George Mason University
Art & Visual Technology Building

Final Thesis Report

Allen Walker

Lighting / Electrical Option

Advisors: Dr. Mistrick and Professor Dannerth

Spring 2008

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George Mason University
Art & Visual Technology Building
Fairfax, VA

Project Design Team
- Architect: Ayers/Saint/Gross
- Structural Engineer: Tadjer/Cohen/Edelson
- MEP Engineer: Mueller Associates
- Lighting: Crampton Dunlop
- Civil Engineer: Edwards & Kelcey

Lighting
- Exterior: Pole Mounted fixtures line pedestrian walkway with in grade fixtures accenting the main entrance.
- Interior: Typical Studios, Classrooms and Offices lit with a linear direct/indirect flourescent fixtures. Track lighting mounted from suspended unistrut grid in studio and gallery spaces.
- Controls: Computer programable for building wide lighting control integrated with dimming panels and wallstations

Architecture
- The Art & Visual Technology building is to be located on the South End of campus. It is to contain the diverse needs of the art & visual technology department which range anywhere from photography to digital arts to sculpture.
- The building represents the creatvity and the vision of the department through a large open and flexibible plan.
- The building utlizies a combination of brick and corrugated metal framing. This combination of the tradtional brick ties into the existing campus while the metal cladding will give the building the uniqueness it desires.

Project Information
- Owner: George Mason University
- Size: 88,902 sq ft across 3 above grade stories
- Cost: $20.5 million
- Construction Dates: Scheduled to open 2009
- Delivery Method: CM (GMP contract)

Electrical
- 34.5kV service to utility transformer to 2000A Main SwitchBoard
- 80kW Diesel Emergency Generator
- Radial Distribution at 480Y/277V & 208Y/120V services

Structural System
- Reinforced Spread Footings
- Lateral resistance achieved through braced & moment framing
- Gravity system is a cambered composite steel & concrete decking total thickness 6 1/4".
- 2 Roofing systems; 3" steel decking & composite steel and concrete.
- Transfer girders utilized where necessary

Mechanical System
- 2 VAV AHU's 70,000cfm (General) & 25,000cfm (Dedicated Workshop)
- Ductless split system for Server & Telecom Spaces
- Hot & Chilled water supplied from existing campus service
- Dedicated dust & particle collection system

Acknowledgements

Thank you for your help and support throughout the journey that has been thesis.

The entire staff of Mueller Associates in particular Adam Fry
George Mason University

Dr. Mistrick
Professor Dannerth
Professor Moses Ling

All of my AE friends especially my fellow lighting/electrical options

Thank you to Ashley Bradford, Bryan Hart, Antonio Verne and Tom Yost whoall provided me great advice on my structural breadth

Megan Kohut who helped me get my 30”x42” drawings scanned.

And finally to my family who have dealt with me coming home at ridiculous hours for the past semester and provided me with unwavering support.

References

AISC Inc., "Steel Construction Manual 13th Edition", 2005

ASHRAE Standard 90.1, "Energy Standard for Buildings", 2004

George Mason University Art & Visual Technology Department webpage
http://www.avt.gmu.edu/

Hughes, "Electrical Systems in Buildings", 1988 Delmar Publishers Inc.

Long, "Architectural Acoustics", 2006 Elsevier Inc.

Mehta, Johnson, Rocafort, "Architectural Acoustics Principles and Design", 1999 Prentice Hall Inc.

NFPA 70, "NEC 2005", 2005

Rea, "The IESNA Lighting Handbook Reference & Application", 2000

Executive Summary

The intent of this report is to evaluate and redesign many of the building systems within the building with aiming to increase the quality of the project. This will be done while taking into account aesthetics, functionality, energy savings, cost savings, constructability and the interrelationship between systems. The main systems the analysis will focus on are the lighting design and electrical distribution with breadth studies in the areas of structural design and acoustics.

The lighting depth portion of the report focuses on four major spaces; the main entrance façade, main entry lobby, exhibit gallery and typical painting studio. For each of these spaces, the report will cover the design criteria, initial concept, fixture selection, light loss factors, lighting controls, allowed power density per ASHRAE 90.1 and AGI32 analysis. Additionally, each space will have a design synopsis and evaluation that will convey my design process and provide commentary on the final product.

The lighting redesign led to the need for the electrical distribution to be redesigned to account for the changes. Branch circuits, feeders and panelboards for each space were redesigned to handle the new lighting loads. In addition, a photovoltaic array study and the use of energy efficient transformers versus standard transformers were both explored to determine the financial feasibility of each system. While It was found that a photovoltaic array may be effective in the Northern Virginia Climate, it was not economically feasible due to GMU being a non-profit organization and not being eligible for financial tax breaks given by the federal government. Meanwhile, it was found that the use of energy efficient transformers would also not be recommended due to the extremely low electrical utility rate.

Upon analysis of the existing daylighting strategy in the typical painting studio, it was found that clerestories were ineffective and therefore changed to diffuse skylights. While this provided more uniform distribution of daylight, it also meant the redesign of the roof framing system to structurally accommodate the skylights.

Finally, an acoustical study was performed to evaluate and improve the existing acoustical conditions for the wood shop in the lower level of the building. The conditions in an adjacent crit room were evaluated as well to check for sound transmission problems from the wood shop into the crit room. While noise levels in the wood shop were unable to drastically change, it was found that by changing the construction of the crit room wall the sound transmission from the wood shop into the crit room could be prevented.

Project Background

The department of Art and Visual Technology at George Mason University began in 1972 when George Mason College obtained its university status. During the 1990's, a nationwide increase in enrollment among fine and performing arts degrees led to increased enrollment at GMU from 200 to about 500 students. In the early 2000's the digital arts and graphic design programs at GMU had grown into among the nation's best, helping to increase enrollment into the department. This put GMU on the map nationally as a significant visual arts program. The increased success and strength of the Art and Visual Technology department has led to the design and construction of a new building for the department which will feature state of the art technology. The new building represents the promising and dynamic future of the department.

Expected to open in 2009, the Art & Visual Technology building is a new three-story building to be built on the Fairfax campus of George Mason University. Innovation Hall is located to the North of the site, while Patriot Circle encloses the site to the South and West. A newly constructed campus quadrangle and Research I building are located to the east. This new building is to manly house the needs of the different disciplines within the department including drawing, digital arts, graphic design, printmaking, photography, art education, sculpture, and painting. It also consists of a prominent gallery off the main entrance to host both student and professional venues. The future addition, also three stories, is to be located at the NW corner of the site and will be connected with the original building to function as one building.

Building Statistics

General Building Information

Building Name:

Art & Visual Technology Building

Location:

George Mason University, Fairfax, VA

Occupancy Type:

Business (B) & Assembly (A3)

Size:

88,902 sq ft. (65,000 sq ft future addition outlined in master plan)

Number of Floors

3 stories (all above grade)

Project Team

Owner: George Mason University

Architect: Ayers/Saint/Gross

Civil Engineer: Edwards & Kelcey

Structural Engineer: Tadjer-Cohen-Edelson

MEP Engineer: Mueller Associates

Lighting: Crampton/Dunlop

Acoustics: Henning Associates

Dates of Construction:

Scheduled to be opened 2009.

Cost:

$21,000,000 (total construction cost)

Project Delivery Method:

CM with GMP contract.

Architecture:

This building is to represent the creativity and vision of the department that it shall contain. A large open and flexible plan will accommodate the changing needs and differing teaching styles of the Art & Visual Technology department. In order to create an open industrial feel that is welcoming to the public, this building incorporates a combination of brick and corrugated metal paneling. The large curved facade will comprise of a metal frame with a brushed steel cladding. This combination of the traditional brick with an industrial feel of the metal cladding will tie this building into the campus while giving the Art & Visual technology department the uniqueness they desire.

Major National Codes:

International Building Code 2003
International Plumbing Code 2003
International Mechanical Code 2003
International Fuel Gas Code 2003
International Energy Conservation Code 2003
National Electric Code 2002
Virginia Statewide Fire Protection Code 2003
International Fire Code 2003
Americans with Disabilities Act Accessibility
Standards Construction & Professional Services Manual 2004 rev.1

Building Envelope (Walls):

The base level is a 1'-0" thick concrete wall with 2" of rigid insulation protection board and an adhesive sheet membrane for waterproofing. Behind the concrete are 6" metal studs which have a

gypsum wallboard finish. The second and third levels are either a brick curtain wall or preformed metal panel curtain wall. Both wall systems have a 1" airspace then a 1/2" thick exterior sheathing for weatherproofing. Behind the weatherproofing is a 2" layer of rigid insulation and finally 6" metal studs for support.

Building Envelope (Roof):

Four types of roof assemblies are employed for this building. The first is a composite roof decking comprising of 3" metal decking and a 6-1/4" concrete slab. On top of the concrete slab is a layer of rigid insulation and tapered insulation. A ½" layer of recovery board and 4" ply built-up roofing system complete the first roofing assembly. Two of the other assemblies both include metal decking, with one containing both rigid and tapered insulation while the other only utilizes rigid insulation. The fourth roofing assembly is also a metal decking using rigid insulation once again, but it also uses plywood, a slip sheet and a pre-finished standing seam metal roof (seams at 24" O.C.)

Construction:

The project is projected to be completed by 2009. However as of now there is no hard date for when construction is going to begin.

Electrical:

Electrical service is supplied to the building from Dominion Virginia Power to a pad mounted exterior utility transformer where it is stepped down from 34.5kV to 480Y/277. It is then fed to the 2000A main switchboard located in the main electrical room on the lower level. 480Y/277V service is distributed to each floor at the east & west electrical closets. 208Y/120V panels are located in each electrical service via 480Y/277V to 208Y/120V transformers. Life safety and stand by loads are on a pad mounted exterior 80kW diesel generator.

Lighting:

In conjunction with a large amount of exposed ceiling, the primary lighting systems utilize pendant fixtures. Classrooms, offices, and studios all use a linear fluorescent direct/indirect fixture. The corridors make use of compact fluorescent downlights. The exhibit gallery and studio spaces make

use of a custom suspended uni-strut grid that has track lighting mounted to it. Clerestories provide daylight to the painting and drawing studios, which are along the southern face of the building on the upper level.

Exterior lighting consists of pole mounted fixtures which line the main north/south walkway. In-grade fixtures accent the main entrance along with curved metal clad wall which slices thru the building.

Mechanical:

The Art & Visual technology building utilizes hot and chilled water which is supplied from an existing campus line. Two rooftop variable airflow AHU's supply the buildings air. A 70,000cfm AHU supplies the majority of the building spaces while a 25,000cfm AHU supplies exclusively the wood, metal and stone/plaster workshops. A dedicated dust and particle collection system serves these spaces as well. Finally, the server room and telecom spaces are served by individual ductless split systems.

Structural:

4" reinforced spread footings are used as the foundation system. Gravity loads are resisted by a cambered composite steel & concrete decking, which has a total thickness of 6 ¼". Lateral resistance is achieved through both braced and moment framing. There are two roofing systems; 3" steel decking and composite steel and concrete. Finally, transfer girders are used throughout the building where necessary.

Fire Protection:

The building is protected by a combined standpipe and sprinkler system. The standpipe is an automatic wet-type class I. Meanwhile, both wet-pipe and pre-action sprinklers are used in the building. The system is comprised of addressable fire detection equipment, the ability to alarm a central campus monitoring system and automatic controls to shut down air handling equipment in the case of fire.

Transportation:

The building has a central elevator shaft with one passenger elevator and one freight elevator. Both elevators are hydraulically powered and serve all three stories of the building. The passenger elevator is rated for 3,500 lbs while the freight elevator is rated for 6,000 lbs. Both are to run on 480 volt, 3 phase, 60 hertz power.

Telecommunications:

The Art & Visual Technology building ties into the campus telecommunications system via a 4" underground duct which connects into the existing system at the north end of the site. The 4" duct runs into the main telecommunications room which is on the lower level. Cable trays run the along the length of the corridors above the accessible ceiling. Combination voice/data outlets are located in practically all spaces. In most studio spaces these are mounted in floor boxes. In the digital studios and graphic design are two areas of extensive telecommunication services where there is a combination outlet for every seat in the room.

Lighting Depth

Introduction

The over-arching theme to the lighting design for Art & Visual Technology building was to design a unique and creative solution to foster imagination and ingenuity among faculty and students, while still meeting the quantitative needs of the space. While many of the designs have a minimalistic feel, they create a dynamic sense of space while still maintaining a simplistic regiment.

Complete lighting analysis of the following spaces will be investigated

1. Main Entrance Courtyard
2. Entry Lobby
3. Typical Painting Studio
4. Exhibit Gallery

In addition to providing the needed documentation to accurately describe the physical appearance of each redesigned space, a discussion of each lighting system will include, but not limited to, the following areas: design criteria, lighting controls, ASHRAE power densities, luminaire schedules and light loss factors and controls.

Main Entrance Courtyard

Space Summary

The main entrance to the building is defined by a curved wall that cuts through the building and the exhibit gallery. This makes the entrance somewhat hidden to pedestrians heading from the north and completely hidden for those approaching from the south. The two main visual cues that this area is the entrance are the department flag/logo which is prominently located at the end of the curved wall and the entrance canopy with the building name on it.

Surface Finishes

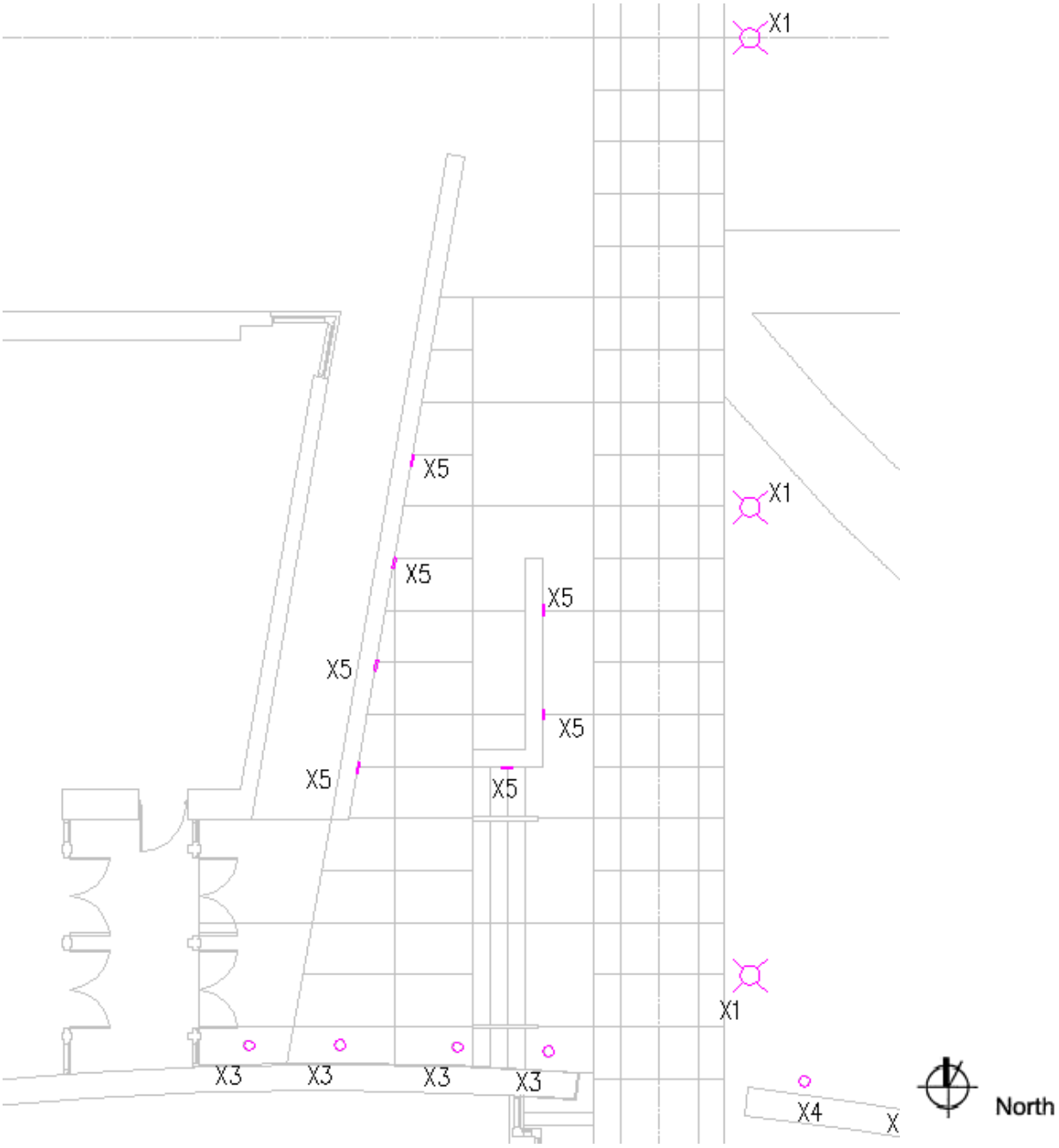
Walkway: Sealed Concrete ρ= .38

Facade: Architectural Concrete ρ= .55

Facade: Aluminum Paneling ρ= .82

Existing Design

The existing design made use of pole mounted fixtures that illuminate the walkway along the length of the building. In-grade and recessed fixtures were utilized for the lighting of the ramp and also the stairs. The existing design had met the safety goals of pedestrians coming to the building but failed to address improving the quality of the space.



Design Criteria

Horizontal Illuminance

The IESNA handbook recommends 5fc on horizontal surfaces at the main building entrance and 0.5fc on pedestrian walkways

Vertical Illuminance

The IESNA handbook recommends 3fc on vertical surfaces at the main building entrance and 0.5 fc on pedestrian walkways.

Appearance of Space and Luminaires

The appearance of space is very important. The lighting design should create a sense of space and for the building. It also should express that the building is for the Art & Visual Technology department.

Light Distribution on Surfaces

Important to help with way finding to help those find their way to the main entrance of the building. This is achieved by having brighter sources as you get closer to the entrance.

Light Distribution on Task Plane

It is important to create a uniform level of light on walkway for safety. In particular, the stairs in front of the main entrance need to be adequately illuminated to prevent a tripping hazard.

Modeling of Faces and Objects

As people walk by the building at night is important for them to feel safe. The modeling of faces and objects puts people at ease because they can see other people and other objects they are approaching.

Points of Interest

Points of interest in the façade courtyard area include the main entrance and the department banner. Another key feature to the entry courtyard is the curved façade which creates the southern boundary to the main entrance space. Both of these features are to be illuminated for aesthetics and way finding. Finally, I would want to illuminate the display banner which is at the end of the curved façade. This is good opportunity to showcase the department and create a "beacon" within this area.

Direct Glare

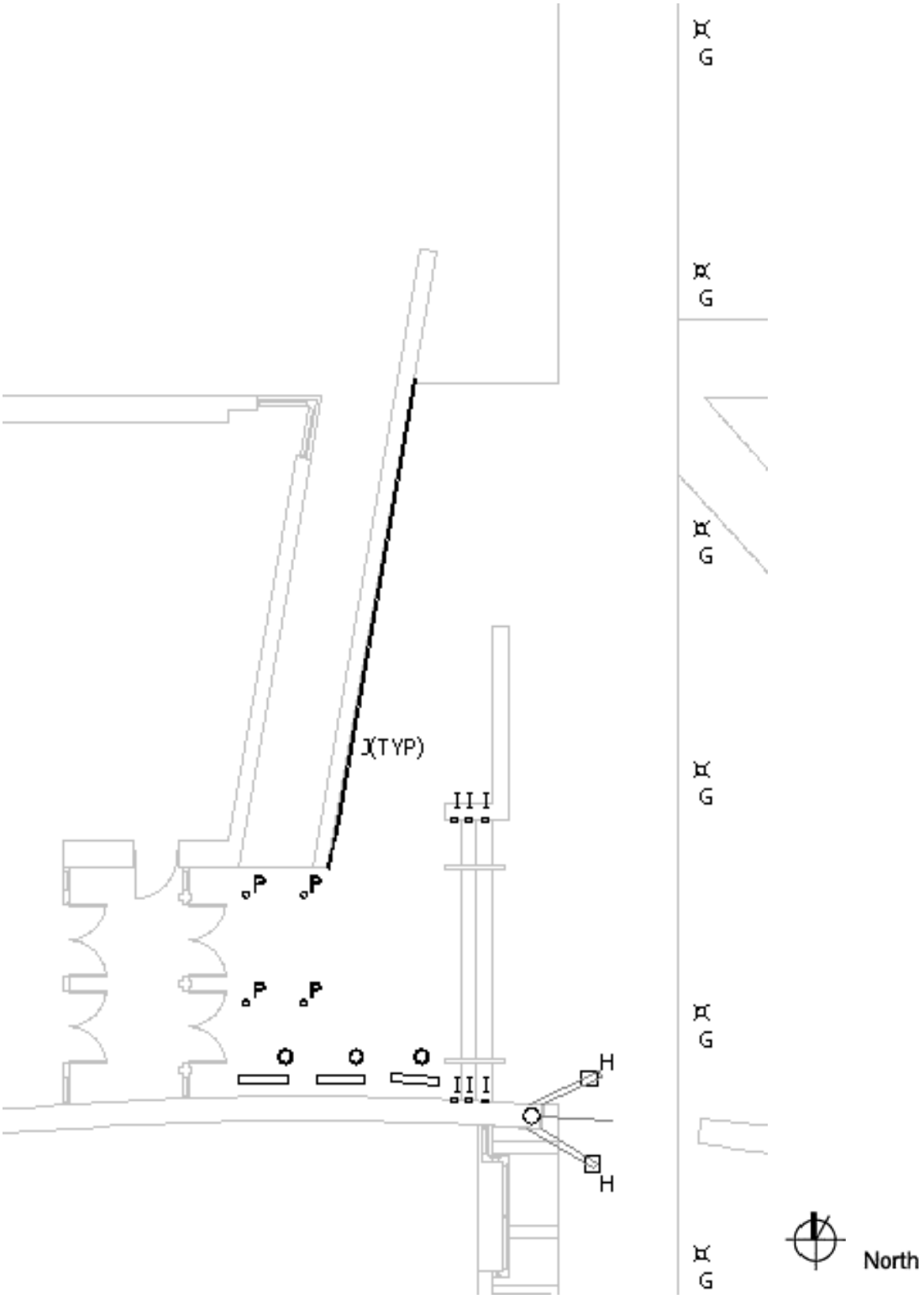
With many people traversing the site without going in the building, it is important to provide adequate lighting along the walkway. All fixtures used to illuminate the walkways should avoid direct views of the lamp as glare is more easily perceived at night.

Design Synopsis

My original concept for the main entrance centered on highlighting the area around the main entrance and also highlighting the department banner logo. After receiving comments from designers at the Lutron presentation during fall semester, I had slightly changed my goals for the lighting of this space. Since this is a building for the Art & Visual Technology department, I decided to do something a little more unique and also a lighting design that defined the building and space. I accomplished this through the use of color changing in grade LEDs that line the ramp up to the building as well as along the curved wall that defines the one edge of the main entrance.

Initial Concept Sketch

Lighting Layout



** Note: See Appendix G for a 1/8" = 1'-0" Plan*

Controls

Lights will be automatically controlled through a astronomical time clock which is integral to the building's existing Lutron Digital Grafik Eye system. The Grafik Eye will also allow for complete user control over the LEDs. This will allow GMU to program the LEDs to change color or during certain times of day or for certain events, etc.

Schedules

Luminaire Schedule

Luminaire Type	Manufacturer	Catalog #	Lamps	Ballast	Volts	Comments
G	Bega	8996MH	(1)CDM100/ 830/ED17	M5	277	Pole area walkway lighting
H	Erco	34105.023	(1)MC39T6/ U/G12/ 835PB (L6)	M6	277	Banner Floodlight
I	Bega	1323	(1)20T3Q/ MINISTAR/S (L7)	-	12v	Step light with integral transformer. Supply 120v to fixture.
J	Light Wild	LW/Tile/FLR/ RECT/ 2.165x11.8/ FROST/RGB/ BOXY	72 LEDs (6W)	-	24V DC	In-grade fixture, integral transformer, supply 120v AC.
O	Color Kinetics	#116/ 000016/ 00/00	144LEDs (280W)	-	120V	Custom in grade housing to accommodate pedestrian traffic load.
P	Prescolite	D4LED/277V/ 4D9/WT	4 LEDS (13W)	-	277V	Surface Mounted Canopy Downlight,

**Note: Please See Appendix A for additional information on luminaires, lamps, and ballasts*

Light Loss Factors

Luminaire Type	Maintenance Category	Room Atmosphere	Cleaning Cycle	Initial Lumens	Mean Lumens	LLD	Ballast Factor	LDD	RSDD	LLF
G	V	Medium	12mo.	8800	6600	.75	.94	.82	-	.58
H	V	Medium	12mo.	3400	2720	.80	1.0	.82	-	.66
I	V	Medium	12mo.	320	-	.90	1.0	.82	-	.74
J	V	Medium	12mo.	132	-	.90	1.0	.82	-	.74
O	V	Medium	12mo.	2282 (White)	-	.9	1.0	.82		.84
P	IV	Medium	12mo.	232	-	.9	1.0	.87	-	.78

ASHRAE Standard 90.1 Power Allowances

Tradable Surfaces

Walkways less than 10 feet Wide: 1.0 W/linear foot

105 linear ft • 1W/linear ft = 105W

Palaza areas: .2W/ft^2

950 ft2 • .2W/ft^2 = 190W

Stairways: 1.0W/ft^2

93ft^2 • 1.0W/ft^2 = 93W

Main entries: 30W/linear foot of door width

12 linear ft • 30W/ft^2 = 360W

Canopies: 1.25W/ft^2

225ft2 • 1.25W/ft^2 = 281W

Total allowable tradable watts =1,029

Non-Tradable Surfaces

Building Facades 0.2W/ft^2 or 5.0 W/linear foot of illuminated wall

52ft• 5.0W/ft = **260W available**

1,760ft * 0.2W/ft^2 = **352W**

= 612W

Tradable Power Consumption

6 “G” fixtures * 118 input watts/fixture = 486 W

2 “H” fixtures * 54 input watts/fixture = 108 W

6 “I” fixtures * 20 input watts/fixture = 120 W

4 “P” Fixtures * 13 input watts/fixture = 52W

Total power consumption = 766W <1,029W

Non-Tradable Power Consumption

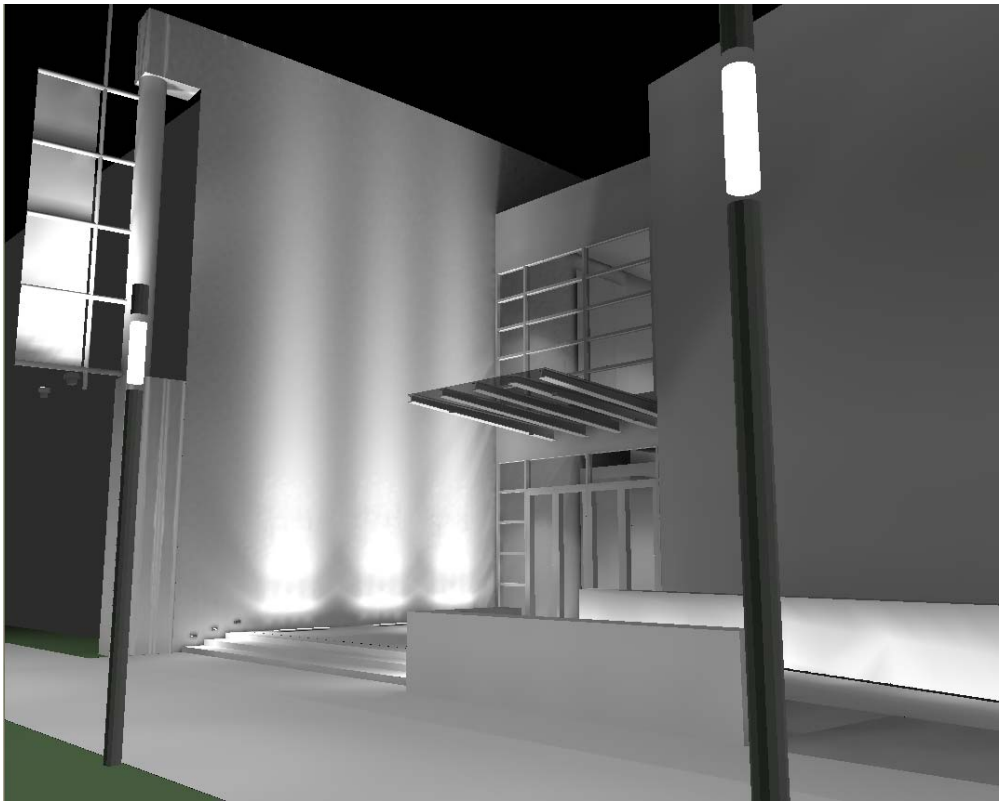
3 “O” Fixtures * 280 input watts/fixture = 840W

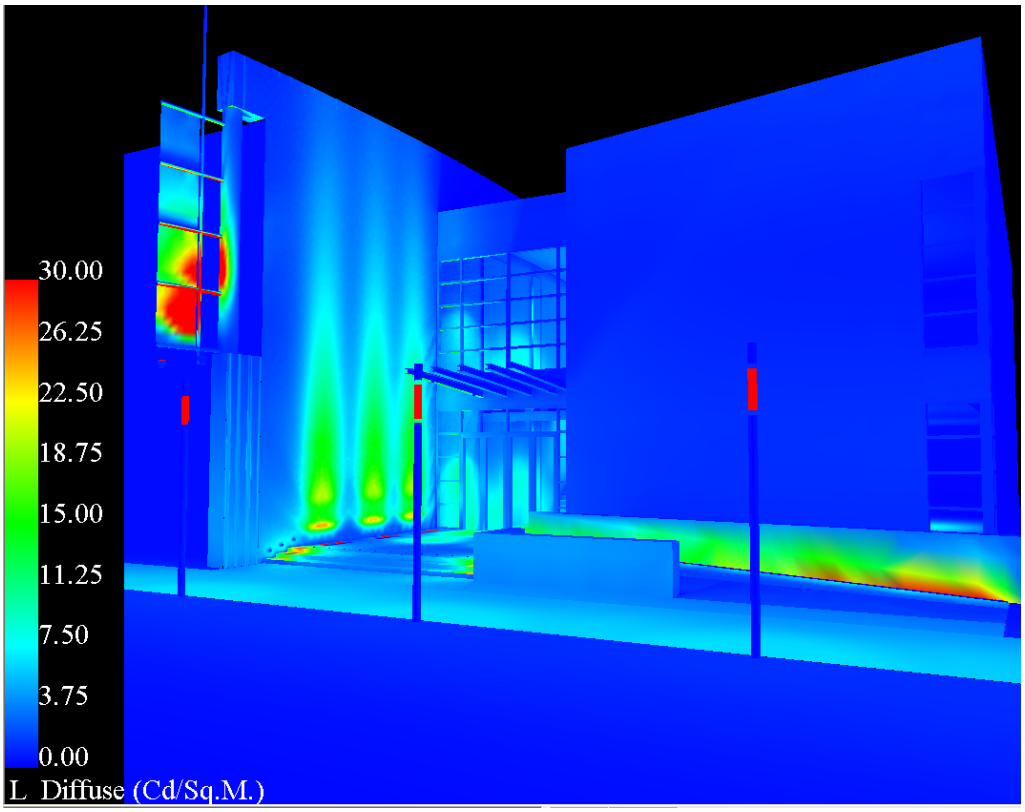
43 “J” fixtures * 6 input watts/fixture = 258 W

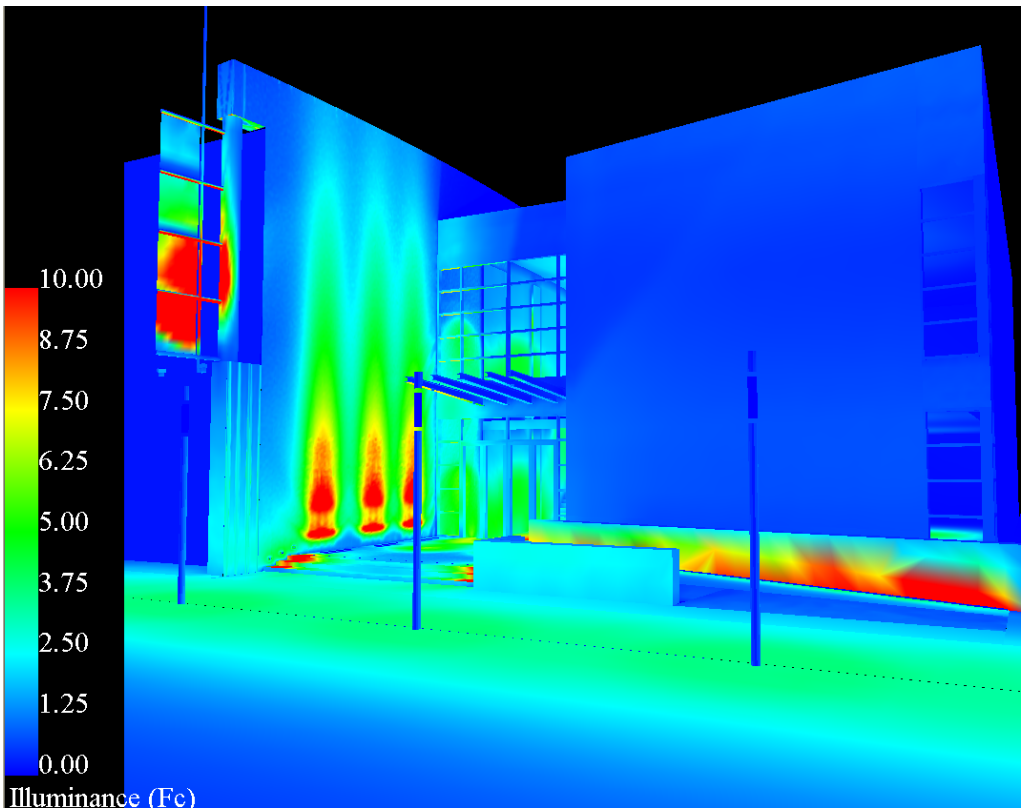
Total power consumption = 1098 W > 612 W

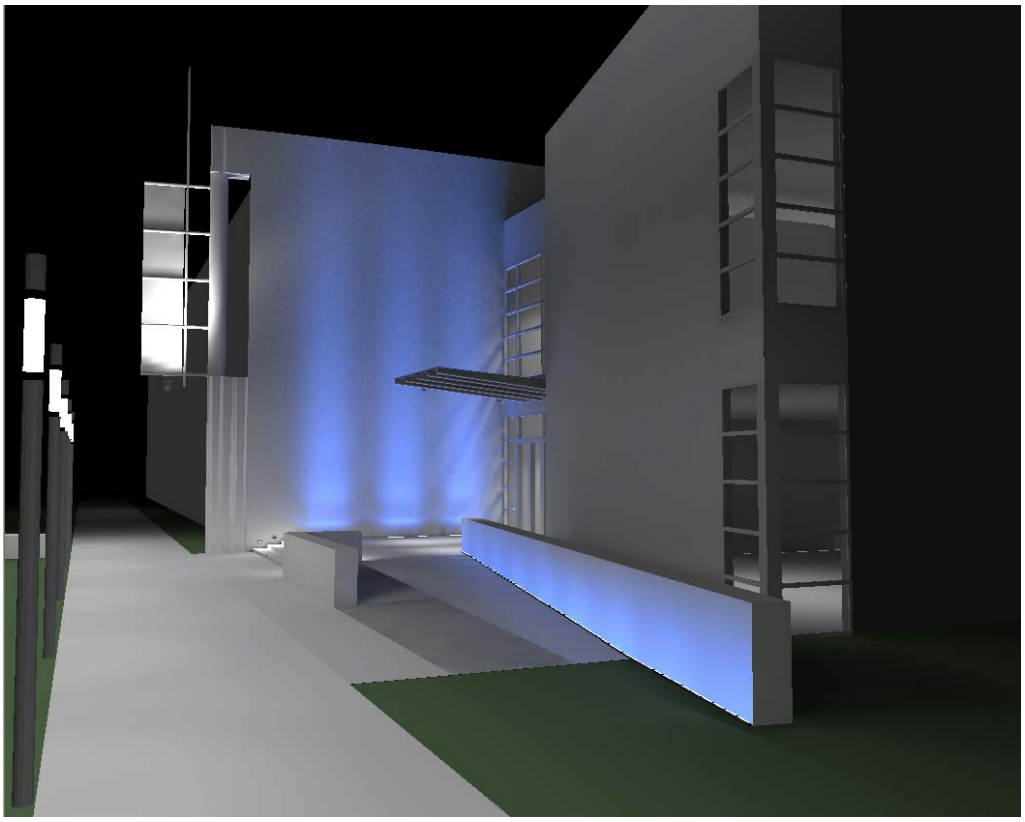
*Though this value is above ASHRAE standards, I feel that the statement that the lighting design makes along with the overall power savings elsewhere in the building justify this design.

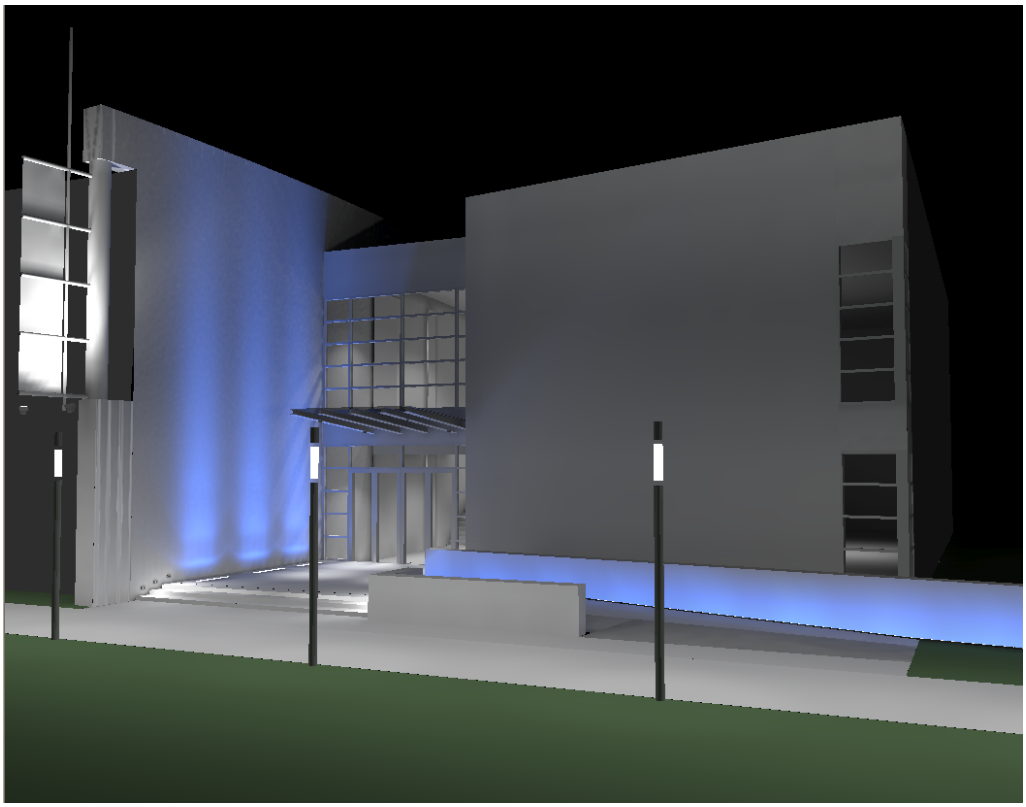
AGI Analysis

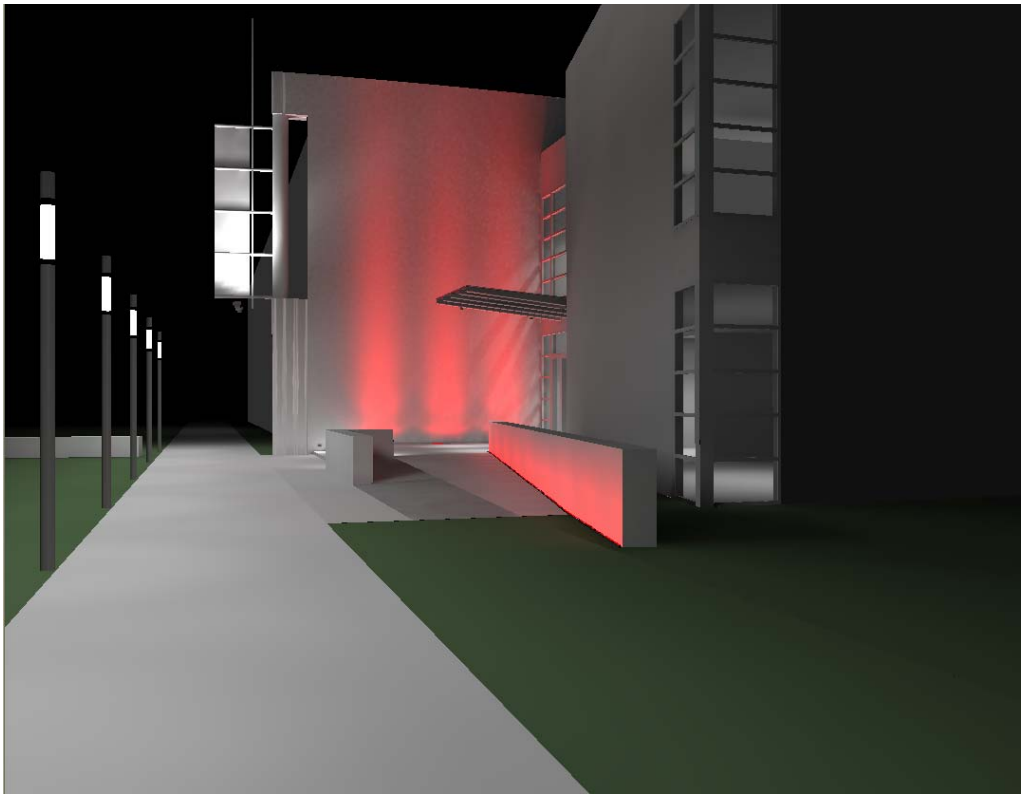



30.00
26.25
22.50
18.75
15.00
11.25
7.50
3.75
0.00
L_Diffuse (Cd/Sq.M.)


10.00
8.75
7.50
6.25
5.00
3.75
2.50
1.25
0.00
Illuminance (Fc)

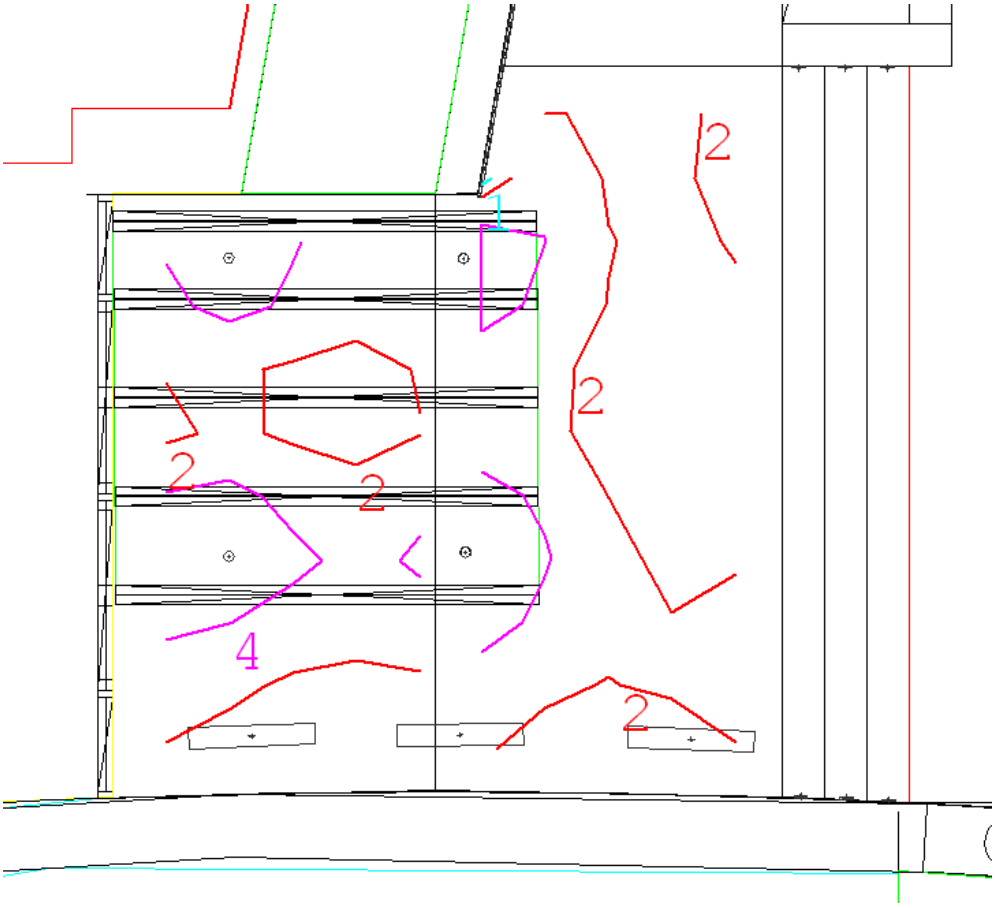






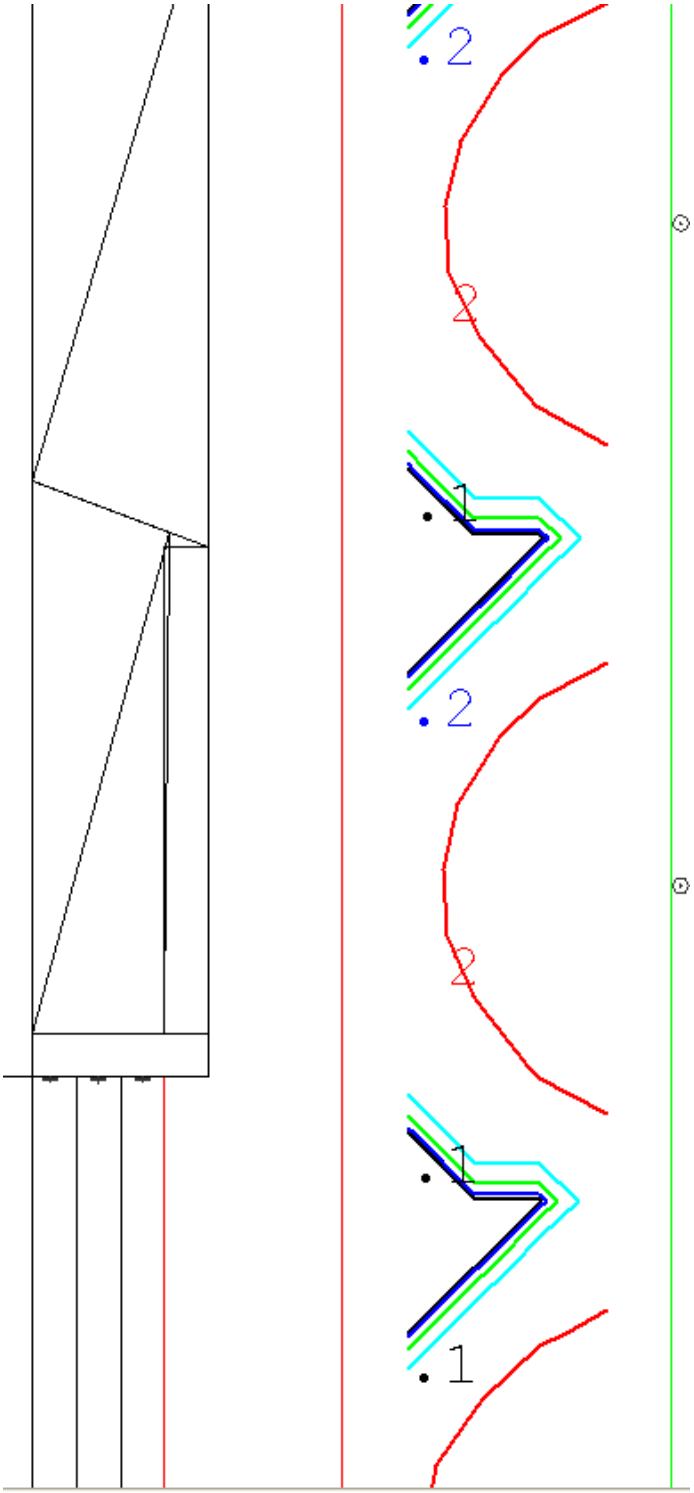
Illuminance Data

Building Entrance Illuminance



CalcPts_1
Illuminance Values(Fc)
Average=2.93 Maximum=5.5
Minimum=1.0 Avg/Min=2.93
Max/Min=5.50

Pedestrian Walkway Illuminance data



CalcPts
Illuminance Values(Fc)
Average=1.78 Maximum=2.8
Minimum=0.0 Avg/Min=N.A.
Max/Min=N.A.

Evaluation

As the icon for the Department of Visual Technology, it is important to make an impressive first statement. The LEDs along the main curved wall and site wall both create a sense of space but also lead people into the building. General area lighting is provided for the pedestrian walkway through pole mounted fixtures (though not accurately depicted due to time constraints). The use of LEDs along the two walls creates a dynamic contrast that defines this building and space as the Art & Visual technology department.

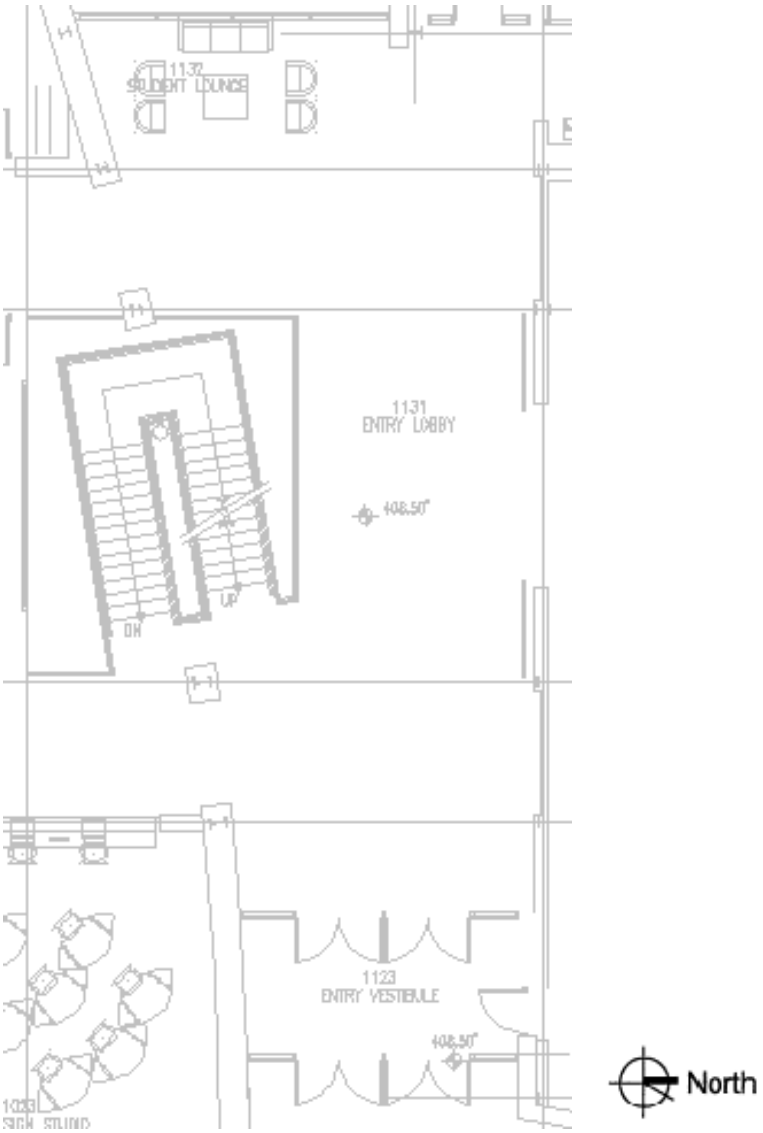
Given more time I feel that this space could be of higher quality. However, I have had many difficulties properly modeling the area luminaries, in particular having the proper photometric center. Another difficulty I encountered was a limitation within AGI, in that it does not allow you to easily align and position fixtures. This was a difficult for the LED fixtures that wash the concrete wall that lines the sloped walkway.

To conclude, I am very pleased with how my lighting design evolved over the course of the year. I feel that my current design achieves the design criteria I set out extremely well. However, I am disappointed in the technical setbacks I faced in depicting my design.

Entry Lobby

Space Summary

The lobby to the main entrance is a long rectangular space that connects the building together. The gallery space is connected to the North of the lobby while the two main corridors come off the lobby to the South. Connected to the west side of the lobby is a small student lounge with seating and a coffee table. The open staircase in the entry lobby spans from the lower level through the upper level. There is a roughly 20'x30'area surrounding the staircase which is open to above and below. The staircase is comprised of a metal handrail & frame with an ornamental wire mesh panel. The ceiling is composed of dry wall at 13 feet above finished floor.



Surface Finishes

Floor/Stairs: Sealed Concrete ρ= .38

Walls: painted gypsum wall board ρ= .80

Handrails: Steel ρ= .38

Ceiling: White Drywall ρ= .80

Existing Design

The existing design made use of a recessed compact fluorescent downlight (type L) and also a direct compact fluorescent pendant fixture (type J). For the illumination of the stairwell a surface mounted direct fixture is mounted to the underside of the stair above.

Design Criteria

Horizontal Illuminance

The IESNA handbook recommends an average of 10fc on the horizontal plane in this space. However, I feel that providing an average of 20fc will make the space feel more welcoming and active.

Vertical Illuminance

The IESNA handbook recommends an average of 3fc on the vertical plane in this space.

Appearance of Space and Luminaires

The main lobby is the first impression for occupants of the Art & Visual Technology building. It is important to provide a visually pleasing space to impress visitors to the building, as well as, set up the creative and innovative atmosphere for students and faculty.

Direct Glare

It is important for those just entering the building to not have any glare hindering their ability to get oriented to the building. Also, this will be a busy area between classes and any glare could cause a disruption in the flow of people in and out of the building.

Luminances of Room Surfaces

I want the design to utilize light distribution on surfaces to help with way finding. High luminances near the stairwell will help guide people to it as well as down the corridor to access the elevators, which are in a remote location.

Modeling of Faces and Objects

The modeling of faces and objects is important as the lobby will be a place of gathering and meeting for many. In addition, having proper modeling of faces and objects will help create a welcoming feeling.

System Control and Flexibility

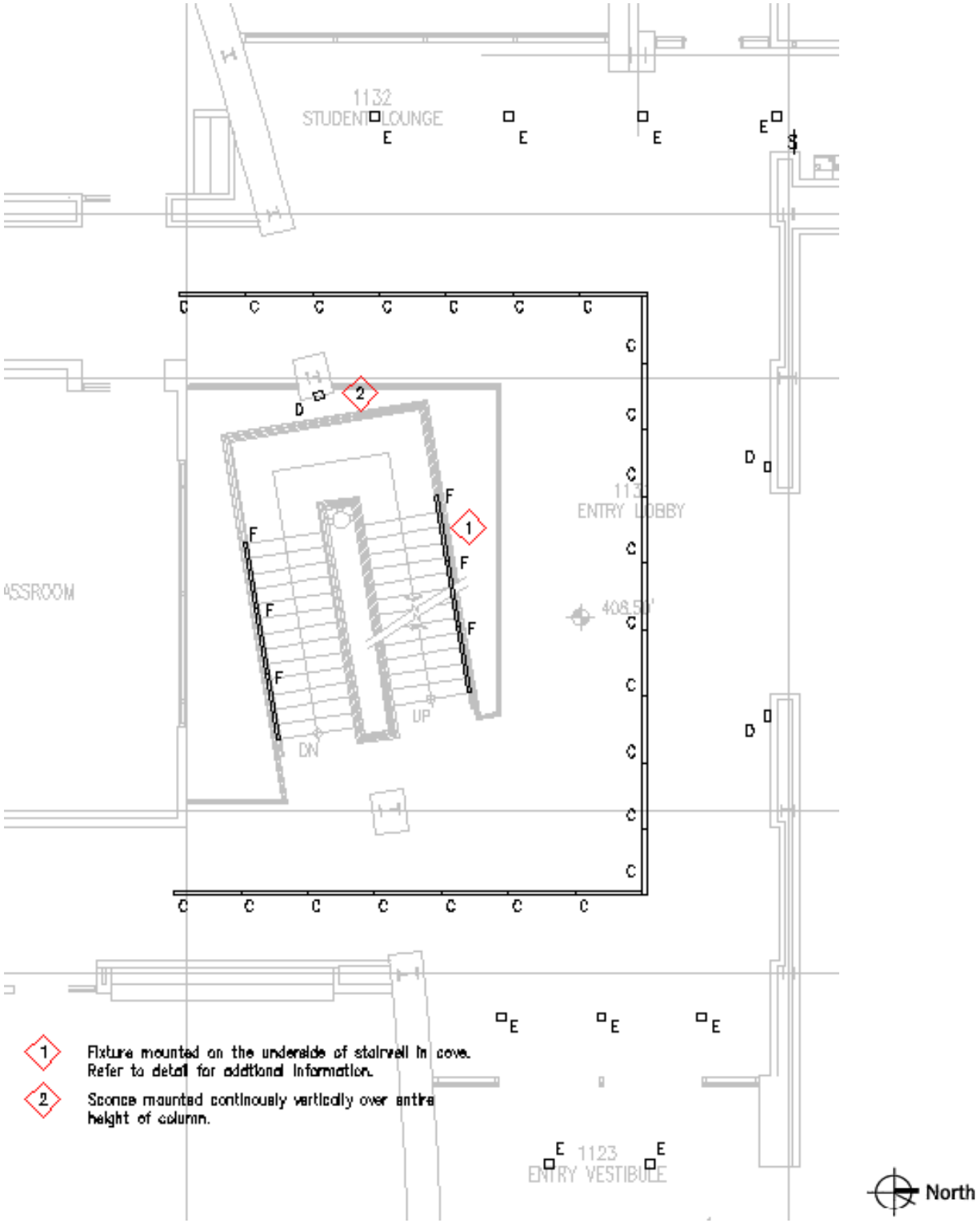
Lighting needs to be integrated with the automated lighting system. Remote manual location of controls is needed to avoid any unintended switching of lights.

Design Synopsis

Based on comments from my presentation at Lutron, I revised my initial design slightly to create a more unified design. The overall concept stayed the same however I changed several things including decreasing the number of rows of slot downlights and also to make them wrap around the corner to continue down the corridors. I also changed from utilizing several wall sconces across the various columns in the lobby to having just one continuous strip on the major column in the stairwell. By making these changes I was able to create a simplistic design that is visually dynamic by expressing the dimensions of the room.

Initial Concept Sketch

Lighting Layout



** Note: See Appendix H for a 1/8" = 1'-0" Plan*

Controls Overview

The primary means of lighting control in the entry lobby will be a time-clock. However, manual operation of the lights is accomplished at the Northwest corner of the lobby. The existing Lutron Digital Graik Eye 7000 has a built in time clock that will automate the control of this space under normal operation.

Schedules

Luminaire Schedule

Luminaire Type	Manufacturer	Catalog #	Lamps	Ballast	Volts	Comments
C	Se'lux	M1B1-1T5-SA-X-SH-004-WH-277	(1)-FP28/835 (L1)	M2	277	Recessed Continuous slot downlight
D	Se'lux	M1N1-TS	(1)-FP28/835 (L1)	M2	277	Recessed continuous sconce with satin diffuse lens
E	Kurt Versen	H8632-WT	(1)-PLT/32W/ 835/ 4P/ ALTO (L3)	M3	277	Recessed 6" Square Downlight
F	Lightolier	CL-1-4-E82	(1)-F032/835/ECO (L4)	M4	277	Stairwell cove fixture. See Proceeding information on mounting details.

**Note: Please See Appendix A for additional information on luminaires, lamps, and ballasts*

Light Loss Factors

Luminaire Type	Maintenance Category	Room Atmosphere	Cleaning Cycle	Initial Lumens	Mean Lumens	LLD	Ballast Factor	LDD	RSDD	LLF
C	IV	Clean	12mo.	2600	2418	.93	.98	.93	.97	.82
D	V	Clean	12mo.	2600	2418	.88	.98	.89	.97	.74
E	IV	Clean	12mo.	3200	2720	.93	.98	.93	.97	.82
F	VI	Clean	12mo.	2950	2710	92	.98	.85	.97	.74

ASHRAE Standard 90.1 Power Allowances:

Lobby = 1.3W/ft^2

Area (~35'x~60') = 2,307 ft^2

Total Allowed Wattage = 2,999.1W

Power Consumption

21 "C" fixtures * 33 input watts/fixture = 693 W

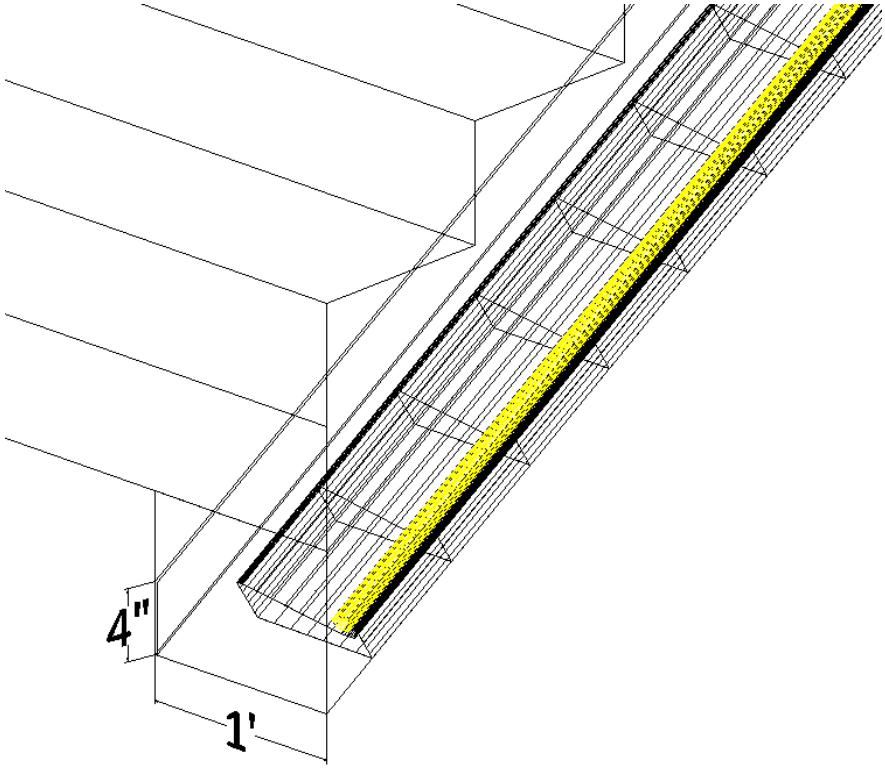
8 "D" fixtures * 33 input watts/fixture = 264 W

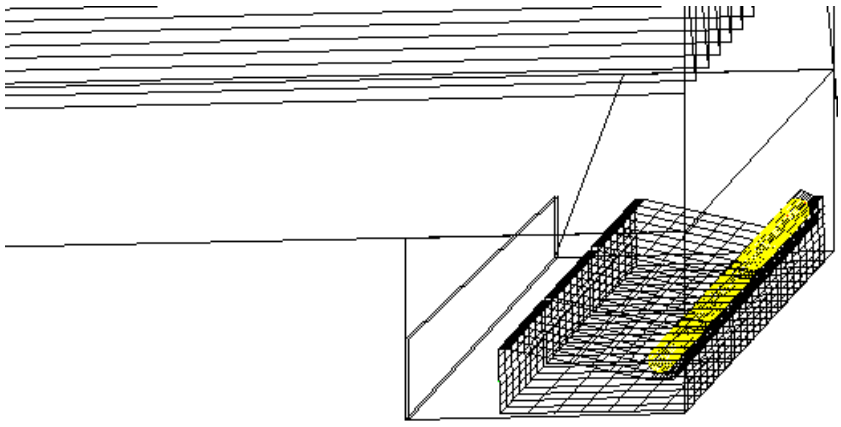
10 "E" fixtures * 36 input watts/fixture = 360 W

6 "F" fixtures * 29 input watts/fixture = 174 W

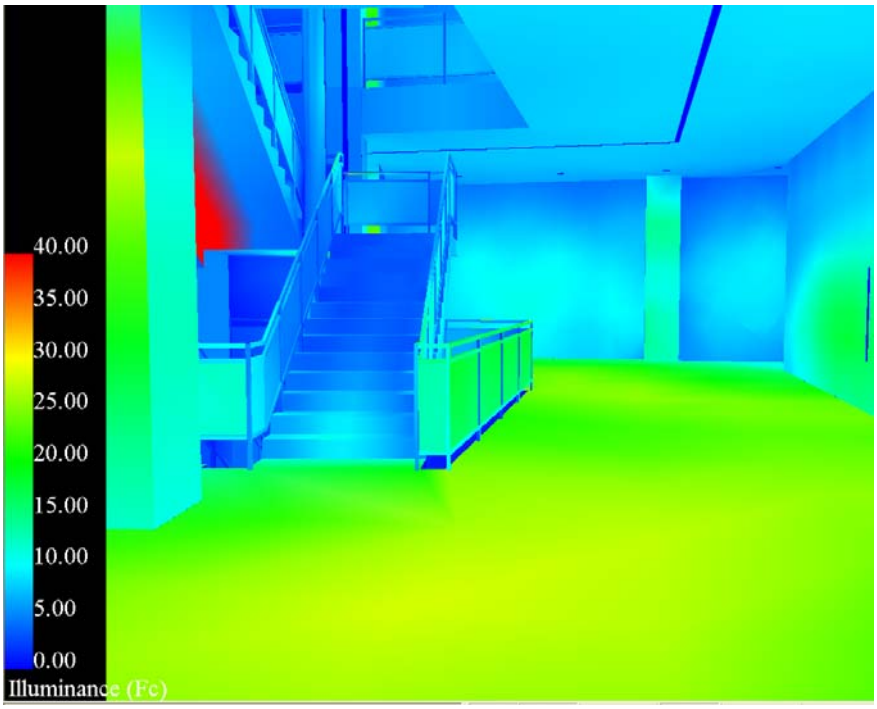
Total power consumption = 1,491 W < 2,999 W

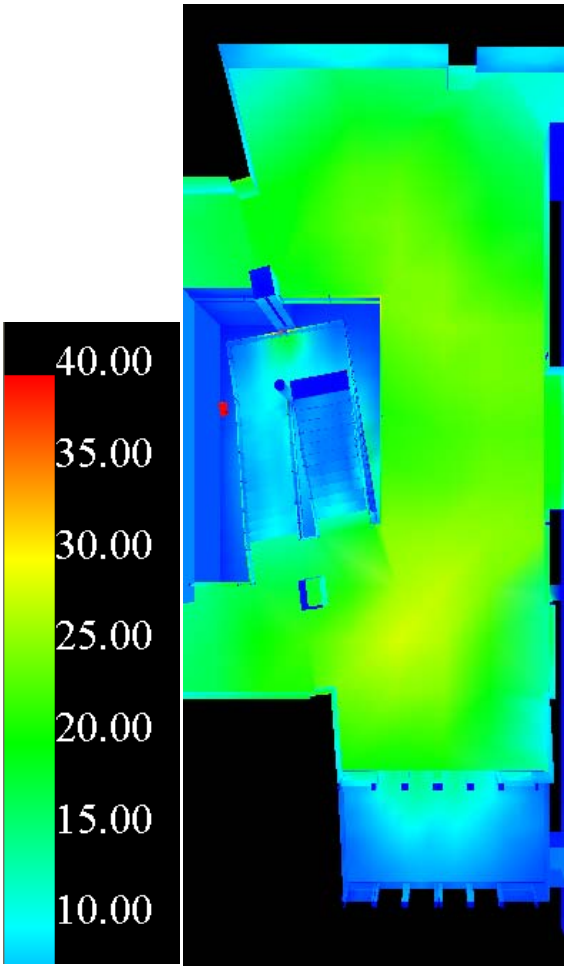
Stairwell Cove Detail



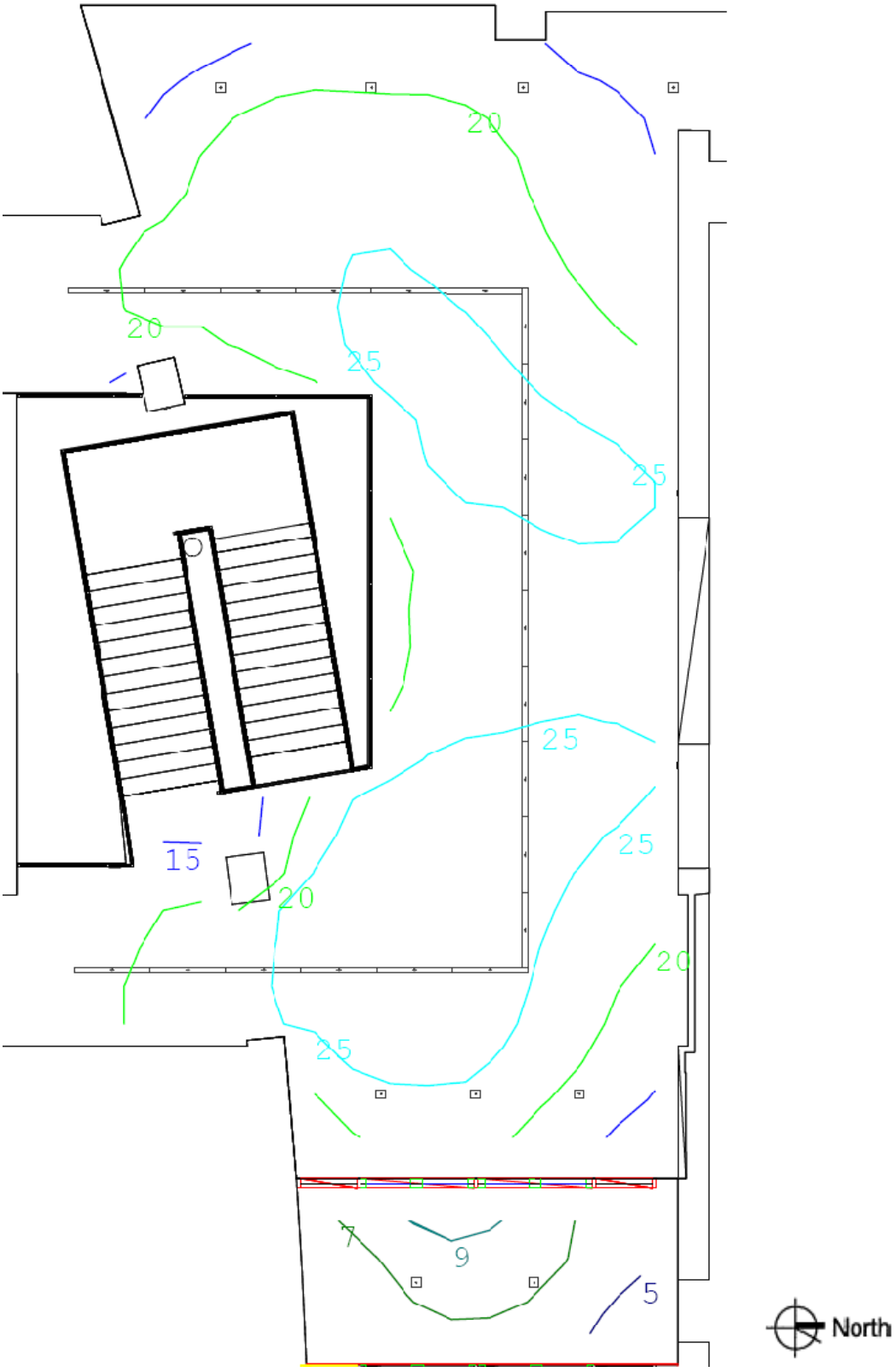


AGI32 Analysis


40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Illuminance (Fc)


40.00
35.00
30.00
25.00
20.00
15.00
10.00

Illuminance Data



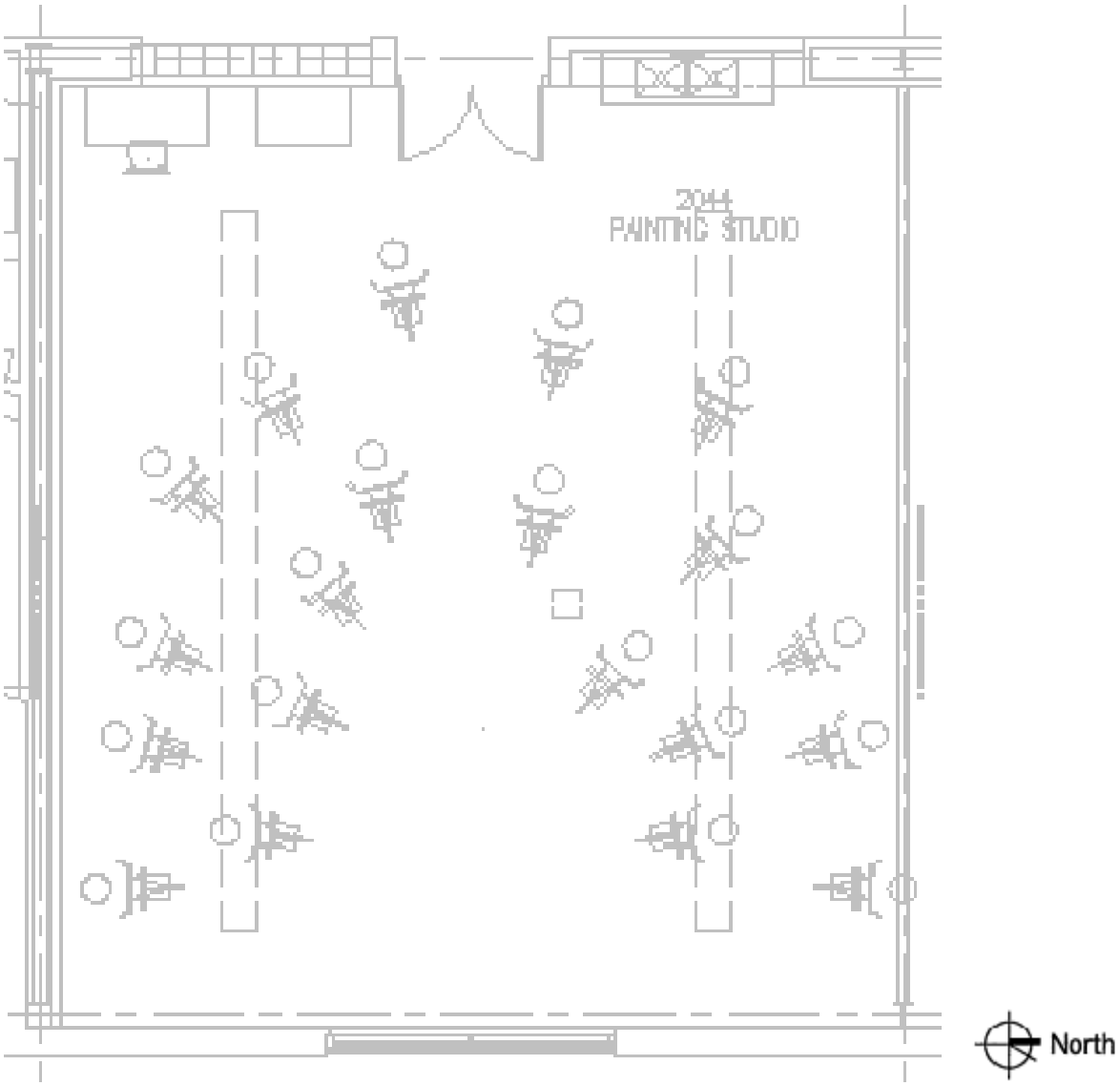
Evaluation

The combination of the slot downlighting and the continuous sconce on the stairwell column creates linearity in all three dimensions of the space. This helps emphasize the volume of the space and also meant to represent how art starts with just one line or brush stroke. In addition, the lighting design helps visitors to the building with way finding by pointing them to the main stairwell and corridors. The cove system creates a unique solution to the lighting of the stairwell area, however due to time limitations I could not refine it as much as I would have liked. Overall, I feel that this design meets my design criteria in an interesting and distinctive way.

Painting Studio

Space Summary

The painting studio is roughly 36'x41' in area with a 17' finished ceiling. In this space the main activity is student's painting. The space is quite open with the main furniture to be movable stools and canvases for painting purposes. There is also a stationary desk along the main wall along with a set of two sinks for cleaning paint supplies. This is one of 4 identical studios on the top floor of the building.



Surface Finishes

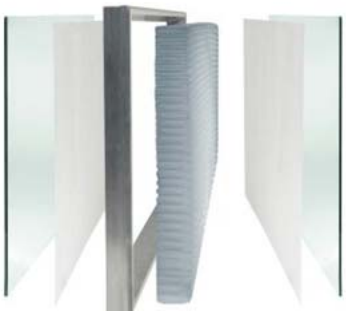
Floor: Sealed Concrete ρ= .38

Walls: painted gypsum wall board ρ= .80

Doors: Finished Wood ρ= .15

Ceiling: White Drywall ρ= .80

Skylight: Skylight: Advcaned Glazings Solera S glazing unit



Internal & External veil 401

Visible Transmittance = 34%

U-Value = 0.2

Solar Heat Gain coefficient = .32

**note: See Appendix B for product cut sheet*

Skylight Wells: painted Drywall ρ= .90

Blackout Skylight Shade (Black in color)

Equinox™ Series 0100
Blackout ShadeCloth
OF: 0%
Stock Width: 100"

Light control Skylight Shade (Black in color)

ThermoVeil® Series 1300
Dense Basket Weave
Approx. OF: 5%
Available in 63", 96" and
126" SuperWide® Widths
(Selected Colors)

Existing Design

The existing design consisted of a suspended uni-strut grid with surface mounted track lighting combined with an indirect/direct pendant fixture. Daylight was achieved through a central clerestory which was roughly the size of the uni-strut grid. The existing design was very energy intensive due

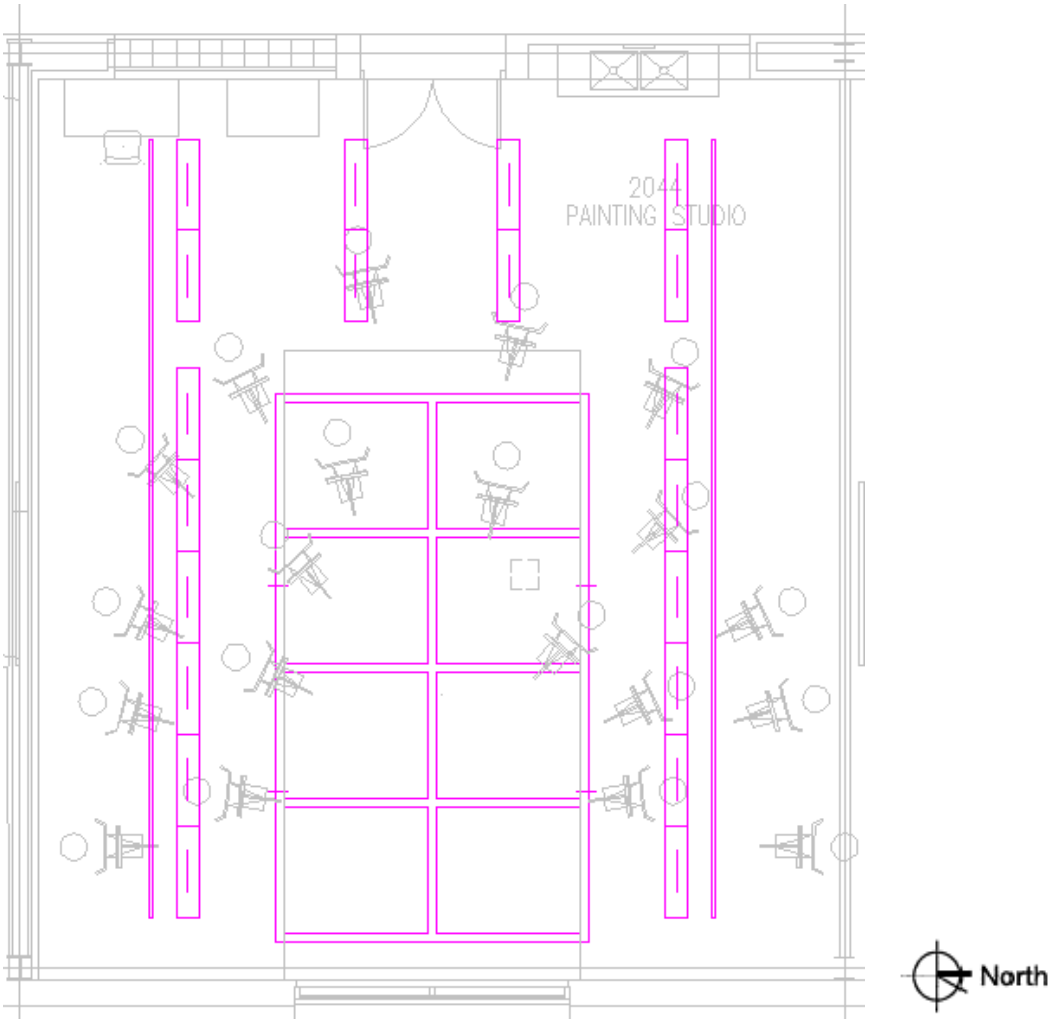
to the large amount of track lighting which was provided. Additionally, the indirect/direct fixtures predominantly lit the ceiling, but left the clerestory a black void during not daylit hours.

Power Consumed with Existing Design

Indirect fixtures 1,280 W

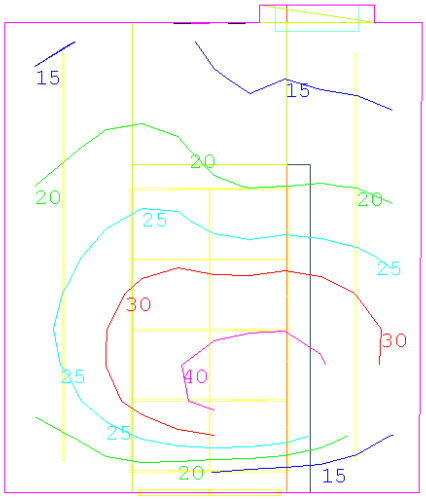
Track Lighting 7,000 W (7 circuits of 10 fixtures at 100W each)

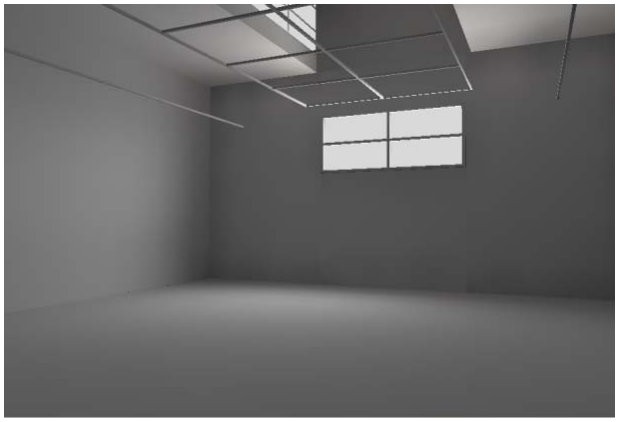
Total power 8,280 W



Electric Lighting with no daylight

Daylight Analysis: September 4, 11:00am





Design Criteria

Horizontal Illuminance

The IESNA handbook recommends 50fc on horizontal surfaces within a painting studio.

Vertical Illuminance

The IESNA handbook recommends 30fc on vertical surfaces within a painting studio

Appearance of Space and Luminaires

It is important that the space is comfortable as students will spend large periods of time in this room. In addition it is important that the space creates a feeling of creativity and ingenuity.

Daylight Integration and Control

This is one of the most crucial criterions for this space. A large window along the east wall and expansive skylights allow a vast amount of daylight into the space. Control of this daylight is necessary to provide a comfortable and efficient working space.

Light Distribution on Task Plane

A uniform and bright distribution of light is required on the task plane(easel) in this space.

Luminances of Room Surfaces

The walls and ceiling need to be bright in order to create a feeling of spaciousness. Lighting these surfaces will "open-up" the space.

Modeling of Faces and Objects

The modeling of faces and objects is paramount to bring out the texture, depth, shape of the objects to be painted

Source/Task/Eye Geometry

Source/Task/Eye geometry is important to consider to avoid shadowing onto the students' easels due to their bodies.

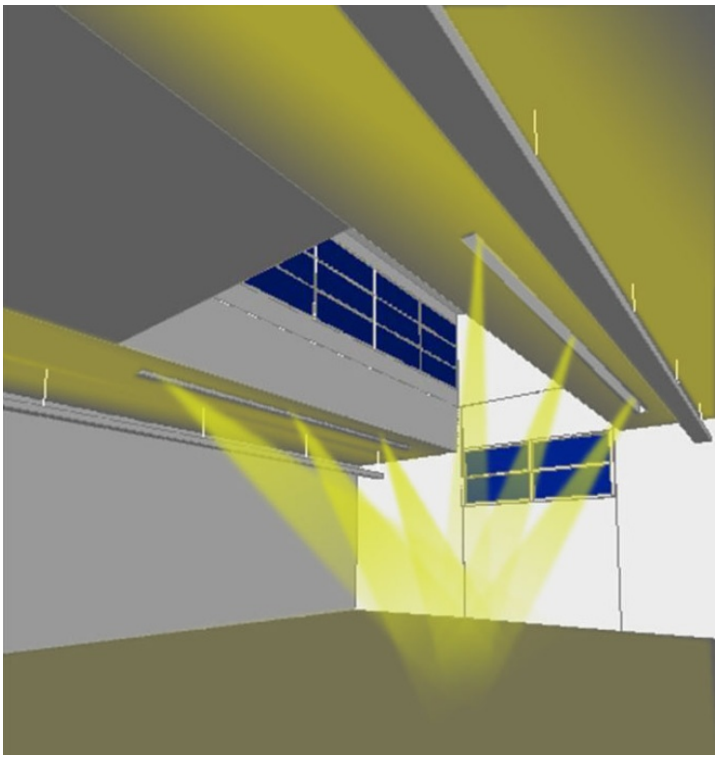
System Control and Flexibility

The lighting system should incorporate daylight sensors to allow automatic dimming during the day to save energy and keep from over lighting the space. Another essential element to the controls is having the capability for manual dimming which gives occupants flexibility to create the desired aesthetic to the space.

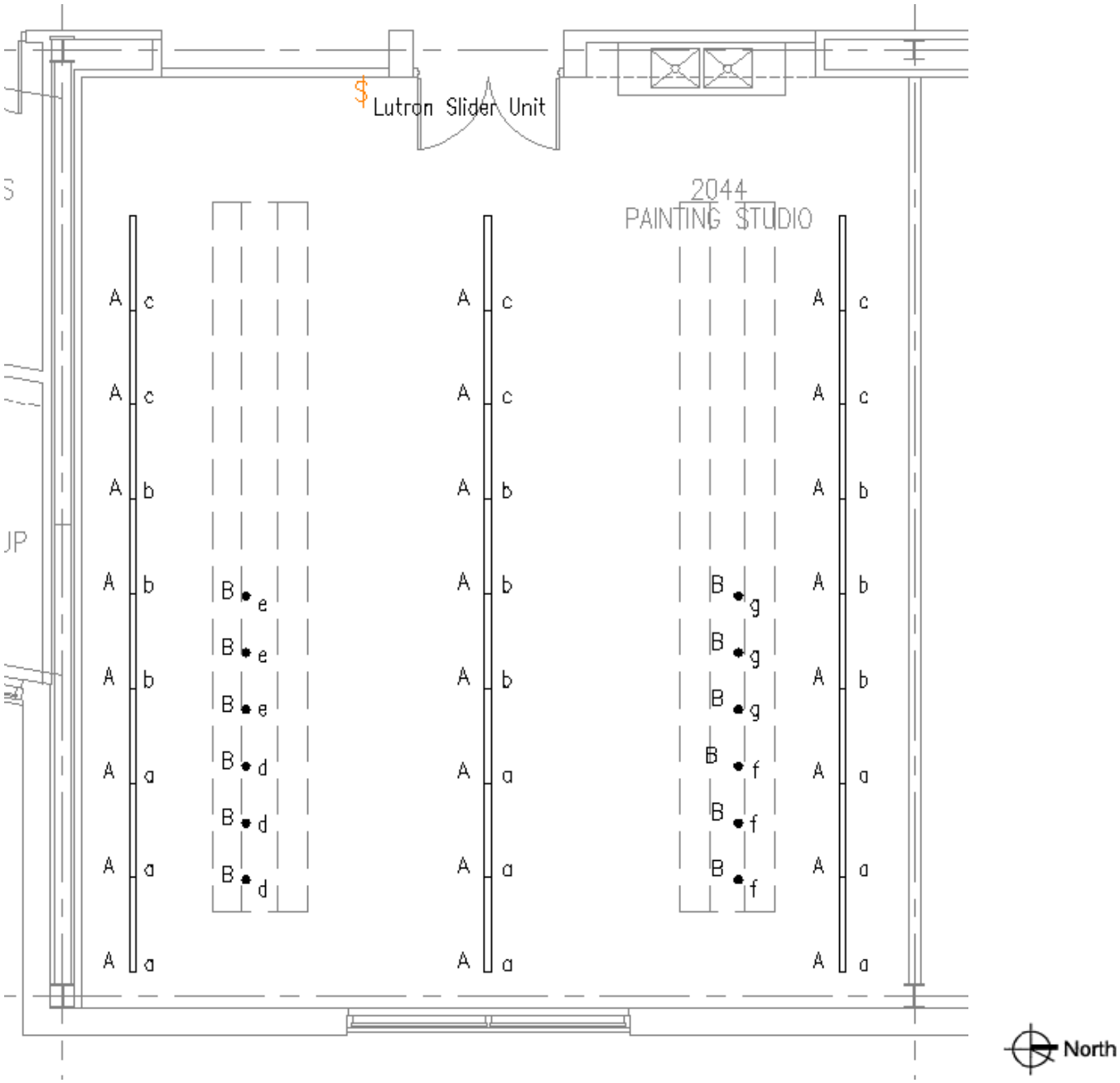
Design Synopsis

The key feature to the original design was a clerestory which allowed natural light into the space. After a daylight analysis, it was found that the clerestory was inefficient and after many design iterations, including the use of SkyCalc and AGI32, it was removed in lieu of a skylight system. Along with the switch to a skylight system, the implementation of mechanical operated shades across both the window and skylights was utilized to allow occupants the flexibility in the appearance of the space. Once the daylighting strategy was in place, the original electric lighting design concept was evaluated and deemed ineffective due to the inefficiencies of using an indirect lighting system in such a tall space with skylights. The lighting design was then switched to a recessed fluorescent slot lighting system. Also, the track lighting moved from a separate recessed channel into mounted on the inside of the skylight well. The final artificial and daylighting systems were then analyzed in SkyCalc and AGI32 to evaluate energy savings and the visual appearance of the space.

Initial Concept Sketch



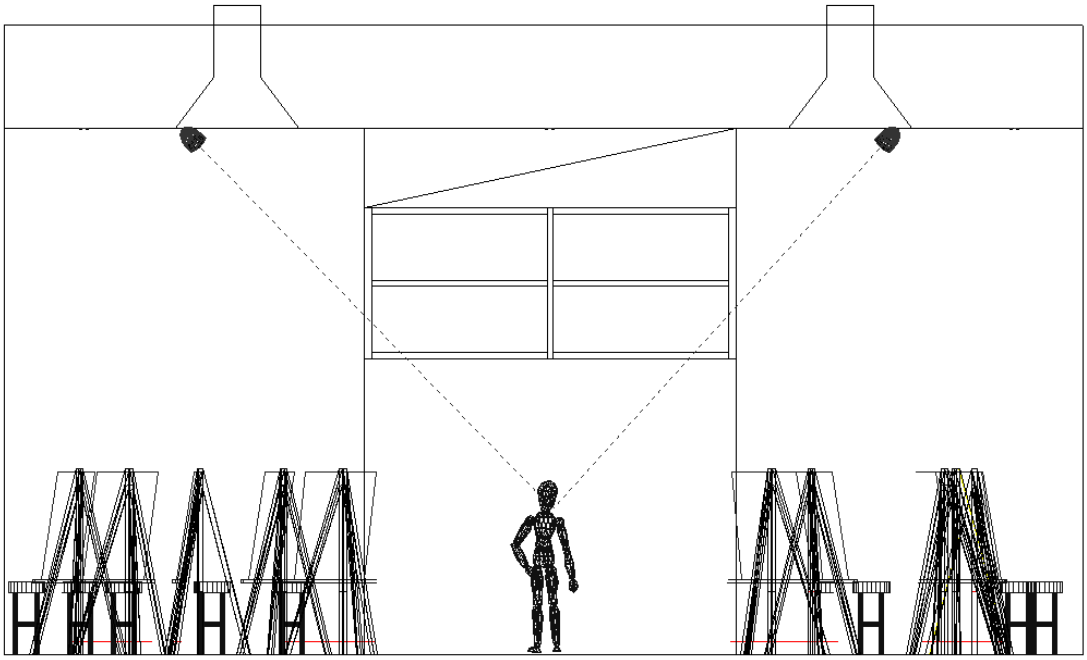
Lighting Layout



** Note: See Appendix I for a 1/8" = 1'-0" Plan*

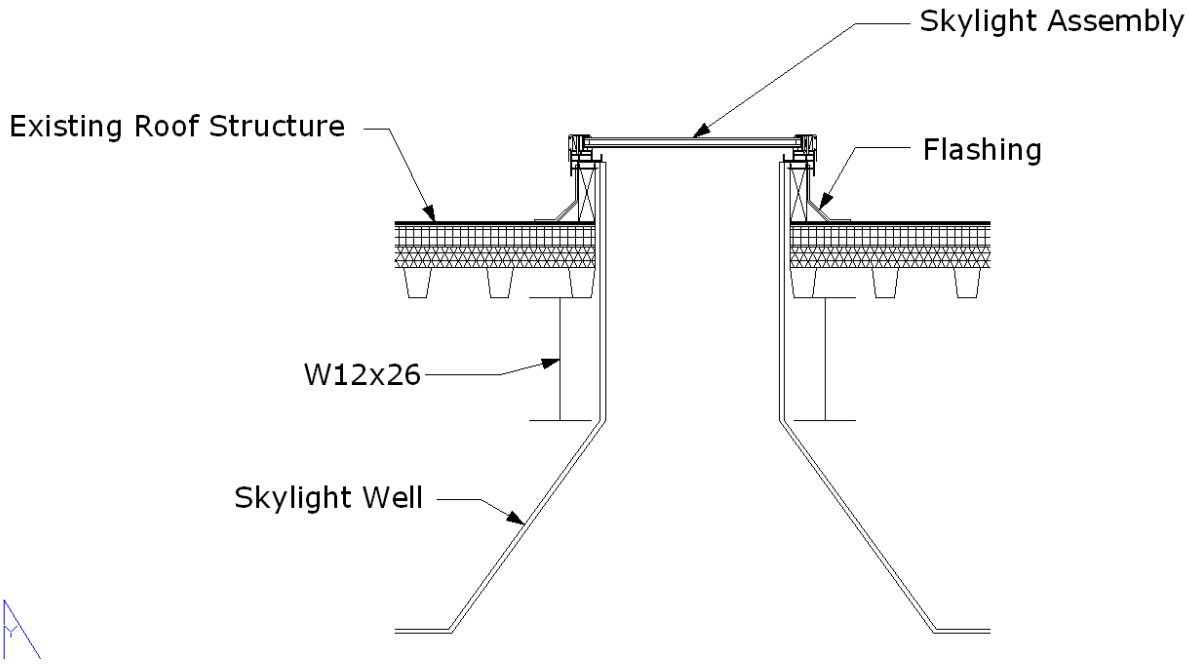
***Note: lower case letters designate zones*

Painting Studio Section



Section thru studio facing east

Skylight Detail



Controls Overview

The painting studio will be integrated into the building's existing Lutron Digital Grafik Eye7000 series. A Lutron slider (product # OMXSL) control unit will be implemented to control the dimming of each individual zone of light. Additionally, shade controls will be integrated into a custom-designed wallbox that houses both lighting and shade controls. Finally, a photocell will be utilized for automatic dimming of the electric lighting under normal daylight conditions.

*****Note: *See appendix C type 1C for a product cut sheet*

Schedules

Luminaire Schedule

Luminaire Type	Manufacturer	Catalog #	Lamps	Ballast Type	Volts	Comments
A	Se'lux	M1B1-2T5-SA-X-SH-004-WH-277-DM	(2) FP28/835 (L1)	M1	120	Recessed slot downlight, Dimming Ballast
B	Lighting Services Inc	C100-00-W	50PAR20-H-SP10 (L2)	n/a	120	Track Lighting Mounted to Skylight Opening

**Note: Please See Appendix A for additional information on luminaires, lamps, and ballasts*

Light Loss Factors

Luminaire Type	Maintenance Category	Room Atmosphere	Cleaning Cycle	Initial Lumens	Mean Lumens	LLD	Ballast Factor	LDD	RSDD	LLF
A	IV	Clean	12mo.	2600	2418	.93	1.0	.89	.96	.79
B	IV	Clean	12mo.	750	-	.95	1.0	.89	.96	.77

ASHRAE Standard 90.1 Power Allowances

Classroom/Lecture/Training = 1.4W/ft^2

Area (37'x41') = 1,517 ft^2

Total Allowed Wattage = 2,123.8W

Power consumption

24 "A" fixtures * 62 input watts/fixture	= 1,488 W
12 "B" fixtures * 50 watts/fixtures	= 600 W
Total power consumption	= 2,088 W < 2,123 W

Motorized Shades

The implementation of MechoShade® motorized shades was necessary to achieve the desired lighting control as well as for overall general comfort of those in the space. While the skylights provide ample daylight under an overcast condition, with average illuminance levels ranging from 30 to 55 footcandles, it provides far too much light in under certain clear sky conditions. The two shade options give the occupants the choice between completely eliminating daylight or just cutting it back to a more comfortable level. The shades will be controlled through an integrated Lutron Grafik-Eye® system which will control the lighting and shades simultaneously.

SkyCalc Analysis

The aim of the SkyCalc analysis was to determine the financial and environmental impact of switching from a clerestory system to a skylight system. SkyCalc was programmed intended towards the analysis of skylight systems and thus the use of it to analyze a clerestory daylighting system or any other system would be not valid. Therefore, it was not possible to get a side by side economic comparison of the clerestory system and skylight system. As mentioned in the design synopsis for the painting studio, the main goal of changing daylighting strategies was to provide daylight more evenly in the space. As such, SkyCalc analysis compares the energy and cost savings of having a skylight system versus not having one at all.

Performance data for the skylight was entered per the specifications of. The electricity rate for the analysis used the off peak charge of $0.00272 per kWh as outlined by the utility rate for the building. While this value seems extremely low, I had spoke with a representative from Dominion Virginia and the confirmed the value of $0.00272 per kWh.

**A copy of the utility rate schedule can be found in appendix D*

As not all options were available to completely tailor the analysis to the Art & Visual Technology building, certain assumptions were made to make this possible. Firstly, weather data for Fairfax, Virginia was not available. Instead, weather data from nearby Washington D.C. was used. Additionally, the cost per thermal of heating was estimated at $1.40/thermal.

SkyCalc: Skylight Design Assistant - Basic Inputs

Company Name: George Mason University
Project Description: Art & Visual Technology Building

Design Skylight to Floor Ratio = 5.9%

Select Location User Generated w/ e-QUE

Climate data loaded = Washington DC.wea3

Climate data needed =

Load Climate Data

Skylights:

Number of skylights 2
Skylight width 1.5 ft
Skylight length 30 ft

At least 4 skylights needed for uniform daylighting

Max skylight spacing = 25.5 ft (1.5 x ceiling ht)

Skylight Description

Glazing type: User Defined
Glazing layers: User Def Lay-3
Glazing color: User Def Col-2

Building

Building type: University 9 mo
Bldg area 1,517 ft^2
Ceiling height 17 ft
Wall color: Off-white paint

Skylight Well

Light well height 3.33 feet
Well color: Off-white paint
Safety grate or screen: ○ Yes, ◉ No

Shelving/Racks or Partitions?

○ Partitions, ○ Shelves/Racks, ◉ None/Open

No data required 7 ft
No data required 8 ft
No data required 8 ft
No data required ft

Heating and Air Conditioning Systems

Air Conditioning: Mechanical A/C
Heating System: Gas/Oil Furnace

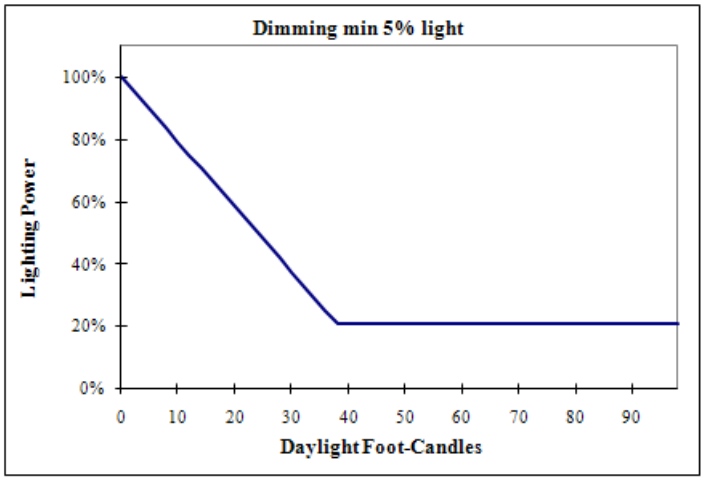
Electric Lighting

Lighting system: Open cell fluorescent
Fixture height 17 ft
Lighting control: Dimming min 5% light

Utilities

Average Elec Cost $0.003 kWh
Heating Fuel Units: Therm
Heating Fuel Cost $1.400 /Therm

Lighting Control Graph - Lighting Setpoint = 40 fc



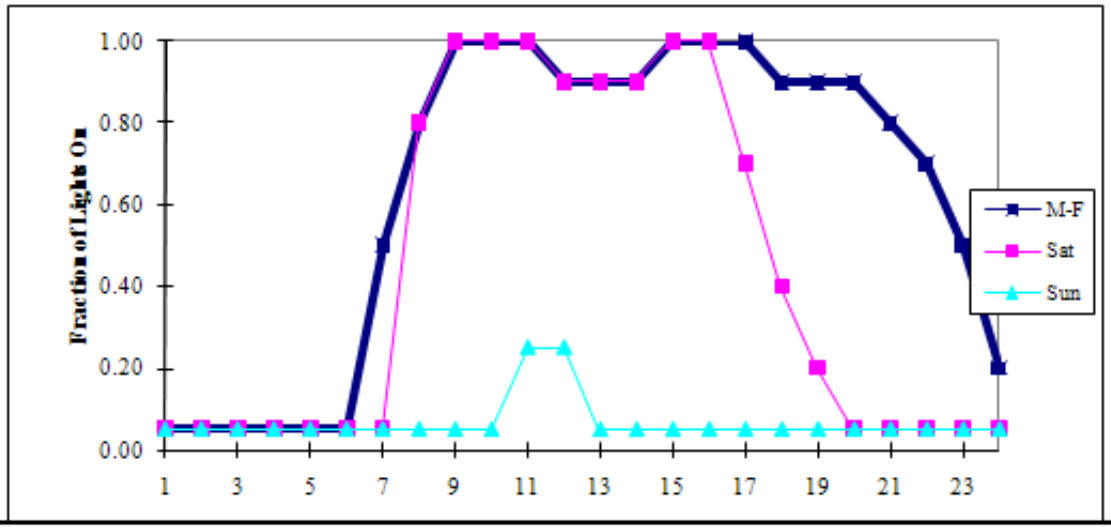
Skylights	Default	User Revisions	Design Input
Skylight shape	Flat	Default	Flat
Height of dome (Rise) (ft)	0		0
Visible transmittance	100%	34%	34%
Solar heat gain coefficient	100%	32%	32%
Curb type	Wood	Default	Wood
Frame type	Metal w/ thermal brk	Default	Metal w/ thermal brk
Unit U-value (Btu/h•°F•ft^2)	1.000	0.200	0.200
Dirt light loss factor	70%		70%
Screen or safety grate factor	100%		100%
Light well reflectance	70%	90%	90%
Well factor (WF)	88%		88%
Bottom of light well:			
Width (ft)	1.50	4.00	4.00
Length (ft)	30.00		30.00
Diffuser on bottom of well?	No	○ Yes, ◉ No	No

Building	Default	User Revisions	Design Input
Building width (ft)	28	37	37
Building length (ft)	55	Change width or area	41
Wall reflectance	70%	80%	80%
Ceiling reflectance	70%	80%	80%
Floor reflectance	20%	29%	29%
Shelving reflectance	40%		40%
Roof U-value (Btu/h•°F•ft^2)	0.063		0.063

Electric Lighting	Default	User Revisions	Design Input
Lighting setpoint (fc)	30	40	40
Task height (ft)	2.50		2.50
Lighting power density (W/ft^2)	0.88	1.40	1.40
Fraction lighting uncontrolled	10%		0.10
Lighting schedule	Class, University	Default	Class, University
Room and luminaire depreciation	80%		80%

Electric Lighting	Default	User Revisions	Design Input
Lighting setpoint (fc)	30	40	40
Task height (ft)	2.50		2.50
Lighting power density (W/ft^2)	0.89	1.40	1.40
Fraction lighting uncontrolled	10%		0.10
Lighting schedule	Class, University	Class, University	Class, University
Room and luminaire depreciation	80%		80%

Lighting Schedule Graph



SkyCalc: Skylight Design Assistant - Graphic Results

Company Name: George Mason University

Project Description: Art & Visual Technology Building

Flat Skylight Effective Aperture = 1.24%, Skylight to Floor Ratio (SFR) = 5.93%

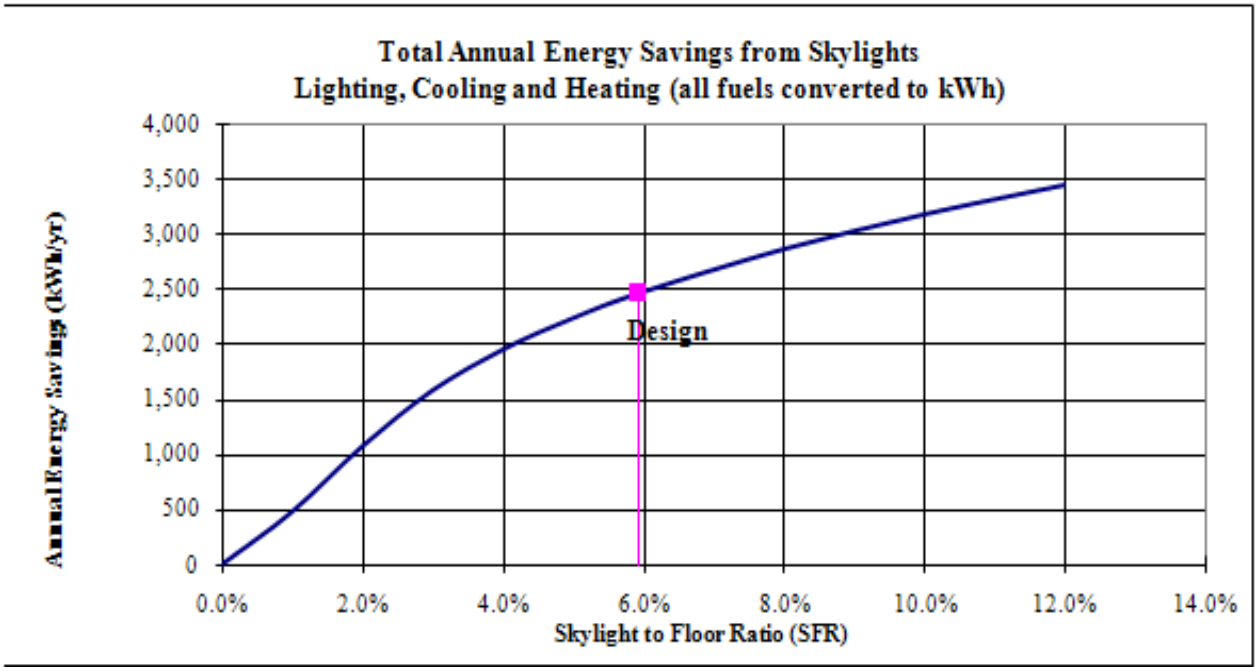
Average daylight footcandles (fc)

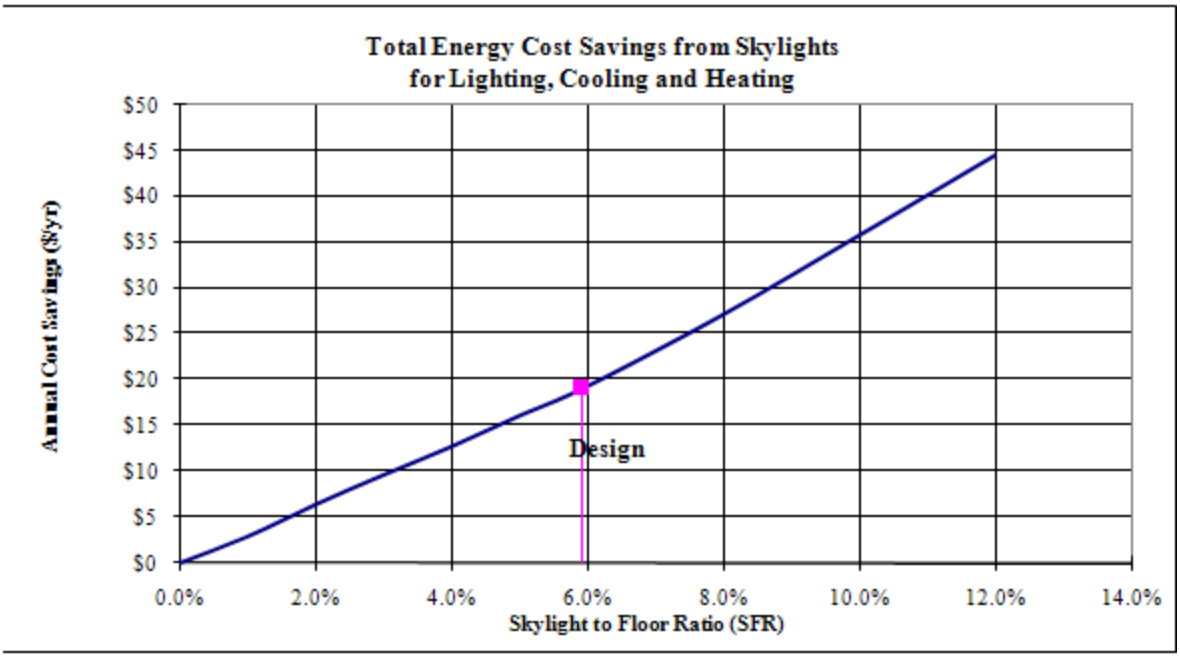
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	1	9	18	29	37	39	34	24	14	5	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	5	14	26	42	50	53	51	39	23	9	2	0	0	0	0	0	0
Mar	0	0	0	0	0	0	2	12	27	47	63	74	75	68	55	39	21	7	0	0	0	0	0	0
Apr	0	0	0	0	0	1	9	23	46	65	80	85	87	81	72	51	29	12	2	0	0	0	0	0
May	0	0	0	0	0	4	16	34	58	80	90	97	95	90	83	58	38	19	5	0	0	0	0	0
Jun	0	0	0	0	0	5	20	38	63	88	106	113	116	108	89	63	40	21	7	1	0	0	0	0
Jul	0	0	0	0	0	3	15	34	57	78	90	96	96	96	90	73	49	24	7	1	0	0	0	0
Aug	0	0	0	0	0	1	11	28	54	82	100	106	105	94	80	61	34	15	4	0	0	0	0	0
Sep	0	0	0	0	0	0	5	19	40	63	79	92	89	75	59	38	19	5	0	0	0	0	0	0
Oct	0	0	0	0	0	0	2	10	25	43	56	63	64	57	42	23	9	1	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	5	15	28	38	45	42	36	25	13	3	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	1	7	16	25	30	32	27	18	10	2	0	0	0	0	0	0	0

Design Illuminance = 40 fc

< 1 fc; < 20 fc; < 40 fc; > 40 fc;

Location = Washington DC





SkyCalc: Skylight Design Assistant - Tabular Results

Company Name: George Mason University
Project Description: Art & Visual Technology Building

Electric Lighting Usage	kWh/yr		
Ltg. Energy without Skylights	7,289	Lighting Fraction Saved	30%
Lighting Energy w/ Skylights	5,119	Full daylighting (h/yr)	936

Update Results

Savings from Design Skylighting System			
Savings		Annual Energy Savings (kWh/yr)	Annual Cost Savings ($/yr)
Lighting		2,170	$6
Cooling		9	$0
Heating		275	$13
Total		**2,454**	**$19**

SkyCalc Evaluation

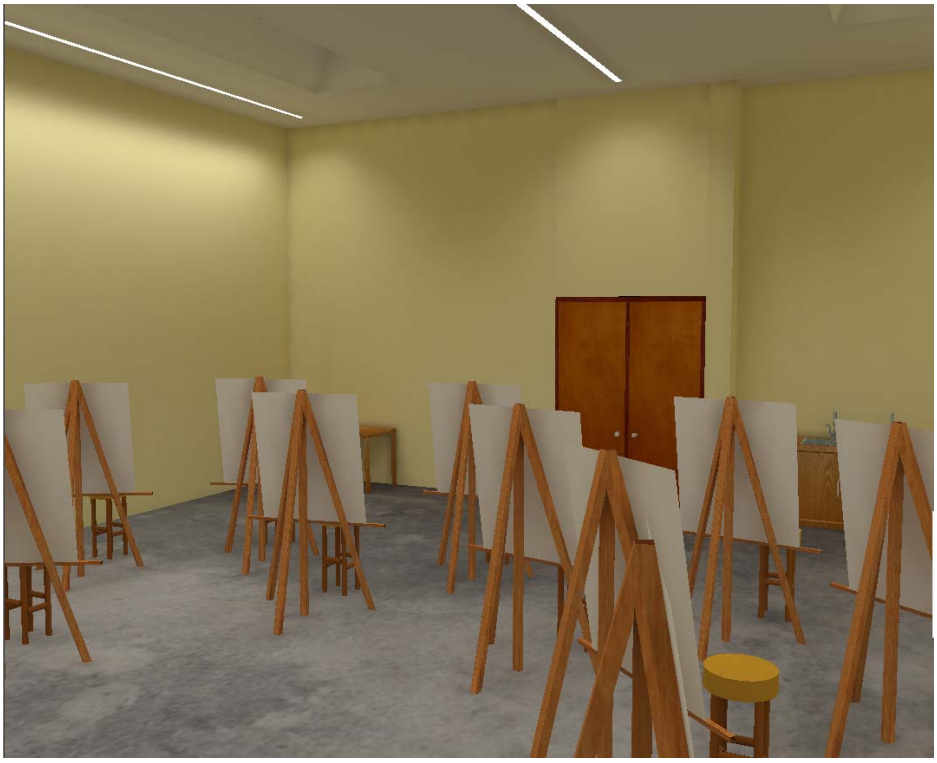
Through the use of SkyCalc it was found that the skylighting system will save up to 2,454 kWh per year or roughly $20 per year for each typical painting studio. There are three additional identical spaces; if the skylights are implemented in these spaces as well the owner could expect to see

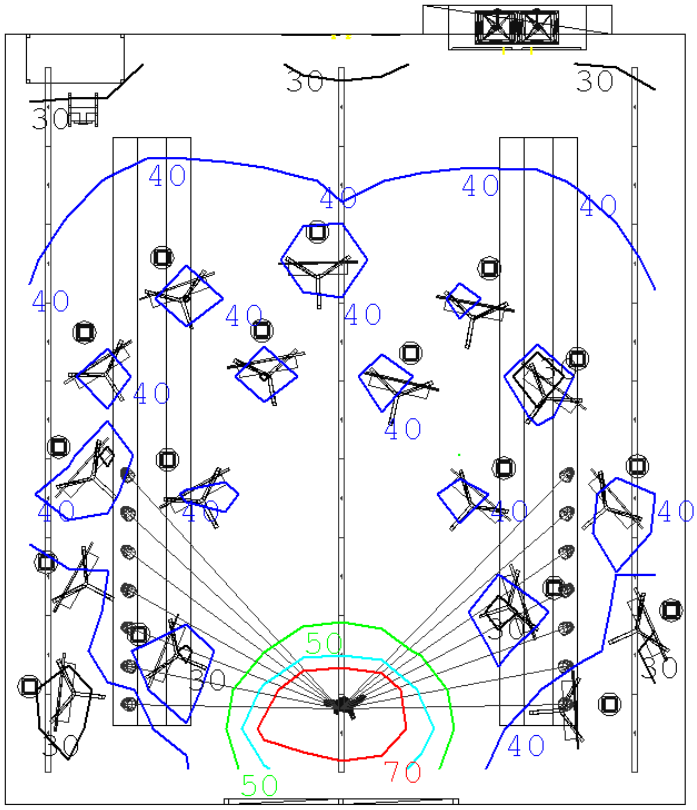
potential annual savings near 10,000 kWh and $80. One thing to note is that these are maximum values as occupants will sometimes close off the skylights to obtain a specific lighting condition for painting purposes.

As noted by graphs, a higher sky to floor ratio could have been utilized for additional energy and cost savings. This was not pursued due to the increasing costs of construction and materials versus the quickly marginalized returns.

Though not within the scope of this report and analysis, the architectural impacts would then need to be addressed, as the clerestories, which were replaced with skylights, provided a rhythm and distinct look for the east façade. Given the improvement of daylight into the space and the fact that it doesn't cost additional money, I would recommend the addition of skylights in the typical painting studio classrooms.

AGI32 Analysis (Electric Only)

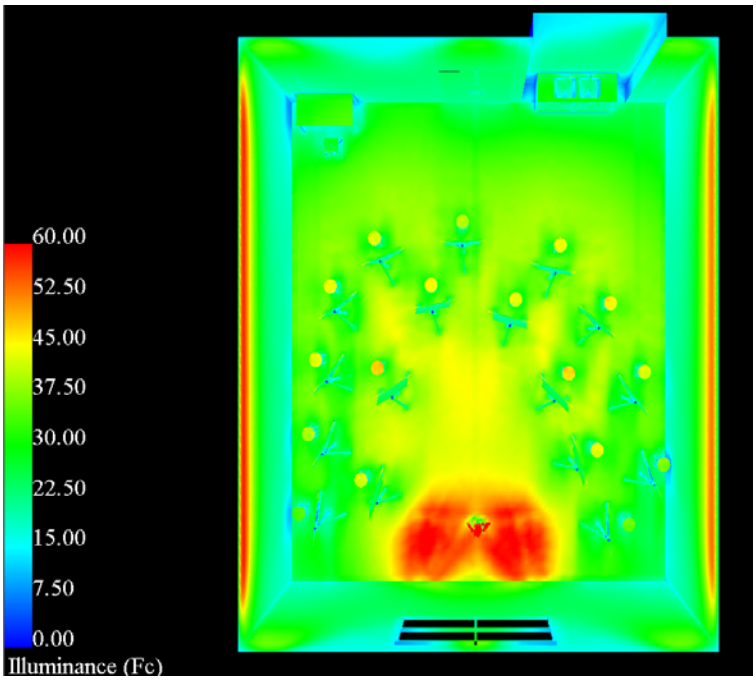




Project_1
Calc Pts

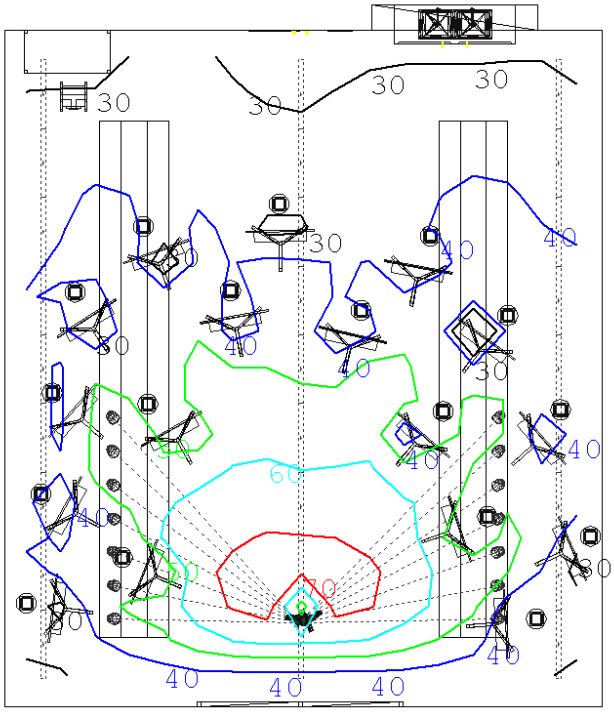
CalcPts
Illuminance Values(Fc)
Average=41.56 Maximum=105
Minimum=0.0 Avg/Min=N.A.
Max/Min=N.A.

North



Illuminance Data (Daylight only)

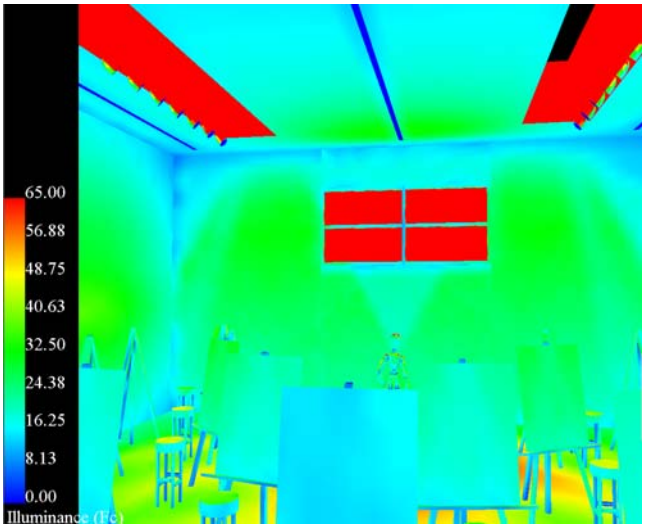
September 4th, 11:00am



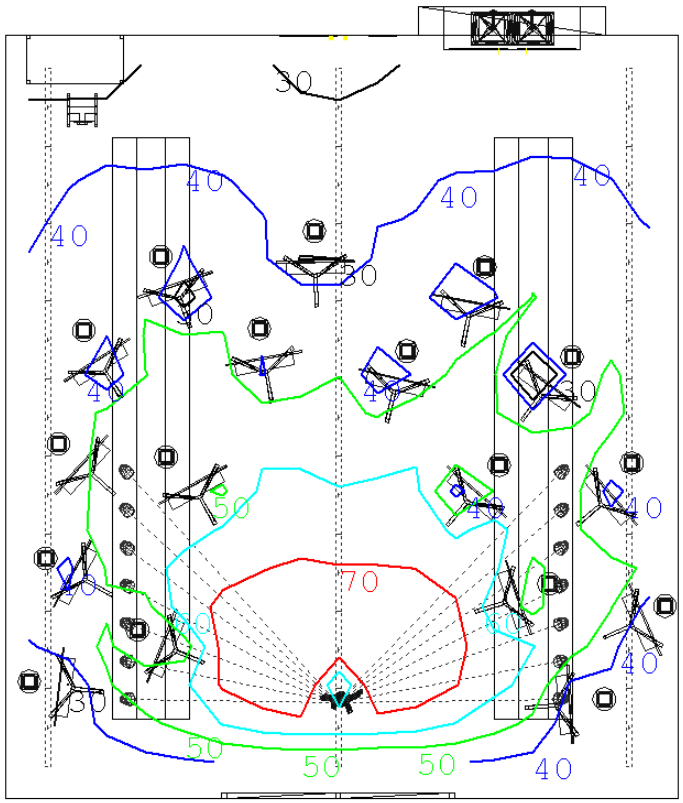
Project_1
Calc Pts

CalcPts
Illuminance Values(Fc)
Average=43.15 Maximum=74.9
Minimum=0.0 Avg/Min=N.A.
Max/Min=N.A.

North



May5th 11:00am



Project_1
Calc Pts

CalcPts
Illuminance Values(Fc)
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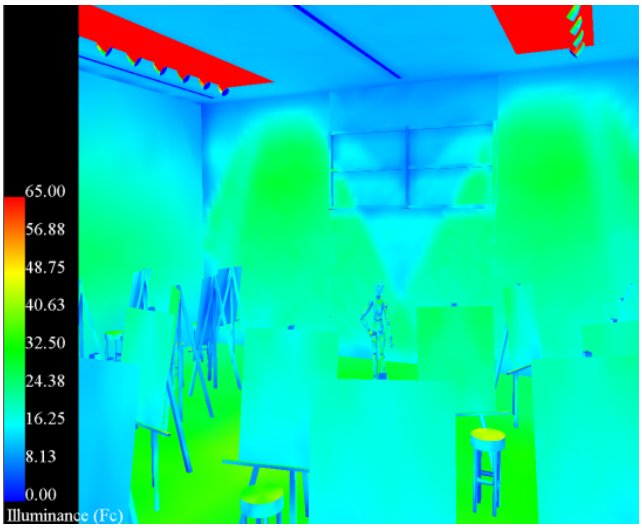
Minimum=0.0 Avg/Min=N.A.
Max/Min=N.A.

North



Evaluation

The new lighting design was able to achieve a more uniform distribution of daylight throughout the year. With the addition of a motorized shading system and a photocell, occupants of the space can reap the benefits while still having total control of the environment they paint in. The creation of the splayed skylight wells allowed for the track lighting to be mounted at the edge of the well, unifying the daylight and electric lighting systems. The electric lighting system creates a sleek, unique feel to the space through the linear slot downlighting. These design goals were met while still meeting ASHRAE and IESNA standards and recommendations.

Exhibit Gallery

The exhibition gallery is located directly off the main lobby of the building. This space is roughly 72'x35' with the East wall angled outward. The exhibit gallery is to display student work for students and professionals. Art of all mediums will be displayed in this space, therefore flexibility is a must. One key note to this space is that there is very little natural light in the space, as the only window is on the North East corner of the space. Therefore, limiting UV light on exhibits should not be an issue.

Surface Finishes

Floor: Sealed Concrete ρ= .38

Walls: painted gypsum wall board ρ= .85

Doors: Finished Wood ρ= .15

Ceiling: Wood Paneling ρ= .30

Existing Design

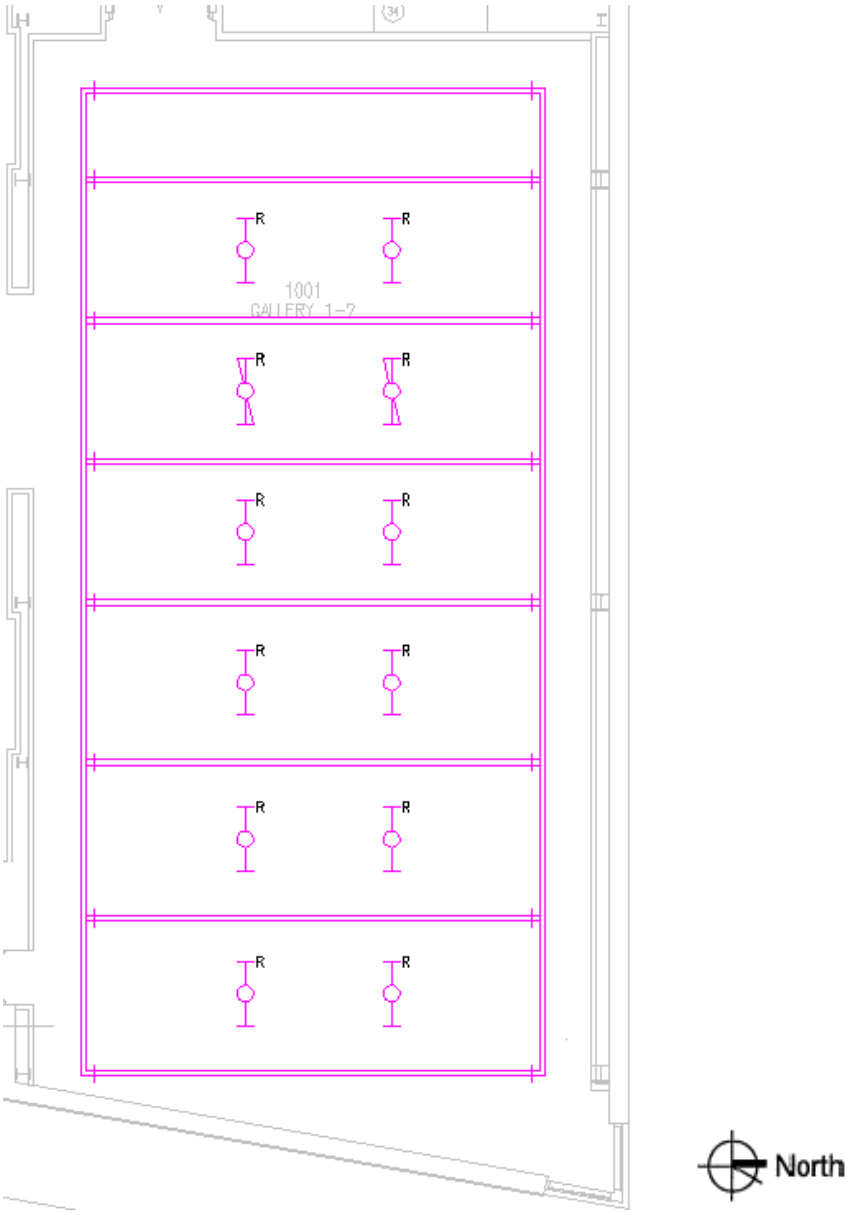
The existing designed used a suspended uni-strut grid to attach the track lighting system. The grid hangs from 12' above the finished floor. Meanwhile, pendant direct/indirect fixtures provided the ambient light for the space.

Power Consumed with Existing Design:

Direct/Indirect Fixtures 768W

Track Lighting 8,000W (8 circuits of 10 fixtures at 100W each)

Total wattage used 8,768W >> 2,345W



Design Criteria

Horizontal Illuminance

The IESNA handbook recommends 30fc on horizontal surfaces within an art exhibit. However, I feel that this would take away from the ambiance of the space, thus I am targeting 15 fc.

Vertical Illuminance

The IESNA handbook recommends 5fc on vertical surfaces within an art exhibit.

Appearance of Space and Luminaires

The fixtures within the art gallery should draw as little attention to the actual fixture themselves. The main purpose of a gallery is to look at the exhibit and the lighting system should embrace this notion rather than try and steal attention away.

Direct Glare

It is important to keep the spotlights out of direct view. As long as fixtures are aimed properly this should be easily achievable.

Light Distribution on Surfaces

Uniformity of light distribution on the painting and other two-dimensional displays is of the utmost importance. However, for any three-dimensional displays crisp, distinct shadows can help the display have a clear distinct view.

Luminances of Room Surfaces

Luminances of non display surfaces should be low to not draw attention away.

Modeling of Faces and Objects

The modeling of objects is extremely important to bring out the texture, depth, shape of the displays whether they are anything from paintings to sculptures. These features are what make many art pieces interesting and unique.

Reflected Glare

This will be an issue dependent on the finish of the display (especially glossy and glass encased). In these situations aiming will need to be done to avoid reflections of source in the display.

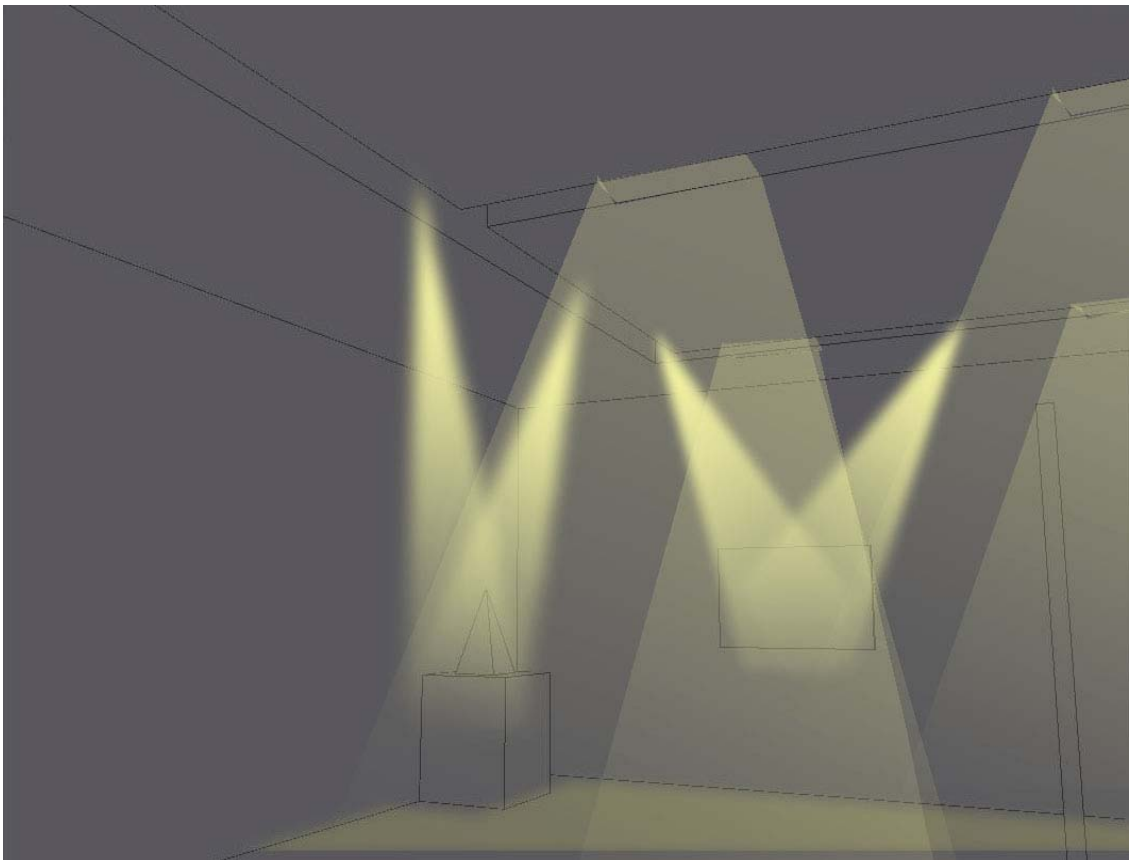
System Control and Flexibility

Flexibility within this space is crucial to be able to effectively light all types of work and layouts for the space. Control of fixtures is very important to have the ability to turn on and off fixtures and dim them as needed. Also, the ability to easily re-aim fixtures for new displays will keep the lighting design working as intended.

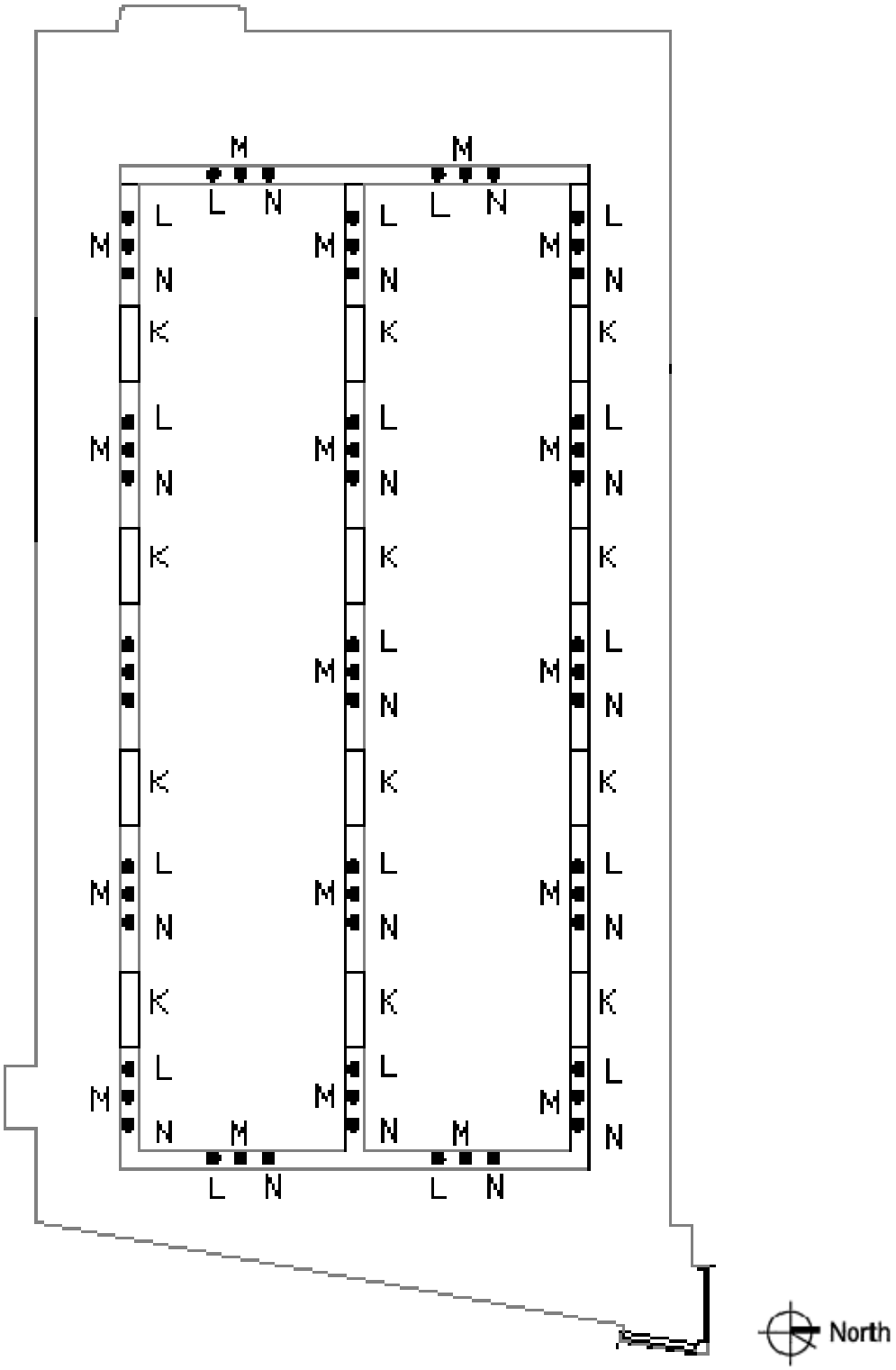
Design Synopsis

My final lighting design for the exhibit gallery was very similar to my schematic design presented at Lutron during fall semester. However, there has been much iteration to finalize fixture selections, especially on what track fixtures to provide. As part of my design, I wanted to provide the maximum amount of flexibility to the lighting system while keeping an extremely low profile for the lighting design. I wanted to keep a very low profile to keep the focus on the exhibits. To help with this goal I selected black baffled video-conference fixtures for the general purpose 1'x4's. These were selected because they will disappear in the black channels I have created to house the lighting design. Then the track lighting will also be recessed in the channel and will have a black finish. I ended up choosing a 10°, 25° and 35° lamps to provide a wide range of distributions for each display.

Initial Concept Sketch

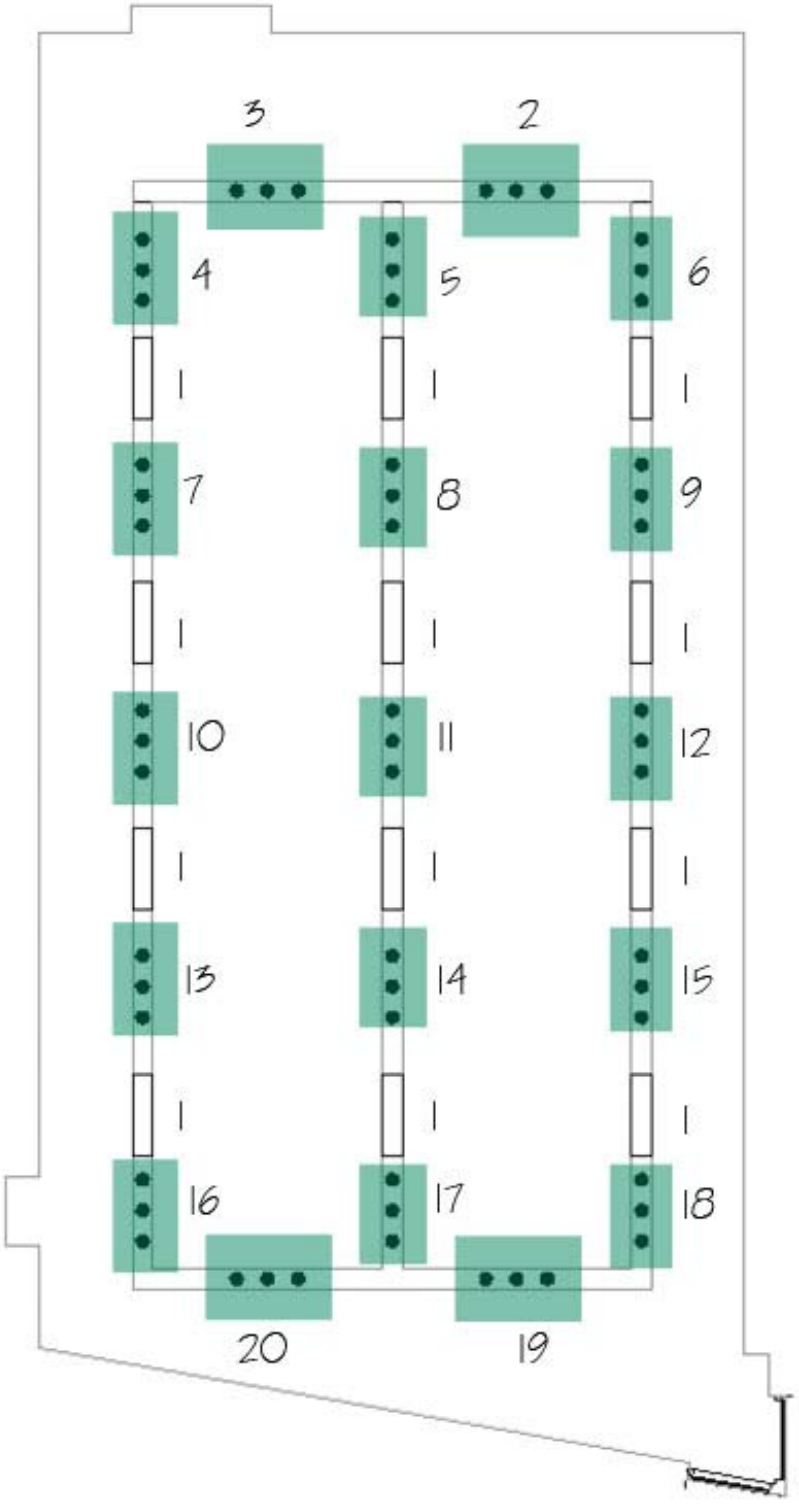


Lighting Layout



** Note: See Appendix J for a 1/8" = 1'-0" Plan*

Lighting Zone Plan



Controls

Control of this space will incorporate the use of Lutron's OMX-4600 unit that has the capability to have 4 predetermined scenes and can control up to 24 zones of light. The first scene would be an all on condition for cleaning and maintenance purposes. The second would have all the type K fixtures off leaving just the accent lights on. The third and fourth scenes would be programmed based on the owners' desire for the appearance of the current display. This gives the owner the flexibility to highlight specific pieces of art work or control overall light levels in the room.

**See appendix C type 2C for the controls cut sheet*

Schedules

Luminaire Schedule

Luminaire Type	Manufacturer	Catalog #	Lamps	Ballast	Volts	Comments
K	Focal Point	FTV/14/D/ 2/T5/E/277/ G/PB/DF/BK	(2) FP28/835 (L1)	M1	120	Recessed 1'x4' troffer, black matte finish louvers. Dimmable Ballast. To be mounted flush with bottom of channel.
L	Lighting Services Inc.	C100-00-B	(1)50PAR20/ H/FL25 (L8)	n/a	120	Recessed Track mounted at top of channel. Black finish housing. 25 degree beam spread.
M	Lighting Services Inc.	C100-00-B	(1)50PAR20/ H/SP10 (L2)	n/a	120	Recessed Track mounted at top of channel. Black finish housing 10 degree beam spread.
N	Lighting Services Inc.	C110-00-B	(1)50PAR30/ HIR/FL35 (L9)	n/a	120	Recessed Track mounted at top of channel. Black finish housing 35 degree beam spread.

**Note: Please See Appendix A for additional information on luminaires, lamps, and ballasts*

Light Loss Factors

Luminaire Type	Maintenance Category	Room Atmosphere	Cleaning Cycle	Initial Lumens	Mean Lumens	LLD	Ballast Factor	LDD	RSDD	LLF
K	IV	Very Clean	12mo.	2600	2418	.93	1.0	.93	.98	.85
L	IV	Very Clean	12mo.	570	498	.87	1.0	.93	.98	.79
M	IV	Very Clean	12mo.	750	-	.9	1.0	.93	.98	.82
N	IV	Very Clean	12mo.	630	-	.9	1.0	.93	.98	.82

ASHRAE Standard 90.1 Power Allowances

Museum – General Exhibition 1.0W/ft^2

Area 35'x67' =2,345ft^2

Exception 9.6.3 (a) "For spaces in which lighting is specified to be in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaires or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0W/ft^2 or such spaces.

Exception allowed wattage = 2,345W

Total allowed wattage = 4,690W

Power Consumption

12 "K" fixtures * 62 input watts/fixture = 744 W

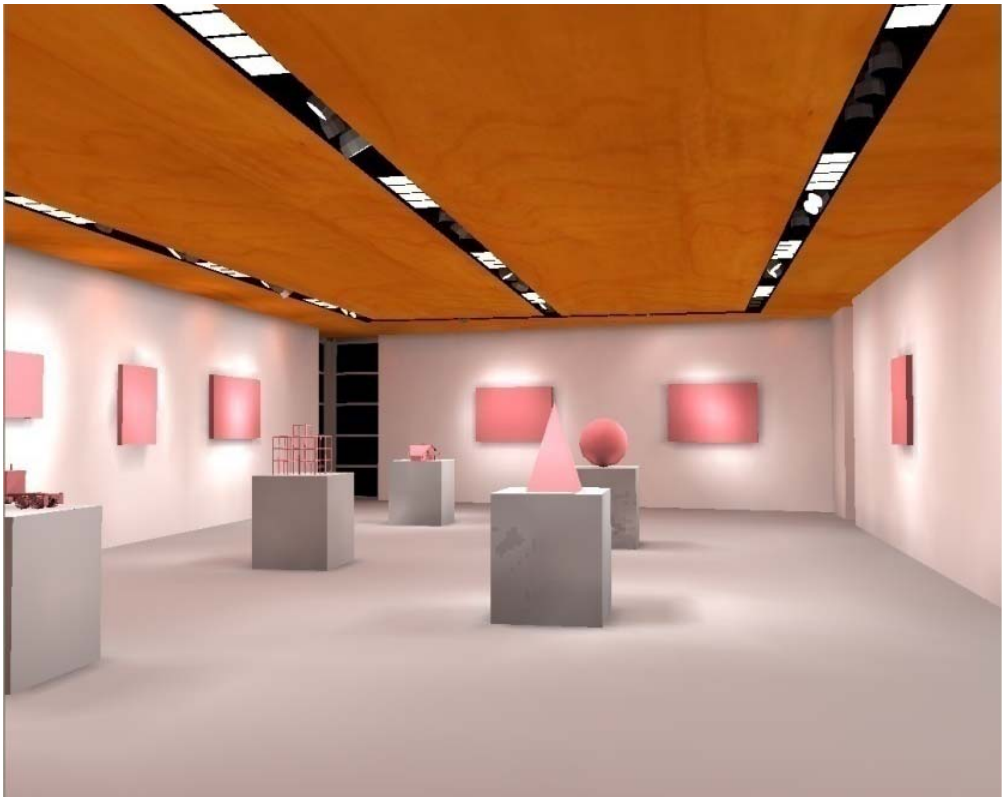
19 "L" fixtures * 50 input watts/fixture = 950 W

19 "M" fixtures * 50 input watts/fixture = 950 W

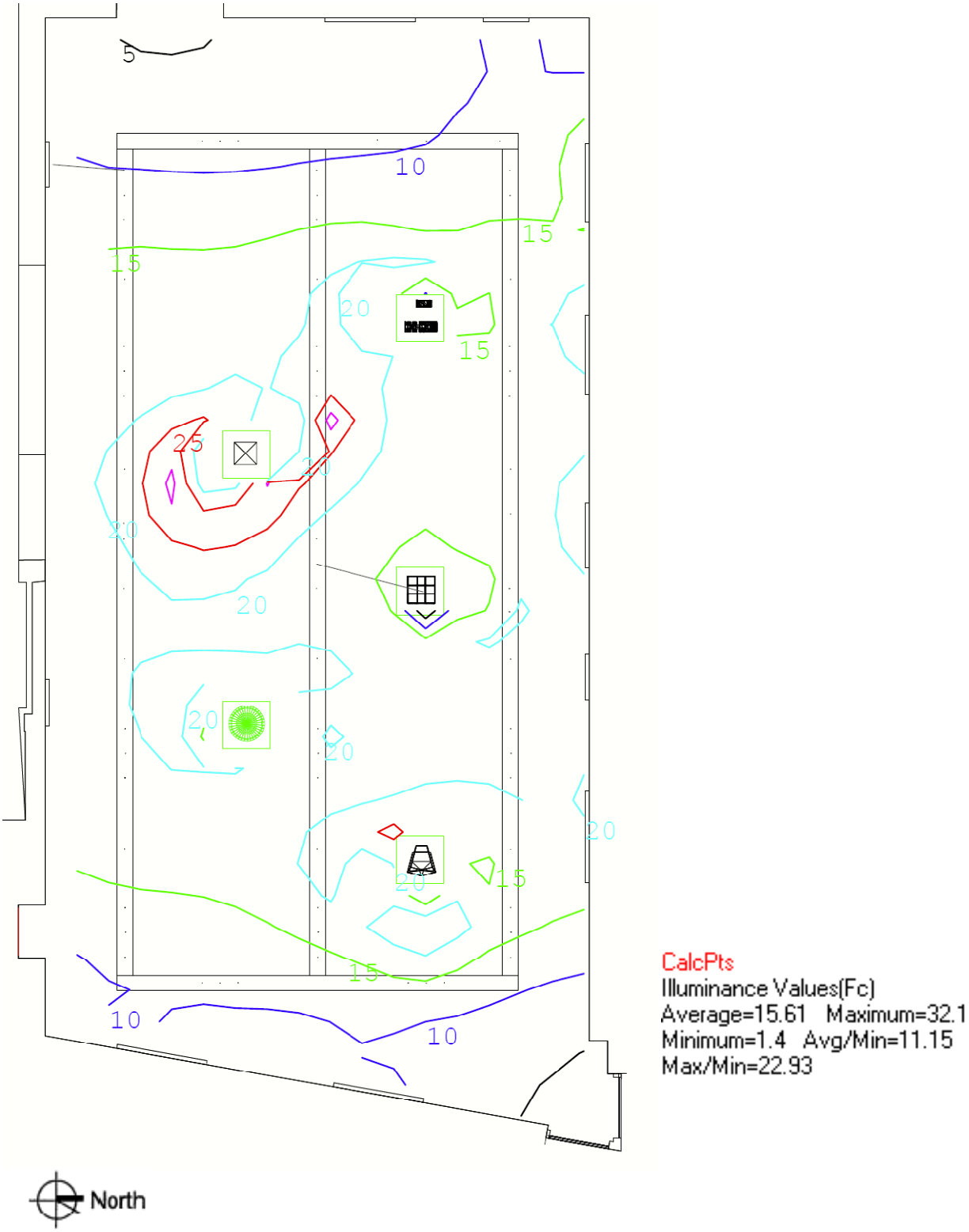
19 "N" fixtures * 50 input watts/fixture = 950 W

Total power consumption = 3,594W <4,690W

AGI Analysis (All On condition)

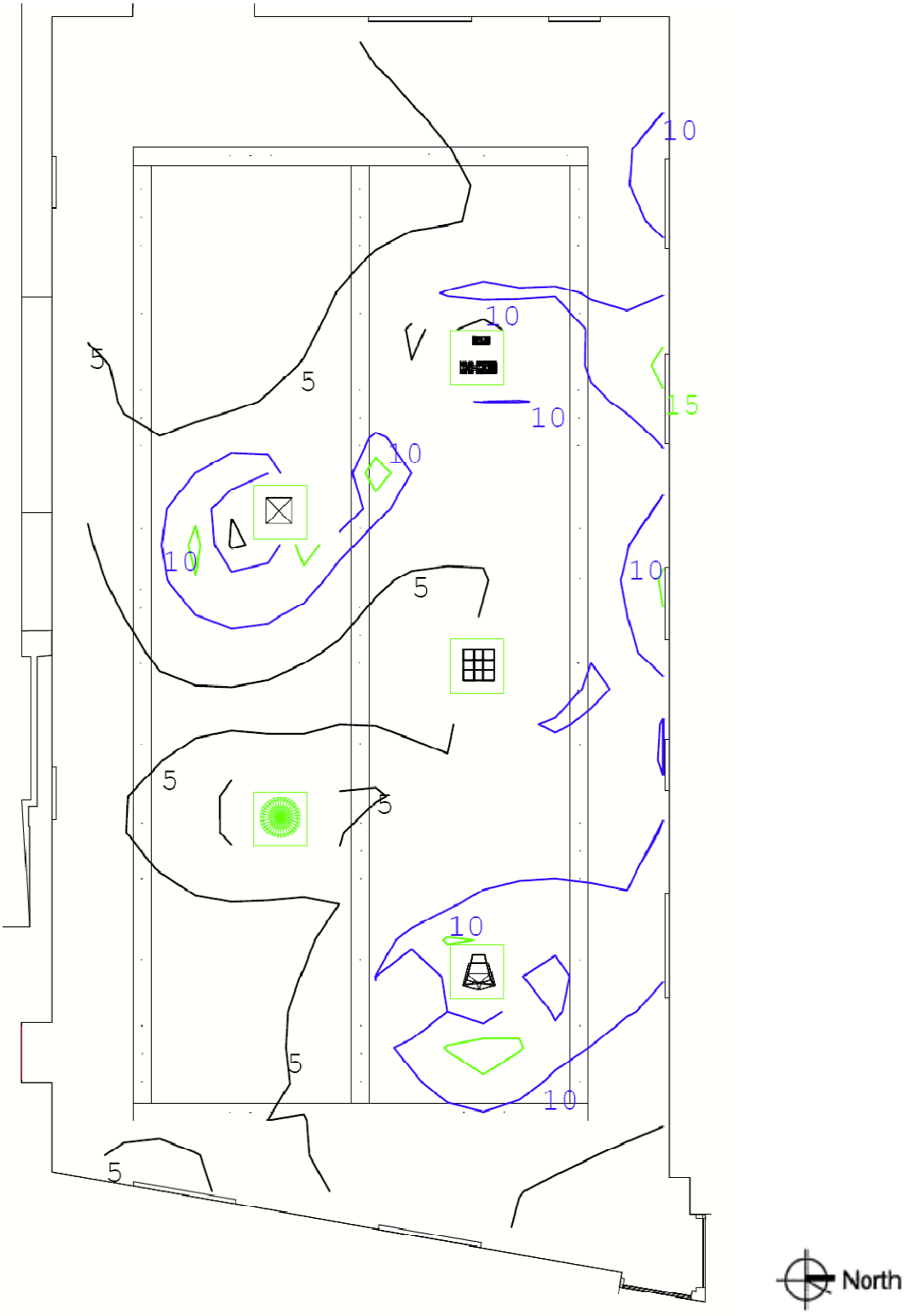


Illuminance Data (All On Condidtion)



AGI Analysis (Accent Fixtures Only)

Illuminance Data (Accent Fixtures only)



Evaluation

The goals of the lighting redesign this space were to provide a flexible lighting system for any configuration of art exhibits and to have a low profile design while meeting ASHRAE standards. Through the use of the recessed channels to house the 1x4 video conference fixtures and the track lighting, the lighting design was able to create a minimal profile within the space. However, I was unable to accurately render how the 1x4 black louvered fixtures would appear within the space. They would be much less apparent than they seem in the all on condition rendered above. With the use of the existing dimmer panel, ambient levels can vary from any full output (all on condition) to where they are off (accent fixtures only). Additionally the accent lighting also has the flexibility to dim from full output (shown) to any other level desired.

Electrical Depth

Introduction

The existing electrical system for each space redesigned in my lighting depth had to be adjusted accordingly to the new design. The following electrical depth will illustrate how these modifications were accommodated.

In addition to adjusting the existing electrical distribution to these spaces, a study was done to evaluate the determine feasibility of implementing a photo voltaic array on the roof of this building. A second study was done to compare standard transformers versus energy efficient ones.

Existing System

The Art & Visual Technology Building utilizes simple radial distribution at 480Y/277V, 3ϕ, 4W. It originates at the 2000A switchboard, which is located in the lower level main electrical room. The main switchboard has ten internal circuit breakers; two are dedicated to the automatic transfer switches, six go to distribution panels throughout the building and the final two are dedicated to each elevator. There are also four spaces left open in the switchboard with frame sizes ranging from 250A to 600A. Distribution is divided into panels that feed the North end of the building and those that feed the South. On the lower level, the main electric room feeds the South end of the building, while there is an electrical closet that feeds the North. On the floors above, electrical closets located in North and South ends of building feed their respective end. Each closet contains 480Y/277V 3ϕ, 4W panels, transformers and 208Y/120 3ϕ, 4W panels. Emergency power is supplied from an 80kW diesel generator and is integrated into normal building power thru automatic transfer switches

Main Entrance Courtyard

Fed from the same panel as the entry lobby, the lighting circuits at the main entrance façade also have a great distance for the conductors to run. One of the LED fixtures and recessed step lights both are low-voltage, with integral transformers, and require 120v power.

Branch Circuit Redesign

Please refer to the proceeding panelboard and power plan for additional information.

Panel L2N Circuit 6

6 "G" fixtures * 118 input watts/fixture = 708 W

2 "H" fixtures * 54 input watts/fixture = 108 W

4 "P" Fixtures * 13 input watts/fixture = 52W

Total watts = 868W/ .9PF = 964VA

964VA/277V = 3.5A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit EMT

**Note: 20A*277V * 80% de-rating = 4,432 W Maximum allowed*

Voltage Drop Calculation

$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	277
power factor	0.9
Length (ft)	220
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.749
Current (A)	3.5
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	2.693
% V_{drop}	**0.972**

0.972% < 3% maximum per NEC recommendations

Panel R2NA Circuit 45

6 "I" fixtures * 20 input watts/fixture = 120 W

43 "J" fixtures * 6 input watts/fixture = 258 W

3 "O" Fixtures * 280 input watts/fixture = 840W

1029W/1.0 PF = 1029VA

1029VA/120 V = 8.58A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit

**Note: 20A*120V * 80% de-rating = 1,920 W Maximum allowed*

Voltage Drop Calculation

$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	120
power factor	1
Length (ft)	205
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.917
Current (A)	8.6
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	6.759
% V_{drop}	**5.633**

3.177% > 3% maximum per NEC recommendations

Resize to #10

Circuit Voltage	120
power factor	1
Length (ft)	205
Wire Size	#10
$V_{drop/(1000\ A\ ft)}$	1.2
Current (A)	8.6
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	4.231
% V_{drop}	**3.526**

3.526% > 3% maximum per NEC recommendations

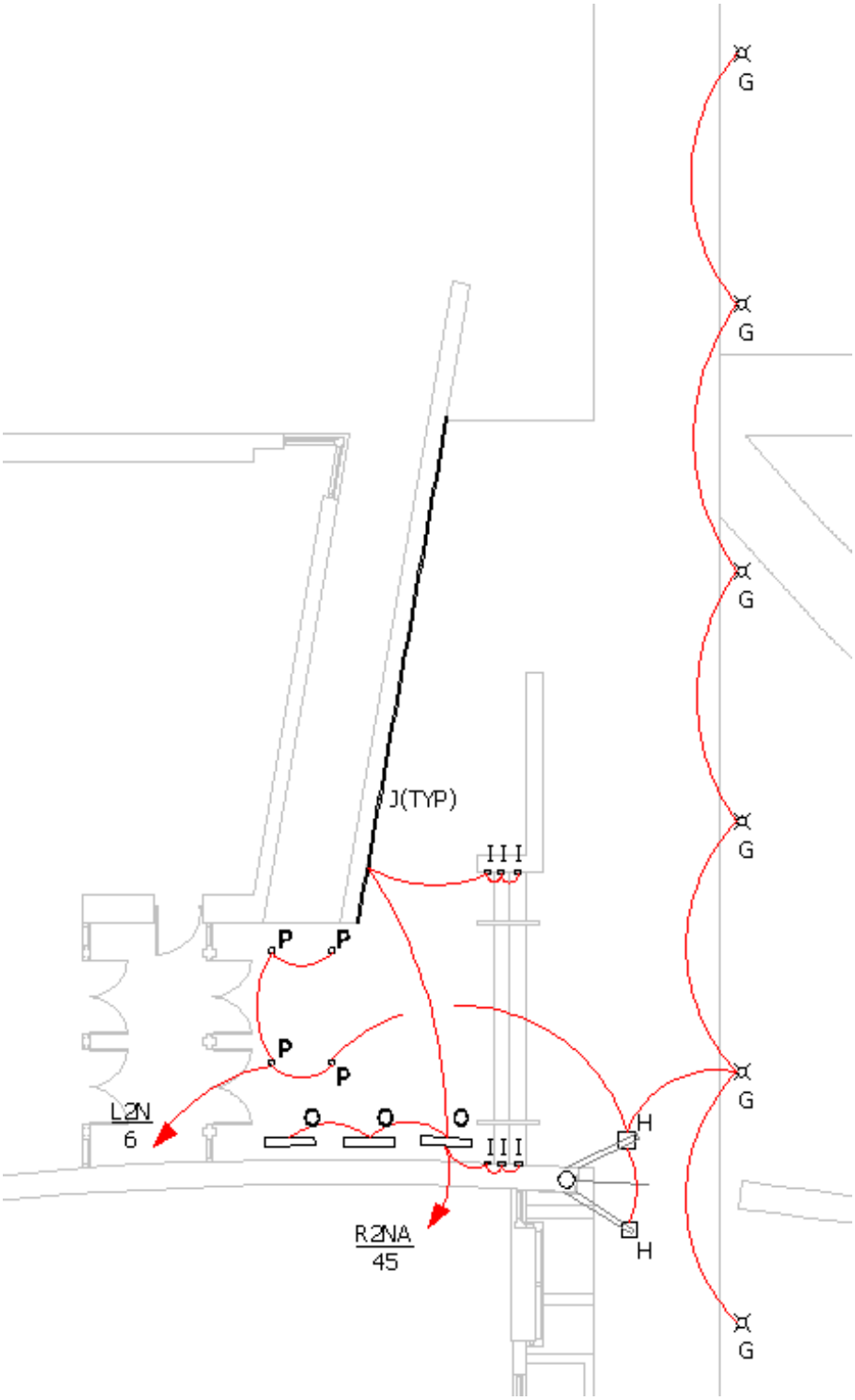
Resize to #10

Circuit Voltage	120
power factor	1
Length (ft)	205
Wire Size	#8
$V_{drop/(1000\ A\ ft)}$	0.75
Current (A)	8.6
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	2.645
% V_{drop}	**2.204**

2.204% < 3% maximum per NEC recommendations

-> **2#8 Copper THWN, 20A single pole breaker, ¾" conduit**

New Lighting Power Plan



** Note: See Appendix G for a 1/8" = 1'-0" Plan*

Existing L2N Panelboard

PANELBOARD: L2N		BUS RATING:							60	A		MAIN OCP OR	
MIN AIC:		VOLTAGE:							208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:							SURFACE			WIRES:	5
LOCATION:		NOTES:											
				LOAD, VA									
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	CIRCUIT DESIGNATION
West Corridor	1	20	1	1100									
West Corridor	1	20	2			1000							
East Corridor & Elevator Lobby	1	20	3					900					
East Corridor	1	20	4	700									
Student Lounge	1	20	5			300							
Exterior Lighting	1	20	6					600					
Exterior Lighting	1	20	7	600									
LTG RM 1001	1	20	8			775							
	1	20	9										
	1	20	10										
	1	20	11										
	1	20	12										
	1	20	13										
	1	20	14										
	1	20	15										
	1	20	16										
	1	20	17										
	1	20	18										
	1	20	19										
	1	20	20										
	1	20	21										
PHASE CONNECTED LOAD, VA					2400		2075		1500				
PHASE BALANCE					20.50%		4.18%		-24.69%				
TOTAL CONNECTED LOAD, VA		5975											
FUTURE GROWTH - 25%		1494											
TOTAL + FUTURE LOAD, VA		7469											
TOTAL CURRENT, A		21											
DESIGN CURRENT, A		26											
MINIMUM MAIN OCP		100											

Existing R2NA Panelboard

PANELBOARD: R2NA		BUS RATING:						400 A		MAIN OCP OR MLO				
MIN AIC:		VOLTAGE:						208 120 V		PHASE(S):		3		
NEMA 1 ENCLOSURE		MOUNTING:						SURFACE		WIRES:		4		
LOCATION:		NOTES:						200% NEUTRAL						
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	CH CIRCUIT DESIGNATION	
Recept - WC	1	20	1	720	784					2	20	1	SOUND BOOTH	
Recept - RM 1126 / 1127	1	20	3			1080				4	20	1	SPARE	
Recept - WC	1	20	5					720		6	20	1	SPARE	
Recept - Corridor (Flat Panel Display)	1	20	7	600						8	20	1	SPARE	
Recept - Corridor	1	20	9			900	660			10	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	11					360	600	12	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	13	720	600					14	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	15			720	600			16	20	1	Recept - RM 1006	
Recept - RM 1004 (AV)	1	20	17					840	600	18	20	1	Recept - RM 1006	
Projector - RM 1004	1	20	19	300	360					20	20	1	Recept - RM 1006	
Recept - Corridor (Flat Panel Display)	1	20	21			600	1200			22	20	1	Recept - RM 1006	
Recept - Corridor	1	20	23					360	1200	24	20	1	Recept - RM 1006	
EF-4	1	20	25	528	912					26	20	1	Recept - RM 1006	
Recept - Proj. RM 1007	1	20	27			300	912			28	20	1	Recept - RM 1006	
Recept - Proj. RM 1007	1	20	29					300	900	30	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	31	360	900					32	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	33			540	360			34	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	35					540	300	36	20	1	Projector - RM 1005	
Recept - RM 1007	1	20	37	540	750					38	20	1	LTG - RM 1005	
Recept - RM 1007 (AV)	1	20	39			840	1875			40	20	1	LTG - RM 1021	
Recept - RM 1125	1	20	41					180	1875	42	20	1	LTG - RM 1022	
Recept - RM 1007 (AV)	1	20	43	840	1875					44	20	1	LTG - RM 1023	
	1	20	45				0			46	20	1	SPARE	
	1	20	47						1125	48	20	1	LTG - RM 1004	
	1	20	49		180					50	20	1	Trap Priming Cabinet	
	1	20	51							52	20	1		
	1	20	53							54	20	1		
	1	20	55							56	20	1		
	1	20	57							58	20	1		
	1	20	59							60	20	1		
	1	20	61							62	20	1		
	1	20	63							64	20	1		
	1	20	65							66	20	1		
	1	20	67							68	20	1		
	1	20	69							70	20	1		
	1	20	71							72	20	1		
	1	20	73		5260					74				
	1	20	75				4792			76	150	3	PNL R2NF	
	1	20	77						4008	78				
	1	20	79		7050					80				
	1	20	81				6450			82	80	3	PNL R2ND	
	1	20	83						5670	84				
PHASE CONNECTED LOAD, VA					23279		21829		19578					
PHASE BALANCE					7.96%		1.24%		-9.20%					

TOTAL CONNECTED LOAD, VA	64686
FUTURE GROWTH - 25%	16172
TOTAL + FUTURE LOAD, VA	80858
TOTAL CURRENT, A	224
DESIGN CURRENT, A	281
MINIMUM MAIN OCP	400

Redesigned L2N Panelboard

PANELBOARD: L2N		BUS RATING:								60	A		MAIN OCP	60A MCB
MIN AIC:		VOLTAGE:								208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:								SURFACE			WIRES:	5
LOCATION:		NOTES:												
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	CIRCUIT DESIGNATION	
West Corridor	1	20	1	747										
West Corridor	1	20	2			952								
East Corridor & Elevator Lobby	1	20	3					644						
East Corridor	1	20	4	652										
Lobby Lighting	1	20	5			1317								
Exterior Lighting	1	20	6					964						
Spare	1	20	7	0										
Lobby Cove Lighting	1	20	8			348								
	1	20	9											
	1	20	10											
	1	20	11											
	1	20	12											
	1	20	13											
	1	20	14											
	1	20	15											
	1	20	16											
	1	20	17											
	1	20	18											
	1	20	19											
	1	20	20											
	1	20	21											
PHASE CONNECTED LOAD, VA					1399		2617		1608					
PHASE BALANCE					-25.37%		39.60%		-14.22%					
TOTAL CONNECTED LOAD, VA		5624												
FUTURE GROWTH - 25%		1406												
TOTAL + FUTURE LOAD, VA		7030												
TOTAL CURRENT, A		20												
DESIGN CURRENT 1.25 CONT. Factor		24												
MINIMUM MAIN OCP		60												

*Note red highlighted circuits correspond to the lobby and blue highlighted correspond to the main façade.

Main Overcurrent Protection

60A breaker

New Feeder Size

(4) #6 and (1) #10 ground in 1" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Redesigned L2N Panelboard

PANELBOARD: R2NA		BUS RATING:						400 A		MAIN OCP: 3P 300A MCI				
MIN AIC:		VOLTAGE:						208 120 V		PHASE(S):		3		
NEMA 1 ENCLOSURE		MOUNTING:						SURFACE		WIRES:		4		
LOCATION:		NOTES:												
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	NCH CIRCUIT DESIGNATION	
Recept - WC	1	20	1	720	784					2	20	1	SOUND BOOTH	
Recept - RM 1126 / 1127	1	20	3			1080				4	20	1	SPARE	
Recept - WC	1	20	5					720		6	20	1	SPARE	
Recept - Corridor (Flat Panel Display)	1	20	7	600						8	20	1	SPARE	
Recept - Corridor	1	20	9			900	660			10	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	11					360	600	12	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	13	720	600					14	20	1	Recept - RM 1006	
Recept - RM 1004	1	20	15			720	600			16	20	1	Recept - RM 1006	
Recept - RM 1004 (AV)	1	20	17					840	600	18	20	1	Recept - RM 1006	
Projector - RM 1004	1	20	19	300	360					20	20	1	Recept - RM 1006	
Recept - Corridor (Flat Panel Display)	1	20	21			600	1200			22	20	1	Recept - RM 1006	
Recept - Corridor	1	20	23					360	1200	24	20	1	Recept - RM 1006	
EF-4	1	20	25	528	912					26	20	1	Recept - RM 1006	
Recept - Proj. RM 1007	1	20	27			300	912			28	20	1	Recept - RM 1006	
Recept - Proj. RM 1007	1	20	29					300	900	30	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	31	360	900					32	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	33			540	360			34	20	1	Recept - RM 1005	
Recept - RM 1007	1	20	35					540	300	36	20	1	Projector - RM 1005	
Recept - RM 1007	1	20	37	540	750					38	20	1	LTG - RM 1005	
Recept - RM 1007 (AV)	1	20	39			840	1875			40	20	1	LTG - RM 1021	
Recept - RM 1125	1	20	41					180	1875	42	20	1	LTG - RM 1022	
Recept - RM 1007 (AV)	1	20	43	840	1875					44	20	1	LTG - RM 1023	
Exterior Lighting	1	20	45			1030	0			46	20	1	SPARE	
	1	20	47						1125	48	20	1	LTG - RM 1004	
	1	20	49		180					50	20	1	Trap Priming Cabinet	
	1	20	51							52	20	1		
	1	20	53							54	20	1		
	1	20	55							56	20	1		
	1	20	57							58	20	1		
	1	20	59							60	20	1		
	1	20	61							62	20	1		
	1	20	63							64	20	1		
	1	20	65							66	20	1		
	1	20	67							68	20	1		
	1	20	69							70	20	1		
	1	20	71							72	20	1		
	1	20	73		5260					74				
	1	20	75				4792			76	150	3	PNL R2NF	
	1	20	77						4008	78				
	1	20	79		7050					80				
	1	20	81				6450			82	80	3	PNL R2ND	
	1	20	83						5670	84				
PHASE CONNECTED LOAD, VA					23279		22859		19578					
PHASE BALANCE					6.27%		4.35%		-10.62%					

TOTAL CONNECTED LOAD, VA	65716
FUTURE GROWTH - 25%	16429
TOTAL + FUTURE LOAD, VA	82145
TOTAL CURRENT, A	228
DESIGN CURRENT, A (1.0 Demand Fac	228
MINIMUM MAIN OCP	300

Main Overcurrent Protection

300A breaker

New Feeder Size

(4) #350 MCM and (1) #4 ground in 3" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Entry Lobby

The entry lobby was divided into two circuits on the basis of constructability. The main circuit feeds all the fixtures on the entry level and the continuous wall sconce on the stairwell column. The second circuit feeds the stairwell cove for the all three levels of the building. One important issue electrically with the lobby was the long length of conductors for each of the circuits. However, by each circuit being at 277V, voltage drop turned out to be not become an issue. Since this is a public space, the primary control for lighting will be done via a time-clock while a manual switch is located remotely by the gallery support area in the NW corner of the lobby.

Branch Circuit Redesign

Please refer to the proceeding panelboard and power plan for additional information.

Panel L2N Circuit 5

21 "C" fixtures * 33 input watts/fixture = 693 W

8 "D" fixtures * 33 input watts/fixture = 264 W

10 "E" fixtures * 36 input watts/fixture = 360 W

Total Watts = 1,317 W/.90PF = 1463VA

1463VA/277V = 5.3A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit EMT

**Note: 20A*277V * 80% de-rating = 4,432 W Maximum allowed*

Voltage Drop Calculation

$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	277
power factor	0.9
Length (ft)	165
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.749
Current (A)	5.3
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	3.059
% V_{drop}	**1.104**

1.104% < 3% maximum per NEC recommendations

Panel L2N Circuit 8

12 "F" fixtures * 29 input watts/fixture = 348 W

348W/.90 PF = 387VA

387VA/277 V = 1.4A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit

**Note: 20A*277V * 80% de-rating = 4,432 W Maximum allowed*

Voltage Drop Calculation

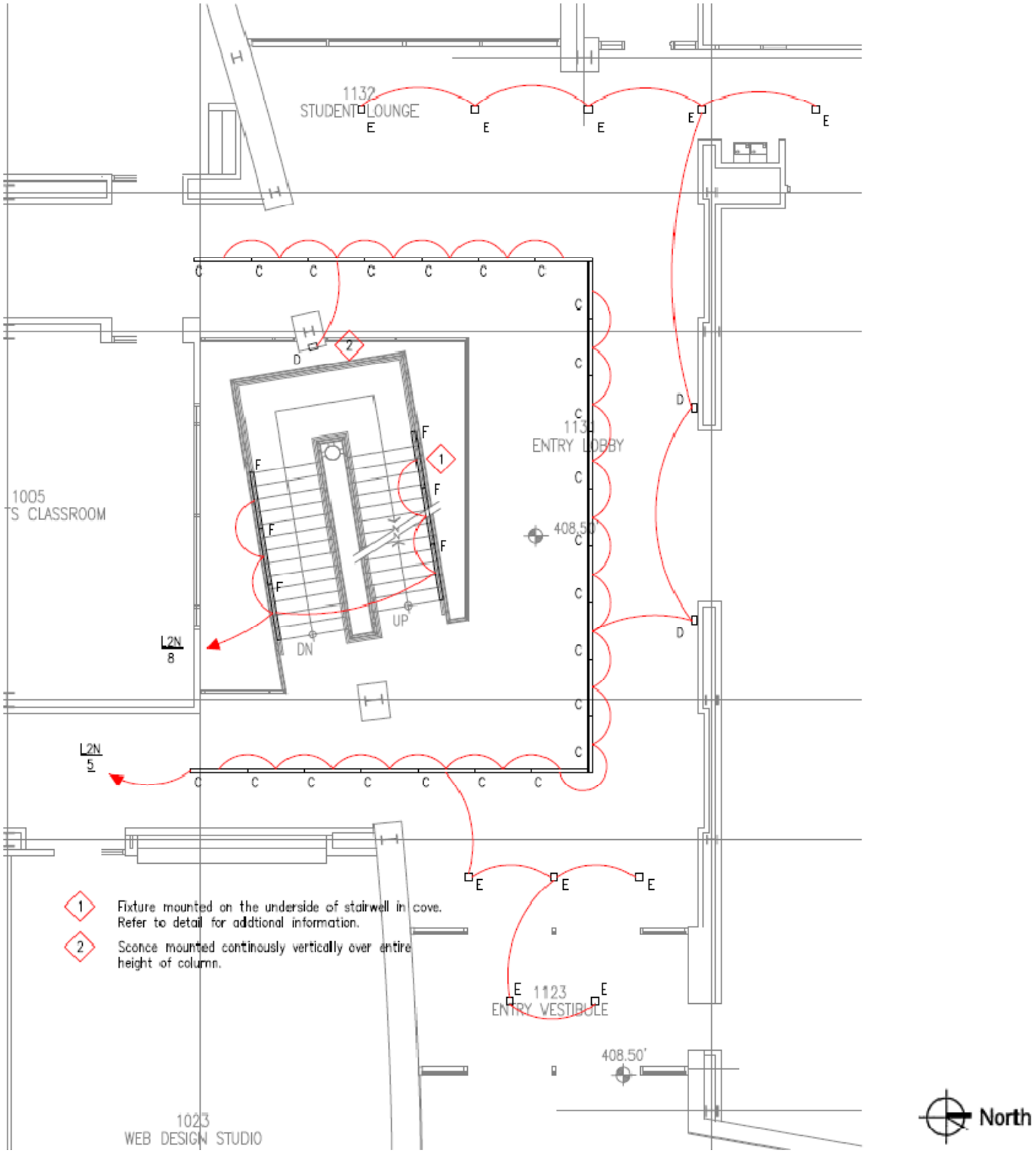
$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	277
power factor	0.9
Length (ft)	140
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.749
Current (A)	1.4
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	0.686
% V_{drop}	**0.248**

0.248% < 3% maximum per NEC recommendations

New Lighting Power Plan



** Note: See Appendix H for a 1/8" = 1'-0" Plan*

Existing L2N Panelboard

PANELBOARD: L2N		BUS RATING:								60	A		MAIN OCP OR	
MIN AIC:		VOLTAGE:								208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:								SURFACE			WIRES:	5
LOCATION:		NOTES:												
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	CIRCUIT DESIGNATION	
West Corridor	1	20	1	1100										
West Corridor	1	20	2			1000								
East Corridor & Elevator Lobby	1	20	3					900						
East Corridor	1	20	4	700										
Student Lounge	1	20	5			300								
Exterior Lighting	1	20	6					600						
Exterior Lighting	1	20	7	600										
LTG RM 1001	1	20	8			775								
	1	20	9											
	1	20	10											
	1	20	11											
	1	20	12											
	1	20	13											
	1	20	14											
	1	20	15											
	1	20	16											
	1	20	17											
	1	20	18											
	1	20	19											
	1	20	20											
	1	20	21											
PHASE CONNECTED LOAD, VA					2400		2075		1500					
PHASE BALANCE					20.50%		4.18%		-24.69%					
TOTAL CONNECTED LOAD, VA		5975												
FUTURE GROWTH - 25%		1494												
TOTAL + FUTURE LOAD, VA		7469												
TOTAL CURRENT, A		21												
DESIGN CURRENT, A		26												
MINIMUM MAIN OCP		100												

Redesigned L2N Panelboard

PANELBOARD: L2N		BUS RATING:							60	A		MAIN OCP	60A MCB
MIN AIC:		VOLTAGE:							208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:							SURFACE			WIRES:	5
LOCATION:		NOTES:											
				LOAD, VA									
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	CIRCUIT DESIGNATION
West Corridor	1	20	1	747									
West Corridor	1	20	2			952							
East Corridor & Elevator Lobby	1	20	3					644					
East Corridor	1	20	4	652									
Lobby Lighting	1	20	5			1317							
Exterior Lighting	1	20	6					660					
Spare	1	20	7	0									
Lobby Cove Lighting	1	20	8			348							
	1	20	9										
	1	20	10										
	1	20	11										
	1	20	12										
	1	20	13										
	1	20	14										
	1	20	15										
	1	20	16										
	1	20	17										
	1	20	18										
	1	20	19										
	1	20	20										
	1	20	21										
PHASE CONNECTED LOAD, VA					1399		2617		1304				
PHASE BALANCE					-21.11%		47.58%		-26.47%				
TOTAL CONNECTED LOAD, VA		5320											
FUTURE GROWTH - 25%		1330											
TOTAL + FUTURE LOAD, VA		6650											
TOTAL CURRENT, A		18											
DESIGN CURRENT 1.25 CONT. Factor		23											
MINIMUM MAIN OCP		60											

**Note Red Highlighted circuits correspond to the entry lobby while blue highlighted circuits correspond to the main courtyard.*

Main Overcurrent Protection

60A breaker

New Feeder Size

(4) #6 and (1) #10 ground in 1" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Painting Studio

The modification of the existing artificial and natural lighting systems led to necessary changes for the electrical demands for this space. Most notably is the added load of the motorized shades. The motors were estimated of having an electrical load of 150kW since electrical specifications were unavailable.

Branch Circuit Redesign

Please refer to the proceeding panelboards and power plan for additional information.

Max Dimmer panel load

9 Type "A" fixtures * 62W/fixture = 558W

558W/1.00 PF = 558VA

558VA/277 V = 2.1A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit EMT

**Note: 20A*120V * 80% de-rating = 1,920 W Maximum allowed*

Voltage Drop Calculation

$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	120
power factor	0.9
Length (ft)	85
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.749
Current (A)	2.1
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	0.624
% V_{drop}	**0.520**

0.520% < 3% maximum per NEC recommendations

Motor Load R3SA Circuit 46

9 Motors * 150W/motor = 1450W

1450W/.80 PF = 1813VA

1813VA/120 V =15.1A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit EMT

**Note: 20A*120V * 80% de-rating = 1,920 W Maximum allowed*

Voltage Drop Calculation

$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	120
power factor	0.8
Length (ft)	85
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.57
Current (A)	15.1
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	4.030
% V_{drop}	**3.358**

3.358% > 3% maximum per NEC recommendations

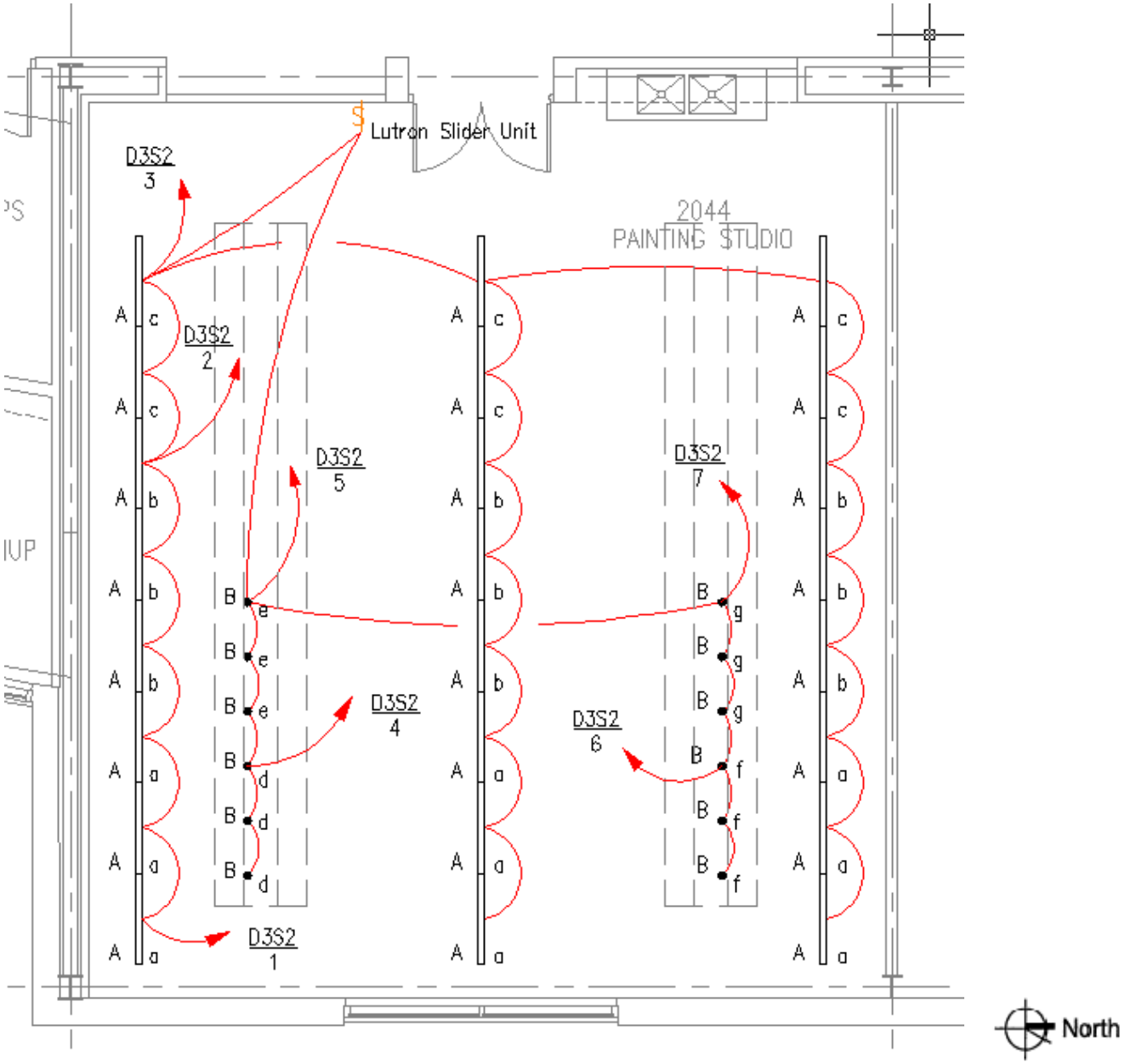
Resize using #10 Wire

Circuit Voltage	120
power factor	0.8
Length (ft)	85
Wire Size	#10
$V_{drop/(1000\ A\ ft)}$	0.993
Current (A)	15.1
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	2.549
% V_{drop}	**2.124**

2.124% < 3% maximum per NEC recommendations

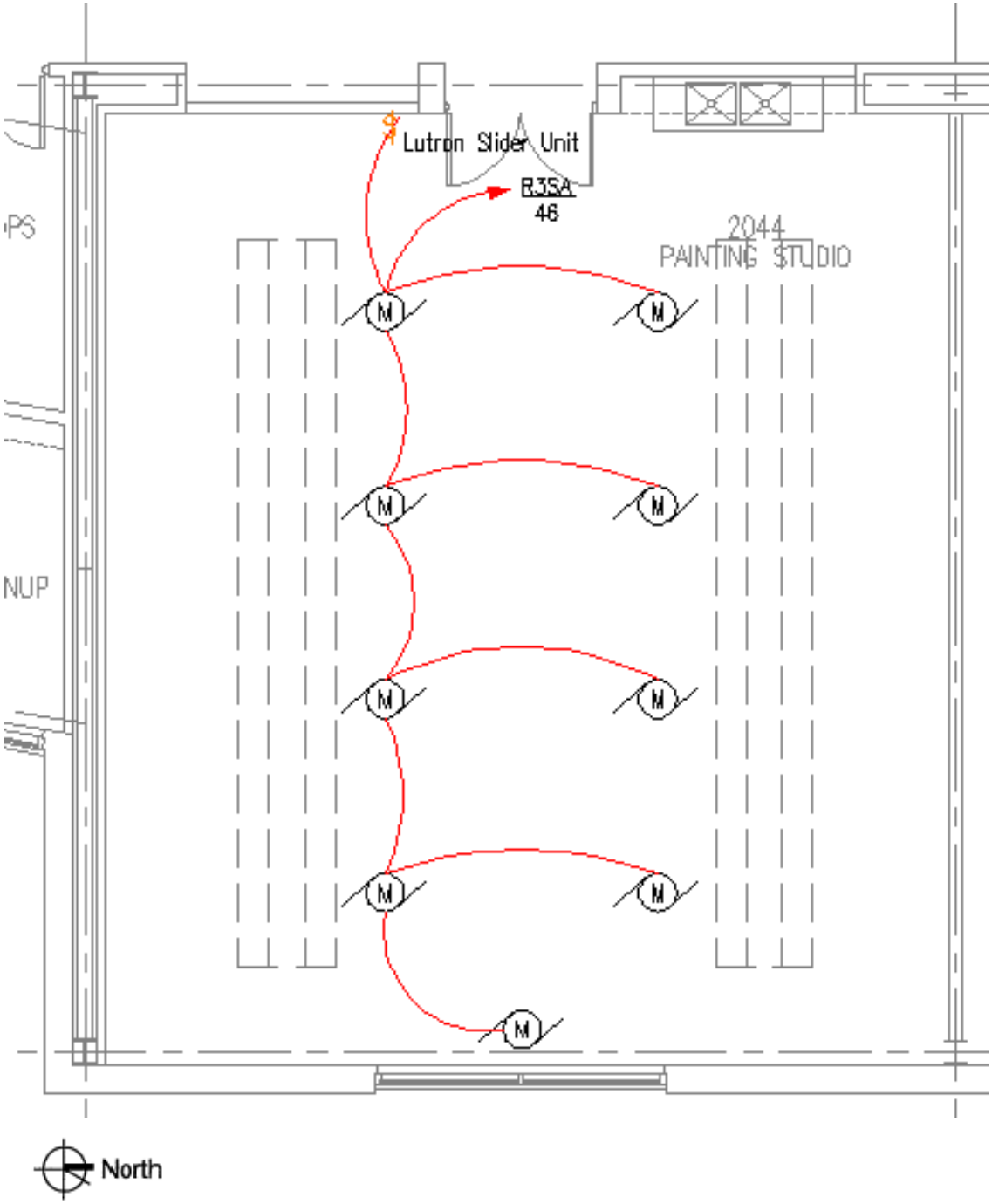
->2#12 Copper THWN, 20A single pole breaker, ¾" Conduit EMT

New Lighting Plan



** Note: See Appendix I for a 1/8" = 1'-0" Plan*

New Power Plan



** Note: See Appendix I for a 1/8" = 1'-0" Plan*

Existing H3SB Panelboard

PANELBOARD: H3SB		BUS RATING:								100	A		MAIN OCP OR MLO: MLO	
MIN AIC:		VOLTAGE:								480	277	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:								SURFACE			WIRES:	4
LOCATION:		NOTES:												
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	BRANCH CIRCUIT DESIGNATION	
LTG - Offices	1	20	1	2150						2	20	1		
LTG - RM 2037 & 2045	1	20	3			400				4	20	1		
LTG -RM 2044	1	20	5					1300		6	20	1		
LTG - RM 2046	1	20	7	1300						8	20	1		
LTG - RM 2035	1	20	9			2050				10	20	1		
	1	20	11							12	20	1		
	1	20	13							14	20	1		
	1	20	15							16	20	1		
	1	20	17							18	20	1		
	1	20	19							20	20	1		
	1	20	21							22	20	1		
	1	20	23							24	20	1		
	1	20	25							26	20	1		
	1	20	27							28	20	1		
	1	20	29							30	20	1		
PHASE CONNECTED LOAD, VA					3450		2450		1300					
PHASE BALANCE					43.75%		2.08%		-45.83%					
TOTAL CONNECTED LOAD, VA		7200												
FUTURE GROWTH - 25%		1800												
TOTAL + FUTURE LOAD, VA		9000												
TOTAL CURRENT, A		11												
DESIGN CURRENT, A		14												
MINIMUM MAIN OCP		60												

Existing R3SA Panelboard

PANELBOARD: R3SA		BUS RATING:								400	A		MAIN OCP OR MLO: 3P250A MCB	
MIN AIC:		VOLTAGE:								208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:								SURFACE			WIRES:	5
LOCATION:		NOTES:								200% NEUTRAL				
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	BRANCH CIRCUIT DESIGNATION	
Recept - RM 2041	1	20	1	720	600					2	20	1	Recept - RM 2034	
Recept - RM 2040	1	20	3			720	600			4	20	1	Recept - RM 2034	
Recept - Corridor	1	20	5					540	360	6	20	1	Recept - RM 2034	
Recept - RM 2039	1	20	7	720	840					8	20	1	Recept - RM 2033	
Recept - RM 2038	1	20	9			720	840			10	20	1	Recept - RM 2031	
Recept - RM 2036	1	20	11					720	840	12	20	1	Recept - RM 2029	
Recept - RM 2035	1	20	13	780	840					14	20	1	Recept - RM 2032	
Recept - RM 2035	1	20	15			480	840			16	20	1	Recept - RM 2030	
Recept - RM 2035	1	20	17					780	840	18	20	1	Recept - RM 2028	
Recept - RM 2035	1	20	19	780	1140					20	20	1	Recept - RM 2027	
Recept - Corridor	1	20	21			540	840			22	20	1	Recept - RM 2025	
Recept - RM 2037/2154	1	20	23					720	840	24	20	1	Recept - RM 2023	
Recept - RM 2041	1	20	25	540	840					26	20	1	Recept - RM 2021	
Recept - RM 2040	1	20	27			540	840			28	20	1	Recept - RM 2024	
Recept - RM 2039	1	20	29					540	840	30	20	1	Recept - RM 2022	
Recept - RM 2038	1	20	31	540	300					32	20	1	Projector - RM 2026	
Recept - RM 2036	1	20	33			540	840			34	20	1	Recept - RM 2026	
Motorized Proj. Screen	1	20	35					300	840	36	20	1	Recept - RM 2020	
Recept - RM 2026 (AV)	1	20	37	840	300					38	20	1	Projector - RM 2026	
LTG - RM 2044	1	20	39			1500	540			40	20	1	Recept - RM 2026	
LTG - RM 2044	1	20	41					1500	840	42	20	1	Recept - RM 2026	
LTG - RM 2044	1	20	43	1500	840					44	20	1	Recept - RM 2026 (AV)	
Recept - Roof	1	20	45			180	938			46	20	1	LTG - RM 2044	
SPARE	1	20	47					0	938	48	20	1	LTG - RM 2046	
LTG - RM 2045	1	20	49	750	938					50	20	1	LTG - RM 2046	
LTG - RM 2045	1	20	51			750	938			52	20	1	LTG - RM 2044	
LTG - RM 2045	1	20	53					750	1125	54	20	1	LTG - RM 2046	
LTG - RM 2044	1	20	55	938	1125					56	20	1	LTG - RM 2046	
LTG - RM 2044	1	20	57			938	1125			58	20	1	LTG - RM 2046	
LTG - RM 2046	1	20	59					938	540	60	20	1	Recept - RM 2045	
LTG - RM 2046	1	20	61	938	720					62	20	1	Recept - RM 2045	
SPARE	1	20	63			0	864			64	20	1	CUH-7	
SPARE	1	20	65					0	180	66	20	1	Recept - Roof	
Recept - Flat Panel Display	1	20	67	600						68	20	1		
	1	20	69							70	20	1		
	1	20	71							72	20	1		
	1	20	73							74	20	1		
	1	20	75							76	20	1		
	1	20	77							78	20	1		
			79	3060						80	20	1		
PNL R3SB	3	100	81			2340				82	20	1		
			83					2460		84	20	1		
PHASE CONNECTED LOAD, VA					21188		18452		17430					
PHASE BALANCE					11.38%		-3.00%		-8.37%					
TOTAL CONNECTED LOAD, VA		57069												
FUTURE GROWTH - 25%		14267												
TOTAL + FUTURE LOAD, VA		71336												
TOTAL CURRENT, A		198												
DESIGN CURRENT, A		248												
MINIMUM MAIN OCP		250												

Redesigned H3SB Panelboard

PANELBOARD: H3SB		BUS RATING:							100	A		MAIN OCP OR MLO: 60A MCB		
MIN AIC:		VOLTAGE:							480	277	V	PHASE(S):		3
NEMA 1 ENCLOSURE		MOUNTING:							SURFACE			WIRES:		4
LOCATION:		NOTES:												
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	BRANCH CIRCUIT DESIGNATION	
LTG - Offices	1	20	1	2150						2	20	1		
LTG - RM 2037 & 2045	1	20	3			400				4	20	1		
Spare	1	20	5					0		6	20	1		
LTG - RM 2046	1	20	7	1300						8	20	1		
LTG - RM 2035	1	20	9			2050				10	20	1		
	1	20	11							12	20	1		
	1	20	13							14	20	1		
	1	20	15							16	20	1		
	1	20	17							18	20	1		
	1	20	19							20	20	1		
	1	20	21							22	20	1		
	1	20	23							24	20	1		
	1	20	25							26	20	1		
	1	20	27							28	20	1		
	1	20	29							30	20	1		
PHASE CONNECTED LOAD, VA					3450		2450		0					
PHASE BALANCE					75.42%		24.58%		-100.00%					
TOTAL CONNECTED LOAD, VA		5900												
FUTURE GROWTH - 25%		1475												
TOTAL + FUTURE LOAD, VA		7375												
TOTAL CURRENT, A		11												
DESIGN CURRENT, A (1.25 Cont. Factor)		14												
MINIMUM MAIN OCP		60												

Main Overcurrent Protection

60A breaker

New Feeder Size

(4) #6 and (1) #10 ground in 1" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Redesigned R3SA Panelboard

PANELBOARD: R3SA		BUS RATING:								400	A		MAIN OCP OR MLO: 3P200A MCB	
MIN AIC:		VOLTAGE:								208	120	V	PHASE(S):	3
NEMA 1 ENCLOSURE		MOUNTING:								SURFACE			WIRES:	5
LOCATION:		NOTES:								200% NEUTRAL				
				LOAD, VA										
BRANCH CIRCUIT DESIGNATION	P	TRIP	CKT#	ϕA		ϕB		ϕC		CKT#	TRIP	P	BRANCH CIRCUIT DESIGNATION	
Recept - RM 2041	1	20	1	720	600					2	20	1	Recept - RM 2034	
Recept - RM 2040	1	20	3			720	600			4	20	1	Recept - RM 2034	
Recept - Corridor	1	20	5					540	360	6	20	1	Recept - RM 2034	
Recept - RM 2039	1	20	7	720	840					8	20	1	Recept - RM 2033	
Recept - RM 2038	1	20	9			720	840			10	20	1	Recept - RM 2031	
Recept - RM 2036	1	20	11					720	840	12	20	1	Recept - RM 2029	
Recept - RM 2035	1	20	13	780	840					14	20	1	Recept - RM 2032	
Recept - RM 2035	1	20	15			480	840			16	20	1	Recept - RM 2030	
Recept - RM 2035	1	20	17					780	840	18	20	1	Recept - RM 2028	
Recept - RM 2035	1	20	19	780	1140					20	20	1	Recept - RM 2027	
Recept - Corridor	1	20	21			540	840			22	20	1	Recept - RM 2025	
Recept - RM 2037/2154	1	20	23					720	840	24	20	1	Recept - RM 2023	
Recept - RM 2041	1	20	25	540	840					26	20	1	Recept - RM 2021	
Recept - RM 2040	1	20	27			540	840			28	20	1	Recept - RM 2024	
Recept - RM 2039	1	20	29					540	840	30	20	1	Recept - RM 2022	
Recept - RM 2038	1	20	31	540	300					32	20	1	Projector - RM 2026	
Recept - RM 2036	1	20	33			540	840			34	20	1	Recept - RM 2026	
Motorized Proj. Screen	1	20	35					300	840	36	20	1	Recept - RM 2020	
Recept - RM 2026 (AV)	1	20	37	840	300					38	20	1	Projector - RM 2026	
----------	-	-	39			696	540			40	20	1	Recept - RM 2026	
Dimmer Panel D3S2	3	20	41					696	840	42	20	1	Recept - RM 2026	
----------	-	-	43	696	840					44	20	1	Recept - RM 2026 (AV)	
Recept - Roof	1	20	45			180	1688			46	20	1	Shade Motors RM 2044	
SPARE	1	20	47					0	938	48	20	1	LTG - RM 2046	
LTG - RM 2045	1	20	49	750	938					50	20	1	LTG - RM 2046	
LTG - RM 2045	1	20	51			750	0			52	20	1	Spare	
LTG - RM 2045	1	20	53					750	1125	54	20	1	LTG - RM 2046	
Spare	1	20	55	0	1125					56	20	1	LTG - RM 2046	
Spare	1	20	57			0	1125			58	20	1	LTG - RM 2046	
LTG - RM 2046	1	20	59					938	540	60	20	1	Recept - RM 2045	
LTG - RM 2046	1	20	61	938	720					62	20	1	Recept - RM 2045	
SPARE	1	20	63			0	864			64	20	1	CUH-7	
SPARE	1	20	65					0	180	66	20	1	Recept - Roof	
Recept - Flat Panel Display	1	20	67	600						68	20	1		
	1	20	69							70	20	1		
	1	20	71							72	20	1		
	1	20	73							74	20	1		
	1	20	75							76	20	1		
	1	20	77							78	20	1		
			79	3060						80	20	1		
PNL R3SB	3	100	81			2340				82	20	1		
			83					2460		84	20	1		
PHASE CONNECTED LOAD, VA					19446		16523		16626					
PHASE BALANCE					10.92%		-5.75%		-5.17%					
TOTAL CONNECTED LOAD, VA		52595												
FUTURE GROWTH - 25%		13149												
TOTAL + FUTURE LOAD, VA		65744												
TOTAL CURRENT, A		182												
DESIGN CURRENT, A		182												
MINIMUM MAIN OCP		200A												

Main Overcurrent Protection

200A Main circuit breaker

New Feeder Size

(4) #3/0 and (1) #6 ground in 2" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. Copper wire rated for 75° C.

New Dimmer Panel D3S2

NEMA 1 ENCLOSURE				MOUNTING:						SURFACE		WIRES:	5
LOCATION:				NOTES:									
				LOAD, VA									
RANCH CIRCUIT DESIGNATIO	P	TRIP	CK	ϕA		ϕB		ϕC		CKT#	TRIP	P	NCH CIRCUIT DESIGNATION
LTG - RM 2044	1	20	1	558						2	20	1	Space
LTG - RM 2044	1	20	3			558				4	20	1	Space
LTG - RM 2044	1	20	5					372		6	20	1	Space
LTG - RM 2044	1	20	7	150						8	20	1	Space
LTG - RM 2044	1	20	9			150				10	20	1	Space
LTG - RM 2044	1	20	11					150		12	20	1	Space
LTG - RM 2044	1	20	13	150						14	20	1	Space
Spare	1	20	15							16	20	1	Space
Spare	1	20	17							18	20	1	Space
Space	1	-	19							20	20	1	Space
Space	1	-	21							22	20	1	Space
Space	1	-	23							24	20	1	Space
PHASE CONNECTED LOAD, VA					858		708		522				
PHASE BALANCE					23.28%		1.72%		-25.00%				

TOTAL CONNECTED LOAD, VA	2088
FUTURE GROWTH - 10%	209
TOTAL + FUTURE LOAD, VA	2297
TOTAL CURRENT, A	6
DESIGN CURRENT, A (*1.25)	8
MINIMUM MAIN OCP	20

Main Overcurrent Protection

20A Main circuit breaker

New Feeder Size

(4) #12 and (1) #12 ground in 1" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. Copper wire rated for 75° C.

Exhibit Gallery

The existing designed utilized a dimmer panel for the control of the 120V track lighting while the suspended direct/indirect fixtures provided ambient light for the space were fed on 277V. Upon redesign, recessed low profile louvered fixtures provide ambient light and were added to the 120V dimmer panel with the redesigned track lighting. The dimming panel was resized for the existing design.

Branch Circuit Redesign

Please refer to the proceeding panelboard and power plan for additional information.

Dimmer Panel D2N1 Circuit 12

12 "K" fixtures * 62 input watts/fixture = 744 W

Total watts = 744W/ .9PF = 827VA

827VA/120V = 6.9A -> 2#12 Copper THWN

20A single pole breaker

¾" Conduit EMT

**Note: 20A*120V * 80% de-rating = 1,920 W Maximum allowed*

Voltage Drop Calculation

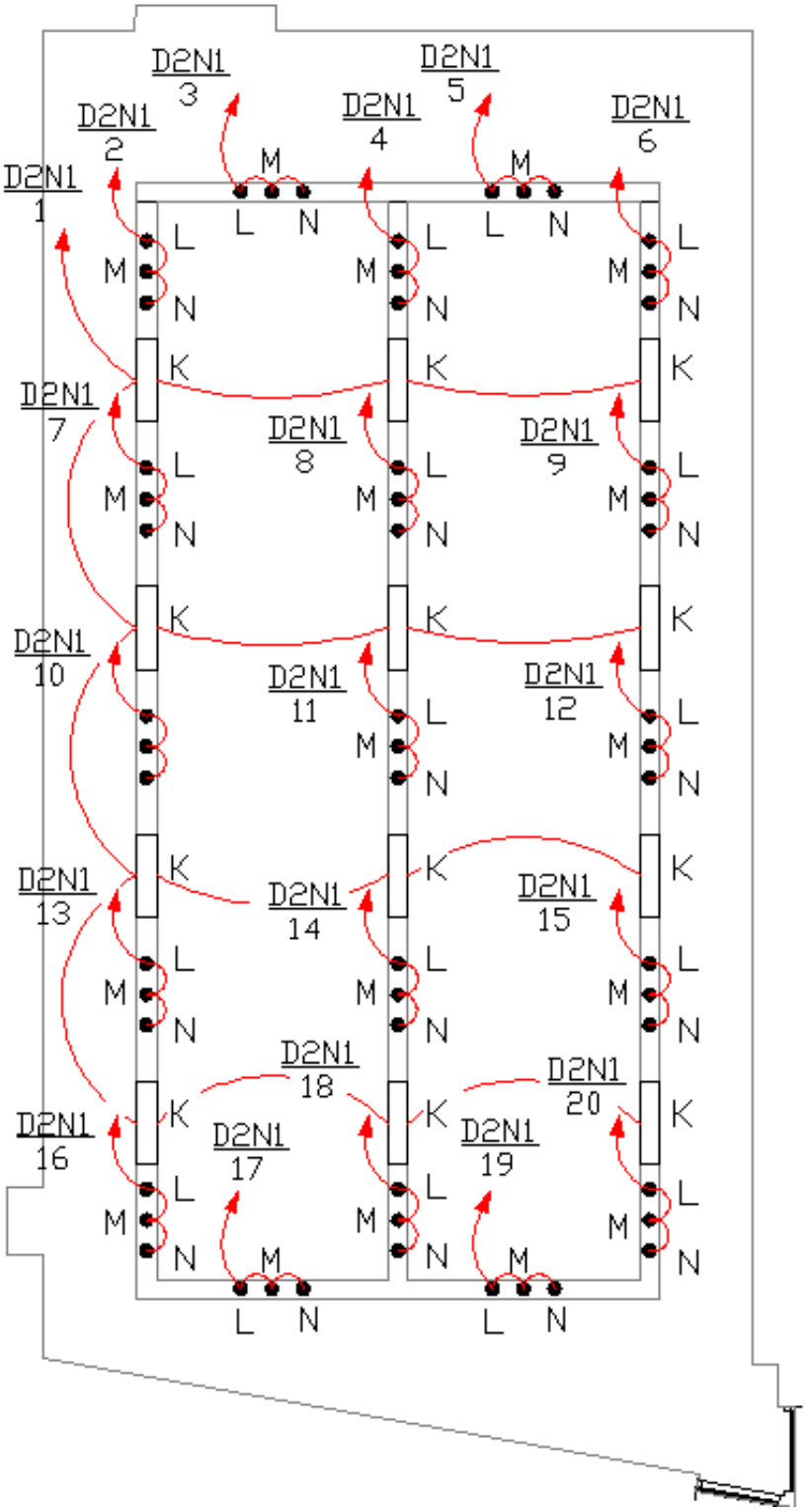
$V_{drop(l\text{-}n)} = A \bullet ft * V_{drop}/(1000\ A \bullet ft) * 2$(if single phase)

$\%V_{drop} = V_{drop(l\text{-}n)} / V$

Circuit Voltage	120
power factor	0.9
Length (ft)	75
Wire Size	#12
$V_{drop/(1000\ A\ ft)}$	1.749
Current (A)	6.9
1ϕ Multiplier	2
$V_{drop(l\text{-}n)}$	1.810
% V_{drop}	**1.509**

1.509% < 3% maximum per NEC recommendations

New Lighting Power Plan



** Note: See Appendix J for a 1/8" = 1'-0" Plan*

Existing R2NF Panelboard

PANELBOARD: R2NF		BUS RATING:							225 A		MAIN OCP		
MIN AIC:		VOLTAGE:							208 120 V		PHASE(S):		3
NEMA 1 ENCLOSURE		MOUNTING:							SURFACE		WIRES:		5
LOCATION:		NOTES:							200% NEUTRAL				
				LOAD, VA									
CH CIRCUIT DESIGN	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	CH CIRCUIT DESIGNATION
Recept - RM 1001	1	20	1	720	840					2	20	1	Recept - RM 1003
Recept - RM 1001	1	20	3			720	720			4	20	1	Recept - WC
Recept - RM 1001	1	20	5					720	300	6	20	1	Recept - RM 1002
Recept - RM 1001	1	20	7	720	900					8	20	1	Recept - RM 1002
Recept - RM 1001	1	20	9			720	1000			10	20	1	Recept - RM 1002
Recept - RM 1001	1	20	11					720	300	12	20	1	Recept - RM 1002
Recept - RM 1001	1	20	13	720	1000					14	20	1	Recept - RM 1002
Recept - RM 1001	1	20	15			720	528			16	20	1	CUH -6
Recept - RM 1001	1	20	17					720	864	18	20	1	CUH-1
Recept - Exterior	1	20	19	180						20	20	1	
Power Door	1	20	21			384				22	20	1	
Power Door	1	20	23					384		24	20	1	
Recept - Exterior	1	20	25	180						26	20	1	
	1	20	27							28	20	1	
	1	20	29							30	20	1	
	1	20	31							32	20	1	
	1	20	33							34	20	1	
	1	20	35							36	20	1	
			37							38			
PNL D2N1	3	60	39							40	60	3	PNL D2N2
			41							42			
PHASE CONNECTED LOAD, VA				5260		4792		4008					
PHASE BALANCE				12.23%		2.25%		-14.48%					

TOTAL CONNECTED L	14060
FUTURE GROWTH - 25	3515
TOTAL + FUTURE LOA	17575
TOTAL CURRENT, A	49
DESIGN CURRENT, A	61
MINIMUM MAIN OCP	150

Existing D2N1 Dimmer Panel

PANELBOARD: D2N1		BUS RATING:						60 A		MAIN OCP OR MLO: MLO			
MIN AIC:		VOLTAGE:						208 120 V		PHASE(S):			3
NEMA 1 ENCLOSURE		MOUNTING:						SURFACE		WIRES:			5
LOCATION:		NOTES:											
				LOAD, VA									
RANCH CIRCUIT DESIGNATIO	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	NCH CIRCUIT DESIGNATION
LTG - RM 1001	1	20	1	640	640					2	20	1	LTG - RM 1001
LTG - RM 1001	1	20	3			640	640			4	20	1	LTG - RM 1001
LTG - RM 1001	1	20	5					640	640	6	20	1	LTG - RM 1001
LTG - RM 1001	1	20	7	640	640					8	20	1	LTG - RM 1001
LTG - RM 1001	1	20	9			640	640			10	20	1	LTG - RM 1001
LTG - RM 1001	1	20	11					640	640	12	20	1	LTG - RM 1001
LTG - RM 1001	1	20	13	640	640					14	20	1	LTG - RM 1001
LTG - RM 1001	1	20	15			640	640			16	20	1	LTG - RM 1001
LTG - RM 1001	1	20	17					640	640	18	20	1	LTG - RM 1001
LTG - RM 1001	1	20	19	640	640					20	20	1	LTG - RM 1001
LTG - RM 1001	1	20	21			640	640			22	20	1	LTG - RM 1001
LTG - RM 1001	1	20	23					640	640	24	20	1	LTG - RM 1001
PHASE CONNECTED LOAD, VA				5120		5120		5120					
PHASE BALANCE				0.00%		0.00%		0.00%					

TOTAL CONNECTED LOAD, VA	15360
FUTURE GROWTH - 10%	1536
TOTAL + FUTURE LOAD, VA	16896
TOTAL CURRENT, A	47
DESIGN CURRENT, A	59
MINIMUM MAIN OCP	60

Redesigned R2NF Panelboard

PANELBOARD: R2NF		BUS RATING:						225 A		MAIN OCP			
MIN AIC:		VOLTAGE:						208 120 V		PHASE(S):		3	
NEMA 1 ENCLOSURE		MOUNTING:						SURFACE		WIRES:		5	
LOCATION:		NOTES:						200% NEUTRAL					
				LOAD, VA									
CH CIRCUIT DESIGN	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	CH CIRCUIT DESIGNATION
Recept - RM 1001	1	20	1	720	840					2	20	1	Recept - RM 1003
Recept - RM 1001	1	20	3			720	720			4	20	1	Recept - WC
Recept - RM 1001	1	20	5					720	300	6	20	1	Recept - RM 1002
Recept - RM 1001	1	20	7	720	900					8	20	1	Recept - RM 1002
Recept - RM 1001	1	20	9			720	1000			10	20	1	Recept - RM 1002
Recept - RM 1001	1	20	11					720	300	12	20	1	Recept - RM 1002
Recept - RM 1001	1	20	13	720	1000					14	20	1	Recept - RM 1002
Recept - RM 1001	1	20	15			720	528			16	20	1	CUH -6
Recept - RM 1001	1	20	17					720	864	18	20	1	CUH-1
Recept - Exterior	1	20	19	180						20	20	1	
Power Door	1	20	21			384				22	20	1	
Power Door	1	20	23					384		24	20	1	
Recept - Exterior	1	20	25	180						26	20	1	
	1	20	27							28	20	1	
	1	20	29							30	20	1	
	1	20	31							32	20	1	
	1	20	33							34	20	1	
	1	20	35							36	20	1	
			37	2344						38			
PNL D2N1	3	40	39			2344				40	60	3	PNL D2N2
			41					2344		42			
PHASE CONNECTED LOAD, VA				7604		7136		6352					
PHASE BALANCE				8.15%		1.50%		-9.65%					

TOTAL CONNECTED L	21093
FUTURE GROWTH - 25	5273
TOTAL + FUTURE LOA	26366
TOTAL CURRENT, A	73
DESIGN CURRENT, A	91
MINIMUM MAIN OCP	150

Main Overcurrent Protection

300A breaker

New Feeder Size

(3) #350 MCM and (1) #4 in 2 1/2" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Redesigned D2N1 Dimmer Panel

PANELBOARD: D2N1		BUS RATING:						60 A		MAIN OCP 40A				
MIN AIC:		VOLTAGE:						208 120 V		PHASE(S):		3		
NEMA 1 ENCLOSURE		MOUNTING:						SURFACE		WIRES:		5		
LOCATION:		NOTES:												
				LOAD, VA										
RANCH CIRCUIT DESIGNATIO	P	TRIP	CKT	ϕA		ϕB		ϕC		CKT#	TRIP	P	NCH CIRCUIT DESIGNATION	
LTG - RM 1001	1	20	1	827	450					2	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	3			450	450			4	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	5					450	450	6	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	7	450	450					8	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	9			450	450			10	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	11					450	450	12	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	13	450	450					14	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	15			450	450			16	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	17					450	450	18	20	1	LTG - RM 1001	
LTG - RM 1001	1	20	19	450	450					20	20	1	LTG - RM 1001	
Space	1	20	21							22	20	1	Space	
Space	1	20	23							24	-	1	Space	
PHASE CONNECTED LOAD, VA					3977		2700		2700					
PHASE BALANCE					27.24%		-13.62%		-13.62%					
TOTAL CONNECTED LOAD, VA		9377												
FUTURE GROWTH - 10%		938												
TOTAL + FUTURE LOAD, VA		10315												
TOTAL CURRENT, A		29												
DESIGN CURRENT, A		36												
MINIMUM MAIN OCP		40												

Main Overcurrent Protection

40A breaker

New Feeder Size

(3) #8 and (1) #10 in 3/4" Conduit

Based per NEC 2005. Tables 310-16, Table C.2, Table 250.122. THWN Copper wire rated for 75°C.

Energy Efficient Transformer Study

The Art & Visual Technology building utilizes 12 transformers throughout the building to supply electricity at either 480/277V or 208/120V power. The following study compares the use of energy efficient transformers versus standard ones.

The cost of the standard transformers was estimated from 2008 RS Means. Additionally, the cost of Powersmith's transformers was estimated to cost an additional 35%. The utility rate of $0.00272/kWh was used per the utility rate schedule of the building (GS-3 Dominion Virginia Power). This value seems extremely low to me, however I called to verify this information and a representative from Dominion Virginia assured me that all the information provided on their utility rate schedules is accurate. A typical 9 month, 12 hour operating schedule was used to estimate the building electrical usage.

**Note: A copy of the utility rate can be found in appendix D*

POWERSMITHS

The ESP Calculator™

Toll Free : 1-800-747-9627 or (905) 791-1493

Energy Savings Payback Calculator

Project Description	**Art & Visual Technology Building**			
Date	**1-Mar-07**			
	Transformers on Project		Standard Xfmr Co	PowerSmith Co
	QTY	**kVA**		
	2	15	$6,530	$8,816
	2	30	$4,385	$5,920
		45	$5,110	$6,899
	5	75	$7,000	$9,450
	3	112.5	$13,439	$18,143
		150	Total Cost	Total Cost
		225	$97,147	$131,148
		300		
		500		
		750		
		1000		
		1500		
		2000		
		7.5		
Available Full Load kW	**802.5**			
Average kVA (calc)	**67**			
equipment operating hrs/ day	12			
equipment operating days/yr	270	Calc Load kW	Calc Annual kWh	
Load during normal operating hours	40%	321	1,040,040	
Load outside operating hours	15%	120	664,470	
		Total Annual Load	**1,704,510**	
Annual Cost to Operate Load Only				
kWh rate	$ 0.003	Annual Consumption:	$ 4,636	
demand rate ($/kW/mo) ex. $10.00	$12.15	Annual Demand:	$ 46,802	
		Total Cost to run load	**$ 51,438**	

Annual Cost of Status Quo Transformer Losses & Associated Air Conditioning (A/C) burden

Status quo Efficiency (Normal Operation)	97.0%	
Transformer kW Losses (Normal Operation)	9.9	kW
Status quo Efficiency (Outside op. hrs)	92.0%	
Transformer kW Losses (Outside op. hrs)	10.5	kW
Annual addititional kWh from transformers	89,946	kWh
Annual Cost of Transformer Losses	$ 1,692	
A/C System Performance (kW/ton)	1.25	
Additional Tons of Cooling (on peak)	2.82	tons
Annual addititional kWh from A/C	31,941	kWh
Annual Cost of Associated A/C	$ 601	
Summary with Status Quo Transformer		
Annual Cost of feeding Building Load	$ 51,438	
Annual Cost of Transformer Losses	$ 1,692	
Annual Cost of Associated A/C	$ 601	
Electrical Bill (Status Quo Transformer)	**$ 53,731**	

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  doc#807-000440-110-AC 1-Mar-07

POWERSMITHS

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Energy Savings Payback Calculator

Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)	98.2%	
Powersmiths kW Losses (Normal Operation)	5.9	kW
Powersmiths Efficiency (Outside op. hrs)	97.6%	
Transformer kW Losses (Outside op. hrs)	3.0	kW
Annual addititional kWh from transformers	35,403	kWh
Annual Cost of Powersmiths Losses	$ 954	
Additional Tons of Cooling (on peak)	1.67	tons
Annual addititional kWh from A/C	12,572	kWh
Annual Cost of Associated A/C	$ 339	

Comparing Status Quo & Powersmiths

	Status Quo	Powersmiths	
Annual Cost of feeding Building Load	$ 51,438	$ 51,438	
Annual Cost of Transformer Losses	$ 1,692	$ 954	
Annual Cost of Associated A/C	$ 601	$ 339	**Reduction**
Annual estimated Electrical Bill	$ 53,731	$ 52,731	**2%**

Peak kW reduction (normal op hours)	**4.0**	**kW**
Annual kWh reduction	**73,912**	**kWh**
Reduction in Air Conditioning Load (on peak)	**1.15**	**tons**

Cost Analysis (calc)

Energy Cost Escalation (above inflation)	3.0%
Annual Power Quality Benefit	$ -

	Annual Operating Cos	Life Cycle Operating Cost & Savings 20 years	32 years
Status Quo Transformers	$2,293	$82,829	$188,952
Powersmiths Transformers	$1,293	$46,706	$106,547
Savings with Powersmiths	**$1,000**	**$36,123**	**$82,404**

Cost	**Cost**
Powersmiths Transformers	$131,148
Status Quo Transformers	$97,147

Payback on total cost	34.00	years	current kWh rate:
Cost of Energy Savings	$ 0.014	/kWh	$0.003
Cost - Benefit Ratio	0.2	times less to save a kWh than to buy a kWh	

Leasing Option	60 Month Term	48 Month Term	36 Month Term
Total Annual Leasing Payments	**$24,563**	**$29,960**	**$38,120**
Net Annual Cost with savings	$23,563	$28,960	$37,120

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)		Equivalence	
55	tons of CO2	10	Acres trees plan
177	tons of Coal	7	Car Emissions
428	kgs of SO2	7	homes heated
184	kgs of NOx		

IMPORTANT: By using the ESP Calculator™, you are agreeing the TERMS OF USE section on pa
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POWERSMITHS

Conclusion

Based on Powersmith's ESP calculator, energy efficient transformers will save roughly $1,000 a year. With the initial increased cost of nearly $35,000, it will take about 34 years for the energy efficient transformers to pay themselves back. Over the life span of the system (32 years) energy efficient transformers will save roughly $82,000 in energy savings. In addition to the financial savings, the reduced energy usage equates to roughly 10 acres of trees planted each year. In this instance, due to the extremely low utility rate, I would not recommend the use of energy efficient transformers. However, in other instances where the utility rate is a more typical range $0.10/kWh energy efficient transformers can be very beneficial.

Photovoltaic Array Study

A relatively attractive climate along with federal and state incentives makes the possibility of a photovoltaic array to be financial feasible for the Art & Visual Technology Building. The following study investigates the use of a photovoltaic array on roof of the Art & Visual Technology building. This study was conducted with the aid of RestScreen® to determine if the proposed system of 170 watt monocyrstalline (product number BP 5170) photovoltaic modules produced by BP Solar would be beneficial to implement. The aim of this study was to compare the cost of the solar panels versus the cost savings of energy production. Therefore, the cost of engineering, feasibility studies, and balancing were not included.

**See appendix E for the product cut sheet*

The federal and state incentives for the installation of a photovoltaic are integral to the financial success of installing such a system. These incentives help offset the high initial cost of purchasing and installing the system. After research of available state incentives for the production of renewable energy, it was found that no state incentives were applicable for this application. Many federal incentives are available but, are based on federal tax rebates. Since GMU is a university, most of these incentives were not applicable. The only incentive obtainable for this project was:

Federal Renewable Energy Production Incentive (REPI)

Introduced in the Energy Policy Act of 1992, the federal government provides financial assistance to energy producing facilities at the rate of 1.5 cents per kilowatt hour (1993 dollars, indexed for inflation) for the first ten years of operation. As estimated by www.moneytimes.com, the average inflation rate over this period was 2.69%, which equates to a rate of 2.22 cents per kilowatt hour.

Design Parameters

To find the potential photovoltaic system size an approximation of available roof square footage was determined. 80% of the available roof area was assumed to be useable for installation of photovoltaic modules.

Available space on roof = 9,775 ft^2

Usable space on roof = 7,820 ft^2

Module Size (31"x 62.7") = 13.5 ft^2

Module Nominal Power = .170kW

Number of Modules = 7,820 ft^2/ 13.5 ft^2 = 579

Maximum Nominal Power = **98.4kW**

Weather data for Fairfax, Virginia was not obtainable, however weather data for Washington D.C. was used as it is close in proximity to Fairfax. The avoided cost of energy was $0.272 which was determined from the utility rate for the campus.

Estimated Initial Cost

Module Cost 98.4kW * $5,750/kW = $565,800

Estimated intermittent Cost

Periodic Inverter Replacement* = $50,000

Misc. Cost** = $28,700

Annual Operating & Maintenance = $880

**Note: Per RetScreen recommendations*

***Note: Includes Training & 5% Contingency*

Federal Renewable Energy Production Incentive (REPI)

Savings $0.0222/kWh for the first ten years

RetScreen Results

RETScreen® Energy Model - Photovoltaic Project

Training Calendar

Site Conditions		Estimate	Notes/Range
Project name		Art & Visual Technology	See Online Manual
Project location		Fairfax, VA	
Nearest location for weather data	-	Washington, DC	Complete SR&SL sheet
Latitude of project location	°N	38.9	-90.0 to 90.0
Annual solar radiation (tilted surface)	MWh/m²	1.52	
Annual average temperature	°C	14.5	-20.0 to 30.0

System Characteristics		Estimate	Notes/Range
Application type	-	On-grid	
Grid type	-	Central-grid	
PV energy absorption rate	%	100.0%	
PV Array			
PV module type	-	mono-Si	
PV module manufacturer / model #		BP Solar/ BP 5170 S	See Product Database
Nominal PV module efficiency	%	13.5%	4.0% to 15.0%
NOCT	°C	45	40 to 55
PV temperature coefficient	% / °C	0.40%	0.10% to 0.50%
Miscellaneous PV array losses	%	5.0%	0.0% to 20.0%
Nominal PV array power	kWp	**98.40**	
PV array area	m²	728.9	
Power Conditioning			
Average inverter efficiency	%	90%	80% to 95%
Suggested inverter (DC to AC) capacity	kW (AC)	88.6	
Inverter capacity	kW (AC)	72.0	
Miscellaneous power conditioning losses	%	0%	0% to 10%

Annual Energy Production (9.19 months analysed)		Estimate	Notes/Range
Specific yield	kWh/m²	126.2	
Overall PV system efficiency	%	11.2%	
PV system capacity factor	%	10.7%	
Renewable energy collected	MWh	102.181	
Renewable energy delivered	MWh	**91.963**	
	kWh	91,963	
Excess RE available	MWh	**0.000**	
			Complete Cost Analysis sheet

RETScreen® Solar Resource and System Load Calculation - Photovoltaic Project

Site Latitude and PV Array Orientation		Estimate	Notes/Range
Nearest location for weather data		Washington, DC	See Weather Database
Latitude of project location	°N	38.9	-90.0 to 90.0
PV array tracking mode	-	Fixed	
Slope of PV array	°	30.0	0.0 to 90.0
Azimuth of PV array	°	0.0	0.0 to 180.0

Monthly Inputs

Month	Fraction of month used (0 - 1)	Monthly average daily radiation on horizontal surface (kWh/m²/d)	Monthly average temperature (°C)	Monthly average daily radiation in plane of PV array (kWh/m²/d)	Monthly solar fraction (%)
January	0.60	1.81	1.4	2.61	-
February	1.00	2.57	3.1	3.34	-
March	1.00	3.55	8.4	4.08	-
April	1.00	4.60	13.6	4.79	-
May	1.00	5.42	19.1	5.23	-
June	0.33	5.99	24.2	5.58	-
July	0.33	5.73	26.7	5.42	-
August	0.33	5.10	25.8	5.14	-
September	1.00	4.23	21.8	4.71	-
October	1.00	3.16	15.4	3.97	-
November	1.00	2.05	9.9	2.91	-
December	0.60	1.52	4.1	2.22	-

		Annual	Season of use
Solar radiation (horizontal)	MWh/m²	1.39	1.01
Solar radiation (tilted surface)	MWh/m²	1.52	1.13
Average temperature	°C	14.5	13.0

Load Characteristics		Estimate
Application type	-	On-grid

Return to Energy Model sheet

RETScreen® Financial Summary - Photovoltaic Project

Annual Energy Balance

Project name		Art & Visual Technology			
Project location		Fairfax, VA	Nominal PV array power	kWp	100.00
Renewable energy delivered	MWh	93.458			
Firm RE capacity	kW	-			
Application type		On-grid			

Financial Parameters

Avoided cost of energy	$/kWh	0.003	Debt ratio	%	0.0%
RE production credit	$/kWh	0.015			
RE production credit duration	yr	20			
RE credit escalation rate	%	2.0%			
			Income tax analysis?	yes/no	No
Energy cost escalation rate	%	5.0%			
Inflation	%	2.5%			
Discount rate	%	9.0%			
Project life	yr	25			

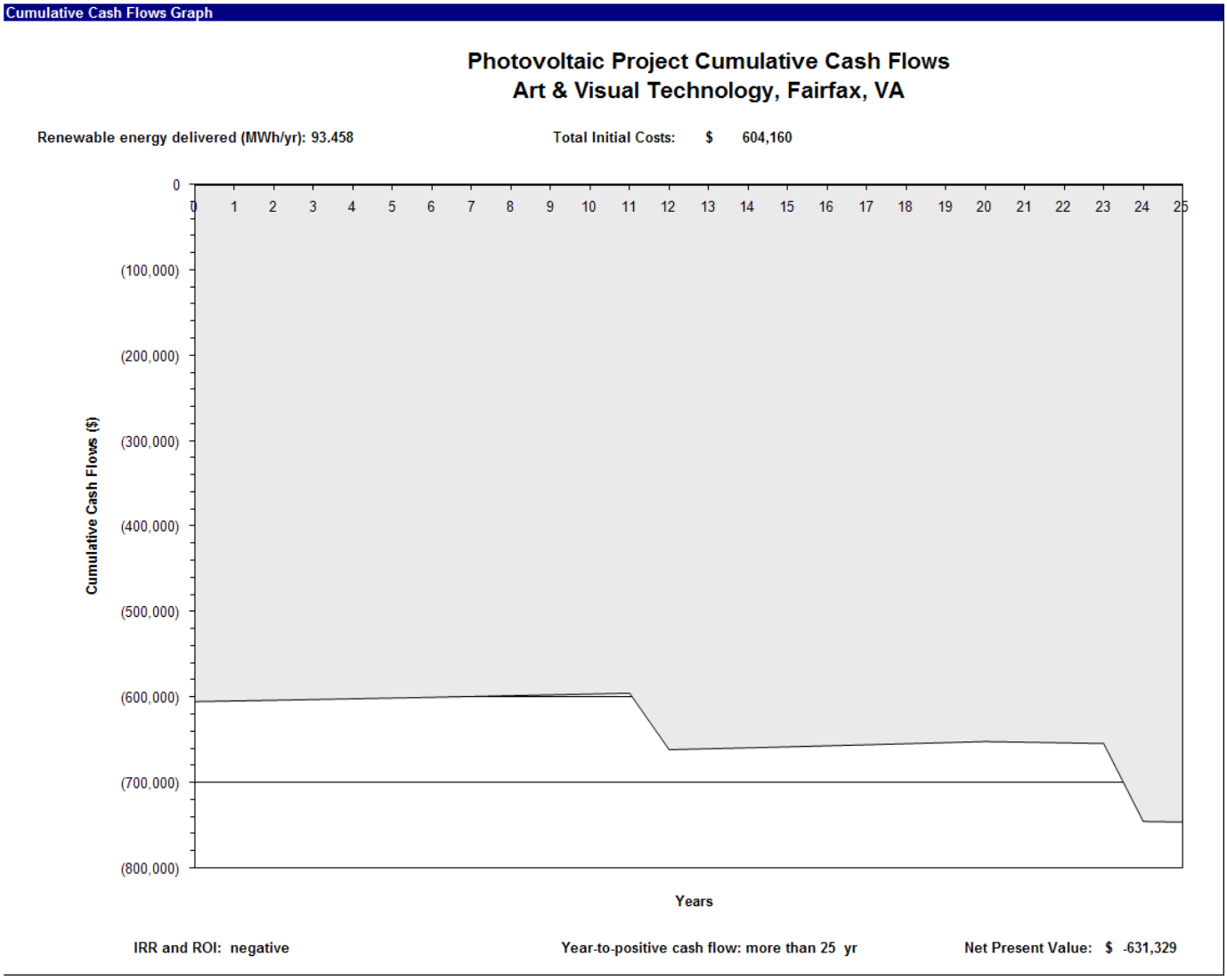
Project Costs and Savings

Initial Costs				Annual Costs and Debt		
Feasibility study	0.0%	$	-	O&M	$	880
Development	0.0%	$	-	Fuel	$	-
Engineering	0.0%	$	-			
Energy equipment	95.2%	$	575,000	**Annual Costs and Debt - Total**	**$**	**880**
Balance of equipment	0.0%	$	-			
Miscellaneous	4.8%	$	29,160	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**604,160**	Energy savings/income	$	254
Incentives/Grants		$	-	RE production credit income - 20 yrs	$	1,402
				Annual Savings - Total	**$**	**1,656**
Periodic Costs (Credits)						
Inverter Repair/Replacement		$	50,000	Schedule yr # 12,24		
		$	-			
		$	-			
End of project life -		$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	Yes
Pre-tax IRR and ROI	%	negative	Energy production cost	$/kWh	0.43
After-tax IRR and ROI	%	negative			
Simple Payback	yr	778.5			
Year-to-positive cash flow	yr	more than 25	Project equity	$	604,160
Net Present Value - NPV	$	(631,329)			
Annual Life Cycle Savings	$	(64,273)			
Benefit-Cost (B-C) ratio	-	(0.04)			

Version 3.2



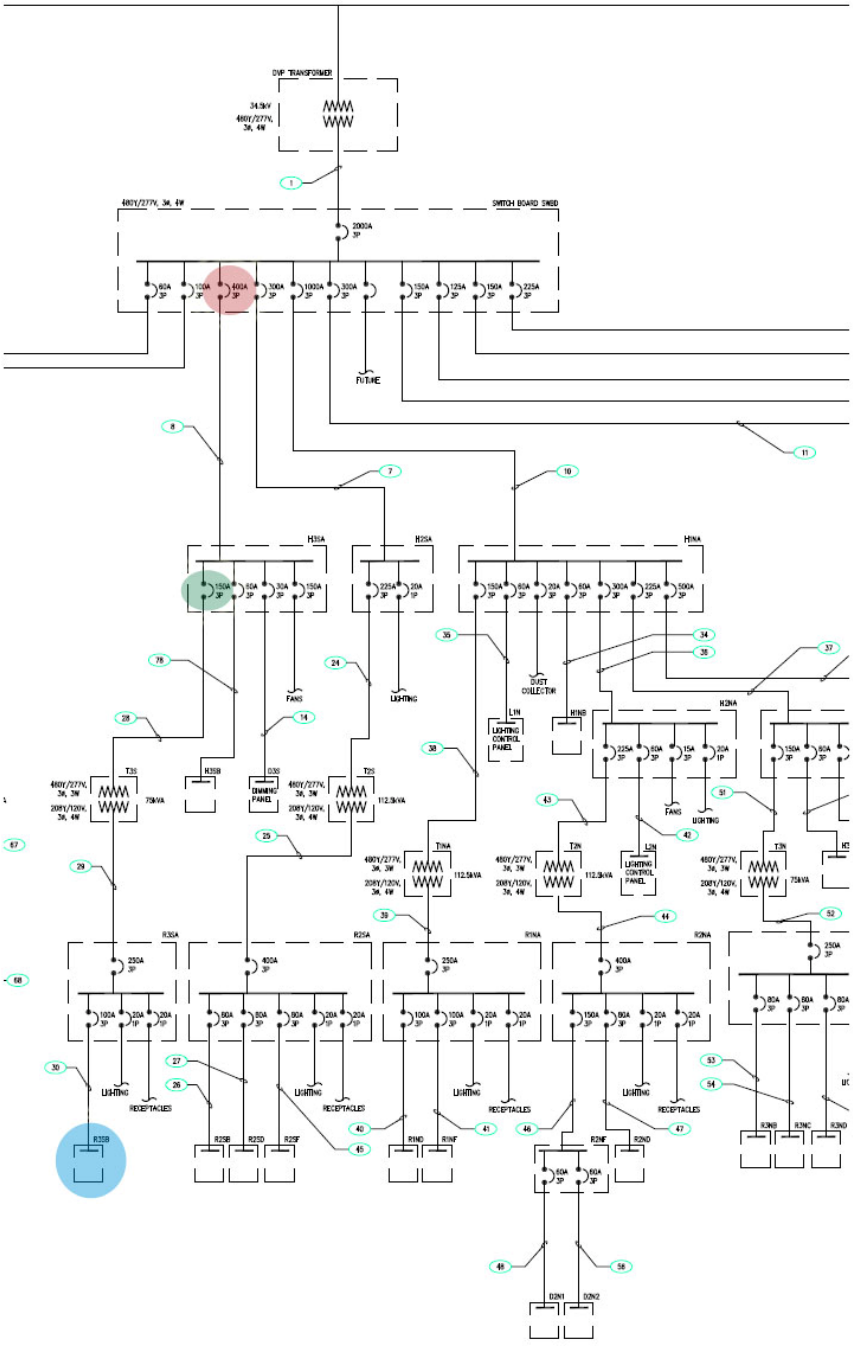
Photovoltaic Array Conclusion

The designed photovoltaic system yielded a twenty-five year plus payback period for the owner. The net energy production cost came out to be roughly $0.43/kWh which is much higher than the utilities' rate of $0.00272/kWh. As discussed earlier in this report, I believe that the utility rate is extremely low. This is what drove the payback period to be at least 25 years. I had tested the same setup with using a rate of $0.10/kWh and got an output of roughly 15 years for the payback period. Since the federal incentive packages are based on federal tax savings and the avoided cost of energy (utility rate), implementing photovoltaic array on the Art & Visual Technology building is not

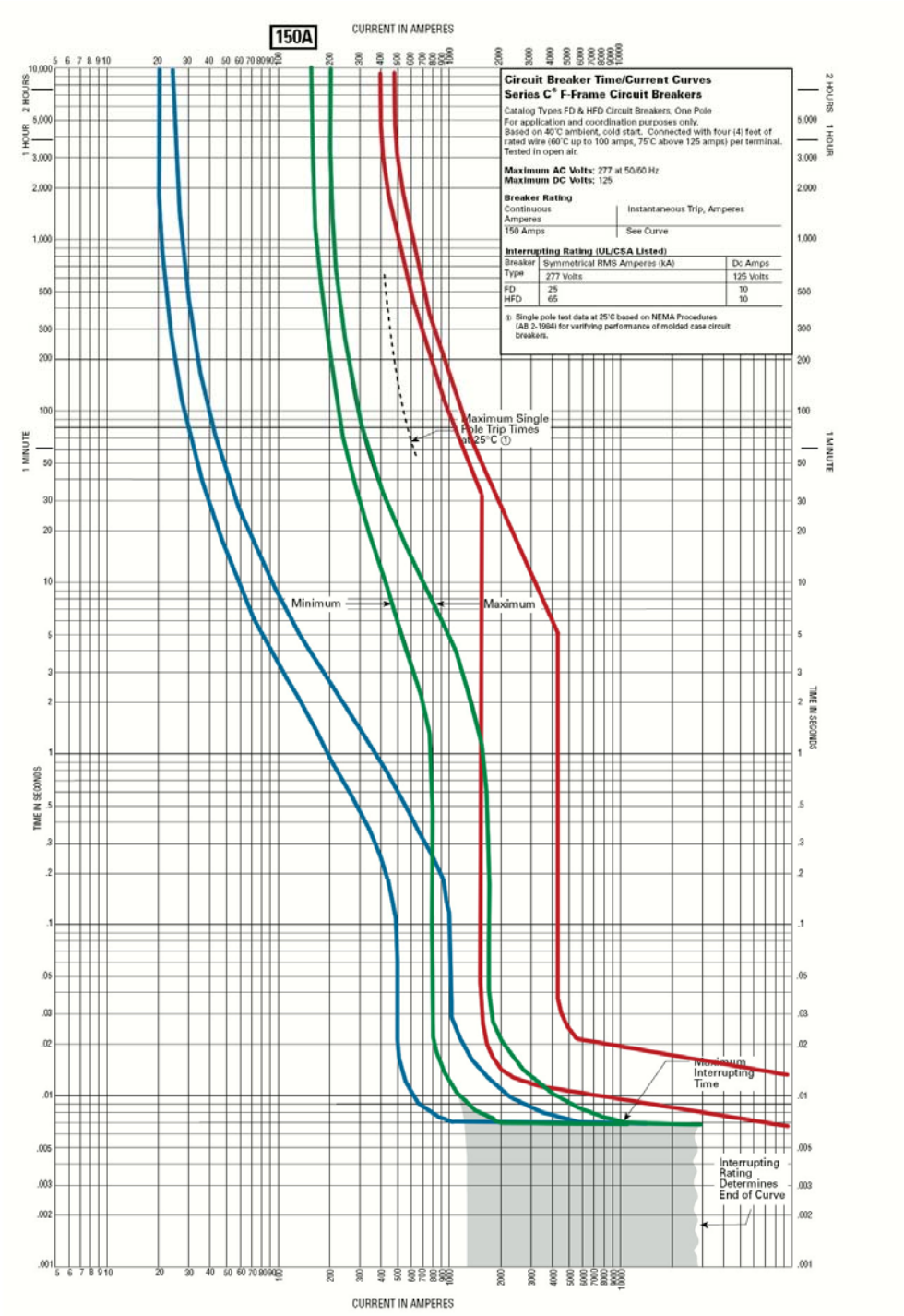
recommended. However, on a project whose owner pays federal taxes and a higher utility rate, a photovoltaic array could be highly recommended.

Over Current Protection Coordination Study

The following coordination study examines the trip time curves for the three breakers shown on the proceeding schematic. A 400A 3 pole breaker on the main switch gear, a 150 A 3 pole breaker on a distribution panel and a typical 20A single pole branch circuit breaker were selected for the analysis.



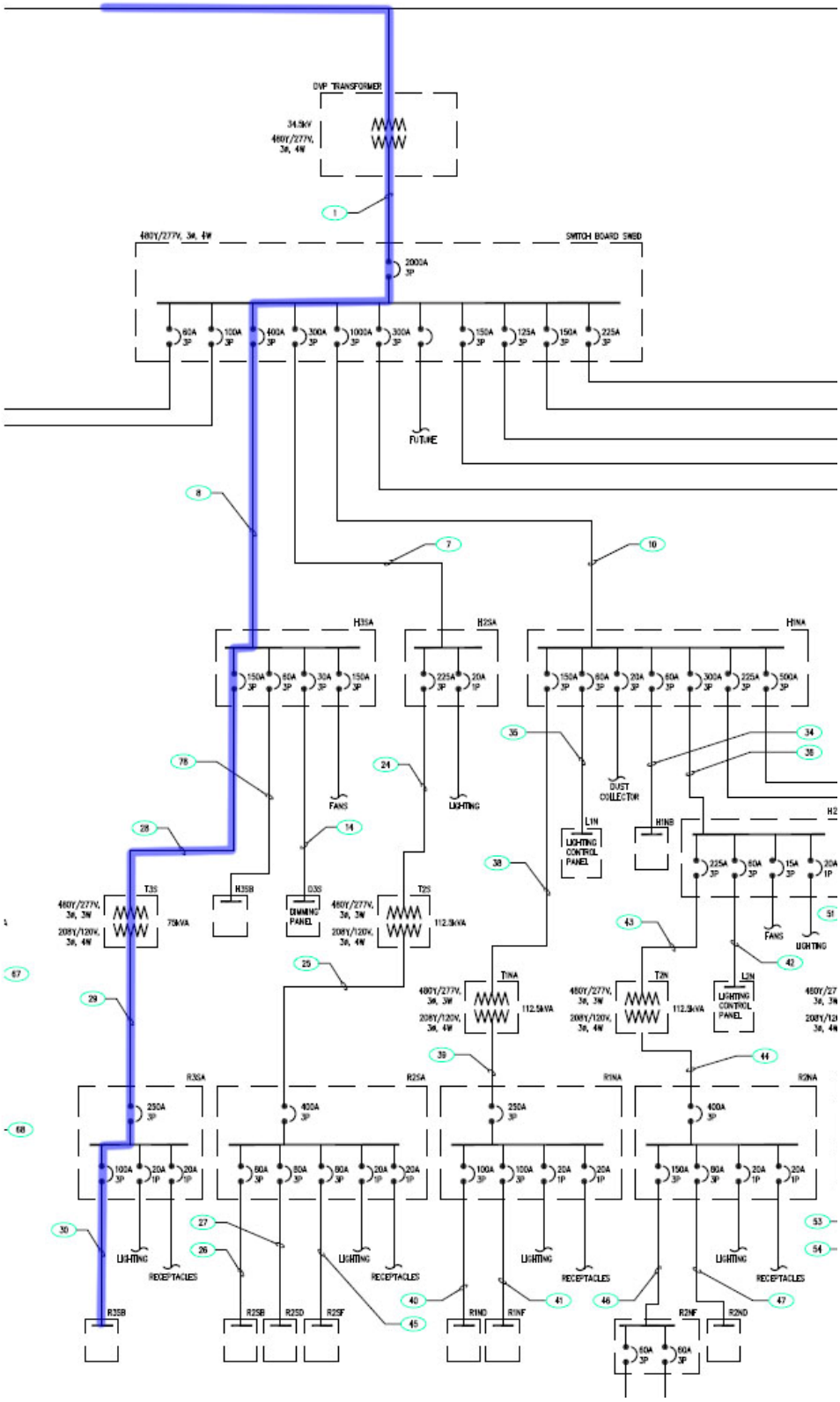
20A Branch Circuit Breaker 150A 3 Phase Circuit Breaker 400A 3 Phase Circuit Breaker



Evaluation

Upon laying the current trip curves over each other, it was found that the coordination of the chosen path was properly coordinated with the breaker furthest downstream tripping first and each consecutive breaker up stream breaking next.

Short Circuit Analysis



I was unable to contact Dominion Virginia Power, therefore with the recommendations of Professor Dannerth, the Utility transformer size was estimated at 750kVA. The following is the summary table of the short circuit analysis at each point throughout the system. The calculations used to tabulate the summary are in the following section.

Point	Location	Available Fault	Standard Breaking Rating
A	Utility Transformer Secondary	17,803	25,000
B	SWBD	16,243	25,000
C	Panel H3SA	14,790	25,000
D	T3S	14,408	25,000
E	R3SA	1,425	14,000
F	R3SB	1,400	14,000

Per Unit Method				
BASE kVA	1000			
Utility Company Available Fault	1000000			
System Voltage (kV)	0.48			
Utility Transformer Primary				
Utility Transformer Size	750		X (p.u.)	0.001
Utility Transformer Secondary				
Average % Z.	5		X (p.u.)= (%X * base kVA/ 100 *xfmr kVA)	0.059507777
Average X/R	1.98		R(p.u.) = (%R * base KVA/ 100 *xfrmr kVA)	0.030054433
X (%)	4.463			
R (%)	2.254		ΣX(p.u.)	0.060507777
			ΣR(p.u.)	0.030054433
			ΣZ(p.u.)	0.067560787
			$I_{sc\ rms\ sym}$	17803.4198
Main SwitchBoard				
# of sets	6		X(p.u.)	0.00531684
length	150		R(p.u.)	0.003862847
Wire Size	400kcmil			
X_L	0.049		ΣX(p.u.)	0.065824617
R	0.0356		ΣR(p.u.)	0.03391728
X	0.001225		ΣZ(p.u.)	0.074049052
R	0.00089		$I_{sc\ rms\ sym}$	16243.46331
Panel H3SA				
# of sets	1		X(p.u.)	0.008038194
length	40		R(p.u.)	0.000111545
Wire Size	600kcmil			
X_L	0.0463		ΣX(p.u.)	0.073862812
R	0.0257		ΣR(p.u.)	0.034028825
X	0.001852		ΣZ(p.u.)	0.08132451
R	2.57E-05		$I_{sc\ rms\ sym}$	14790.28972
Transformer T3S				
# of sets	1		X(p.u.)	0.00234375
length	10		R(p.u.)	5.55556E-05
Wire Size	#1/0			
X_L	0.054		ΣX(p.u.)	0.076206562
R	0.0128		ΣR(p.u.)	0.034084381
X	0.00054		ΣZ(p.u.)	0.083481645
R	1.28E-05		$I_{sc\ rms\ sym}$	14408.11404

Secondary T3S				
Transformer Size	75		X (p.u.)= (%X * base kVA/ 100 *xfmr kVA)	0.615409881
Average % Z.	5.7		R(p.u.) = (%R * base KVA/ 100 *xfrmr kVA)	0.445949189
Average X/R	1.38			
X (%)	4.616		ΣX(p.u.)	0.691616442
R (%)	3.345		ΣR(p.u.)	0.480033569
			ΣZ(p.u.)	0.841882136
			$I_{sc\ rms\ sym}$	1428.719068
Panel R3SA				
# of sets	1		X(p.u.)	0.002148438
length	10		R(p.u.)	0.000239583
Wire Size	250kcmil			
X_L	0.0495		ΣX(p.u.)	0.69376488
R	0.0552		ΣR(p.u.)	0.480273153
X	0.000495		ΣZ(p.u.)	0.843784338
R	5.52E-05		$I_{sc\ rms\ sym}$	1425.498206
Panel R3SB				
# of sets	1		X(p.u.)	0.018554688
length	75		R(p.u.)	6.94444E-05
Wire Size	#1			
X_L	0.057		ΣX(p.u.)	0.712319567
R	0.016		ΣR(p.u.)	0.480342597
X	0.004275		ΣZ(p.u.)	0.859143863
R	0.000016		$I_{sc\ rms\ sym}$	1400.013564

Structural Breadth

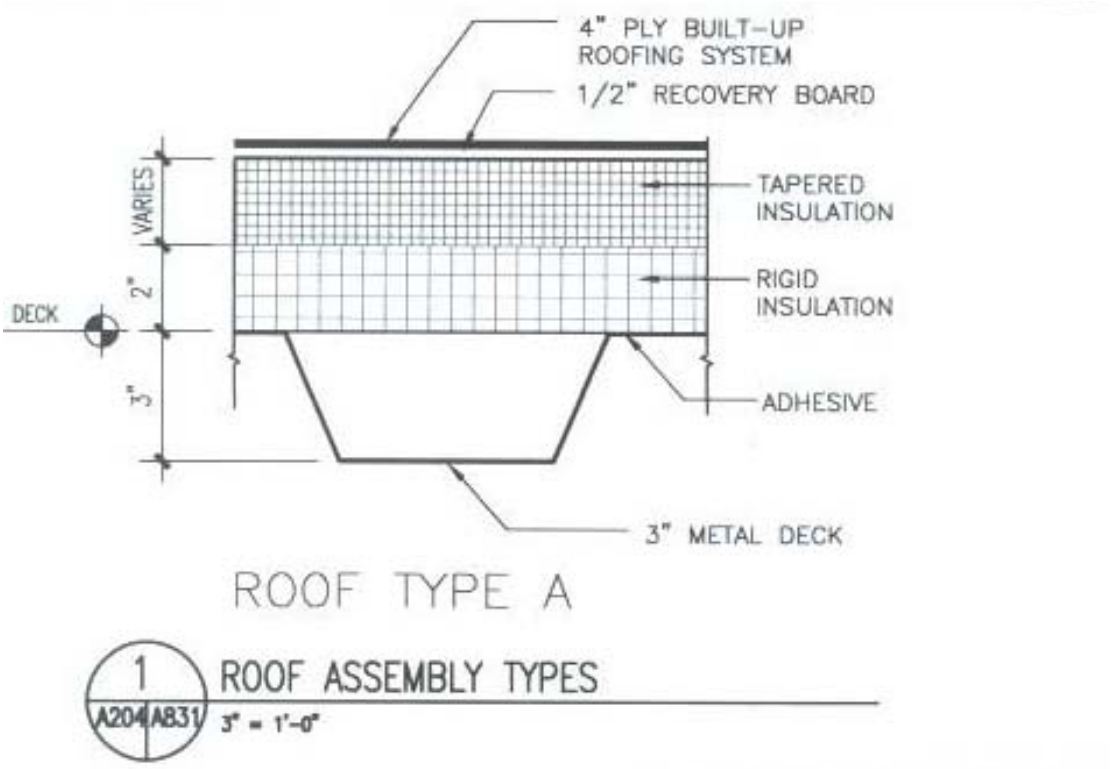
Upon the redesign of the typical painting studio, the original clerestory design was switched to a skylight system. While this created the opportunity for a more uniform distribution of daylight, it also required modification to the existing system. The existing roof design made use of a 3" Type N Deep-Rib Steel Decking. The beams to be redesigned were assumed to be fully braced due to the metal decking and skylights. Therefore, sizing of members was based on the Steel Construction manual table 3-2.

Please note that the scope of this depth is limited to the resizing and cost analysis of the structural members only.

Design Roof Loads

1. Dead Loads: (In accordance with IBC 2000, sections 1606 and 1605.3.1)

Roof Type A



Metal Decking - 2.71 PSF

½" Recovery Board – 0.65PSF

Tapered Insulation – 1.0 PSF

Rigid Insulation – 0.8PSF

Skylight – 10psf

**Note: Value Calculated from Vulcraft decking see appendix F for cut sheet*

2. Live Loads: (In accordance with IBC 2000, sections 1607 and 1605.3.1)

20PSF

3. Snow Load (In accordance with IBC 2003 section 1608.2)

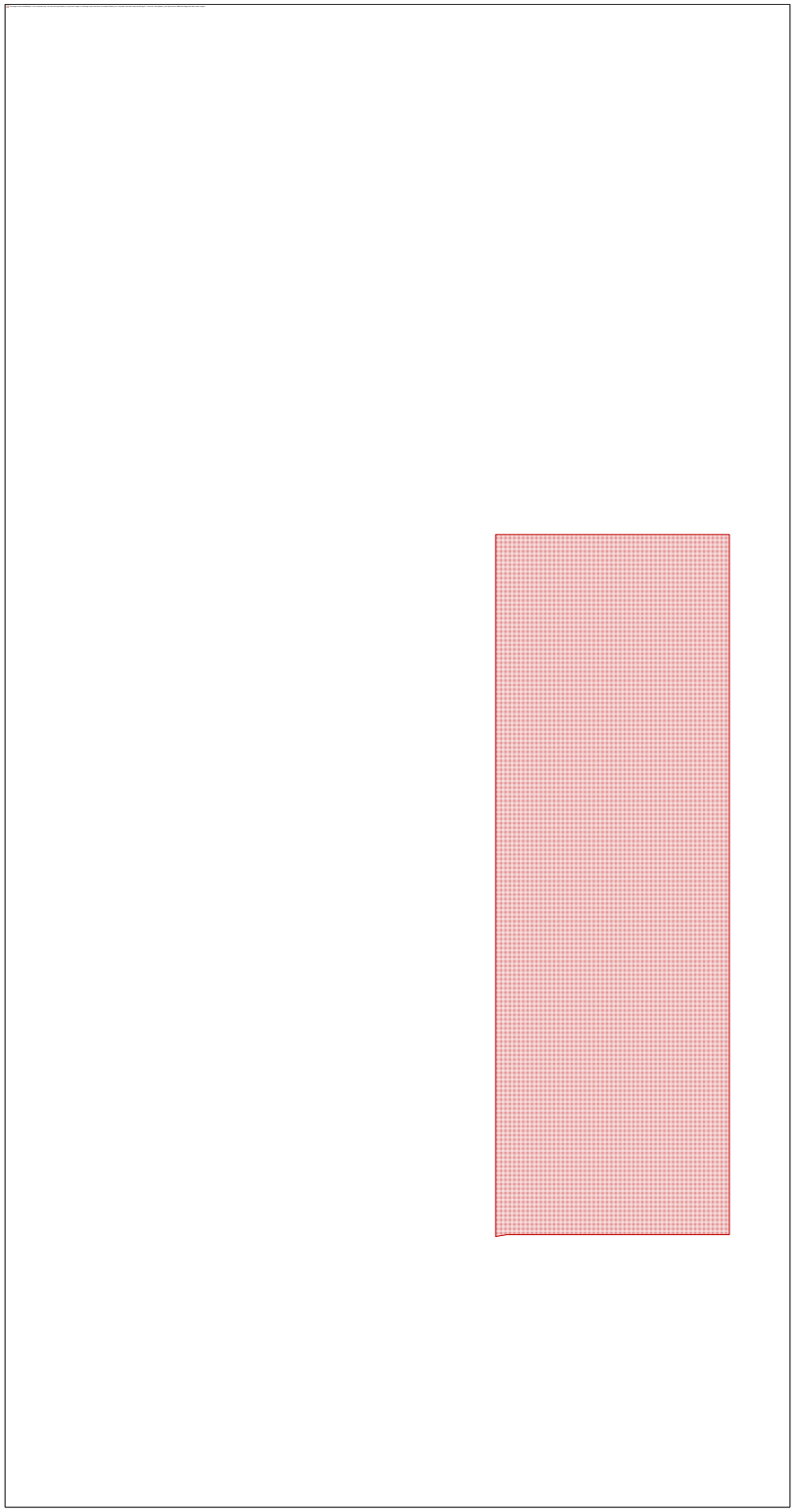
30 PSF snow load

Design Load = 1.2D + 1.6S + 0.5L

= 1.2(5.16) + 1.6 (30) + 0.5(20)

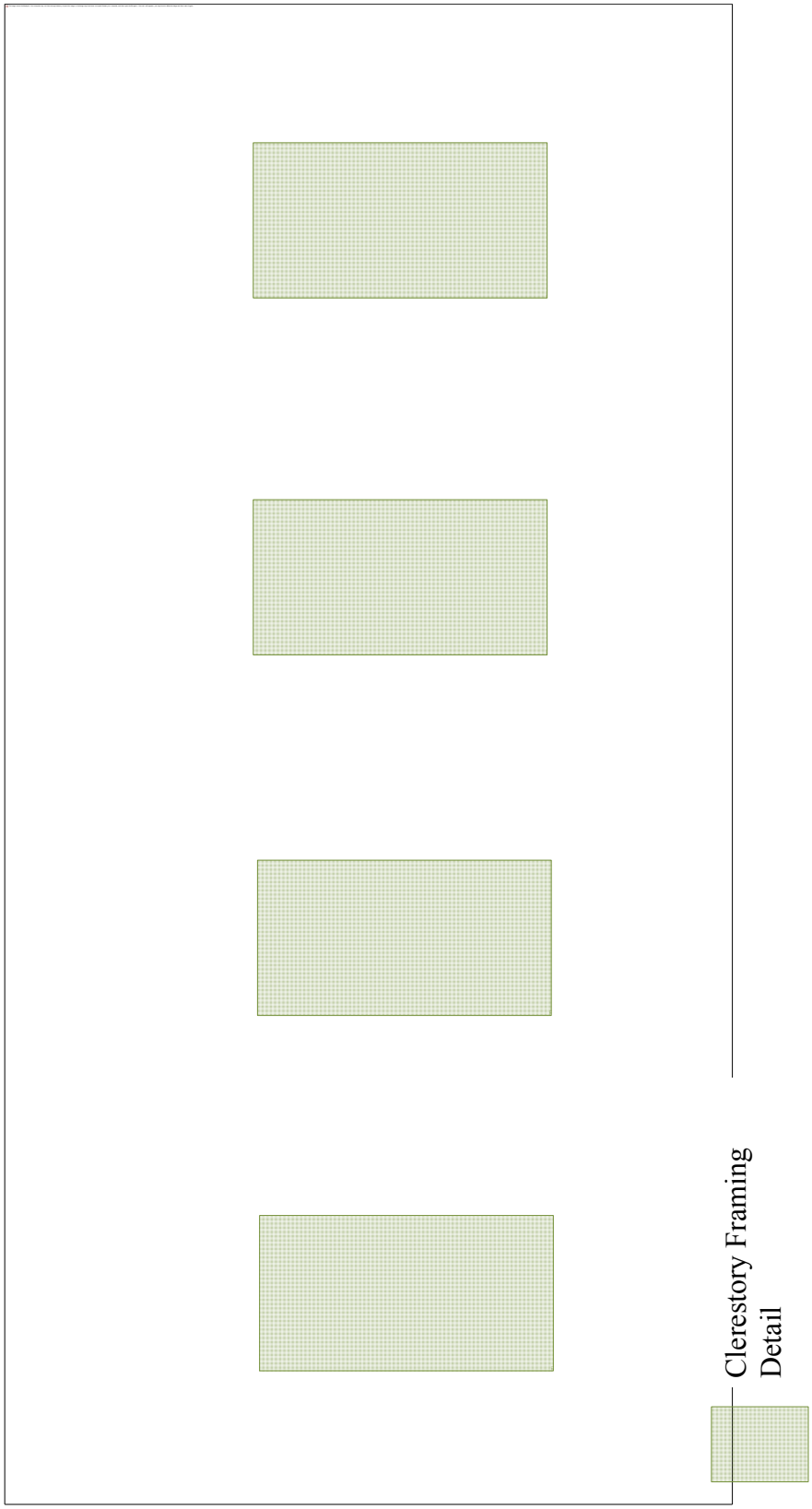
= 64.2 PSF

Existing Roof Framing Plan

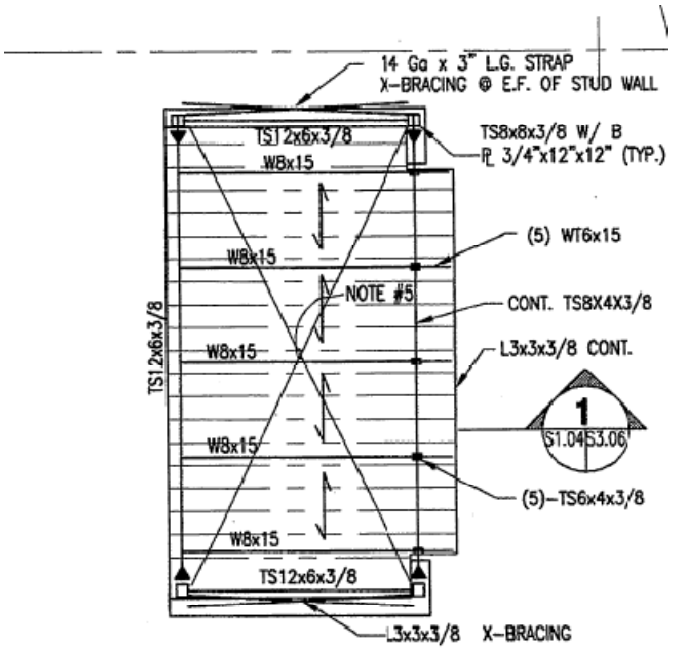


Modified Area

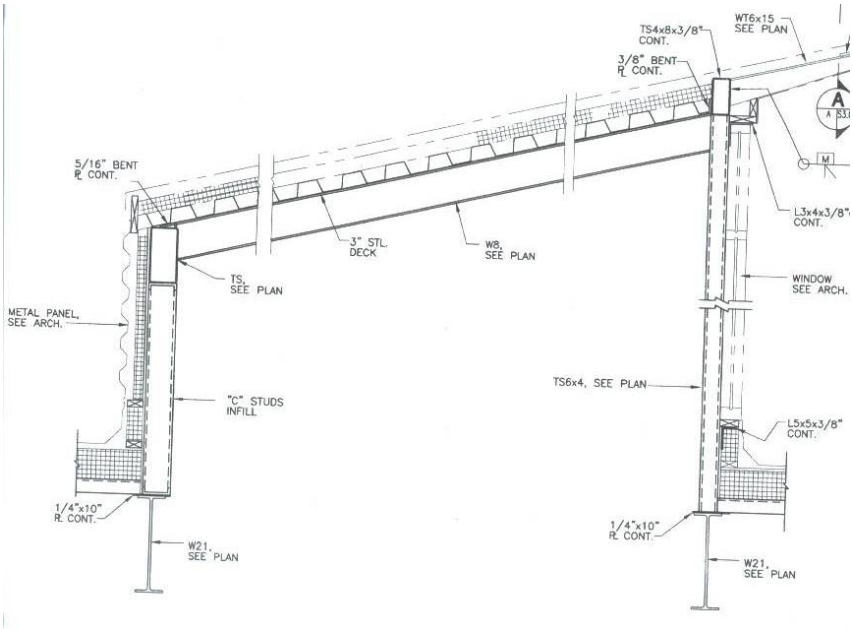
Existing Roof Framing Part Plan



Existing Clerestory Framing Detail

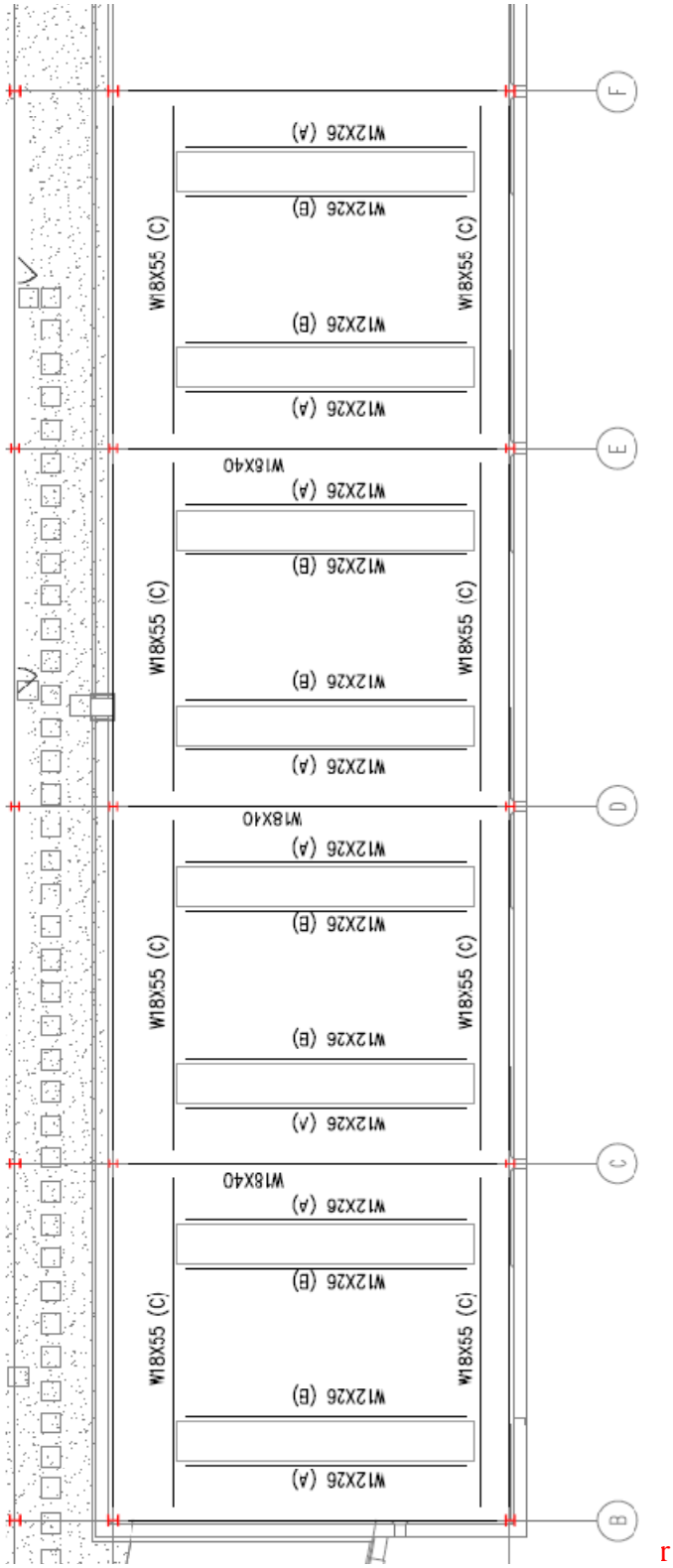


PLAN DETAIL 1-S1.04



1 SECTION
S1.04 S3.06 SCALE 3/4"=1'-0"

Revised Roof Framing Part Plan



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Beam Schedule

Joist Member Sizing (Assuming Moment Controls)

Member	Design Load (PSF)	Tributary Area (ft)	Braced Length (ft)	Design Shear (kips)	Design Moment (kip ft)	Member Size	Moment of Inertia (in^4)	Available Shear (kips)	Available Moment (kip ft)	Max Allowed Deflection (LL/360) in.	Live Deflection (in)	Max Allowed Deflection (Total/240) (in)	Total Load Deflection (in)
Joist A	64.20	5.08	30.00	4.89	36.71	W10x12	53.80	56.30	46.90	1.00	1.78	1.50	2.09
Joist B	64.20	9.95	30.00	9.58	71.86	W12x16	103.00	79.10	75.40	1.00	1.82	1.50	2.13

All members are controlled by deflection

**20psf used for Live load deflection calculation*

*** 35.16psf used for total load deflection calculation*

Calculation to find necessary Moment of Inertia to satisfy deflection

Member	Live Max Deflection (L/360) in.	Required Moment of Inertia (in^4)	Total Load Max Deflection (L/240) in.	Required Moment of Inertia (in4)	Member Size	Moment of Inertia	Available Shear (kips)	Available Moment (kip ft)	Design Shear (kips)	Design Moment (kip ft)
Joist A	1.00	95.83	1.50	74.88	*W12x26	204.00	84.30	140.00	4.89	36.71
Joist B	1.00	187.59	1.50	146.57	*W12x26	204.00	84.30	140.00	9.58	71.86

**While a w14x 22 would be a more structural economical solution, a w12x26 was selected to limit the depth of the beam.*

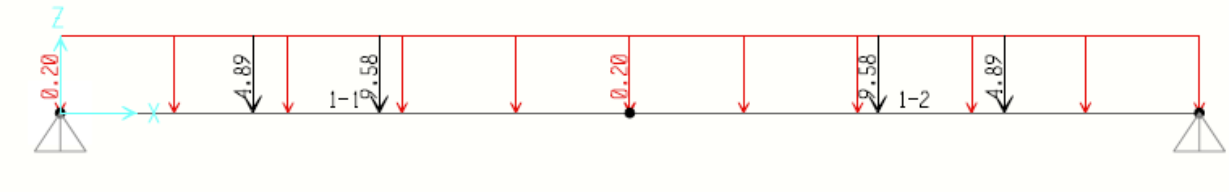
Girder Design "C" (SAP2000 ver.11)

W18x55 Selected

Available Shear = 212 kips

Available Moment = 420 ft • k

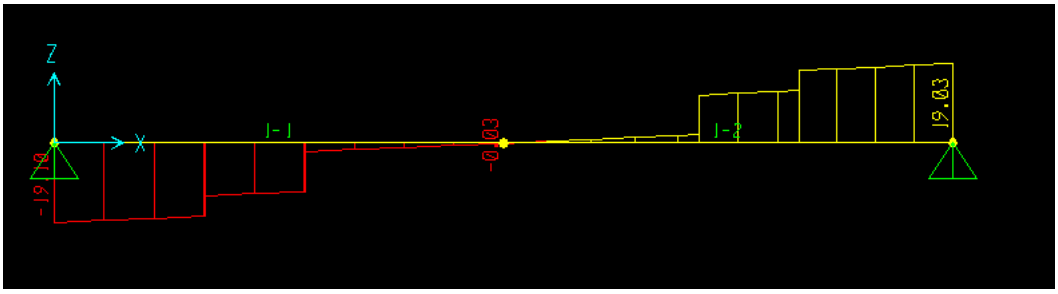
Moment of Inertia = 890 in^4



*black loads indicate point loads from joists "A" & "B" onto Girder

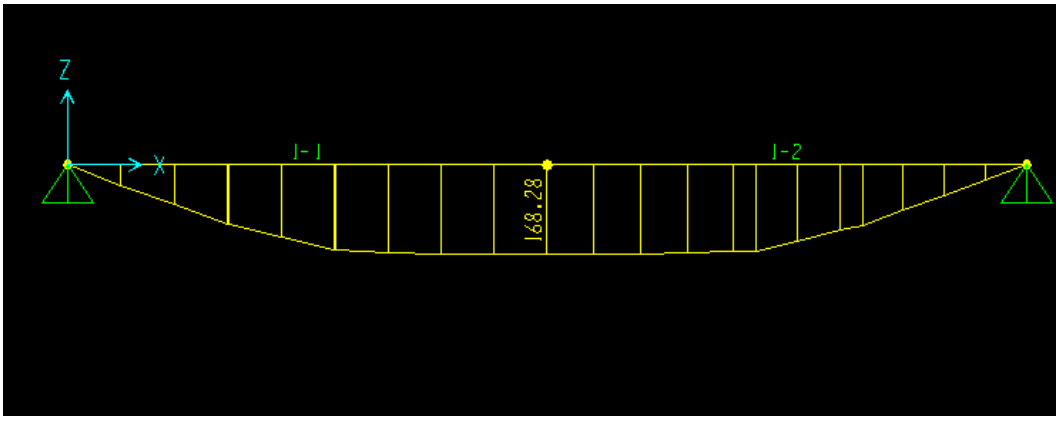
* Red load indicates uniform distributed load of roof framing

Shear Diagram



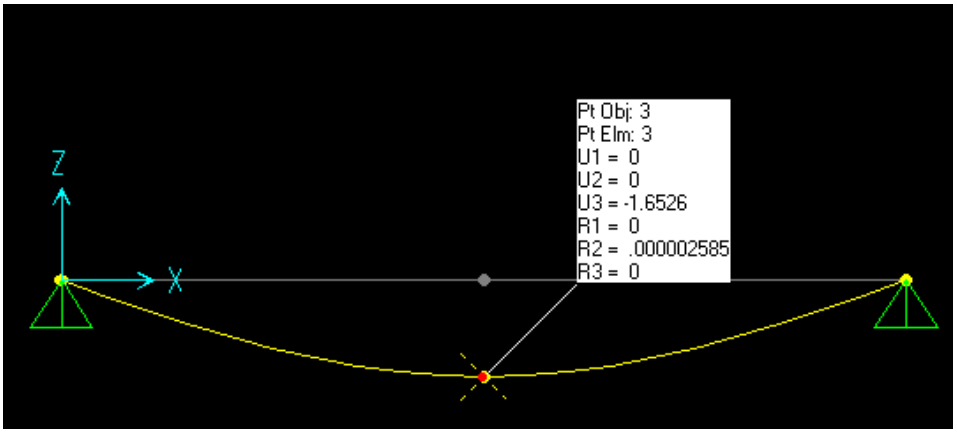
Max Shear= 19.03 kips <212 kips

Moment Diagram



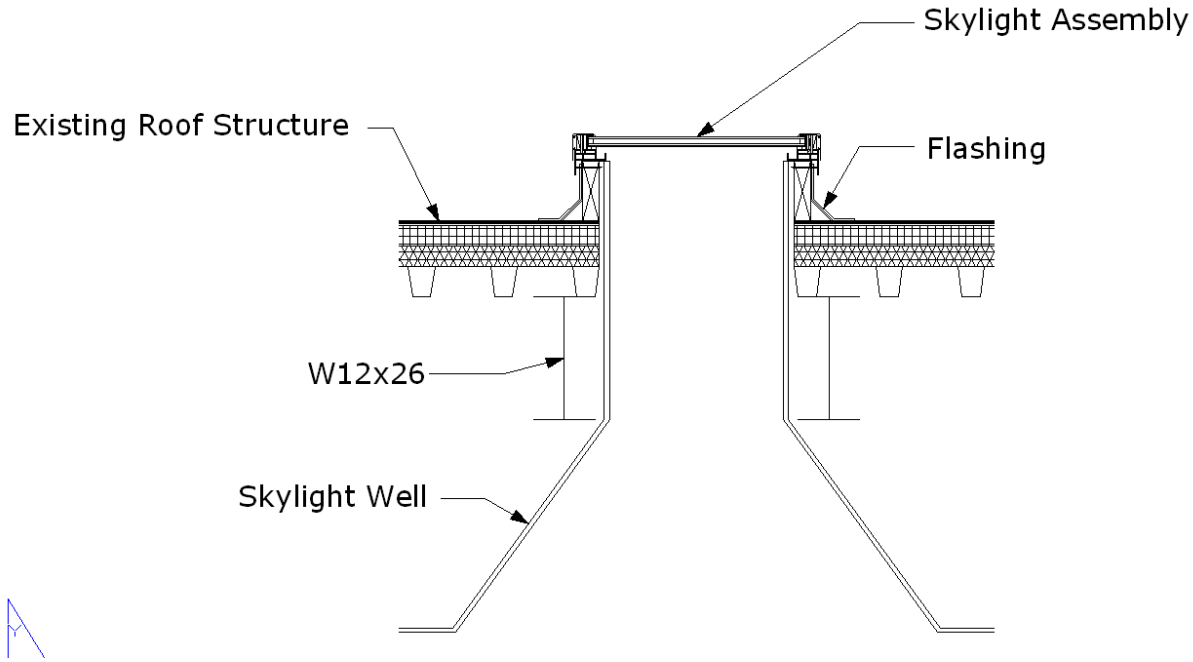
Max Moment = 168.28 ft • k < 420 ft • k

Deflection



Max Deflection = 1.653 in. < 1.8 in. Max Allowed L/240 (1.8inches =12*36/240)

Skylight Framing Detail



Financial Analysis

With the removal of clerestories and addition of members to frame the skylight, a financial analysis was performed, using a per tonnage cost of $3,800/ton of structural steel, to determine if the new system would cut steel costs. An 20% allowance of tonnage was included for connections in both systems. The following tables show the tonnage of each system and the associated cost.

Existing Framing System

Member Size	Linear Feet	Weight lb/linear ft	total weight (lbs)
w12x14(B3)	71.00	14.00	994.00
w21x44	320.00	44.00	14,080.00
w12x19	64.00	19.00	1,216.00
w18x40	120.00	40.00	4,800.00
w8x15	340.00	15.00	5,100.00
TS12x6x3/8	248.00	42.70	10,589.60
L3x3x3/8	264.00	7.17	1,892.88
TS8x4x3/8	88.00	27.40	2,411.20
WT6x15	53.30	15.00	799.50
TS6x4x3/8	150.00	22.30	3,345.00
	total tons		22.61
	*Connection Tonnage		4.52
	**Price/ton		3,800.00
	total Estimated Cost		103,120.25

New Framing System

Member Size	Linear Feet	weight (lbs)/linear ft	total Weight (lbs)
w12x26	480.00	26.00	12,480.00
w18x40	320.00	48.00	15,360.00
w18x55	288.00	55.00	15,840.00
	total tonage		21.84
	*Connection Tonage (20%)		4.368
	**Price/ton		3,800.00
	total estimated cost		99,590.40

Conclusion

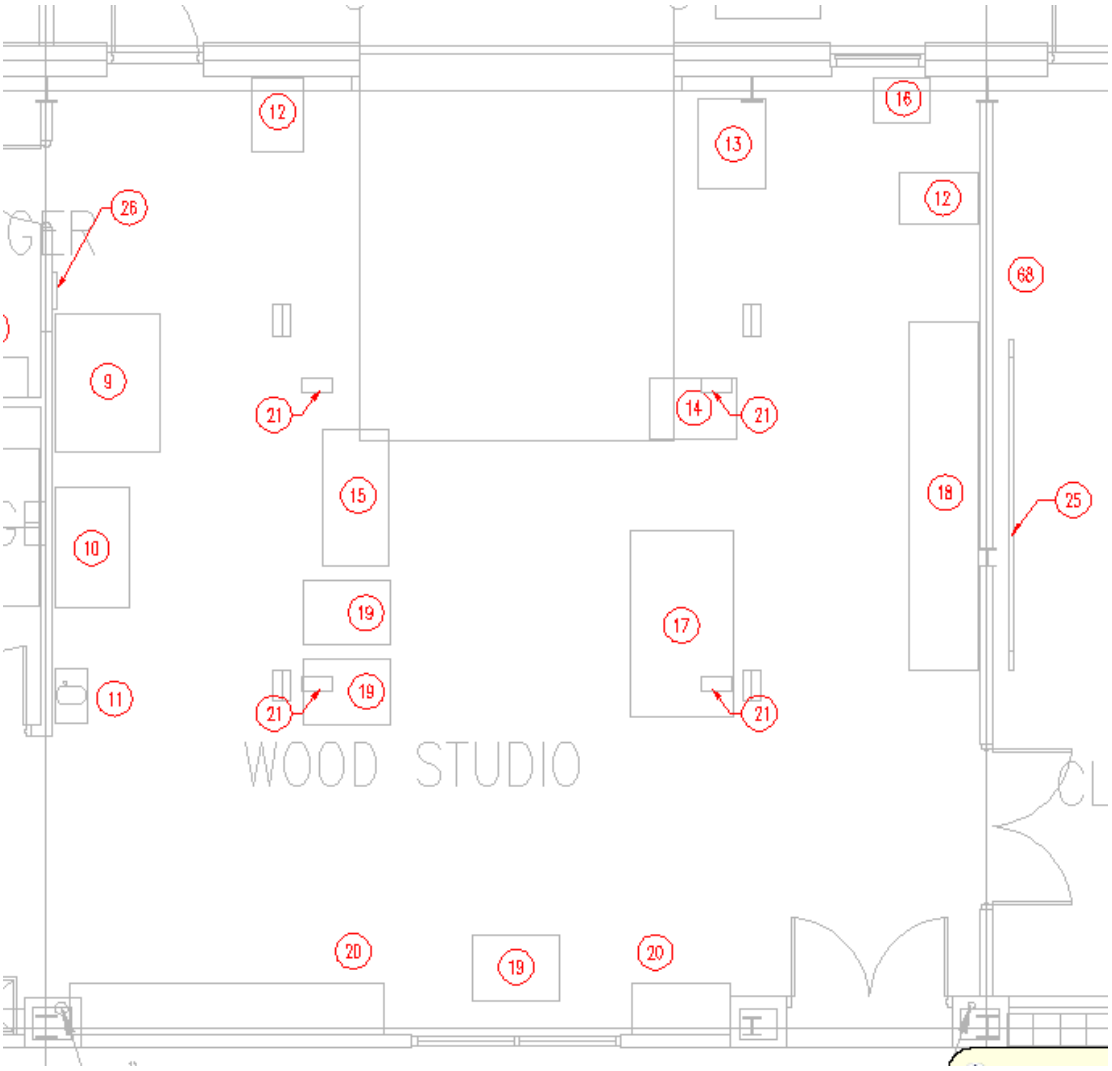
The redesign of the existing roof framing system was done in response to the change in daylighting strategies. The goal of the redesigned system was to adequately frame the new skylights while minimizing any impact to the current design, constructability and cost. The redesigned system effectively meets these goals by maintaining the existing structural bays, decreasing the number and type of joints, and maintaining similar tonnage of steel. In addition to a slight decrease in steel costs, I feel the decrease in the number of joints and complexity of joints would add to the savings.

Acoustical Breadth

The acoustical breadth scope was to analyze the existing conditions in the wood shop classroom and surrounding areas on the lower level of the building. The criteria used to evaluate the existing system are noise level in the room, reverberation time and sound transmission loss.

Not all acoustical properties could be found for each material in the space, therefore the most appropriate approximation was made in each instance. Additionally, the noise levels of the room were estimated by taking a sound meter to the SALA building wood shop and measure existing conditions.

Equipment Floor Plan



Equipment Schedule

Equipment Schedule	
Tag	**Description**
9	Radial Arm Saw
10	Chop Saw
11	Drill Press
12	Band Saw 14"
13	Band Saw large
14	Planer
15	Table Saw 63"x30"
17	large work table
18	panel saw
19	Small Work Table
20	Storage Shelving
21	Cord Reel receptacle
26	Wall Clock

Existing Noise Conditions

Wood Studio Existing Noise Conditions (Noise Level dB)						
Condition	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
Max Conidition	101	100	102	100	104	105
Dust Collector Only	72	73	75	71	70	69

Reverberation Time Analysis

Wood Studio Existing Acoustical Analysis			125 Hz		250 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz	
Surface Description	Material	Surface Area (S)	α	a	α	a	α	a	α	a	α	a	α	a
Floor	Sealed Concrete	1409.0	0.01	14.09	0.01	14.09	0.01	14.09	0.02	28.18	0.02	28.18	0.02	28.18
Ceiling	Acoutical Ceiling Tile	1409.0	0.27	380.43	0.60	845.40	0.64	901.76	0.80	1127.20	0.91	1282.19	0.99	1394.91
North Wall	Wall Type 2D	448.0	0.16	71.68	0.07	31.36	0.04	17.92	0.04	17.92	0.03	13.44	0.03	13.44
Main Entrance Door Wall	Wall type 4B	140.0	0.27	37.80	0.10	14.00	0.05	7.00	0.04	5.60	0.03	4.20	0.03	4.20
East Wall Glazing	Glazing Type G4A	51.4	0.15	7.70	0.05	2.57	0.04	2.05	0.03	1.54	0.02	1.03	0.02	1.03
East Wall	Wall Type 4B	84.0	0.27	22.68	0.10	8.40	0.05	4.20	0.04	3.36	0.03	2.52	0.03	2.52
East Wall	Wall Type 2D	291.6	0.16	46.66	0.07	20.42	0.04	11.67	0.04	11.67	0.03	8.75	0.03	8.75
East Wall	Wall Type 2D	133.0	0.16	21.28	0.07	9.31	0.04	5.32	0.04	5.32	0.03	3.99	0.03	3.99
South Wall	Wall Type 2D	119.0	0.16	19.04	0.07	8.33	0.04	4.76	0.04	4.76	0.03	3.57	0.03	3.57
East Tool Cage Wall	Wall Type 1A	126.0	0.14	17.64	0.06	7.56	0.04	5.04	0.03	3.78	0.03	3.78	0.03	3.78
North Tool Cage Wall	Wall Type 1A	300.3	0.14	42.05	0.06	18.02	0.04	12.01	0.03	9.01	0.03	9.01	0.03	9.01
Tool Cage wall Glazing	Glazing Type G8	28.7	0.15	4.30	0.05	1.43	0.04	1.15	0.03	0.86	0.02	0.57	0.02	0.57
West Wall	Wall Type 2C	333.0	0.22	73.26	0.08	26.64	0.05	16.65	0.04	13.32	0.03	9.99	0.03	9.99
West Wall Overhead Door	Aluminum	150.0	0.01	1.50	0.01	1.50	0.01	1.50	0.02	3.00	0.02	3.00	0.02	3.00
West Wall Glazing	Glazing G	25.1	0.15	3.76	0.05	1.25	0.04	1.00	0.03	0.75	0.02	0.50	0.02	0.50
Wood Door	Wood	168.0	0.10	16.80	0.11	18.48	0.10	16.80	0.08	13.44	0.08	13.44	0.11	18.48
Steel Door	Steel	21.0	0.01	0.21	0.01	0.21	0.01	0.21	0.02	0.42	0.02	0.42	0.02	0.42
Room Volume ft^3		19726												
Σa			780.9		1029.0		1023.1		1250.1		1388.6		1506.3	
Reverberation Time T= (.05V/ΣA)			1.3		1.0		1.0		0.8		0.7		0.7	
Target Time			0.7-1.1sec		0.7-1.1sec		0.7-1.1sec		0.7-1.1sec		0.7-1.1sec		0.7-1.1sec	

Based on the existing materials in the room, the reverberation time for the room meets the target time of 0.7sec-1.1 sec for demonstration and teaching purposes for all but the 125 Hz frequency which is 0.2 seconds over. Based on this data I found it unnecessary to modify the materials in the room.

Noise Reduction

A noise reduction analysis performed below will analyze if the noise from the wood shop will transmit into the crit room which is across the common corridor.

Composite TL Calculation for Shared Wall

TL Calculation													
Surface Description	Surface Area	TL @ 125 Hz	τ @ 125Hz	TL @ 250 Hz	τ @ 250 Hz	TL @ 500 Hz	τ @ 500 Hz	TL @ 1000 Hz	τ @ 1000 Hz	TL @ 2000 Hz	τ @ 2000 Hz	TL @ 4000 Hz	τ @ 4000 Hz
Wall	348.5	29	0.0013	41	8E-05	51	8E-06	56	3E-06	43	5E-05	48	1.6E-05
door	21	14	0.0398	15	0.0316	17	0.02	18	0.0158	22	0.00631	29	0.00126
glass	49	30	0.001	33	0.0005	36	0.0003	32	0.0006	40	0.0001	50	0.00001
ΣS	418.5												
Composite TL		25.00		27.67		29.84		30.60		34.32		41.10	

Wood Shop to Corridor Transmission

Noise Reduction (Wood Shop -> Corridor)							
Surface Description	Surface Area (ft^2)	(α) 125Hz	(α) 250Hz	(α) 500Hz	(α) 1000Hz	(α) 2000Hz	(α) 4000Hz
Floor	372	0.01	0.01	0.01	0.02	0.02	0.02
Common Wall	348.5	0.16	0.07	0.04	0.04	0.03	0.03
Common Wall Door	21	0.10	0.11	0.10	0.08	0.08	0.11
Common Wall Glazing	49	0.15	0.05	0.04	0.03	0.02	0.02
Crit Room Wall	418.5	0.22	0.08	0.05	0.04	0.03	0.03
Ceiling	372	0.27	0.60	0.64	0.80	0.91	0.99
A_2= ΣSα		261.44	289.56	280.725	338.87	371.63	402.02
Composite TL Common Wall		24.99886	27.666	29.8412	30.5986	34.3174	41.1047
10 log a2/S		-2.043234	-1.5996	-1.7341	-0.9166	-0.51585	-0.17448
NR= TL + 10 log a2/S		22.95563	26.066	28.1071	29.6819	33.8015	40.93022

Noise Levels in Corridor

Corridor Existing Noise Conditions (Noise Level dB)						
Condition	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
Max Conidition	78.04	73.93	73.89	70.32	70.20	64.07
Dust Collector Only	49.04	46.93	46.89	41.32	36.20	28.07

Corridor to Crit Room Transmission

Noise Reduction (Corridor -> Crit Room)							
Surface Description	**Surface Area (ft^2)**	**(α) 125Hz**	**(α) 250Hz**	**(α) 500Hz**	**(α) 1000Hz**	**(α) 2000Hz**	**(α) 4000Hz**
Floor (Concrete)	382	0.01	0.01	0.01	0.02	0.02	0.02
Common Wall	348.5	0.16	0.07	0.04	0.04	0.03	0.03
Walls	1016.4	0.10	0.11	0.10	0.08	0.08	0.11
Ceiling (Exposed)	382	0.10	0.05	0.06	0.07	0.09	0.08
$A_2 = \Sigma S\alpha$		199.42	159.12	142.32	129.63	133.79	160.46
Common Wall		24.00	37.00	44.00	49.00	36.00	41.00
10 log a2/S		-2.42	-3.40	-3.89	-4.29	-4.16	-3.37
NR= TL + 10 log a2/S		21.58	33.60	40.11	44.71	31.84	37.63

Noise levels in Crit Room

Crit Room Existing Noise Conditions (Noise Level dB)						
Condition	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
Max Conidition	56.47	40.34	33.78	25.61	38.36	26.44
Dust Collector Only	27.47	13.34	6.78	0.00	4.36	0.00

Recommended NC Curve

Crit Recommended Noise Criteron Curve						
NC 25	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
db	45	38	31	27	25	21

Redesigned Crit Room/Corridor wall construction

Existing 3 5/8" 20 gauge metal studs with GWB on each side

Redesigned Construction 3 5/8" 24 gauge metal studs with 2 layers of 5/8" GWB and 3" fiberglass insulation

Redesigned Corridor to Crit Room Transmission

Noise Reduction (Corridor -> Crit Room)							
Surface Description	**Surface Area (ft^2)**	**(α) 125Hz**	**(α) 250Hz**	**(α) 500Hz**	**(α) 1000Hz**	**(α) 2000Hz**	**(α) 4000Hz**
Floor (Concrete)	382	0.01	0.01	0.01	0.02	0.02	0.02
Common Wall	348.5	0.16	0.07	0.04	0.04	0.03	0.03
Walls	1016.4	0.10	0.11	0.10	0.08	0.08	0.11
Ceiling (Exposed)	382	0.10	0.05	0.06	0.07	0.09	0.08
$A_2 = \Sigma S\alpha$		199.42	159.12	142.32	129.63	133.79	160.46
Composite TL Common Wall		38.00	52.00	59.00	60.00	56.00	62.00
10 log a2/S		-2.42	-3.40	-3.89	-4.29	-4.16	-3.37
NR= TL + 10 log a2/S		35.58	48.60	55.11	55.71	51.84	58.63

Noise Levels in redesigned Crit Room

Crit Redesigned Noise Conditions (Noise Level dB)						
Condition	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
Max Conidition	42.47	25.34	18.78	14.61	18.36	5.44
Dust Collector Only	13.47	0.00	0.00	0.00	0.00	0.00

Recommended NC Curve

Crit Recommended Noise Criteron Curve						
NC 25	**125Hz**	**250Hz**	**500 Hz**	**1000Hz**	**2000Hz**	**4000Hz**
db	45	38	31	27	25	21

Evaluation

Initial analysis of the wood shop helped lead my design as I originally intended to try and quiet the wood shop room itself. After trying numerous attempts I found this to be a lost cause. I then turned my attention towards sound isolation. Occupants within the wood shop would be wearing ear protection from the harmful noises, therefore the main goal was to make sure the wood shop did not disturb adjacent spaces. While not exactly adjacent, the crit room, across the corridor from the woodshop, was used to evaluate sound propagation through the existing building construction. It was found that the proposed design would create unsatisfactory noise levels in the crit room while the machines were running in the wood shop. It was then determined that the most cost effective method to isolate the crit room from this noise was to redesign the wall construction. By changing to 3 5/8" 24 gauge metal studs with 2 layers of 5/8" GWB and 3" fiberglass insulation, noise transmission was able to be limited to meet the target noise criterion (NC) of 25.

Conclusion & Final Remarks

The past year's work on the Art & Visual Technology Building has taught me as much as it has challenged me. While in many instances only the final design or solution is shown, it was a learning process including much iteration to come to the point I have. This building and thesis have taught me a great deal about the relationship between systems and how to approach design.

The lighting depth portion of the report focused on four major spaces; the main entrance façade, main entry lobby, exhibit gallery and typical painting studio. For each space I ended up having much different design criteria. Through much iteration I was able to come to a design solution for each that met the design criteria I had set out to meet. Through the use of the wall-washing LEDs I was able to create a dynamic and creative solution to give the building and department a sense of place and identity. The use of the slot downlighting and continuous wall sconce in the main lobby emphasizes the dimensions of the space while creating a unique feel. The painting studio provides a flexible and workable condition for painting students that is both effective and energy efficient. Finally, the use of the recessed channels in the exhibit gallery allows the design to have the low profile I desired, while still meeting the needs of the space.

The electrical distribution including branch circuits, feeders and panelboards for each space were adequately redesigned to handle the new lighting loads. Additionally, it was found that the extremely low utility rate coupled with George Mason University not being eligible for federal tax incentives led to a photovoltaic array not being financially viable for this project. Meanwhile, it was found that the use of energy efficient transformers would also not be recommended due to the extremely low electrical utility rate.

The redesign of the roof framing system was done to structurally accommodate the newly designed skylights. While providing a better distribution of natural daylight into the painting studio, it will cost less in the amount of structural steel needed as well as decrease the number and complexity of connections in the system.

Finally, an acoustical study was performed to evaluate and improve the existing acoustical conditions for the wood shop in the lower level of the building. Through the intial design it was found that no practical method could be employed to decrease noise levels in the shop to recommended levels. However, a redesign of the wall framing assembly for the adjacent crit room prevented the transmission of noise from the wood shop to penetrate this space.

Appendix A

Luminaire Schedule

Luminaire Cutsheets

Lamp Cutsheets

Ballast Cutsheets

Luminaire Schedule

Luminaire Type	Manufacturer	Catalog #	Lamps	Ballast Type	Volts	Comments
A	Se'lux	M1B1-2T5-SA-X-SH-004-WH-277-DM	(2) FP28/835 (L1)	M1	120	Recessed slot downlight, Dimming Ballast
B	Lighting Services Inc	C100-00-W	50PAR20-H-SP10 (L2)	n/a	120	Track Lighting Mounted to Skylight Opening
C	Se'lux	M1B1-1T5-SA-X-SH-004-WH-277	(1)-FP28/835 (L1)	M2	277	Recessed Continuous slot downlight
D	Se'lux	M1N1-TS	(1)-FP28/835 (L1)	M2	277	Recessed continuous sconce with satin diffuse lens
E	Kurt Versen	H8632-WT	(1)-PLT/32W/ 835/ 4P/ ALTO (L3)	M3	277	Recessed 6" Square Downlight
F	Lightolier	CL-1-4-E82	(1)-F032/835/ECO (L4)	M4	277	Stairwell cove fixture. See Proceeding information on mounting details.
G	Bega	8996MH	(1)CDM100/ 830/ED17 (L5)	M5	277	Pole area walkway lighting
H	Erco	34105.023	(1)MC39T6/ U/G12/ 835PB (L6)	M6	277	Banner Floodlight
I	Bega	1323	(1)20T3Q/ MINISTAR/S (L7)	-	12v	Step light with integral transformer. Supply 120v to fixture.
J	Light Wild	LW/Tile/FLR/ RECT/ 2.165x11.8/ FROST/RGB/ BOXY	72 LEDs (6W)	-	24V DC	In-grade fixture, integral transformer, supply 120v AC.
K	Focal Point	FTV/14/D/ 2/T5/E/277/ G/PB/DF/BK	(2) FP28/835 (L1)	M1	120	Recessed 1'x4' troffer, black matte finish louvers. Dimmable Ballast. To be mounted flush with bottom of channel.
L	Lighting Services Inc.	C100-00-B	(1)50PAR20/ H/FL25 (L8)	n/a	120	Recessed Track mounted at top of channel. Black finish housing. 25 degree beam spread.
M	Lighting Services Inc.	C100-00-B	(1)50PAR20/ H/SP10 (L2)	n/a	120	Recessed Track mounted at top of channel. Black finish housing 10 degree beam spread.
N	Lighting Services Inc.	C110-00-B	(1)50PAR30/ HIR/FL35 (L9)	n/a	120	Recessed Track mounted at top of channel. Black finish housing 35 degree beam spread.
O	Color Kinetics	#116/ 000016/ 00/00	144LEDs (280W)	-	120V	Custom in grade housing to accommodate pedestrian traffic load.
P	Prescolite	D4LED/277V/ 4D9/WT	4 LEDS (13W)	-	277V	Surface Mounted Canopy Downlight,

M100 Super Recessed Linear Fluorescent Flanged Extrusion

se'lux

Project: _____ **Type:** A **Qty:** _____

M1B1	– 2T5	– SA	– x	– SH	– 004	– WH	– 277
Fixture Series	Lamp Type	Upper Shielding	Lower Shielding	Mounting	Nominal Length	Finish	Voltage

DM _ _ _ _ _ _ _ _

Options (refer to separate data sheets for ordering codes and details)

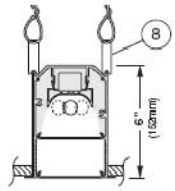
Fixture Series	Lamp Type	Upper / Lower Shielding	Mounting	Nominal Length	Finish	Voltage	Options
M1B1 M100 Super Recessed Continuous Flange (Flanged Extrusion/ Flanged Endcaps)	1T5 F28T5	SA Specular Parabolic	SH Suspension Clips	004 4 foot	WH White	120	TB Lengths to Fit 2' Grid T-Bar Ceiling System[1]
M1B2 M100 Super Recessed Flush End (Flanged Extrusion/ Flangeless Endcaps)	2T5 (2x)F28/T5	MA Matte Parabolic	TS 1" Studs (factory installed)	008 8 foot	BK Black	277	(qty.)EM Stand-by Battery Pack[2] (prefix quantity, i.e. - 5EM)
	1T5HO F54T5HO	MP Silky Specular Parabolic	RC Rotating Crossbars	012 12 foot	SV Silver	347	FS Single Fusing
	1T8 F032/T8	PL Matte Perforated Parabolic	PM Perimeter Mount	For actual lengths see following page. For other lengths, configurations indicate nominal length rounded to the next highest foot. Factory will supply layout drawings. Individual fixtures cannot be field joined.	SP Specify RAL#		DM Dimming[2] (specify system)
		SD Satine Lens					DMA Digital Addressable Dimming[2]
		OD Extra Diffuse Lens					SI Satine Acrylic Inlay[4]
		X None					FW Flex Whip (standard)
							FW1 Flex Whip (dimming)
							Track Eutrac Standard[3]
							DL Suitable for Damp Locations
							CCEA Chicago Plenum
							Downlights (See MR16 spec sheets, pp.98-99)

[1]M1B1 w/ T5 & T5HO lamps only, consult factory for other lamps. [2]Must be low profile ballasts (1½"W x 1⅜"H); consult factory for details. [3]Consult factory for details. [4]SA, MA, MP & PL shieldings only.

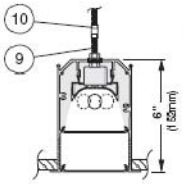
Mounting Diagrams

Scale = 1 : 8

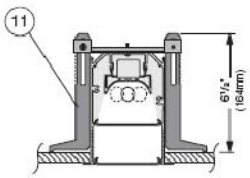
Suspension Clips (SH)



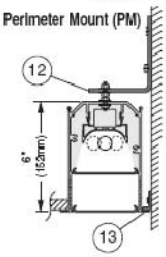
Pre-installed Rod (TS)



Rotating Crossbars (RC)

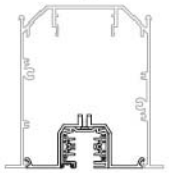


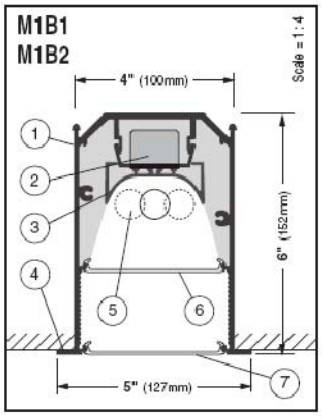
Perimeter Mount (PM)



Track

Track insert including track available for all configurations, consult factory for details.





1. Housing - Continuous, 6063-T5 extruded aluminum profile up to 16 feet long. Joined with Connector Plus Joining System for ease of installation and to assure a uniform appearance.

2. Ballast - Electronic, high power factor, class "P", type "A" sound rating. Specify 120v, 277v, or 347v. Ballast is factory pre-wired with leads to one end of fixture. Consult factory for ballast options.

3. Gear Tray - Extruded aluminum,with white painted finish. Gear tray installed as a complete electrical unit and is held in place with knurled dress nuts. It is fully accessible from below ceiling.

4. Flange - 1/2" (12mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (M1B1) or flush end (M1B2).

5. Lamps - As noted (by others). Other lamp lengths or wattages available, consult factory.

6. Upper Shielding - Louvers offer excellent glare control in longitudinal, lateral, and all diagonal planes. High quality aluminum louvers and acrylic shielding allow true freedom of layout for today's modern spaces.

7. Lower Shielding - Same options as Upper Shielding #6.

8. Spring Steel Suspension Clips - Supplied two places, located nominally every 4 ft. Support wires supplied and installed by others.

9. Pre-installed 1" 1/4-20 Stud - Attached to fixture every nominal 4 feet.

10. Coupling and Threaded Rod to Structure - Supplied and installed by others.

11. Rotating Crossbar - For inaccessible ceilings, adjustable for ceiling thicknesses from 1/4" to 2". Support required nominally every 4 feet.

12. Steel Wall Bracket and 1/4-20 Rod - Supplied nominally every 4 ft. (Fasteners to wall and wall anchors by others)

13. Aluminum wallbracket - Secured to wall (fasteners and wall anchors by others) and runs entire length of fixture. Also supplied for width of fixtures when supplied with continuous flange. Allows for 1/8" gap between flange and wall to create shadow line allowing for unevenness of wall.

Interior Luminaire Finish - Standard interior colors are White (WH), Black (BK) and Silver (SV). RAL colors (SP) are available, please specify RAL#.

TEL: (845) 691-7723
FAX: (845) 691-6749
www.selux.com/usa
M1B1-01 (v5.0)

c UL us LISTED
Union Made Affiliated with IBEW Local 363

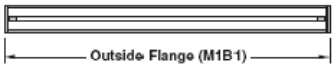
M100 Super Recessed Linear Fluorescent Flanged Extrusion

selux

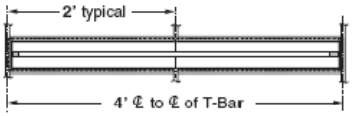
M1B1 and M1B2 Layout Dimensions

Specify T5 lamps when using in grid ceiling systems where 24" or 48" light openings are required.

M1B1 Recessed - nominal 4 foot individual

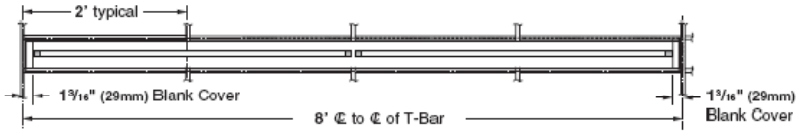


M1B1 Recessed - T-Bar Length - nominal 4 foot individual



M1B1 Recessed - nominal 8 foot individual

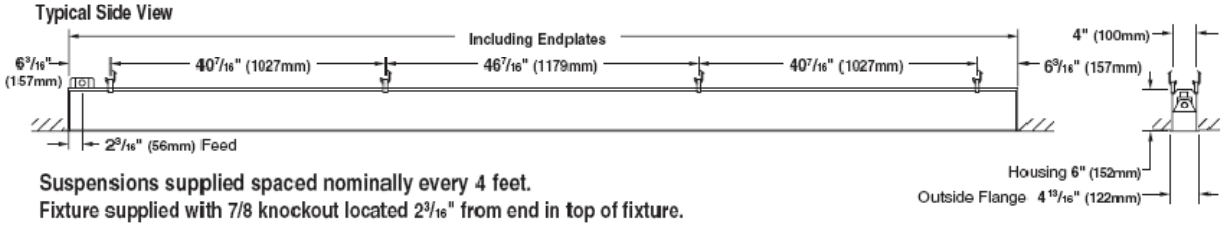
M1B1 Recessed - T-Bar Length - nominal 8 foot individual



M1B1 Recessed - nominal 12 foot individual

M1B1 Recessed - T-Bar Length - nominal 12 foot individual

Typical Side View

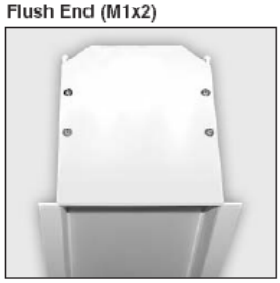


Suspensions supplied spaced nominally every 4 feet.
Fixture supplied with 7/8 knockout located 2 9/16" from end in top of fixture.

Continuous Flange (M1x1)

(M1R1 Shown)

Flush End (M1x2)



(M1R2 Shown)

	T5 (1 or 2 lamp)				T8 (1 lamp)	
	M1B1/M1B2 Including Endplates	M1B1 Outside Flange	M1B1/M1B2 - TB Including Endplates	M1B1 - TB Outside Flange	M1B1/M1B2 Including Endplates	M1B1 Outside Flange
4 foot individual	46.81" (1186mm)	47.58" (1209mm)	47.03" (1195mm)	47.91" (1216mm)	48.33" (1228mm)	49.20" (1250mm)
8 foot individual	93.21" (2365mm)	94.00" (2388mm)	95.03" (2414mm)	95.91" (2436mm)	96.37" (2448mm)	97.24" (2470mm)
12 foot individual	139.65" (3544mm)	140.41" (3567mm)	143.03" (3633mm)	143.91" (3655mm)	144.41" (3668mm)	145.28" (3690mm)

For other lengths, lamping, continuous runs or configurations please specify overall length (in feet), accessories desired and sketch/drawing of configuration. SELUX will detail project drawings upon order and supply submittal drawings for approval. Individual fixtures cannot be field joined. If you have any questions please contact SELUX customer service or applications engineering for assistance (1-800-SELUX-CS).

PO Box 1060, 5 Lumen Lane / Highland, NY 12528
TEL: (845) 691-7723 / FAX: (845) 691-6749
E-mail: seluxus@selux.com / Web Site: www.selux.com/usa
M1B1-02 (02/06)

Job Name:

Type: B

Order Number: C100-00-W

C100 Series 120V PAR16/20

C100-00

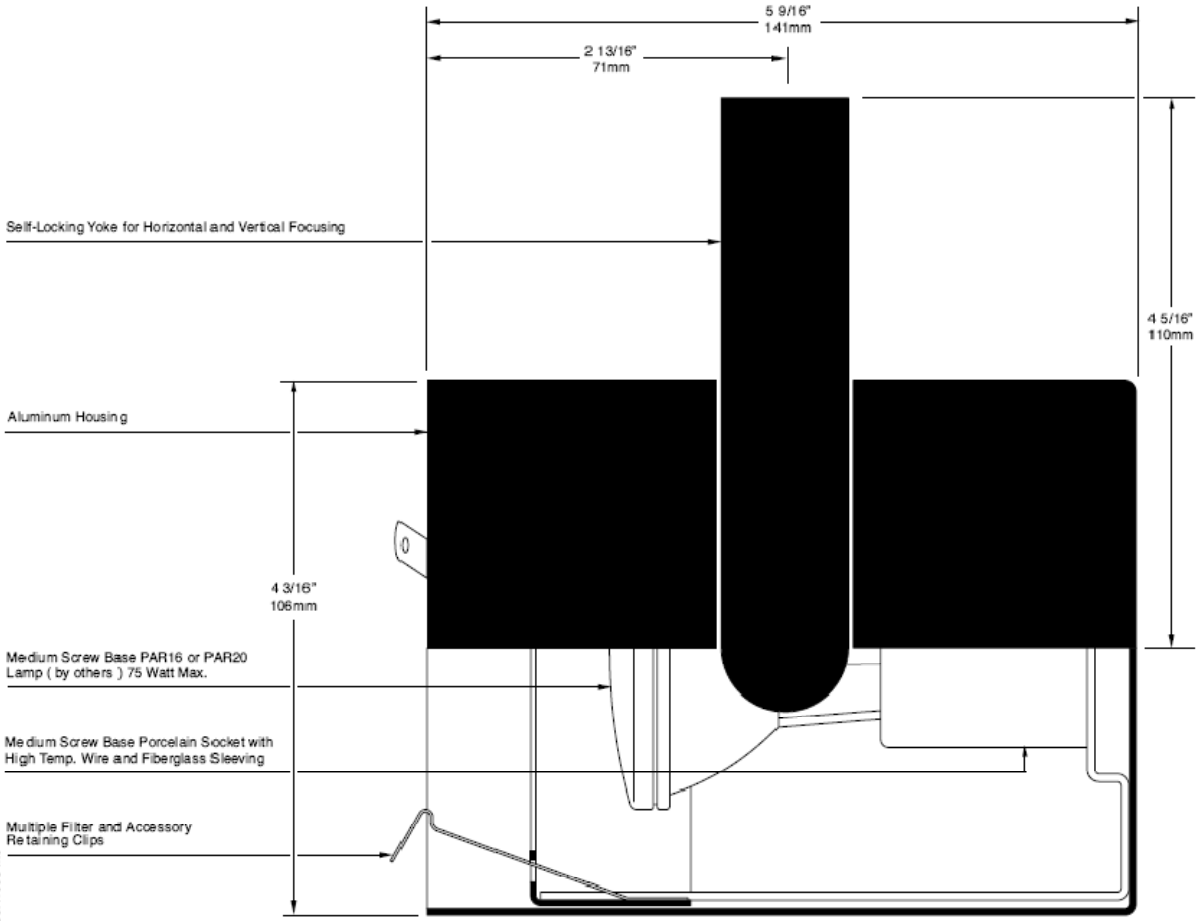
The C100 Cylinder is a fully adjustable specification grade fixture that aesthetically conforms to most architectural spaces. It can be utilized for either accent or general lighting dependent upon the wattage and beam spread of the PAR16 or PAR20 medium screw base lamp used. Its clean appearance makes it perfect for interior spaces such as museums, galleries, exhibits, boutiques, residences and similar areas where short and medium throw applications are needed.

Optional A size accessories include: Louver, Glass Color Filters and Spread Lens, Glass UV Blocking Filter and Stainless Steel Light Blocking Screens. Integral Dimmer and Coiled Cord are also available.

Features include self-locking adjustable full steel yoke for focusing in all planes, on/off safety switch for relamping and maintenance, and multiple accessory clips that will hold a combination of any LSI accessories.

Units will also accept all of the energy conserving Halogen lamps up to 75 watts.

UL and CUL Listed
USA Manufactured / IBEW



Lighting Services Inc 2 Kay Fries Drive, Stony Point NY 10980-1996 / +1 845 942-2800 Fax +1 845 942-2177 / www.LightingServicesInc.com CM035 7-06

Job Name:

Type: B

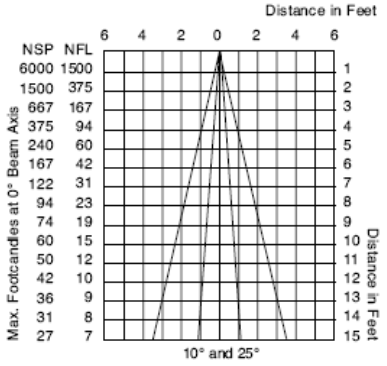
Order Number: C100-00-W

C100 Series 120V PAR16/20

Photometric Data[6]

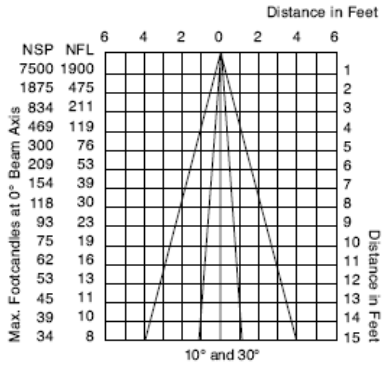
50PAR20/H/SP10° 50 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000

50PAR20/H/FL25° 50 watt, Narrow Flood
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500



75PAR16/CAP/NSP/10 75 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500

75PAR16/CAP/NFL/30 75 watt, Narrow Flood
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900



Lamp Types

35PAR20/CAP/NSP 35 watt, 2500 hours
Beam Spread to 50% of CBCP 8°
Center Beam Candlepower 3000
Color Temperature 2800K

35PAR20/CAP/NFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 900
Color Temperature 2800K

35PAR20/CAP/WFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 40°
Center Beam Candlepower 600
Color Temperature 2800K

50PAR20/H/SP10° 50 watt, 2500 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000
Color Temperature 2800K

50PAR20/H/FL25° 50 watt, 2000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500
Color Temperature 2800K

75PAR16/CAP/NSP 75 watt, 2000 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500
Color Temperature 3000K

75PAR16/CAP/NFL 75 watt, 2000 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900
Color Temperature 3000K

Accessories

Louver A
1/2" cellular metal louver, controls spill light and glare, 45° cutoff.

Glass Color Filters, Size A
Selection of 95 permanent rimmed dichroic, and rimmed and slotted standard colors.

Spread Lens A990
Permanent glass lens for spreading light beam in one axis, 5°X 50°.

Spread Lens A992
Permanent molded glass lens for spreading light beam in one axis—nominal 5°X 30°.

Spread Lens A995
Permanent molded glass lens for spreading light beam in all directions—nominal 50°X 50°.

Spread Lens A996
Permanent molded glass lens for spreading light beam in one direction slightly more than the other—nominal 45°X 50°.

Beam Softener A998
Permanent glass lens for conditioning light to create a softer beam.

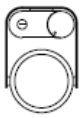
OPTIVEX™ UV Blocking Filter A962
Eliminates ultra-violet wavelengths below 410±10nm. Especially useful for conservation of artworks and to help prevent fading.

Light Blocking Screens, Size A
A801S-20% Light Blocking, A802S-30% Light Blocking, A803S-40% Light Blocking Stainless Steel Screens. Used individually or in combination to reduce transmitted light without changing its color temperature.

Coiled Cord
18/3 105°C, 18" retracted, 6 foot extended. Specify by adding suffix **CC** to model number. White fixture supplied with white cord, all other finishes supplied with black cord.

Wrench Locking
For permanent locking of fixture position, add "WL" to model number.

Integral Dimmer
For Yoke Mounted Dimmer add Suffix "FD" to model number.

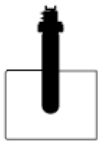


Ordering Information

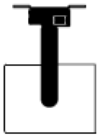
Model Number
add suffix letters for finish

C100-00
Lexan Fitting for 1 and 2 circuit LSI Track. With switch.

C100-00F
Same as above, with fuse.



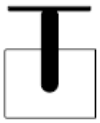
C100-2G
Universal fitting for Unistrut Systems and any screw or bolt-up applications. With switch, 6-foot 3-wire grounding cord and plug.



C100-3G
C-clamp for pipes from 5/8" to 2" O.D. With switch, 6-foot 3-wire grounding cord and plug.

***C100-4G**
Cushioned weighted base for floor or table use. With switch,6-foot 3-wire grounding cord and plug.

C100-5A
Canopy for permanent mounting on standard 4" octagonal outlet boxes



Finishes (Paint)
Black (suffix B)
White (suffix W)
Silver (suffix S)
Graphite (suffix G)
Platinum (suffix P)

Notes:
1. CBCP = Center Beam Candlepower
2. K = Color Temperature in Kelvin degrees
3. H = Halogen
4. CAP = Capsylite
5. OPTIVEX™ glass is a trademark of Bausch & Lomb Inc
6. Lamp manufacturers published data
*Non-UL and Non-CUL

Lighting Services Inc 2 Kay Fries Drive, Stony Point NY 10980-1996 / +1 845 942-2800 Fax +1 845 942-2177 / www.LightingServicesInc.com CM035 7-06

M100 Super Recessed Linear Fluorescent Flanged Extrusion

se'lux

Project: _____ **Type:** C **Qty:** _____

M1B1	1T5	SA	X	SH	004	WH	277
Fixture Series	Lamp Type	Upper Shielding	Lower Shielding	Mounting	Nominal Length	Finish	Voltage

Options (refer to separate data sheets for ordering codes and details)

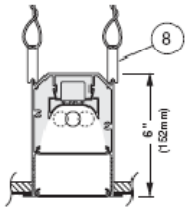
Fixture Series	Lamp Type	Upper / Lower Shielding	Mounting	Nominal Length	Finish	Voltage	Options
M1B1 M100 Super Recessed Continuous Flange (Flanged Extrusion/ Flanged Endcaps) **M1B2** M100 Super Recessed Flush End (Flanged Extrusion/ Flangeless Endcaps)	1T5 F28T5 2T5 (2x)F28/T5 1T5HO F54T5HO 1T8 F032/T8	SA Specular Parabolic MA Matte Parabolic MP Silky Specular Parabolic PL Matte Perforated Parabolic SD Satine Lens OD Extra Diffuse Lens X None	SH Suspension Clips TS 1" Studs (factory installed) RC Rotating Crossbars PM Perimeter Mount	004 4 foot 008 8 foot 012 12 foot For actual lengths see following page. For other lengths, configurations indicate nominal length rounded to the next highest foot. Factory will supply layout drawings. Individual fixtures cannot be field joined.	WH White BK Black SV Silver SP Specify RAL#	120 277 347	TB Lengths to Fit 2' Grid T-Bar Ceiling System[1] (qty)EM Stand-by Battery Pack[2] (prefix quantity, i.e. - 5EM) FS Single Fusing DM Dimming[2] (specify system) DMA Digital Addressable Dimming[2] SI Satine Acrylic Inlay[4] FW Flex Whip (standard) FW1 Flex Whip (dimming) Track Eutrac Standard[3] DL Suitable for Damp Locations CCEA Chicago Plenum Downlights (See MR16 spec sheets, pp.98-99)

[1]M1B1 w/ T5 & T5HO lamps only, consult factory for other lamps. [2]Must be low profile ballasts (1"⅛" W x 1"⅝" H); consult factory for details. [3]Consult factory for details. [4]SA, MA, MP & PL shieldings only.

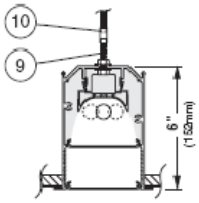
Mounting Diagrams

Scale = 1 : 8

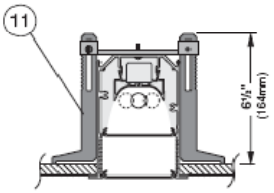
Suspension Clips (SH)



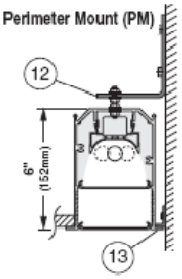
Pre-Installed Rod (TS)



Rotating Crossbars (RC)

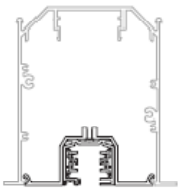


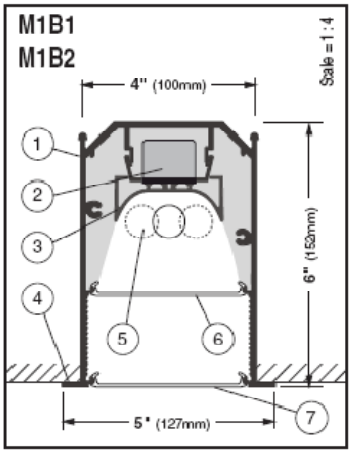
Perimeter Mount (PM)



Track

Track insert including track available for all configurations, consult factory for details.





1. Housing - Continuous, 6063-T5 extruded aluminum profile up to 16 feet long. Joined with Connector Plus Joining System for ease of installation and to assure a uniform appearance.

2. Ballast - Electronic, high power factor, class "P", type "A" sound rating. Specify 120v, 277v, or 347v. Ballast is factory pre-wired with leads to one end of fixture. Consult factory for ballast options.

3. Gear Tray - Extruded aluminum, with white painted finish. Gear tray installed as a complete electrical unit and is held in place with knurled dress nuts. It is fully accessible from below ceiling.

4. Flange - 1/2" (12mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (M1B1) or flush end (M1B2).

5. Lamps - As noted (by others). Other lamp lengths or wattages available, consult factory.

6. Upper Shielding - Louvers offer excellent glare control in longitudinal, lateral, and all diagonal planes. High quality aluminum louvers and acrylic shielding allow true freedom of layout for today's modern spaces.

7. Lower Shielding - Same options as Upper Shielding #6.

8. Spring Steel Suspension Clips - Supplied two places, located nominally every 4 ft. Support wires supplied and installed by others.

9. Pre-installed 1" 1/4-20 Stud - Attached to fixture every nominal 4 feet.

10. Coupling and Threaded Rod to Structure - Supplied and installed by others.

11. Rotating Crossbar - For inaccessible ceilings, adjustable for ceiling thicknesses from 1/4" to 2". Support required nominally every 4 feet.

12. Steel Wall Bracket and 1/4-20 Rod - Supplied nominally every 4 ft. (Fasteners to wall and wall anchors by others)

13. Aluminum wallbracket - Secured to wall (fasteners and wall anchors by others) and runs entire length of fixture. Also supplied for width of fixtures when supplied with continuous flange. Allows for 1/8" gap between flange and wall to create shadow line allowing for unevenness of wall.

Interior Luminaire Finish - Standard interior colors are White (WH), Black (BK) and Silver (SV). RAL colors (SP) are available, please specify RAL#.

TEL: (845) 691-7723
FAX: (845) 691-6749
www.selux.com/usa
M1B1-01 (v5.0)

c UL us LISTED
Union Made Affiliated with IBEW Local 363

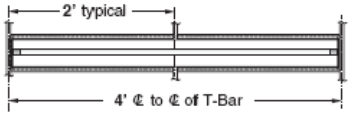
M100 Super Recessed Linear Fluorescent Flanged Extrusion

M1B1 and M1B2 Layout Dimensions

Specify T5 lamps when using in grid ceiling systems where 24" or 48" light openings are required.

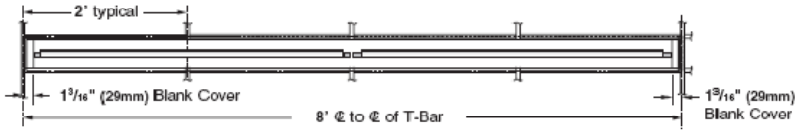
M1B1 Recessed - nominal 4 foot individual

M1B1 Recessed - T-Bar Length - nominal 4 foot individual



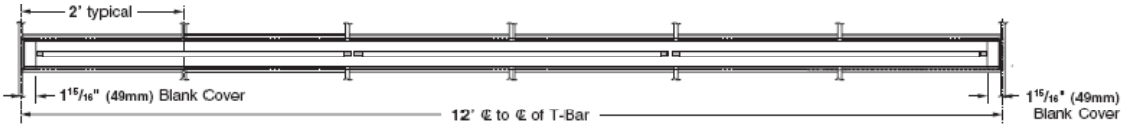
M1B1 Recessed - nominal 8 foot individual

M1B1 Recessed - T-Bar Length - nominal 8 foot individual

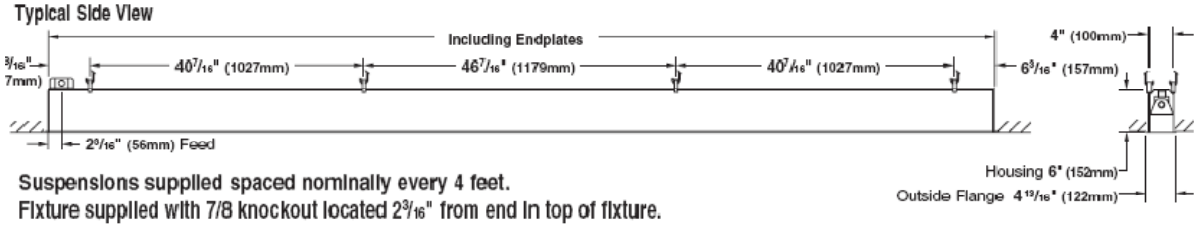


M1B1 Recessed - nominal 12 foot individual

M1B1 Recessed - T-Bar Length - nominal 12 foot individual



Typical Side View



Suspensions supplied spaced nominally every 4 feet.
Fixture supplied with 7/8 knockout located 2 3/16" from end in top of fixture.

Continuous Flange (M1x1)

(M1R1 Shown)

Flush End (M1x2)

(M1R2 Shown)

	T5 (1 or 2 lamp)				T8 (1 lamp)	
	M1B1/M1B2 Including Endplates	M1B1 Outside Flange	M1B1/M1B2 - TB Including Endplates	M1B1 - TB Outside Flange	M1B1/M1B2 Including Endplates	M1B1 Outside Flange
4 foot individual	46.81" (1186mm)	47.58" (1209mm)	47.03" (1195mm)	47.91" (1216mm)	48.33" (1228mm)	49.20" (1250mm)
8 foot individual	93.21" (2365mm)	94.00" (2388mm)	95.03" (2414mm)	95.91" (2436mm)	96.37" (2448mm)	97.24" (2470mm)
12 foot individual	139.65" (3544mm)	140.41" (3567mm)	143.03" (3633mm)	143.91" (3655mm)	144.41" (3668mm)	145.28" (3690mm)

For other lengths, lamping, continuous runs or configurations please specify overall length (in feet), accessories desired and sketch/drawing of configuration. SELUX will detail project drawings upon order and supply submittal drawings for approval. Individual fixtures cannot be field joined. If you have any questions please contact SELUX customer service or applications engineering for assistance (1-800-SELUX-CS).

PO Box 1060, 5 Lumen Lane / Highland, NY 12528
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E-mail: seluxus@selux.com / Web Site: www.selux.com/usa
M1B1-02 (02/06)

M100 Vertical Wall Mounting

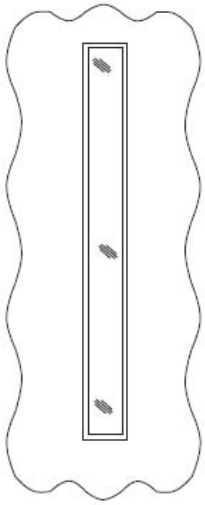
se'lux

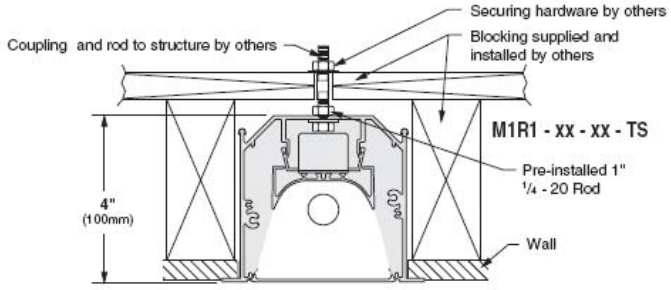
Vertical Wall Mount Application (Recessed Continuous Flange Mounting)

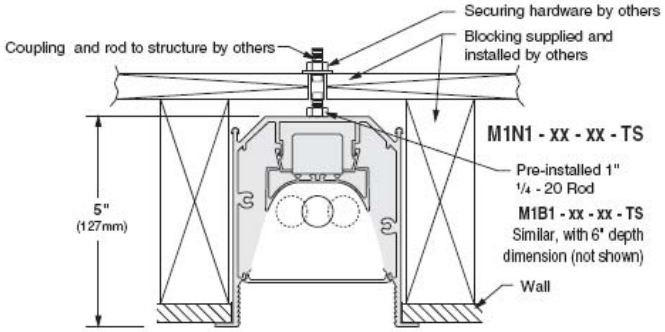
Ordering Code: As indicated

For use with Super Recessed (M1B1), Tannenbaum (M1N1) and Recessed (M1R1) fixtures.

Support is required nominally every 4 feet.





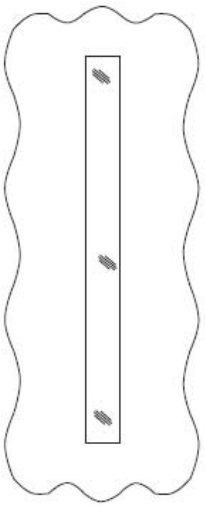


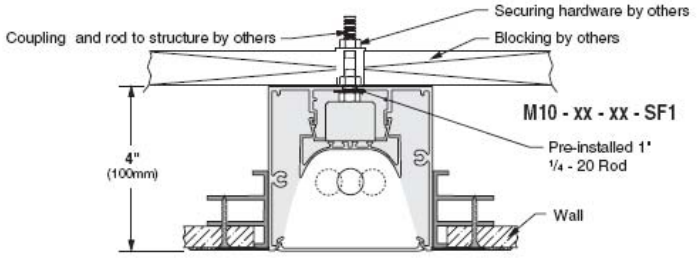
Vertical Wall Mount Application (Recessed Spackle Flange Mounting)

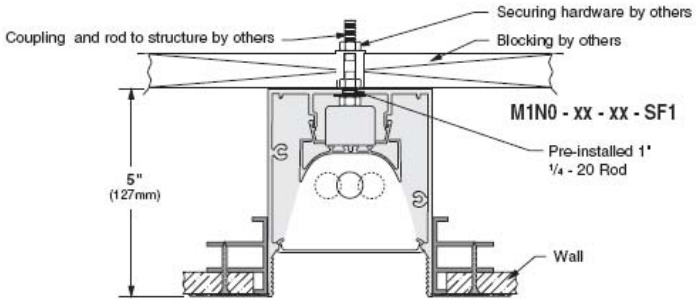
Ordering Codes: As indicated

For use with Super Recessed (M1B0), Tannenbaum (M1N0) and Recessed (M10) fixtures.

Support is required nominally every 4 feet.







M1B0 - xx - xx - SF1
Similar, with 6" depth dimension (not shown)

In a continuing effort to offer the best product possible, we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product. Specification sheets found at www.selux.com/usa are the most recent versions and supercede all other printed or electronic versions.

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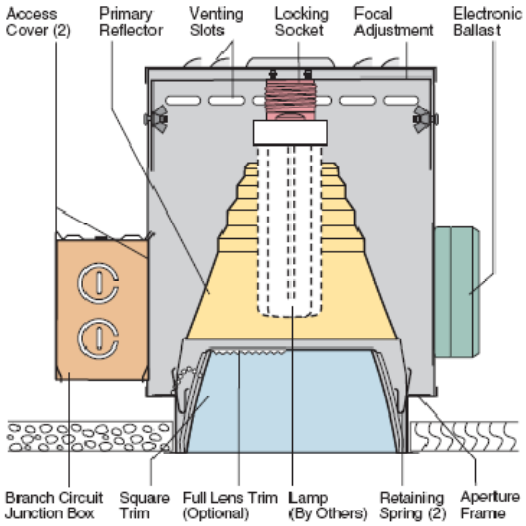
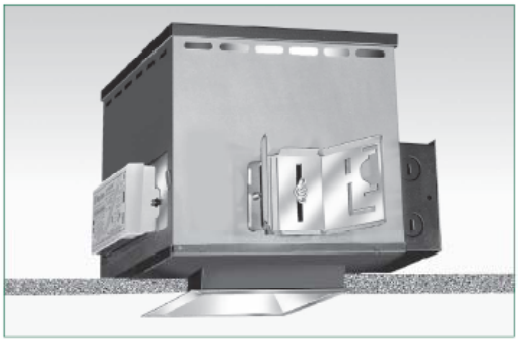
M10MNT (02/06)





H8632 One 26 or 32W Triple Tube
H8642 One 42W Triple Tube

H22

Compact Fluorescent Downlights
6" Square Parabolic Trim

Optics and Applications
The primary reflector has a unique faceted shape designed for triple tube lamps. Distribution is for general use or task lighting. Suitable for damp locations.

Design Features
Steel housings protect and align reflectors and lamps. A safety locking socket prevents lamp fallout. Trims are stabilized to prevent racking and are retained by constant pressure springs. Maximum ceiling thickness 1½". Top or bottom service.

Finish
Structural parts are painted matte black to suppress stray light leaks. Standard trims are anodized Softglow® clear. Special finishes, textures and colors are available.

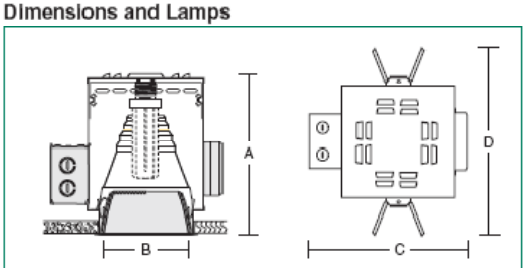
Trim Textures
Select among different embossed patterns to match the ambiance of the space being illuminated. Refer to Squares brochure for descriptive photos.

Ballasts
Fully electronic, microprocessor controlled with programmed start to assure rated lamp life. Input voltage ranges from 120V through 277V. Power factor .98, starting temperature 0°F (-18°C), THD<10%. Pre-heat start < 1.0 second. End of lamp life protection. Rated for > 50,000 starts.

General
Fixtures are pre-wired, UL and C-UL listed for eight wire 75°C branch circuit wiring. Union made IBEW. Luminaire Efficiency Rating (LER) data is in the photometric directory located in Section Z.

Accessories
R2 26" support rails.
R5 52" support rails.
SB Softglow black.
SG Softglow gold.
SH Softglow mocha.
SP Softglow graphite.
ST Softglow titanium.
SW Softglow wheat.
SY Softglow pewter.
SZ Softglow bronze.
BR Bright trim finish.
FC Four cell cross baffle.
F Fuse.
WT White trim flange.
WHT White complete trim.
BP Ball Peen texture.
CG Corrugated texture.
DS Distressed texture.
WV Woven texture.
LL Linear spread lens.
LP Large prism lens.
MP Microprism lens.
DM Dimming ballast.
V347 347 volt ballast.
FR Frosting on lens, specify lens type.
EM Emergency power includes integral charger light and test switch visible through aperture. Battery operation for 90 minutes.
FLT6 Full lens trim, specify lens type, e.g. H8632-FLT6LL.
WRL Wattage restriction label, specify wattage.

Dimensions and Lamps



Number	A Depth	B Aperture	C Width	D Length	Lamps
H8632	11¼" 286mm	6" sq. 153mm	12" 305mm	14" 356mm	26-32W Triple Tube compact fluorescent
H8642	11¼" 286mm	6" sq. 153mm	12" 305mm	14" 356mm	42W Triple Tube compact fluorescent

Brightness

Number	Lamps	85°	75°	65°	55°	45°
H8632	32W PL-T Philips	55	132	224	391	10904
	32W T/E Osram/Syl	32	84	148	247	9212
H8642	42W PL-T Philips	54	147	252	436	15069
	42W T/E Osram/Syl	37	116	231	2369	15908

Data in footlamberts. Photometer readings, Maximum Brightness Method.

Matching Square Units *

Incandescent downlights	Pages H7, H8, H9 , H10
Tungsten halogen downlights	Page H11
Low voltage downlights	Pages H5, H6
Metal halide downlights	Pages H26, H27, H28

* Click for link to pages in blue.

kurt versen

Kurt Versen Company Point Source Lighting
Westwood, New Jersey 07675

H22 H8632 H8642

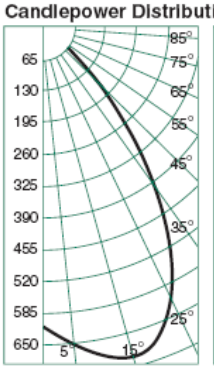
Performance Datachart

Single Unit, Initial Footcandles, 30" Work Plane							Ceiling to Floor	Multiple Units, Initial Footcandles, 30" Work Plane			
H8632 One 32W Philips Read Top Data H8632 One 32W Osram Read Bottom Data								Ceiling 80% Walls 50% Floor 20%			
Nadir	10°		20°		30°			Spacing is Maximum Over Work Plane			
FC	FC	Diam	FC	Diam	FC	Diam		Spacing	RCR 1	RCR 3	RCR 8
20 21	21 21	2' 2'	18 17	4' 4'	11 9	6' 6'	8'	7' 6'	24 28	20 24	14 16
15 15	15 15	2' 2'	13 12	5' 5'	8 7	8' 8'	9'	8' 7'	17 20	14 17	10 11
11 11	12 11	3' 3'	10 9	5' 5'	6 5	9' 9'	10'	9' 8'	13 15	11 13	8 9
9 9	9 9	3' 3'	8 7	6' 6'	5 4	10' 10'	11'	10' 9'	10 12	8 10	6 7
7 7	7 7	3' 3'	6 6	7' 7'	4 3	11' 11'	12'	11' 10'	8 9	7 8	5 5

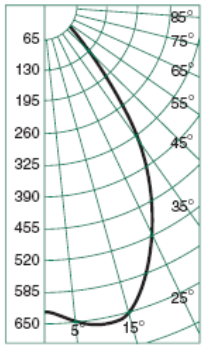
For 26 Watt x.88

Single Unit, Initial Footcandles, 30" Work Plane							Ceiling to Floor	Multiple Units, Initial Footcandles, 30" Work Plane			
H8642 One 42W Philips Read Top Data H8642 One 42W Osram Read Bottom Data								Ceiling 80% Walls 50% Floor 20%			
Nadir	10°		20°		30°			Spacing is Maximum Over Work Plane			
FC	FC	Diam	FC	Diam	FC	Diam		Spacing	RCR 1	RCR 3	RCR 8
25 30	27 29	2' 2'	22 22	4' 4'	13 12	6' 6'	8'	6' 6'	30 38	26 32	18 23
18 21	19 20	2' 2'	16 16	5' 5'	9 8	8' 8'	9'	7' 7'	22 27	19 23	13 16
14 16	14 15	3' 3'	12 12	5' 5'	7 6	9' 9'	10'	9' 8'	16 21	14 17	10 12
11 12	11 12	3' 3'	9 9	6' 6'	5 5	10' 10'	11'	10' 9'	13 16	11 13	7 10
9 10	9 16	3' 3'	7 7	7' 7'	4 4	11' 11'	12'	11' 10'	10 13	9 11	6 8

Candlepower Distribution



H8632 32W Philips
Eff 39% S/M 1.19



H8632 32W Osram
Eff. 36% S/M 1.07

Candelas

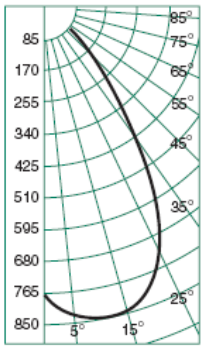
○	P 32W 2400*	O 32W 2400*
0	620	629
5	643	650
10	678	663
15	692	648
20	673	602
25	615	529
30	517	434
35	389	339
40	283	252
45	174	166
50	41	81
55	15	25
60	11	14
65	0	10
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

○ Vertical Angles
* Initial Lamp Lumens

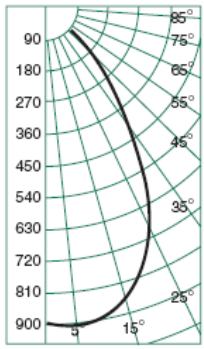
Coefficients of Utilization

Ceiling	80%				70%		50%		30%		0
Wall %	70	50	30	10	50	10	50	10	50	10	0
RCR	Zonal Cavity Method - Floor Reflectance 20%										
1	.44	.43	.42	.41	.42	.40	.40	.39	.39	.38	.36
2	.42	.40	.38	.36	.39	.36	.38	.35	.36	.34	.33
3	.39	.36	.34	.33	.36	.32	.35	.32	.34	.31	.30
4	.37	.34	.31	.30	.33	.29	.32	.29	.32	.29	.28
5	.35	.31	.29	.27	.31	.27	.30	.26	.29	.26	.25
6	.33	.29	.26	.25	.29	.24	.28	.24	.27	.24	.23
7	.31	.27	.24	.23	.27	.22	.26	.22	.26	.22	.21
8	.29	.25	.22	.21	.25	.21	.24	.21	.24	.20	.20
9	.28	.23	.21	.19	.23	.19	.23	.19	.22	.19	.18
10	.26	.22	.19	.18	.22	.18	.21	.18	.21	.18	.17

H8632 Osram 32W Triple Tube x .93
H8642 Philips and Osram 42W Triple Tube x .86



H8642 42W Philips
Eff 34% S/M 1.14



H8642 42W Osram
Eff. 34% S/M 1.01

○	P 42W 3200*	O 42W 3200*
0	770	898
5	814	908
10	849	903
15	850	853
20	813	797
25	724	682
30	588	550
35	436	408
40	310	297
45	176	195
50	38	86
55	17	17
60	13	12
65	0	0
70	0	0
75	0	0
80	0	0
85	0	0
90	0	0

○ Vertical
* Initial Lamp Lumens

Notes

1 For microprism spread lens multiply data x.88.

2 All data with standard trim, Softglow® clear.

3 Datachart degree headings measure one side from nadir. Diameter data includes both sides. Therefore the 20° column value describes a 40° pattern diameter at the work plane 30" above the floor. Footcandle values are at the diameter edge.

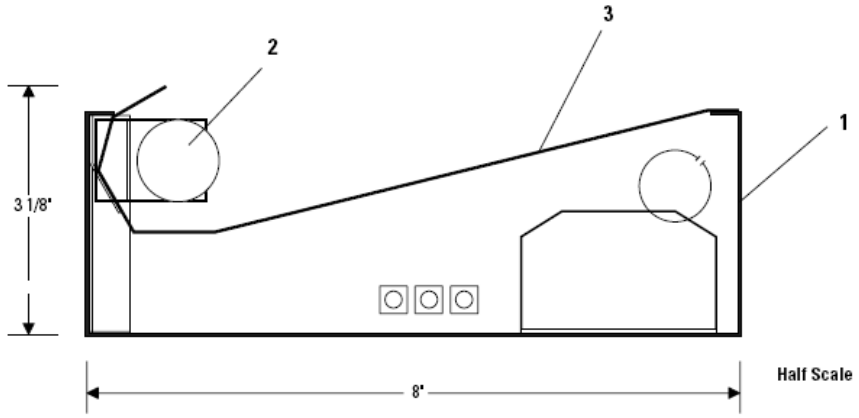
4 Datachart spacing is rounded off to the nearest foot.

5 Data by IES methods. Compact fluorescent data vary due to lamp lumen differences, power input, burning position, ambient temperature and ballast characteristics. A modification factor should be applied.

6 Colored trim multipliers: Gold x .90, Wheat x .85, Mocha x .80, Pewter x .80, Graphite x .75, Titanium x .75, Bronze x .70, Black x .70.

Lighting Systems Covelite™ CL-1

1-Lamp T8 Per 4' Section



Ordering Information

Style	Lamps	Length	Ballast & Voltage
CL	1	4	E82
	1 = 1 Lamp T8	2 = 2 Foot (24") 3 = 3 Foot (36") 4 = 4 Foot (48") 6 = 6 Foot (72") 8 = 8 Foot (96")	E81 = Electronic 120V E82 = Electronic 277V HD1 = PowerSpec® HDF Dimming T8 120V HD2 = PowerSpec® HDF Dimming T8 277V

Features

1. **Housing:** Die-formed 20 gauge pre-painted steel. Low profile 3 1/8" height and 8" wide.
2. **Lamping:** One T8 fluorescent lamp: 18 watt for 2 foot, 32 watt for 4 foot and 8 foot modules, 25 watt for 3 foot and 6 foot modules. Lamps by others.
3. **Reflector:** Constructed of precision die-formed specular aluminum lighting sheet. Reflector is covered with a scratch resistant protective coating to prevent damage during installation.

Electrical

Specify 120V or 277V. 3 conductor, 18 gauge wire. Color-coded quick connectors allow ease of connection for joiner modules. For special circuiting, consult factory. Rapid start, HPF, class "P" thermally protected. PowerSpec HDF dimming ballast is available.

Labels

UL, cUL and I.B.E.W.

Job Information **Type:**

Job Name:

Cat. No.:

Lamp(s):

Notes:

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

LIGHTOLIER®

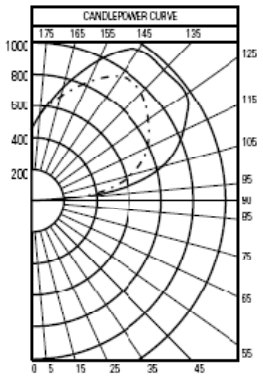
Lighting Systems Covelite™ CL-1

Page 2 of 2

1-Lamp T8 Per 4' Section

Performance

CANDLEPOWER CURVE



CANDLEPOWER

Zone ➤	0	22	45	67	90	112	135	157	180
Deg. ▼	CANDELAS								
180	433	433	433	433	433	433	433	433	433
175	540	524	514	464	444	393	382	352	344
165	772	739	678	535	438	303	238	171	160
155	985	926	816	579	411	199	153	96	91
145	1142	1099	952	607	364	122	76	39	30
135	1142	1084	959	608	297	74	25	6	0
125	1154	1034	888	619	231	33	0	0	0
115	1034	988	816	487	145	0	0	0	0
105	721	703	660	385	85	0	0	0	0
95	255	250	227	180	33	0	0	0	0
90	72	66	48	25	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Distribution Summary

Zone	Lumens	% Barelamp	%Luminaire
0-90	769	0.0	0.0
90-180	2184	75.3	100.00
0-180	2184	75.3	100.00

REPORT NO: LRL896-1F
LAMP: 1-F32T8
LUMENS: 2900
EFFICIENCY: 75.3%

COEFFICIENTS OF UTILIZATION

% EFFECTIVE CEILING CAVITY REFLECTANCE

	80			70			50		
	WALL REFLECTANCE								
	50	30	10	50	30	10	50	30	10
1	62	59	57	53	51	49	36	35	34
2	54	50	47	47	43	40	32	30	28
3	48	43	39	41	37	34	28	26	24
4	42	37	32	36	32	28	25	22	20
5	37	31	27	32	27	24	22	19	17
6	33	27	23	28	24	20	19	17	14
7	29	24	20	25	21	17	17	15	12
8	26	21	17	23	18	15	16	13	11
9	24	19	15	21	16	13	14	11	9
10	22	17	13	19	15	12	13	10	8

ROOM CAVITY RATIO

20% FLOOR CAVITY REFLECTANCE

Quick Calculators and Ceiling Brightness

Readings are rounded off based on initial footcandles at center of 20' run of luminaires. Room reflectance is 80% ceiling, 50% wall and 20% floor.

1Lt, 2 Fixtures, 2 Walls, 11" from Ceiling

Distance from wall

Distance From Ceiling	0'	2'	4'	6'	8'	10'	12'	14'
11"		105	32	14	14	32	105	
8'6"		36	36	35	35	36	36	
9'6"		34	34	34	34	34	34	
10'6"		31	32	32	32	32	31	
11'6"		30	30	30	30	30	30	
12'6"		28	29	29	29	29	28	

1Lt, 2 Fixtures, 2 Walls, 14" from Ceiling

Distance from wall

Distance From Ceiling	0'	2'	4'	6'	8'	10'	12'	14'
14"		116	44	17	17	44	116	
8'6"		35	36	35	35	36	35	
9'6"		33	34	34	34	34	33	
10'6"		31	32	32	32	32	31	
11'6"		29	30	30	30	30	29	
12'6"		27	28	29	29	28	27	

1Lt, 1 Fixture, 1 Wall, 11" from Ceiling

Distance from wall

Distance From Ceiling	0'	2'	4'	6'	8'	10'	12'	14'
11"		100	27	8	6	5	5	
8'6"		26	24	20	15	12	10	
9'6"		23	22	18	15	12	10	
10'6"		21	20	17	15	12	10	
11'6"		19	18	16	14	12	10	
12'6"		18	17	15	14	12	10	

1Lt, 2 Fixtures, 1 Wall, 14" from Ceiling

Distance from wall

Distance From Ceiling	0'	2'	4'	6'	8'	10'	12'	14'
14"		111	39	10	7	5	5	
8'6"		25	23	20	16	12	10	
9'6"		23	21	18	15	12	10	
10'6"		20	19	17	15	12	10	
11'6"		19	18	16	14	12	10	
12'6"		17	17	15	13	12	10	

Maximum Candle Power: 1154 CD at 125°
Brightness ratio on vertical wall above fixture is:
1:1.5 when mounted 11" from ceiling;
1:1.7 when mounted 14" from ceiling.

Job Information **Type:**

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

LIGHTOLIER®

Linear direct, indirect lighting element luminaires

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

Post construction: One piece extruded aluminum. .188' wall thickness. with one piece die cast aluminum top and base and four structural integrally extruded aluminum "fins". Access plate to ballast.

Housing. Four vertical "fins" match the pole with die cast aluminum top and bottom elements. Reflective disk of .125' thick spun aluminum.

Optical enclosure: Lamp is contained in an optical assembly comprised of an indirect reflector and direct reflective louver stack, internally semi-specular, outside finished in a matte gray anodized aluminum, enclosed in a 5½" O.D. cast, clear acrylic. Fully gasketed against water and insect infiltration.

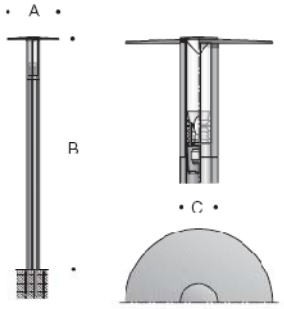
Electrical: Lampholders: Lampholders are medium base porcelain with nickel plated copper screw shell supplied with 200°C high temperature leads, rated 4KV.

Ballast is in the pole base available in 120V or 277V, HPF - specify.

Anchor base: The #890A anchorage consists of a heavy gauge welded assembly of .157" thick galvanized steel. Luminaire slip fits over base and is secured by six (6) stainless steel socket head screws.

Finish: These luminaires are available in five standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV); Eurocoat™ (URO). To specify, add appropriate suffix to catalog number. For complete description of BEGA finishing process, refer to technical information section at end of catalog. Custom colors supplied on special order.

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



Direct/Indirect luminaire with integrated fixed height pole.
U.L. listed, suitable for wet locations. IP 65.
Colors: Standard BEGA finishes.

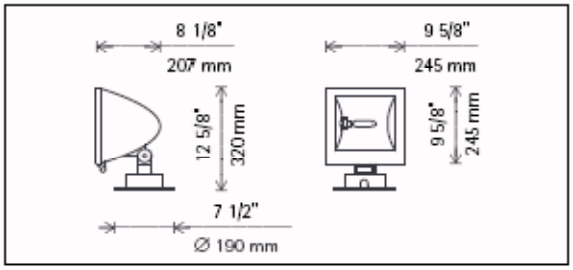
	Lamp	Lumen	A	B	C
8996MH	1 100W ED-17 MH	8800	35⅞	157½	9 1/16
890A	Anchorage supplied with pole for 13' - 1½' O.A.H.				

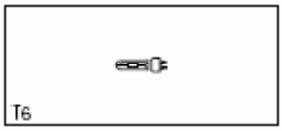
BEGA/US 1000 BEGA Way, Carpinteria, CA 93013 [P] 805·684·0533 [F] 805·684·6682

ERCO

Focalflood II Floodlight

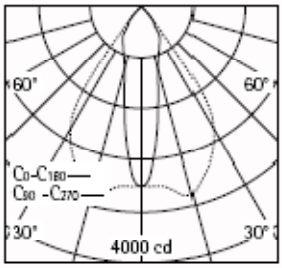
with mounting plate for metal halide lamps





34103.023 Graphit m
T6 39W G12 3400lm
ECG

Product description
Housing and hinge: corrosion-resistant, cast aluminum, No-rinse surface treatment. Double powder-coated. Optimized surface for reduced accumulation of dirt. Hinge with internal wiring, 0-90° tilt. Luminaire rotatable throught 240°. Graduated disc and mounting plate: corrosion-resistant aluminum.
Electronic control gear 120V/277V, 60Hz. 2 cable entries. Through-wiring possible. 3-pole terminal block.
Flood reflector with focal emphasis in beam direction: Aluminum, silver, specular anodized. Side reflectors to increase the visual comfort along the lamp axis, specular anodized. Cut-off angle 50° along the main axes. Without spill light.
Screw-fastened cover with safety glass: corrosion-resistant cast aluminum, double powder-coated. Hinge open for lamp replacement. Suitable for wet location (IP65): dust-proof and water jet-proof.
Weight 11.46lbs / 5.20kg
Maximum wind load area 0.75ft²



T6 39W G12 3400lm

h(ft)	E(fc)	D C0	C90
		22°	71°
3	311	1'2"	4'3"
6	78	2'4"	8'7"
9	35	3'6"	12'10"
12	19	4'8"	17'1"
15	12	5'10"	21'5"

ERCO Lighting, Inc.
160 Raritan Center Parkway
Suite 10
Edison, NJ 08837
USA
Tel.: +1 732 225 8856
Fax: +1 732 225 8857
info.us@erco.com

Technical Region: 120V/277V, 60Hz
Edition: 11.15.2007
Please download latest version from
www.erco.com/34103.023

1/3

Recessed wall luminaires - low voltage

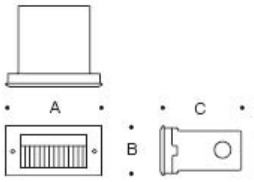
Type: I
BEGA Product #:
Project:
Voltage:
Color:
Options:
Modified:

Housing: Constructed of die cast and extruded aluminum with integral wiring compartment.
Enclosure: One piece die cast aluminum faceplate, tempered glass, linear prism spread lens with translucent white ceramic mask. Faceplate is secured by two (2) socket head, stainless steel, captive screws threaded into stainless steel inserts in the housing casting. Full hydroformed internal asymmetrical distribution reflector is specular anodized aluminum. Continuous high temperature O-ring gasket for weather tight operation.

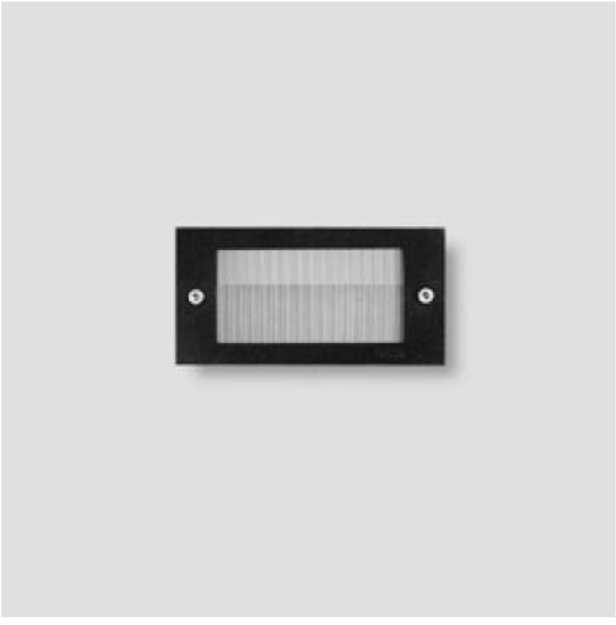
Electrical: Low voltage lampholder: G4, bi-pin with ceramic insulator and high temperature leads. Integral electronic 120V/11.6V transformer. For dimming refer to page 326 of catalog.
Through Wiring: Maximum of four (4) No. 12 AWG conductors (plus ground) suitable for 75°C. Two 7/8" knockouts provided for ½" conduit.

Finish: These luminaires are available in five standard BEGA colors: Black (BLK); White (WHT); Bronze (BRZ); Silver (SLV); Eurocoat™ (URO). To specify, add appropriate suffix to catalog number. For complete description of BEGA finishing process, refer to technical information section at end of catalog. Custom colors supplied on special order.

U.L. listed, suitable for wet locations and for installation within 3 feet of ground. Suitable for all types of construction including poured concrete. Type non-IC. Protection class: IP 64.



Tungsten halogen luminaire with high output. Die cast aluminum trim. Tempered glass spread lens with a translucent ceramic mask. Asymmetrical reflector. Integral 120V-11.6V electronic transformer. Lamp supplied with luminaire.
Opening: 4¾" x 2 3/16" x 4"
U.L. listed, suitable for wet locations. IP 64.
Color: Standard BEGA finishes.

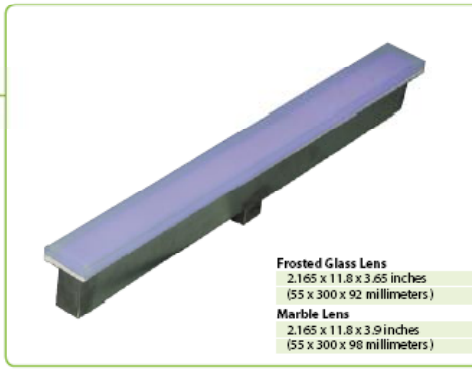


		Lamp		Lumen	A	B	C
1323	W/Spread Lens ADA	1	20W T3 G4,12V	320	5	2 5/16	4

BEGA/US 1000 BEGA Way, Carpinteria, CA 93013 [P] 805·684·0533 [F] 805·684·6682

2.165 inch (55 mm) WIDTH LED TILE SERIES

LIGHTWILD FLOOR TILE



TILE SPECIFICATION

ordering example: LW-TILE-FLR-RECT-2.165x11.8-FROST-B-BOX-Y

1 Part No.	2 Location	3 Shape	4 Dimensions
LW-TILE	FLR Floor Installation WALL Wall Installation	RECT Rectangular	2.165 x 11.8 Width x Length

5 Lens	6 LED Color			7 Recessed Box
FROST Frosted Lens MARB Marble Lens	WW Warm White	CW Cool White	B Blue	BOX-Y Include recessed box
	R Red	G Green	A Amber	BOX-N Do not include recessed box
	RGB Color-changing, color-controllable			

GENERAL

- **Nominal Colors:** Available in warm white* (WW), cool white (CW)*, blue (B), red (R), green (G), amber (A), or color-controllable RGB (RGB) LEDs
- **Number of LEDs:** 72 LEDs (24 red, 24 green, 24 blue in RGB model)
- **Beam Angle:** See IES files at www.lightwild.com/products/tilesandblocks_floortiles.asp
- **Lens:** Tempered, frosted glass or tempered glass with translucent marble
- **Housing:** Stainless steel
- **Cable Connection:** 2- or 4-conductor (for RGB) jacketed cable with plain ends
- **Ship Weight:** 10 lbs per tile
- **Cable Attachment:** Cable enters back of tile
- **Listings:** c UL us LISTED

ENVIRONMENTAL

- **Temperature Range:** -13 to 167 F (-25 to 75 C)
- **Moisture Ingress:** IP67

CONTROL

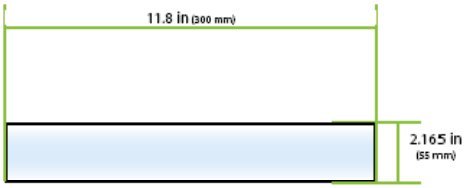
- **Options:** LightWild offers turnkey control solutions including basic power on/off control, dimming, pre-programmed controllers for RGB fixtures, and interface to third party DMX controllers. See LightWild's Floor Tiles Control Options page for more information.

ELECTRICAL

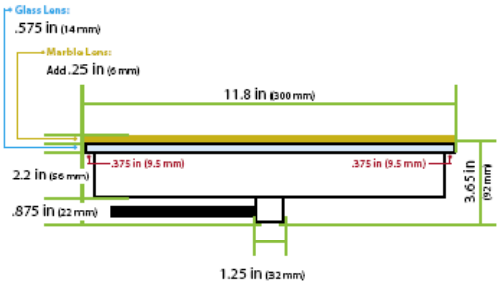
- **Power Requirement:** 24VDC (Contractor supplies 120/240 VAC to control and power unit, which includes a transforming power supply that delivers 24VDC to fixture.)
- **Power Consumption:** 6 W (W = Watts per tile)
- **Life of Bulbs:** Under ideal environmental and electrical conditions operating normal effects, LightWild's LEDs are expected to last approximately 50,000 to 80,000 hours according to LED manufacturers. As with all light sources, users can expect a depreciation in brightness during the course of this estimated lifetime. A depreciation in brightness can be expedited by a change in environmental conditions and electrical uses.

* LightWild selects from an LED bin with a range of 2700K-3200K with a goal of matching 3000K for its warm white tiles and from an LED bin with a range of 5600K-9000K with a goal of matching 7300K for its cool white tiles.

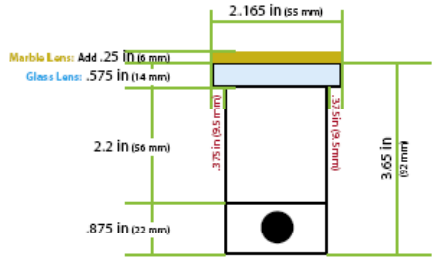
TOP VIEW



SIDE VIEW



END VIEW



LightWild Floor Tiles · 913-851-3000 · www.lightwild.com

LIGHTWILD

vision™ I

FOCAL POINT

FEATURES

1'x2' or 1'x4' recessed luminaire designed specifically to address teleconference lighting requirements.

Shielding may be specified in following configurations:

Lens only

Louver only

Lens and Louvers

Asymmetric or Symmetric distribution models available.

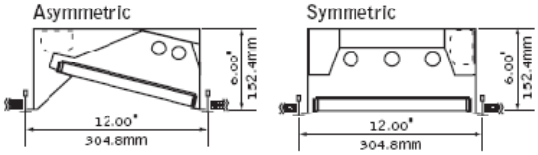
Matte black louver eliminates glare.

Luminaires may be continuously row mounted.

Vision™ I is an essential part of videoconferencing lighting systems.

september 2005

DIMENSIONAL DATA



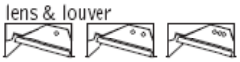
lamping options

asymmetric

lens

louver

lens & louver

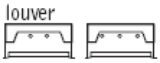


T8, T5 & T5HO LAMPS

symmetric

lens

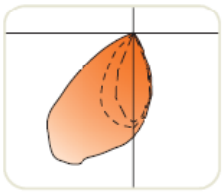
louver



lens & louver

T8, T5 & T5HO LAMPS

PERFORMANCE



2-Lamp T5 Asymmetric
24% Efficiency
2210 cd @ 25°

See Photometric section for additional performance data.

152

fixture type:
project name:

RECESSED

DETAILS

mounting

specify "G" for flat 9/16" and 15/16" tee or "ST" for 9/16" slot tee grid types.

"G" flat tee

"ST" slot tee
Luminaire sits of top of 9/16" slot tee grid.

Luminaires cannot be installed in T-bar ceiling systems over 1.5" high in T8 lamp configurations.

drywall frame kit

specify "DF" Drywall Frame Kit for drywall ceiling conditions.

Use tie-wire or screws to secure frame kit.

cut out dimensions:
1': Min: 12.125"
Max: 12.563"

4': Min: 48.125"
Max: 48.563"

SPECIFICATIONS

construction

One-piece 20 Ga. steel housing.
One-piece 20 Ga. steel regressed bevel for asymmetric applications.
Bottom access 20 Ga. steel ballast compartment.

2' unit weight: 12 lbs.
4' unit weight: 22 lbs.

Optic

Die-formed .023" thick specular aluminum reflector
Parallel Louver Blade: .040" aluminum, 1"H x 1" frequency x .187" thick, Matte Black finish.
Shielding: clear acrylic lens with K19 diagonal prismatic pattern.
Paracube Louver: injection molded specular silver, .75" x .75" x .5"H.

electrical

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

emergency

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

T8 Lamps: Up to 475 lumens
T5 Lamps: Up to 550 lumens
T5HO Lamps: Up to 825 lumens

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

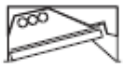
finish

Polyester powder coat applied over a 5-stage pre-treatment.
Standard luminaire housing finished in Matte Black.

ORDERING

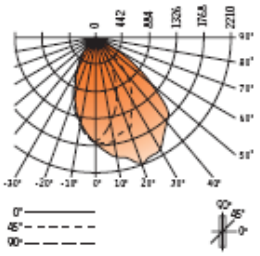
luminaire series		FTV
Vision	FTV	
nominal size		14
1' x 4'	14	
1' x 2'	12	
distribution		D
Direct Symmetrical	D	
Direct Asymmetrical	W	
lamp quantity		2
One Lamp	1	
Two Lamps	2	
Three Lamps	3	
lamp type		T5
T8	T8	
T5	T5	
T5HO	T5HO	
Asymmetric: 1,2 or 3 Lamps		
Symmetric: 2 or 3 Lamps		
ballast		E
Electronic Instant Start <20% THD (T8 only)	E	
Electronic Program Start <10% THD	S	
Electronic Dimming Ballast (Consult factory for dimming availability)	D	
voltage		277
120 Volt	120	
277 Volt	277	
347 Volt (Consult factory for availability)	347	
mounting		G
Grid	G	
shielding		PB
<12 Lens	12	
Parallel Blade Louver, Black	PB	
Parallel Blade Louver, Black with K12 Overlay	PBA	
Silver Paracube, 3/4 x 3/4 x 1/2	PQ	
factory options		
Chicago Plenum	CP	DF
Drywall Frame Kit (Cut out dimensions: Min: 12.125"/Max: 12.563" Min: 24.125"/Max: 24.563" Min: 48.125"/Max 48.563")	DF	
Emergency Battery Pack	EM	
Earthquake Clip	EQ	
HLR/GLR Fuse	FU	
Flex Whip	FW	
Include 3000K Lamp	L830	
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
Separate Circuit	SC	
finish		BK
Matte Black	BK	

vision™ I



Filename: FTV14W3TePBA.IES
Catalog #: FTV-14-W-3-Te-E-120-G-PBVA-BK
Efficiency: 24%
Test #: 9699.0

CANDLEPOWER DISTRIBUTION



Vertical Angle	Horizontal Angle 0°	22.5°	45°	67.5°	90°	Zonal Lumens
0°	1797	1797	1797	1797	1797	
5°	1906	1858	1787	1718	1660	165
15°	2105	1896	1660	1445	1276	412
25°	2210	1881	1445	1069	816	511
35°	2007	1575	1032	578	320	434
45°	1736	1209	577	132	37	290
55°	890	568	456	26	14	143
65°	311	161	20	10	5	45
75°	73	17	4	2	1	6
85°	1	0	0	0	0	0
90°	0	0	0	0	0	
95°	0	0	0	0	0	0
105°	0	0	0	0	0	0
115°	0	0	0	0	0	0
125°	0	0	0	0	0	0
135°	0	0	0	0	0	0
145°	0	0	0	0	0	0
155°	0	0	0	0	0	0
165°	0	0	0	0	0	0
175°	0	0	0	0	0	0
180°	0	0	0	0	0	

LUMEN SUMMARY

	Zone	Lumens	% Lamp	% Fix
	0°-30°	1088	12.7	54.2
	0°-40°	1522	17.8	75.9
	0°-60°	1955	22.9	97.5
	0°-90°	2006	23.5	100.0
Total Luminaire	0°-180°	2006	23.5	100.0

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

Job Name: | Type: | Order Number:

C100 Series 120V PAR16/20

C100-00

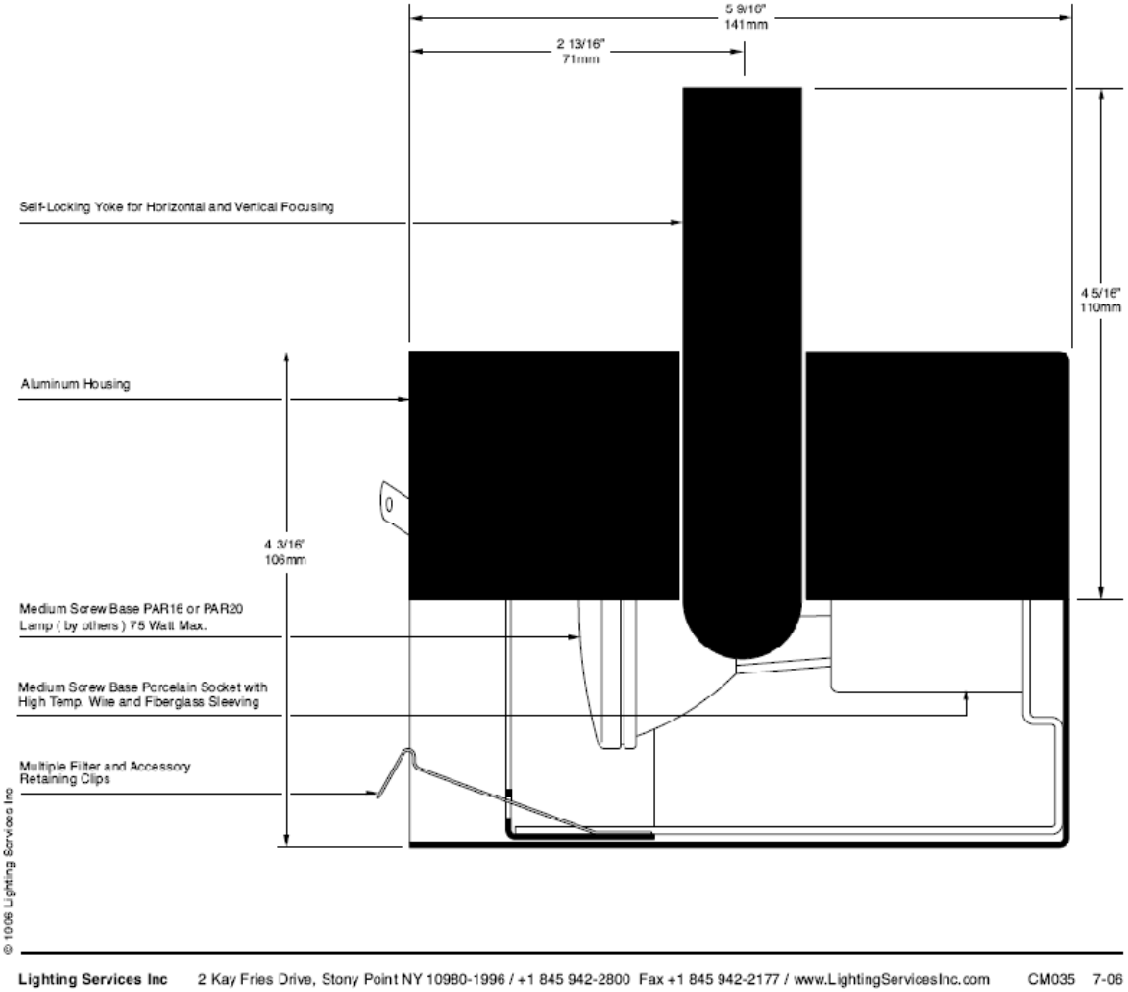
The C100 Cylinder is a fully adjustable specification grade fixture that aesthetically conforms to most architectural spaces. It can be utilized for either accent or general lighting dependent upon the wattage and beam spread of the PAR16 or PAR20 medium screw base lamp used. Its clean appearance makes it perfect for interior spaces such as museums, galleries, exhibits, boutiques, residences and similar areas where short and medium throw applications are needed.

Optional A size accessories include: Louver, Glass Color Filters and Spread Lens, Glass UV Blocking Filter and Stainless Steel Light Blocking Screens. Integral Dimmer and Coiled Cord are also available.

Features include self-locking adjustable full steel yoke for focusing in all planes, on/off safety switch for relamping and maintenance, and multiple accessory clips that will hold a combination of any LSI accessories.

Units will also accept all of the energy conserving Halogen lamps up to 75 watts.

UL and CUL Listed
USA Manufactured / IDEW



Lighting Services Inc 2 Kay Fries Drive, Stony Point NY 10980-1996 / +1 845 942-2800 Fax +1 845 942-2177 / www.LightingServicesInc.com CM035 7-06

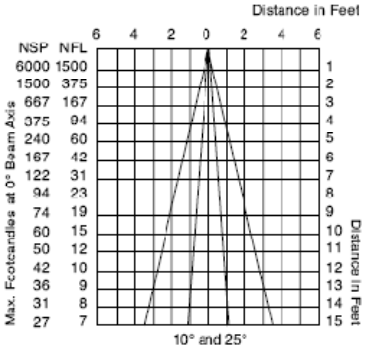
Job Name: | Type: | Order Number:

C100 Series 120V PAR16/20

Photometric Data[6]

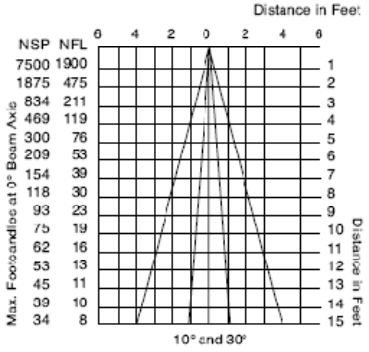
50PAR20/H/SP10° 50 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000

50PAR20/H/FL25° 50 watt, Narrow Flood
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500



75PAR16/CAP/NSP/10 75 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500

75PAR16/CAP/NFL/30 75 watt, Narrow Flood
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900



Lamp Types

35PAR20/CAP/NSP 35 watt, 2500 hours
Beam Spread to 50% of CBCP 8°
Center Beam Candlepower 3000
Color Temperature 2800K

35PAR20/CAP/NFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 900
Color Temperature 2800K

35PAR20/CAP/WFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 40°
Center Beam Candlepower 600
Color Temperature 2800K

50PAR20/H/SP10° 50 watt, 2500 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000
Color Temperature 2800K

50PAR20/H/FL25° 50 watt, 2000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500
Color Temperature 2800K

75PAR16/CAP/NSP 75 watt, 2000 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500
Color Temperature 3000K

75PAR16/CAP/NFL 75 watt, 2000 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900
Color Temperature 3000K

Accessories

Louver A
1/2" cellular metal louver controls spill light and glare, 45° cutoff.

Glass Color Filters, Size A
Selection of 95 permanent rimmed dichroic, and rimmed and slotted standard colors.

Spread Lens A990
Permanent glass lens for spreading light beam in one axis, 5°X 50°.

Spread Lens A992
Permanent molded glass lens for spreading light beam in one axis—nominal 5°X 30°.

Spread Lens A995
Permanent molded glass lens for spreading light beam in all directions—nominal 50°X 50°.

Spread Lens A996
Permanent molded glass lens for spreading light beam in one direction slightly more than the other—nominal 45°X 50°.

Beam Softener A998
Permanent glass lens for conditioning light to create a softer beam.

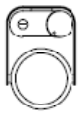
OPTIVEX™ UV Blocking Filter A962
Eliminates ultra-violet wavelengths below 410±10nm. Especially useful for conservation of artworks and to help prevent fading.

Light Blocking Screens, Size A
A801S-20% Light Blocking, A802S-30% Light Blocking, A803S-40% Light Blocking Stainless Steel Screens. Used individually or in combination to reduce transmitted light without changing its color temperature.

Coiled Cord
18/3 105°C, 18" retracted, 6 foot extended. Specify by adding suffix **CC** to model number. White fixture supplied with white cord, all other finishes supplied with black cord.

Wrench Locking
For permanent locking of fixture position, add "WL" to model number.

Integral Dimmer
For Yoke Mounted Dimmer add Suffix "FD" to model number.

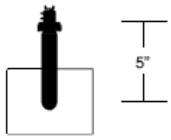


Ordering Information

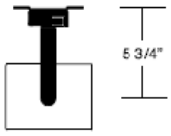
Model Number
add suffix letters for finish

C100-00
Lexan Fitting for 1 and 2 circuit LSI Track. With switch.

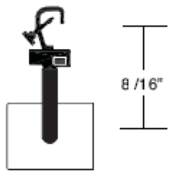
C100-00F
Same as above, with fuse.



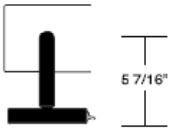
C100-2G
Universal fitting for Unistrut Systems and any screw or bolt-up applications. With switch, 6-foot 3-wire grounding cord and plug.



C100-3G
C-clamp for pipes from 5/8" to 2" O.D. With switch, 6-foot 3-wire grounding cord and plug.



***C100-4G**
Cushioned weighted base for floor or table use. With switch,6-foot 3-wire grounding cord and plug.



C100-5A
Canopy for permanent mounting on standard 4" octagonal outlet boxes

Finishes (Paint)
Black (suffix B)
White (suffix W)
Silver (suffix S)
Graphite (suffix G)
Platinum (suffix P)

Notes:
1. CBCP = Center Beam Candlepower
2. K = Color Temperature in Kelvin degrees
3. H = Halogen
4. CAP = Capsylite
5. OPTIVEX™ glass is a trademark of Bausch & Lomb Inc
6. Lamp manufacturers published data
*Non-UL and Non-CUL

Lighting Services Inc 2 Kay Fries Drive, Stony Point NY 10980-1996 / +1 845 942-2800 Fax +1 845 942-2177 / www.LightingServicesInc.com CM035 7-06

Job Name: | Type: | Order Number:

C100 Series 120V PAR16/20

C100-00

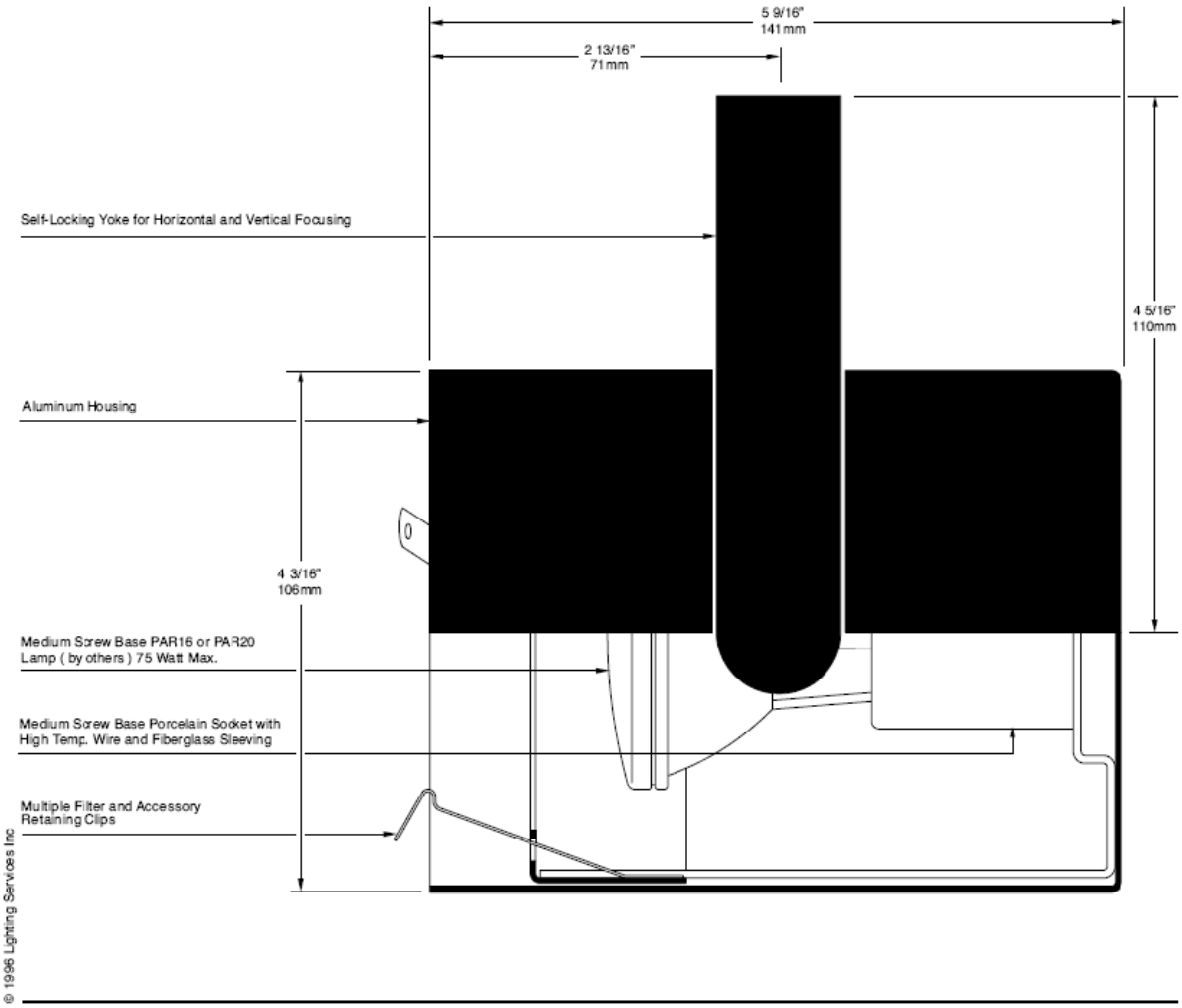
The C100 Cylinder is a fully adjustable specification grade fixture that aesthetically conforms to most architectural spaces. It can be utilized for either accent or general lighting dependent upon the wattage and beam spread of the PAR16 or PAR20 medium screw base lamp used. Its clean appearance makes it perfect for interior spaces such as museums, galleries, exhibits, boutiques, residences and similar areas where short and medium throw applications are needed.

Optional A size accessories include: Louver, Glass Color Filters and Spread Lens, Glass UV Blocking Filter and Stainless Steel Light Blocking Screens. Integral Dimmer and Coiled Cord are also available.

Features include self-locking adjustable full steel yoke for focusing in all planes, on/off safety switch for relamping and maintenance, and multiple accessory clips that will hold a combination of any LSI accessories.

Units will also accept all of the energy conserving Halogen lamps up to 75 watts.

UL and CUL Listed
USA Manufactured / IBEW



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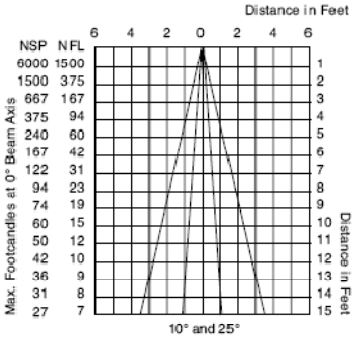
Job Name: Type: Order Number:

C100 Series 120V PAR16/20

Photometric Data[6]

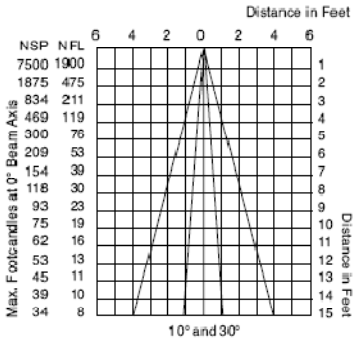
50PAR20/H/SP10° 50 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000

50PAR20/H/FL25° 50 watt, Narrow Flood
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500



75PAR16/CAP/NSP/10 75 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500

75PAR16/CAP/NFL/30 75 watt, Narrow Flood
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900



Lamp Types

35PAR20/CAP/NSP 35 watt, 2500 hours
Beam Spread to 50% of CBCP 8°
Center Beam Candlepower 3000
Color Temperature 2800K

35PAR20/CAP/NFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 900
Color Temperature 2800K

35PAR20/CAP/WFL 35 watt, 2500 hours
Beam Spread to 50% of CBCP 40°
Center Beam Candlepower 600
Color Temperature 2800K

50PAR20/H/SP10° 50 watt, 2500 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 6000
Color Temperature 2800K

50PAR20/H/FL25° 50 watt, 2000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 1500
Color Temperature 2800K

75PAR16/CAP/NSP 75 watt, 2000 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 7500
Color Temperature 3000K

75PAR16/CAP/NFL 75 watt, 2000 hours
Beam Spread to 50% of CBCP 30°
Center Beam Candlepower 1900
Color Temperature 3000K

Accessories

Louver A
1/2" cellular metal louver, controls spill light and glare, 45° cutoff.

Glass Color Filters, Size A
Selection of 95 permanent rimmed dichroic, and rimmed and slotted standard colors.

Spread Lens A990
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Coiled Cord
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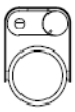
Wrench Locking
For permanent locking of fixture position, add "WL" to model number.

Integral Dimmer
For Yoke Mounted Dimmer add Suffix "FD" to model number.

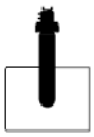


Ordering Information

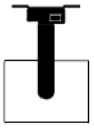
Model Number
add suffix letters for finish

C100-00
Lexan Fitting for 1 and 2 circuit LSI Track. With switch.

C100-00F
Same as above, with fuse.



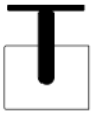
C100-2G
Universal fitting for Unistrut Systems and any screw or bolt-up applications. With switch, 6-foot 3-wire grounding cord and plug.



C100-3G
C-clamp for pipes from 5/8" to 2" O.D. With switch, 6-foot 3-wire grounding cord and plug.

***C100-4G**
Cushioned weighted base for floor or table use. With switch,6-foot 3-wire grounding cord and plug.

C100-5A
Canopy for permanent mounting on standard 4" octagonal outlet boxes



Finishes (Paint)
Black (suffix B)
White (suffix W)
Silver (suffix S)
Graphite (suffix G)
Platinum (suffix P)

Notes:
1. CBCP = Center Beam Candlepower
2. K = Color Temperature in Kelvin degrees
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4. CAP = Capsylite
5. OPTIVEX™ glass is a trademark of Bausch & Lomb Inc
6. Lamp manufacturers published data
* Non-UL and Non-CUL

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Job Name: | Type: | Order Number:

C110 Series 120V PAR30

C110-00

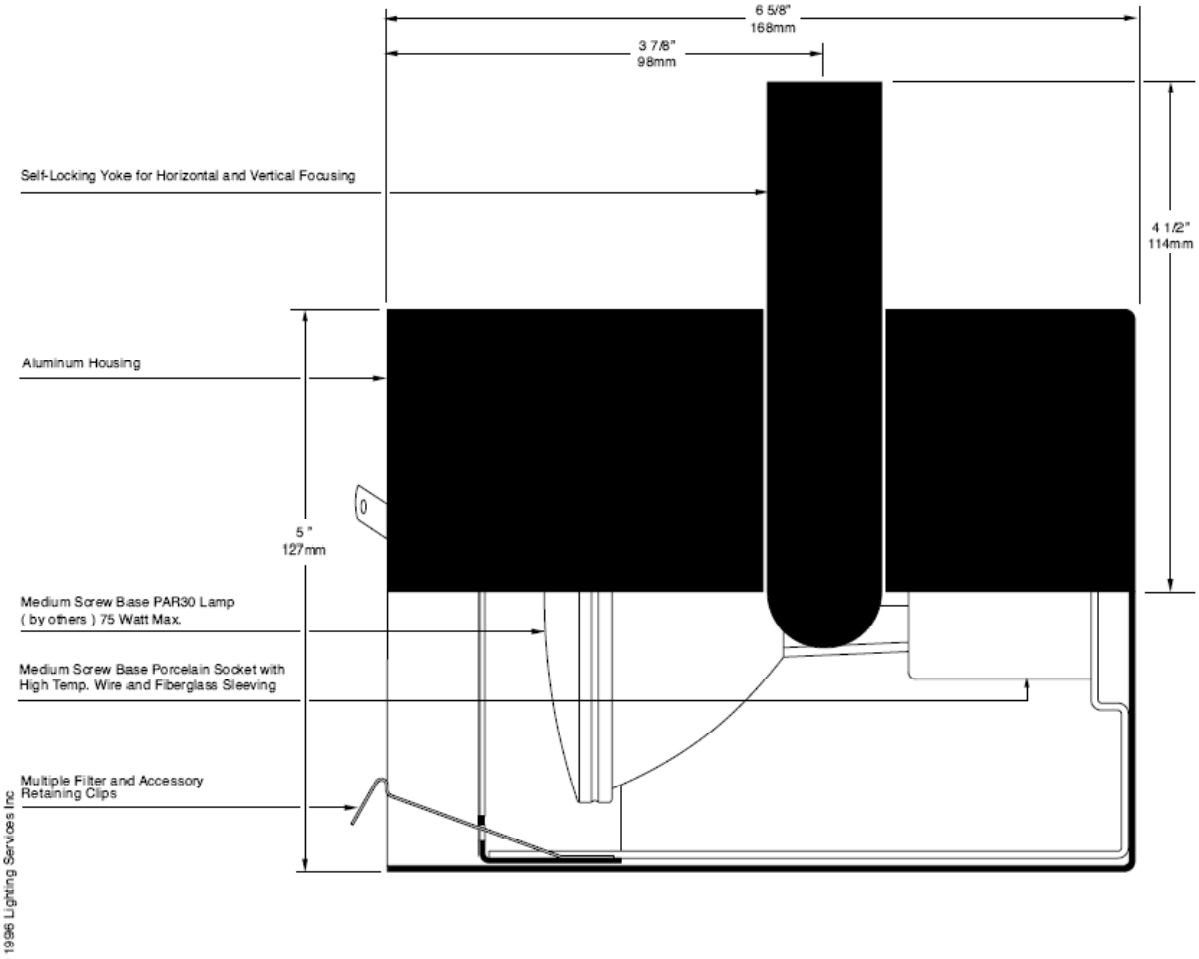
The C110 Cylinder is a fully adjustable specification grade fixture that aesthetically conforms to most architectural spaces. It can be utilized for either accent or general lighting dependent upon the wattage and beam spread of the PAR30 medium screw base lamp used. Its clean appearance makes it perfect for interior spaces such as museums, galleries, exhibits, boutiques, residences and similar areas where medium throw applications are needed.

Optional B size accessories include: Louver, Glass Color Filters and Spread Lens, Glass UV Blocking Filter and Stainless Steel Light Blocking Screens. Integral Dimmer and Coiled Cord are also available.

Features include self-locking adjustable full steel yoke for focusing in all planes, on/off safety switch for relamping and maintenance, and multiple accessory clips that will hold a combination of any LSI accessories.

Units will also accept all of the energy conserving Halogen lamps up to 75 watts.

UL and CUL Listed
USA Manufactured / IBEW



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Job Name: | Type: | Order Number:

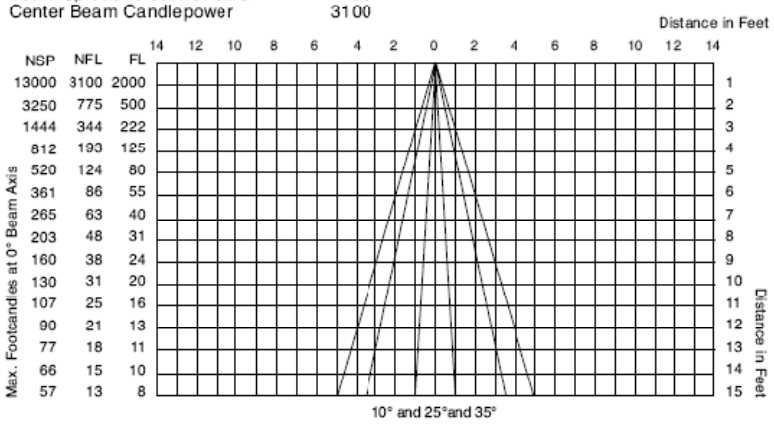
C110 Series 120V PAR30

Photometric Data[6]

75PAR30/H/SP10° 75 watt, Narrow Spot
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 13000

75PAR30/H/FL25° 75 watt, Narrow Flood
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 3100

75PAR30/H/FL35° 75 watt, Flood
Beam Spread to 50% of CBCP 35°
Center Beam Candlepower 2000



Lamp Types

50PAR30/HIR/SP9° 50 watt, 3000 hours
Beam Spread to 50% of CBCP 9°
Center Beam Candlepower 13000
Color Temperature 2810K

50PAR30/HIR/FL25° 50 watt, 3000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 2700
Color Temperature 2810K

50PAR30/HIR/FL35° 50 watt, 3000 hours
Beam Spread to 50% of CBCP 35°
Center Beam Candlepower 1500
Color Temperature 2810K

60PAR30/H/SP10° 60 watt, 3000 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 10000
Color Temperature 2800K

60PAR30/H/FL25° 60 watt, 3000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 2400
Color Temperature 2800K

60PAR30/H/FL35° 60 watt, 3000 hours
Beam Spread to 50% of CBCP 35°
Center Beam Candlepower 1700
Color Temperature 2800K

75PAR30/H/SP10° 75 watt, 2000 hours
Beam Spread to 50% of CBCP 10°
Center Beam Candlepower 13000
Color Temperature 2830K

75PAR30/H/FL25° 75 watt, 2000 hours
Beam Spread to 50% of CBCP 25°
Center Beam Candlepower 3100
Color Temperature 2830K

75PAR30/H/FL35° 75 watt, 2000 hours
Beam Spread to 50% of CBCP 35°
Center Beam Candlepower 2000
Color Temperature 2830K

Accessories

Louver B
1/2" cellular metal louver, controls spill light and glare, 45° cutoff.

Glass Color Filters, Size B
Selection of 95 permanent rimmed dichroic, and rimmed and slotted standard colors.

Spread Lens B990
Permanent glass lens for spreading light beam in one axis, 5°X 50°, rimmed and slotted for heat expansion.

Spread Lens B992
Permanent molded glass lens for spreading light beam in one axis—nominal 5°X 30°.

Spread Lens B995
Permanent molded glass lens for spreading light beam in all directions—nominal 50°X 50°.

Spread Lens B996
Permanent molded glass lens for spreading light beam in one direction slightly more than the other—nominal 45°X 50°.

Beam Softener B998
Permanent glass lens for conditioning light to create a softer beam.

OPTIVEX™ UV Blocking Filter B962
Eliminates ultra-violet wavelengths below 410±10nm. Especially useful for conservation of artworks and to help prevent fading.

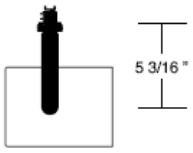
Light Blocking Screens, Size B
B801S-20% Light Blocking, B802S-30% Light Blocking, B803S-40% Light Blocking Stainless Steel Screens. Used individually or in combination to reduce transmitted light without changing its color temperature.

Coiled Cord
18/3 105°C, 18" retracted, 6 foot extended. Specify by adding suffix **CC** to model number. White fixture supplied with white cord, all other finishes supplied with black cord.

Ordering Information

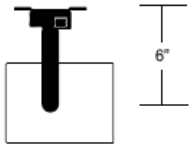
Model Number
add suffix letters for finish

C110-00
Lexan Fitting for 1 and 2 circuit LSI Track. With switch.

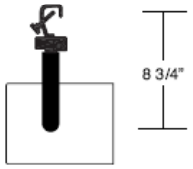


C110-00F
Same as above, with fuse.

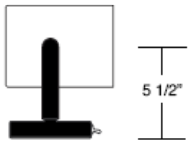
C110-2G
Universal fitting for Unistrut Systems and any screw or bolt-up applications. With switch, 6-foot 3 wire grounding cord and plug.



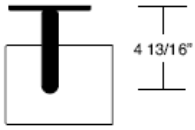
C110-3G
C-clamp for pipes from 5/8" to 2" C.D. With switch, 6-foot 3-wire grounding cord and plug.



*C110-4G
Cushioned weighted base for floor or table use. With switch, 6-foot 3-wire grounding cord and plug.



C110-5A
Canopy for permanent mounting on standard 4" octagonal outlet boxes



Wrench Locking
For permanent locking of fixture position, add "WL" to model number.

Integral Dimmer
For Yoke Mounted Dimmer add Suffix "FD" to model number.

Finishes (Paint)
Black (suffix B)
White (suffix W)
Silver (suffix S)
Graphite (suffix G)
Platinum (suffix P)

Notes:
1. CBCP = Center Beam Candlepower
2. K = Color Temperature in Kelvin degrees
3. H = Halogen
4. HIR = Halogen Infra Red
5. OPTIVEX™ glass is a trademark of Bausch & Lomb
6. Lamp manufacturers published data
* Non-UL and Non-CUL

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COLOR KINETICS

PHILIPS

COLORBLAZE 48

The ColorBlaze® 48 fixture washes large areas with far-reaching, rich, saturated colors and color-changing lighting effects. The streamlined, four-foot black metal housing provides a simple yet powerful solution for large-area scenery and wash lighting for theaters, TV and video studios, concerts, events, casinos, and exhibits. On-board power supplies and addressing capabilities eliminate the need for dedicated support equipment and simplifies specification and installation. The auto-switching power supplies work around the world.

Designed in a rugged extruded aluminum housing, each fixture features attached mounting brackets with two, 1/2-inch (13 mm) mounting holes for use with Cheeseborough clamps or pipe clamps. Locking knobs located on the mounting brackets allow for 180° rotational adjustment and locking without the use of special tools. Optional mounting brackets are available for T-handle mount applications. The housing is equipped to support spread lenses, louvers, and other attachments. A single 3-wire, 18AWG 6-foot (1.8 m) UL/cUL rated cord with IEC and flying leads is supplied. (Consult distribution for cord sets listed for PSE or CE).

Each ColorBlaze 48 fixture has eight individual circuit board assemblies, each with 18 high-intensity LEDs. This makes it sequentially controllable in 6-inch increments by a Color Kinetics DMX controller or a third-party DMX512 controller. Each circuit board is pre-addressed for Light# 1-8/DMX# 1-24. Data can be daisy-chained from fixture to fixture with an RJ-45 data cable or an XLR-5 data cable.

For protection from overheating, ColorBlaze 48 has been designed with a temperature monitoring feature. If operating temperatures rise to an unsafe level, a compensation circuit is triggered and ColorBlaze 48 operation is interrupted causing the lights to turn dull red. After 30 minutes the lights will auto-cycle and return to full intensity.

COLORBLAZE 48 SPECIFICATIONS

COLOR RANGE	16.7 million (24 bit) additive RGB colors; continuously variable intensity output range
SOURCE	High intensity power light emitting diodes (LEDs)
BEAM ANGLE	10°
HOUSING	Extruded aluminum with black finish
POWER CONNECTOR	IEC 15A (max) with C13 plug, UL/cUL rated 2-pole, 3-wire, grounded, 15A, flying leads
DATA CONNECTORS	RJ-45 or XLR-5
LISTINGS	UL/cUL, CE, PSE

COMMUNICATION SPECIFICATIONS

DATA INTERFACE	DMX512
CONTROL	Color Kinetics' line of DMX controllers or other DMX512 (RS-485) controllers

ELECTRICAL SPECIFICATIONS

POWER REQUIREMENT	100-240VAC
POWER CONSUMPTION	280W, 2.5A nominal at full intensity (full RGB)

ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE RANGE	-40°F to 122°F (-40°C to 50°C) operating temperature 14°F to 122°F (-10°C to 50°C) starting temperature

CHROMACORE® BY COLOR KINETICS

OPTIBIN® BY COLOR KINETICS

PS E CE c UL us LISTED

ITEM#116-000016-00

BR0116 Rev 07

LED SOURCE LIFE

In traditional lamp sources, lifetime is defined as the point at which 50% of the lamps fail. This is also termed Mean Time Between Failure [MTBF]. LEDs are semiconductor devices and have a much longer MTBF than conventional sources. However, MTBF is not the only consideration in determining useful life. Color Kinetics uses the concept of useful light output for rating source lifetimes. Like traditional sources, LED output degrades over time (lumen depreciation) and this is the metric for SSL lifetime.

LED lumen depreciation is affected by numerous environmental conditions such as ambient temperature, humidity and ventilation. Lumen depreciation is also affected by means of control, thermal management, current levels, and a host of other electrical design considerations. Color Kinetics systems are expertly engineered to optimize LED life when used under normal operating conditions. Lumen depreciation information is based on LED manufacturers' source life data as well as other third party testing. Low temperatures and controlled effects have a beneficial effect on lumen depreciation. Overall system lifetime could vary substantially based on usage and the environment in which the system is installed.

Temperature and effects will affect lifetime. Color Kinetics rates product lifetime using lumen depreciation to 50% of original light output. When the fixture is running at room temperature using a color wash effect, the range of lifetime is in the range of 80,000-100,000 hours. This is LED manufacturers' test data. High output is defined as any LED device that is 1/2 watt or above. For more detailed information on source life, please see www.colorkinetics.com/lifetime.

OPTIBIN®

There are inherent variations in the fabrication processes of all semiconductor materials. For LEDs, this variance results in differences in the color and intensity of light output as well as electrical characteristics. Due to these differences, LED manufacturers sort production into "bins," but insuring the availability of a single bin is very difficult. To minimize this issue and achieve optimal color consistency in its products, Color Kinetics has developed and uses a proprietary technology called Optibin. Optibin is an advanced production binning optimization process that minimizes the effects of LED variance for the best possible output uniformity in the final product. Color Kinetics Optibin technology gives the most consistent control of color and intensity from product to product.

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TEL 888 FULL RGB • TEL 617 423 9999 • FAX 617 423 9998 • INFO@COLORKINETICS.COM • WWW.COLORKINETICS.COM

COLORBLAZE 48

PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

SOURCE SPECIFICATIONS

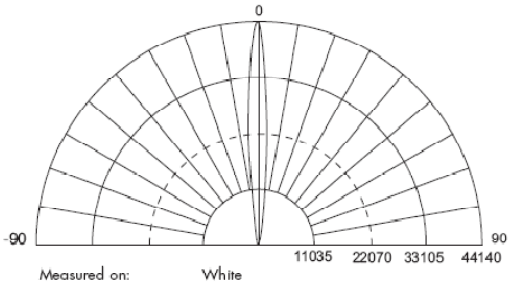
Optics:	Clear polycarbonate
Source:	144 LEDs (48 Red, 48 Green, 48 Blue)
Beam Angle:	10° (at 50% of peak illuminance)
Distribution:	Symmetric direct illumination
CCT:	Adjustable 1,000 – 10,000K
CRI:	Not measurable (CIE 13.3-1995)

ILLUMINANCE DISTRIBUTION

7.9 / 85.0	10.7 / 115.2	11.9 / 128.1	11.4 / 122.7	9.6 / 103.3	6.9 / 74.3	6.0'/2.0m
15.3 / 164.7	25.3 / 272.3	29.3 / 315.4	27.6 / 297.1	19.1 / 205.6	10.0 / 107.6	
52.8 / 568.3	99.1 / 1066.7	107.0 / 1151.7	109.0 / 1173.3	68.0 / 732.0	18.0 / 193.8	3.0'/1.0m
59.0 / 635.1	144.0 / 1550.0	183.0 / 1969.8	183.0 / 1969.8	140.0 / 1507.0	54.6 / 587.7	
23.4 / 251.9	82.5 / 888.0	127.0 / 1367.0	125.0 / 1345.5	112.0 / 1205.6	57.3 / 616.8	
10.1 / 108.7	25.5 / 274.5	38.9 / 418.7	40.5 / 435.9	35.4 / 381.0	19.6 / 211.0	0.0'/0.0m
3.0'/1.0m		0'/0m			3.0'/1.0m	

Units:	Footcandles (top)/Lux (bottom) 10.8 lux = 1 fc
Measured on:	All, reflectance model 80/50/20%
Distance from surface:	Bottom of grid, 3' (1.0 m) from surface, light at a 45° angle off horizontal

CANDLE POWER DISTRIBUTION



Measured on:	White
Beam center:	44140 cd
Thin dashed line:	Indicates 50% of peak
Multipliers:	0.33 Red, 0.50 Green, 0.18 Blue

ILLUMINANCE

COLOR	3' / 1m	6' / 2m	9' / 3m	15' / 5m
WHITE	2162.0 / 23271.8	675.0 / 7265.7	253.0 / 2723.3	127.0 / 1367.0
RED	721.2 / 7763.5	225.2 / 2423.8	84.4 / 908.5	42.4 / 456.0
GREEN	1070.2 / 11519.5	334.1 / 3596.5	125.2 / 1348.0	62.9 / 676.7
BLUE	393.5 / 4235.5	122.9 / 1322.4	46.0 / 495.6	23.1 / 248.8

Measured in Footcandles (top)/Lux (bottom) on axis.
Measured on: All, reflectance 0.

LIGHT OUTPUT

COLOR	TOTAL OUTPUT (lumens)	POWER (Watts)	EFFICACY (Lm/W)
WHITE	2282	240.0	9.5
RED	761.3	84.0	9.1
GREEN	1129.6	84.0	13.4
BLUE	415.3	84.0	4.9

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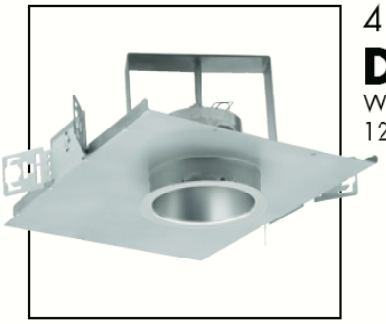


4" LED Downlight
D4LED
Wet Location
120V, 277V

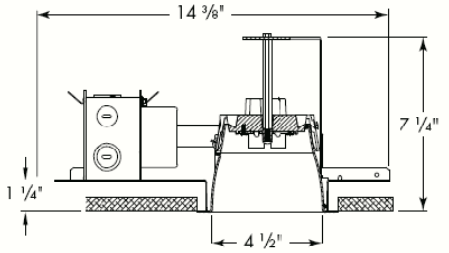
DATE: TYPE:

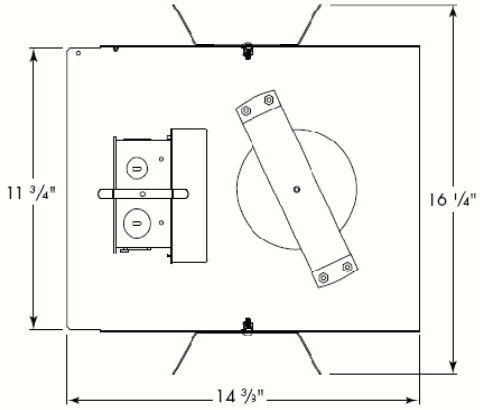
FIRM NAME:

PROJECT:

Architektūr

Ceiling Cutout: 5⅜"
Contact Factory For Shallow Ceiling
Maximum Ceiling Thickness 1¼"
For conversion to millimeters, multiply inches by 25.4
Not to Scale





APPLICATIONS:
Architektūr D4LED is a 4" specification grade LED downlight that provides superior brightness control. The D4LED is suitable for a variety of commercial, retail, and institutional applications, including outdoor cold environments.

Fixture should be installed in applications where ambient temperatures do not exceed 50°C (122°F) while illuminated. Installations in applications that exceed this temperature will result in a reduction of lamp life and void product warranty.

HOUSING:
One-piece 18 gauge steel platform. Pre-wired J-Box with snap-on cover for easy access.

REFLECTOR:
High purity spun aluminum reflector with iridescence suppressed Alzak anodized reflector. Reflector/Light Engine assembly is attached to the housing with a Truss head tamper proof screw (tool required). Self flanged reflector. Painted white trim available as option.

LED LIGHT ENGINE:
Each equipped with (4) 3-Watt white Lumileds Luxeon K2 LEDs with integral heat sink that will provide 70% average lumen maintenance at 50,000 hours. LED board is attached to the heat sink with two pin in socket button head tamper proof screws. One #8 tamper proof bit included.

LED DRIVER:
Solid state electronic 700mA, FCC class B compliant, 24V. 50,000 hour minimum anticipated life. Rated for -40°C/F starting temperature.

Stepdown transformer for 277V option.

LABELS:
CSA C/US listed suitable for wet location under covered ceiling. Approved for through wiring. Non-IC rated.

CATALOG NUMBER: EXAMPLE: D4LED277V-4D9MFC

HOUSING	HOUSING OPTIONS	TRIM	REFLECTOR FINISH	REFLECTOR COLOR	REFLECTOR OPTIONS	ACCESSORIES
❑ **D4LED** 4" LED Housing	❑ **277V**	❑ **4D9** 4" Open Reflector/ Light Engine Assembly	❑ **BLANK** Specular ❑ **SS** Semi-Specular ❑ **MFC** American Matte	❑ **BLANK** Clear Alzak ❑ **CG** Champagne Gold Alzak ❑ **BL** Black Alzak ❑ **WE** Wheat Alzak ❑ **LW** Light Wheat Alzak ❑ **PW** Pewter Alzak ❑ **WH**[1] White Paint	❑ **WT** White Trim ❑ **TRG** Trim Ring Gasket (factory installed)	❑ **B24** Set of two(2) 24" bar hangers for T-bar ceilings ❑ **B6** Set of two (2) bar hangers for ceiling joist up to 24" centers ❑ **SCA5** Sloped ceiling adapter for 4" housings. Specify degree of slope and type of ceiling. Slope ceiling adapter and housing must be installed at the same time.

[1]Requires WT option.

prescolite
A Division of Hubbell Lighting, Inc.

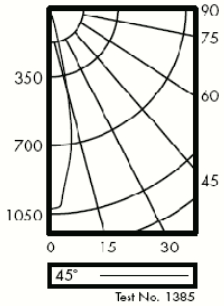
In a continuing effort to offer the best product possible we reserve the right to change, without notice, specifications or materials that in our opinion will not alter the function of the product.
Web: **www.prescolite.com** • Tech Support: **(888) 777-4832**

ARCH-LED-001

PHOTOMETRIC DATA

Architektūr - 4" D4LED Downlight

D4LED/4D9
Lamp: Four 3-watt White LEDs (Lumileds K2)
Spacing Criteria = 0.4
Efficiency=101.8%**



Test No. 1385

CANDLEPOWER SUMMARY

Angle	45°
0	1038
5	919
15	414
25	47
35	13
45	6
55	0
65	0
75	0
85	0
90	0

INPUT PARAMETER	VALUE	UNITS
Input Voltage range	120 ± 10%	V
Frequency	60	Hz
Power	15	W
Current	0.125	A
Efficiency	80	%

OPTICAL CHARACTERISTICS

Color Temperature				Lumens
Color	Min.	Typ	Max.	TYP
White	5,000 K	5,500 K	6,000 K	57

*LEDS have inherent variances in light output of +/- 10% of rated lumens The above published data assumes a weighted average of 57 lumens/LED.

**Efficiency > 100% because the luminaire's thermal management causes LED array to produce more lumens when installed in the luminaire than in free air.

ZONAL LUMEN SUMMARY

ZONE	LUMENS	%LAMP	%LUMINAIRE
0-30	219	96.3	94.5
0-40	228	100.2**	98.4
0-60	232	101.8**	100.0
0-90	232	101.8**	100.0
90-180	0	0.0	0.0
0-180	232	101.8**	100.0

LUMINANCE DATA IN CANDELA/SQ. METER

Angle in Vertical	Average
45	1046
55	0
65	0
75	0
85	0

D4LED/4D9
AVERAGE INITIAL FOOTCANDLES
Assumptions:
1. Multiple Units (Square Array)
2. Ceiling 80% Wall 50% Floor 20%
3. 4 fixtures evenly spaced in the center of the room.
4. The room is square and has a width and length equal to twice the lamp spacing.
5. The lumen depreciation factor is 0.8
6. The dirt depreciation factor is 0.98

3W LED SPACING	RCR1	RCR3	RCR7
7.0	4	4	3
8.0	3	3	3
9.0	3	2	2
10.0	2	2	2
11.0	2	2	1
12.0	1	1	1
13.0	1	1	1
14.0	1	1	1
15.0	1	1	1

Test No. 1385

COEFFICIENTS OF UTILIZATION Zonal Cavity Method

Room Cavity Ratio	% Effective Floor Cavity Reflectance: 80%				70%				50%			30%			10%		
	20% Effective Floor Cavity Reflectance																
	% Wall Reflectance																
	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10
1	118	115	114	112	115	113	112	110	109	108	107	106	105	104	102	101	101
2	114	110	107	105	112	109	106	104	105	103	101	102	101	99	100	98	97
3	110	106	102	99	109	104	101	98	102	99	97	100	97	95	97	96	94
4	107	102	98	95	105	101	97	94	99	96	93	97	94	92	95	93	91
5	104	98	94	91	103	97	93	91	96	92	90	94	91	89	93	90	88
6	101	95	91	88	100	94	90	87	93	89	87	92	89	86	90	88	86
7	98	92	88	85	97	91	87	85	90	87	84	89	86	84	88	85	83
8	96	89	85	82	95	89	85	82	88	84	82	87	84	81	86	83	81
9	93	87	83	80	92	86	82	80	85	82	79	85	82	79	84	81	79
10	91	84	80	78	90	84	80	78	83	80	77	83	79	77	82	79	77

D4LED/4D9 Test No. 1385

NOTES
Refer to www.prescolite.com for additional photometric tests (IES Files).

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Specifications subject to change without notice. • Printed in U.S.A. • A3CHLED-001 • 06/11/07

HUBBELL®
Hubbell Lighting, Inc.

Lamp Cut Sheets

T5 Mini Bipin

PENTRON® T5 LAMPS

PENTRON® High Performance T5 Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @35°C/95°F	Symbols & Footnotes
21	T5	36	34	Mini Bipin	20924	FP21/841/ECO	40	20000	4100	82	1890 2100	1767 1953	1,2,6, 8,9,11
28	T5	48	45.8	Mini Bipin	20838	FP28/60[RED]	40	10000			2100		1,2,8,9,11
					20839	FP28/66[GREEN]	40	10000			3500		1,2,8,9,11
					20840	FP28/67[BLUE]	40	10000			700		1,2,8,9,11
					20836	FP28/830	40	20000	3000	82	2600 2900	2418 2697	1,2,8,9,11
					20868	FP28/830/ECO	40	20000	3000	82	2600 2900	2418 2697	1,2,6, 8,9,11
					20841	FP28/835	40	20000	3500	82	2600 2900	2418 2697	1,2,8,9,11
					20901	FP28/835/ECO	40	20000	3500	82	2600 2900	2418 2697	1,2,6, 8,9,11
					20842	FP28/841	40	20000	4100	82	2600 2900	2418 2697	1,2,8,9,11
					20902	FP28/841/ECO	40	20000	4100	82	2600 2900	2418 2697	1,2,6, 8,9,11
35	T5	60	57.6	Mini Bipin	20843	FP35/830	40	20000	3000	82	3300 3650	3069 3394	1,2,8,9,11
					20925	FP35/830/ECO	40	20000	3000	82	3300 3650	3069 3394	1,2,6, 8,9,11
					20844	FP35/835	40	20000	3500	82	3300 3650	3069 3394	1,2,8,9,11
					20926	FP35/835/ECO	40	20000	3500	82	3300 3650	3069 3394	1,2,6, 8,9,11
					20845	FP35/841	40	20000	4100	82	3300 3650	3069 3394	1,2,8,9,11
					20927	FP35/841/ECO	40	20000	4100	82	3300 3650	3069 3394	1,2,6, 8,9,11

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  - Compact PAR30
  - Compact PAR20
  - Halogen Compact PAR16
  - Diamond Precise™ Electronic MR16
  - PAR36
  - A-Line/Decorative
  - Precise Cover Glass IR MR16

Compact PAR20 Item Detail

Product Image | Product Image | Product Image

Subcategory	Compact PAR20
Product Code	14927
Description	50PAR20/H/SP10
Volts	120
Watts	50
Average Life in Hours	2500
Lumens	570
CBCP	6000
Color Temperature (K)	2800
Bulb Type	PAR20
Base Type	Med NP
Max Overall Length (in.)	3.125
Max Overall Length (mm)	80
Filament Type	CC-8
Sales Unit UPC	043168906333
Case UPC	043168149273
SCC	00043168149273
Case Quantity	6
Additional Information	Spotlight
Footnotes	WARNING - Turn power off before inspection, installation or removal - Keep combustible materials away from lamp - Use in fixture rated for this product--see instructions - Do not use lamp if outer glass is scratched or broken

Compact Fluorescent Lamps

PL-C, PL-L, PL-T Lamps

Watts	Bulb	Base	Product Number	Symbols, Footnotes	Ordering Code	Generic Designation	Pkg. Qty.	Description	MOL (In.)	Avg. Hrs. Life (230)	Approx. Initial (231) Lumens	Design Lumens (208)	CRI
PL-C Cluster 4-Pin Fluorescent Lamps, Electronic Operation (204)													
13	PL-C	G24q-1	**38325-7**	$	**PL-C 13W/827/4P/ALTO**	CFQ13W/G24q/827	10	2700K	5 3/8	12,000	900	775	82
			38326-5	$	**PL-C 13W/830/4P/ALTO**	CFQ13W/G24q/830	10	3000K	5 3/8	12,000	900	775	82
			38327-3	$	**PL-C 13W/835/4P/ALTO**	CFQ13W/G24q/835	10	3500K	5 3/8	12,000	900	775	82
			38328-1	$	**PL-C 13W/841/4P/ALTO**	CFQ13W/G24q/841	10	4100K	5 3/8	12,000	900	775	82
18	PL-C	G24q-2	**38329-9**	$	**PL-C 18W/827/4P/ALTO**	CFQ18W/G24q/827	10	2700K	5 11/16	12,000	1250	1075	82
			38330-7	$	**PL-C 18W/830/4P/ALTO**	CFQ18W/G24q/830	10	3000K	5 11/16	12,000	1250	1075	82
			38332-3	$	**PL-C 18W/835/4P/ALTO**	CFQ18W/G24q/835	10	3500K	5 11/16	12,000	1250	1075	82
			38333-1	$	**PL-C 18W/841/4P/ALTO**	CFQ18W/G24q/841	10	4100K	5 11/16	12,000	1250	1075	82
26	PL-C	G24q-3	**38334-9**	$	**PL-C 26W/827/4P/ALTO**	CFQ26W/G24q/827	10	2700K	6 1/2	12,000	1800	1550	82
			38335-6	$	**PL-C 26W/830/4P/ALTO**	CFQ26W/G24q/830	10	3000K	6 1/2	12,000	1800	1550	82
			38336-4	$	**PL-C 26W/835/4P/ALTO**	CFQ26W/G24q/835	10	3500K	6 1/2	12,000	1800	1550	82
			38337-2	$	**PL-C 26W/841/4P/ALTO**	CFQ26W/G24q/841	10	4100K	6 1/2	12,000	1800	1550	82
PL-L Long Fluorescent Lamps (204)													
18	PL-L	2G11	**34500-9**	$	**PL-L 18W/830/4P**	FT18W/2G11/830	25	3000K	8 7/16	15,000	1250	1125	82
			35932-3	$	**PL-L 18W/835/4P**	FT18W/2G11/835	25	3500K	8 7/16	15,000	1250	1125	82
			34501-7	$	**PL-L 18W/841/4P**	FT18W/2G11/841	25	4100K	8 7/16	15,000	1250	1125	82
24	PL-L	2G11	**34505-8**	$	**PL-L 24W/830/4P**	FT24W/2G11/830	25	3000K	12 7/16	15,000	1800	1620	82
			35933-1	$	**PL-L 24W/835/4P**	FT24W/2G11/835	25	3500K	12 7/16	15,000	1800	1620	82
			34508-2	$	**PL-L 24W/841/4P**	FT24W/2G11/841	25	4100K	12 7/16	15,000	1800	1620	82
36	PL-L	2G11	**34511-6**	$	**PL-L 36W/830/4P**	FT36W/2G11/830	25	3000K	16 7/16	15,000	2900	2610	82
			34942-3	$	**PL-L 36W/835/4P**	FT36W/2G11/835	25	3500K	16 7/16	15,000	2900	2610	82
			34513-2	$	**PL-L 36W/841/4P**	FT36W/2G11/841	25	4100K	16 7/16	15,000	2900	2610	82
40	PL-L	2G11	**30042-6**	$	**PL-L 40W/830/4P/RS/IS**	FT40W/2G11/RS/830	25	3000K	22 1/2	20,000	3300	2970	82
			30043-4	$	**PL-L 40W/835/4P/RS/IS**	FT40W/2G11/RS/835	25	3500K	22 1/2	20,000	3300	2970	82
			30044-2	$	**PL-L 40W/841/4P/RS/IS**	FT40W/2G11/RS/841	25	4100K	22 1/2	20,000	3300	2970	82
50	PL-L	2G11	**34747-6**	$	**PL-L 50W/830/4P/RS**	FT50W/2G11/RS/830	25	3000K	22 1/2	20,000	4300	3870	82
			34753-4	$	**PL-L 50W/835/4P/RS**	FT50W/2G11/RS/835	25	3500K	22 1/2	20,000	4300	3870	82
			34770-8	$	**PL-L 50W/841/4P/RS**	FT50W/2G11/RS/841	25	4100K	22 1/2	20,000	4300	3870	82
55	PL-L	2G11	**13844-6**	$	**PL-L 55W/950/4P/RS**	FT55W/2G11/RS/950	25	5000K	21 3/8	20,000	3650	3358	91
80	PL-L	2G11	**38697-9**	$	**PL-L 80W/830/4P**	FT80W/2G11/830	25	3000K	22 1/2	20,000	6000	5400	82
			38698-7	$	**PL-L 80W/835/4P**	FT80W/2G11/835	25	3500K	22 1/2	20,000	6000	5400	82
			38699-5	$	**PL-L 80W/841/4P**	FT80W/2G11/841	25	4100K	22 1/2	20,000	6000	5400	82
PL-T Triple 4-Pin Fluorescent Lamps (204)													
18	PL-T	GX24q-2	**38437-0**	$	**PL-T 18W/827/4P/ALTO**	CFTR18W/GX24q/827	12	2700K	4 3/8	12,000	1200	1020	82
			26802-9	$	**PL-T 18W/830/4P/ALTO**	CFTR18W/GX24q/830	12	3000K	4 3/8	12,000	1200	1020	82
			26820-1	$	**PL-T 18W/835/4P/ALTO**	CFTR18W/GX24q/835	12	3500K	4 3/8	12,000	1200	1020	82
			26822-7	$	**PL-T 18W/841/4P/ALTO**	CFTR18W/GX24q/841	12	4100K	4 3/8	12,000	1200	1020	82
26	PL-T	GX24q-3	**38440-4**	$	**PL-T 26W/827/4P/ALTO**	CFTR26W/GX24q/827	12	2700K	5	12,000	1800	1530	82
			26823-5	$	**PL-T 26W/830/4P/ALTO**	CFTR26W/GX24q/830	12	3000K	5	12,000	1800	1530	82
			26824-3	$	**PL-T 26W/835/4P/ALTO**	CFTR26W/GX24q/835	12	3500K	5	12,000	1800	1530	82
			26825-0	$	**PL-T 26W/841/4P/ALTO**	CFTR26W/GX24q/841	12	4100K	5	12,000	1800	1530	82
32	PL-T	GX24q-3	**38443-8**	$	**PL-T 32W/827/4P/ALTO**	CFTR32W/GX24q/827	12	2700K	5 3/8	12,000	2400	2040	82
			26832-6	$	**PL-T 32W/830/4P/ALTO**	CFTR32W/GX24q/830	12	3000K	5 3/8	12,000	2400	2040	82
			26833-4	$	**PL-T 32W/835/4P/ALTO**	CFTR32W/GX24q/835	12	3500K	5 3/8	12,000	2400	2040	82
			26872-2	$	**PL-T 32W/841/4P/ALTO**	CFTR32W/GX24q/841	12	4100K	5 3/8	12,000	2400	2040	82
42	PL-T	GX24q-4	**38450-3**	$	**PL-T 42W/827/4P/ALTO**	CFTR42W/GX24q/827	12	2700K	6 3/8	12,000	3200	2720	82
			26873-0	$	**PL-T 42W/830/4P/ALTO**	CFTR42W/GX24q/830	12	3000K	6 3/8	12,000	3200	2720	82
			26875-5	$	**PL-T 42W/835/4P/ALTO**	CFTR42W/GX24q/835	12	3500K	6 3/8	12,000	3200	2720	82
			26876-3	$	**PL-T 42W/841/4P/ALTO**	CFTR42W/GX24q/841	12	4100K	6 3/8	12,000	3200	2720	82
			13487-4	X $ (242)	**PL-T 42W/830/4P/HTA ALTO**	CFTR42W/GX24q/830	12	3000K	6 3/8	12,000	3200	2720	82
			13488-2	X $ (242)	**PL-T 42W/835/4P/HTA ALTO**	CFTR42W/GX24q/835	12	3500K	6 3/8	12,000	3200	2720	82
			13659-8	X $ (242)	**PL-T 42W/841/4P/HTA ALTO**	CFTR42W/GX24q/841	12	4100K	6 3/8	12,000	3200	2720	82
57	PL-T	GX24q-5	**14631-6**	$	**PL-T 57W/830/4P/A**	CFTR57W/GX24q/830	10	3000K	7 3/4	12,000	4300	3741	82
			14632-4	$	**PL-T 57W/835/4P/A**	CFTR57W/GX24q/835	10	3500K	7 3/4	12,000	4300	3741	82
			14633-2	$	**PL-T 57W/841/4P/A**	CFTR57W/GX24q/841	10	4100K	7 3/4	12,000	4300	3741	82

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Compact Fluorescent symbols and footnotes located on page 87
This product utilizes ALTO® Lamp Technology

T8 Med Bipin

FLUORESCENT

OCTRON® AND OCTRON® CURVALUME® FLUORESCENT LAMPS

OCTRON® lamps are T8 fluorescent lamps designed to be operated on dedicated magnetic rapid start or electronic instant start, rapid start or programmed rapid start (also known as programmed start) ballasts. OCTRON lamps may be operated on electronic instant start ballasts with ballast factors ranging from .71 to 1.20 at the nominal ballast input voltage. For details on various lamp/ballast system combinations, please refer to the Systems Performance Guide in the "SYLVANIA QUICKTRONIC® Ballast Technology & Specification Guide".

OCTRON® 800, 800 XP™ and 800 XPS® Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
17	T8	24	23.78	Med Bipin	22137	FO17/841/ECO	30	20000	4100	82	1350	1240	1,2,6,8,20,21
					21907	FO17/841/XP/ECO	30	24000	4100	85	1375	1305	1,2,6,8,21,22,23
					22152	FO17/841/XPS/ECO	30	30000	4100	85	1400	1340	1,2,6,8,21,28,31
25	T8	36	35.78	Med Bipin	22138	FO25/830/ECO	30	20000	3000	82	2150	1975	1,2,6,8,20,21
					21910	FO25/830/XP/ECO	30	24000	3000	85	2175	2065	1,2,6,8,21,22,23
					22153	FO25/830/XPS/ECO	30	30000	3000	85	2200	2090	1,2,6,8,21,28,31
					22139	FO25/835/ECO	30	20000	3500	82	2150	1975	1,2,6,8,20,21
					21776	FO25/835/XP/ECO	30	24000	3500	85	2175	2065	1,2,6,8,21,22,23
					22154	FO25/835/XPS/ECO	30	30000	3500	85	2200	2090	1,2,6,8,21,28,31
					22140	FO25/841/ECO	30	20000	4100	82	2150	1975	1,2,6,8,20,21
					21774	FO25/841/XP/ECO	30	24000	4100	85	2175	2065	1,2,6,8,21,22,23
					22155	FO25/841/XPS/ECO	30	30000	4100	85	2200	2090	1,2,6,8,21,28,31
28	T8	48	47.78	Med Bipin	22177	FO28/830/XP/SS/ECO	30	18000	3000	82	2725	2560	1,2,6,22,23,29,30
					22178	FO28/835/XP/SS/ECO	30	18000	3500	82	2725	2560	1,2,6,22,23,29,30
					22179	FO28/841/XP/SS/ECO	30	18000	4100	82	2725	2560	1,2,6,22,23,29,30
30	T8	48	47.78	Med Bipin	22063	FO30/830/XP/SS/ECO	30	18000	3000	82	2850	2680	1,2,6,22,23,29,30
					22060	FO30/835/XP/SS/ECO	30	18000	3500	82	2850	2680	1,2,6,22,23,29,30
					22062	FO30/841/XP/SS/ECO	30	18000	4100	82	2850	2680	1,2,6,22,23,29,30
32	T8	48	47.78	Med Bipin	22039	FO32/827/XP/ECO	30	24000	2700	84	3000	2850	1,2,6,8,21,22,23
					21777	FO32/830/ECO	30	20000	3000	82	2950	2710	1,2,6,8,20,21
					21759	FO32/830/XP/ECO	30	24000	3000	85	3000	2850	1,2,6,8,21,22,23
					21680	FO32/830/XPS/ECO	30	30000	3000	85	3100	2945	1,2,6,8,14,21,28,31
					21779	FO32/835/ECO	30	20000	3500	82	2950	2710	1,2,6,8,20,21

For more complete product information visit www.sylvania.com
Symbols/Footnotes on page 139-143

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Lighting

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MasterColor CDM 100W/830 Med ED17 CO ALTO

Lamp Description

Range of high-efficiency long life ceramic metal halide lamps with a stable color over life time and a crisp, sparkling light.

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Product specs: | + Images: | + Family info:

Warning/Caution notice
MSDS sheets

PRODUCT DATA	
Product Number	208892
Full product name	MasterColor CDM 100W/830 Med ED17 CO ALTO
Ordering Code	MHC100/C/U/M/3K ALTO
Pack type	1 Sleeve Open End
Pieces per Sku	1
Skus/Case	12
Pack UPC	046677208899
EAN2US	
Case Bar Code	50046677208894
Successor Product number	
General Characteristics	
Base	Medium [Single Contact Medium Screw]
Base Information	Brass [Brass Base]
Bulb	ED17
Bulb Material	Hard Glass
Bulb Finish	Coated
Operating Position	Universal [Any or Universal (U)]
Packing Type	1SL [1 Sleeve Open End]
Packing Configuration	12
RatedAvgLife(See Family Notes)	16000 hr
Feature	ALTO®
Ordering Code	MHC100/C/U/M/3K ALTO
Pack UPC	046677208899
Case Bar Code	50046677208894
ANSI Code HID	M140/M90/E
Electrical Characteristics	
Watts	100W
Lamp Voltage	100 V
Environmental Characteristics	
Mercury (Hg) Content	6.4 mg
Light Technical Characteristics	
Color Code	830 [CCT of 3000K]
Color Rendering Index	85 Ra8
Color Designation	Warm White
Color Temperature	3000 K
Initial Lumens	8800 Lm
Design Mean Lumens	6600 Lm
Product Dimensions	
Light Center Length L	3.438 in
Max Overall Length (MOL) - C	5.438 in
Diameter D	2.125 in
Logistic and Packing Data	
Product Number	208892

POWERBALL® CERAMIC METALARC® TUBULAR SINGLE-ENDED
High CRI, Pulse Start, UV Stop – Enclosed Fixtures Only

Watts	Bulb	Base	Product Number	Ordering Abbreviation	ANSI Code	Pkg Qty	Lamp Finish	Operating Position	Fix Req	Avg Rated Life (hrs)	Approx Lumens (initial)	Lumens (mean)	CRI	CCT (K)	Symbols & Footnotes
20	T4.5	G8.5	64882	MC20TC/U/G8.5/830PB	M156/E	12	Clear	Universal	E	12000	1700	1275	83	3000	1,4,18, 24,25,30,48
39	T4.5	G8.5	64791	MC39TC/U/G8.5/830PB	M130/E	12	Clear	Universal	E	12000	3400	2720	82	3000	1,4,18,24, 25,30,48
	T6	G12	64363	MC39T6/U/G12/830PB	M130/E	12	Clear	Universal	E	12000	3400	2720	82	3000	1,4,18,24, 25,30,48
			64325	MC39T6/U/G12/940PB	M130/E	12	Clear	Universal	E	12000	3300	2640	90	4200	1,4,18, 24,25,26,30,48
70	T4.5	G8.5	64825	MC70TC/U/G8.5/930PB	M139/E, M98/E	12	Clear	Universal	E	12000	6300	5040	95	3000	1,4,18, 24,25,26,30,48
	T6	G12	64361	MC70T6/U/G12/830PB	M139/E, M98/E	12	Clear	Universal	E	12000	7000	5600	87	3000	1,4,18,24, 25,26,30,48
			64200	MC70T6/U/G12/930PB	M139/E, M98/E	12	Clear	Universal	E	12000	6400	5120	95	3000	1,4,18, 24,25,26,30,48
			64338	MC70T6/U/G12/940PB	M139/E, M98/E	12	Clear	Universal	E	12000	6700	5360	93	4200	1,4,18,24, 25,26,30,48
150	T7.5	G12	64359	MC150T7.5/U/G12/830	M102/E, M142/E	12	Clear	Universal	E	12000	15500	12400	89	3000	1,4,18,24, 30,31,48
			64337	MC150T7.5/U/G12/940PB	M102/E, M142/E	12	Clear	Universal	E	12000	14500	11600	95	4200	1,4,18,24, 30,31,48
250	T9	G22	64167	MC250T9/U/G22/830PB	M80/E	10	Clear	Universal	E	12000	24500	19600	86	3000	1,4 ,18,24,30,31,48

POWERBALL® CERAMIC METALARC® TUBULAR DOUBLE-ENDED

Watts	Bulb	Base	Product Number	Ordering Abbreviation	ANSI Code	Pkg Qty	Lamp Finish	Operating Position	Fix Req	Avg Rated Life (hrs)	Approx Lumens (initial)	Lumens (mean)	CRI	CCT (K)	Symbols & Footnotes
70	T6	RX7s RSC	64793	MC70T6/DE/830PB	M139/E, M85/E, M98/E	12	Clear	HOR ± 45°	E	12000	6900	5520	88	3000	1,4,18,25, 26,30,35,48
150	T7.5	RX7s RSC	64794	MC150T7.5/DE/830PB	M102/E, M142/E, M81/E	12	Clear	HOR ± 45°	E	12000	14800	11840	91	3000	1,4,18,30, 37,48

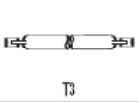
POWERBALL® CERAMIC METALARC® PAR
High CRI, Pulse Start, UV Stop – Open or Enclosed Fixtures

Watts	Bulb	Base	Product Number	Ordering Abbreviation	ANSI Code	Pkg Qty	Beam Type	Beam Angle	Operating Position	Fix Req	Avg Rated Life (hrs)	MBCP	Approx Lumens (initial)	CRI	CCT (K)	Symbols & Footnotes
20	PAR30LN	E26 Med	64879	MCP20PAR30LN/U/830/SP/ECOPB	M156/O	6	SP	10°	Universal	O	12000	24000	1200	82	3100	1,4,7,17,24,30,48
			64878	MCP20PAR30LN/U/830/FL/ECOPB	M156/O	6	FL	30°	Universal	O	12000	4000	1200	82	3100	1,4,7,17,24,30,48
39	PAR20	E26 Med	64824	MCP39PAR20/U/830/SPPB	M130/O	12	SP	10°	Universal	O	12000	20000	2000	87	3000	1,4,17, 24,25,30,48
			64826	MCP39PAR20/U/830/FLPB	M130/O	12	FL	30°	Universal	O	12000	5000	2000	87	3000	1,4,17, 24,25,30,48
	PAR30LN	E26 Med	64880	MCP39PAR30LN/U/830/SP/ECOPB	M130/O	6	SP	10°	Universal	O	12000	39600	2300	85	3000	1,4, 7,17,24,25,30,48
			64881	MCP39PAR30LN/U/830/FL/ECOPB	M130/O	6	FL	30°	Universal	O	12000	8000	2300	85	3000	1,4, 7,17,24,25,30,48

For more complete product information visit www.sylvania.com

Symbols/Footnotes on page 101-102

H I D



TUNGSTEN HALOGEN

DOUBLE END QUARTZ LAMPS

A suitable protective shield, screening technique or both shall be used to protect people and surroundings from the possibility of a lamp shattering and from possible ultraviolet radiation.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Lamp Finish	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	LCL (in)	MOL (in)
300	T3	RSC	58920	123,139	300T3Q/CL/RP(EHM)	120	6	Clear	C,C-8	2000	6000 2950		4.69
			59000	123,139	300T3Q/CL	130	20	Clear	C,C-8	2000	6000 2950		4.69
500	T3	RSC	58996	123,139	500T3Q/CL(FCL)	120	20	Clear	C,C-8	2000	8750 2950		4.69
			58865	123,139	500T3Q/CL/RP(FCL)	120	6	Clear	C,C-8	2000	8750 2950		4.69
			58997	123,139	500T3Q/CL	130	20	Clear	C,C-8	2000	8750 2950		4.69
1000	T3	RSC	58948	123,139	1000T3Q/CL	240	12	Clear	C,C-8	2000	21500 2950		10.06
1500	T3	RSC	58859	123,139	1500T3Q/CL	208	12	Clear	C,C-8	2000	33000 2950		10.06
			58857	123,139	1500T3Q/CL	240	12	Clear	C,C-8	2000	33000 2950		10.06
			58858	123,139	1500T3Q/CL	277	12	Clear	C,C-8	2000	33000 2950		10.06

OSRAM MINISTAR LAMPS

Suitable for use in unshielded fixtures. Consult most recent luminaire standards for your area to determine luminaire requirements.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Beam Type	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	CBCP	Beam Angle	MOL (in)
10	T3	G4 Bipin	58520	72,84,123,145	10T3Q/MINISTAR/S	12	40	FL	C,C-8	2000	3000	80	35 x 60	1.31
20	T3	G4 Bipin	58521	72,84,123,145	20T3Q/MINISTAR/S	12	40	FL	C,C-8	2000	3000	120	35 x 60	1.31
	BT4	GY6.35 Bipin	58518	72,84,123,145	20BT4Q/MINISTAR/AX	12	40	FL	C,C-8	2000	3000	800	20	1.75
35	BT4	GY6.35 Bipin	58519	72,84,123,145	35BT4Q/MINISTAR/AX	12	40	FL	C,C-8	2000	3000	1000	30	1.75

BI-PIN IR LAMPS

UV Filter capsule with axial filament and infrared reflective coating. Suitable for use in unshielded fixtures. Consult most recent luminaire standards for your area to determine luminaire requirements.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Lamp Finish	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	LCL (in)	MOL (in)
25	BT4	GY6.35 Bipin	58897	145	25BT4Q/IR	12	40	Clear	C,AXIAL	4000	450 3000	1.13	1.75
35	BT4	GY6.35 Bipin	58896	145	35BT4Q/IR	12	40	Clear	C,AXIAL	4000	800 3000	1.13	1.75

For more complete product information visit www.sylvania.com
Symbols/Footnotes on page 54-68

WORLDWIDE PARTNER

GE Lighting

Commercial Products & Solutions

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Products > Halogen > PAR > PAR20 > 17868

PRINT

17868 – 50PAR20/H/FL25

GE PAR20

• Standard Halogen - Crisp, white light

Energy Savings

Bulb

View Larger

GENERAL CHARACTERISTICS

Lamp type	Halogen - PAR
Bulb	PAR20
Base	Medium NP
Filament	CC-8
Wattage	50/46
Voltage	130/120
Rated Life	3000 hrs/6000 hrs

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	570/498
Center Beam Candlepower (CBCP)	1500
Color Temperature	2800 K
Nominal Initial Lumens per Watt	11

DIMENSIONS

Maximum Overall Length (MOL)	3 1/8
Bulb Diameter (DIA)	2 1/2

PRODUCT INFORMATION

Product Code	17868
Description	50PAR20/H/FL25
Standard Package	Case
Standard Package GTIN	00043168178686
Standard Package Quantity	15
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	15
UPC	043168970112

⚠ CAUTIONS & WARNINGS

See list of cautions & warnings.

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures

- Halogen Lamps

IES/Photometric Download

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

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Products > Halogen > PAR > PAR30 > 14022

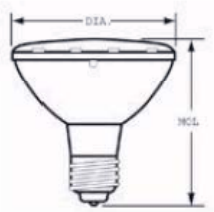
PRINT

14022 – 50PAR30/H/FL35

GE Edison™ PAR30

- Edison™ halogen bulbs provide a brighter, crisper light that makes your home look its best
- That's why professionals choose Edison for exceptional results and longer bulb life.
- Showcase the beauty of your home with the highest quality of light.

Energy Savings



Bulb

Package

View Larger

GENERAL CHARACTERISTICS

Lamp type	Halogen - PAR
Bulb	PAR30
Base	Medium NP
Filament	CC-8
Wattage	50
Voltage	120
Rated Life	3000 hrs
Primary Application	Indoor Floodlight

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	630
Center Beam Candlepower (CBCP)	1400
Color Temperature	2800 K
Nominal Initial Lumens per Watt	12

DIMENSIONS

Maximum Overall Length (MOL)	3.6200 in (91.9 mm)
Bulb Diameter (DIA)	3.750 in (95.2 mm)

PRODUCT INFORMATION

Product Code	14022
Description	50PAR30/H/FL35
Standard Package	Case
Standard Package GTIN	10043168140222
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168140225

⚠ CAUTIONS & WARNINGS

ADDITIONAL RESOURCES

Catalogs

Testimonials

Brochures

Product Brochures
- Halogen Lamps
- Industrial Lighting

Application/Segment Brochures
- Healthcare Lighting
- Office Lighting
- Retail Lighting

IES/Photometric Download

MSDS (Material Safety Data Sheets)

Disposal Policies & Recycling Information

Ballast Cut Sheets

Item Number	OSRAM SYLVANIA Description	Input Voltage (VAC)	Input Current (AMPS)	Lamp Type	Rated Lumens (lm)	No. of Lamps	Ballast Factor (BF)	System Lumens	Input Wattage (W)	System Efficacy (lm/W)
QUICKTRONIC® *PROFESSIONAL* DALI DIMMING SYSTEMS - 100-1% Dimming Range - <10% THD - For a list of DALI controllers, contact OSRAM SYLVANIA										
				T8						
51350	QTP 1x32T8/UNV DALI	120-277	0.31/0.13	FO32XP	3000	1	1.00 0.01	3000 30	36 6	83
51352	QTP 2x32T8/UNV DALI	120-277	0.61/0.26	FO32XP	3000	2	1.00 0.01	6000 60	72/70 12	83/86
DALI QTP models above also operate these lamps: FB032										
				T5HO						
51364	QTP 1x54T5HO/UNV DALI	120-277	0.52/0.22	FP54HO	5000	1	1.00 0.01	5000 50	62/61 9	81/82
51366	QTP 2x54T5HO/UNV DALI	120-277	1.05/0.44	FP54HO	5000	2	1.00 0.01	10,000 100	122/119 18	82/84
				T5						
51356	QTP 1x28T5/UNV DALI	120-277	0.27/0.11	FP28	2900	1	1.00 0.01	2900 29	32 6	91
51358	QTP 2x28T5/UNV DALI	120-277	0.55/0.23	FP28	2900	2	1.00 0.01	5800 58	64/62 12	91/94
51357	QTP 1x14T5/UNV DALI	120-277	0.15/0.07	FP14	1350	1	1.00 0.01	1350 14	18	75
51359	QTP 2x14T5/UNV DALI	120-277	0.29/0.13	FP14	1350	2	1.00 0.01	2700 27	34/33	79/82
51360	QTP 1x35T5/UNV DALI	120-277	0.34/0.14	FP35	3650	1	1.00 0.01	3650 37	40/39	91/94
51361	QTP 2x35T5/UNV DALI	120-277	0.67/0.28	FP35	3650	2	1.00 0.01	7300 73	79/76	92/96
QUICKTRONIC® *PROFESSIONAL* DALI COMPACT FLUORESCENT DIMMING SYSTEMS - For a list of DALI controllers, contact OSRAM SYLVANIA										
				T4 and TT5 DALI - 100-3% Dimming Range - <10% THD						
51370	QTP 1x18CF/UNV DALI	120-277	0.16/0.08	18W DD/E, T/E	1200	1	1.00 0.03	1200 35	20	60
51372	QTP 2x18CF/UNV DALI	120-277	0.33/0.14	18W DD/E, T/E	1200	2	1.00 0.03	2400 70	39/38	61/63
51375	QTP 1x26CF/UNV DALI	120-277	0.24/0.10	26W DD/E, T/E	1800	1	1.00 0.03	1800 55	28	64
51377	QTP 2x26CF/UNV DALI	120-277	0.49/0.22	26W DD/E, T/E	1800	2	1.00 0.03	3600 110	55/54	65/67
51380	QTP 1x32CF/UNV DALI	120-277	0.34/0.15	32W DT/E	2400	1	1.00 0.03	2400 70	38	63
51382	QTP 2x32CF/UNV DALI	120-277	0.60/0.25	32W DT/E	2400	2	1.00 0.03	4800 140	71/70	68/69
51384	QTP 1x42CF/UNV DALI	120-277	0.43/0.19	42W DT/E	3200	1	1.00 0.03	3200 95	49	65
51386	QTP 2x42CF/UNV DALI	120-277	0.82/0.36	42W DT/E	3200	2	1.00 0.03	6400 190	92/91	69/70
51390	QTP 1x40TT5/UNV DALI	120-277	0.41/0.17	40W D_	3150	1	1.00 0.03	3150 95	45/44	70/72
51392	QTP 2x40TT5/UNV DALI	120-277	0.83/0.37	40W D_	3150	2	1.00 0.03	6300 190	97/94	65/67
QUICKTRONIC® 96IS & 96HO										
				F96T12 Instant Start - Normal Ballast Factor- <20% THD						
49881	QT 2x96/120 IS	120	1.12	F96SS F96	5300 6420	2 2	0.85 0.85	9010 10910	107 132	84 83
49882	QT 2x96/277 IS	277	0.49	F96SS F96	5300 6420	2 2	0.85 0.85	9010 10910	107 132	84 83
QT IS models above also operate these lamps: F04T12, F72T12 & F60T12										
				F96T12 High Output- Normal Ballast Factor- <20% THD						
49883	QT 2x96/120 HO	120	1.74	F96HOSS F96HO	8000 9050	2 2	0.89 0.89	14240 16109	170 205	84 79
49884	QT 2x96/277 HO	277	0.76	F96HOSS F96HO	8000 9050	2 2	0.85 0.85	13600 15385	170 205	80 75
QT HO models above also operate these lamps: F84T12/HO, F72T12/HO, F60T12/HO, & F48T12/HO										

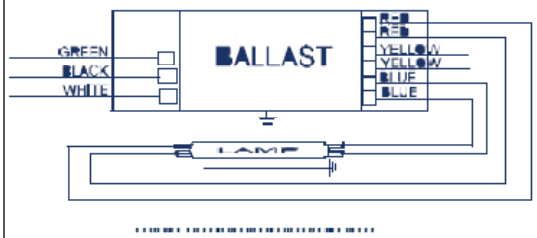
ADVANCE

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

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.16	19	1.07	20	0.98	1.7	5.63
F14T5	2	14	0/-18	0.29	34	1.06	10	0.98	1.7	3.12
F21T5	1	21	0/-18	0.21	26	1.03	15	0.99	1.7	3.96
F21T5	2	21	0/-18	0.40	48	1.02	10	0.98	1.7	2.13
* F28T5	1	28	0/-18	0.28	33	1.04	10	0.98	1.7	3.15
F28T5	2	28	0/-18	0.55	64	1.03	10	0.99	1.7	1.61
F35T5	1	35	0/-18	0.34	41	1.01	10	0.98	1.7	2.46
F35T5	2	35	0/-18	0.67	80	1.00	10	0.99	1.7	1.25

Wiring Diagram



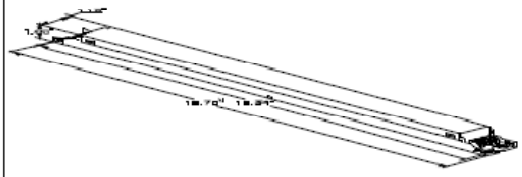
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

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

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

Enclosure



Enclosure Dimensions

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

Revised 08/21/2006

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

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
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Corporate Offices: Phone: 800-322-2086

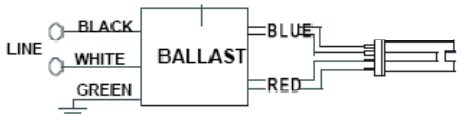
RCF-2S26-H1-LD-QS	
Brand Name	AMBISTAR - HPF
Ballast Type	Electronic
Starting Method	Rapid Start
Lamp Connection	Series
Input Voltage	120
Input Frequency	60
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFQ26W/G24Q	1	26	0/-18	0.23	27	1.00	10	0.98	1.7	3.70
CFQ26W/G24Q	2	26	0/-18	0.43	51	1.00	10	0.98	1.7	1.96
CFTR26W/GX24Q	1	26	0/-18	0.24	29	1.10	10	0.98	1.7	3.79
CFTR26W/GX24Q	2	26	0/-18	0.45	54	1.00	10	0.98	1.7	1.85
* CFTR32W/GX24Q	1	32	0/-18	0.31	36	0.98	10	0.98	1.7	2.72
CFTR42W/GX24Q	1	42	0/-18	0.38	46	0.98	10	0.98	1.7	2.13

Wiring Diagram

WIRING: (1) LAMP



Green Terminal must be Grounded

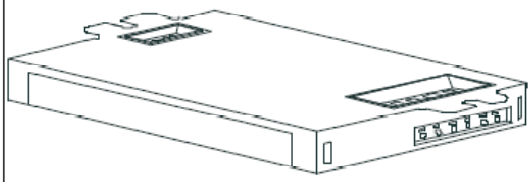
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

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

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

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/10/2007

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

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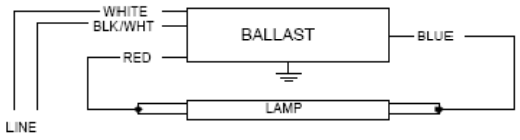
ADVANCE

REL-1P32-LW-SC	
Brand Name	STANDARD ELEC
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	120
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F17T8	1	17	0/-18	0.17	18	0.87	25	0.90	1.7	4.83
F25T8	1	25	0/-18	0.21	24	0.82	20	0.95	1.7	3.42
* F32T8	1	32	0/-18	0.24	29	0.75	20	0.98	1.7	2.59
F32T8/ES (30W)	1	30	60/16	0.23	27	0.75	20	0.98	1.7	2.78

Wiring Diagram



Diag. 63

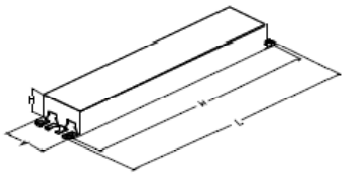
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		
White	25.0	
Blue	31.0	
Red	37.0	
Yellow		
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White	25.0	
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 08/26/2002

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

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Corporate Offices: Phone: 800-322-2086

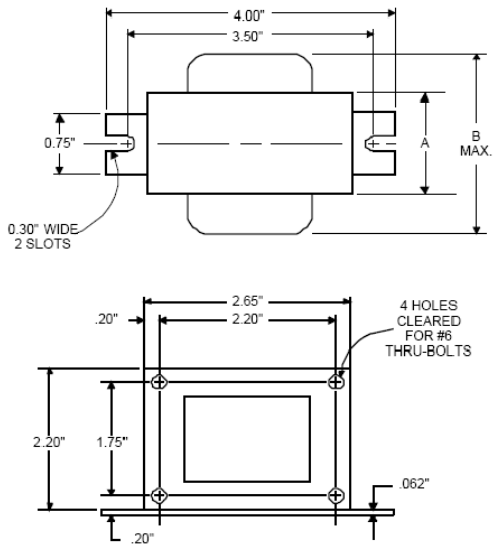
ADVANCE

Metal Halide Lamp Ballast

Catalog Number 71A5337BP
For 100W M90/M140
60 Hz R-HPF
Status: Active

DIMENSIONS AND DATA

2 5/8 X 2 3/16 CORE



~~INPUT VOLTS~~		277				
CIRCUIT TYPE	R-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.45				
Open Circuit		1.05				
Starting		0.70				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	A				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	277					
INPUT VOLTAGE AT LAMP DROPOUT		190				
INPUT WATTS	118					
RECOMMENDED FUSE (Amps)		3				
CORE and COIL						
Dimension (A)	1.80					
Dimension (B)	3.10					
Weight (lbs.)	3.2					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	10.0					
Volts (min.)	280					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Advance Test Procedure for HID Ballasts - Form 1270)						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2500					
Open Circuit Voltage Test (Volts)	260-290					
Short-Circuit Current Test (Amps)						
Secondary Current	1.05-1.55					
Input Current		0.25 0.35	-	-	-	-

Capacitor: 7C100M33-R

Capacitance: 10
Dia/Oval Dim: 1.5
Height: 2.9
Temp Rating: 105°C

Ignitor: INTEGRAL

An ignitor integral to the core and coil assembly is used to start the lamp.

Ballast to Lamp Distance (BTL) = 2 feet
Temp Rating: 125°C

Wiring Diagram:

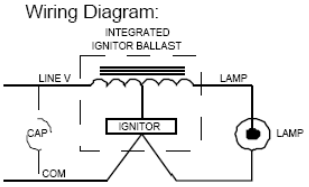


Fig. H

U.L. RECOGNIZED

Typical Ordering Information

(please call Advance for suffix availability)

Order Suffix	Description
500DB	Ballast With Integral Igniter and Dry Film Capacitor
510DB	Ballast w/Welded Bracket, Integral Igniter & Dry Film Cap.
600B	Ballast and Integral Igniter, No Capacitor
610B	Ballast w/Welded Bracket and Integral Igniter, No Capacitor

Data is based upon tests performed by Advance Transformer in a controlled environment, and representitive of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

ADVANCE
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

08/12/04

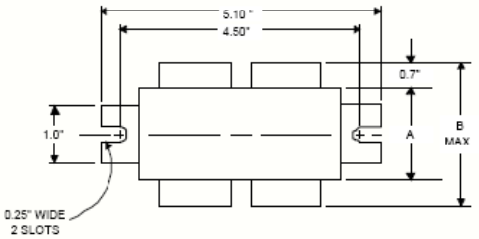
ADVANCE

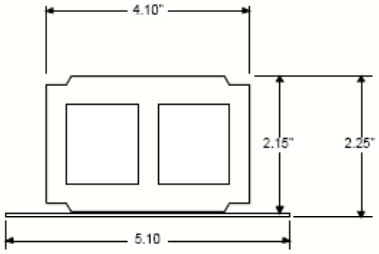
Metal Halide Lamp Ballast

Catalog Number 71A50M5
For 35/39W M130
50 Hz HX-HPF
Status: Active

DIMENSIONS AND DATA

2 X 4 CORE





INPUT VOLTS		100				
CIRCUIT TYPE	HX-HPF					
POWER FACTOR (min)	90%					
REGULATION						
Line Volts	±5%					
Lamp Watts	±10%					
LINE CURRENT (Amps)						
Operating		0.60				
Open Circuit		1.20				
Starting		0.55				
UL TEMPERATURE RATINGS						
Insulation Class	H(180°C)					
Coil Temperature Code	1029	B				
MIN. AMBIENT STARTING TEMP.	-20°F or -30°C					
NOM. OPEN CIRCUIT VOLTAGE	245					
INPUT VOLTAGE AT LAMP DROPOUT		80				
INPUT WATTS	54					
RECOMMENDED FUSE (Amps)		2				
CORE and COIL						
Dimension (A)	1.90					
Dimension (B)	2.50					
Weight (lbs.)	4					
Lead Lengths	12"					
CAPACITOR REQUIREMENT						
Microfarads	45.0					
Volts (min.)	120					
Fault Current Withstand (amps)						
60 Hz TEST PROCEDURES (Refer to Advance Test Procedure for HID Ballasts - Form 1270)						
High Potential Test (Volts)						
1 minute	2000					
2 seconds	2600					
Open Circuit Voltage Test (Volts)	225-275					
Short-Circuit Current Test (Amps)						
Secondary Current	0.45-0.55					
Input Current		0.25 0.45	-	-	-	-

Capacitor: 7C450P12

Capacitance: 45
Dia/Oval Dim: 1.75
Height: 3.75
Temp Rating: 105°C

Ignitor: LI533-H4

Ballast to Lamp Distance (BTL) = 15 feet
Temp Rating: 105°C

Wiring Diagram:

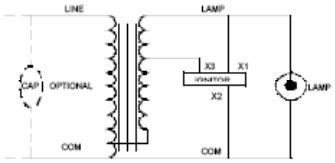


Fig.F

U.L. RECOGNIZED

Typical Ordering Information

(please call Advance for suffix availability)

Order Suffix	Description
500D.	Ballast With Ignitor and Dry Film Capacitor
510D.	Ballast w/Welded Bracket, Ignitor, & Dry Film Capacitor
600.	Ballast and Ignitor, No Capacitor
610.	Ballast with Welded Bracket and Ignitor, No Capacitor

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance.
Actual performance can vary depending on operating conditions. Specifications are subject to change without notice.

ADVANCE

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11/13/06

Appendix B

Solera® S

Solera S is a 3" thick high thermal performance translucent glazing unit designed to integrate into most
and some skylight systems

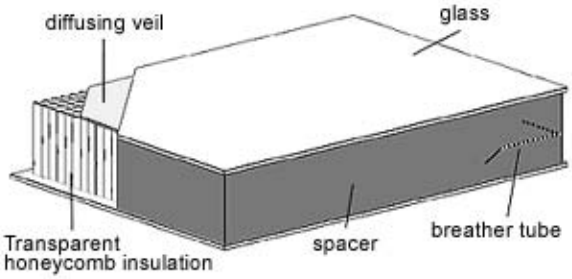
Solera S is highly configurable. The wide range of configurations allows the building designer to choose performance that is tailored exactly to his / her project. Below are som

	External Veil	Internal Veil	Light Diffusing Power	Visible Light Transmittance (VLT)	Shading coefficient (SC)	Solar Heat Gain Coefficient (SHGC)	U-Value
	401	401	Good	55%	0.61	0.51	.2
	300	401	Excellent	47%	0.52	0.44	.2
	401	300	Excellent	47%	0.52	0.44	.2
	300	300	Excellent	%40	0.44	0.37	.2
Solera S with clear glass	401	545	Excellent	34%	0.38	0.32	.2
	545	401	Excellent	32%	0.36	0.30	.2
	300	545	Excellent	30%	0.33	0.28	.2
	545	300	Excellent	28%	0.31	0.26	.2
	545	545	Excellent	21%	0.23	0.20	.2
	401	401	Good	47%	0.40	0.34	.2
	300	401	Excellent	40%	0.34	0.29	.2
	401	300	Excellent	40%	0.34	0.29	.2
	300	300	Excellent	34%	0.29	0.25	.2
Solera S with Solexia glass	401	545	Excellent	29%	0.25	0.21	.2
	545	401	Excellent	27%	0.23	0.20	.2
	300	545	Excellent	26%	0.22	0.18	.2
	545	300	Excellent	24%	0.21	0.17	.2
	545	545	Excellent	18%	0.15	0.13	.2

CONSTRUCTION/DIMENSIONS
PRODUCTS

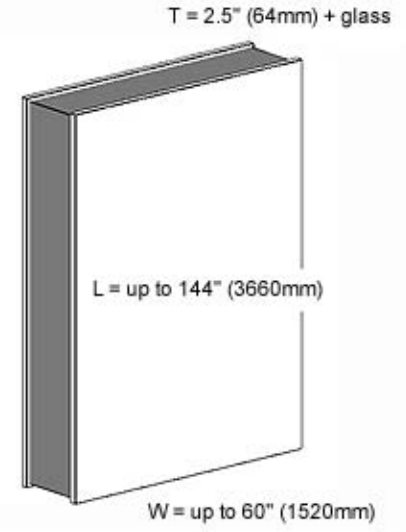
Construction

Solera glazing units consist of a transparent honeycomb insulation plus light diffusing veils sandwiched between two lites of architectural glass. An energy-efficient metal spacer and structural silicone surround the structure and a breather tube assures air pressure equilibrium.



Dimensions

Unit thickness is 2.5" (64mm) plus glass. Unit widths are available up to 5'(1.5m). Unit heights are available to 12'(3.1m) with greater heights possible on request.

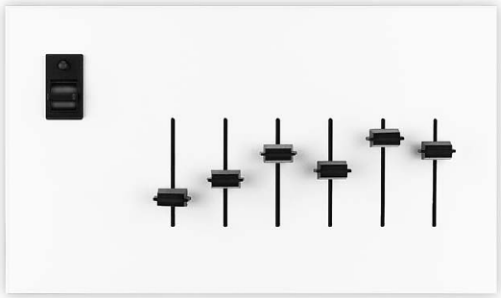


Appendix C Lighting Controls

GRAFIK Systems | Slider Control | Control Units

omxsld-1 07.09.04

GRAFIK Slider Control Unit



OMXSL-6-4G

Description

- Controls up to 12 zones of lighting.
- Allows full-range dimming using zone sliders.
- Controls virtually any light source via dimming panels.
- Mounts in a custom-designed wallbox.

Models available to:

- Control 1 to 12 zones of lighting.

Slider Control Units work with:

- GP and LP Dimming Panels

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
	OMXSL-7-4G-WH	
Job Number:		

GRAFIK Systems	Slider Control	Control Units

omxsld-2 07.09.04

Specifications

Power

- Low-voltage type Class 2 (PELV)
  Operating voltage: 32VDC.

Lighting Sources/Load Types

Controls lighting sources with a smooth, continuous Square Law dimming curve via GP and LP Dimming Panels.

Lighting Control

- Sliders provide intuitive method of controlling a local lighting space.

Key Design Features

- Meets IEC 801-2. Tested to withstand 15kV electrostatic discharge without damage or memory loss.
- Power failure memory automatically restores lighting to the level selected prior to power interruption.
- Faceplate snaps on with no visible means of attachment.

System Communications and Capacities

- Low-voltage type Class 2 (PELV) wiring connects Control Units to other system components.
- The Slider Control Unit counts as one of 32 maximum Wallstations and/or Control Interfaces allowed on a Class 2 (PELV) Wallstation Link.

Environment

- 32-104°F (0-40°C). Relative humidity less than 90% non-condensing.

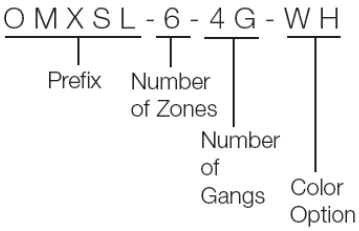
LUTRON® SPECIFICATION SUBMITTAL Page 2

Job Name:	Model Numbers:	
	OMXSL-7-4G-WH	
Job Number:		

GRAFIK Systems | Slider Control | Control Units

omxsld-3 07.09.04

How to Build a Model Number



Prefix:

OMXSL for GRAFIK Slider Control Units

Number of Zones:

1,2,3,4,5,6,7,8,9,10,11, or 12

Number of Gangs:

Indicates number of wallbox gangs required for installation. Example: 4G = 4 gangs.

Color Option:

Architectural Matte Finishes

White	WH
Ivory	IV
Beige	BE
Gray	GR
Brown	BR
Black	BL

Architectural Metal Finishes

Bright Brass	BB
Bright Chrome	BC
Satin Brass	SB

Model Numbers

Number of Zones	Model Number
1	OMXSL-1-1G-__
2	OMXSL-2-2G-__
3	OMXSL-3-2G-__
4	OMXSL-4-3G-__
5	OMXSL-5-3G-__
6	OMXSL-6-4G-__
7	OMXSL-7-4G-__
8	OMXSL-8-5G-__
9	OMXSL-9-5G-__
10	OMXSL-10-6G-__
11	OMXSL-11-6G-__
12	OMXSL-12-7G-__

LUTRON SPECIFICATION SUBMITTAL Page 3

Job Name:	Model Numbers:	
	OMXSL-7-4G-WH	
Job Number:		

GRAFIK Systems | Slider Control | Control Units

omxsld 4 07.09.04

Dimensions

Model Number	Wallbox Size	Width	Height	Depth[1]
OMXSL-1-1G-__	Single-gang	2.31" (59mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-2-2G-__	Two-gang	4.13" (105mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-3-2G-__	Two-gang	4.13" (105mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-4-3G-__	Three-gang	5.94" (151mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-5-3G-__	Three-gang	5.94" (151mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-6-4G-__	Four-gang	7.88" (200mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-7-4G-__	Four-gang	7.88" (200mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-8-5G-__	Five-gang	9.56" (243mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-9-5G-__	Five-gang	9.56" (243mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-10-6G-__	Six-gang	11.38" (289mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-11-6G-__	Six-gang	11.38" (289mm)	4.06" (103mm)	3.00" (76mm)
OMXSL-12-7G-__	Seven-gang	13.19" (335mm)	4.06" (103mm)	3.00" (76mm)

[1] Depth includes wallplate and backbox. Wallplate depth is 0.25" (6.35mm)

LUTRON SPECIFICATION SUBMITTAL Page 4

Job Name:	Model Numbers:	
	OMXSL-7-4G-WH	
Job Number:		

GRAFIK Systems	OMX-4600	Preset Dimming Controls

4600-1 04.05.04

OMX-4600 Control Unit

Cover (shown open)

Description

- Used with GRAFIK 5000/6000/7000 lighting control systems.
- Supplies dimming for up to 24 zones of lighting[1].
- Provides pushbutton recall of four preset lighting scenes, plus Off.
- Controls virtually any light source via dimming and switching panels.
- Provides lockout options to prevent accidental changes.
- Includes built-in infrared receiver for operation with an optional remote control.

Models available to:

- Control two to 24 zones of lighting[1].

[1] OMX-4600 Control Unit zones count towards the maximum number of zones allowed in GRAFIK 5000/6000/7000 Systems.

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
	OMX-4624-A-WH	
Job Number:		

GRAFIK Systems	OMX-4600	Preset Dimming Controls

4600-2 04.05.04

Specifications

Power

- Low-voltage type Class 2 (PELV)
  Operating voltage: 32 V Direct Current.

Lighting Sources/Load Types

Controls lighting sources with a smooth, continuous Square Law dimming curve or on a full conduction non-dim basis via GP and LP Dimming Panels and XP Softswitch™ Panels.

Preset Control

- 4 preset lighting scenes and off are accessible from the Control Unit front panel.
- Additional scenes are stored in Processor Panel. These scenes are accessible via Wallstations, Control Interfaces, and/or PC.
- Light levels fade smoothly between scenes. Fade time can be set differently for each scene, between 0-59 sec. or 1-60 min. Fade time from Off is capped at 5 sec. Fade time can be set differently for each zone through the Processor.

Key Design Features

- Meets IEC 801-2. Tested to withstand 15kV electrostatic discharge without damage or memory loss.
- Power failure memory automatically restores lighting to the scene selected prior to power interruption.
- Faceplate snaps on with no visible means of attachment.

System Communications and Capacities

- Low-voltage type Class 2 (PELV) wiring connects Control Units to other system components.
- The OMX-4600 Control Unit counts as one of 32 maximum Wallstations and/or Control Interfaces allowed on a Class 2 (PELV) Wallstation Link.

Environment

- 32-104°F (0-40°C). Relative humidity less than 90% non-condensing.

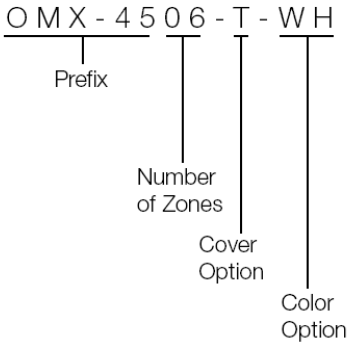
LUTRON® SPECIFICATION SUBMITTAL Page 2

Job Name:	Model Numbers:	
	OMX-4624-A-WH	
Job Number:		

GRAFIK Systems | OMX-4600 | Preset Dimming Controls

4600-3 04.05.04

How to Build a Model Number



Prefix:

OMX for Control Units used with GRAFIK 5000/6000/7000 systems.

Number of Zones:

2, 3, 4, 6, 8, 16, or 24

Cover Option:

A for Opaque
T for Translucent Black

Color Option:

See Color Options list

Cover Options

Opaque A
Cover and Base will match.

Translucent Black T
Black Cover and choice of Base color.

Also available:
- Custom controls
- Color matching
- Engraving

These options ship in 4 to 6 weeks.

Color Options

Architectural Matte Finishes
Standard – Ship in 48 hours
Cover Option: A or T

White	WH
Ivory	IV
Beige	BE
Gray	GR
Brown	BR
Black	BL

Designer Gloss Finishes
Ship in 4 to 6 weeks
Cover Option: A only

White	GWH
Ivory	GIV
Light Almond	GLA
Almond	GAL

Satin Color Matte Finishes
Cover Option: A or T

Hot	HT
Ochre	OC
Terracotta	TC
Desert Stone	DS
Stone	ST
Limestone	LS
Blue Mist	BT
Midnight	MN
Taupe	TP
Biscuit	BI
Eggshell	ES
Snow	SW

Architectural Metal Finishes
Cover Option: T only

Bright Brass	BB
Bright Chrome	BC
Bright Nickel	BN
Satin Brass	SB
Satin Chrome	SC
Satin Nickel	SN
Antique Brass	QB
Antique Bronze	QZ

Anodized Aluminum Finishes
Cover Option: T only

Clear	CLA
Black	BLA
Brass	BRA
Bronze	BZA

Model Numbers

Number of Zones	Standard Setup
2	OMX-4602-_-__
3	OMX-4603-_-__
4	OMX-4604-_-__
6	OMX-4606-_-__
8	OMX-4608-_-__
16	OMX-4616-_-__
24	OMX-4624-_-__

LUTRON® SPECIFICATION SUBMITTAL Page 3

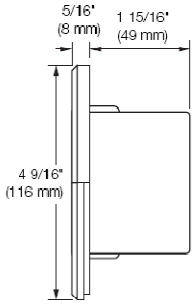
Job Name:	Model Numbers:	
	OMX-4624-A-WH	
Job Number:		

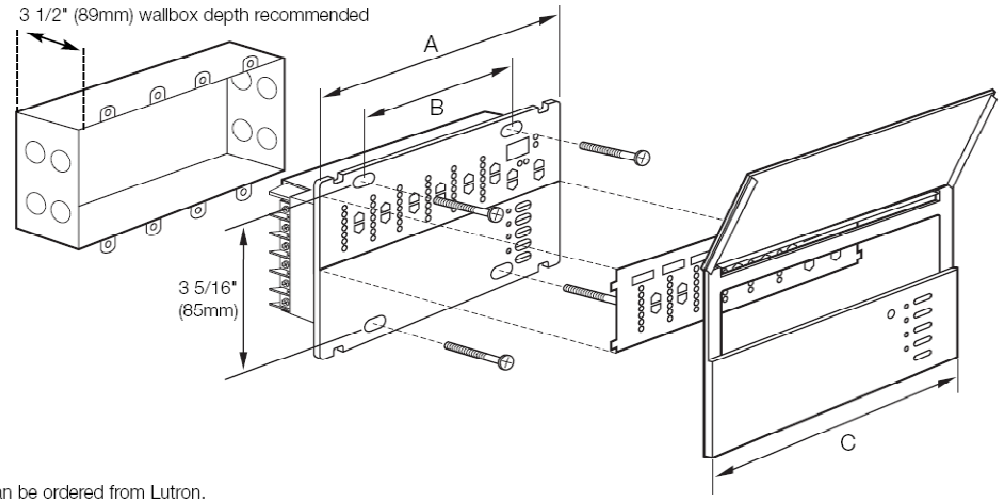
GRAFIK Systems	OMX-4600	Preset Dimming Controls

4600-4 04.05.04

Dimensions and Mounting

Model	Side View	A	B	C	Wallbox[1] U.S. Size	Depth
2-Zone: OMX-4602		4 5/16" (123mm)	1 13/16" (46mm)	5.56" (141mm)	2 Gang	3.5" (89mm)
3-Zone: OMX-4603		6 11/16" (168mm)	3 5/8" (92mm)	7.25" (184mm)	3 Gang	3.5" (89mm)
4-Zone: OMX-4604		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)
6-Zone: OMX-4606		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)
8-Zone: OMX-4608		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)
16-Zone: OMX-4616		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)
24-Zone: OMX-4624		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)





[1] Can be ordered from Lutron.

LUTRON® SPECIFICATION SUBMITTAL Page 4

Job Name:	Model Numbers:	
	OMX-4624-A-WH	
Job Number:		

Appendix D

Virginia Electric and Power Company
N:\Rates\Retail Rate Schedules\Virginia Jurisdictional\Currently Approved\Rate Schedules\Bundled\SchGS3

Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

I. APPLICABILITY

A. Except as modified herein, this schedule is applicable only to a non-residential secondary voltage Customer (as defined in Paragraph XI.) who elects to receive Electricity Supply Service and Electric Delivery Service from the Company and whose peak measured demand has reached or exceeded 500 kW during at least three billing months within the current and previous 11 billing months.

B. For a Customer served under this schedule whose peak measured demand has decreased to less than 500 kW, this schedule shall remain applicable to the Customer and the Customer shall not have the option to purchase electricity under Schedule GS-1, GS-2 or GS-2T until such time the maximum measured demand has remained at less than 500 kW during all billing months within the current and previous 11 billing months.

C. Notwithstanding any other provisions of this schedule, if a Customer: (1) received or was eligible to receive service under this schedule during the preceding 24 months; (2) installed and began operating bona fide automated load management equipment or high-efficiency equipment which replaces standard-efficiency equipment; and (3) is currently ineligible for service under Paragraphs I.A. and I.B. because of the installation and operation of such equipment, then the customer shall be eligible for service under this schedule. Once service is provided under this Paragraph I.C., service may continue to be supplied under this schedule only so long as the Customer regularly operates such equipment in a bona fide manner. The type and design of such equipment must be approved by the Company and the equipment shall be subject to inspection by the Company.

D. At such time the Customer no longer meets the above applicability requirements, the Customer will remain on this schedule for the period (not exceeding two additional billing months) required to achieve an orderly transfer to the applicable schedule.

E. For new service, this schedule is applicable when the anticipated kW demand meets the criteria of Paragraph I.A., above.

(Continued)

Filed 06-28-07
Electric-Virginia

Superseding Filing Effective For Usage On and After 01-01-04. This Filing Effective For Usage On and After 07-01-07.

Virginia Electric and Power Company
N:\Rates\Retail Rate Schedules\Virginia Jurisdictional\Currently Approved\Rate Schedules\Bundled\SchGS3

Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

II. 30-DAY RATE

A. Distribution Service Charges

1. Basic Customer Charge
Basic Customer Charge $119.80 per billing month.

2. Plus Distribution Demand Charge
All kW of Distribution Demand @ $2.120 per kW

3. Plus rkVA Demand Charge @ $0.15 per rkVA

B. Electricity Supply Service Charges

1. On-Peak Electricity Supply Demand Charge
All On-Peak kW @ $12.154 per kW

2. Plus Off-Peak Electricity Supply Demand Charge
All Off-Peak kW @ $0.656 per kW

3. Plus Electricity Supply Adjustment Demand Charge
All kW of Demand @ ($0.640) per kW

4. Plus Electricity Supply kWh Charge
All On-peak kWh @ 0.404¢ per kWh
All Off-peak kWh @ 0.272¢ per kWh

5. Each Electricity Supply kilowatthours used are subject to Fuel Charge Rider A.

C. The minimum charge shall be as may be contracted for.

(Continued)

Filed 06-28-07
Electric-Virginia

Superseding Filing Effective For Usage On and After 01-01-04. This Filing Effective For Usage On and After 07-01-07.

Virginia Electric and Power Company
N:\Rates\Retail Rate Schedules\Virginia Jurisdictional\Currently Approved\Rate Schedules\Bundled\SchGS3

Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

(Continued)

III. DETERMINATION OF ON-PEAK AND OFF-PEAK HOURS

The following on-peak and off-peak hours are applicable to the billing of all charges stated in this schedule.

A. On-peak hours are as follows:

1. For the period of June 1 through September 30, 10 a.m. to 10 p.m., Mondays through Fridays.

2. For the period of October 1 through May 31, 7 a.m. to 10 p.m., Mondays through Fridays.

B. All hours not specified in III.A. are off-peak.

IV. DETERMINATION OF DISTRIBUTION DEMAND

A. The Distribution Demand billed under Paragraph II.A.2. shall be such as may be contracted for but not less than the highest of:

1. The highest average kW measured at the location during any 30-minute interval of the current and previous 11 billing months.

2. 500 kW.

B. When the Customer's power factor is less than 85 percent, a minimum Distribution Demand of not less than 85 percent of the Customer's maximum kVA demand may be established.

V. DETERMINATION OF rkVA DEMAND

The rkVA of demand billed shall be the highest average rkVA measured in any 30-minute interval during the current billing month.

(Continued)

Filed 06-28-07
Electric-Virginia

Superseding Filing Effective For Usage On and After 01-01-04. This Filing Effective For Usage On and After 07-01-07.

Virginia Electric and Power Company
N:\Rates\Retail Rate Schedules\Virginia Jurisdictional\Currently Approved\Rate Schedules\Bundled\SchGS3

Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

(Continued)

VI. DETERMINATION OF ON-PEAK ELECTRICITY SUPPLY DEMAND

The kW of demand billed under II.B.1. shall be the highest of:

A. The highest average kW measured in any 30-minute interval of the current billing month during on-peak hours.

B. Seventy-five percent of the highest kW of demand at this location as determined under VI.A., above, during the billing months of June through September of the preceding 11 billing months.

C. 100 kW.

VII. DETERMINATION OF OFF-PEAK ELECTRICITY SUPPLY DEMAND

The kW of demand billed under Paragraph II.B.2. shall be the off-peak demand which is in excess of 90% of the On-Peak Electricity Supply Demand determined under Paragraph VI.

VIII. DETERMINATION OF ELECTRICITY SUPPLY ADJUSTMENT DEMAND

This credit is required in order to achieve customer bill neutrality, arising from changes to the Distribution Demand Charge while maintaining the overall capped rates. The kW of demand billed under Paragraph II.B.3. shall be the Distribution Demand determined under Paragraph IV.

IX. METER READING AND BILLING

When the actual number of days between meter readings is more or less than 30 days, the Basic Customer Charge, the Distribution Demand Charge, the rkVA Demand Charge, the On-Peak Electricity Supply Demand Charge, the Off-Peak Electricity Supply Demand Charge, the Electricity Supply Adjustment Demand Charge, and the minimum charge of the 30-day rate will each be multiplied by the actual number of days in the billing period and divided by 30.

(Continued)

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Superseding Filing Effective For Usage On and After 01-01-04. This Filing Effective For Usage On and After 07-01-07.

Virginia Electric and Power Company
N:\Rates\Retail Rate Schedules\Virginia Jurisdictional\Currently Approved\Rate Schedules\Bundled\SchGS3

Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

(Continued)

X. STANDBY, MAINTENANCE OR PARALLEL OPERATION SERVICE

A Customer requiring standby, maintenance or parallel operation service may elect service under this schedule provided the Customer contracts for the maximum kW which the Company is to supply. Standby, maintenance or parallel operation service is subject to the following provisions:

A. Suitable relays and protective apparatus shall be furnished, installed, and maintained at the Customer's expense in accordance with specifications furnished by the Company. The relays and protective equipment shall be subject, at all reasonable times, to inspection by the Company's authorized representative.

B. In case the Distribution Demand determined under Paragraph IV. exceeds the contract demand, the contract demand shall be increased by such excess demand.

C. The demand billed under II.A.2. and II.B.3. shall be the contract demand.

XI. DEFINITION OF TRANSMISSION, PRIMARY AND SECONDARY VOLTAGE CUSTOMER

A. A transmission voltage Customer is any Customer whose delivery voltage is 69 kV or above.

B. A primary voltage Customer is any Customer (a) served from a circuit of 69 kV or more where the delivery voltage is 4,000 volts or more, (b) served from a circuit of less than 69 kV where Company-owned transformation is not required at the Customer's site, (c) where Company-owned transformation has become necessary at the Customer's site because the Company has changed the voltage of the circuit from that originally supplied, or (d) at a location served prior to October 27, 1992 where the Customer's connection to the Company's facilities is made at 2,000 volts or more.

C. A secondary voltage Customer is any Customer not defined in XI.A. or XI.B. as a transmission or primary voltage Customer.

(Continued)

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Electric-Virginia

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Schedule GS-3
LARGE GENERAL SERVICE
SECONDARY VOLTAGE

(Continued)

XII. TERM OF CONTRACT

The contract shall be open order unless (a) standby, maintenance or parallel operation service is provided, or (b) the Customer or the Company requests a written contract. In such cases, the term of contract for the purchase of electricity under this schedule shall be as mutually agreed upon, but for not less than one year. During the minimum term of applicability, the Customer may be billed under the corresponding Unbundled Rate Schedule, Schedule GS-3U, if applicable.

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Appendix E

bp solar

BP 5170

170-Watt High-Efficiency
Monocrystalline Photovoltaic Modules

The BP 5170 photovoltaic module uses the world's leading commercial laser cell processing technology to produce volume-manufactured photovoltaics with exceptional efficiency. Its premium laser-grooved buried grid monocrystalline cells and large module area provide a premium power performance of 170 watts nominal maximum power and 24 volts of nominal output, providing more power than any other BP Solar module. Powering DC loads or, with an inverter, AC loads, its high efficiency is particularly suited for applications that need maximum energy generation from a limited array area, and for climates with poor insolation. Applications include utility grid-connected residential and commercial roof systems, building facades, distributed generation systems, telecommunication systems, and other arrays requiring high energy density.

Available versions include:
BP 5170S – Framed module with rugged clear-anodized frame;
BP 5170L – Unframed laminate version of the BP 5170S.

Proven Materials and Construction

BP Solar's quarter-century of field experience shows in every aspect of these modules' construction and materials:

- Frame strength exceeds requirements of certifying agencies;
- Laser patterning and processing minimizes cell front shading, maximizes efficiency;
- 72 high-efficiency monocrystalline cells laminated between sheets of ethylene vinyl acetate (EVA) and high-transmissivity low-iron 3mm tempered glass;
- Integral bypass diodes;
- Asymmetrical cables enable side-by-side or end-to-end module placement in arrays
- DC-rated plug-and-socket connectors provide reliable low-resistance connections and eliminate wiring errors.

DC Connectors

Limited Warranties

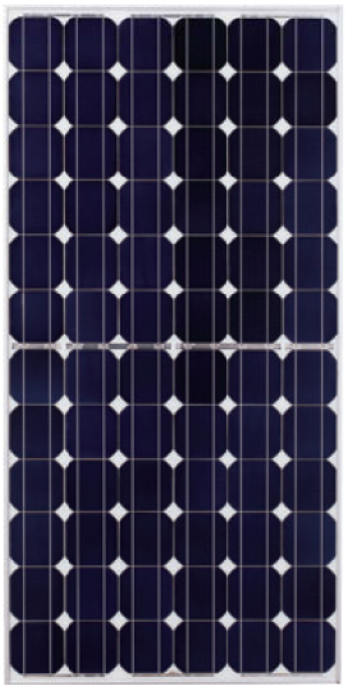
- Power output for 25 years;
- Freedom from defects in materials and workmanship for 5 years.

See our website or your local representative for full terms of these warranties.

Clear Anodized Universal Frame

Quality and Safety

- Manufactured in ISO 9001-certified factories;
- Conforms to Directives 89/336/EEC, 73/23/EEC and 93/68/EEC of the European Community;
- BP 5170S is listed by Underwriter's Laboratories for electrical and fire safety (Class C fire rating);
- BP 5170S is certified by TÜV Rheinland as Class II equipment;
- BP 5170S complies with the requirements of IEC 61215, including:
  - repetitive cycling between -40°C and 85°C at 85% relative humidity;
  - simulated impact of 25mm (one-inch) hail at terminal velocity;
  - a "hot-spot" test, which determines a module's ability to tolerate localized shadowing (which can cause reverse-biased operation and localized heating);
  - static loading, front and back, of 2400 pascals (50 psf); front loading (e.g. snow) of 5400 pascals (113 psf).
- The BP 5170L is recognized by Underwriter's Laboratories for electrical and fire safety.



BP 5170S

01-3004-3B 6/02

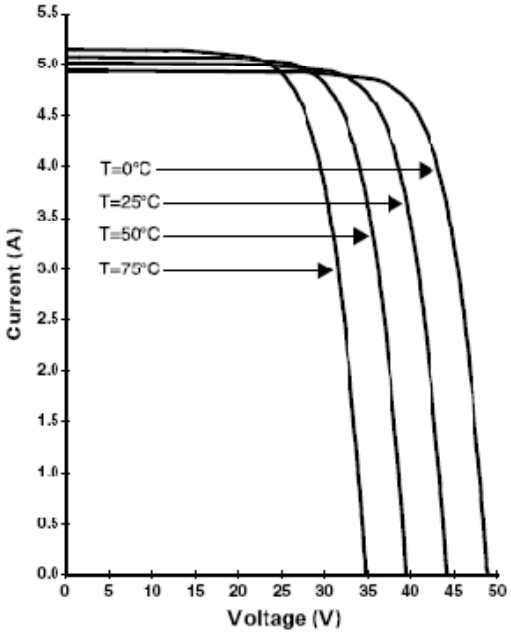
Electrical Characteristics[1]

	BP 5170	BP 5160[4]
Maximum power (P_{max})[3]	170W	160W
Voltage at P_{max} (V_{mp})	36.0V	36.0V
Current at P_{max} (I_{mp})	4.72A	4.44A
Warranted minimum P_{max}	161.5W	152W
Short-circuit current (I_{sc})	5.0A	4.7A
Open-circuit voltage (V_{oc})	44.2V	44.0V
Temperature coefficient of I_{sc}	(0.065±0.015)%/°C	
Temperature coefficient of V_{oc}	-(160±10)mV/°C	
Temperature coefficient of power	-(0.5±0.05)%/°C	
NOCT[2]	47±2°C	
Maximum series fuse rating	15A	
Maximum system voltage	600V (U.S. NEC rating) 1000V (TÜV Rheinland rating)	

Notes

1. These data represent the performance of typical BP 5160 and BP 5170 modules and laminates as measured at their output terminals. The data are based on measurements made in accordance with ASTM E1036 corrected to SRC (Standard Reporting Conditions, also known as STC or Standard Test Conditions), which are:
   - illumination of 1 kW/m² (1 sun) at spectral distribution of AM 1.5 (ASTM E892 global spectral irradiance);
   - cell temperature of 25°C.
2. The cells in an illuminated module operate hotter than the ambient temperature. NOCT (Nominal Operating Cell Temperature) is an indicator of this temperature differential, and is the cell temperature under Standard Operating Conditions: ambient temperature of 20°C, solar irradiation of 0.8 kW/m², and wind speed of 1m/s.
3. During the stabilization process which occurs during the first few months of deployment, module power may decrease approximately 3% from typical P_{max}.
4. The power of solar cells varies in the normal course of production; the BP 5160 is assembled using cells of slightly lower power than the BP 5170.

BP 5170 I-V Curves

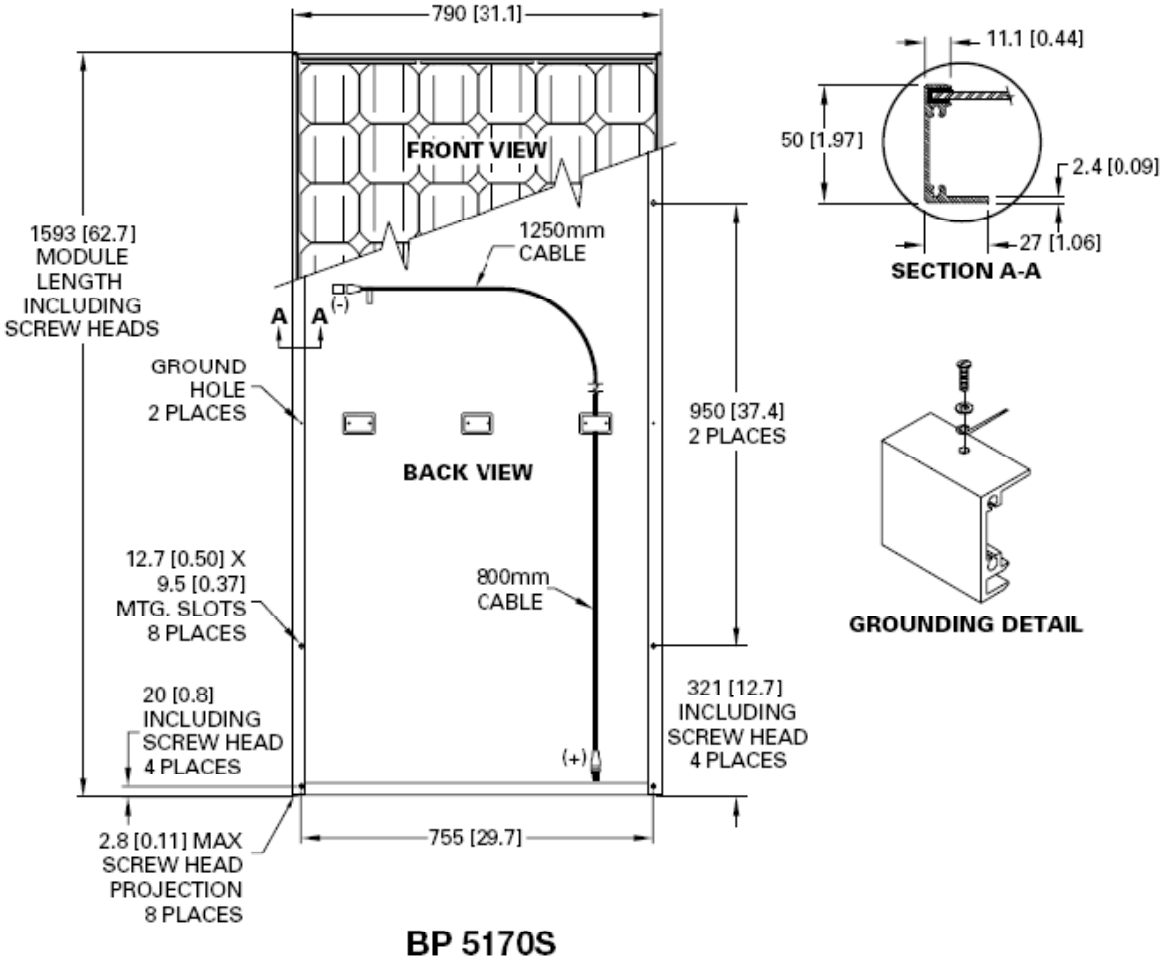


Mechanical Characteristics

Weight
BP 5170S 15.0 kg (33.1 pounds)
BP 5170L 12.4 kg (27.3 pounds)

Output
Asymmetrical RHW AWG# 12 (3.3mm²)
2-conductor cable with weatherproof polarized connectors

Dimensions
BP 5170S: See drawing
BP 5170L: 1580 [62.2] x 783 [30.8] x 19 [0.75]
Unbracketed dimensions are in millimeters.
Bracketed dimensions are in inches.
Overall tolerances ±3mm (1/8")



BP 5170S

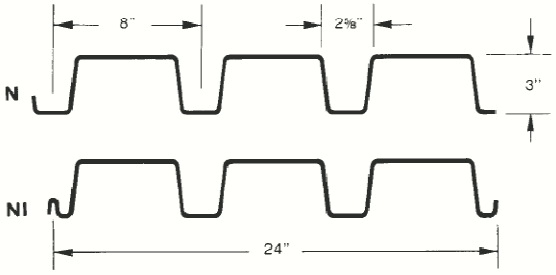
Appendix F

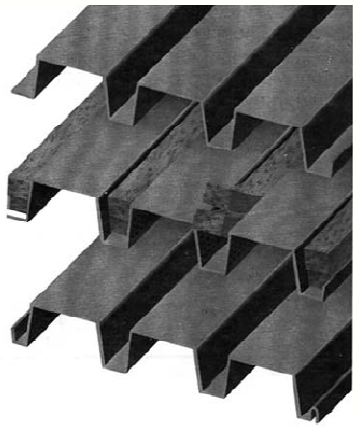
VULCRAFT

3 N, NI, NA, NIA

ROOF

Maximum Sheet Length 42'-0
Extra Charge for Lengths Under 6'-0
ICBO Approved (No.3415)





SECTION PROPERTIES

Deck Type	Design Thick.	Weight (PSF) Ptd.	Galv.	I in^4/ft	Sp in^3/ft	Sn in^3/ft	Fy KSI
N22	0.0295	2.16	2.26	0.772	0.382	0.433	33
N21	0.0329	2.40	2.50	0.876	0.445	0.497	33
N20	0.0358	2.61	2.71	0.964	0.501	0.552	33
N19	0.0418	3.05	3.15	1.153	0.597	0.659	33
N18	0.0474	3.46	3.56	1.334	0.688	0.749	33
N16	0.0598	4.36	4.46	1.745	0.893	0.944	33

ACOUSTICAL INFORMATION

Deck Type	Absorption Coefficient 125	250	500	1000	2000	4000	Noise Reduction Coefficient*
3NA, 3NIA	.14	.36	.89	.95	.53	.34	.70

* Source: Riverbank Acoustical Laboratories — RAL™ A95–21.
Test was conducted with 3 inches of 1.65 pcf fiberglass insulation on 3 inch EPS Plaza deck for the SDI.

Acoustical deck (Type 3 NA, NIA) is paticularly suitable in structures such as auditoriums, schools and theaters where sound control is desirable. Acoutstic perforations are located in the vertical webs where the load carrying properties are negligibly affected (less than 5%).

Inert, non-organic glass fiber sound absorbing batts are placed in the rib openings to absorb up to 70% of the sound striking the deck.

Batts are field installed and may require separation.

VERTICAL LOADS FOR TYPE 3N

No. of Spans	Deck Type	Max. SDI Const. Span	Allowable Total (Dead + Live) Uniform Load (PSF) Span (ft.-in.) C. to C. of Support 10'-0	10'-6	11'-0	11'-6	12'-0	12'-6	13'-0	13'-6	14'-0	14'-6	15'-0
1	N22	11'-7	51	46	42	38	35	32	30	28	26	24	23
	N21	12'-5	59	53	47	43	39	36	33	30	28	26	25
	N20	13'-2	66	58	52	47	42	38	35	33	30	28	26
	N19	14'-7	79	69	61	55	50	45	41	38	35	32	30
	N18	15'-11	91	80	71	63	57	52	47	43	40	37	34
	N16	18'-6	119	105	93	83	74	66	60	55	50	46	43
2	N22	14'-9	58	52	48	44	40	37	34	32	29	27	26
	N21	15'-9	66	60	55	50	46	42	39	36	34	32	29
	N20	16'-6	74	67	61	56	51	47	44	40	38	35	33
	N19	18'-1	88	80	73	66	61	56	52	48	45	42	39
	N18	19'-5	100	91	83	76	69	64	59	55	51	47	44
	N16	22'-3	126	114	104	95	87	81	74	69	64	60	56
3	N22	14'-9	70	65	60	55	50	46	43	40	37		
	N21	15'-9	83	75	68	63	58	53	49	45	42		
	N20	16'-6	92	83	76	70	64	59	54	50	47		
	N19	18'-1	110	100	91	83	76	70	65	60	56		
	N18	19'-5	125	113	103	94	87	80	74	68	64		
	N16	22'-3	157	143	130	119	109	101	93	86	80		

Notes: 1. Load tables are calculated using sectional properties based on the steel design thickness shown in the Steel Deck Institute (SDI) Design Manual.
2. Loads shown in the shaded areas are governed by the live load deflection not in excess of 1/240 of the span. A dead load of 10 PSF has been included.
3. 3N, NI, NA, NIA are not covered under Factory Mutual.

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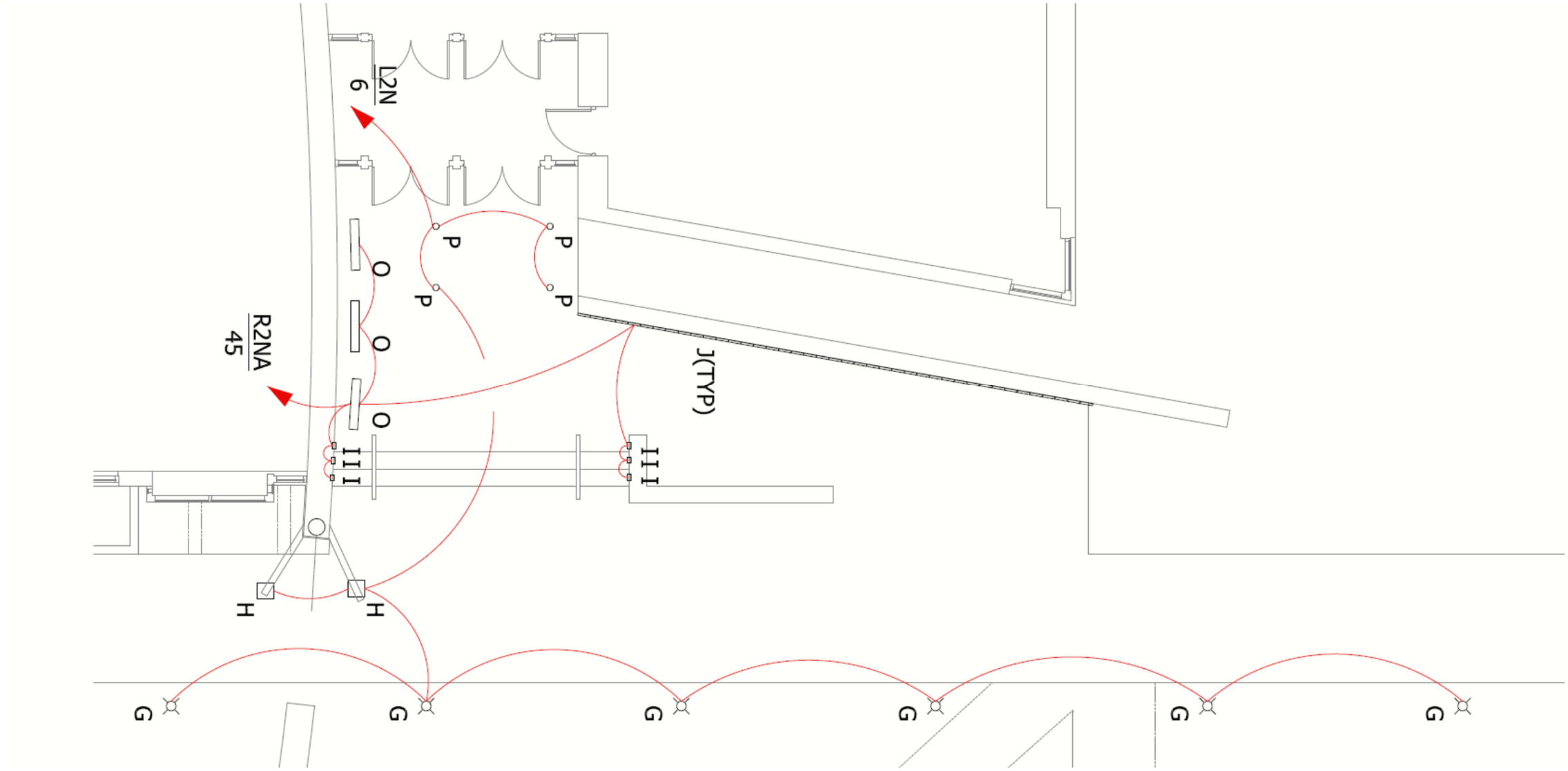
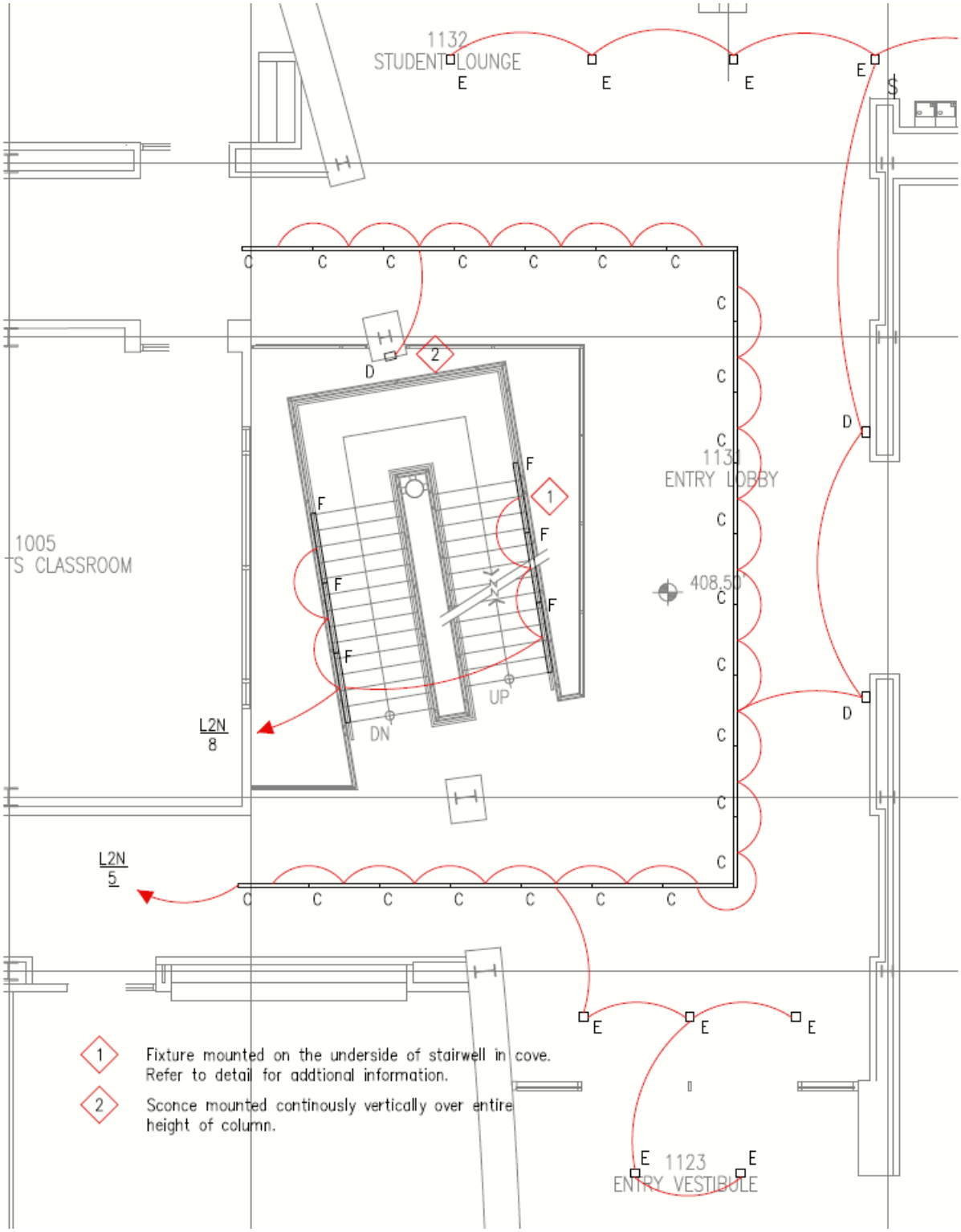
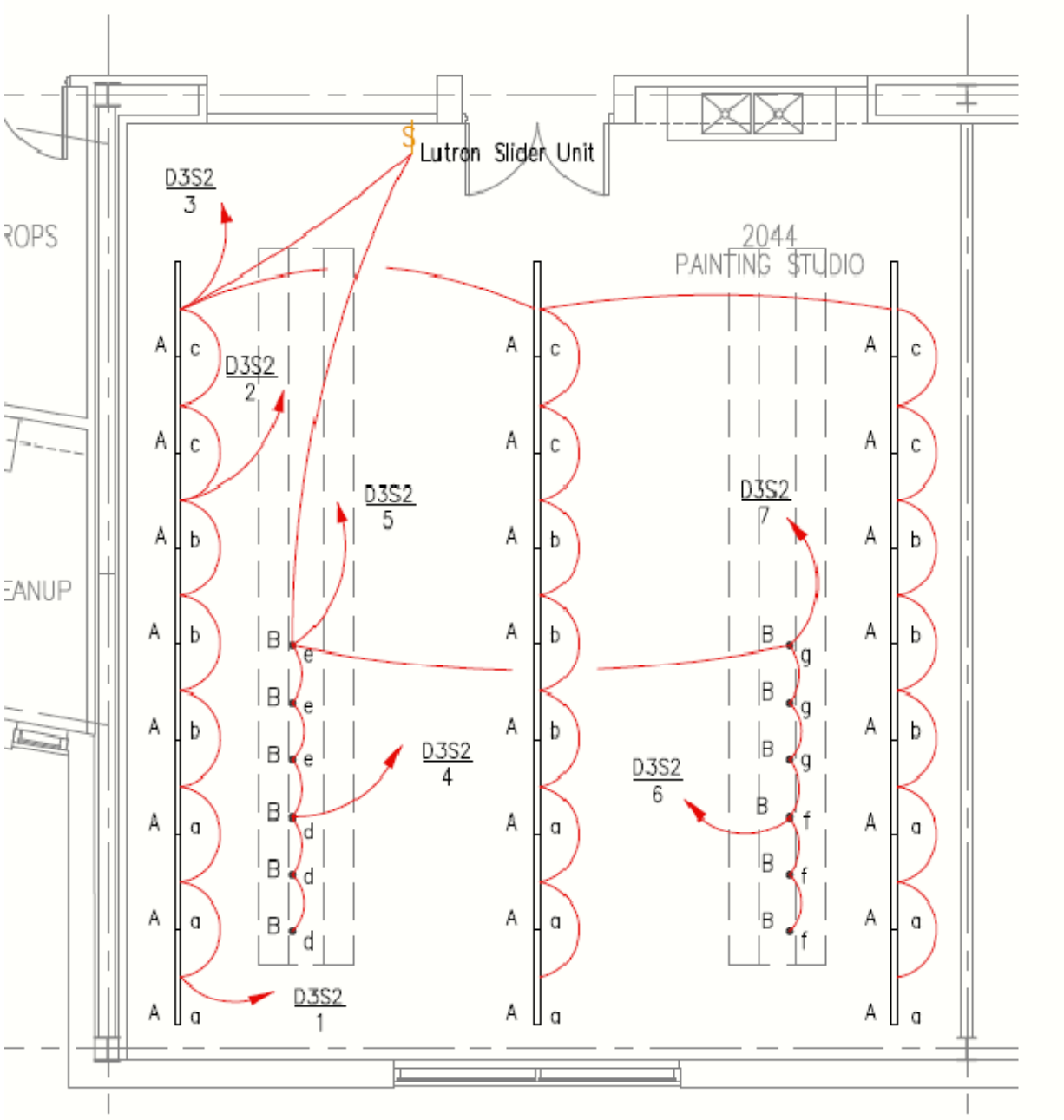
Appendix G Main Entrance Courtyard Plan

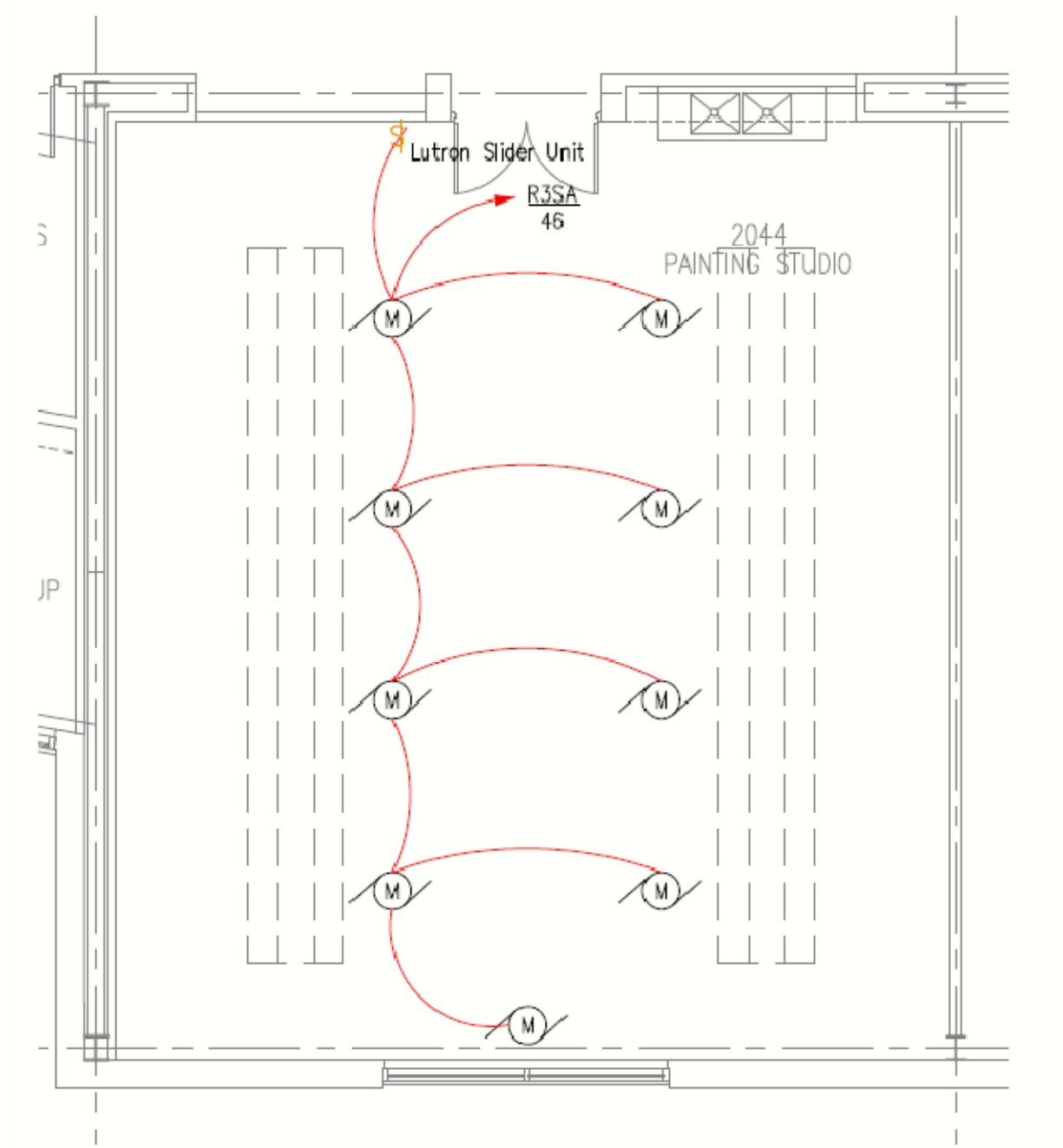


Appendix H Lobby Plan



Appendix I Typical Painting Studio




Lutron Slider Unit
R3SA
46
2044
PAINTING STUDIO
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Appendix J Typical Painting Studio