof. The PV panel arrays were uniquely designed to present the appearance of skylights built into the roof. These arrays are aligned with the large library windows on the south façade which allows them to become their own integrated architectural feature. A simple Sketch Up model was created to maximize PV array design capacity while analyzing its aesthetic value. This model then provided the total number of PV panels and inverters required for the final system designed. It was determined that the system will use (162) 255W panels and (5) 10500W inverters. The final nameplate capacity of the system comes to 42.8kWdc covering 260m^2. This information was then input to System Advisory Model (SAM) provided by the National Renewable Energy Laboratory (NREL). SAM is a computer program that generates performance predictions and cost of energy estimates for energy projects based on installation costs and system design parameters that the user specifies into the program. A few assumptions listed below were required to evaluate the system performance over the 20 year analysis period.

Assumptions

- The annual decline in panel performance is 1% compounded yearly
- The average cost of commercial electricity in New York is $0.1637/kWh

Renewable energy incentives were also applied in the analysis. These include a 30% federal tax credit, a state rebate of $1.00/W for first 50kW of installed capacity per meter, an exemption from sales tax for solar energy systems in New York, and university tax exemptions. SAM concluded that the system would have an acceptable payback period of 4.27 years making it a viable installation for the Bronx Community College.

PV Array Design

Figure 41: North Instructional Building Site Orientation courtesy of Google Earth

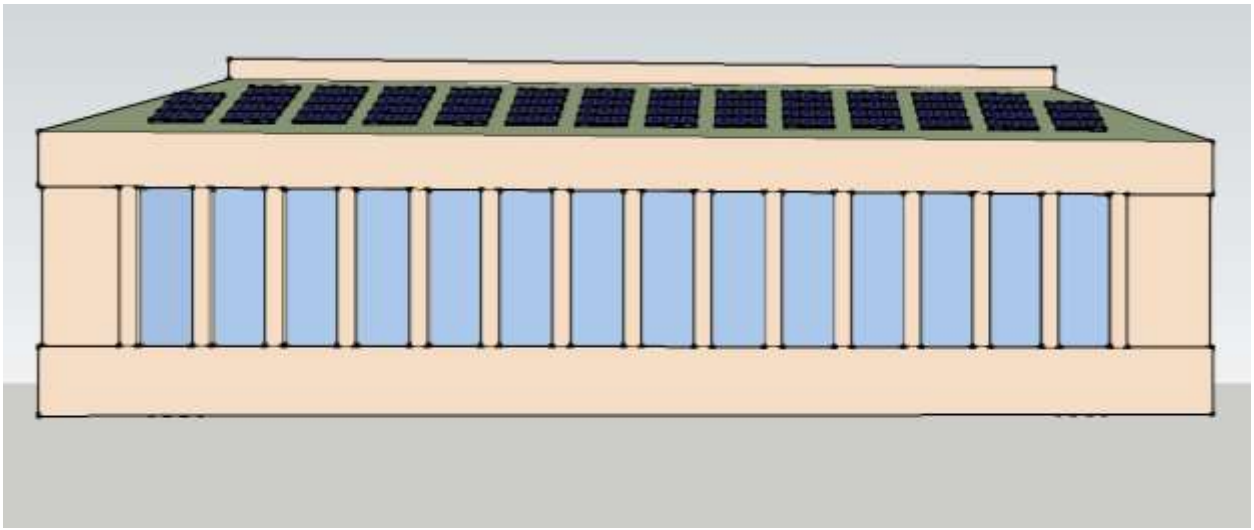


Figure 42: PV Array Design Front View

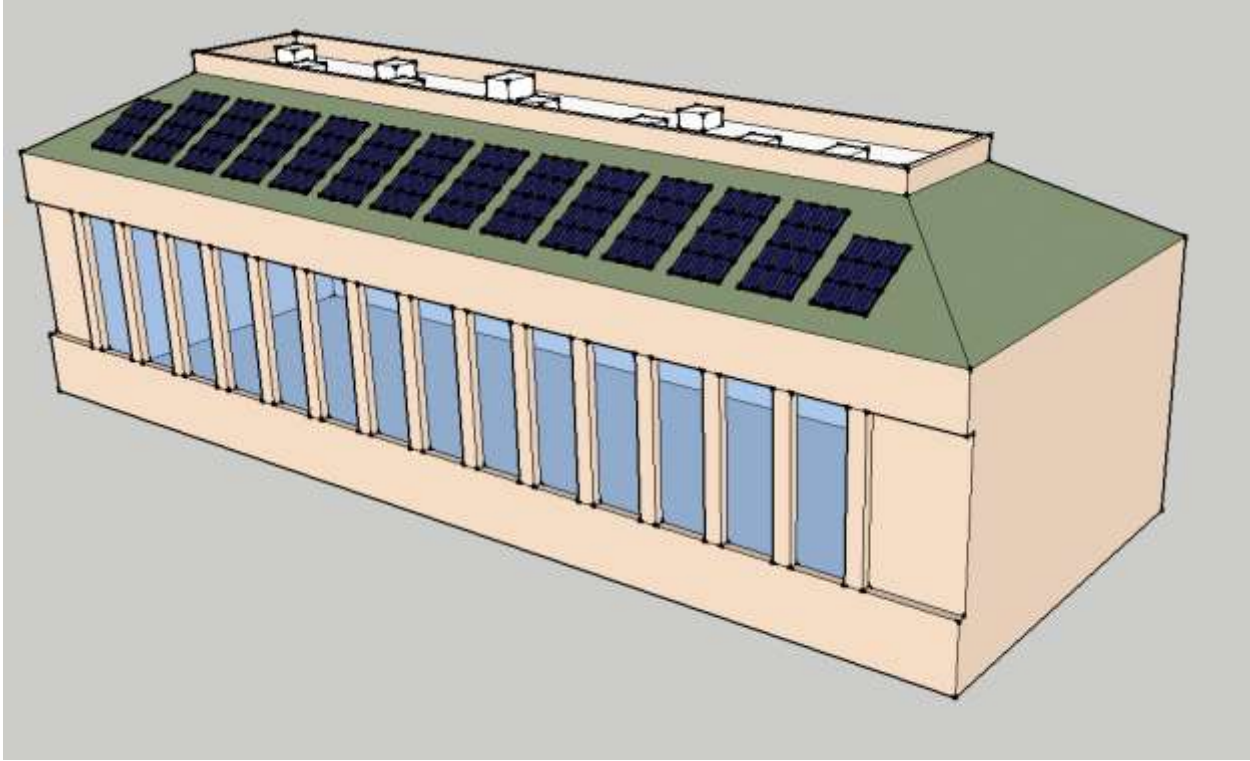


Figure 43: PV Array Design Perspective View

Equipment

Solar Panel Selection Data					
Manufacturer	**Product Code**	**Watts**	**$/Panel**	**$/Watts**	**Efficiency**
Canadian Solar	CS6P-255M	255	259	**1.02**	**15.85**
Suniva	OPT255-60-4-100	255	256	1.00	15.71
Eoplly	EP156MB-60-240W	240	260	1.08	14.75
Eoplly	EP156M-60-250W	250	275	1.10	15.37
SolarWorld	SW250	265	285	1.08	14.91

*Price Quotes from freecleansolar.com, gogreensolar.com, and theenergyconscious.com
*Mono-crystalline solar panels with silver frame were selected for performance and aesthetics

Further structural analysis would be required to investigate if the roof would require additional support for increased load of 41 lbs. per panel (162 total) on the roof system. This could be done by analyzing the distributed load over a central roof truss where the weight is symmetrical and maximize for the entire system array. The panels themselves are able to support 113psf snow load. Snow load calculation for a sloped roof can be performed using Solar World USA's Determining Wind and Snow Loads for Solar Panels technical document.

Inverter Selection Data							
Manufacturer	**Product Code**	**System Capacity(W)**	**Max W(DC)**	**Units Req.**	**$/Unit**	**Total Cost**	**Efficiency**
SunnyBoy	7000US	41310	8750	5	2770	**$13,850**	**96**
SunnyBoy	8000US	41310	10000	5	3000	$15,000	96
SunnyBoy	6000US	41310	7500	6	2550	$15,300	95.5
SunnyBoy	5000US	41310	6250	7	2300	$16,100	95.5

* Price quotes from solarpanelstore.com

Equipment Totals		
Manufacturer	**Product Code**	**# of Units**
Canadian Solar	CS6P-255M	162
SunnyBoy	7000US	5

Tax Incentives

Solar Tax Incentives (New York)
Federal
30% Tax Credit
State Rebate Program
$1.00/W for first 50kW of installed capacity per meter
Sales Tax Incentive
100% exemption from sales tax
Property Tax Incentive (local option)
100% exemption for 15 years

Performance and Payback Data

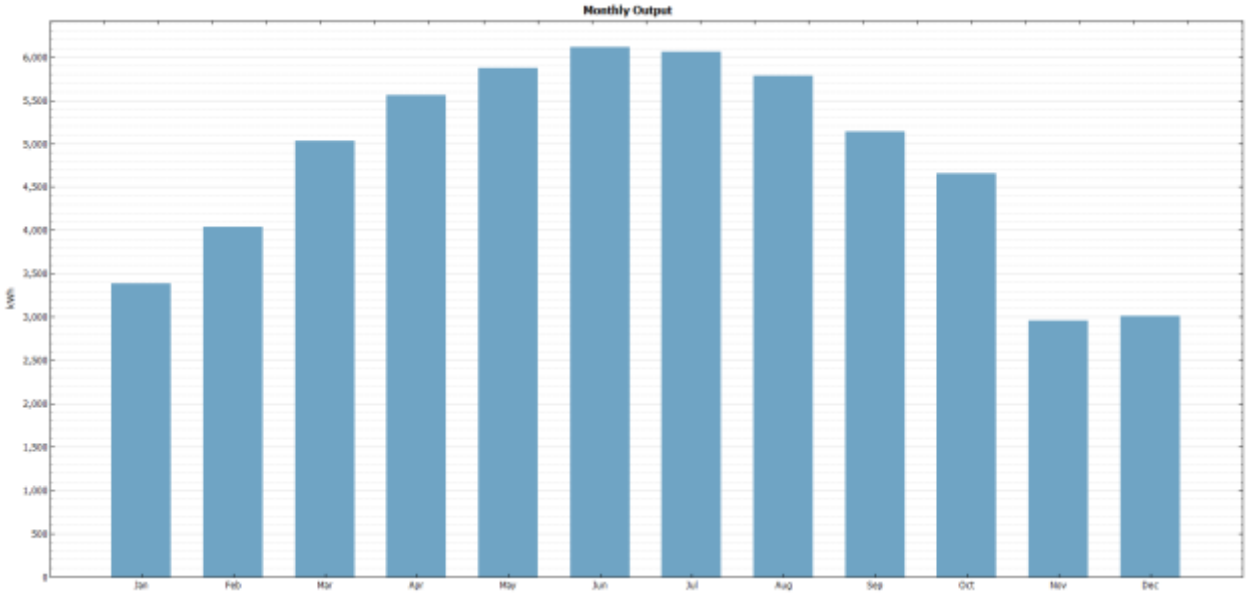


Figure 44: PV System Monthly Output Graph

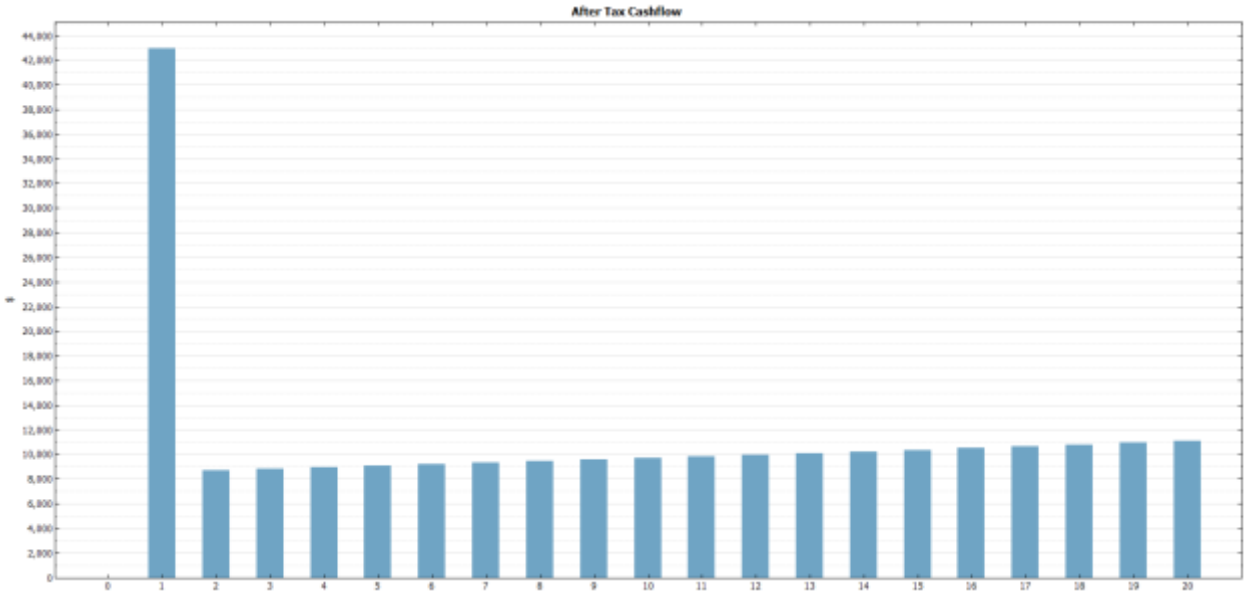


Figure 45: PV System After Tax Cashflow Graph

Performance Data	
Annual Energy	57,627 kWh
Capacity Factor	15.4%
System Performance Factor	0.86
Net Savings with System	$9,433.21
Payback	**4.27 years**

Electrical Depth

Branch Circuit Analysis

Updated panelboards are required since the loads have changed due to the redesign of the lighting in the prior lighting depth. New circuit loads are calculated in accordance to NEC 2011 standards for the new loadings on the affected panelboards. The table below shows the calculation for the target kVA value on each 20A lighting circuit on a 277V single pole circuit.

Amps	Voltage	VA	Cont. Load / 1.25	Max kVA/ Ckt	Target kVA / Ckt X 0.8 Growth Factor
20	277	5540	4432	4.432	**3.546**

The following analysis individually breaks down the panelboards into the existing panelboard with altered circuits highlighted in light blue, followed by the circuit load calculations and finally the new panelboard with new circuit values highlighted in dark blue. The main circuit breakers for the panelboards did not need to be resized since the new high efficient lighting fixtures provided loadings under the original design loads. The current breaker sizes also allow for future expansion to the circuits.

Panelboard LP-GB

Spaces covered:

- 1st Floor (East)

LOCATION:	GROUND FLOOR ELEC CLOSET B					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**LP-GB**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						
MOUNTING TYPE:	SURFACE					**M.C.B.:** 175 AMPS						**EXISTING**
GROUNDING:	GROUND BUS: YES					**M.L.O.:** NO						
	ISOLATED GRD. BUS: NO					**POLES:** 30						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
CLASSROOM 130, 131, 133 LTG	3.95			20	1	-	2	125	19.84			
CLASSROOM 141, 137 LTG		3.05		20	3		4			20.72		RP-GB VIA TRANSFORMER
GND FLR VEST & CORR LTG			1.95	20	5		6	3P			20.64	
GND FLR DISPLAY LTG	1.45			20	7	-	8	20	2.91			FAN POWERED VAV BOXES
CAFÉ LTG		0.47		20	9		10	20		3.82		FAN POWERED VAV BOXES
CLASSROOM 136 LTG			1.72	20	11		12	20			3.82	FAN POWERED VAV BOXES
SPARE				20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SUBTOTALS	5.40	3.52	3.67						22.75	24.54	24.46	

TOTAL LOADS:	28.15	**KVA PHASE A**	101.6	**A PHASE A**	**CONNECTED LOAD (LTG):**		84.34	KVA
	28.06	**KVA PHASE B**	101.3	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	28.13	**KVA PHASE C**	101.6	**A PHASE C**	**DEMAND LOAD:**		84.34	KVA
TOTAL CONNECTED LOAD:	84.34	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	105.425	KVA
					AMP:	**(at** 480 **V)**	127	A

Lighting Load Calculation

LP-GB

CKT 5	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L4	4	277	16	20	0.08	
L5	4	277	16	20	0.08	
L3	13	277	7	8.75	0.11375	
L6	196	277	1.5	1.875	0.3675	
L5	4	277	16	20	0.08	
EXISTING						
L8	4	277	128	160	0.64	
L16	2		18	22.5	0.045	
L3	2		32	40	0.08	
L4	6		32	40	0.24	**1.72625**
REMOVED						
L8	3	277	128	160	0.48	
C KT 7	**QTY**	**VOLTAGE**	**VA**	**1.25 CONT. LOAD FACT.**	**kVA**	**TOTAL**
NEW						
L3	128	277	7	8.75	1.12	
EXISTING						
L3	2	277	32	40	0.08	**1.2**
REMOVED						
L3	8	277	32	40	0.32	
L8	8	277	128	160	1.28	
CKT 13	**QTY**	**VOLTAGE**	**VA**	**1.25 CONT. LOAD FACT.**	**kVA**	**TOTAL**
NEW						
L1	8	277	5	6.25	0.05	
						0.05

Circuit Redesign

LOCATION:	GROUND FLOOR ELEC CLOSET B					REMARKS:						PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						LP-GB
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION						
MOUNTING TYPE:	SURFACE					M.C.B.: 175 AMPS						NEW
GROUNDING:	GROUND BUS: YES					M.L.O.: NO						
	ISOLATED GRD. BUS: NO					POLES: 30						
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
CLASSROOM 130, 131, 133 LTG	3.95			20	1	-	2	125	19.84			
CLASSROOM 141, 137 LTG		3.05		20	3		4			20.72		RP-GB VIA TRANSFORMER
GND FLR VEST & CORR LTG			1.73	20	5		6	3P			20.64	
CAFÉ LTG	0.47			20	7	-	8	20	2.91			FAN POWERED VAV BOXES
GND FLR DISPLAY LTG		1.20		20	9		10	20		3.82		FAN POWERED VAV BOXES
CLASSROOM 136 LTG			1.72	20	11		12	20			3.82	FAN POWERED VAV BOXES
NEW EXT. CANOPY LTG	0.05			20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SUBTOTALS	4.47	4.25	3.45						22.75	24.54	24.46	

TOTAL LOADS:	27.22	KVA PHASE A	98.3	A PHASE A	CONNECTED LOAD (LTG):		83.92	KVA
	28.79	KVA PHASE B	103.9	A PHASE B	DEMAND FACTOR (LTG):		100%	
	27.91	KVA PHASE C	100.8	A PHASE C	DEMAND LOAD:		83.92	KVA
TOTAL CONNECTED LOAD:	83.92	KVA			DEM. LOAD x	1.25 SPARE	104.9	KVA
					AMP:	(at 480 V)	126	A

Panelboard LP-2A

Spaces covered:

- Library 2nd Floor (West)

LOCATION:	2ND FLOOR ELEC. CLOSET					REMARKS:						PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						LP-2A
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION						
MOUNTING TYPE:	SURFACE					M.C.B.: 200 AMPS						EXISTING
GROUNDING:	GROUND BUS: YES					M.L.O.: NO						
	ISOLATED GRD. BUS: NO					POLES: 42						
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
2ND FL FACILITY OFFICE LTG	2.96			20	1	-	2	125	23.52			
3rd FL FAC OFF. OPEN SPACE		1.88		20	3		4			21.21		RP-2A VIA TRANSFORMER
2ND FL PROC. STORAGE			1.45	20	5		6	3P			20.26	
GROUP STUDY RMS LTG	3.46			20	7	-	8	20	1.99			FAN POWERED VAV BOXES
CORRIDOR & LIBRARY LTG		1.59		20	9		10	20		1.80		FAN POWERED VAV BOXES
SPARE				20	11		12	20				SPARE
SPARE				20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	6.42	3.47	1.45						25.51	23.01	20.26	

TOTAL LOADS:	31.93	KVA PHASE A	115.3	A PHASE A	CONNECTED LOAD (LTG):		80.12	KVA
	26.48	KVA PHASE B	95.6	A PHASE B	DEMAND FACTOR (LTG):		100%	
	21.71	KVA PHASE C	78.4	A PHASE C	DEMAND LOAD:		80.12	KVA
TOTAL CONNECTED LOAD:	80.12	KVA			DEM. LOAD x	1.25 SPARE	100.15	KVA
					AMP:	(at 480 V)	121	A

Lighting Load Calculation

LP-2A

C KT 11	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8A	8	277	190	237.5	1.9	
EXISTING						
						1.9
REMOVED						

Circuit Redesign

LOCATION:	2ND FLOOR ELEC. CLOSET					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**LP-2A**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						
MOUNTING TYPE:	SURFACE					**M.C.B.:** 200 AMPS						**NEW**
GROUNDING:	GROUND BUS: YES					**M.L.O.:** NO						
	ISOLATED GRD. BUS: NO					**POLES:** 42						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
2ND FL FACILITY OFFICE LTG	2.96			20	1	-	2	125	23.52			
3rd FL FAC OFF. OPEN SPACE		1.88		20	3		4			21.21		RP-2A VIA TRANSFORMER
2ND FL PROC. STORAGE			1.45	20	5		6	3P			20.26	
GROUP STUDY RMS LTG	3.46			20	7	-	8	20	1.99			FAN POWERED VAV BOXES
CORRIDOR & LIBRARY LTG		1.59		20	9		10	20		1.80		FAN POWERED VAV BOXES
NEW 2ND FLR LIBRARY LTG			1.90	20	11		12	20				SPARE
SPARE				20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	6.42	3.47	3.35						25.51	23.01	20.26	

TOTAL LOADS:	31.93	**KVA PHASE A**	115.3	**A PHASE A**	**CONNECTED LOAD (LTG):**		82.02	KVA
	26.48	**KVA PHASE B**	95.6	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	23.61	**KVA PHASE C**	85.2	**A PHASE C**	**DEMAND LOAD:**		82.02	KVA
TOTAL CONNECTED LOAD:	82.02	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	102.525	KVA
					AMP:	**(at** 480 **V)**	123	A

Panelboard LP-2B

Spaces covered:

- Library Second Floor (East)

LOCATION:	2ND FLOOR ELEC CLOSET B					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**LP-2B**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						
MOUNTING TYPE:	SURFACE					**M.C.B.:** 150 AMPS						**EXISTING**
GROUNDING:	GROUND BUS: YES					**M.L.O.:** NO						
	ISOLATED GRD. BUS: NO					**POLES:** 30						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
LIBRARY LTG	2.25			20	1	-	2	125 / 3P	18.30			RP-2B VIA TRANSFORMER
WND FL CIRC & REFE DESK LTG		3.14		20	3		4			17.40		
WND STORAGE GRP STUDY LTG			1.96	20	5		6				17.23	
LIBRARY LTG	2.05			20	7	-	8	20	2.71			FAN POWERED VAV BOXES
CLASSROOM LTG		1.12		20	9		10	20		2.71		FAN POWERED VAV BOXES
SPARE				20	11		12	20				SPARE
SPARE				20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SUBTOTALS	4.30	4.26	1.96						21.01	20.11	17.23	

TOTAL LOADS:	25.31	**KVA PHASE A**	91.4	**A PHASE A**	**CONNECTED LOAD (LTG):**		68.87	KVA
	24.37	**KVA PHASE B**	88.0	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	19.19	**KVA PHASE C**	69.3	**A PHASE C**	**DEMAND LOAD:**		68.87	KVA
TOTAL CONNECTED LOAD:	68.87	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	86.0875	KVA
					AMP:	(at 480 **V)**	104	A

Lighting Load Calculation

LP-2B

C KT 11	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8A	4	277	190	237.5	0.95	
EXISTING						
						0.95
REMOVED						

Circuit Redesign

LOCATION:	2ND FLOOR ELEC CLOSET B					REMARKS:						PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						LP-2B
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION						
MOUNTING TYPE:	SURFACE					M.C.B.: 150 AMPS						
GROUNDING:	GROUND BUS: YES					M.L.O.: NO						NEW
	ISOLATED GRD. BUS: NO					POLES: 30						
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
LIBRARY LTG	2.25			20	1	-	2	125 / 3P	18.30			RP-2B VIA TRANSFORMER
WND FL CIRC & REFE DESK LTG		3.14		20	3		4			17.40		
WND STORAGE GRP STUDY LTG			1.96	20	5		6				17.23	
LIBRARY LTG	2.05			20	7	-	8	20	2.71			FAN POWERED VAV BOXES
CLASSROOM LTG		1.12		20	9		10	20		2.71		FAN POWERED VAV BOXES
NEW 2ND FLR LIBRARY LTG			0.95	20	11		12	20				SPARE
SPARE				20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SUBTOTALS	4.30	4.26	2.91						21.01	20.11	17.23	

TOTAL LOADS:	25.31	KVA PHASE A	91.4	A PHASE A	CONNECTED LOAD (LTG):		69.82	KVA
	24.37	KVA PHASE B	88.0	A PHASE B	DEMAND FACTOR (LTG):		100%	
	20.14	KVA PHASE C	72.7	A PHASE C	DEMAND LOAD:		69.82	KVA
TOTAL CONNECTED LOAD:	69.82	KVA			DEM. LOAD x	1.25 SPARE	87.275	KVA
					AMP:	(at 480 V)	105	A

Panelboard LP-3A

Spaces covered:

- Library Third Floor (West)

LOCATION:	3RD FLOOR ELECT. CLOSET A					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**LP-3A**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						**EXISTING**
MOUNTING TYPE:	SURFACE					**M.C.B.:** 125 AMPS						
GROUNDING:	GROUND BUS: YES ISOLATED GRD. BUS: NO					**M.L.O.:** NO **POLES: 42**						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
LAW LIBRARY LTG	3.23			20	1	-	2	70 / 3P	11.27			
LIBRARY LTG		1.91		20	3		4			9.72		RP-3A VIA TRANSFORMER
LIBRARY LTG			2.72	20	5		6				7.98	
LIBRARY LTG	3.56			20	7	-	8	20	1.61			FAN POWERED VAV BOXES
LIBRARY LTG		3.56		20	9		10	20		0.10		EXTERIOR TERRACE LTG
LIBRARY LTG			3.56	20	11		12	20				SPARE
LIBRARY LTG	3.56			20	13	-	14	20				SPARE
LAW LIBRARY LTG		2.15		20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	10.35	7.62	6.28						12.88	9.82	7.98	

TOTAL LOADS:	23.23	**KVA PHASE A**	83.9	**A PHASE A**	**CONNECTED LOAD (LTG):**	54.93	KVA
	17.44	**KVA PHASE B**	63.0	**A PHASE B**	**DEMAND FACTOR (LTG):**	100%	
	14.26	**KVA PHASE C**	51.5	**A PHASE C**	**DEMAND LOAD:**	54.93	KVA
TOTAL CONNECTED LOAD:	54.93	**KVA**			**DEM. LOAD x** 1.25 **SPARE**	68.6625	KVA
					AMP: (at 480 **V)**	83	A

Circuit Lighting Load Calculations

LP-3A

CKT 7	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW L8 EXISTING	3	277	190	237.5	0.7125	
		ALL OTHERS				0.7125
REMOVED L2	4	277	400	500	2	
						-1.2875
DIC KT 9	**QTY**	**VOLTAGE**	**VA**	**1.25 CONT. LOAD FACT.**	**kVA**	**TOTAL**
NEW L8 EXISTING	4	277	190	237.5	0.95	
		ALL OTHERS				0.95
REMOVED L2	4	277	400	500	2	
						-1.05

CKT 11	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	4	277	190	237.5	0.95	
EXISTING						
		ALL OTHERS				
						0.95
REMOVED						
L2	4	277	400	500	2	
						-1.05
C KT 13	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	4	277	190	237.5	0.95	
EXISTING						
		ALL OTHERS				0.95
REMOVED						
L2	4	277	400	500	2	
						-1.05
CKT 17	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L7	4	277	360	450	1.8	
						1.8
C KT 19	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L7	4	277	360	450	1.8	
						1.8
CKT 1	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L4	2	277	16	20	0.04	
						0.04
C KT 15	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L3	9	277	28	35	0.315	
L9	32	277	45	56.25	1.8	
L3A	2	277	21	26.25	0.0525	
						2.1675
CKT 23	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L10	14	277	74	92.5	1.295	
L10	16	277	74		1.184	**2.479**

Circuit Redesign

LOCATION:	3RD FLOOR ELECT. CLOSET A					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**LP-3A**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						
MOUNTING TYPE:	SURFACE					**M.C.B.:** 125 AMPS						
GROUNDING:	GROUND BUS: YES					**M.L.O.:** NO						**NEW**
	ISOLATED GRD. BUS: NO					**POLES: 42**						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
NEW LAW LIBRARY LTG	0.04			20	1	-	2	70	11.27			
LIBRARY LTG		1.91		20	3		4	3P		9.72		RP-3A VIA TRANSFORMER
LIBRARY LTG			2.72	20	5		6				7.98	
LIBRARY LTG	2.27			20	7	-	8	20	1.61			FAN POWERED VAV BOXES
LIBRARY LTG		2.51		20	9		10	20		0.10		EXTERIOR TERRACE LTG
LIBRARY LTG			2.51	20	11		12	20				SPARE
LIBRARY LTG	2.51			20	13	-	14	20				SPARE
NEW LAW LIBRARY LTG		2.17		20	15		16	20				SPARE
NEW LIBRARY LTG			1.80	20	17		18	20				SPARE
NEW LIBRARY LTG	1.80			20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
MOBILE STACK LIGHTING			2.48	20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	6.62	6.59	9.51						12.88	9.82	7.98	

TOTAL LOADS:	19.50	**KVA PHASE A**	70.4	**A PHASE A**	**CONNECTED LOAD (LTG):**		53.40	KVA
	16.41	**KVA PHASE B**	59.2	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	17.49	**KVA PHASE C**	63.1	**A PHASE C**	**DEMAND LOAD:**		53.4	KVA
TOTAL CONNECTED LOAD:	53.40	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	66.75	KVA
					AMP:	**(at** 480 **V)**	80	A

Panelboard LP-3B

Spaces covered:

- Library Third Floor (East)

LOCATION:	3RD FLOOR ELECT. CLOSET B					REMARKS:					PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL					LP-3B
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION					EXISTING
MOUNTING TYPE:	SURFACE					M.C.B.: 125 AMPS					
GROUNDING:	GROUND BUS: YES ISOLATED GRD. BUS: NO					M.L.O.: NO POLES: 42					
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
LIBRARY LTG	3.56			20	1	-	2	70 / 3P	10.43			
LIBRARY LTG		2.67		20	3		4			9.85		RP-3B VIA TRANSFORMER
LIBRARY LTG			2.72	20	5		6				8.69	
LIBRARY LTG	3.56			20	7	-	8	20	0.10			EXTERIOR TERRACE LTG
LIBRARY LTG		2.67		20	9		10	20				SPARE
LIBRARY LTG			2.25	20	11		12	20				SPARE
LOBBY LTG	0.60			20	13	-	14	20				SPARE
SPARE				20	15		16	20				SPARE
SPARE				20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	7.72	5.34	4.97						10.53	9.85	8.69	

TOTAL LOADS:	18.25	KVA PHASE A	65.9	A PHASE A	CONNECTED LOAD (LTG):		47.10	KVA
	15.19	KVA PHASE B	54.8	A PHASE B	DEMAND FACTOR (LTG):		100%	
	13.66	KVA PHASE C	49.3	A PHASE C	DEMAND LOAD:		47.1	KVA
TOTAL CONNECTED LOAD:	47.10	KVA			DEM. LOAD x	1.25 SPARE	58.875	KVA
					AMP:	(at 480 V)	71	A

Lighting Load Calculation

LP-3B

CKT 1	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	3	277	190	237.5	0.7125	
EXISTING						
	ALL OTHERS					
						0.7125
REMOVED						
L2	4	277	400	500	2	
						-1.2875

C KT 3	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	3	277	190	237.5	0.7125	
EXISTING						

	ALL OTHERS					0.7125
REMOVED						
L2	3	277	400	500	1.5	
						-0.7875
CKT 7	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	4	277	190	237.5	0.95	
EXISTING						
	ALL OTHERS					0.95
REMOVED						
L2	4	277	400	500	2	
						-1.05
C KT 9	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L8	3	277	190	237.5	0.7125	
EXISTING						
	ALL OTHERS					0.7125
REMOVED						
L2	3	277	400	500	1.5	
						-0.7875
CKT 15	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L7	4	277	360	450	1.8	
						1.8
C KT 17	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L7	4	277	360	450	1.8	
						1.8

Circuit Redesign

LOCATION:	3RD FLOOR ELECT. CLOSET B					REMARKS:						PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						LP-3B
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION						
MOUNTING TYPE:	SURFACE					M.C.B.: 125 AMPS						NEW
GROUNDING:	GROUND BUS: YES					M.L.O.: NO						
	ISOLATED GRD. BUS: NO					POLES: 42						
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
LIBRARY LTG	2.27			20	1	-	2	70 / 3P	10.43			
LIBRARY LTG		1.88		20	3		4			9.85		RP-3B VIA TRANSFORMER
LIBRARY LTG			2.72	20	5		6				8.69	
LIBRARY LTG	2.51			20	7	-	8	20	0.10			EXTERIOR TERRACE LTG
LIBRARY LTG		1.88		20	9		10	20				SPARE
LIBRARY LTG			2.25	20	11		12	20				SPARE
LOBBY LTG	0.60			20	13	-	14	20				SPARE
SPARE		1.80		20	15		16	20				SPARE
SPARE			1.80	20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	5.38	5.56	6.77						10.53	9.85	8.69	

TOTAL LOADS:	15.91	KVA PHASE A	57.4	A PHASE A	CONNECTED LOAD (LTG):		46.78	KVA
	15.41	KVA PHASE B	55.6	A PHASE B	DEMAND FACTOR (LTG):		100%	
	15.46	KVA PHASE C	55.8	A PHASE C	DEMAND LOAD:		46.78	KVA
TOTAL CONNECTED LOAD:	46.78	KVA			DEM. LOAD x	1.25 SPARE	58.475	KVA
					AMP:	(at 480 V)	70	A

Emergency Panelboard ELP-BSMT

Spaces Covered

- BASEMENT
- FIRST FLOOR

LOCATION:	BASEMENT ATS ROOM						REMARKS:					PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE						22KAIC, SIEMENS TYPE I3 PANEL					ELP-BSMT
MAINS:	225 AMPS						MAIN OVERCURRENT PROTECTION					
MOUNTING TYPE:	SURFACE						M.C.B.: 100 AMPS					EXISTING
GROUNDING:	GROUND BUS: YES						M.L.O.: NO					
	ISOLATED GRD. BUS: NO						POLES: 42					
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:
BSMT EMERGENCY LTS	3.15			20	1	-	2	80 / 3P	5.15			
BSMT EXIT LTS		0.12		20	3		4			3.49		ERP-BSMT VIA TRANSFORMER
GND FLR EMERGENCY LTS			2.34	20	5		6				4.18	
GND FLR EXIT LTS	0.18			20	7	-	8	20	1.00			FIRE/SMOKE DAMPERS
STAIR A LTG				20	9		10	20				SPARE
STAIR B LTG				20	11		12	20				SPARE
STAIR C LTG				20	13	-	14	20				SPARE
EXTERIOR LTG				20	15		16	20				SPARE
GND FLR EMERGENCY LTS			2.08	20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	3.33	0.12	4.42						6.15	3.49	4.18	

TOTAL LOADS:	9.48	KVA PHASE A	34.22	A PHASE A	CONNECTED LOAD (LTG):		21.69	KVA
	3.61	KVA PHASE B	13.03	A PHASE B	DEMAND FACTOR (LTG):		100%	
	8.60	KVA PHASE C	31.05	A PHASE C	DEMAND LOAD:		21.69	KVA
TOTAL CONNECTED LOAD:	21.69	KVA			DEM. LOAD x	1.25 SPARE	27.1125	KVA
					AMP:	(at 480 V)	33	A

Lighting Load Calculation

ELP-BSMT

E5	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L6	276	277	1.5	1.875	0.5175	
L5	1	277	16	20	0.02	
EXISTING						
L13	5	277	56	70	0.35	
L22	2	277	32	40	0.08	
L8	3	277	128	160	0.48	**1.4475**
REMOVED						
L8	5	277	128	160	0.8	
L3	10	277	32	40	0.4	
L15B	1	277	56	70	0.07	

LX2	2	277	32	40	0.08	
E15	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
L1	4	277	13	16.25	0.065	
EXISTING						
LX2	1	277	32	40	0.04	
LX6	10	277	50	62.5	0.625	
LX7	2	277	50	62.5	0.125	**0.855**
REMOVED						
LX3	4	277	128	160	0.64	

Circuit Redesign

LOCATION:	BASEMENT ATS ROOM					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						**ELP-BSMT NEW**
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						
MOUNTING TYPE:	SURFACE					**M.C.B.:** 100 AMPS						
GROUNDING:	GROUND BUS: YES ISOLATED GRD. BUS: NO					**M.L.O.:** NO **POLES: 42**						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
BSMT EMERGENCY LTS	3.15			20	1	-	2	80	5.15			
BSMT EXIT LTS		0.12		20	3		4	3P		3.49		ERP-BSMT VIA TRANSFORMER
GND FLR EMERGENCY LTS			1.45	20	5		6				4.18	
GND FLR EXIT LTS	0.18			20	7	-	8	20	1.00			FIRE/SMOKE DAMPERS
STAIR A LTG				20	9		10	20				SPARE
STAIR A LTG				20	11		12	20				SPARE
STAIR A LTG				20	13	-	14	20				SPARE
EXTERIOR LTG		0.86		20	15		16	20				SPARE
GND FLR EMERGENCY LTS			2.08	20	17		18	20				SPARE
SPARE				20	19	-	20	20				SPARE
SPARE				20	21		22	20				SPARE
SPARE				20	23		24	20				SPARE
SPARE				20	25	-	26	20				SPARE
SPARE				20	27		28	20				SPARE
SPARE				20	29		30	20				SPARE
SPARE				20	31	-	32	20				SPARE
SPARE				20	33		34	20				SPARE
SPARE				20	35		36	20				SPARE
SPARE				20	37	-	38	20				SPARE
SPARE				20	39		40	20				SPARE
SPARE				20	41		42	20				SPARE
SUBTOTALS	3.33	0.98	3.53						6.15	3.49	4.18	

TOTAL LOADS:	9.48	**KVA PHASE A**	34.22	**A PHASE A**	**CONNECTED LOAD (LTG):**		21.66	KVA
	4.47	**KVA PHASE B**	16.14	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	7.71	**KVA PHASE C**	27.83	**A PHASE C**	**DEMAND LOAD:**		21.658	KVA
TOTAL CONNECTED LOAD:	21.66	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	27.0725	KVA
					AMP:	**(at** 480 **V)**	33	A

Emergency Panelboard ELP-2

Spaces Covered:

- Second Floor
- Third Floor

LOCATION:	2ND FLOOR ELEC CLOSET B					REMARKS:					PANEL DESIGNATION:
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL					ELP-2
MAINS:	225 AMPS					MAIN OVERCURRENT PROTECTION					EXISTING
MOUNTING TYPE:	SURFACE					M.C.B.: 150 AMPS					
GROUNDING:	GROUND BUS: YES					M.L.O.: NO					
	ISOLATED GRD. BUS: NO					POLES: 42					
SERVICE TO:	A	B	C	SIZE	NO.	NO.	SIZE	A	B	C	SERVICE TO:
2ND FL EMERGENCY LTS	1.71			20	1	2	70 / 3P	7.88			
2ND FLOOR EXIT SIGNS		0.08		20	3	4			9.56		ERP-2 VIA TRANSFORMER
3RD FLOOR EMERGENCY LTS			2.83	20	5	6				6.82	
3RD FLOOR EXIT SIGNS	0.06			20	7	8	100 / 3P	11.96			
3RD FLOOR EMERGENCY LTS		1.68		20	9	10			10.25		ELP-M
3RD FLOOR EMERGENCY LTS			3.33	20	11	12				7.40	
3RD FLOOR EMERGENCY LTS	1.50			20	13	14	20				SPARE
2ND FL EMERGENCY LTS				20	15	16	20				SPARE
SPARE				20	17	18	20				SPARE
SPARE				20	19	20	20				SPARE
SPARE				20	21	22	20				SPARE
SPARE				20	23	24	20				SPARE
SPARE				20	25	26	20				SPARE
SPARE				20	27	28	20				SPARE
SPARE				20	29	30	20				SPARE
SUBTOTALS	3.27	1.76	6.16					19.84	19.81	14.22	

TOTAL LOADS:	23.11 KVA PHASE A	83.43 A PHASE A	CONNECTED LOAD (LTG):	65.06	KVA		
	21.57 KVA PHASE B	77.87 A PHASE B	DEMAND FACTOR (LTG):	100%			
	20.38 KVA PHASE C	73.57 A PHASE C	DEMAND LOAD:	65.06	KVA		
TOTAL CONNECTED LOAD:	65.06 KVA		DEM. LOAD x 1.25 SPARE	81.325	KVA		
			AMP: (at 480 V)	98	A		

Lighting Load Calculation

ELP-2

E5	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
NEW						
		277		35	1.12	
EXISTING						
	ALL OTHERS					1.12
REMOVED						
L7C	13	277	112	140	1.82	
						-0.7

Circuit Redesign

LOCATION:	2ND FLOOR ELEC CLOSET B					**REMARKS:**						**PANEL DESIGNATION:**
SERVICE:	480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL						
MAINS:	225 AMPS					**MAIN OVERCURRENT PROTECTION**						**ELP-2 NEW**
MOUNTING TYPE:	SURFACE					**M.C.B.:** 150 AMPS						
GROUNDING:	GROUND BUS: YES					**M.L.O.:** NO						
	ISOLATED GRD. BUS: NO					**POLES: 42**						
SERVICE TO:	**A**	**B**	**C**	**SIZE**	**NO.**		**NO.**	**SIZE**	**A**	**B**	**C**	**SERVICE TO:**
2ND FL EMERGENCY LTS	1.71			**20**	**1**	-	**2**	**70** / **3P**	7.88			ERP-2 VIA TRANSFORMER
2ND FLOOR EXIT SIGNS		0.08		**20**	**3**		**4**			9.56		
3RD FLOOR EMERGENCY LTS			2.13	**20**	**5**		**6**				6.82	
3RD FLOOR EXIT SIGNS	0.06			**20**	**7**	-	**8**	**100** / **3P**	11.96			ELP-M
3RD FLOOR EMERGENCY LTS		1.68		**20**	**9**		**10**			10.25		
3RD FLOOR EMERGENCY LTS			3.33	**20**	**11**		**12**				7.40	
3RD FLOOR EMERGENCY LTS	1.50			**20**	**13**	-	**14**	**20**				SPARE
2ND FL EMERGENCY LTS				**20**	**15**		**16**	**20**				SPARE
SPARE				**20**	**17**		**18**	**20**				SPARE
SPARE				**20**	**19**	-	**20**	**20**				SPARE
SPARE				**20**	**21**		**22**	**20**				SPARE
SPARE				**20**	**23**		**24**	**20**				SPARE
SPARE				**20**	**25**	-	**26**	**20**				SPARE
SPARE				**20**	**27**		**28**	**20**				SPARE
SPARE				**20**	**29**		**30**	**20**				SPARE
SUBTOTALS	3.27	1.76	5.46						19.84	19.81	14.22	

TOTAL LOADS:	23.11	**KVA PHASE A**	83.43	**A PHASE A**	**CONNECTED LOAD (LTG):**		64.36	KVA
	21.57	**KVA PHASE B**	77.87	**A PHASE B**	**DEMAND FACTOR (LTG):**		100%	
	19.68	**KVA PHASE C**	71.05	**A PHASE C**	**DEMAND LOAD:**		64.36	KVA
TOTAL CONNECTED LOAD:	64.36	**KVA**			**DEM. LOAD x**	1.25 **SPARE**	80.45	KVA
					AMP:	**(at** 480 **V)**	97	A

Short Circuit Analysis

A short circuit analysis was performed at (5) five locations within the electrical system in order establish short circuit currents running through each of these points. These calculations can be used to ensure that new or existing equipment are properly rated to withstand the short circuit energy at these critical points in the circuit. The calculation was performed using the X/R ratio method by breaking down each point of impedance into its two vector components (Xu,Ru), enabling the summation of the multiple component values observed along the path to the point of interest within the circuit. This calculation method can be applied to any branch within the electrical system as long as the impedance is summed beginning at the service entrance and following along a designated circuit path found on a detailed one-line diagram.

Equations

UTILITY $$Xu = \frac{Base\ kVA}{Utility\ S.C.kVA}$$

TRANSFORMER $$Xu = \frac{(X)(Base\ kVA)}{XFMR\ kVA}$$

$$Ru = \frac{(R)(Base\ kVA)}{XFMR\ kVA}$$

WIRE $$Xu = \frac{(X)(Base\ kVA)}{1000\ (kV)^2}$$

$$Ru = \frac{(R)(Base\ kVA)}{1000\ (kV)^2}$$

IMPEDANCE $$Zu^2 = Xu^2 * Ru^2$$

SHORT CIRCUIT $$Isc = \frac{Base\ kVA}{(\sqrt{3})(kV)(Zu)}$$

Single-line Diagram and Short Circuit Evaluation Points

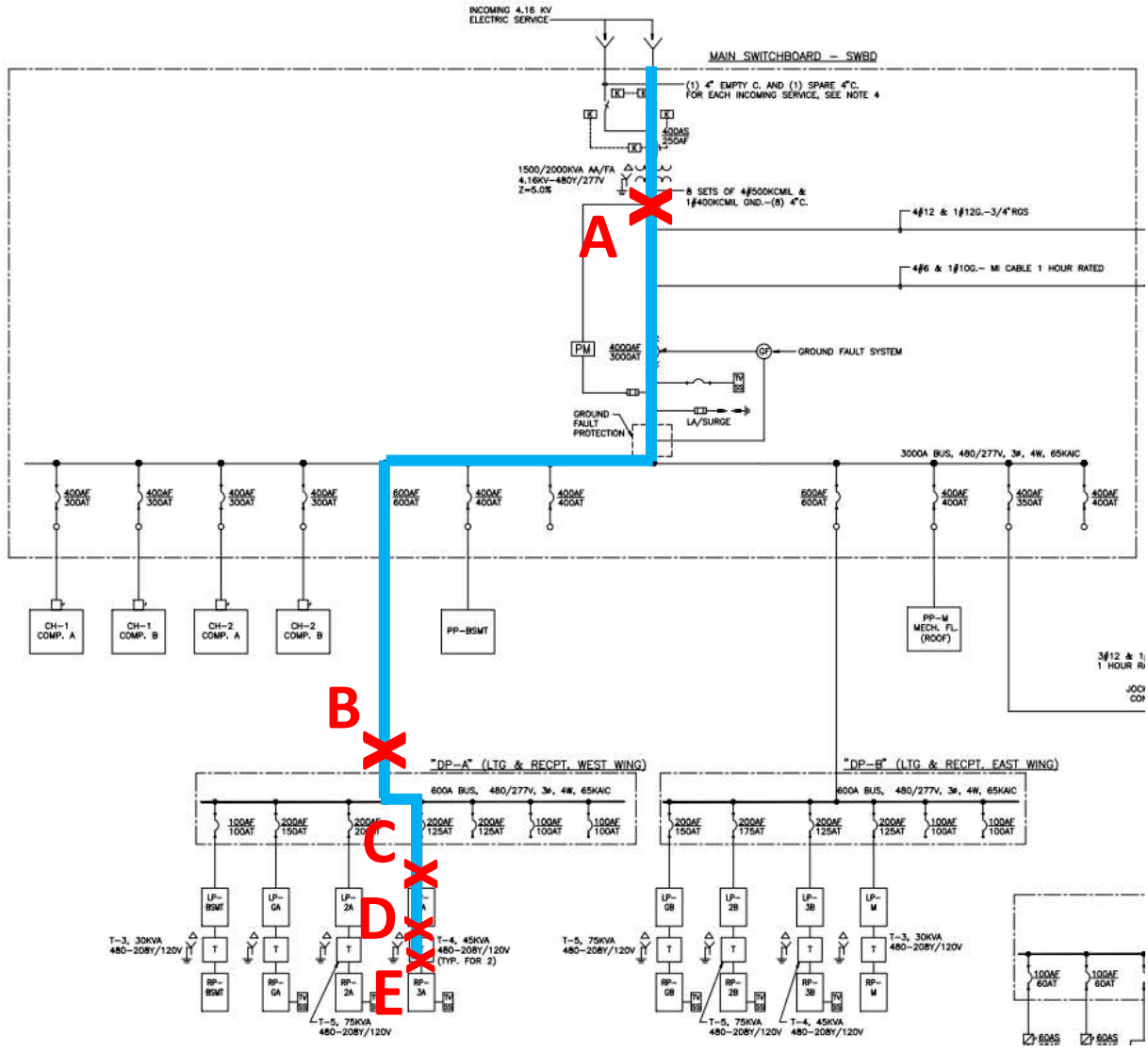


Figure 46: One Line Diagram with S.C Path and Points of Interest

Calculations

A	XFMR, Switchboard					
		1500	kVA			
		Z=	5%			
	GE Table 13	X/R=		6.5		
	$Z^2=X^2+R^2$	R=		0.76	X=	4.94
		Xu=		**0.3293**	**Ru=**	**0.050667**

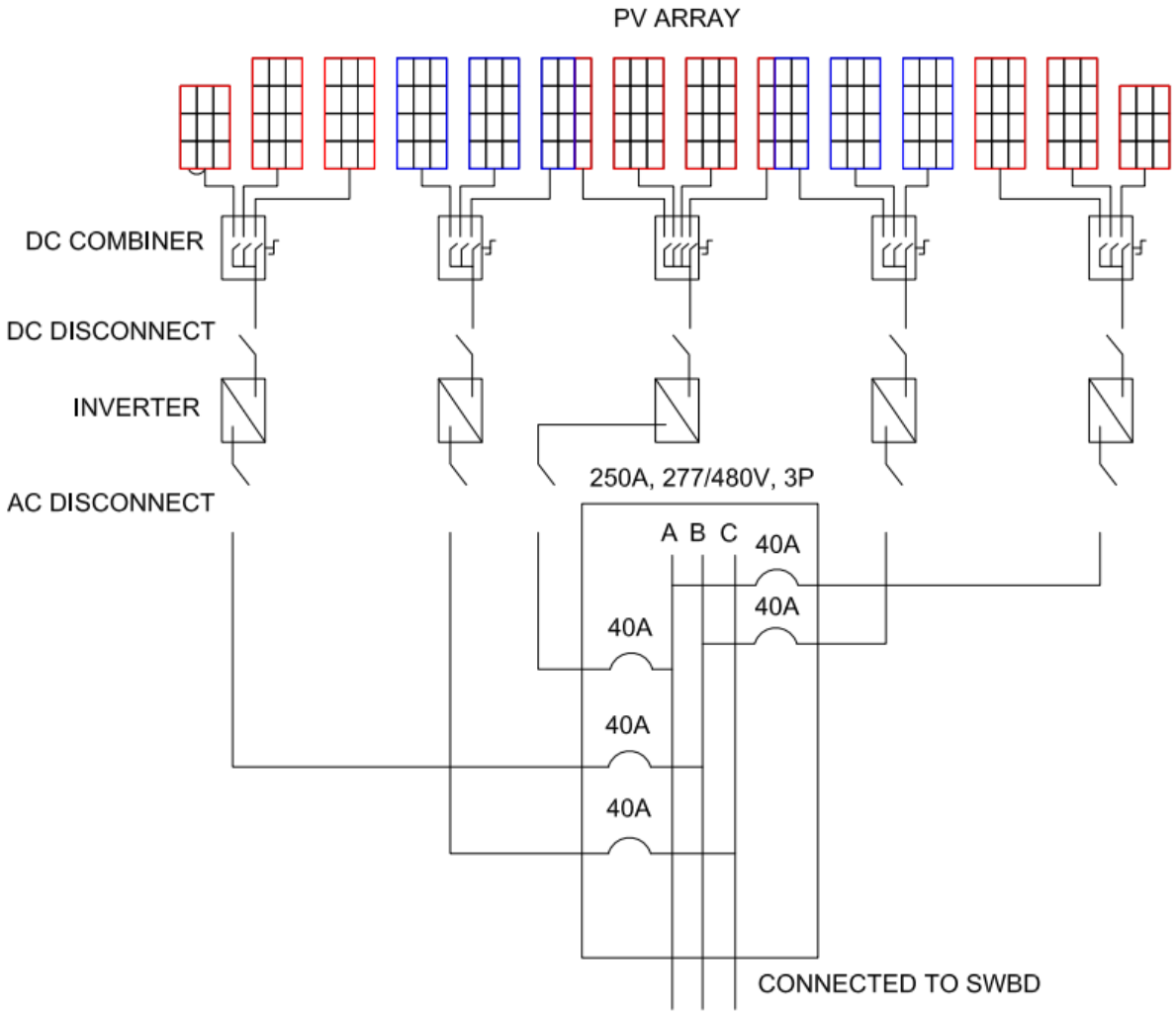
B	250 kcmil to DP-A		2	sets	25	ft	
		GE Table 17	R=	0.0534	X=	0.0328	
			Xu=	**0.0007**	**Ru=**		**0.00041**
C	1/O AWG to LP-3A		1	sets	100	ft	
		GE Table 17	R=	0.1231	X=	0.035	
			Xu=	**0.0123**	**Ru=**		**0.0035**
D	1/O AWG to XFMR, T-4		1	sets	10	ft	
		GE Table 17	R=	0.1231	X=	0.035	
			Xu=	0.0012	**Ru=**		0.00035
E	XFMR, T-4						
			45	kVA			
			Z=	3%			
		GE Table 14	R=	0.0252	X=	0.0173	
			Xu=	**0.0384**	**Ru=**		**0.056**

Results

		Xu	Ru	Zu	Isc (A)
A	XFMR, Switchboard	0.329333	0.050667	0.333208	**36,098**
	(+) 25O kcmil to DP-A	0.000668	0.00041		
B		0.330001	0.051077	0.33393	**36,020**
	(+) 1/O AWG to DP-A	0.01231	0.0035		
C		0.342311	0.054577	0.346634	**34,700**
	(+) 1/O AWG to DP-A	0.001231	0.00035		
D		0.343542	0.054927	0.347905	**34,573**
	(+) XFMR, T-4	0.038444	0.056		
E		0.381986	0.110927	0.397767	**30,239**

PV Roof System One-Line Diagram

The PV roof system designed in the previous breadth contains (14) separate clusters of PV panels broken into (5) arrays per DC combiner which feeds into the (5) inverters. The multiple inverter single pole design feeds into PV Panelboard. By code, the circuit breakers for the panelboard must be rated no less than 1.25 times the inverter continuous output current rating. With the inverter maximum output current of 25A, the overcurrent protection rating selected for the circuits was 40A. The inverters produce 277VAC power and connect across the 3 poles of the 250A, 277/480V, 3-Pole panelboard. The PV panelboard is then tied into the main switchboard to supply additional power to the building. Looking back at the design, for a single-pole inverter PV system it would have been optimal to have selected the number of inverters in multiples of three in order to balance the phases. This could have been accomplished with the 162 total panels. An alternate analysis may provide improved system efficiencies.



Summary and Conclusions

The overall goal of this thesis was to further understand the integration of the architectural buildings systems within the Bronx Community College's North Instructional Building through the investigation and hand on redesign and analysis of the architectural design, lighting systems, electrical distribution systems, and the potential integration of solar energy conversion systems.

This was accomplished by redesigning the lighting for six spaces, four of which were designed to control the entire lit environment beginning at the exterior canopy and implementing cove lighting through the lobbies and into the corridors to create a consistent, interconnected design. The remaining two spaces were the two story library and adjacent law classroom containing the law stacks. An alternative design to the existing illumination system was implemented into the library providing uniform lighting and highlights to the structure of the central reading room columns and the grand barrel vaulted ceiling. The adjacent law classroom was architecturally redesigned to incorporate high density mobile shelving, integral lighting solutions, and adaptable furniture which successfully created 43% more workspace in the classroom and enhanced aesthetic value.

The new lighting required branch circuit loads to be recalculated and updated in the affected panelboards resulting in slightly decreased lighting loads. Additionally, a photo-voltaic roof system was investigated and established to be a cost effective energy harvesting installation to provide additional power to the main switchboard and save on the building's energy demands.

Each endeavor had its strengths and weaknesses which demanded evaluation on performance vs. cost vs. integration with other systems in order to formulate accurate recommendations and achieve efficient design solutions.

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DiLaura, Houser, Mistrick, and Stefly. The IESNA Lighting Handbook: Reference & Application. 10th ed. New York: Illumination Engineering Society of North America, 2011.

General Electric Company. Short Circuit Current Calculations. Plainville, CT: General Electric Company, 1989.

National Fire Protection Association. NFPA 70 National Electric Code. 2011 Edition. Quincy, MA: National Fire Protection Association, 2008.

Software

- Adobe Photoshop
- AGi32
- Autodesk AutCAD
- Autodesk REVIT
- System Advisory Model (SAM)

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I would like to thank the members of the Penn State Architectural Engineering faculty who I have had the pleasure of studying under, especially the following individuals who have provided their time and guidance throughout the length of my thesis project.

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Leslie Beahm

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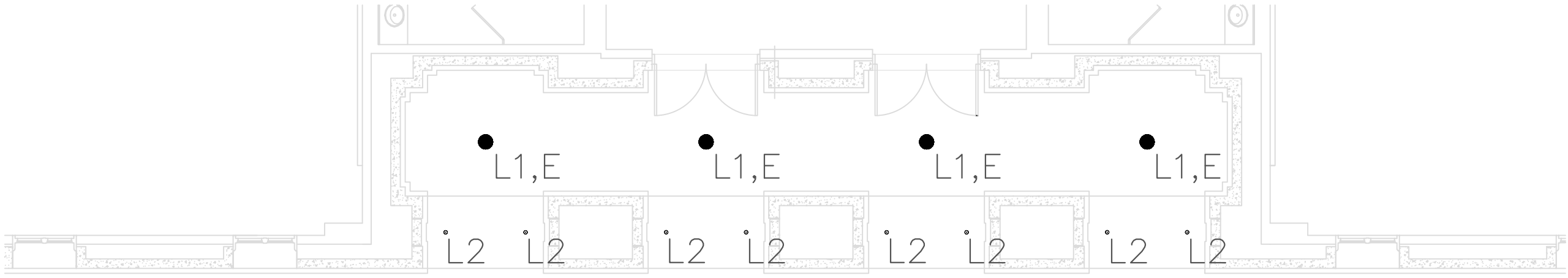
Jeffrey Brownson

I would additionally like to thank my family; friends and fellow classmates who have supported me throughout my college experience.

Appendix A: Luminaire Schedule

Luminaire Schedule							
Type		**Description**	**Lamp**	**Ballast**	**Voltage**	**Input Watts**	**Manufacturer**
L1		Exterior decorative pendant with LED lamping	(1) A19/DM/ 800/GU24/LED 3000K 85+CRI		277	13W	Kicler
L2		Exterior in-grade LED uplight	3000K LED 85+CRI		277	5W	BEGA
L3		4' Recessed Linear LED	3500K LED 80+CRI		277	27W	Lumenpulse
L3A		3' Recessed Linear LED	3500K LED 80+CRI		277	21W	Lumenpulse
L4		Decorative LED Wall Sconce	3500K LED 80+CRI		277	16W	Beta Calco
L5		4" LED Downlight Wide Distribution Specular Reflector	3500K LED 80+CRI		277	16W	Gotham
L6		LED Linear Ribbon	LED 3500K 83 CRI		277	1.5 W/Ft	Acolyte
L7		46" Decorative LED Pendant	3500K LED 80+CRI		277		Beta Calco
L8		30" Decorative LED Wall Sconce	3500K LED 80+CRI		277		Beta Calco
L8A		30" Decorative LED Wall Sconce w/ custom baffle insert	3500K LED 80+CRI		277		Beta Calco
L9		4' LED linear HO Cove	3500K LED 80+CRI		277	45W	Lumenpulse

Appendix B: Lighting Plans



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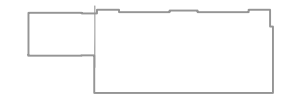
KEY PLAN



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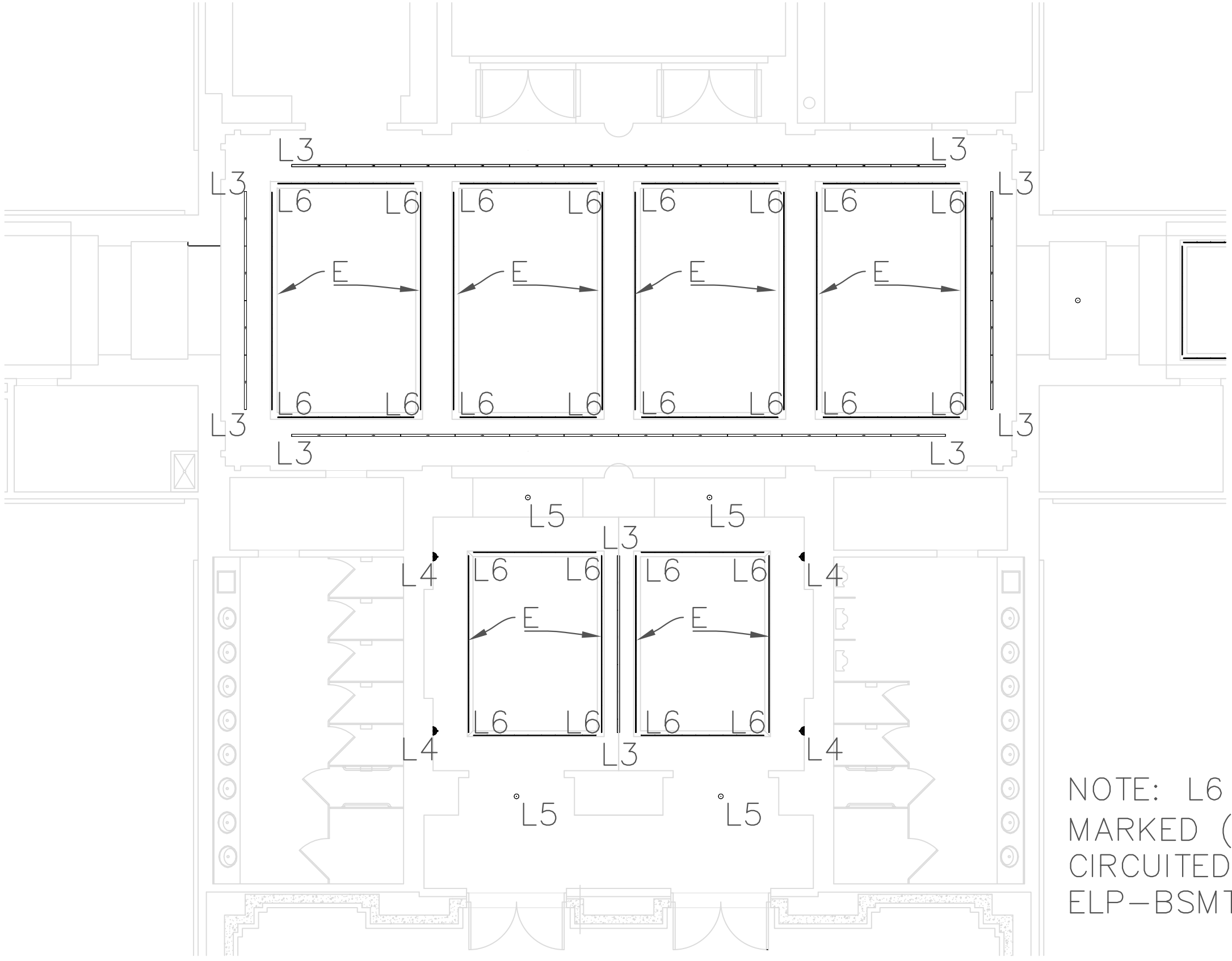

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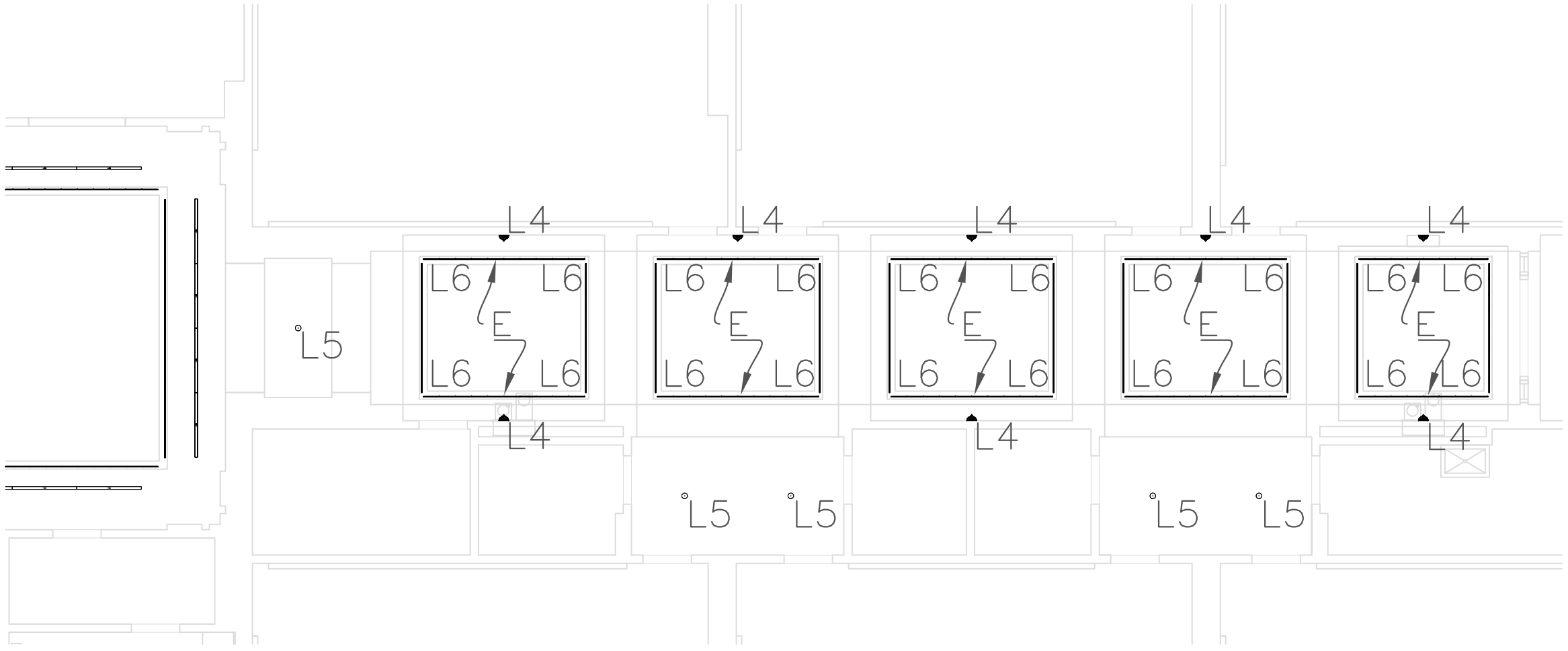

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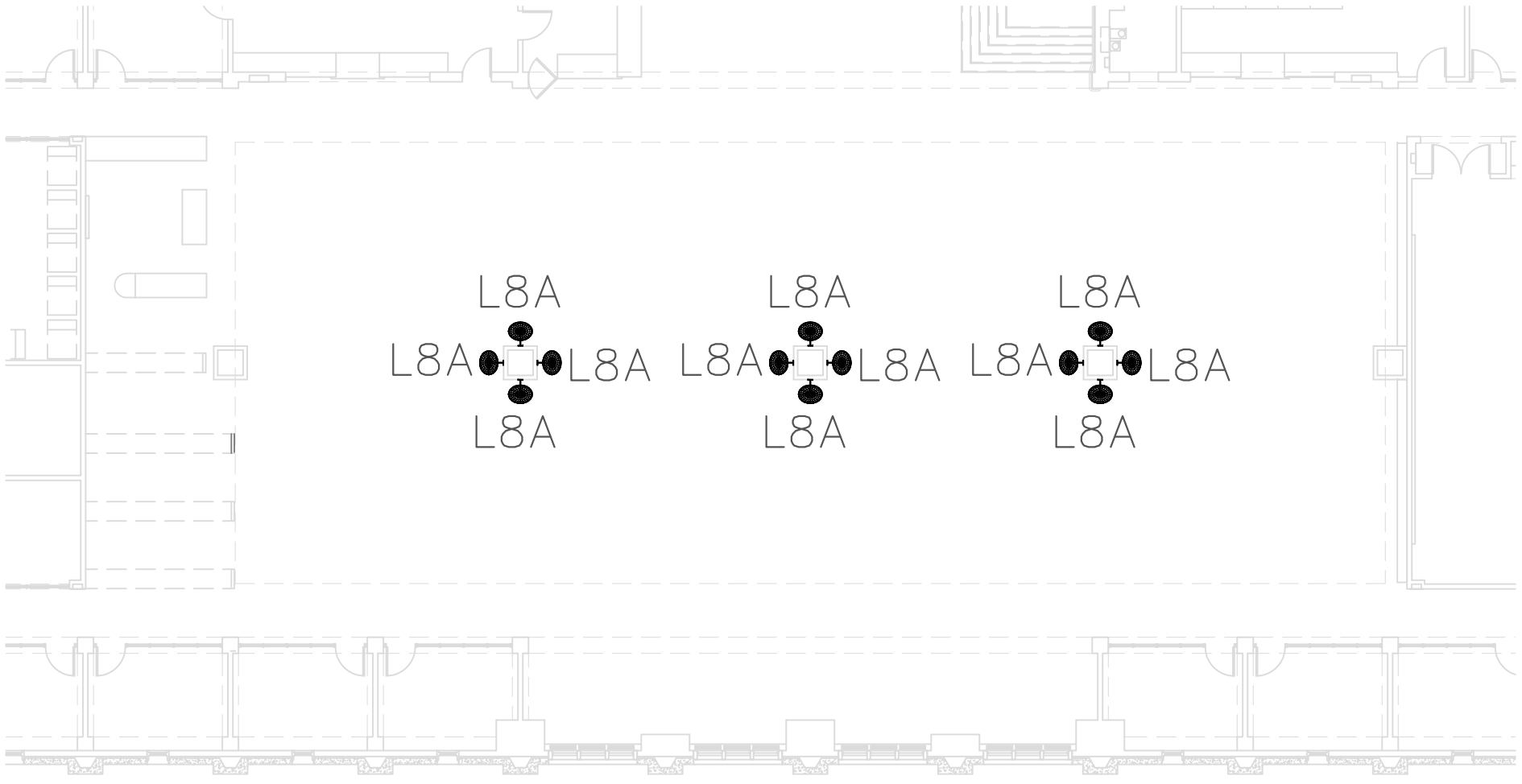

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FAX: (212) 687-2323

LIGHTING DESIGNER
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NEW YORK, NY 10010
PHONE: (212) 741-3280
FAX: (212) 741-3112

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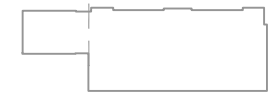
SHEN MILSOM WILKE
417 FIFTH AVENUE
NEW YORK, NY 10016
PHONE: (212) 725-6800
FAX: (212) 725-6864

SUSTAINABILITY CONSULTANT
VIRIDIAN ENERGY AND ENVIRONMENTAL
60 WEST 39TH STREET, SUITE 3W
NEW YORK, NY 10018
PHONE: (212) 704-9920
FAX: (212) 704-9929

KEY PLAN



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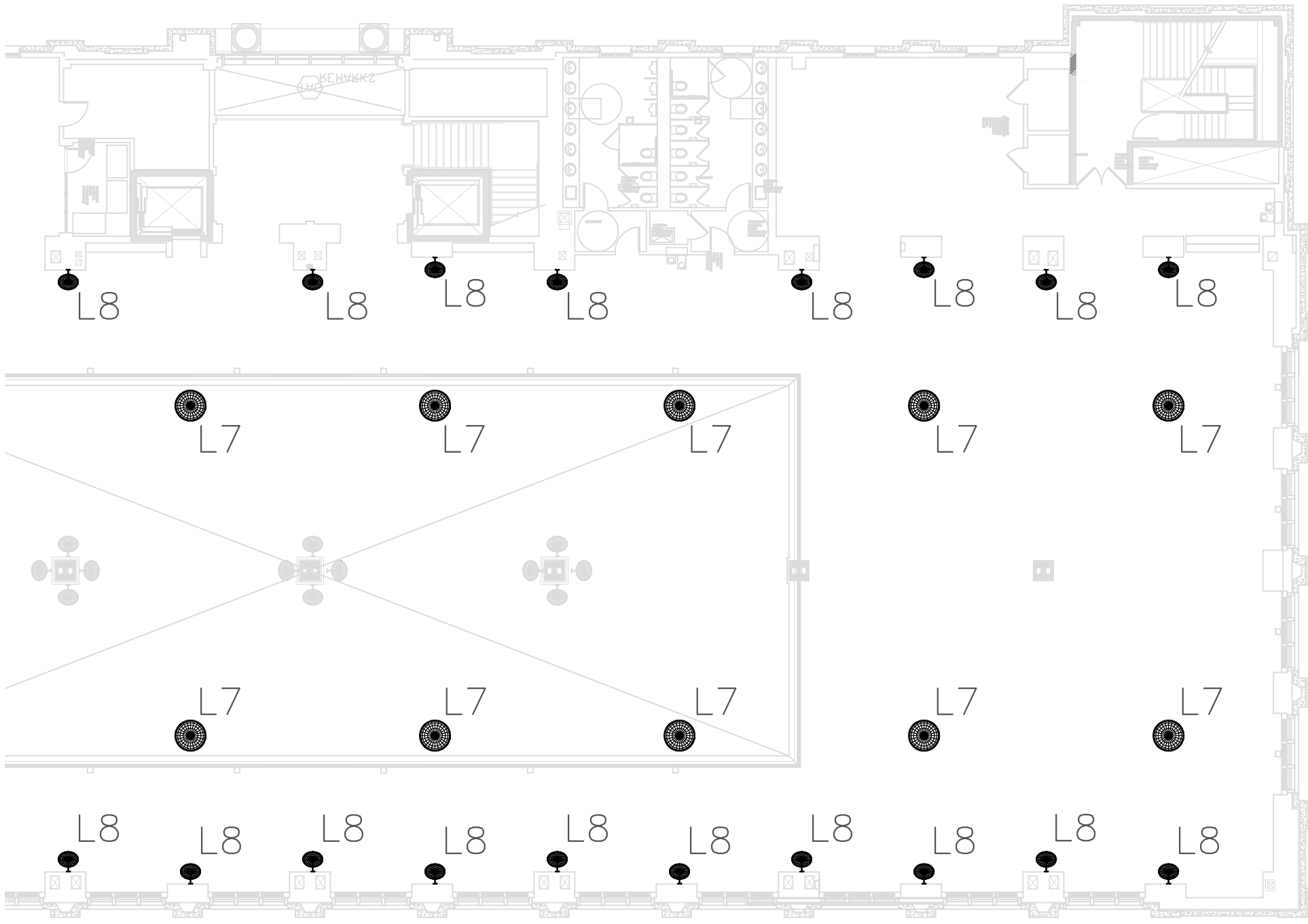
LIGHTING PLAN
SECOND FLOOR

Project No. A05034.01	Date 2010-12-16
CAD File No.	Scale
Drawing No.	



THIRD FLOOR – LIBRARY LIGHTING EAST

1/8" = 1'–0"

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12207-2964

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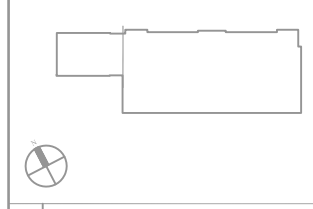

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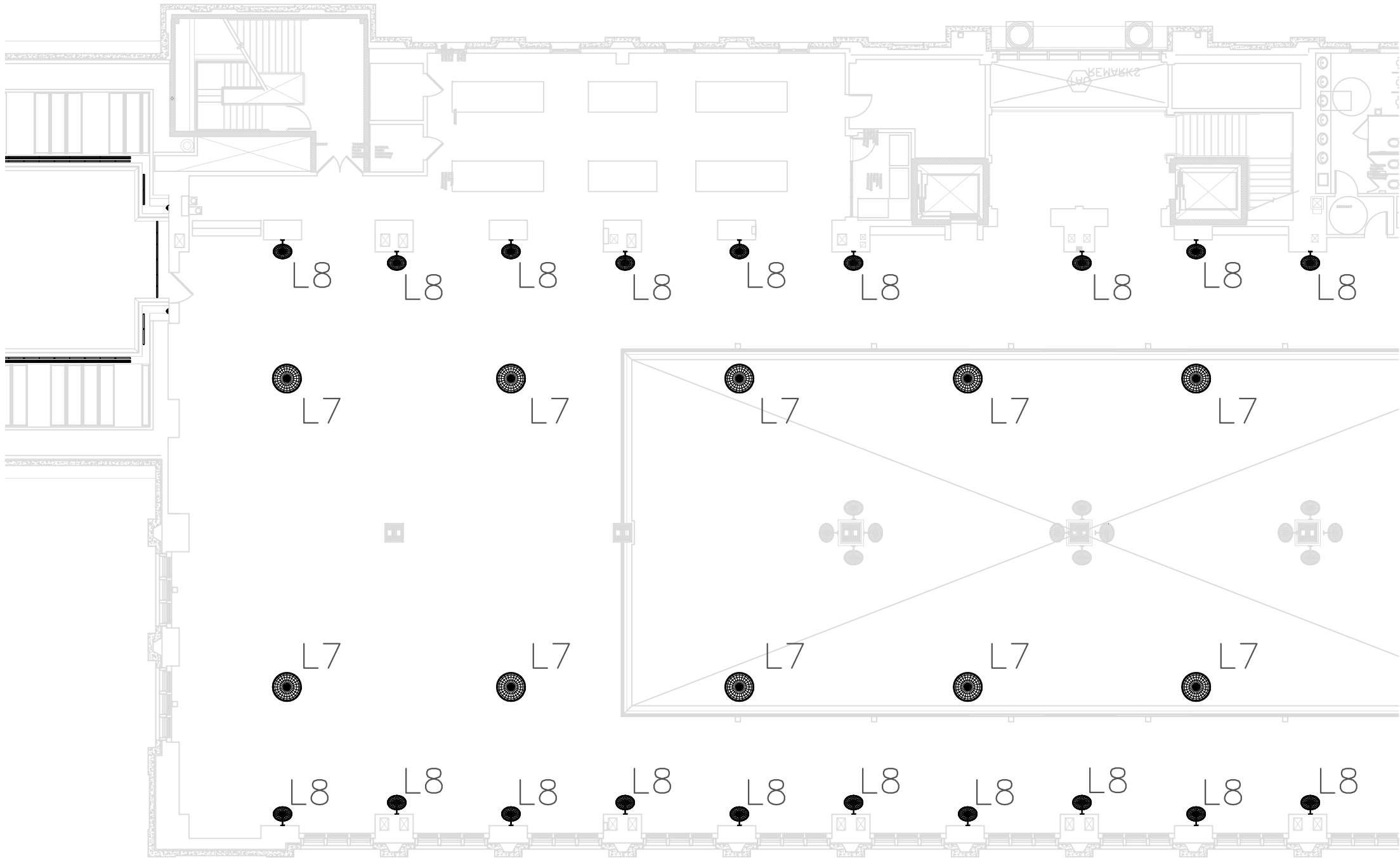
LIGHTING PLAN THIRD FLOOR

Project No. A05034.01	Date 2010-12-16
CAD File No.	Scale
Drawing No.	



THIRD FLOOR – LIBRARY LIGHTING WEST

1/16" = 1'–0"

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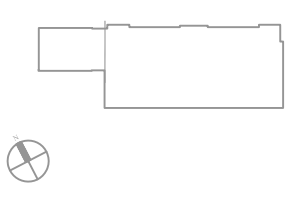

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THIRD FLOOR

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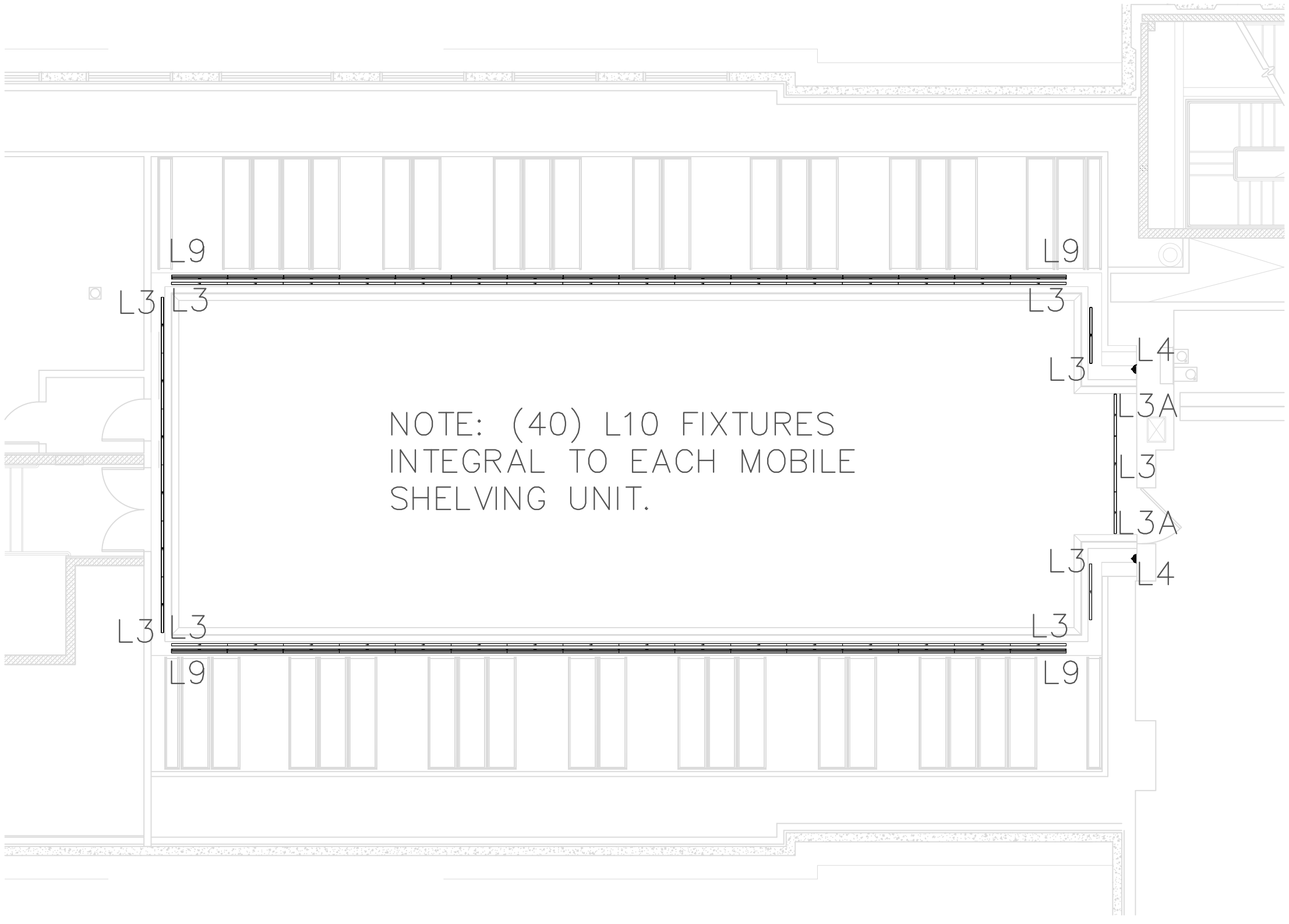

THIRD FLOOR – LAW CLASSROOM LIGHTING

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12207–2964

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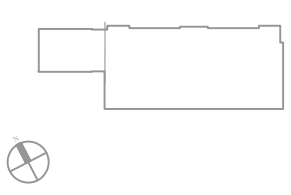

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LIGHTING PLAN THIRD FLOOR

Project No. A05034.01	Date 2010-12-16
CAD File No.	Scale
Drawing No.	

Appendix C: Lighting Equipment Specs

L1

KICHLER

Style to live by™

Project	
Type	
Ordering #	
Comments	

Salisbury Collection
Outdoor Hanging 1Lt Fluorescent RZ

11006RZ (Rubbed Bronze)

Product Description:

With an unmistakable British influence, this 1 light fluorescent hanging pendant from the elegant Salisbury™ collection projects timeless style for exterior spaces. Accented with a Rubbed Bronze™ finish and White Linen Glass, this piece is as functional as it is refined.

Technical Information

Lamp Included:	Included
Weight:	9.2LBS
Lead Wire Length:	22"
Glass Description:	WHITE LINEN
Chain Length:	72"
Safety Rated:	Damp
Base Backplate:	5.625 SQ.
Energy Efficient:	Yes
Title 24:	Yes
Dual Mount:	No
Light Source:	Fluorescent
Number of Bulbs:	1
Lamp Type:	MLS26GUWW
Max Watt:	26W
Width:	12"
Height:	24.75"
Overall Height:	98.75"
Collection:	Salisbury Collection
Finish:	Rubbed Bronze

L1 LAMP

Lightbulbsurplus.com
Brand Name Lighting For Less
Call toll free 24/7 888.553.5655

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ALP Lighting Components
Area Lighting Research
Bergen Industries
Bestekauf LED
Bulb Eater
CH Lighting
Ecology Lighting
Edwin Gaynor
EIKO
Espen Technology
Eye Hortilux Light Bulbs

Home :: LED A19 Lamps :: Feit Electric A19/DM/800/GU24/LED 13W Dimmable Light Bulb 3000K

Feit Electric A19/DM/800/GU24/LED 13W Dimmable Light Bulb 3000K

larger image

$22.88

Qty Discounts Off Price

1-71	72+
$22.88	$21.74

Quantity: 1

Add To Cart

13 Watt PerformanceLED A-19 Dimming LED Twist & Lock Base Lamp

Tired of always changing out your light bulbs? The Feit Electric A19/DM/800/GU24/LED A19 retrofit standard LED light bulb is an extra long lasting light bulb that lasts 25 times longer than the typical incandescent lamp, up to 25,000 hrs while consuming only 13 Watts of electricity equivalent to a 60 watt incandescent. You can save $129 in energy costs on average using this bulb as a replacement to an 60W incandescent based on using it for 25,000 hours at 11 cents per kWh with an estimated annual energy cost of $1.57. That is 78% less energy used! Talk about "going green"! The Feit Electric replacement lamp is even backed by an iron-clad 2 year warranty. One of the most notable environmental features of LED light bulb is that they contain no mercury and do not emit UV rays.

Manufacturer:	Feit Electric	Finish:	White	Model #:	A19/DM/800/GU24/LED
Wattage:	13 Watt	Color Temperature:	3,000 Kelvin	Base:	GU-24
RoHS:	Compliant	Light Output:	800 Lumens	UL Listed:	#330072
UPC:	01780113745	Warranty:	2 Years	Power Factor:	0.98
Voltage:	120 VAC	Location:	Dry Location Listed	Color Rendering:	80+ CRI
Life Hours:	25,000 Hours	Bulb Type:	G25	Lumens/Watt:	61.54~ lm/w
Price Break:	36 Units	Beam Spread:	200 Degrees	Case Code:	20017801137457
Length (in):	4.6"	Diameter (in):	2.5"	Dimmable:	Yes

Price Match Policy

? Question
(get expert advice on this item)

Add to Amazon Wish List

CUSTOMERS WHO BOUGHT THIS PRODUCT ALSO PURCHASED...

Small scale in-grade luminaires
STAINLESS STEEL for LEDs

Housing: Constructed of one-piece cast stainless steel.

Enclosure: Tempered clear safety glass, machined to be flush with the stainless steel faceplate. Faceplate is secured by four (4) captive flat head stainless steel screws and is machined to fit flush to mounting surface. Pure anodized aluminum reflector. One piece molded U-channel, high temperature silicone rubber gasket for weather tight operation.

Electrical: 4.3W LED luminaire on a 24V DC circuit, 5.8 total system watts. Remote 24V DC driver required. Standard LED color temperature is 4000K with an 85 CRI. Available in 3000K (85 CRI); add suffix K3 to order. Pre-wired with ten (10) feet of 12 AWG wire and waterproof cable gland entry into housing.

Note: LEDs supplied with luminaire. Due to the dynamic nature of LED technology, LED luminaire data on this sheet is subject to change at the discretion of BEGA-US. For the most current technical data, please refer to www.bega-us.com.

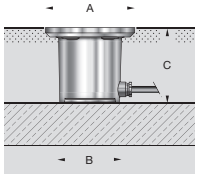
Finish: Machined #4 brushed stainless steel. Custom colors are not available.

Note: A foundation must be supplied by the customer. These luminaires are designed to bear pressure loads up to 4400 lbs. from vehicles with pneumatic tires. The luminaires must not be used for traffic lanes where they are subject to horizontal pressure from vehicles braking, accelerating and changing direction.

CSA certified to U.S. and Canadian standards, suitable for wet locations. Protection class IP67

Weight: 3.1 lbs.

Type:
BEGA Product:
Project:
Voltage:
Color:
Options:
Modified:



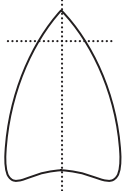
Symmetrical floodlight · **clear** safety glass

round	Lamp	β	A	B	C
7018 LED*	4.3W LED, 24V DC	23°	4 5/8	3 1/8	3 7/8

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

gotham®

Luminaire Type:
Catalog Number (autopopulated):



Gotham Architectural Downlighting
LED Downlights

4" Evo®
Open Reflector

Solid-State Lighting

ENERGY STAR

FEATURES

OPTICAL SYSTEM
- Self-flanged semi-specular, matte-diffuse or specular lower reflector
- Patented Bounding Ray™ optical design (U.S. Patent No. 5,800,050)
- 45° cutoff to source and source image
- Top-down flash characteristic

MECHANICAL SYSTEM
- 16-gauge galvanized steel construction; maximum 1-1/2" ceiling thickness
- Telescopic mounting bars maximum of 32" and minimum of 15", preinstalled, 4" vertical adjustment
- Toolless adjustments post installation
- Junction box capacity: 8 (4 in, 4 out) 12AWG rated for 90°C
- Light engine and driver accessible through aperture

ELECTRICAL SYSTEM
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours based on IESNA LM-79-2008
- 120-277VAC, 50/60hz power supply with 0-10V dimming (10-100%)
- Overload and short circuit protected
- LEDs tested under LM80

LISTINGS
- Fixtures are CSA certified to meet US and Canadian standards; wet location, covered ceiling

WARRANTY
- 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

ORDERING INFORMATION

EXAMPLE: EVO 35/10 4AR 120

Series	Color temperature	Nominal lumen values	Aperture/Trim color	Distribution	Finish	Voltage
EVO	**27/** 2700 K	**06** 600 lumens	**4AR** Clear	(blank) 1.0 s/mh	(blank) Semi-specular	**120**
	30/ 3000 K	**10** 1000 lumens	**4PR** Pewter	**MD** Medium (0.8 s/mh)	**LD** Matte diffuse	**277**
	35/ 3500 K	**14** 1400 lumens	**4WTR** Wheat	**WD** Wide (1.5 s/mh)	**LS** Specular	**347**[2]
	41/ 4100 K	**18** 1800 lumens	**4GR** Gold			
		20 2000 lumens	**4WR**[1] White			

Driver		Options			
(blank)[3]	0-10V dimming driver. Minimum dimming level 10%	**SF**	Single fuse	**TRBL**	Black painted flange
ECOS2[4,5]	Lutron® Hi-Lume® 2-wire forward-phase dimming driver. Minimum dimming level 1%	**RRL__**	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature.	**EL**[8]	Emergency battery pack with integral test switch
ECOS3[3,4]	Lutron® Hi-Lume® 3-wire or EcoSystem® dimming driver. Minimum dimming level 1%	**NEPP**[6]	Interface for Sensor Switch® nLight® network provided with integral power supply. Refer to TN-623-01.	**ELR**[8]	Emergency battery pack with remote test switch
		NSD[6]	Sensor Switch® nLight® one 5A relay with one 0-10 VDC dimming output; requires bus power, such as nPP16 power pack. Refer to nSP5-D.	**CP**[9]	Chicago plenum
		TRW[7]	White painted flange	**BGTD**	Bodine generator transfer device

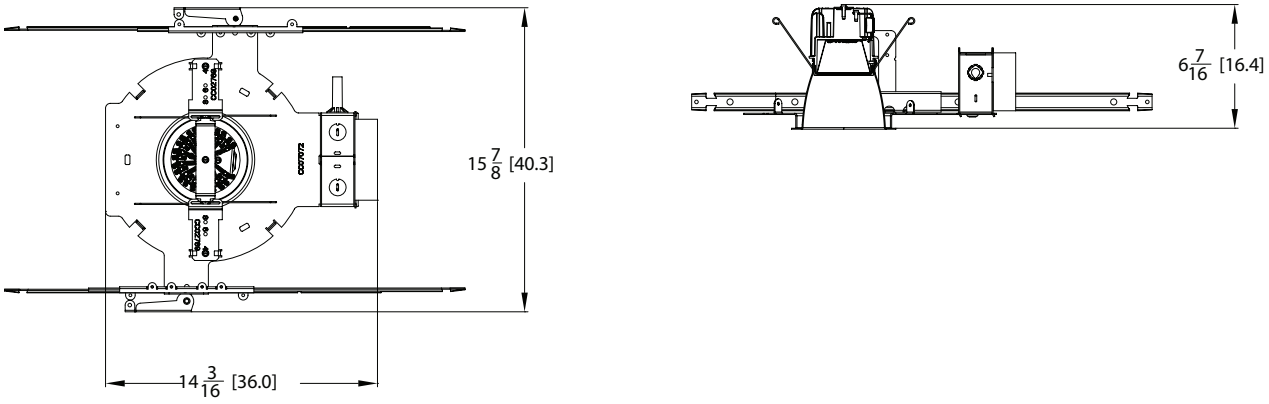
ACCESSORIES order as separate catalog numbers (shipped separately)

SCA4	Sloped ceiling adapter. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Ex: SCA4 10D. Refer to TECH-190.
CTA4-8 YK	Ceiling thickness adapter (extends mounting frame to accommodate ceiling thickness up to 2").
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.
NSP5 D ER KIT	Sensor Switch nLight secondary relay and dimming pack device used to switch and dim luminaires powered via an emergency circuit. Refer to NSP5 D ER KIT.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers GA 30012 | P 800.315.4982 | gothamlighting.com

DIMENSIONAL DATA

All dimensions are inches (centimeters) unless otherwise noted.



Aperture: 4-5/16 (11)
Ceiling Opening: 5-1/8 (13)
Overlap Trim: 5-7/16 (13.8)

ELECTRICAL

WATTAGE CONSUMPTION MATRIX		
LUMENS	**WATTAGE**	**LUMENS per WATT**
2000	31	65
1800	29	58
1400	26	55
1000	21	51
600	16	49

NOTES

ORDERING NOTES

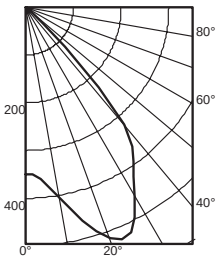
1. Not available with finishes.
2. Not valid with emergency options, i.e., EL and ELR.
3. Refer to TECH-240 for compatible dimmers.
4. Not available with NEPP option.
5. 120V only.
6. For Emergency generator/inverter applications order non-nLight-enabled fixture and NSP5 D ER KIT as an accessory. Refer to NSP5 D ER KIT.
7. Not available with white reflector.
8. For dimensional changes, refer to TECH-140. Access above ceiling required. Not available with CP option. Not available with 347V.
9. Not available with EL or ELR options.

PHOTOMETRY

Distribution Curve	Distribution Data	Output Data	Coefficient of Utilization	Illuminance: Single Luminaire 30" Above Floor

EVO 35/6 4AR LS

INPUT WATTS: 15.6, DELIVERED LUMENS: 757.7, LM/W=48.6, 1.6 S/MH, TEST NO. LTL21260



	Ave	Lumens
0	349	
5	361	36
15	463	133
25	520	234
35	393	245
45	117	105
55	2	4
65	1	1
75	0	0
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	402.6	53.1
0° - 40°	647.4	85.4
0° - 60°	756.6	99.9
0° - 90°	757.7	100.0
90° - 180°	0.0	0.0
0° - 180°	757.7	*100.0

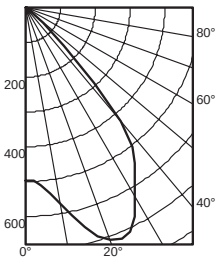
*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	105	108	105	103	104	102	100
2	101	97	93	99	95	92	96	93	90
3	93	87	83	92	86	82	89	85	81
4	86	79	75	84	79	74	82	77	73
5	79	72	68	78	72	67	76	71	67
6	73	66	61	72	66	61	71	65	61
7	68	61	56	67	60	56	65	60	55
8	63	56	51	62	56	51	61	55	51
9	58	51	47	58	51	47	57	51	47
10	54	48	43	54	47	43	53	47	43

Mounting Height	Inital FC Center Beam	50% beam - 76.1° Diameter	50% beam - 76.1° FC	10% beam - 91.1° Diameter	10% beam - 91.1° FC
8.0	11.5	8.6	5.8	11.2	1.2
10.0	6.2	11.7	3.1	15.3	0.6
12.0	3.9	14.9	1.9	19.4	0.4
14.0	2.6	18.0	1.3	23.5	0.3
16.0	1.9	21.1	1.0	27.5	0.2

EVO 35/10 4AR LS

INPUT WATTS: 20.6, DELIVERED LUMENS: 1039.0, LM/W=50.4, 1.5 S/MH, TEST NO. LTL21209



	Ave	Lumens
0	497	
5	513	51
15	653	186
25	709	320
35	547	337
45	156	138
55	3	5
65	1	1
75	0	0
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	557.2	53.6
0° - 40°	894.6	86.1
0° - 60°	1037.7	99.9
0° - 90°	1039.0	100.0
90° - 180°	0.0	0.0
0° - 180°	1039.0	*100.0

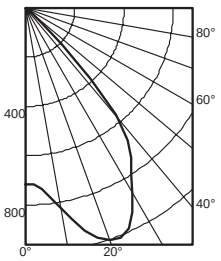
*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	105	108	105	103	104	102	100
2	101	97	93	99	95	92	96	93	90
3	93	88	83	92	87	83	89	85	81
4	86	80	75	85	79	74	82	77	74
5	79	73	68	78	72	68	76	71	67
6	73	66	62	72	66	61	71	65	61
7	68	61	56	67	61	56	66	60	56
8	63	56	51	62	56	51	61	55	51
9	58	52	47	58	52	47	57	51	47
10	54	48	44	54	48	44	53	47	43

Mounting Height	Inital FC Center Beam	50% beam - 75.3° Diameter	50% beam - 75.3° FC	10% beam - 90.7° Diameter	10% beam - 90.7° FC
8.0	16.4	8.5	8.2	11.1	1.6
10.0	8.8	11.6	4.4	15.2	0.9
12.0	5.5	14.7	2.8	19.2	0.6
14.0	3.8	17.7	1.9	23.3	0.4
16.0	2.7	20.8	1.4	27.3	0.3

EVO 35/14 4AR LS

INPUT WATTS: 26.2, DELIVERED LUMENS: 1431.9, LM/W=54.7, 1.5 S/MH, TEST NO. LTL21213



	Ave	Lumens
0	716	
5	738	73
15	934	265
25	986	445
35	743	458
45	203	182
55	4	6
65	1	1
75	0	0
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	784.3	54.8
0° - 40°	1242.2	86.8
0° - 60°	1430.4	99.9
0° - 90°	1431.9	100.0
90° - 180°	0.0	0.0
0° - 180°	1431.9	*100.0

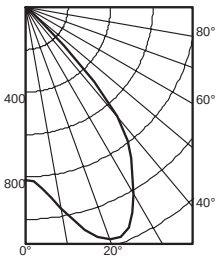
*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	105	108	105	103	104	102	100
2	101	97	93	100	96	92	96	93	90
3	93	88	83	92	87	83	89	85	81
4	86	80	75	85	79	75	83	78	74
5	80	73	68	79	72	68	77	71	67
6	74	67	62	73	66	62	71	66	61
7	68	61	57	67	61	57	66	60	56
8	63	57	52	63	56	52	62	56	52
9	59	52	48	58	52	48	57	52	48
10	55	48	44	54	48	44	54	48	44

Mounting Height	Inital FC Center Beam	50% beam - 73.6° Diameter	50% beam - 73.6° FC	10% beam - 90.0° Diameter	10% beam - 90.0° FC
8.0	23.7	8.2	11.8	11.0	2.4
10.0	12.7	11.2	6.4	15.0	1.3
12.0	7.9	14.2	4.0	19.0	0.8
14.0	5.4	17.2	2.7	23.0	0.5
16.0	3.9	20.2	2.0	27.0	0.4

EVO 35/18 4AR LS

INPUT WATTS: 29.0, DELIVERED LUMENS: 1682.7, LM/W=58.0, 1.5 S/MH, TEST NO. LTL21149



	Ave	Lumens
0	813	
5	854	85
15	1086	308
25	1149	519
35	869	536
45	256	223
55	6	9
65	2	2
75	1	1
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	913.1	54.3
0° - 40°	1449.4	86.1
0° - 60°	1680.5	99.9
0° - 90°	1682.7	100.0
90° - 180°	0.0	0.0
0° - 180°	1682.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	105	108	105	103	104	102	100
2	101	97	93	99	95	92	96	93	90
3	93	88	83	92	87	83	89	85	81
4	86	80	75	85	79	75	83	78	74
5	79	73	68	78	72	68	77	71	67
6	73	67	62	73	66	62	71	65	61
7	68	61	56	67	61	56	66	60	56
8	63	56	52	62	56	52	61	56	51
9	59	52	48	58	52	47	57	51	47
10	55	48	44	54	48	44	53	48	44

Mounting Height	Inital FC Center Beam	50% beam - 74.3° Diameter	50% beam - 74.3° FC	10% beam - 90.7° Diameter	10% beam - 90.7° FC
8.0	26.9	8.3	13.4	11.1	2.7
10.0	14.5	11.4	7.2	15.2	1.4
12.0	9.0	14.4	4.5	19.2	0.9
14.0	6.1	17.4	3.1	23.3	0.6
16.0	4.5	20.5	2.2	27.3	0.4

PHOTOMETRY NOTES

- Tested in accordance with IESNA LM-79-08.
- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- Actual performance may differ as a result of end-user environment and application.
- Actual wattage may differ by +/- 10% when operating between 120-277V +/- 10%.
- CRI: 83 typical.
- Consult factory or IES file for microgroove baffle, black cone or other photometric reports.

STATIC WHITE RIBBONLYTE

White lighting is the way we see the world. With so many variations of color temperature and wattage, our Static White RibbonLyte will help you create the ultimate lighting scheme.

Whether you want to imitate the warm glow of candelight, or provide a high visibility work environment similar to a bright afternoon outdoors, we can provide a solution to fill your needs.

Not only do we offer a variety of color temperatures, but our RibbonLyte comes in a number of wattages as well. As energy costs rise, the benefits of our lower wattage LEDs are even more apparent.

Pictured: RibbonLyte 4.4 3000K @Fetta Panini Bar, Toronto Pearson Intl Airport, Mississagua, ON
Designed by ICRAVE

ACOLYTE LED 251 West 30th St, Suite 12E New York, NY 10001 **212.629.6830** INFO@**ACOLYTELED.COM**

L6

White

RIBBONLYTE 1.5

RoHS Compliant

Dry or wet location flexible LEDs

12 or 24 Volt

1.5 Watts per foot, 18 LEDs per foot

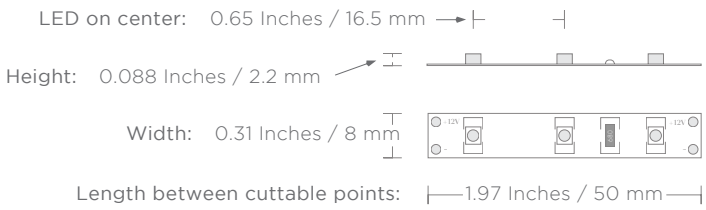
IP65 and IP68 versions are UV resistant

2400K, 2700K, 3000K, 3500K, 4100K, and 6000K

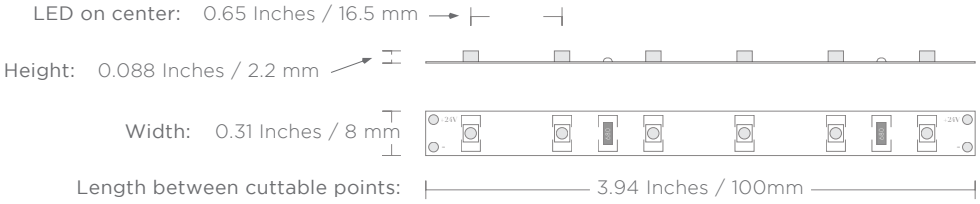
Cuttable every 1.97 inches (12V) or 3.94 inches (24V)

DIMENSIONS

1.5 - 12 Volt



1.5 - 24 Volt



PART NUMBER BUILDER

Category		Waterproof		Voltage		Wattage		Color Temperature		
RB	+		+		+	1.5	+		=	Your Part Number Example: RB121.527
		65 - IP65 68 - IP68 Blank - None (IP40)		12 - 12V 24 - 24V				24 - 2400K 27 - 2700K 30 - 3000K 35 - 3500K 41 - 4100K 60 - 6000K		

Rev. 2013.08.08

SPECIFICATIONS **RIBBONLYTE 1.5**

Operating Voltage	12 Volt / 24 Volt
Power Consumption	1.5 Watts / Linear Foot
Amperage	12v: 125 mA / Foot 24v: 63 mA / Foot
Protection Rating	IP40/IP65/IP68
Dimming	Triac / 0-10 Volt / DMX / Lutron A-Series 1% dimming LED drivers
Operating Temperature	-40° C to 70° C
Color Temperature	2400K 2700K 3000K 3500K 4100K 6000K
Lumen Output	2400K: 92.86 lm/ft; 2700K: 80.46 lm/ft; 3000K: 82.8 lm/ft; 3500K: 96.84 lm/ft; 4100K: 85.68 lm/ft; 6000K: 89.64 lm/ft
Binning Tolerance	+/- 100K
LED Beam Angle	160°
Lamp Life	50,000 Hours
Cuttable	12v: Every 1.97" (50 mm) 24v: Every 3.94" (100 mm)
CRI* *CRI >90 available upon request	2400K: >50.4; 2700K: >56; 3000K: >62.8; 3500K: >66.3; 4100K: >69.2; 6000K: >73.8
Lumens per Watt (per ft)	2400K: 61.91 lm/W; 2700K: 53.64 lm/W; 3000K: 55.2 lm/W; 3500K: 64.56 lm/W; 4100K: 57.12 lm/W; 6000K: 59.76 lm/W
Constant Voltage	Yes
Max Length Before Additional Power is Needed	12V: 29' 4.6" (9 Meters) 24V: 68' 7.5" (21 Meters)

DIMENSIONS **RIBBONLYTE 1.5**

IP40 + IP65

Width	0.31" / 8 mm
Length	Up to 29' 4.6" (12V) in ~2 inch sections or 68' 7.5" (24V) in ~4 inch sections
Height	IP40: 0.088" / 2.2 mm IP65: 0.125" / 3.2 mm

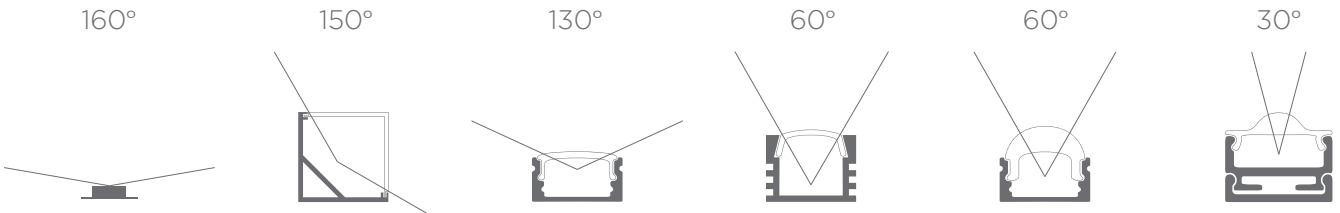
OUTDOOR - IP68

Width	0.41" / 10.4 mm
Length	Up to 29' 4.6" (12V) in ~2 inch sections or 68' 7.5" (24V) in ~4 inch sections
Height	0.18" / 4.5 mm

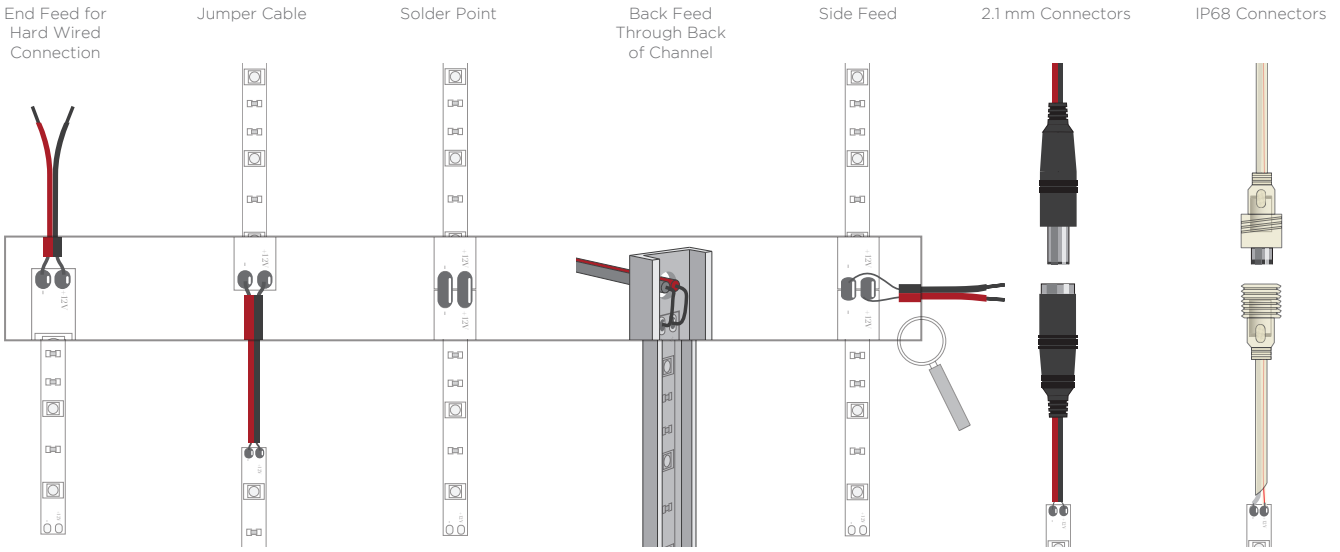
Rev. 2013.08.08

RIBBONLYTE 1.5

SAMPLE **BEAM ANGLES**



CONNECTION **OPTIONS**



CHANNEL **COMPATIBILITY**

Protection	Compatible Channels
Non-Waterproof (IP40)	All Channel
IP65	All Channel
IP68	All Channel

Rev. 2013.08.08

USAGE **GUIDELINES**

Compatible with a wide variety of control products including the entire line of Lutron dimming systems.

For use with Acolyte drivers, triac dimming modules, 0-10 modules and interface controllers (DMXINF models).

Use with non-Acolyte triac, MLV or ELV drivers is not supported or warrantied.

Due to the nature of the product, RibbonLyte cuttable lengths are generally longer or shorter than the customer requested length. Unless specified, RibbonLyte is factory cut at the shorter cuttable point.

IP65 and IP68 versions can be used in wet, outdoor locations around swimming pools and spa tubs, but not submerged in swimming pools and spa tubs.

We reserve the right to make changes to product lineup, specifications, design and finishes at any time without notice.

ACCESSORIES **RIBBONLYTE 1.5**

CHANNEL
See Acolyte Channel Guide

DRIVERS
See Acolyte Drivers Guide

CONTROLLERS
See Acolyte Controllers Guide

PARTS AND ACCESSORIES
See Acolyte Parts and Accessories Guide

STATIC WHITE RIBBONLYTE COMPARISON GUIDE

SPECIFICATIONS	1.5	2.2	3.0	4.4	5.0	6.0	8.8
Operating Voltage	12 V and 24 V versions						24 V
Power Consumption	1.5 W / Ft	2.2 W / Ft	3.0 W / Ft	4.4 W / Ft	5.0 W / Ft	6.0 W / Ft	8.8 W / Ft
Current (mA) - 12 V	125	183	250	366	417	500	--
Current (mA) - 24 V	63	92	125	183	208	250	367
Protection Rating	IP45, IP65 and IP68						
Beam Angle	160°						
Color Temperatures	2400K, 2700K, 3000K, 3500K, 4100K, 6000K (5.0 is only avail. in 3000K, 4100K, 6000K)						
LED's / Foot	18	9	36	18	15	72	36
Width - IP45 / IP65	0.31"	0.39"	0.31"	0.39"	0.41"	0.50"	0.59"
Width - IP68	0.41"	0.52"	0.41"	0.52"	0.54"	0.66"	0.70"
Cuttable Length - 12 V	1.97"	3.94"	0.98"	1.97"	2.46"	1.97"	--
Cuttable Length - 24 V	3.94"	6.55"	1.97"	3.94"	4.92"	3.94"	1.97"
Max Length - 12 V	29' 4.6"	26' 3"	19' 8.2"	16' 4.9"	16' 4.9"	16' 4.9"	--
Max Length - 24 V	68' 7.5"	45' 10.3"	32' 9.7"	26' 3"	32' 9.7"	26' 3.0"	25' 7.1"
Lumen / Ft - 2400 K	92.86	149.13	185.73	298.26	--	371.46	596.52
Lumen / Ft - 2700 K	80.46	153.99	160.92	307.98	--	321.84	615.96
Lumen / Ft - 3000 K	82.80	175.68	165.60	351.36	438.91	331.20	702.72
Lumen / Ft - 3500 K	96.84	161.10	193.68	322.20	--	387.36	644.40
Lumen / Ft - 4100 K	85.68	157.23	171.36	314.46	441.96	342.72	628.92
Lumen / Ft - 6000 K	89.64	169.38	179.28	338.76	445.01	358.56	677.52
Lumens / Watt - 2400 K	61.91	67.79	61.91	67.79	--	61.91	67.69
Lumens / Watt - 2700 K	53.64	70.00	53.64	70.00	--	53.64	70.00
Lumens / Watt - 3000 K	55.2	79.85	55.2	79.85	87.78	55.20	79.85
Lumens / Watt - 3500 K	64.56	73.23	64.56	73.23	--	64.56	73.23
Lumens / Watt - 4100 K	57.12	71.47	57.12	71.47	88.39	57.12	71.47
Lumens / Watt - 6000 K	59.76	77.00	59.76	77.00	89.00	59.76	77.00
CRI - 2400 K	50.4	50.5	50.4	50.5	--	50.4	50.5
CRI - 2700 K	56.0	58.9	56.0	58.9	--	56.0	58.9
CRI - 3000 K	62.8	63.0	62.8	63.0	72.0	62.8	63.0
CRI - 3500 K	66.3	65.3	66.3	65.3	--	66.3	65.3
CRI - 4100 K	69.2	70.8	69.2	70.8	70.0	69.2	70.8
CRI - 6000 K	73.8	73.4	73.8	73.4	69.0	73.8	73.4

Rev. 2013.08.08

SPECIFICATION SHEET

lumencove®

WHITE & STATIC COLORS

L9

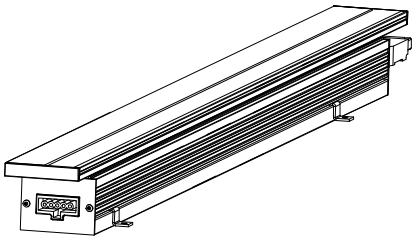
Client: _____

Project name: _____

Order #: _____

Type: _____ Qty: _____

FEATURES AND BENEFITS



Physical :

- Low copper content extruded aluminum housing
- Available in 1', 2', 3', 4' or 8' sections
- Electro-statically applied polyester powder coat finish
- Tool-less LED frame adjustable mechanism
- Low profile design
- White standard finish
- Indoor applications, dry location only
- 1 locking mechanism is included per fixture, installed. (Two locks provided for 8ft sections.Locking mechanism is made of unpainted steel).
- Single feed option available for end of run fixtures

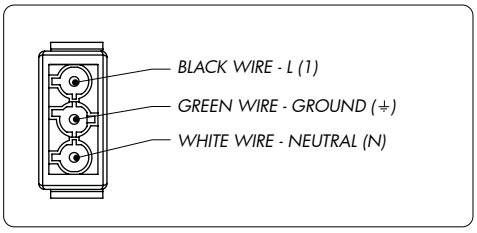
Performance :

- 2700K, 3000K, 3500K, 4000K, Red, Green, Blue static colors available
- Available in Regular Output or High Output versions
- 407 delivered lumens per foot (RO version)
- 773 delivered lumens per foot (HO version)
- Lumen maintenance L70 @ 25°C - 80,000 hrs
- Lumen measurements comply with LM - 79 - 08 standard
- Resolution per foot or per fixture (see page 9)
- Operating temperatures: -25° C to 50° C [-13F to 122F]

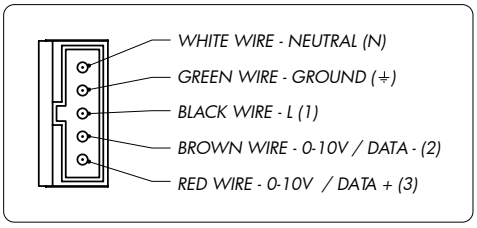
Electrical :

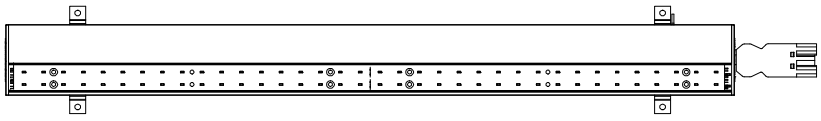
- Line voltage luminaire for 120 to 277V
- Power and data in 1 cable (#16-5)
- Up to 180 feet on 1 power feed (112 feet/HO version)
- 6W/ft - RO version, 12W/ft - HO version
- 0-10V, DMX or DALI dimming options

Wiring detail - non dimming

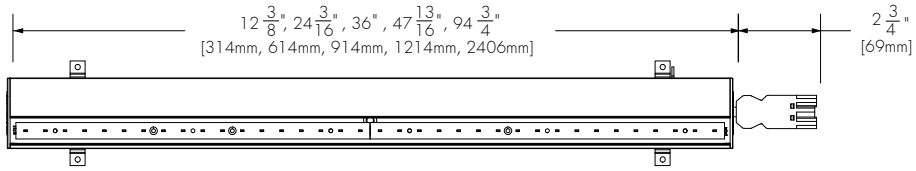


Wiring detail - dimming

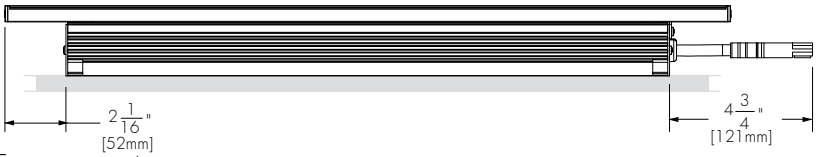




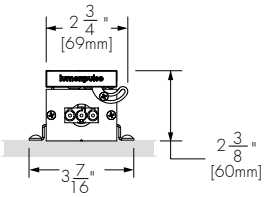
HIGH OUTPUT VERSION



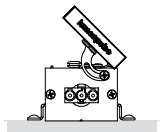
REGULAR OUTPUT VERSION



5 year warranty



Non-Dimming Fixture
(3-pin connector shown)



0-80° angle adjustment

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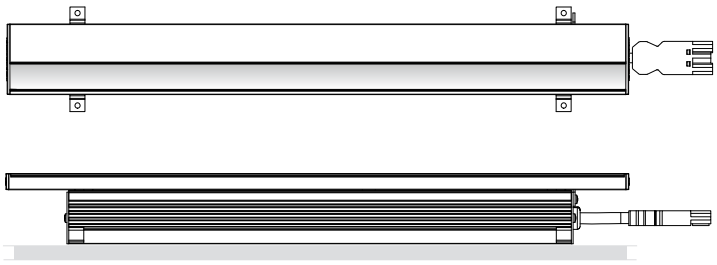
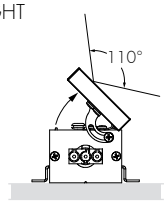
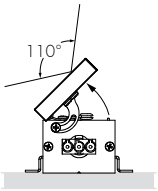
FEEDING SIDE



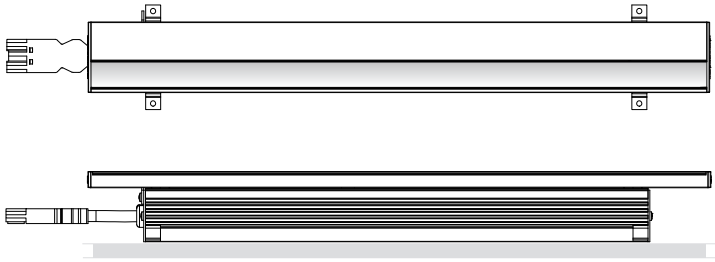


LED housing rotates
in a clockwise direction

RF
Right Feeding side
standard clips shown



LED housing rotates
in a counter-clockwise direction



LF
Left Feeding side
standard clips shown

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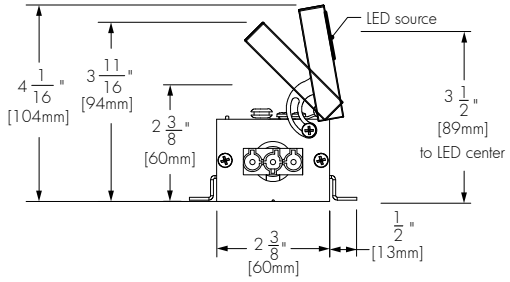
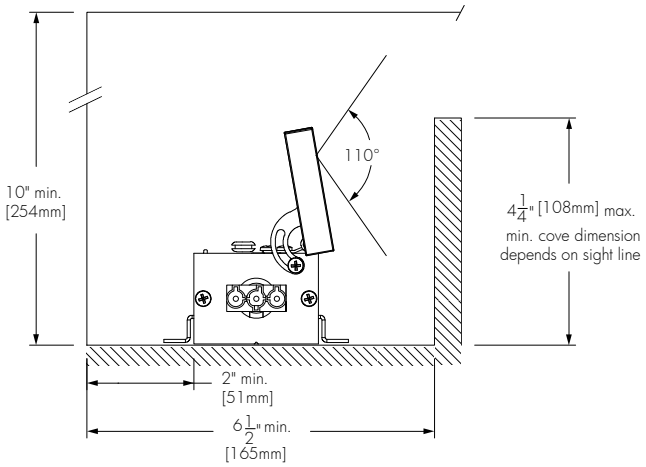
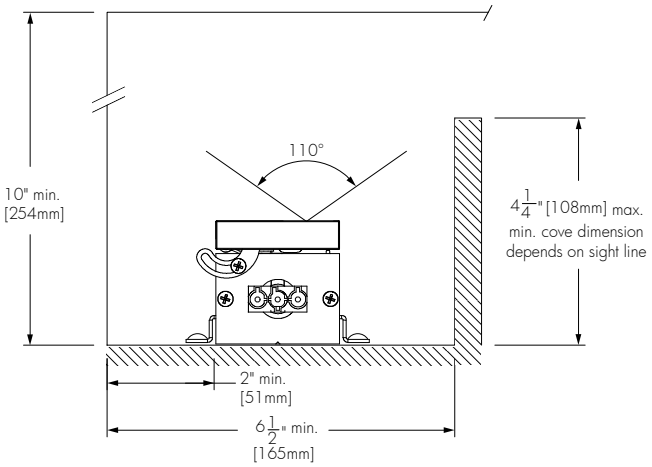
MOUNTING DETAILS

MINIMUM COVE DIMENSIONS





OUTWARD FACING



INWARD FACING

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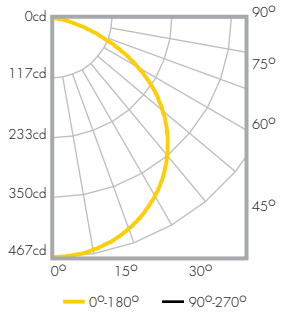
PHOTOMETRICS

Lumencove® RO 4'
2700K
clear lens

Lamping	25.4 W
Lumens	1269
Efficacy	50 lm/W

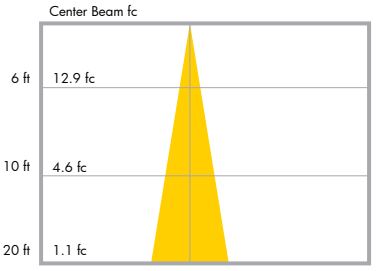
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	467	467	467	467	467
5	465	465	465	465	465
15	450	450	450	450	450
25	421	421	421	421	421
35	377	377	377	377	377
45	318	318	318	318	318
55	241	241	241	241	241
65	145	145	145	145	145
75	52	52	52	52	52
85	6	6	6	6	6
90	0	0	0	0	0

Illuminance at Distance

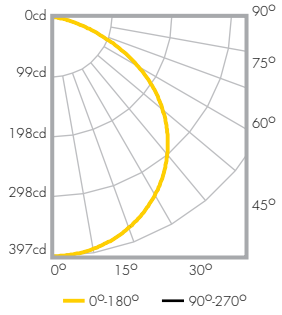


21.6 ft (6.5 m)
1 fc @ nadir maximum distance

Lumencove® RO 4'
2700K
frosted lens

Lamping	25.4 W
Lumens	1079
Efficacy	55 lm/W

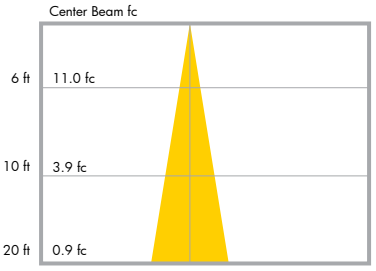
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	397	397	397	397	397
5	395	395	395	395	395
15	383	383	383	383	383
25	358	358	358	358	358
35	321	321	321	321	321
45	270	270	270	270	270
55	205	205	205	205	205
65	123	123	123	123	123
75	44	44	44	44	44
85	5	5	5	5	5
90	0	0	0	0	0

Illuminance at Distance

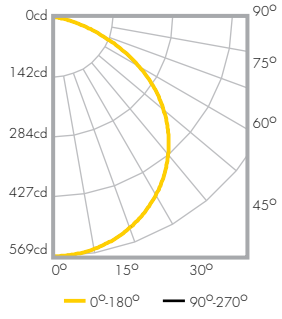


19.9 ft (6.0 m)
1 fc @ nadir maximum distance

Lumencove® RO 4'
3000K
clear lens

Lamping	25 W
Lumens	1513
Efficacy	60 lm/W

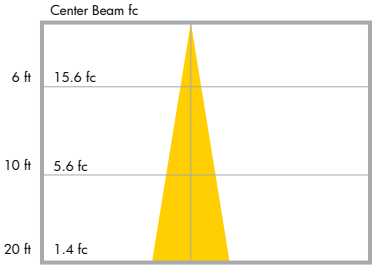
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	565	565	565	565	565
5	563	561	561	565	567
15	544	542	543	547	548
25	507	506	506	510	510
35	451	450	450	455	455
45	375	374	376	381	382
55	281	277	280	289	290
65	168	164	168	177	178
75	61	59	61	64	65
85	8	7	7	6	5
90	0	0	0	0	0

Illuminance at Distance

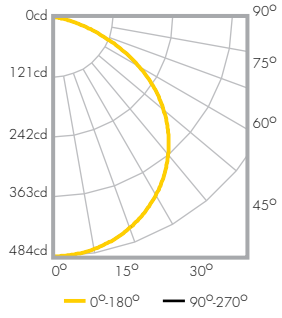


23.7 ft (7.2 m)
1 fc @ nadir maximum distance

Lumencove® RO 4'
3000K
frosted lens

Lamping	25 W
Lumens	1286
Efficacy	51 lm/W

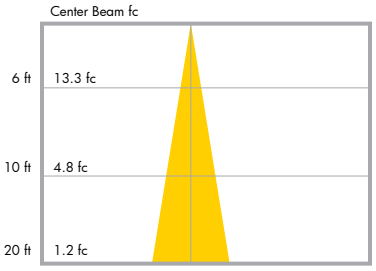
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	480	480	480	480	480
5	479	477	477	480	482
15	462	461	461	465	466
25	431	430	430	433	434
35	384	382	382	387	387
45	319	318	319	324	325
55	239	236	238	246	247
65	143	140	143	151	151
75	51	50	52	54	55
85	5	5	4	4	3
90	0	0	0	0	0

Illuminance at Distance



21.9 ft (6.6 m)
1 fc @ nadir maximum distance

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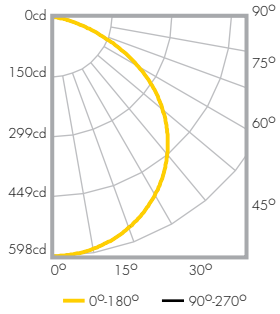
PHOTOMETRICS

Lumencove® RO 4'
4000K
clear lens

Lamping	25 W
Lumens	1627
Efficacy	65 lm/W

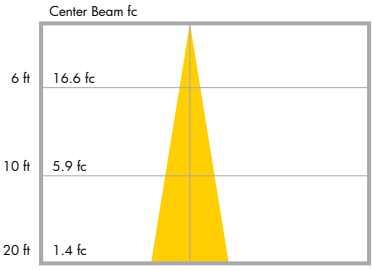
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	598	598	598	598	598
5	596	596	596	596	596
15	577	577	577	577	577
25	540	540	540	540	540
35	484	484	484	484	484
45	408	408	408	408	408
55	309	309	309	309	309
65	186	186	186	186	186
75	67	67	67	67	67
85	8	8	8	8	8
90	0	0	0	0	0

Illuminance at Distance

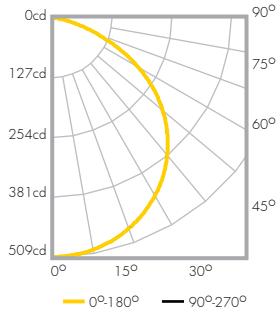


24.4 ft (7.4 m)
1 fc @ nadir maximum distance

Lumencove® RO 4'
4000K
frosted lens

Lamping	25 W
Lumens	1383
Efficacy	55 lm/W

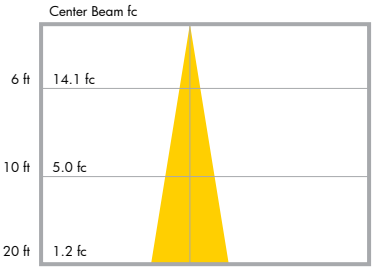
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	509	509	509	509	509
5	507	507	507	507	507
15	491	491	491	491	491
25	459	459	459	459	459
35	411	411	411	411	411
45	346	346	346	346	346
55	262	262	262	262	262
65	158	158	158	158	158
75	57	57	57	57	57
85	6	6	6	6	6
90	0	0	0	0	0

Illuminance at Distance



22.5 ft (6.8 m)
1 fc @ nadir maximum distance

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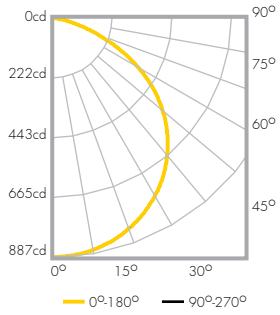
PHOTOMETRICS

Lumencove® HO 4'
2700K
clear lens

Lamping	45 W
Lumens	2412
Efficacy	53 lm/W

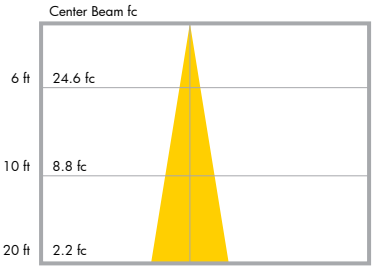
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	887	887	887	887	887
5	884	884	884	884	884
15	856	856	856	856	856
25	801	801	801	801	801
35	717	717	717	717	717
45	604	604	604	604	604
55	457	457	457	457	457
65	275	275	275	275	275
75	99	99	99	99	99
85	11	11	11	11	11
90	0	0	0	0	0

Illuminance at Distance

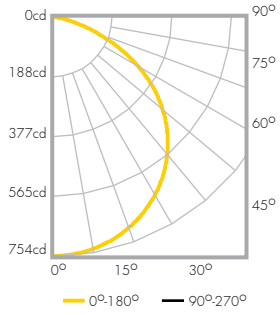


29.7 ft (9.0 m)
1 fc @ nadir maximum distance

Lumencove® HO 4'
2700K
frosted lens

Lamping	45 W
Lumens	2050
Efficacy	45 lm/W

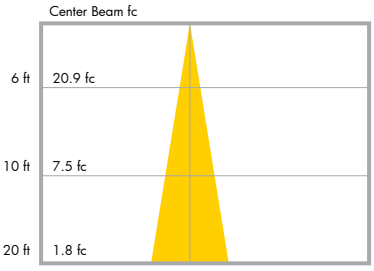
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	754	754	754	754	754
5	751	751	751	751	751
15	727	727	727	727	727
25	681	681	681	681	681
35	610	610	610	610	610
45	514	514	514	514	514
55	389	389	389	389	389
65	234	234	234	234	234
75	84	84	84	84	84
85	10	10	10	10	10
90	0	0	0	0	0

Illuminance at Distance

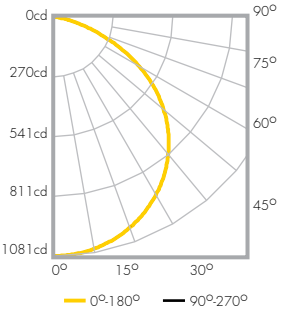


27.4 ft (8.3 m)
1 fc @ nadir maximum distance

Lumencove® HO 4'
3000K
clear lens

Lamping	45 W
Lumens	2876
Efficacy	63 lm/W

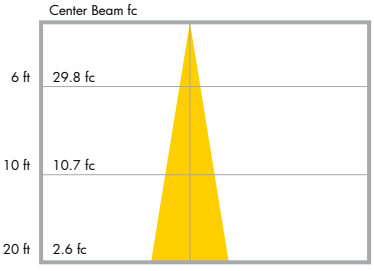
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	1075	1075	1075	1075	1075
5	1071	1067	1067	1074	1077
15	1034	1031	1032	1039	1041
25	964	961	961	969	970
35	858	855	855	865	865
45	713	711	714	725	727
55	534	527	533	550	552
65	319	313	319	337	338
75	115	113	116	122	123
85	15	14	14	12	11
90	0	0	0	0	0

Illuminance at Distance

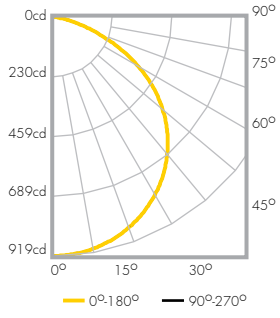


32.7 ft (9.9 m)
1 fc @ nadir maximum distance

Lumencove® HO 4'
3000K
frosted lens

Lamping	45 W
Lumens	2444
Efficacy	54 lm/W

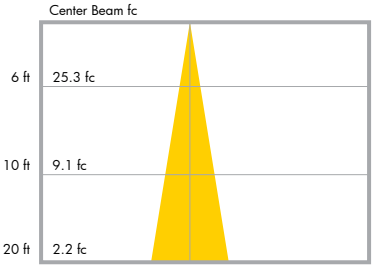
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	913	913	913	913	913
5	910	907	907	913	915
15	879	876	877	883	885
25	819	817	817	824	824
35	729	727	727	735	735
45	606	604	607	616	618
55	453	448	453	467	469
65	271	266	271	286	288
75	98	96	99	104	105
85	13	12	12	10	9
90	0	0	0	0	0

Illuminance at Distance



30.2 ft (9.2 m)
1 fc @ nadir maximum distance

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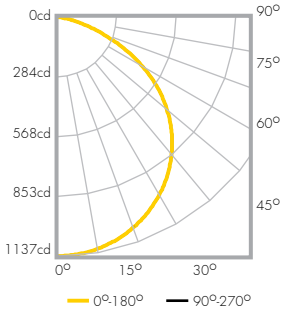
PHOTOMETRICS

Lumencove® HO 4'
4000K
clear lens

Lamping	45 W
Lumens	3092
Efficacy	68 lm/W

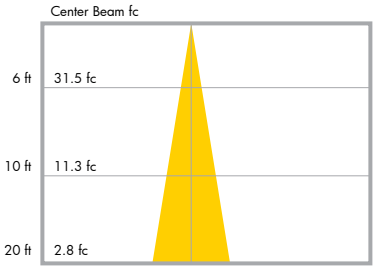
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	1137	1137	1137	1137	1137
5	1133	1133	1133	1133	1133
15	1097	1097	1097	1097	1097
25	1026	1026	1026	1026	1026
35	919	919	919	919	919
45	775	775	775	775	775
55	586	586	586	586	586
65	353	353	353	353	353
75	126	126	126	126	126
85	14	14	14	14	14
90	0	0	0	0	0

Illuminance at Distance

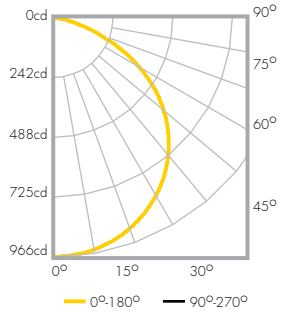


33.7 ft (10.2 m)
1 fc @ nadir maximum distance

Lumencove® HO 4'
4000K
frosted lens

Lamping	45 W
Lumens	2628
Efficacy	58 lm/W

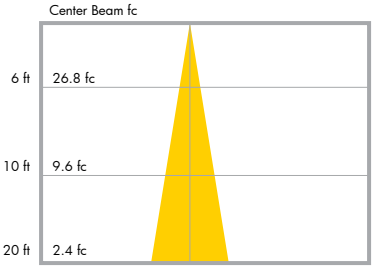
Polar Candela Distribution



Candela Table

	0	22.5	45	67.5	90
0	966	966	966	966	966
5	963	963	963	963	963
15	932	932	932	932	932
25	872	872	872	872	872
35	781	781	781	781	781
45	658	658	658	658	658
55	498	498	498	498	498
65	300	300	300	300	300
75	107	107	107	107	107
85	12	12	12	12	12
90	0	0	0	0	0

Illuminance at Distance



31.0 ft (9.4 m)
1 fc @ nadir maximum distance

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ACCESSORIES
Order separately

Control Systems:

LTO Lumentouch is a wall mount DMX 512 controller keypad

LCU Lumencue is a USB / mini SD DMX 512 controller

LID LumenID is a diagnostic and addressing DMX 512 controller.
It must be specified on all DMX applications.
Refer to LID specification sheet for details.

LTN Lumentone is a simple pre-programmed DMX 512 controller
with a push button rotary dial and live feedback.

CBOX :

iCBOX-___V-___-___ Interior DMX 512 data box.
Data input and output, M20 provision holes with plugs.
Voltage input and output, M20 provision holes with plugs.
Up to six outputs to fixtures, M20 provision holes with plugs.
Please specify desired input voltage and finish.
Refer to iCBOX specification sheet for details.

CBOX-___V-___-___ DMX 512 data box.
Data input and output, M20 provision holes with plugs.
Voltage input and output, M20 provision holes with plugs.
Up to six outputs to fixtures, M20 provision holes with plugs.
Please specify desired input voltage and finish.
Refer to CBOX specification sheet for details.

Leader Cable :

LCSLC___ Leader Cable for Lumencove® fixture (3 conductor cable).
Please add desired cable length : 6, 8 or 10 feet

LCSLCD___ Leader Cable for dimming Lumencove® fixture (5 conductor cable).
Please add desired cable length : 6, 8 or 10 feet

Jumper Cable :

LCSJC___ Jumper Cable for Lumencove® fixture (3 conductor cable).
Please add desired cable length : 1, 2, 4 or 8 feet

LCSJCD___ Jumper Cable for dimming Lumencove® fixture (5 conductor cable).
Please add desired cable length : 1, 2, 4 or 8 feet

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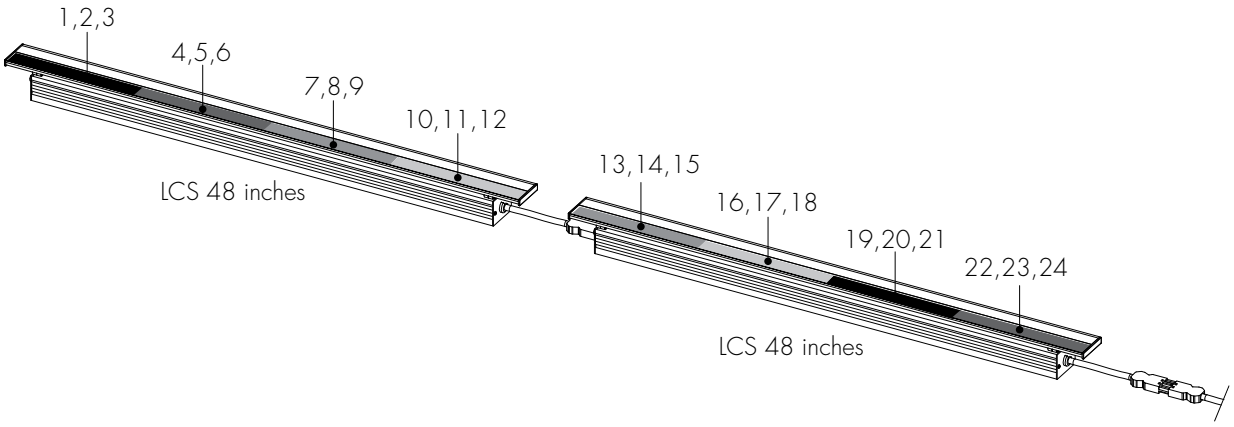
RESOLUTION DETAILS
APPLICABLE FOR DMX DIMMING OPTION ONLY

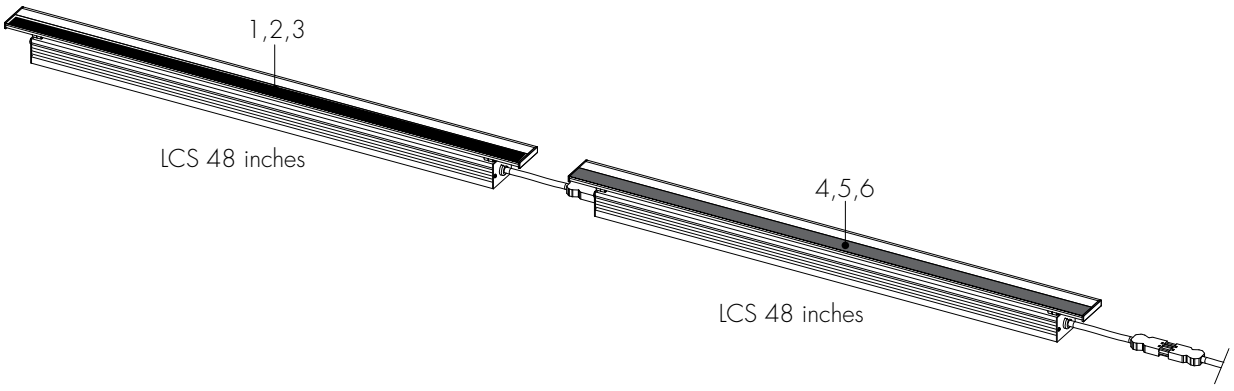
DMX 1FT - Resolution per foot: each foot is addressed independently (recommended for most installations).
1% minimum dimming value

DMX ADDRESSES:



DMX 1FX - Resolution per fixture: each fixture is addressed independently.
1% minimum dimming value

DMX ADDRESSES:



*Warning: resolution is a factory setting and cannot be changed in the field.

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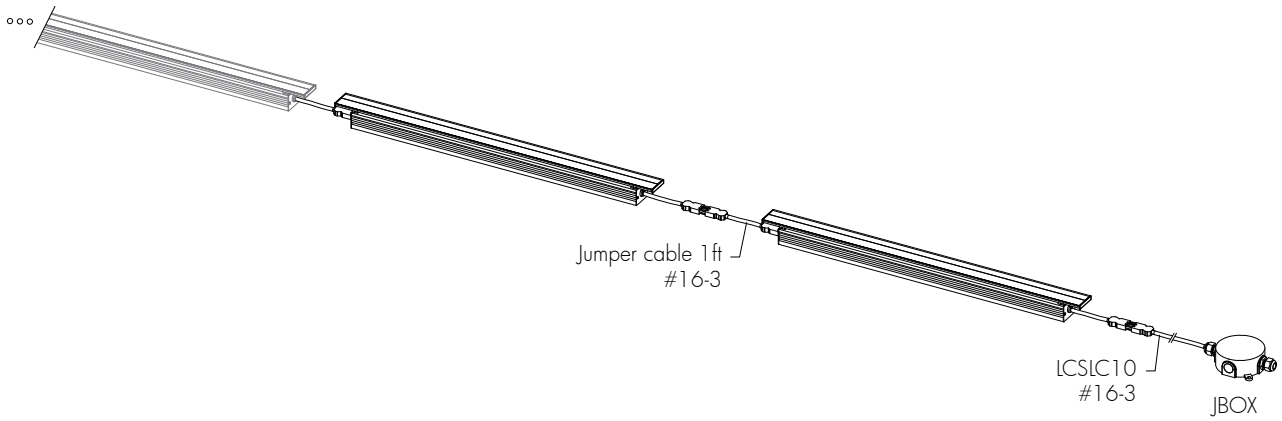
TYPICAL WIRING DIAGRAMS

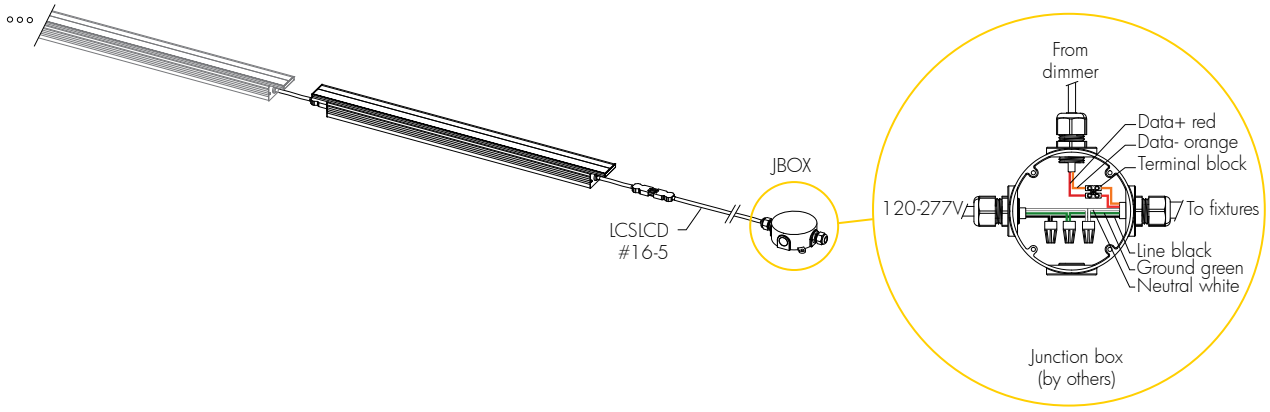
Non-Dimming Version



Maximum run length by 15A circuit - Lumencove® RO 6W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	180ft	292ft	300ft
50ft leader cable	152ft	260ft	292ft
Maximum run length by 15A circuit - Lumencove® HO 12W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	112ft	180ft	200ft
50ft leader cable	88ft	152ft	172ft

Dimming Version (0-10V)

10% minimum dimming value



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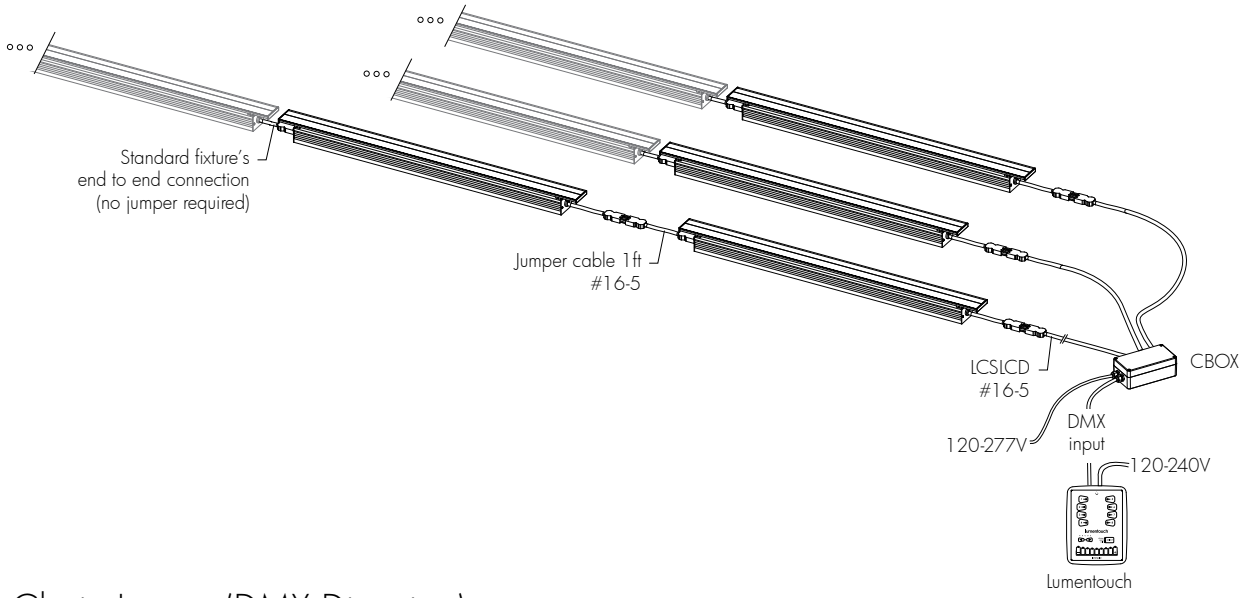
TYPICAL WIRING DIAGRAMS

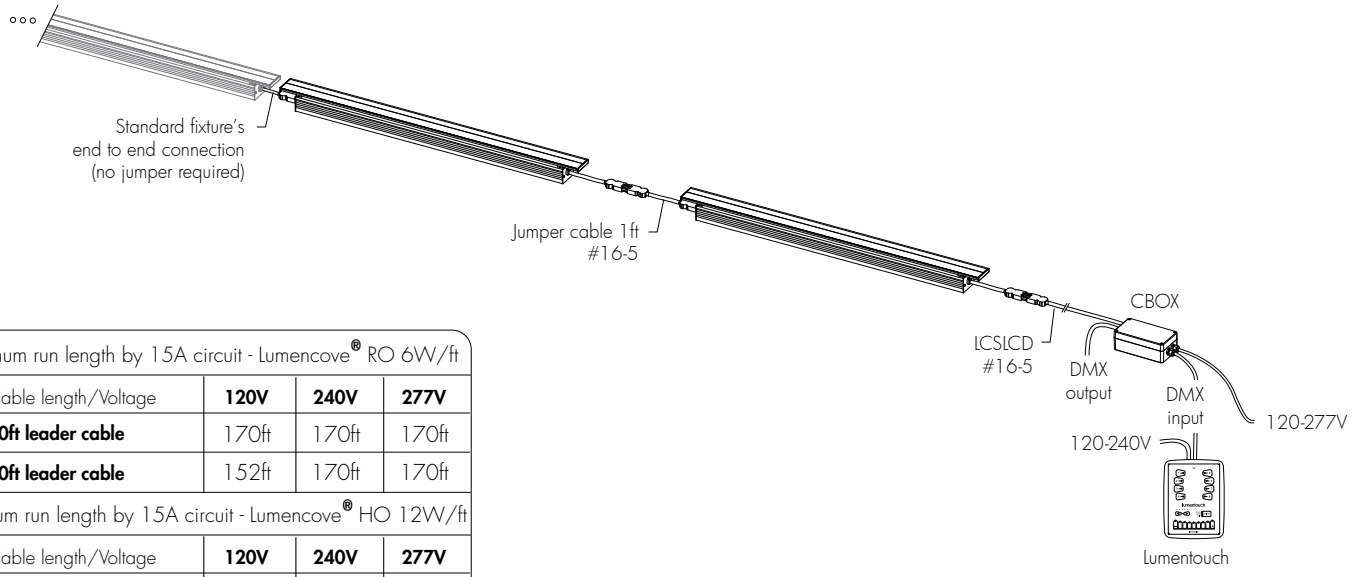
Star Layout (DMX Dimming)

*Make sure that the addition of all cable lengths and fixture lengths for each run do not exceed the recommended limit.
1% minimum dimming value



Daisy Chain Layout (DMX Dimming)

1% minimum dimming value



Maximum run length by 15A circuit - Lumencove® RO 6W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	170ft	170ft	170ft
50ft leader cable	152ft	170ft	170ft
Maximum run length by 15A circuit - Lumencove® HO 12W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	112ft	170ft	170ft
50ft leader cable	88ft	152ft	170ft

*Up to 170 individually addressable 1 foot sections per DMX run.
Consult factory for specific applications.

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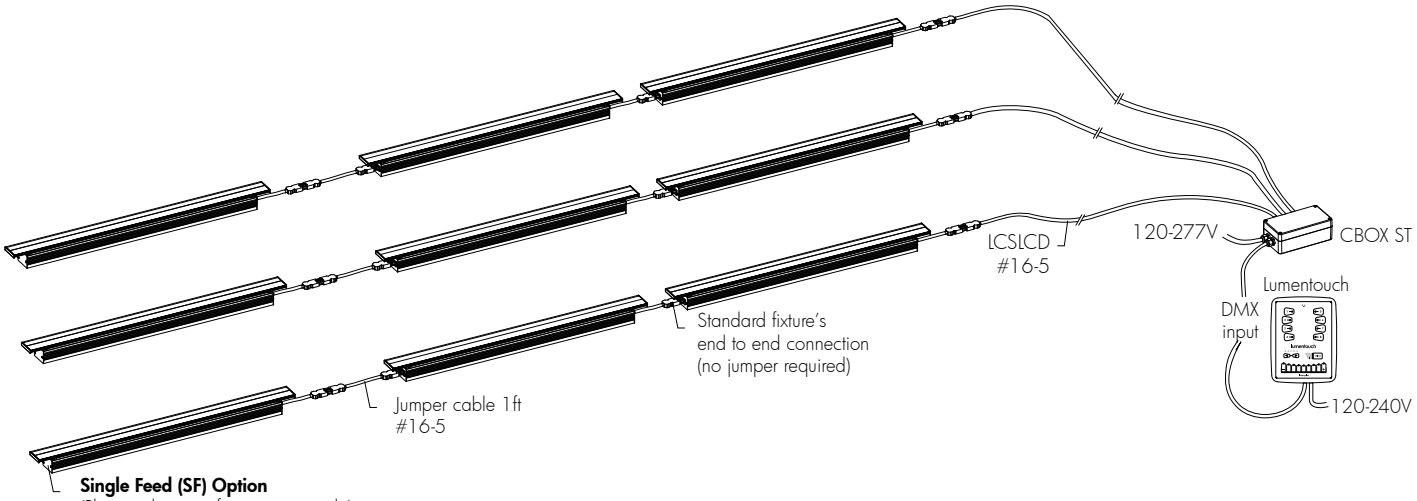
TYPICAL WIRING DIAGRAMS - Single Feed Option Shown

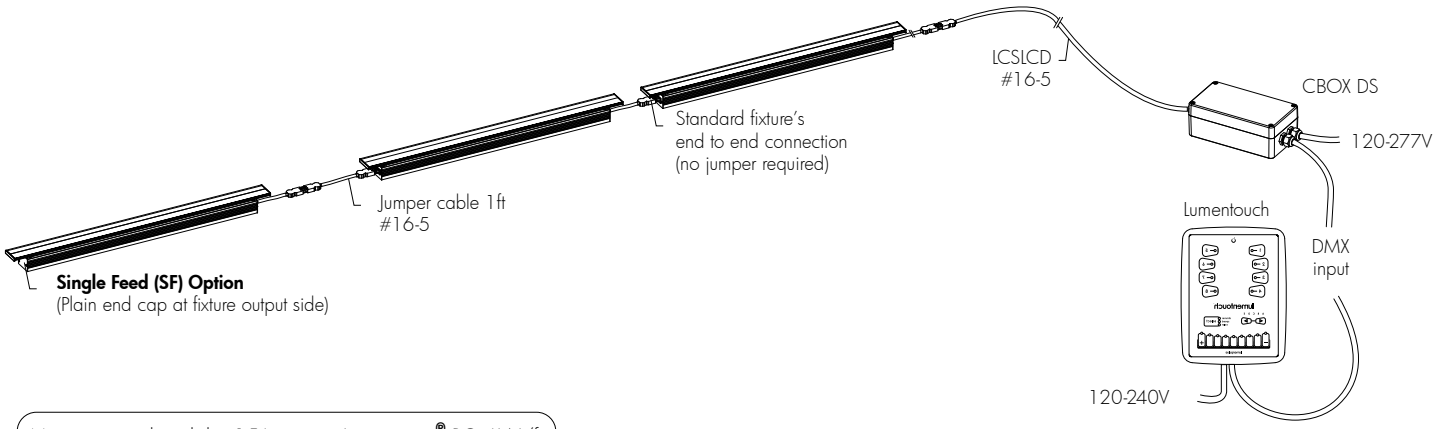
Star Layout (DMX Dimming)

*Make sure that the addition of all cable lengths and fixture lengths for each run do not exceed the recommended limit.
1% minimum dimming value



Daisy Chain Layout (DMX Dimming)

1% minimum dimming value



Maximum run length by 15A circuit - Lumencove® RO 6W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	170ft	170ft	170ft
50ft leader cable	152ft	170ft	170ft
Maximum run length by 15A circuit - Lumencove® HO 12W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	112ft	170ft	170ft
50ft leader cable	88ft	152ft	170ft

*Up to 170 individually addressable 1 foot sections per DMX run.
Consult factory for specific applications.

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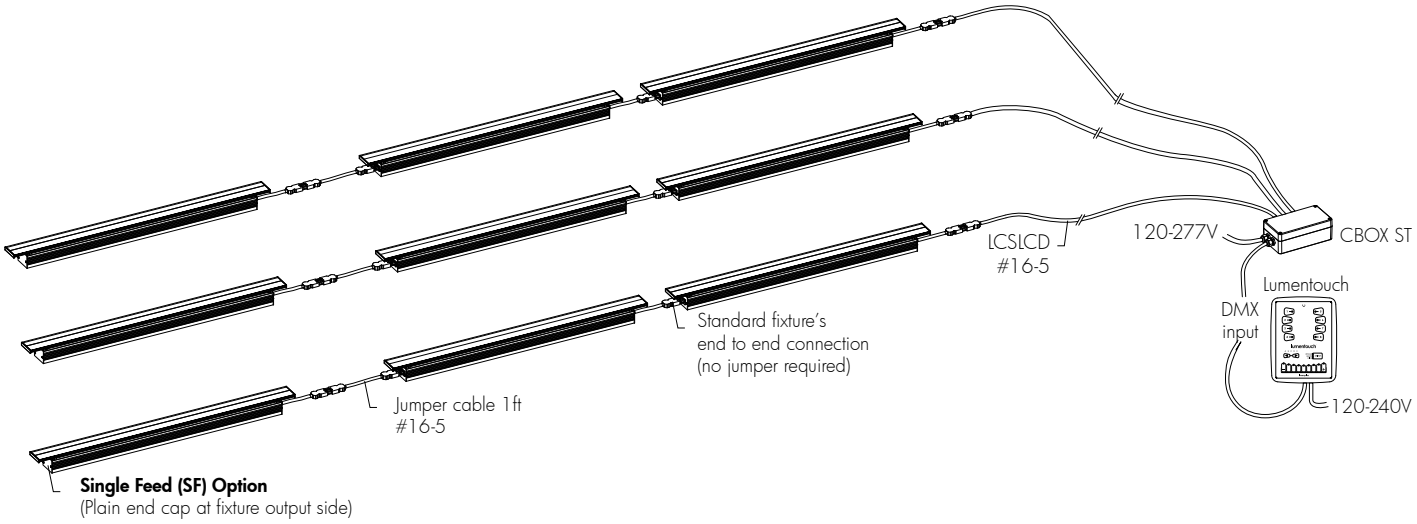
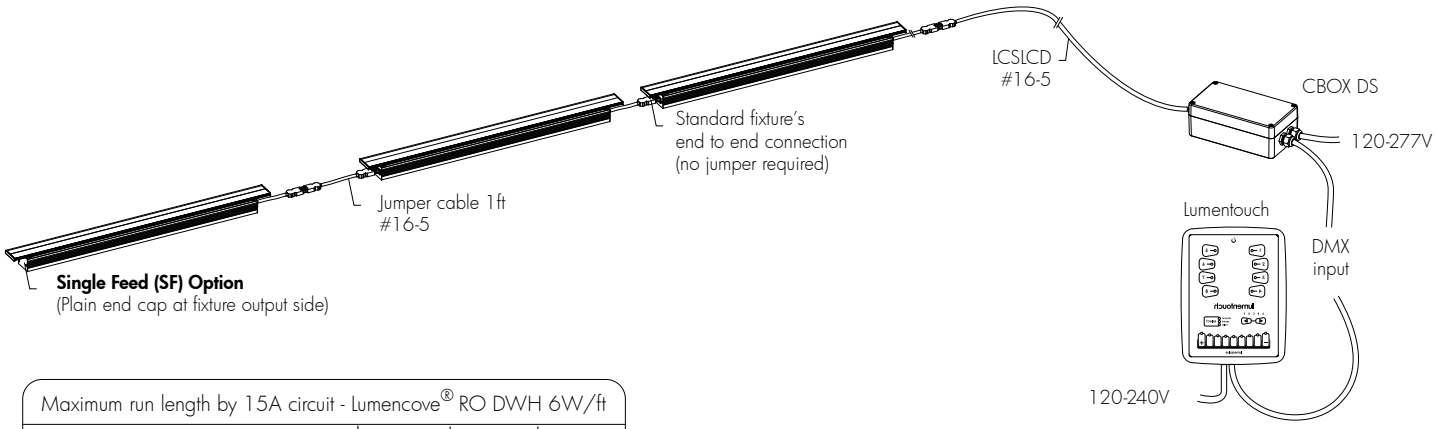
TYPICAL WIRING DIAGRAMS - Single Feed Option Shown

Star Layout

*Make sure that the addition of all cable lengths and fixture lengths for each run do not exceed the recommended limit.



Daisy Chain Layout



Maximum run length by 15A circuit - Lumencove® RO DWH 6W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	170ft	170ft	170ft
50ft leader cable	152ft	170ft	170ft
Maximum run length by 15A circuit - Lumencove® HO DWH 12W/ft			
Cable length/Voltage	**120V**	**240V**	**277V**
10ft leader cable	112ft	170ft	170ft
50ft leader cable	88ft	152ft	170ft

*Up to 170 individually addressable 1 foot sections per DMX run.
Consult factory for specific applications.

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HOW TO ORDER

LCS HO		48	35K	CL	RF		DIM	SF
Housing	Voltage	Length	Colors and color temperatures	Lens	Feeding Side	Finish	Dimming	Option
1	2	3	4	5	6	7	8	9

1

Housing:

LCS RO - Lumencove® Regular Output 6W/ft

LCS HO - Lumencove® High Output 12W/ft

2

Voltage:

120 - 120 volts

208 - 208 volts

240 - 240 volts

277 - 277 volts

3

Length:

12 - 12 3/8 inches (314mm) (0.72 kg/1.59 lbs)

24 - 24 3/16 inches (614mm) (1.45 kg/3.19 lbs)

36 - 36 inches (914mm) (2.16 kg/4.77 lbs)

48 - 47 13/16 inches (1214mm) (2.57 kg/5.68 lbs)

96 - 94 3/4 inches (2406mm) (5.76 kg/12.72 lbs)

4

Colors and Color temperatures:

27K - 2700K

30K - 3000K

35K - 3500K

40K - 4000K

RD - Red

GR - Green

BL - Blue

5

Lens:

CL - Clear lens

FR - Frosted lens

6

Feeding Side:

Please specify one of the following:

(Right Feeding side is standard unless otherwise specified)

LF - Left Feeding side

RF - Right Feeding side

7

Finish:

WH - White (standard finish)

CC - Custom (please specify RAL color)

8

Dimming:

DIM - 0-10V Dimming option (10% minimum dimming value)

DMX 1FT - DMX Dimming option, resolution per foot (1% minimum dimming value)

DMX 1FX - DMX Dimming option, resolution per fixture (1% minimum dimming value)

DALI - DALI Dimming option (1% minimum dimming value)

NO - No Dimming

9

Option:

SF - Single Feed option
(Plain end cap at fixture output side)

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TECH DATA
LIGHTING SYSTEMS

MOBILE SYSTEMS AISLE LIGHTING

Spacesaver's energy efficient aisle lights provide automatic "rapid start" illumination for open mobile system aisles, and are available in an aesthetically pleasing designer style fixture with mounting brackets that adjust to fit most shelving sizes and aisle configurations.

DESIGN AND CAPABILITIES

Aisle lights from Spacesaver feature a special top mounted bracket that automatically conceals the fixture above the shelving canopy when the aisle is compacted, and then centers it over the active aisle* when it is opened. To conserve energy, lights are automatically deactivated over all compacted system aisles and activated only over the aisle that is open. Each four foot (1220 mm) long fixture uses two energy efficient, fluorescent lamps for added energy savings.

Aisle light fixtures feature a durable, baked enamel finish in high gloss white. Fixtures are available in a designer square basket wraparound style.

Light mount brackets are constructed of steel tubing which houses and conceals the wiring to the fixture. They are powder coat painted white as standard.

INSTALLATION

Mobile System Mounted Aisle Lights are securely attached to the front and back of the canopy tops of the shelving sections with fully adjustable attaching clips that make optimum positioning possible for shelving 18" to 36" (457 to 914 mm) deep, and do not require drilling. A minimum of one fixture for each nine feet (2750 mm) of carriage length is recommended for effective aisle illumination.

For powered systems, aisle lights can be wired to share the mobile system's circuit, or to use their own dedicated circuit, depending on power requirements. Optional hardwiring can also be provided by the field installation team. Several options are possible for operating system mounted aisle lights, depending upon the mobile system's mode of operation:

Powered systems feature instant automatic aisle light activation as soon as a new aisle begins to open, or delayed automatic activation when the new aisle is fully opened and carriage movement stops. Automatic deactivation can be timed to follow the users' exit(s) from the active aisle or programmed not to occur until a new aisle is selected. Manual activation of aisle lights is also possible by pressing the "Move" button at the open aisle. To manually deactivate them, press the "Stop/Reset" button at the open aisle.

Mechanical Assist and Manual system aisle lights automatically activate over a new aisle when it is opened, and deactivate when it is closed and another aisle is opened.

APPLICATION

Mobile System Mounted Aisle Lighting is available on Spacesaver Powered, Mechanical Assist and Manual systems that are configured with shelving systems having canopy tops. Fluorescent bulbs are provided by local Area Contractor/Distributor.

TECHNICAL SPECIFICATIONS

System Mounted Aisle Light:
Provide system mounted aisle light consisting of a light mount and a light fixture. Light mounts shall be constructed of designer style 1" (25 mm) square seamless tubing finished with white powder coat paint. All wiring to the fixture shall be enclosed in the seamless tubing. White nylon plugs shall finish and cap each end. Light mount shall securely attach to the front and rear edge of the canopy top without drilling any holes in the canopy top. The attaching clips shall be fully adjustable along the top of the canopy to allow optimum installation placement. Each light fixture shall use two 32W T8, fluorescent, cool white energy efficient lamps. Fixtures shall be attached to the canopy tops centered over each open aisle 36" (914 mm) wide or less. (For aisles greater than 36" (914 mm) wide fixture will be slightly off center.) Aisle Lights shall provide an average of 25 footcandles of illumination for the full length of the aisle when a minimum of one fixture for each nine feet (2750 mm) of carriage length is provided. Fixture ballast shall be thermally protected, resetting, class P, HPF, non-PCB and sound rated A. Entire fixture shall be UL listed and labeled. Fixture shall be 48" (1220 mm) long designer style with acrylic prismatic wraparound diffuser with full depth end plates and finished with high-gloss white baked enamel finish. Diffuser shall hinge open from either side for easy maintenance.
Aisle light operation shall depend on mobile system mode of operation as follows:
For powered systems, add:
Lights shall be automatically activated SELECT (1 or 2)
(1. INSTANT ON:) as soon as carriage movement begins.
(2. DELAYED ON:) when aisle is fully opened and carriage movement stops.
Lights shall be automatically deactivated SELECT (1 or 2)
(1. TIMED OFF:) after a specified period (SELECT BETWEEN 5 SECONDS AND 18 HOURS) of inactivity of the Zero Force Sensor® System.
(2. UNTIMED OFF:) when a new aisle is selected. Lights shall be activated manually in an open aisle by depressing the "Move" button for that aisle and deactivated manually by pressing the "Stop/Reset" button for the open aisle. For mechanical assist/manual systems, add: Lights are automatically activated when a new aisle is opened and automatically deactivated over the open aisle when it is closed and a new aisle is opened.

(NOTE: Mechanical assist and manual systems require power pantographs for aisle light installation.)
Alternative: Bay (Ceiling) Lighting Interface
Provide a bay (ceiling) lighting interface box between the powered compact storage system and the ceiling mounted bay lights (existing) permitting not-timed or timed light activation (select NOT-TIMED or TIMED).
NOT-TIMED: Bay (ceiling) lights shall turn ON when:
1. The compact mobile storage system starts to move
2. The compact mobile storage system completes its move (aisle is fully open)
3. The aisle entry sensor, sweep or cross-aisle sensors are activated in an open aisle
4. The already open aisle is requested again (a move button is pressed)

Bay (ceiling) lights shall turn OFF when:
1. Any reset button is pushed (and the relock timer has expired)
2. The system off control is invoked

TIMED:
Bay (ceiling) lights shall turn ON when:
1. The compact mobile storage system starts to move
2. The compact mobile storage system completes its move (aisle is fully open)
3. The aisle entry sensor, sweep or cross-aisle sensors are activated in an open aisle
4. The already open aisle is requested again (a move button is pressed)

Bay (ceiling) lights shall turn OFF when:
1. The light timer value has expired
2. The system off control is invoked

Each bay lighting interface box shall accommodate multiple circuits depending on the number of lights; up to 3 circuits per box; each circuit being good for 20 amps. Bay (ceiling) lights require their own, separate circuit. The interface box may be mounted to the end stationary platform within the compact mobile storage system or above the ceiling (preferred). The compact mobile carriage control box shall send a low voltage signal to the bay lighting interface box to activate bay (ceiling) lights.

**Aisle lights will be centered over open aisles up to 36" (914 mm) wide. For aisles over 36" (914 mm) wide lights will be positioned slightly off center.*

Spacesaver®

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Fort Atkinson, WI 53538-2798
1-800-492-3434
www.spacesaver.com

KI
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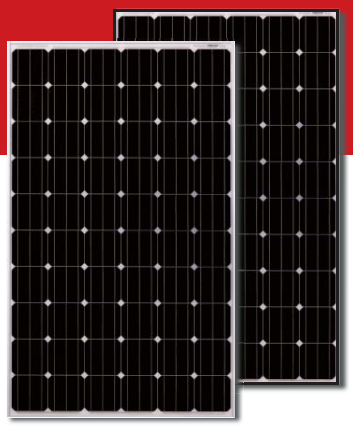
Green Bay, WI 54302-8100
1-800-424-2432
www.ki.com

Appendix D: PV Panel and Inverter Specs

CanadianSolar
Make The Difference

CS6P-255 I 260M



*Black frame product can be provided upon request.

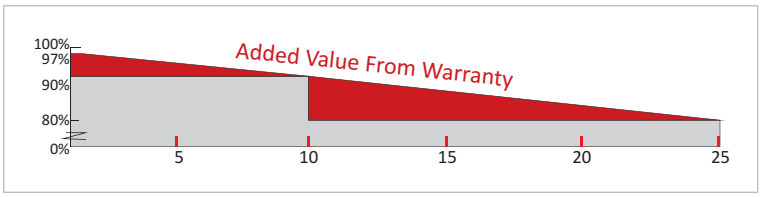
PRODUCT | KEY FEATURES

- Excellent module efficiency up to 16.16%
- Outstanding performance at low irradiance above 96.5%
- Positive power tolerance up to 5w
- High PTC rating up to 91.31%
- Self-cleaning & anti-glaring module surface available
- IP67 junction box available long-term weather endurance
- Heavy snow load up to 5400pa
- Salt mist, ammonia and blowing sand resistance, apply to seaside, farm and desert environment

THE BEST IN CLASS

Canadian Solar's modules are the best in class in terms of power output and long term reliability. Our meticulous product design and stringent quality control ensure our modules deliver a higher PV energy yield in live PV system as well as in PVsyst's system simulation. Our in-house PV testing facilities guarantee all module component materials meet the highest quality standards possible.

PRODUCT | WARRANTY & INSURANCE



25 Year Industry leading linear power output warranty
10 Year Product warranty on materials and workmanship

25 YEARS Warranty Insurance

Canadian Solar provides 100% non-cancellable, immediate warranty insurance

PRODUCT & MANAGEMENT SYSTEM | CERTIFICATES*

IEC 61215 / IEC 61730: VDE / MCS / CE / CEC AU / CQC
UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)
UL 1703: CSA | IEC 61701 ED2: VDE | IEC 62716: TUV | IEC60068-2-68: SGS
PV CYCLE (EU) | UNI9177 Reaction to Fire: Class 1

ISO9001: 2008 I Quality management system
ISOTS16949:2009 I The automotive industry quality management system
ISO14001:2004 I Standards for environmental management system
QC080000:2012 I The certificate for hazardous substances process management
OHSAS 18001:2007 I International standards for occupational health and safety
*Please contact your sales representative for the entire list of certificates applicable to your products

CANADIAN SOLAR INC.

Founded in 2001 in Canada, Canadian Solar Inc., (NASDAQ:CSIQ) is one of the world's largest and foremost solar power companies. As a leading manufacturer of solar modules and PV project developer with about 6 GW of premium quality modules deployed around the world in the past 12 years, Canadian Solar is one of the most bankable solar companies in Europe, USA, Japan and China. Canadian Solar operates in six continents with customers in over 70 countries and regions. Canadian Solar is committed to providing high quality solar products, solar system solutions and services to customers around the world.

www.canadiansolar.com
support@canadiansolar.com

Canadian Solar Inc.
545 Speedvale Avenue West
Guelph | Ontario N1K 1E6 | Canada

CanadianSolar
Make The Difference

ELECTRICAL DATA | STC

Electrical Data	CS6P-255M	CS6P-260M
Nominal Maximum Power (Pmax)	255W	260W
Optimum Operating Voltage (Vmp)	30.5V	30.7V
Optimum Operating Current (Imp)	8.35A	8.48A
Open Circuit Voltage (Voc)	37.7V	37.8V
Short Circuit Current (Isc)	8.87A	8.99A
Module Efficiency	15.85%	16.16%
Operating Temperature	-40℃~+85℃	
Maximum System Voltage	1000V (IEC) / 1000V (UL) / 600V (UL)	
Maximum Series Fuse Rating	15A	
Application Classification	Class A	
Power Tolerance	0 ~ +5W	

*Under Standard Test Conditions (STC) of irradiance of 1000W/m^2, spectrum AM 1.5 and cell temperature of 25℃.

ELECTRICAL DATA | NOCT

Electrical Data	CS6P-255M	CS6P-260M
Nominal Maximum Power (Pmax)	184W	188W
Optimum Operating Voltage (Vmp)	27.8V	28.0V
Optimum Operating Current (Imp)	6.62A	6.70A
Open Circuit Voltage (Voc)	34.6V	34.7V
Short Circuit Current (Isc)	7.18A	7.28A

*Under Nominal Operating Cell Temperature(NOCT), irradiance of 800 W/m^2, spectrum AM 1.5, ambient temperature 20℃, wind speed 1 m/s.

MODULE | MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline, 6inch
Cell Arrangement	60 (6 x 10)
Dimensions	1638 x 982 x 40mm (64.5 x 38.7 x 1.57in)
Weight	18.5kg (40.8 lbs)
Front Cover	3.2mm tempered glass
Frame Material	Anodized aluminium alloy
J-BOX	IP67, 3 diodes
Cable	4mm^2(IEC)/4mm^2&12AWG 1000V(UL1000V)/ 12AWG(UL600V), 1000mm
Connectors	MC4 or MC4 comparable
Standard Packaging	24pcs, 504kg (quantity and weight per pallet)
Module Pieces per Container	672pcs (40'HQ)

TEMPERATURE CHARACTERISTICS

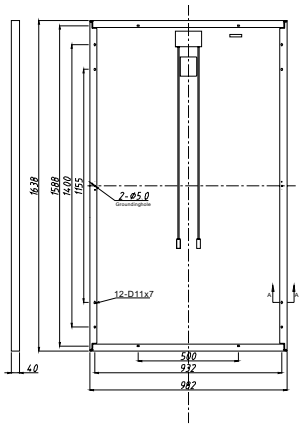
Specification	Data
Temperature Coefficient (Pmax)	-0.45%/℃
Temperature Coefficient (Voc)	-0.35 %/℃
Temperature Coefficient (Isc)	0.060 %/℃
Nominal Operating Cell Temperature	45±2℃

PERFORMANCE AT LOW IRRADIANCE

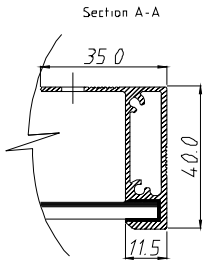
Industry leading performance at low irradiation environment, +96.5% module efficiency from an irradiance of 1000w/m^2 to 200w/m^2(AM 1.5, 25 ℃)

MODULE | ENGINEERING DRAWING

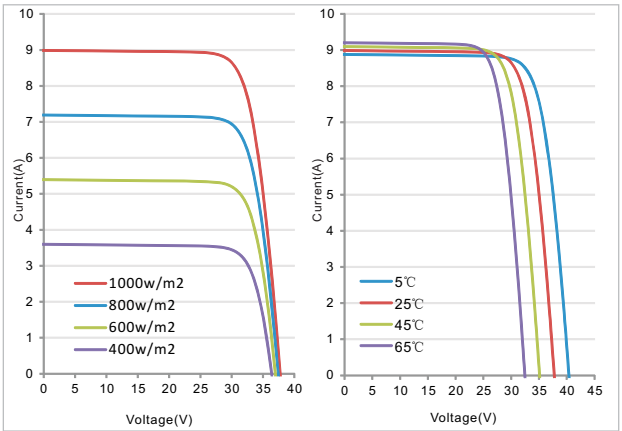
Rear View



Frame Cross Section



CS6P-260M | I-V CURVES



Partner Section

*The specifications made herein may deviate slightly and are not guaranteed. Due to ongoing innovation, research and product enhancement we reserve the right to make any adjustments to the information contained herein at any time without notice.. Please always obtain the most recent revision of datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.

Certifications
- For countries that require UL certification (UL 1741/IEEE 1547)
- Optional integrated AFCI functionality meets the requirements of NEC 2011 690.11

Efficient
- 97% peak efficiency
- OptiCool™ active temperature management system

Safe
- Galvanic isolation

Simple
- Patented automatic grid voltage detection*
- Integrated DC disconnect switch

SUNNY BOY 5000-US / 6000-US / 7000-US / 8000-US

Versatile performer with UL certification

The Sunny Boy 5000-US, 6000-US, 7000-US and 8000-US inverters are UL certified and feature excellent efficiency. Graduated power classes provide flexibility in system design. Automatic grid voltage detection* and an integrated DC disconnect switch simplify installation, ensuring safety as well as saving time. These models feature galvanic isolation and can be used with all types of modules – crystalline as well as thin-film.

* US Patent US7352549B1

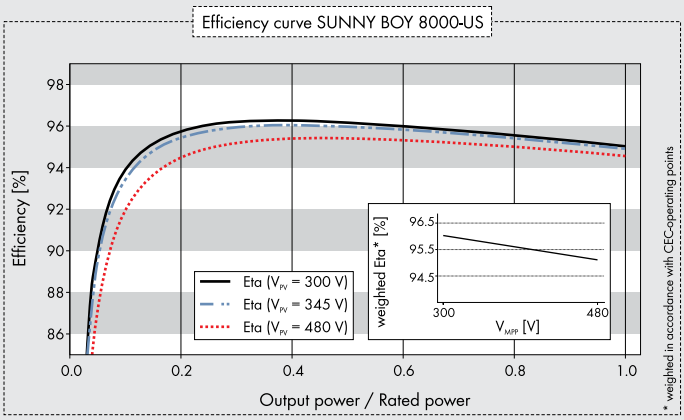
Technical data	Sunny Boy 5000-US			Sunny Boy 6000-US			Sunny Boy 7000-US			Sunny Boy 8000-US	
	208 V AC	240 V AC	277 V AC	208 V AC	240 V AC	277 V AC	208 V AC	240 V AC	277 V AC	240 V AC	277 V AC
Input (DC)											
Max. recommended PV power (@ module STC)	6250 W			7500 W			8750 W			10000 W	
Max. DC power (@ cos φ = 1)	5300 W			6350 W			7400 W			8600 W	
Max. DC voltage	600 V			600 V			600 V			600 V	
DC nominal voltage	310 V			310 V			310 V			345 V	
MPP voltage range	250 V – 480 V			250 V – 480 V			250 V – 480 V			300 V – 480 V	
Min. DC voltage / start voltage	250 V / 300 V			250 V / 300 V			250 V / 300 V			300 V / 365 V	
Max. input current / per string (at DC disconnect)	21 A / 20 A 36 A @ combined terminal			25 A / 20 A 36 A @ combined terminal			30 A / 20 A 36 A @ combined terminal			30 A / 20 A 36 A @ combined terminal	
Number of MPP trackers / fused strings per MPP tracker	1 / 4 (DC disconnect)										
Output (AC)											
AC nominal power	5000 W			6000 W			7000 W			7680 W	8000 W
Max. AC apparent power	5000 VA			6000 VA			7000 VA			7680 VA	8000 VA
Nominal AC voltage / adjustable	208 V / ●	240 V / ●	277 V / ●	208 V / ●	240 V / ●	277 V / ●	208 V / ●	240 V / ●	277 V / ●	240 V / ●	277 V / ●
AC voltage range	183 – 229 V	211 – 264 V	244 – 305 V	183 – 229 V	211 – 264 V	244 – 305 V	183 – 229 V	211 – 264 V	244 – 305 V	211 – 264 V	244 – 305 V
AC grid frequency; range	60 Hz; 59.3 – 60.5 Hz			60 Hz; 59.3 – 60.5 Hz			60 Hz; 59.3 – 60.5 Hz			60 Hz; 59.3 – 60.5 Hz	
Max. output current	24 A	21 A	18 A	29 A	25 A	22 A	34 A	29 A	25 A	32 A	29 A
Power factor (cos φ)	1			1			1			1	
Phase conductors / connection phases	1 / 2	1 / 2	1 / 1	1 / 2	1 / 2	1 / 1	1 / 2	1 / 2	1 / 1	1 / 2	1 / 1
Harmonics	< 4%			< 4%			< 4%			< 4%	
Efficiency											
Max. efficiency	96.7%	96.8%	96.8%	96.9%	96.8%	97.0%	97.1%	96.9%	97.0%	96.3%	96.5%
CEC efficiency	95.5%	95.5%	95.5%	95.5%	95.5%	96.0%	95.5%	96.0%	96.0%	96.0%	96.0%
Protection devices											
DC reverse-polarity protection	●			●			●			●	
Integrated AFCI*	○			○			○			○	
AC short circuit protection	●			●			●			●	
Galvanically isolated / all-pole sensitive monitoring unit	●/–			●/–			●/–			●/–	
Protection class / overvoltage category	I / III			I / III			I / III			I / III	
General data											
Dimensions (W / H / D) in mm (in)	470 / 615 / 240 (18.5 / 24 / 9)										
DC Disconnect dimensions (W / H / D) in mm (in)	187 / 297 / 190 (7 / 12 / 7.5)										
Packing dimensions (W / H / D) in mm (in)	390 / 580 / 800 (16 / 23 / 31.5)										
DC Disconnect packing dimensions (W / H / D) in mm (in)	370 / 240 / 280 (15 / 9 / 11)										
Weight / DC Disconnect weight	64 kg (141 lb) / 3.5 kg (8 lb)									66 kg (145 lb) / 3.5 kg (8 lb)	
Packing weight / DC Disconnect packing weight	67 kg (147 lb) / 4 kg (9 lb)									69 kg (152 lb) / 4 kg (9 lb)	
Operating temperature range (full power)**	–25 °C ... +45 °C (–13 °F ... +113 °F)										
Noise emission (typical)	44 dB(A)			45 dB(A)			46 dB(A)			49 dB(A)	
Internal consumption at night	0.1 W			0.1 W			0.1 W			0.1 W	
Topology	LF transformer			LF transformer			LF transformer			LF transformer	
Cooling concept	OptiCool			OptiCool			OptiCool			OptiCool	
Electronics protection rating / connection area	NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R	
Features											
Display: text line / graphic	●/–			●/–			●/–			●/–	
Interfaces: RS485 / *Bluetooth*®	○/○			○/○			○/○			○/○	
Warranty: 10 / 15 / 20 years	●/○/○			●/○/○			●/○/○			●/○/○	
Certificates and permits (more available on request)	UL1741 (Second Ed.), UL1998, UL1699B, IEEE 1547, FCC Part 15 (Class A & B), CSA C22.2 No. 107.1-2001										

*For AFCI functionality specify SBXXXXUS-12 when ordering.

**For extended operating temperature range to -40 °C (-40 °F), specify SBXXXXUS-11 or SBXXXXUS-12 when ordering.

● Standard features ○ Optional features – Not available Data at nominal conditions NOTE: US inverters ship with gray lids.

Type designation	SB 5000US	SB 6000US	SB 7000US	SB 8000US



Accessories


RS485 interface
485USPB-NR


Bluetooth Piggy-Back
BTPBINV-NR
with External Antenna
BTPB-EXTANT-NR


Combi-Switch
DC disconnect and PV array combiner box
COMBO-SWITCH


Combiner Box
Simplify wiring for added convenience and safety
SBCB-6-3R or SBCB-6-4


SMA Power Balancer Set
PBL-SBUS-10-NR

Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

Appendix E: SAM PV System Model Report

System Advisor Model Report

Photovoltaic System | 43 DC kW Nameplate | NEW_YORK_CITY, NY
Commercial | $2.68/W Installed Cost | 40.78 N, -73.97 E GMT -5

Performance Model

Modules	
Canadian Solar CS6P-255M	
Cell material	c-Si
Module area	1.5 m^2
Module capacity	254.7 DC Watts
Quantity	168
Total capacity	42.8 DC kW
Total area	260 m^2

Inverters	
SMA America: SB7000US-11 277V	
Unit capacity	7 AC kW
Input voltage	250 - 480 VDC DC V
Quantity	5
Total capacity	35 AC kW
DC to AC Capacity Ratio	1.22
AC derate factor	0.99

Array	
Strings	14
Modules per string	12
String voltage (DC V)	366.0
Tilt (deg from horizontal)	31.5
Azimuth (deg E of N)	203.5
Tracking	fixed
Backtracking	-
Rotation limit (deg)	-
Shading	no
Soiling	yes
DC derate factor	0.96

Performance Adjustment	
Annual	none
Year-to-year decline	1%/yr
Hourly factors	no

Annual Results (in Year 1)	
Horizontal solar kW/m^2	1,459
Incident solar kW/m^2	0
DC GWh from array	0.064
Net to inverter	61,260 DC kWh
Gross from inverter	58,200 AC kWh
Net to grid	57,620 AC kWh
Capacity factor	15.4%
Performance factor	0.86

Financial Model

Project Costs	
Total installed cost	$114,694
Salvage value	$0

Analysis Parameters	
Project life	20 years
Inflation rate	2.5%
Real discount rate	5.2%

Project Debt Parameters	
Debt fraction	100%
Amount	$114,694
Term	0 years
Rate	0%

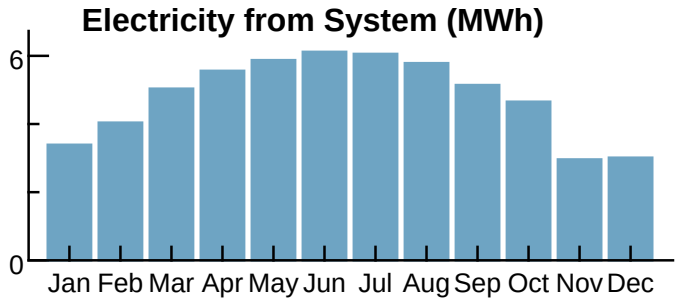
Tax and Insurance Rates	(% of installed cost)
Federal income tax	0%/year
State income tax	0%/year
Sales tax	0%
Insurance	0%/year
Property tax (% of assess. val.)	0%/year

Incentives	
Federal ITC	30%
Federal Depreciation	5-yr MACRS
State Depreciation	5-yr MACRS
State CBI	$1/W, $87,500 max

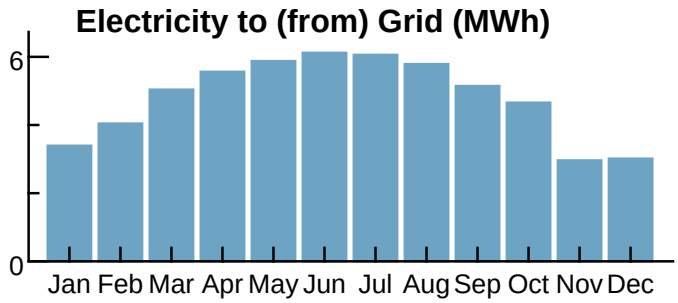
Electricity Demand and Rate Summary

System delivers power directly to grid (no building load)
Consolidated Edison Co-NY Inc: SC 9 - General Larg...
Fixed fee: $97.72/month
Flat buy rate $0.164/kWh, flat sell rate $0.164/kWh
Monthly fixed TOU demand charge $0
Monthly fixed demand charge $0

Results	
Nominal LCOE	-4.1 cents/kWh
Net present value	$126,000
Payback period	4.3 years



No Building Load



Net Metering not Applicable

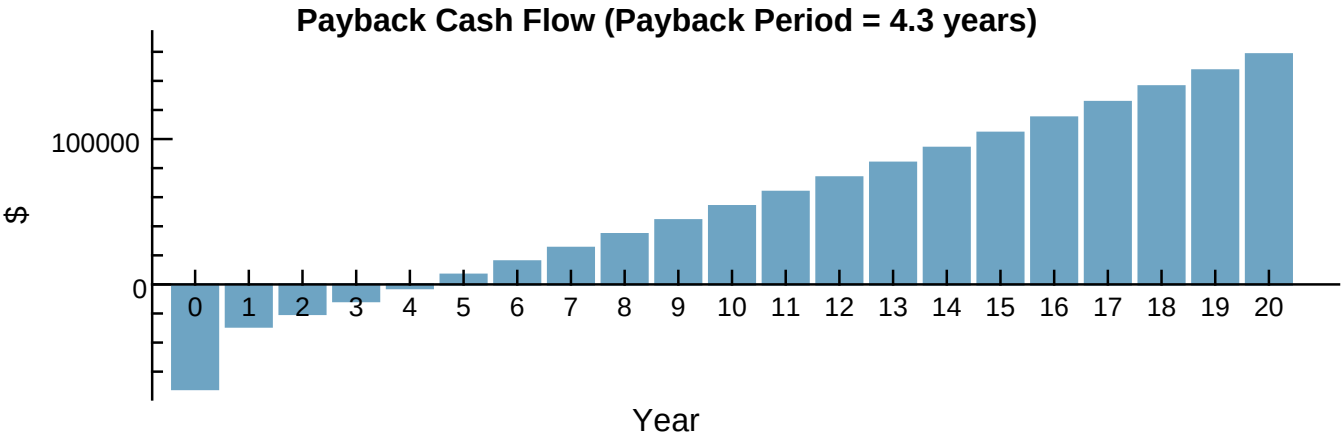
Monthly Electricity Purchases and Savings (Year 1 $)

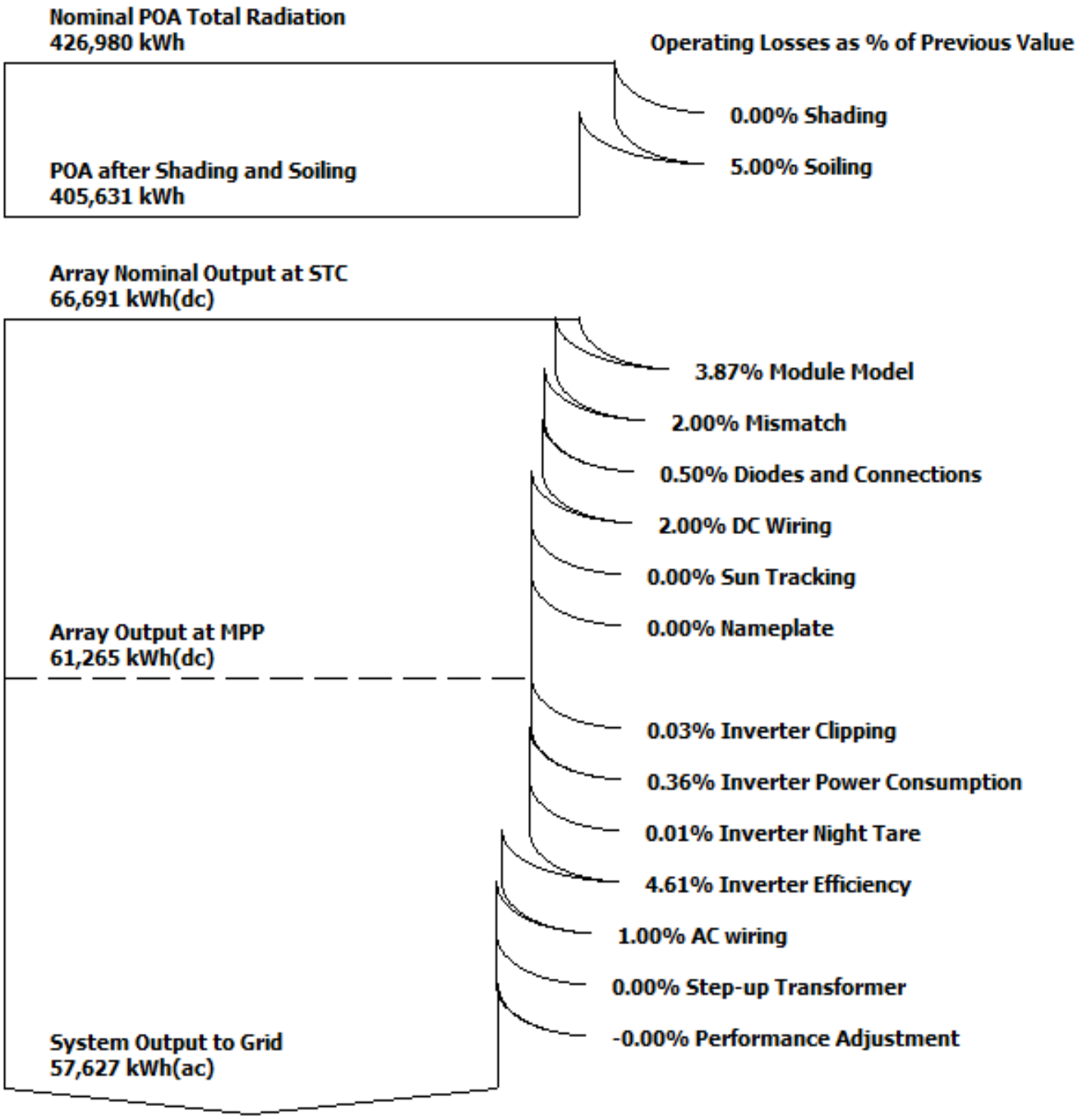
Month	Without System	With System	Savings
Jan	97	-457	554
Feb	97	-563	661
Mar	97	-726	824
Apr	97	-812	910
May	97	-863	961
Jun	97	-903	1,001
Jul	97	-893	991
Aug	97	-849	947
Sep	97	-744	841
Oct	97	-664	761
Nov	97	-386	484
Dec	97	-395	492
Annual	1,172	-8,260	9,432

NPV Approximation using Annuities

Annuities, Capital Recovery Factor (CRF) = 0.1006		
Investment	$0	Sum:
Expenses	$-1,000	$12,600
Savings	$3,200	NPV = Sum / CRF:
Energy value	$10,400	$126,000

Investment = Installed Cost - Debt Principal - IBI - CBI
Expenses = Operating Costs + Debt Payments
Savings = Tax Deductions + PBI
Energy value = Tax Adjusted Net Savings
Nominal discount rate = 7.83%




Nominal POA Total Radiation
426,980 kWh
Operating Losses as % of Previous Value
0.00% Shading
5.00% Soiling
POA after Shading and Soiling
405,631 kWh
Array Nominal Output at STC
66,691 kWh(dc)
3.87% Module Model
2.00% Mismatch
0.50% Diodes and Connections
2.00% DC Wiring
0.00% Sun Tracking
0.00% Nameplate
Array Output at MPP
61,265 kWh(dc)
0.03% Inverter Clipping
0.36% Inverter Power Consumption
0.01% Inverter Night Tare
4.61% Inverter Efficiency
1.00% AC wiring
0.00% Step-up Transformer
-0.00% Performance Adjustment
System Output to Grid
57,627 kWh(ac)