LIGHTING DESIGN

PRIMARY PRINCIPLES

During the redesign of the lighting system, there were three (3) underlining concepts that influenced the design.

The first concept was to get the right amount of light to the task while avoiding glare and maintaining quality lighting. The placement of luminaires were determined by the located of permanent equipment and flow of movement throughout the space. Lighting levels were determined by IESNA Lighting Handbook 9th Edition.

The second concept was to use energy efficient luminaires / systems. The primary candidate for this concept will be fluorescent fixtures. Controls were a important part of the design of the lighting system. Often, energy is wasted by active luminaires in unoccupied rooms. Power densities were coordinated with ASHRAE 90.1 2004.

The final concept was the use of sustainable design practices. Daylight harvesting was a important factor in the initial design of the building and it will continue to be used in this redesigned system.

This report will only cover the in-depth study of four (4) spaces. These spaces are:

- Exterior / Landscape
- Gallery
- Dean's Office
- Studio

The photometric data, analysis and lighting layouts of all other spaces can be found in the supplement sheet set located at www.arche.psu.edu/thesis/eportfolio/2007/portfolios/knd107.

LIGHTING DESIGN

EXTERIOR / LANDSCAPE

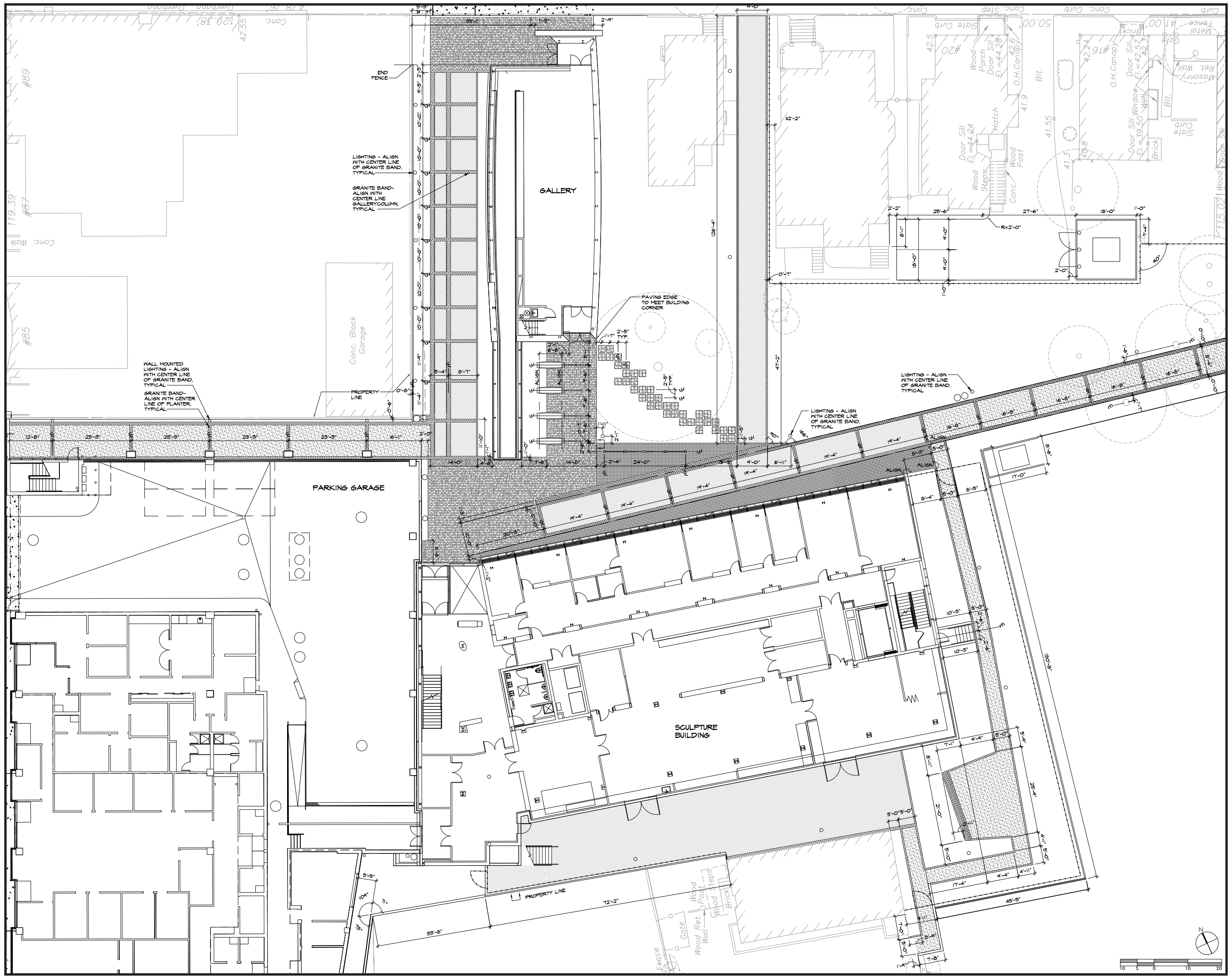
The exterior / landscape connects the residential area to the University campus. The lighting design of this space was determined by LEED 2.2 Sustainable Sites Credit 8.0 Light Pollution. The design complies with this requirement with the use of full cut-off luminaires that operates on a timer / motion sensor combination. The landscape will also house / display student works. Due to weather constraints, a custom luminaire housing was designed to protect both fixtures and sculptures alike.

DESIGN CRITERIA

ILLUMINANCE (Horizontal and Vertical)	30 lux or 3 fc for both horizontal and vertical illuminances
DIRECT / REFLECTED GLARE	Provide a comfortable environment for pedestrian traffic
PUBLIC SAFETY	Ample light levels for facial recognition and traveling path
LIGHTING POLLUTION / TRESPASS	LEED SS Credit 8.0 - Preserve the environment
LIGHT DISTRIBUTION	Even distribution on paths and higher at points of interest

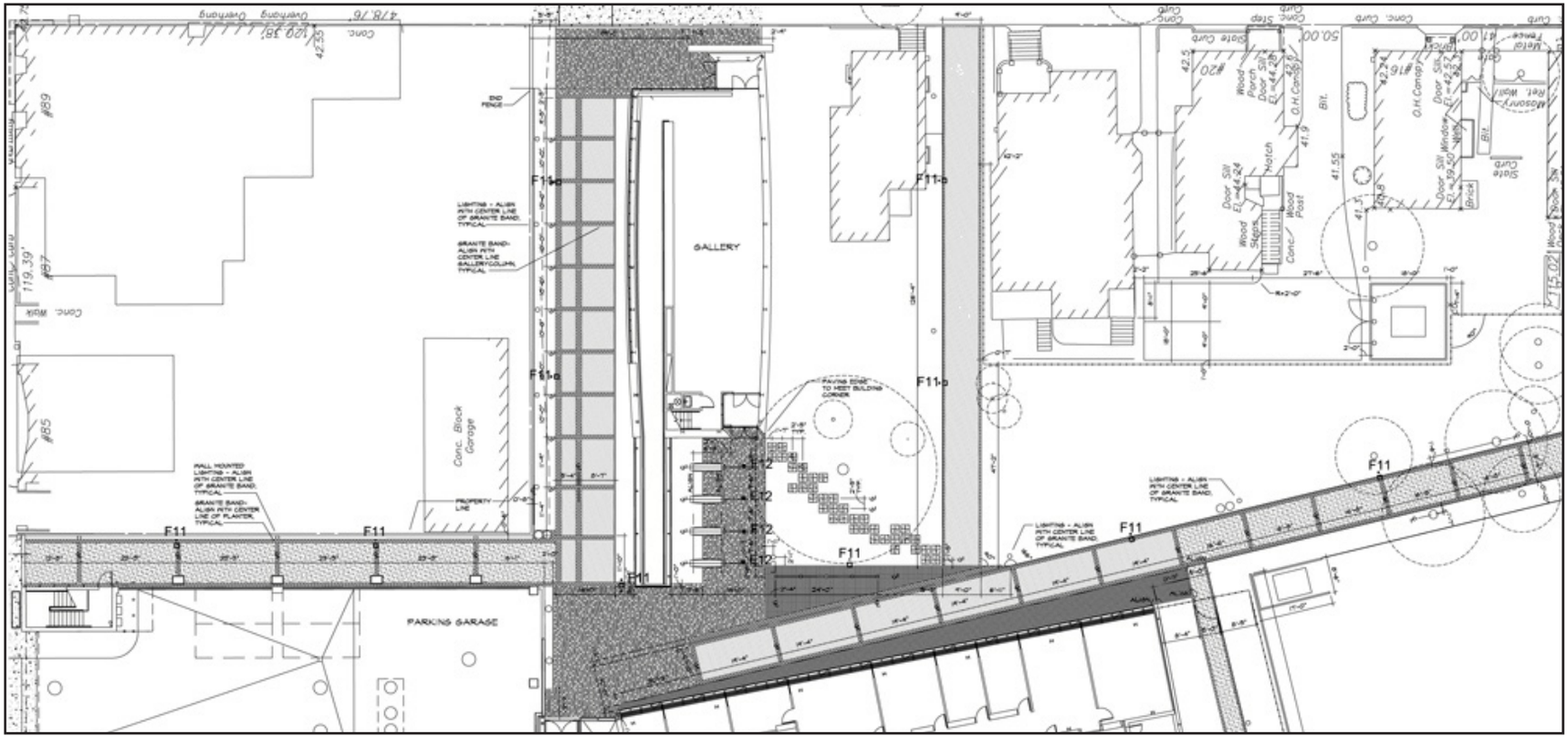
SURFACE REFLECTANCE

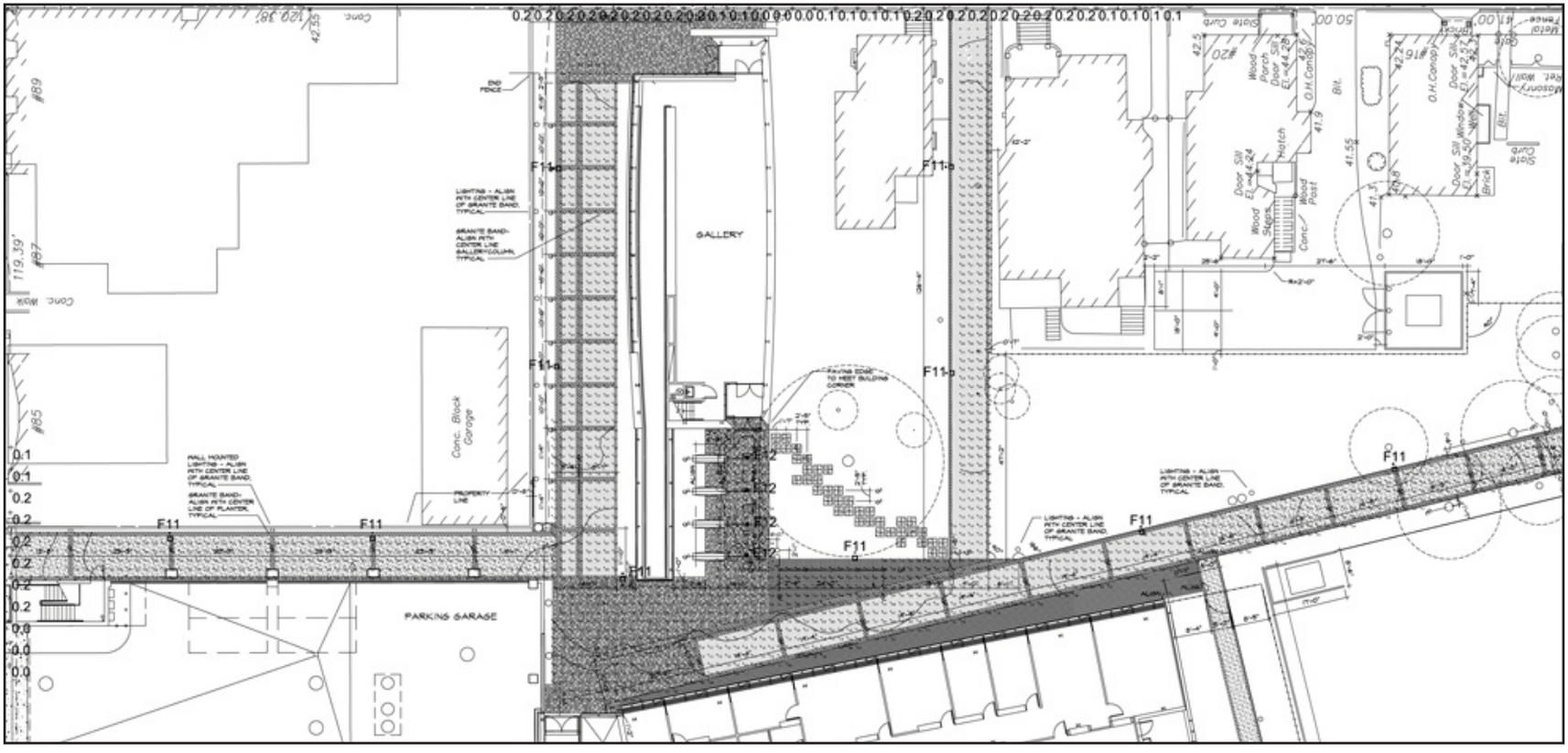
STEEL (W-Beams)	0.20
CONCRETE	0.20
MULLIONS (Painted)	0.35
GLAZING (Double Glazed Low E IGU)	0.6
METAL (Custom Fixture Housing)	0.35


GALLERY
PARKING GARAGE
SCULPTURE BUILDING
PROPERTY LINE

■ LIGHTING DESIGN

EXTERIOR / LANDSCAPE





Please Refer to supplement sheet set for clarifications and larger size drawings (CS-100 & CS-101). The PDF version located at www.arche.psu.edu/thesis/eportfolio/2007/portfolios/knd107 can be used to view details.

LIGHTING DESIGN

EXTERIOR / LANDSCAPE

LUMINAIRE SCHEDULE

SYMBOL	LABEL	QTY	CATALOG NUMBER	DESCRIPTION	LAMP	LLF	WATTS
▭	F11	10	FH3-150MH	TYPE 4 FULL CUT OFF	150W ED-17 MH	0.62	185
○	F12	4	ALR8-50MH	BOLLARD	50W CLR MH V-S-C	0.62	95

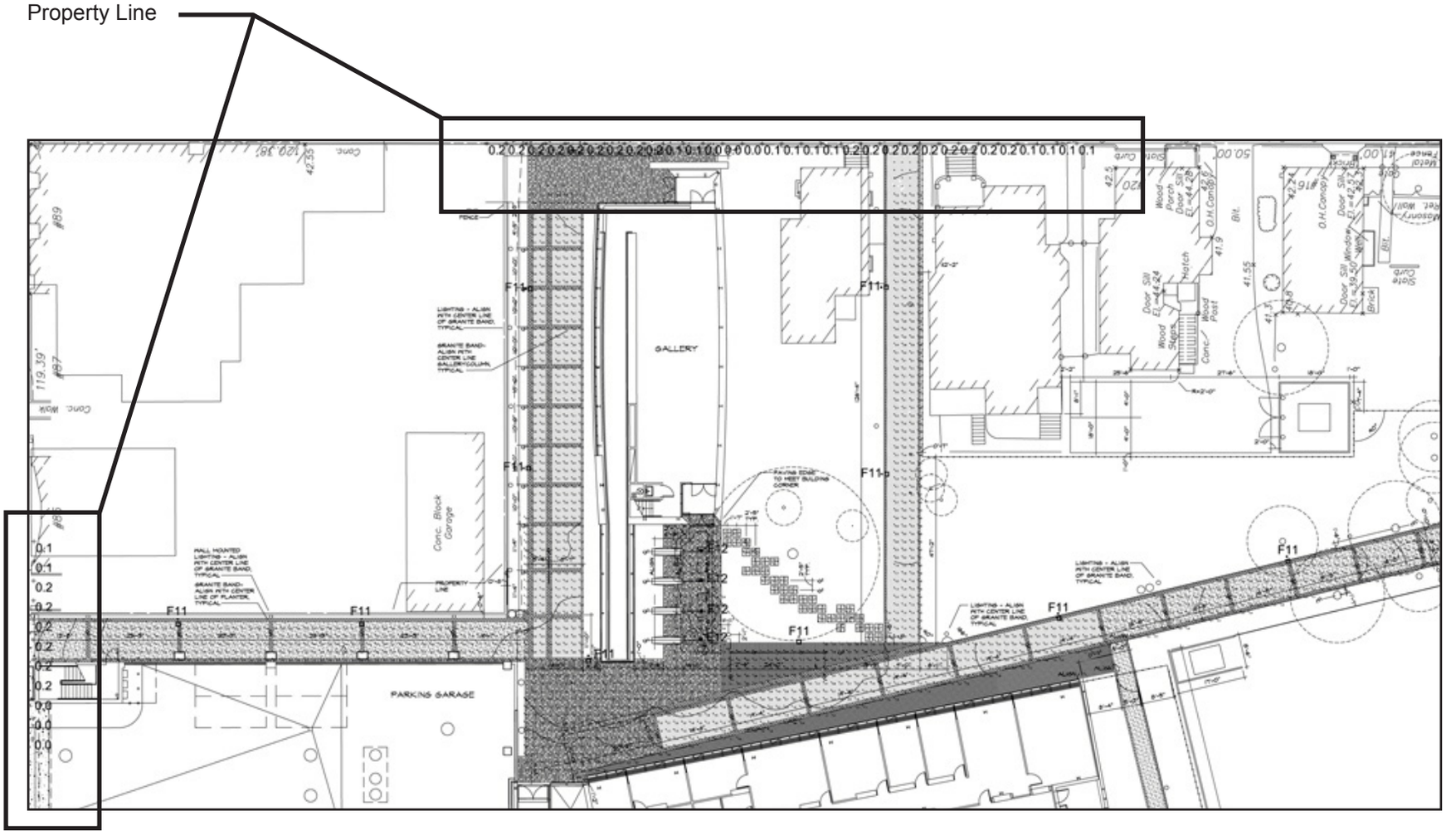
POWER DENSITY

Luminaires	14
Total Power	2230.0 W
Area	13936 SF (Appox)
Power Density	0.16 W/SF

PHOTOMETRIC DATA

Average Illuminance	3 FC
Maximum	7.2 FC
Minimum	0.2 FC
Max/Min	36.0:1
Average/Min	14.0:1

The minimum occurs at the property boundary. The average is 36 lx or 3 FC which complies with IES standards.



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LIGHTING DESIGN

EXTERIOR / LANDSCAPE

LEED - SUSTAINABLE SITES CREDIT 8.0

INTENTS

Minimize light trespass from building and site

Reduce sky-glow to increase night sky access

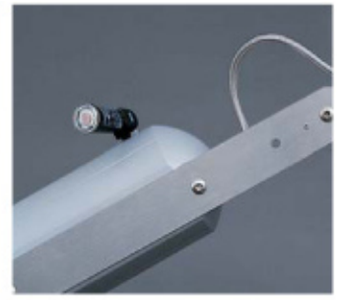
Improve visibility (Glare)

Reduce development impact on environment

☐ **HSS**

HOUSE SIDE SHIELD

House side shield to cutoff light behind the pole and shield the lamp from view.



☐ **BPC12** 120 volt

☐ **BPC27** 208/240/277 volt

PHOTOCELL

Button type photocell with adjustable swivel for aiming. Requires field wiring.

INTERIOR LIGHTING

Non-emergency lighting is controlled to turn off during non-business hours with manual override controls. Refer to individual spaces for control systems.

EXTERIOR LIGHTING

Achieve lower lighting power densities required by ASHRAE 90.1-2004 Section 9 Table 9.4.5

- 20% lower than standard
- Allowable LPD = 0.20W/SF
- Achieved LPD = 0.16W/SF (achieved 20% lower LPD)

Follow requirements defined by IESNA RP-33

- Site Lighting Zone 3 (Commercial/Industrial, Hi-Density Res.)
- 0.2 Horizontal & Vertical at site boundary
- Luminaire is full cut-off and controlled by localized photocell

LIGHTING DESIGN

GALLERY

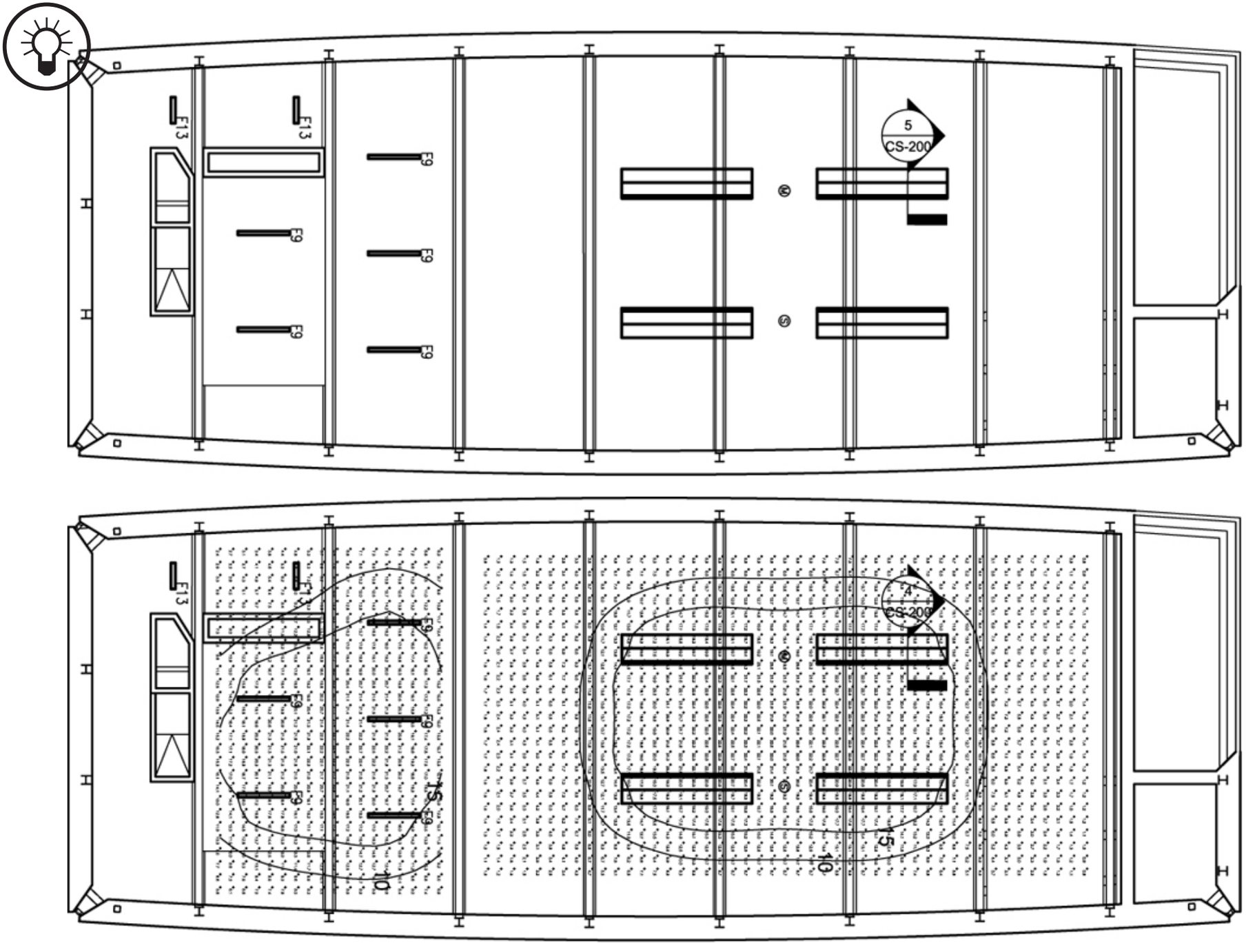
Here the viewer can explore various forms of art work. The gallery has various exhibitions and student works displayed at different times of the year. From the Gallery, a connection tunnel unifies the Gallery and Sculpture Building.

DESIGN CRITERIA

ILLUMINANCE (Horizontal and Vertical)	10 lux or 1 fc for both horizontal and vertical illuminances (Egress)
DIRECT / REFLECTED GLARE	Provide a comfortable environment for viewing sculptures and art
ACCENT LIGHTING	Make the sculptures look dynamic
DAYLIGHT INTEGRATION	Decrease direct glare from windows (clerestories)
LIGHT DISTRIBUTION	Even distribution on paths and higher at points of interest

SURFACE REFLECTANCE

STEEL (W-Beams)	0.20
CONCRETE	0.20
MULLIONS (Painted)	0.8
GLAZING (Double Glazed Low E IGU)	0.6
METAL (Custom Fixture Housing)	0.35
Gypsum Board	0.70
CLR FIN (Clearance Finish)	0.80
RCB (Rubber Cove Band)	0.50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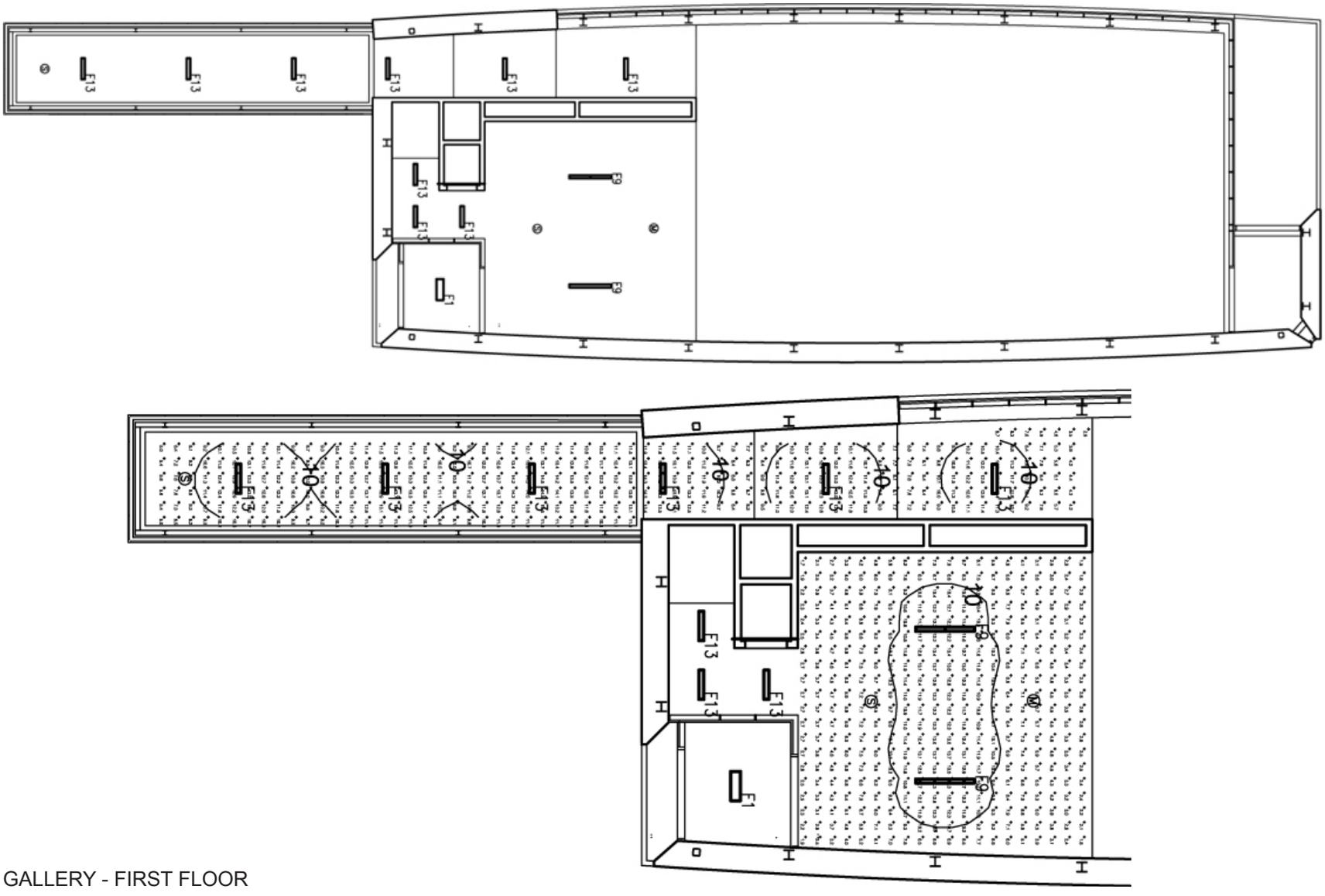
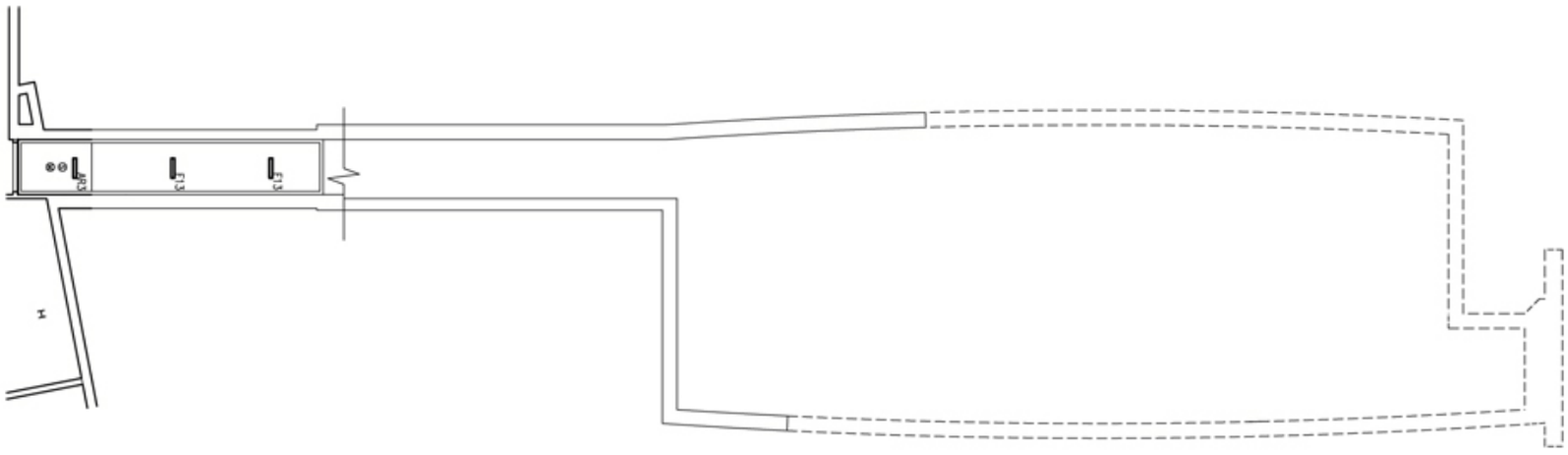
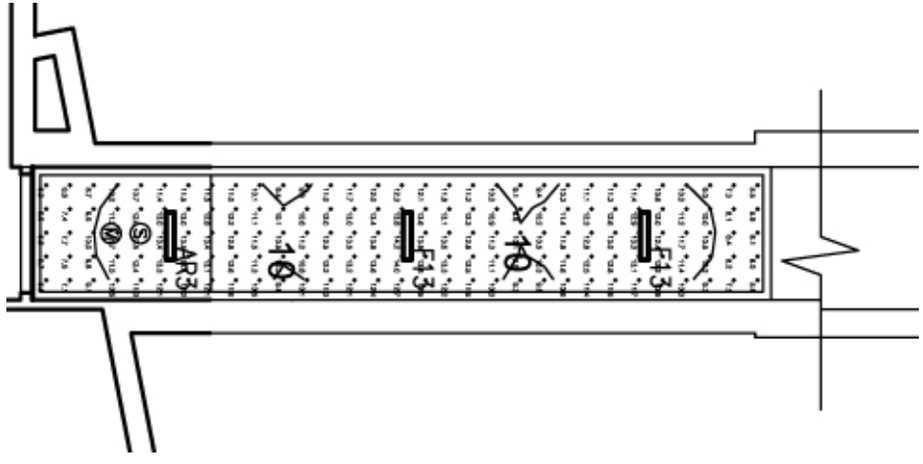
■ LIGHTING DESIGN

GALLERY



GALLERY - FIRST FLOOR





GALLERY - BASEMENT

Please Refer to supplement sheet set for clarifications and larger size drawings (CS-200 & CS-201). The PDF version located at www.arche.psu.edu/thesis/eportfolio/2007/portfolios/knd107 can be used to view details.

LIGHTING DESIGN

GALLERY

LUMINAIRE SCHEDULE

SYMBOL	LABEL	QTY	CATALOG NUMBER	DESCRIPTION	LAMP	LLF	WATTS
	F9	15	RX5-DX-RX5F	FLUORESCENT	54W T5	0.75	99
	F13	9	RC45-D-1-ET5-MBL	FLUORESCENT	T5	0.75	33

POWER DENSITY

DESCRIPTION	LUMINAIRES	WATT	AREA	POWER DENSITY
Basement	3	99 W	154 SF	0.6 W/SF
First Floor	8	396.0 W	851.0 SF	0.5 W/SF
Second Floor	13	1287.0 W	2048.3 SF	0.6 W/SF

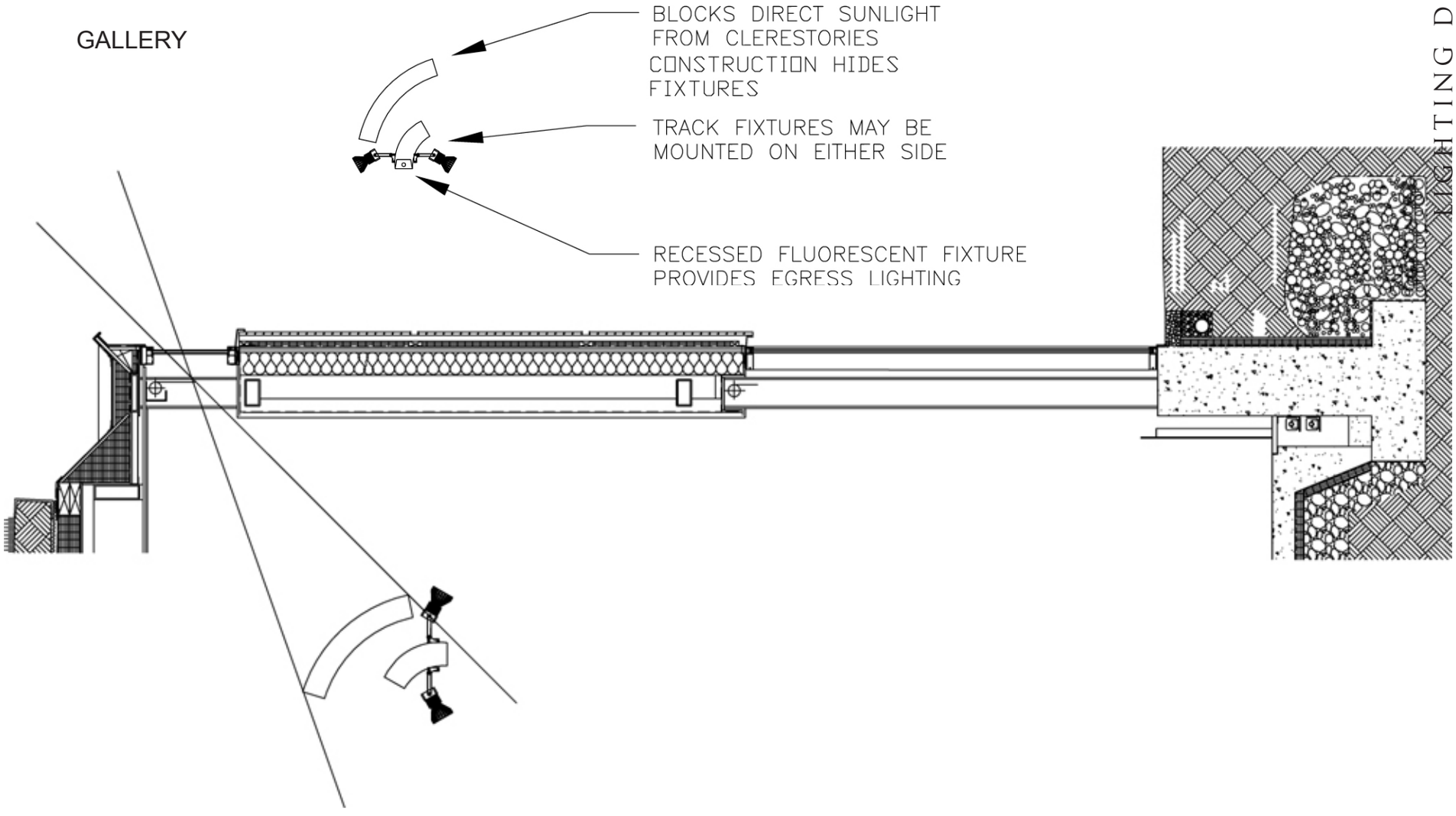
PHOTOMETRIC DATA

DESCRIPTION	AVG	MAX	MIN	MAX/MIN	AVG/MIN
First Floor	7.2 FC	13.7 FC	1.5 FC	9.1:1	4.8:1
Main Floor	11.3 FC	22.9 FC	0.8 FC	28.6:1	14.1:1
Mezzanine	14.5 FC	22.7 FC	2.4 FC	9.5:1	6.0:1
Tunnel	11.0 FC	14.5 FC	2.9 FC	5.0:1	3.7:1

GENERAL LIGHTING WAS DESIGNED WITH LIFE SAFETY CODE IN MIND. SUITABLE TRACK FIXTURES ARE LISTED IN APPENDIX A.

LIGHTING DESIGN

GALLERY



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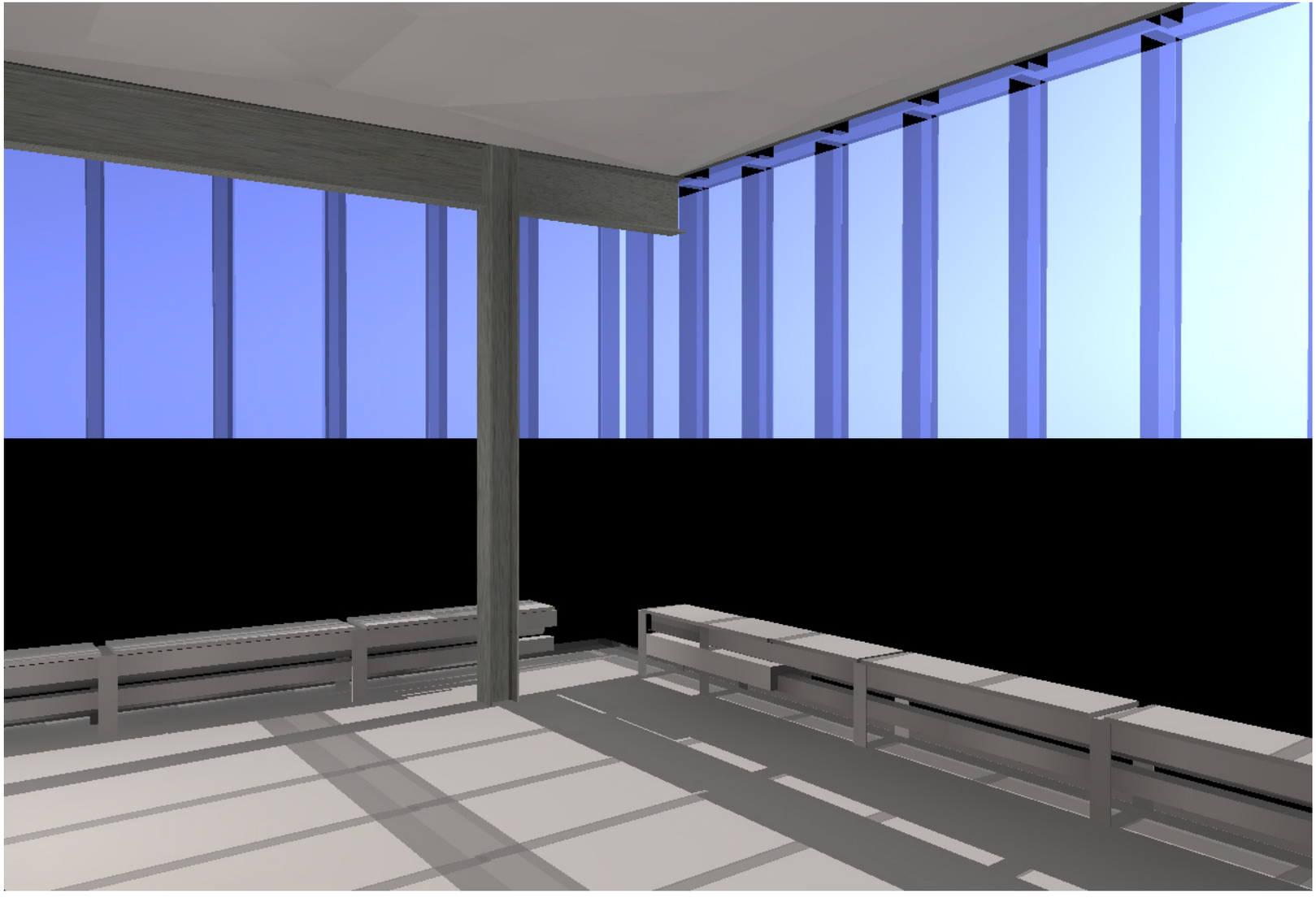


LIGHTING DESIGN

DEAN'S OFFICE

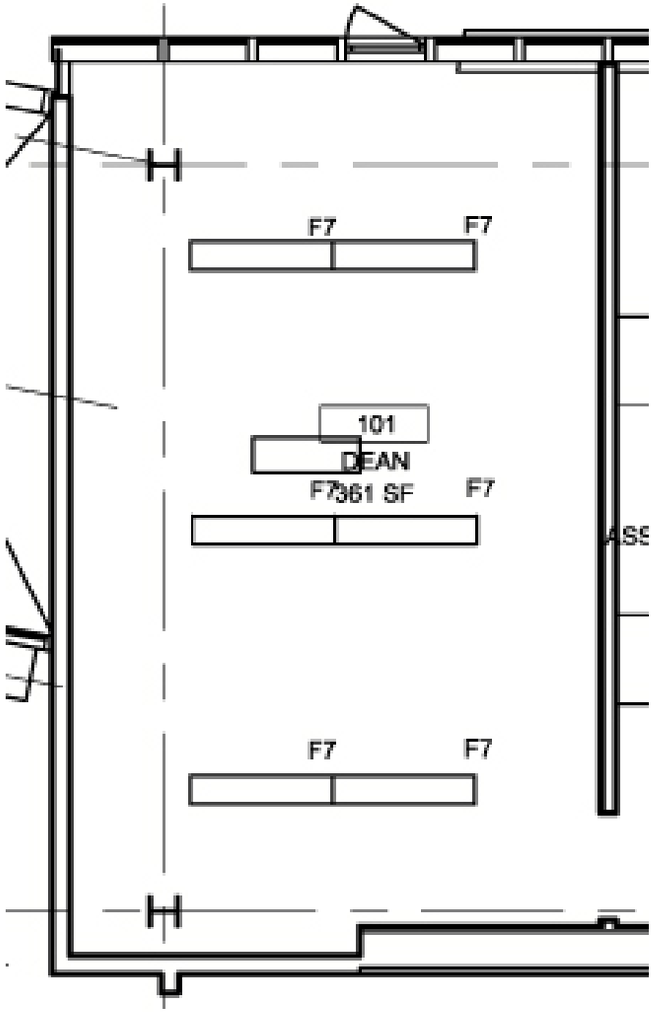
The Dean's Office was a study on daylighting controls and lighting quality. The room has ample daylight so a control scheme will be very important to keep the space pleasant to work in.

DESIGN CRITERIA

ILLUMINANCE (Horizontal and Vertical)	500 lux or 50 fc on workplane (2.5 AFF)
DIRECT / REFLECTED GLARE	Provide a comfortable environment
DAYLIGHT INTEGRATION	Decrease direct glare from windows
LIGHT DISTRIBUTION	Even distribution on the workplane

SURFACE REFLECTANCE

STEEL (W-Beams)	0.20
CONCRETE	0.20
MULLIONS (Painted)	0.8
GLAZING (Double Glazed Low E IGU)	0.6
METAL (Custom Fixture Housing)	0.35
Gypsum Board	0.70
CLR FIN (Clearance Finish)	0.80
RCB (Rubber Cove Band)	0.50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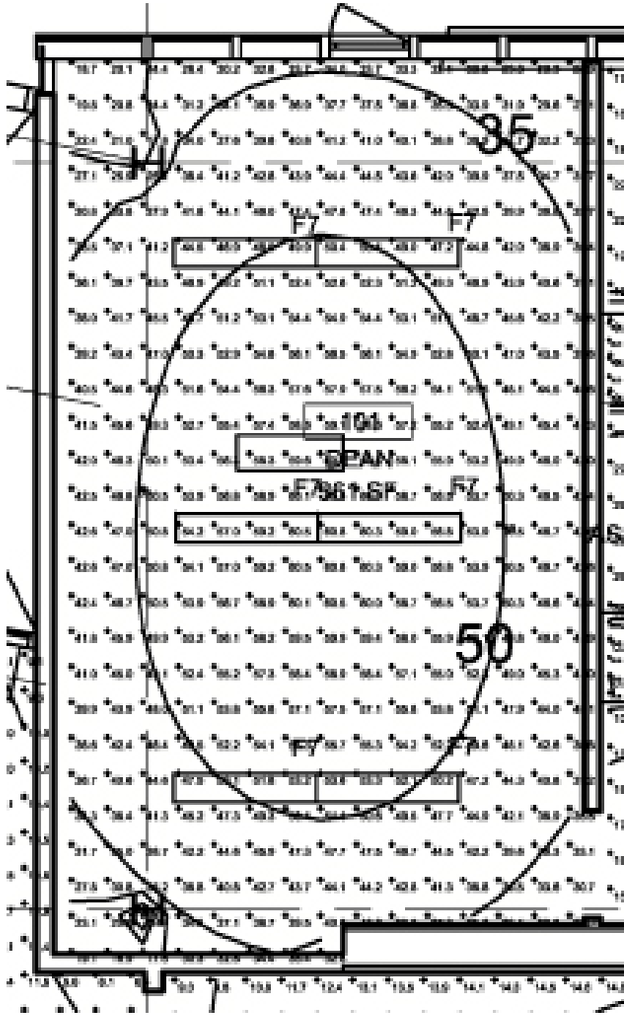
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LIGHTING DESIGN

DEAN'S OFFICE

LUMINAIRE SCHEDULE

SYMBOL	LABEL	QTY	CATALOG NUMBER	DESCRIPTION	LAMP	LLF	WATTS
▭	F7	6	EGAM1-2-54T5HO	FLUORESCENT	54W T5	0.75	117

POWER DENSITY

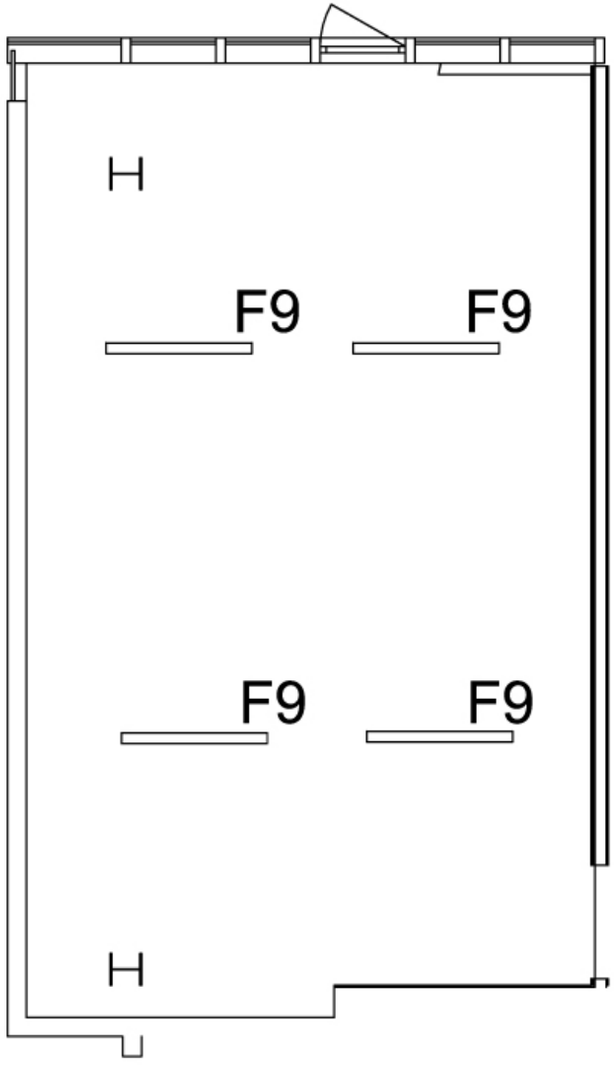
Luminaires	6
Total Power	702W
Area	370 SF
Power Density	1.9 W/SF

PHOTOMETRIC DATA

Average Illuminance	45 FC
Maximum	60.8 FC
Minimum	4.4 FC
Max/Min	13.8:1
Average/Min	10.3:1

This design supplies ample amount of electrical lighting into the space. The system uses mostly indirect lighting for glare control. This system will also work seamless with dimming, a change in illuminance will be less noticeable than direct lighting.

REFER TO APPENDIX B FOR DAYLIGHT ANALYSIS.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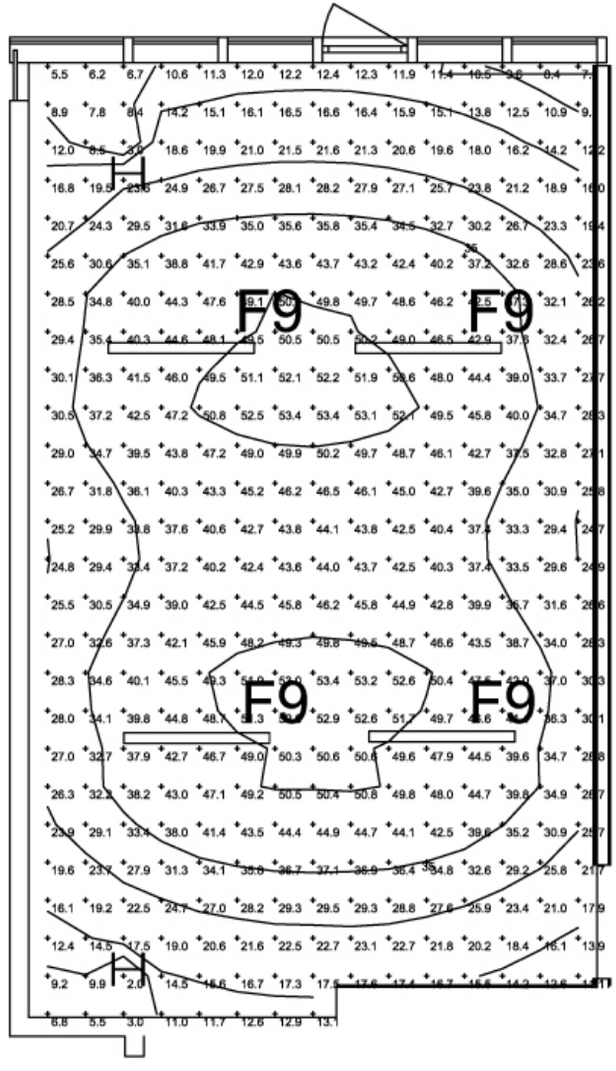
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LIGHTING DESIGN

DEAN'S OFFICE

LUMINAIRE SCHEDULE

SYMBOL	LABEL	QTY	CATALOG NUMBER	DESCRIPTION	LAMP	LLF	WATTS
▭	F9	4	rx5-dx-rx5-2445	FLUORESCENT	54W T5	0.75	99

POWER DENSITY

Luminaires	4
Total Power	396.0W
Area	370 SF
Power Density	1.1 W/SF

PHOTOMETRIC DATA

Average Illuminance	35 FC
Maximum	53.4 FC
Minimum	2.0 FC
Max/Min	26.7:1
Average/Min	16.5:1

This design uses 4 luminaires instead of the 6 from the first design. The first design has a better control of glare since it is all indirect lighting. However, this design has a lower power density and initial cost compared to the first design.

REFER TO APPENDIX C FOR DAYLIGHT ANALYSIS and EL-200 & EL-201 for details

LIGHTING DESIGN

STUDIO

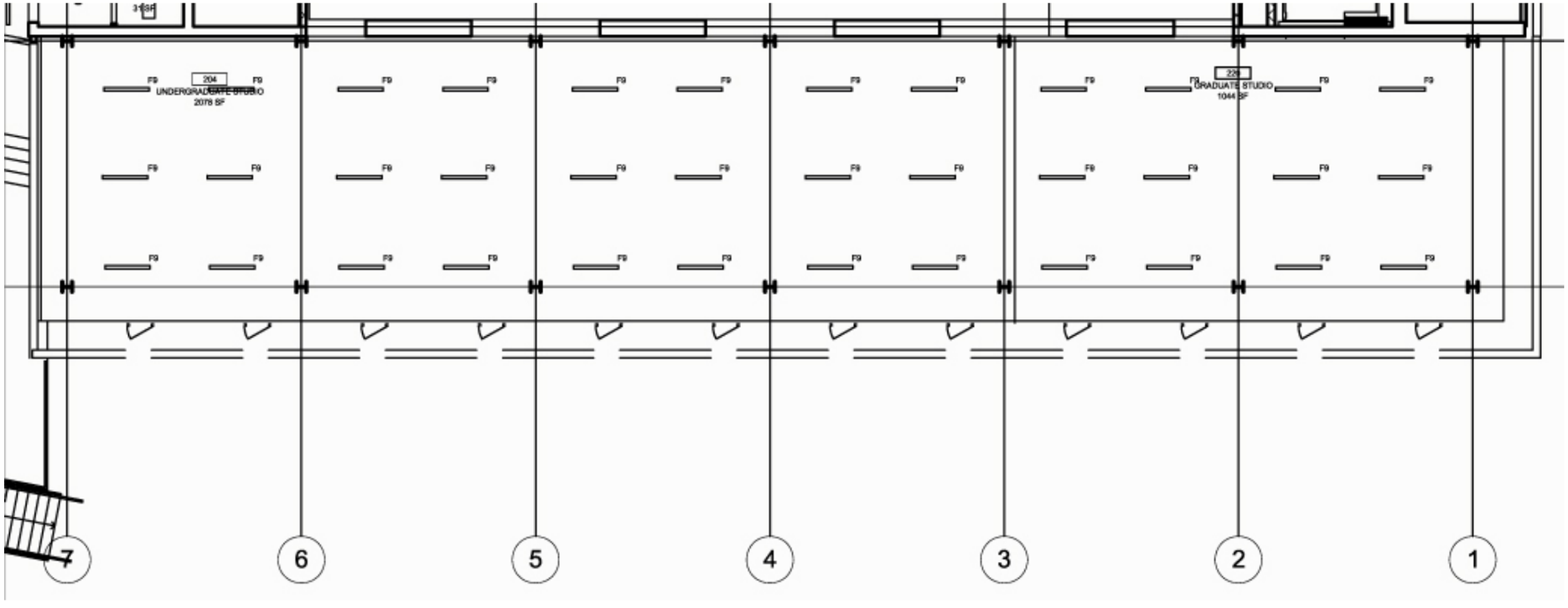
The studios occupy floors two - four on the North and South sides of the main Sculpture Building. These areas are the optimal spaces for daylight harvesting and energy conservation.

DESIGN CRITERIA

ILLUMINANCE (Horizontal and Vertical)	500 lux or 50 fc on workplane (2.5 AFF)
DIRECT / REFLECTED GLARE	Provide a comfortable environment for student activities
DAYLIGHT INTEGRATION	Decrease direct glare from windows and clerestories
LIGHT DISTRIBUTION	Even distribution on the workplane

SURFACE REFLECTANCE

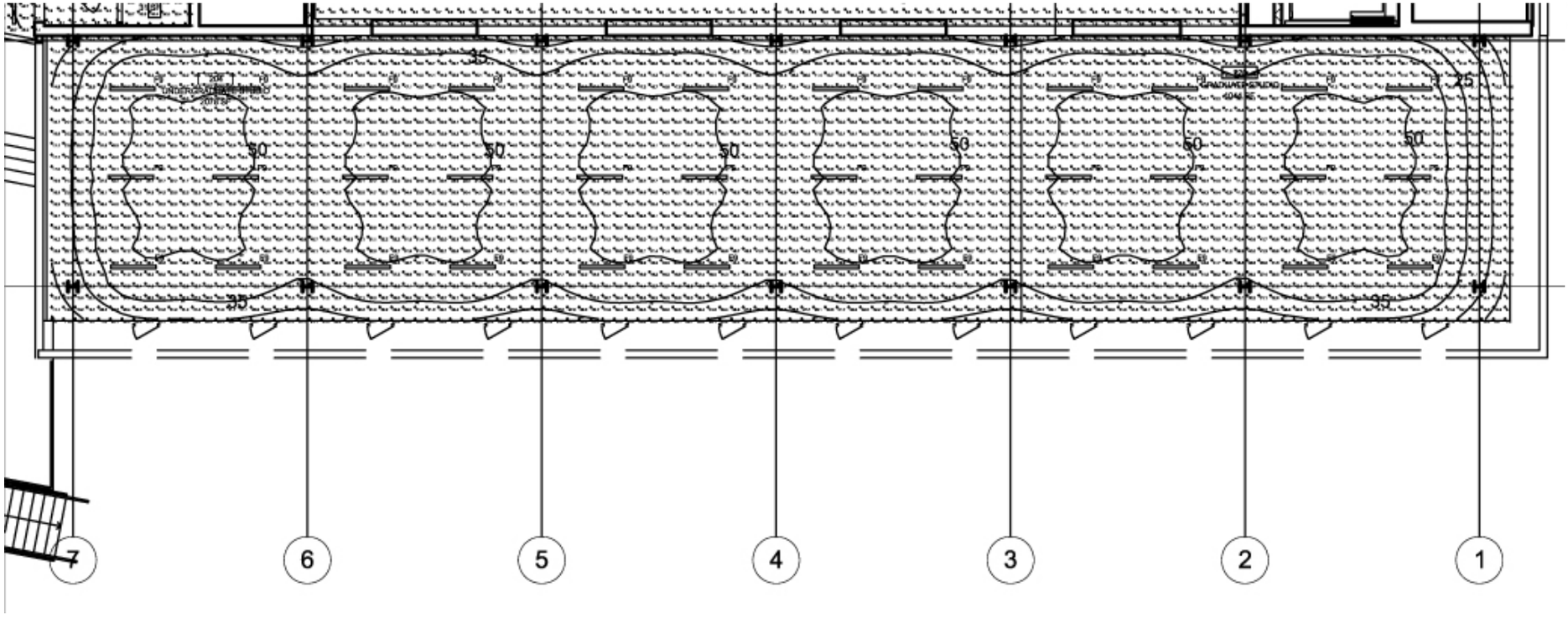
STEEL (W-Beams)	0.20
CONCRETE	0.20
MULLIONS (Painted)	0.8
GLAZING (Double Glazed Low E IGU)	0.6
METAL (Custom Fixture Housing)	0.35
Gypsum Board	0.70
CLR FIN (Clearance Finish)	0.80
RCB (Rubber Cove Band)	0.50



Please Refer to supplement sheet set for clarifications and larger size drawings (EL-300 & EL-301). The PDF version located at www.arche.psu.edu/thesis/eportfolio/2007/portfolios/knd107 can be used to view details.

■ LIGHTING DESIGN

STUDIO



LIGHTING DESIGN

DEAN'S OFFICE

LUMINAIRE SCHEDULE

SYMBOL	LABEL	QTY	CATALOG NUMBER	DESCRIPTION	LAMP	LLF	WATTS
▭	F9	36	rx5-dx-rx5-2445	FLUORESCENT	54W T5	0.75	99

POWER DENSITY

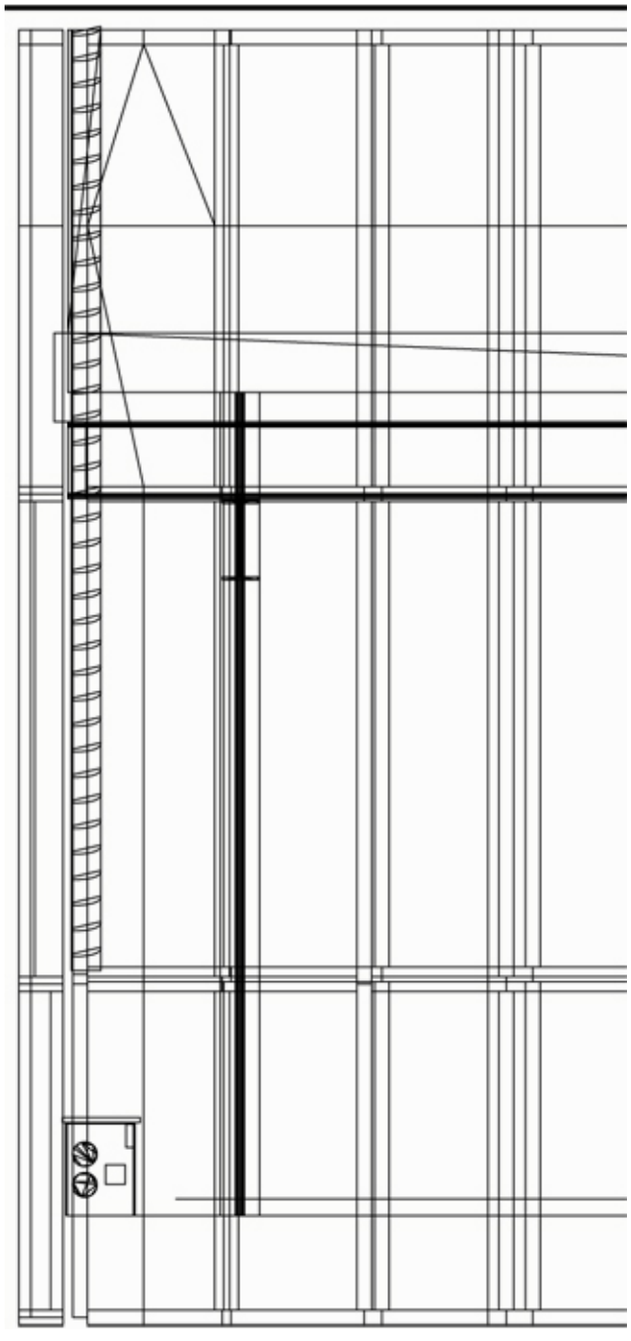
Luminaires	36
Total Power	3564.0 W
Area	3038.6 SF
Power Density	1.2 W/SF

PHOTOMETRIC DATA

Average Illuminance	43.0 FC
Maximum	56.7 FC
Minimum	8.0 FC
Max/Min	7.7:1
Average/Min	5.7:1

This design allows the rows to be dimmed individual according to available daylight. The design is repeated for floors 2-4 with the fourth floor including a clerestory. The lighting in the room is controlled by temperature sensors, occupancy sensors and photocells.

SEE ELECTRICAL DRAWINGS FOR CONTROLS, APPENDIX D FOR DAYLIGHT ANALYSIS AND EL-300, EL-301 FOR DETAILS.



SHADE DEVICE

The geometry of the louvers allows viewing to the outside while deflecting direct sunlight. The curved design is intended to increase the amount of diffused sunlight into the space.

SEE CS-300 FOR FURTHER DETAILS.

LIGHTING DESIGN

STUDIO

The South Facade of the Sculpture Building has a exterior shading device in the original design. In this design, a new interior shade device was modeled to decrease unwanted glare and heat loss/gain. The reason for interior controls are so that the end user can adjust the shade to their preference. The shade system operates similarly to garage doors. The shade can be automatically opened and shut via a motor and track system. The shade is pulled on a track that secures the device between to beams (appox 10'). The operation of this system coordinates with a Building Automation System (BAS).

The overall control scheme is the following:

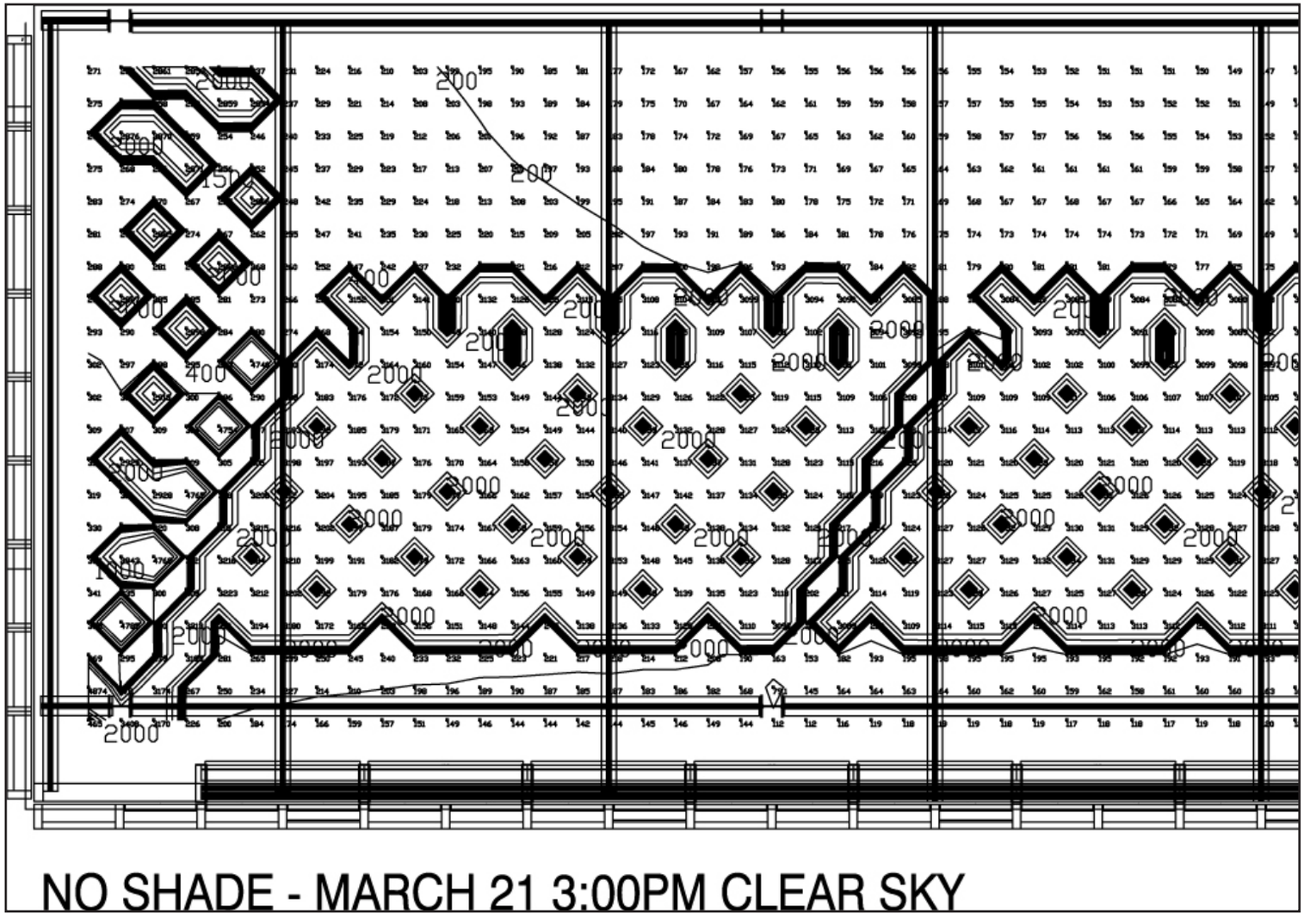
Temperature Sensor

Photocell

Occupancy Sensor

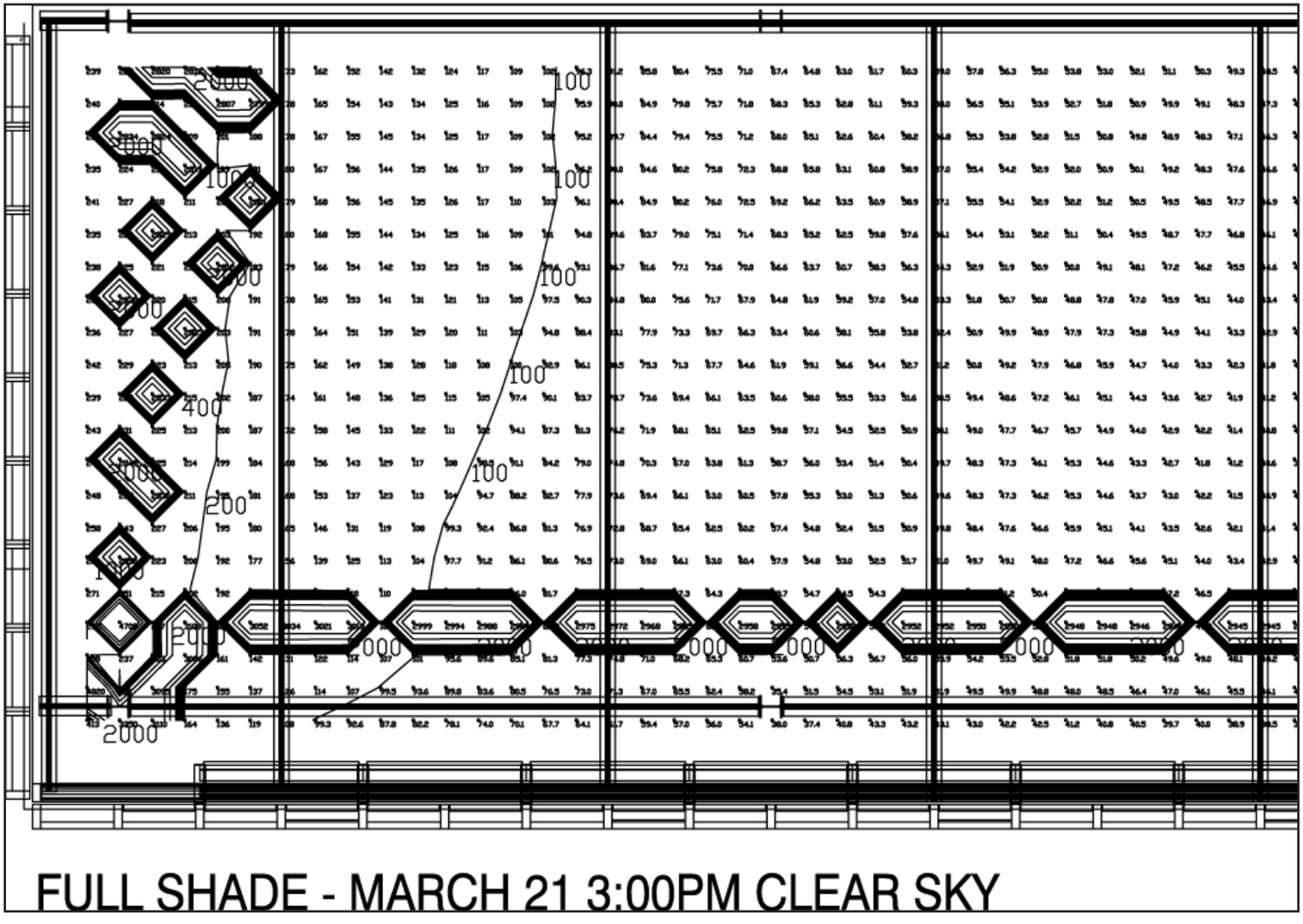
The Temperature sensor controls the electric lighting and shades. If the temperature reaches 72 degrees (winter) or 75 degrees (summer) then the shades are pulled down and the electrical lighting turned on. This ensures that the minimal amount of energy is used since cooling the space will require more energy.

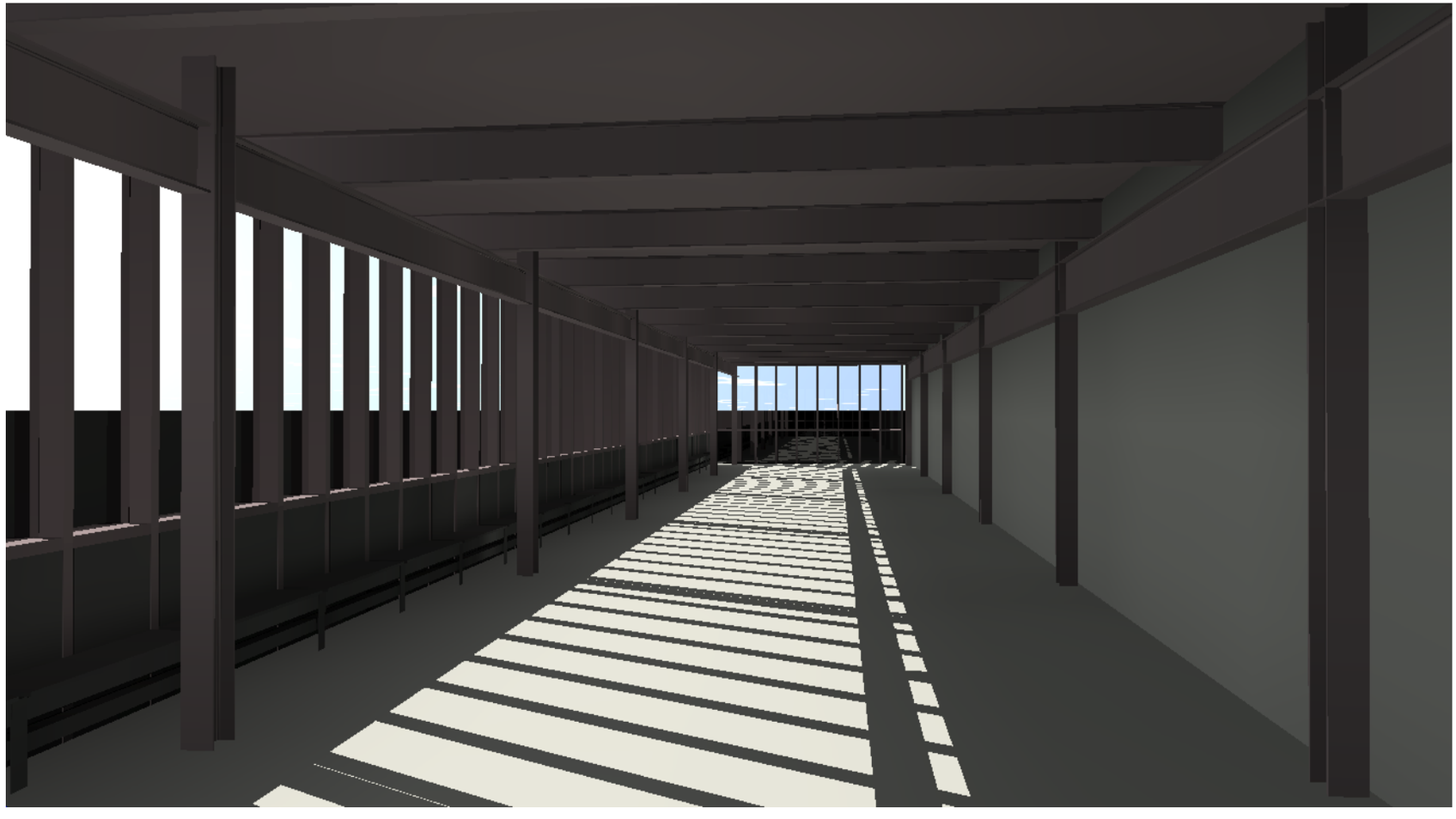
The Occupancy sensor has overriding controls on the electrical lighting. If there are no occupants then the lights will turn off.



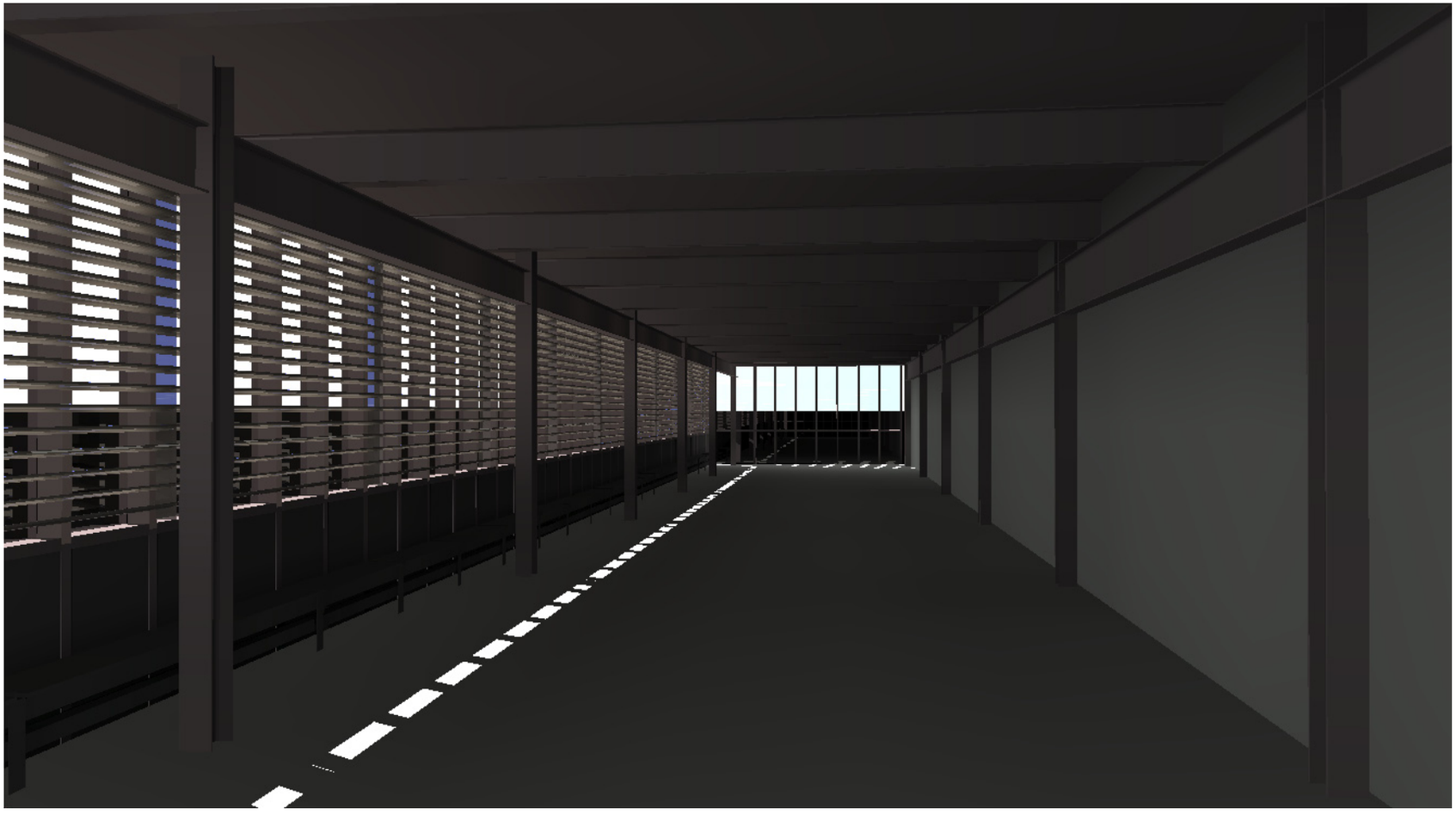
NO SHADE - MARCH 21 3:00PM CLEAR SKY

■ LIGHTING DESIGN





■ LIGHTING DESIGN



LIGHTING DESIGN