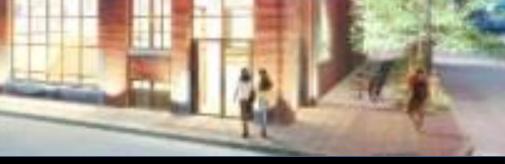


Xiaoyin Wu (Laura) Lighting/Electrical | Architectural Engineering | Penn State University

Fraunhofer CSE Renovation Project **Boston**, MA



PROJECT OVERVIEW

LOBBY LIGHTING DESIGN



OFFICE REDESIGN

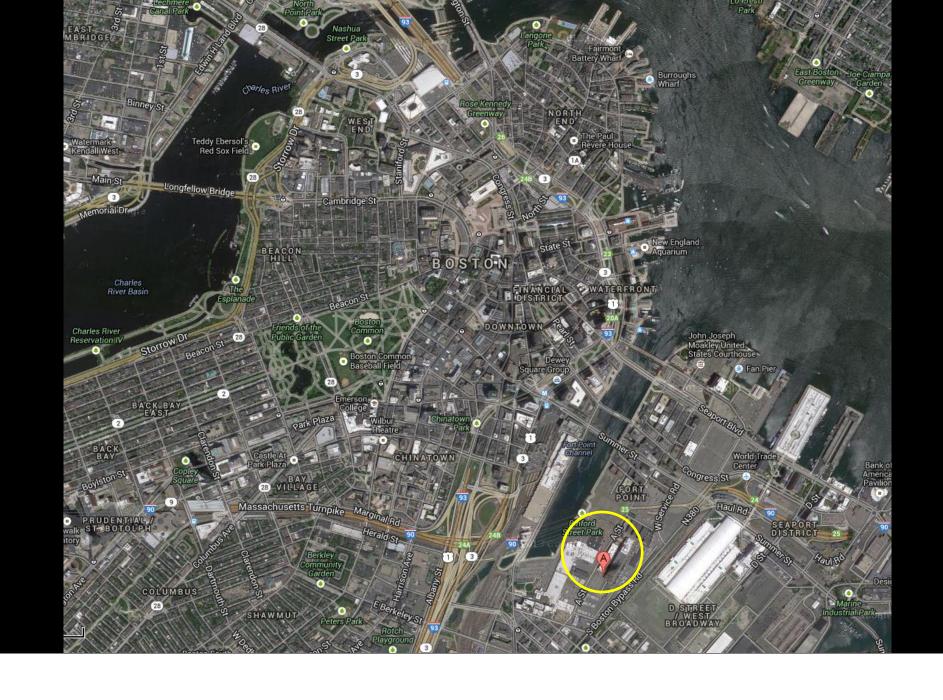
ELECTRICAL DEPTH

SUMMARY



Building Name
Location-Fraunhofer CSEOccupancy Type-5 Channel Center Street, Boston, MAOffices and research laboratories (Group B)
Conference room (Group A-3)Size-42150SFStories above Grade-6









Building Name
Location-
Occupancy Type-Fraunhofer CSE
5 Channel Center Street, Boston, MAOccupancy Type-
Offices and research laboratories (Group B)
Conference room (Group A-3)Size-
Stories above Grade-6



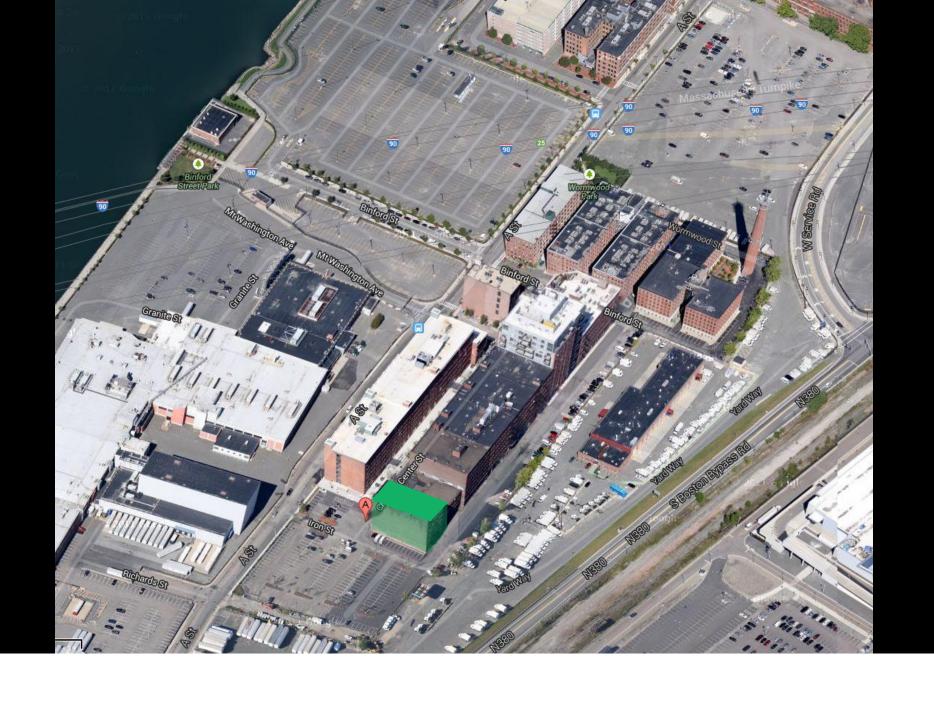






Building Name
LocationFraunhofer CSEOccupancy Type5 Channel Center Street, Boston, MAOffices and research laboratories (Group B)
Conference room (Group A-3)Size42150SFStories above Grade6











a renovation for a 100-year old historical building classical revival-style detailing the Fort Point Channel district is marked by an exceptional degree of visual uniformity buildings are elegantly proportioned, with classically inspired details concentrated at entrances and cornices the structure is left unchanged in this project to conserve the significant continuity throughout the District in terms of massing, scale, and style



Design Concept

scope of work

lobby lighting design

office architecture breadth lighting design

electrical depth



Based in Boston, MA, the Fraunhofer Center for Sustainable Energy Systems (CSE) is an applied research and development laboratory dedicated to the commercialization of CLEAN energy **TECHNOLOGY**. CSE engages in **COLLABORATIVE** research and development with private companies, government entities, and academic institutions, performing research that broadly benefits firms, industries, and society.

LIGHTING DESIGN OBJECTIVES

Design Concept

scope of work

lobby lighting design

office architecture breadth lighting design

electrical depth













Design Concept

scope of work

lobby lighting design

office architecture breadth lighting design

electrical depth





What you expect to see before you enter the building

Vs. What you **WILL** see when you enter



design concept

Scope of Work

lobby lighting design

office architecture breadth lighting design

electrical depth



Lighting Redesign

- Lobby
- Conference Room
- Open Office
- Façade

Electrical Depth Branch Circuit Redesign and Feeder Resizing PV Economical Analysis

Breadth

- Architecture
- Structure

SCOPE OF WORK



design concept

Scope of Work

lobby lighting design

office architecture breadth lighting design

electrical depth

Lighting Redesign

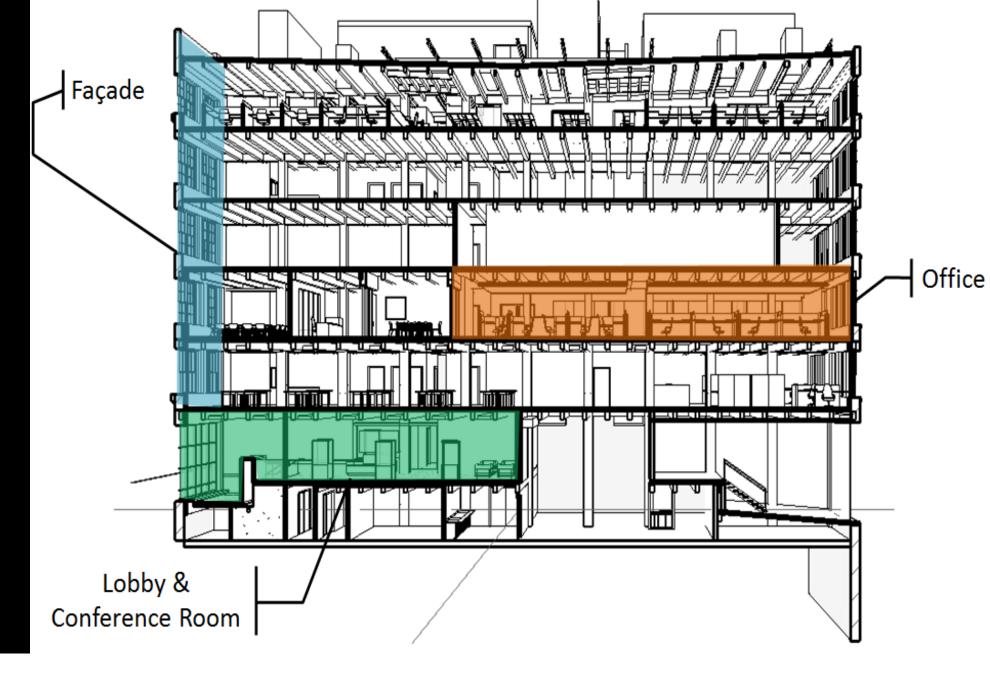
- LOBBY
- Conference Room
- OPEN OFFICE
- Façade

Electrical Depth Branch Circuit Redesign And Feeder Resizing PV ECONOMICAL ANALYSIS

Breadth

- ARCHITECTURE
- Structure





PRESENTATION COVERAGE

design concept

scope of work

Lobby Lighting Design

office architecture breadth lighting design

electrical depth





design concept

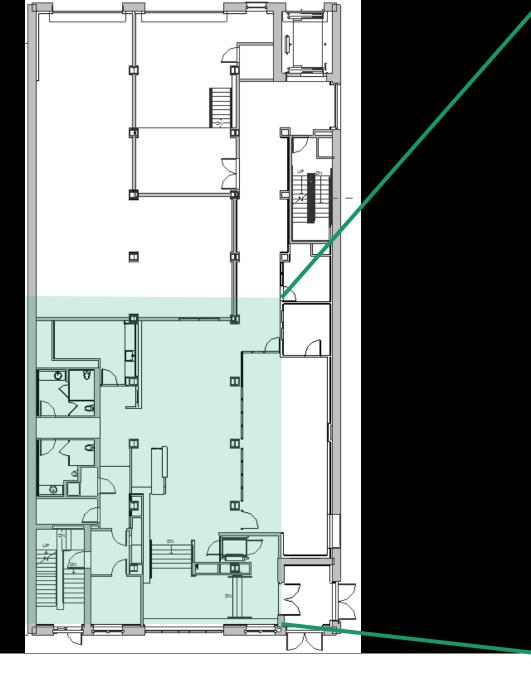
scope of work

Lobby Lighting Design

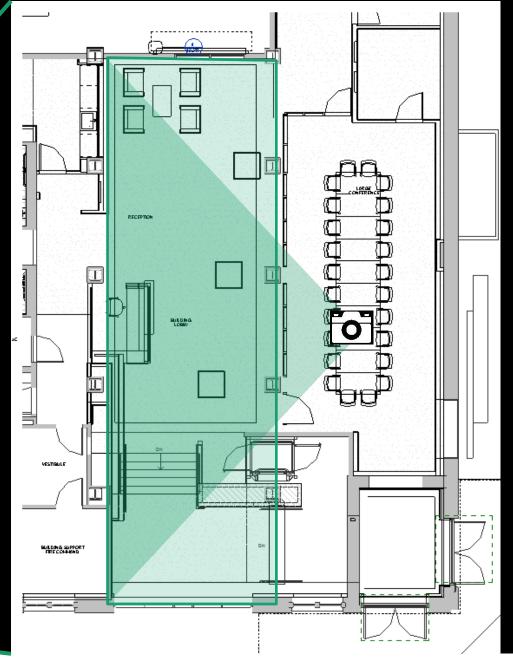
office architecture breadth lighting design

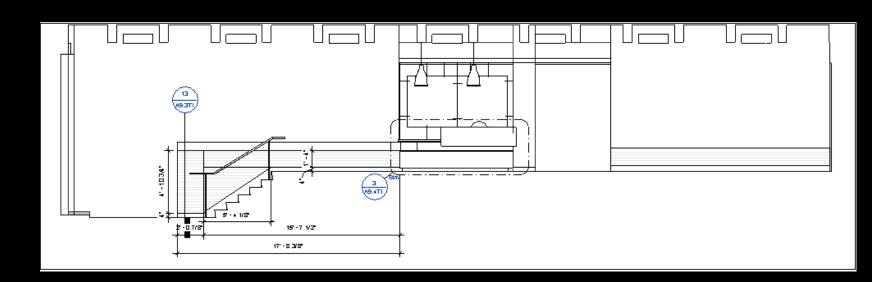
electrical depth

Width: 19'-10" Length: 47'-8" Height: 8'-10 1/4



Fraunhofer







design concept

scope of work

Lobby Lighting Design

office architecture breadth lighting design

electrical depth



Gateway from history to the contemporary

Visual Considerations

- Appearance
- Accenting
- Flexibility
- Way finding/Orientation

Quality Lighting

- 100lux horizontally
- avg:min = 4:1





design concept

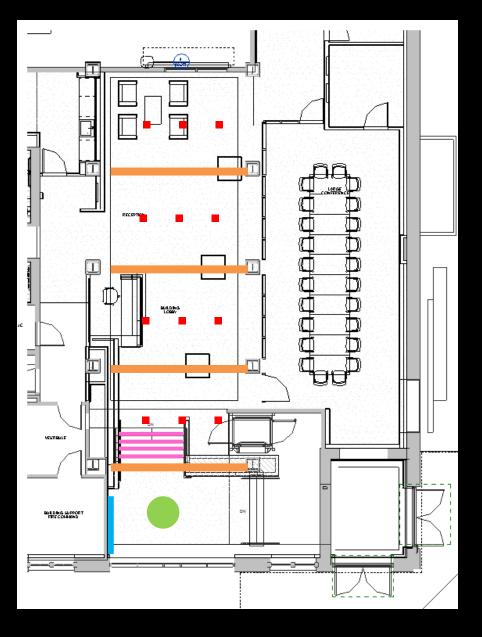
scope of work

Lobby Lighting Design

office architecture breadth lighting design

electrical depth















LUMIANIRES

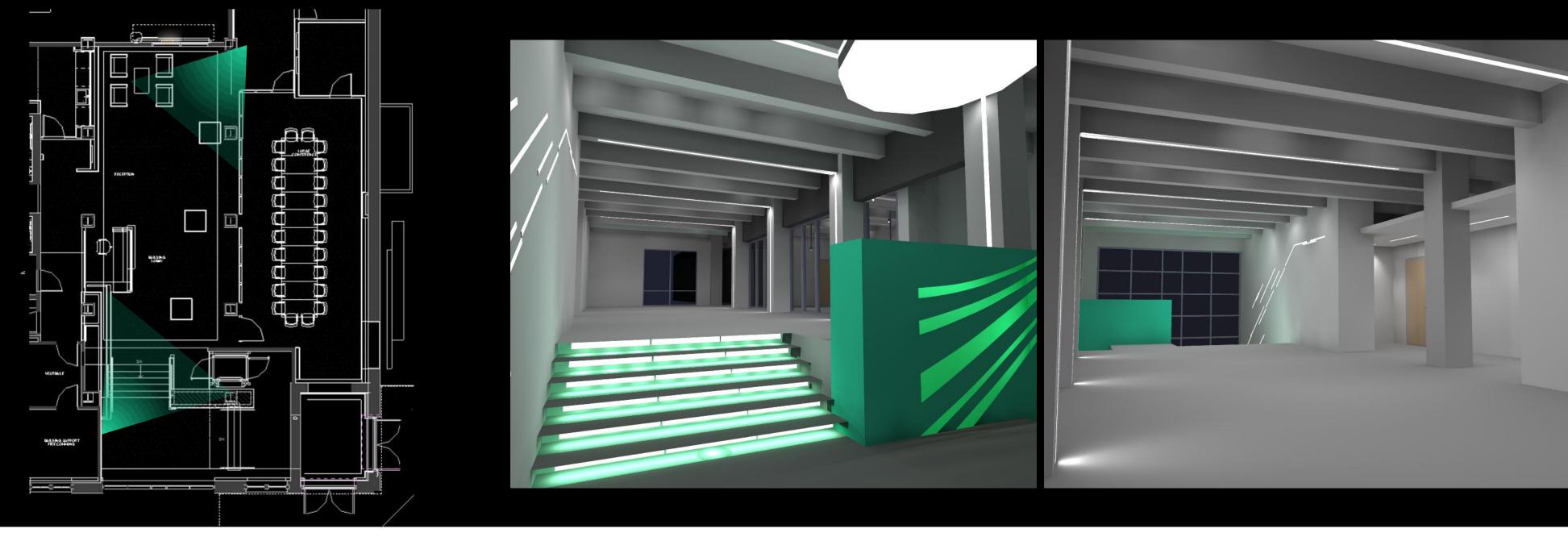
design concept

scope of work

Lobby Lighting Design

office architecture breadth lighting design

electrical depth





RENDERINGS

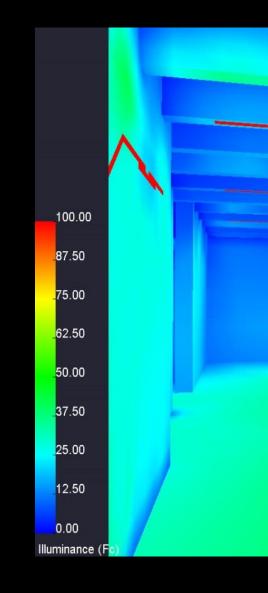
design concept

scope of work

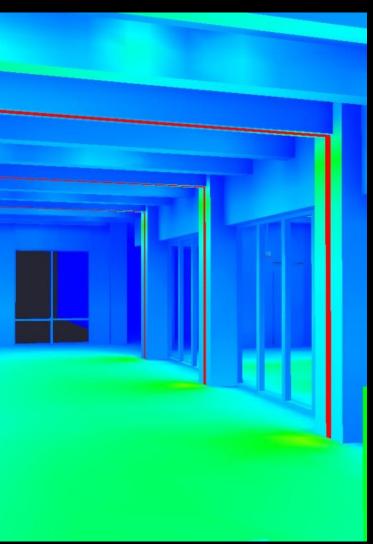
Lobby Lighting Design

office architecture breadth lighting design

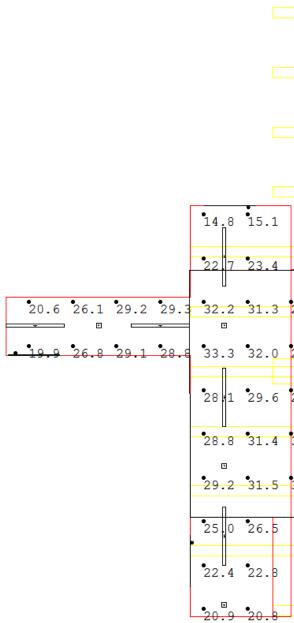
electrical depth







Average Illuminance | 29.5Fc Avg : Min | 2.76



Total Watts = 965.476 Lighting Power Density = 0.926 Watts 14.7 15.8 14.3 12.8 11.5 10.7 18.3 19.9 20.3 19.5 17.6 14.1 21.9 24.4 26.2 26.5 24.5 18.2 25.1 28.9 31.7 33.6 35.7 28.6 26.7 30.8 33.9 35.8 37.7 30.7 27.3 30.5 33.3 33.9 31.3 23.7 29.4 28.6 31.0 33.8 34.4 31.8 24.0 26.9 28.1 32.2 35.9 37.9 39.1 30.4 26.4 29.3 33.0 36.8 38.9 41.4 37.5 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8			ea =			_			76					
14.7 15.8 14.3 12.8 11.5 10.7 18.3 19.9 20.3 19.5 17.6 14.1 21.9 24.4 26.2 26.5 24.5 18.2 25.1 28.9 31.7 33.6 35.7 28.6 26.7 30.8 33.9 35.8 37.7 30.7 29.4 28.6 31.0 33.8 34.4 31.8 24.0 26.9 28.1 32.2 35.9 37.9 39.1 30.4 26.4 29.3 33.0 36.8 38.9 41.4 37.5 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8		Lic	hti	ng	Pow	er	De	ns:	ity	=	0.9	26	Wat	t۹
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			-		_		-		-		-		-	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			18. ¤	3	1 9.	9	2 0	.3 ©	1 9	.5	•17	.6	14.	1
26.7 30.8 33.9 35.8 37.7 30.7 27.3 30.5 33.3 33.9 31.3 23.7 29.4 28.6 31.0 33.8 34.4 31.8 24.0 26.9 28.1 32.2 35.9 37.9 39.1 30.4 26.4 29.3 33.0 36.8 38.9 41.4 37.5 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8	_		21.	9	24.	4	26	.2	26	.5	24	.5	18.	2
27.3 30.5 33.3 33.9 31.3 23.7 29.4 28.6 31.0 33.8 34.4 31.8 24.0 26.9 28.1 32.2 35.9 37.9 39.1 30.4 26.4 29.3 33.0 36.8 38.9 41.4 37.5 30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8			25.	1	28.	9	31	.7	33	.6	35	.7	28.	6
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			26.	7	30.	8	33	.9	3 5	.8	37	.7	30.	7
26.9 28.1 32.2 35.9 37.9 39.1 30.4 $26.4 29.3 33.0 36.8 38.9 41.4 37.5$ $30.4 29.7 32.3 35.8 36.5 34.0 26.0$ $30.5 30.2 32.9 37.0 37.2 34.1 25.8$ $30.9 34.8 40.4 41.5 41.4 31.1$ $32.2 36.4 43.4 44.2 46.0 47.8$			27. ¤	3	30.	5			33	.9	31		23.	7
26.4 29.3 33.0 36.8 38.9 41.4 37.5 $30.4 29.7 32.3 35.8 36.5 34.0 26.0$ $30.5 30.2 32.9 37.0 37.2 34.1 25.8$ $30.9 34.8 40.4 41.5 41.4 31.1$ $32.2 36.4 43.4 44.2 46.0 47.8$	29	. 4	28.	6	3 1.	0	33	.8	. 34	.4	. 31	.8	2 4	0
30.4 29.7 32.3 35.8 36.5 34.0 26.0 30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8	26	.9	28.	1	32.	2	35	.9	3 7	.9	39	.1	3 0.	4
30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8	26	.4	29.	3	33.	0	36	.8	38	.9	41	.4	37.	5
30.5 30.2 32.9 37.0 37.2 34.1 25.8 30.9 34.8 40.4 41.5 41.4 31.1 32.2 36.4 43.4 44.2 46.0 47.8	30	.4		7	3 2.	3			3 6	.5	•34		26.	0
32.2 36.4 43.4 44.2 46.0 47.8	30	.5		2	3 2.	9			• 37	.2	. 34		25.	8
			3 0.	9	3 4.	8	• <mark>4</mark> 0	.4	4 1	.5	• 41	.4	3 1.	1
		Г		-	I		-	1	-		1	-	_	
32.2 35.7 43.5 42.4 38.6 29.0		H	32.	2	36.	4	43	. 4	4 4	.2	46	.0	47.	8
			32.	2	35.	7	4 3	.5	4 2	. 4	3 8	.6	29.	0

CALCULATION

design concept

scope of work

lobby lighting design

Office architecture breadth lighting design

electrical depth



3rd FLOOR OFFICE



design concept

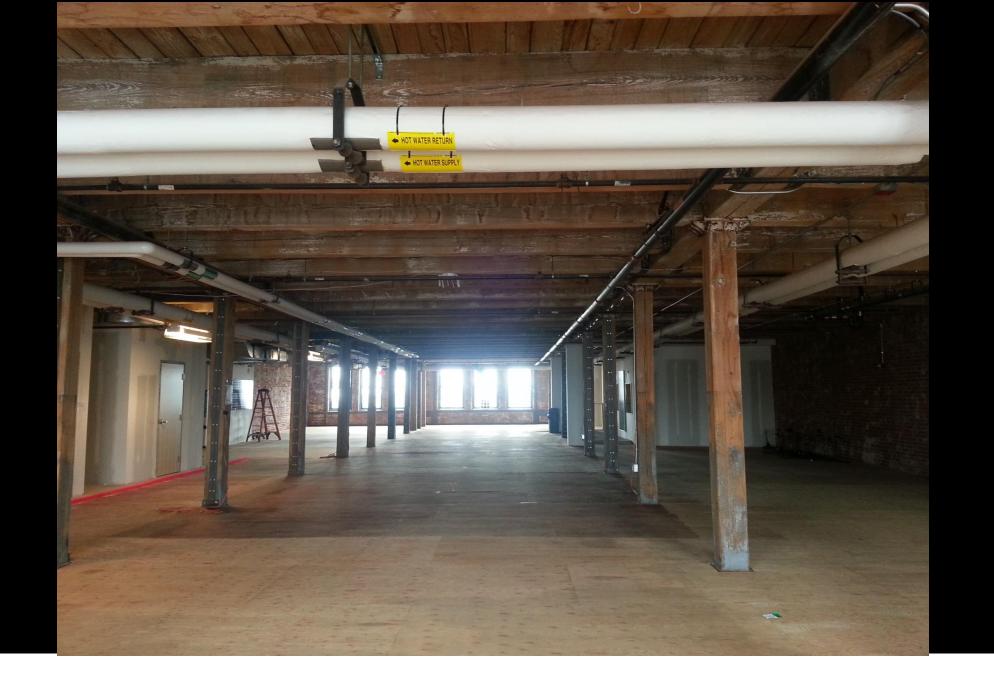
scope of work

lobby lighting design

Office architecture breadth lighting design

electrical depth







design concept

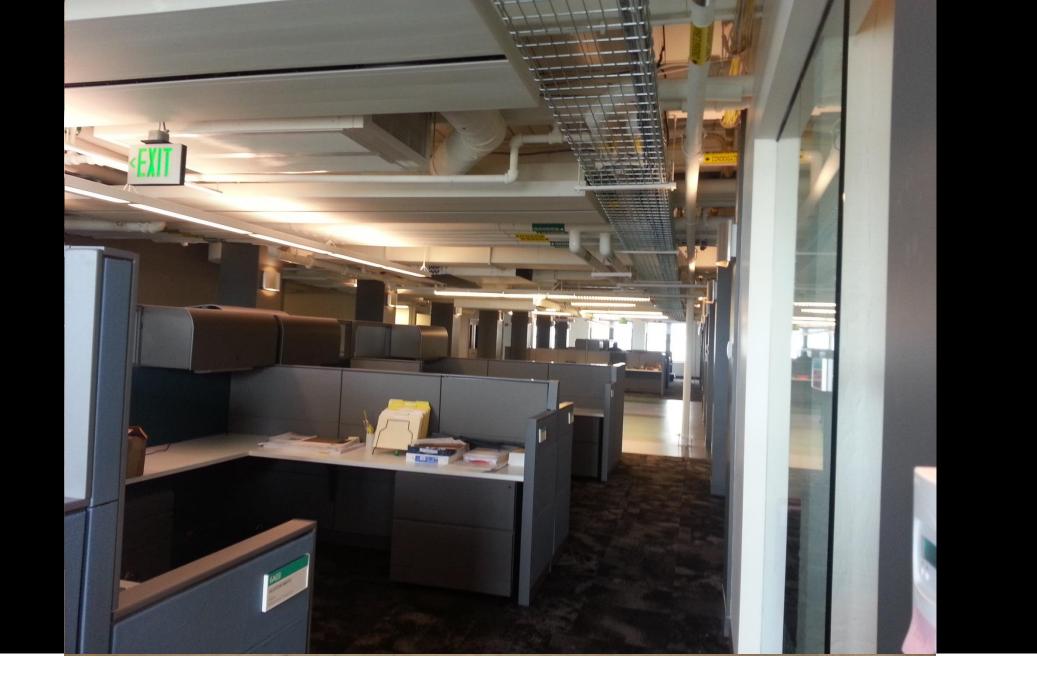
scope of work

lobby lighting design

Office architecture breadth lighting design

electrical depth







design concept

scope of work

lobby lighting design

Office Architecture breadth lighting design

electrical depth



open office



design concept

scope of work

lobby lighting design

Office Architecture breadth lighting design

electrical depth



OPEN office

Brighten Your Everyday

life style." -- U.S. Bureau of labor Statistics

Interior design is a practice that responds to changes in the economy, organization, technology, demographics, and business goals of an organization.

"Practical, aesthetic, and conducive to intended purposes, such as raising productivity, selling merchandise, or improving

ARCHITECTURE DESIGN OBJECTIVES

design concept

scope of work

lobby lighting design

Office Architecture breadth lighting design

electrical depth



OPEN office

Brighten Your Everyday

Affecting Floors -



design concept

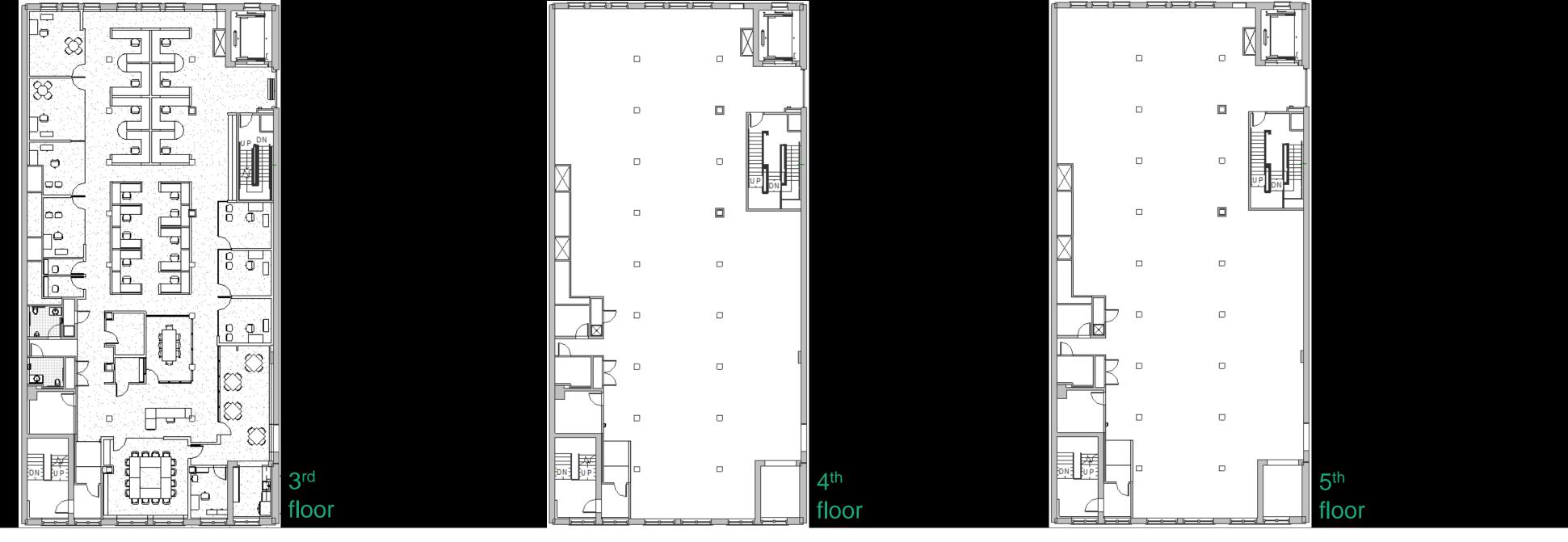
scope of work

lobby lighting design

Office Architecture breadth lighting design

electrical depth





design concept

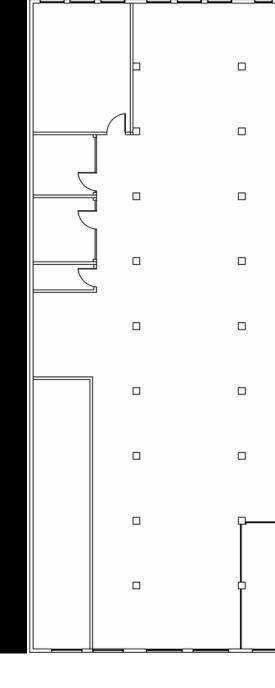
scope of work

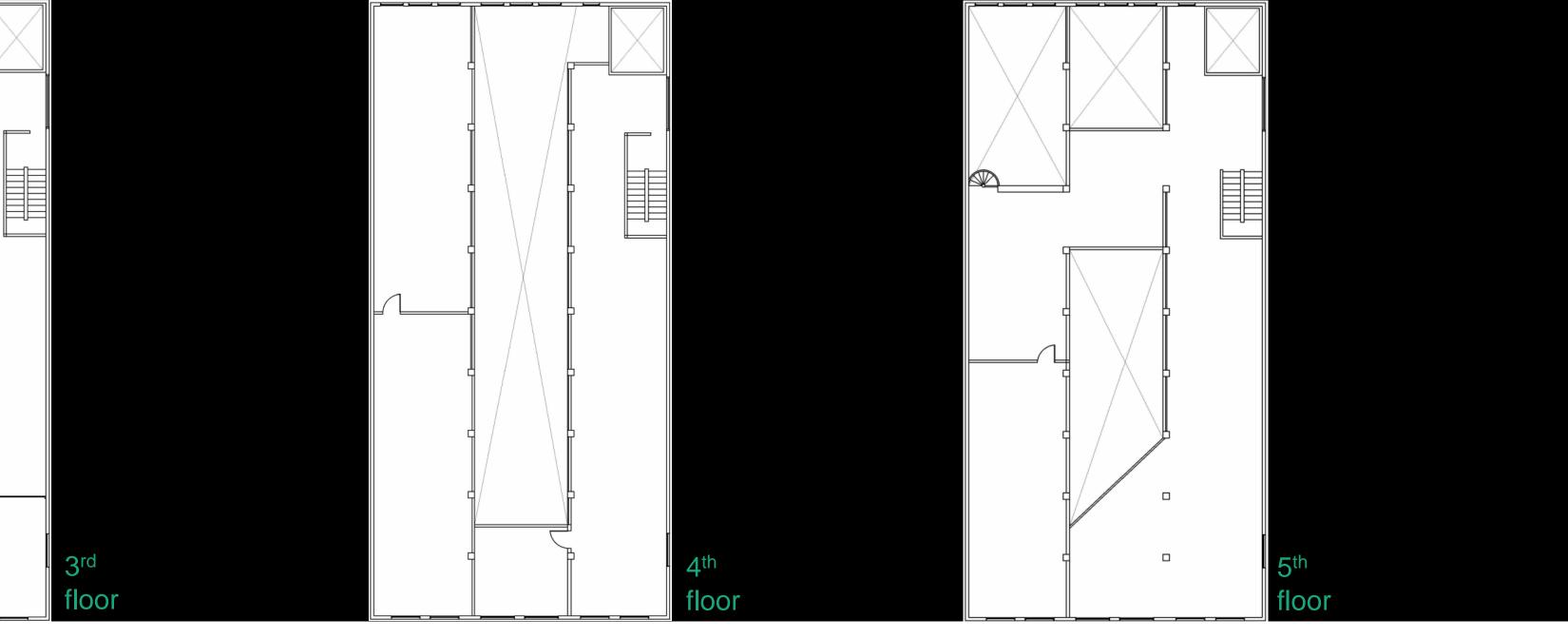
lobby lighting design

Office Architecture breadth lighting design

electrical depth







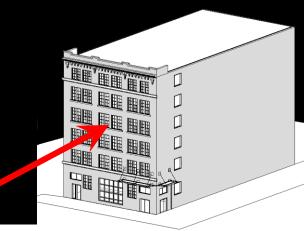
design concept

scope of work

lobby lighting design

Office Architecture breadth lighting design

electrical depth









design concept

scope of work

lobby lighting design

Office architecture breadth Lighting design

electrical depth



OFFICE LIGHTING REDESIGN

Visual Considerations

- Task oriented
- Flexibility
- Appearance

Quality Lighting

- 150lux horizontally
- avg:min = 1.5:1

LIGHTING CRITERIA

design concept

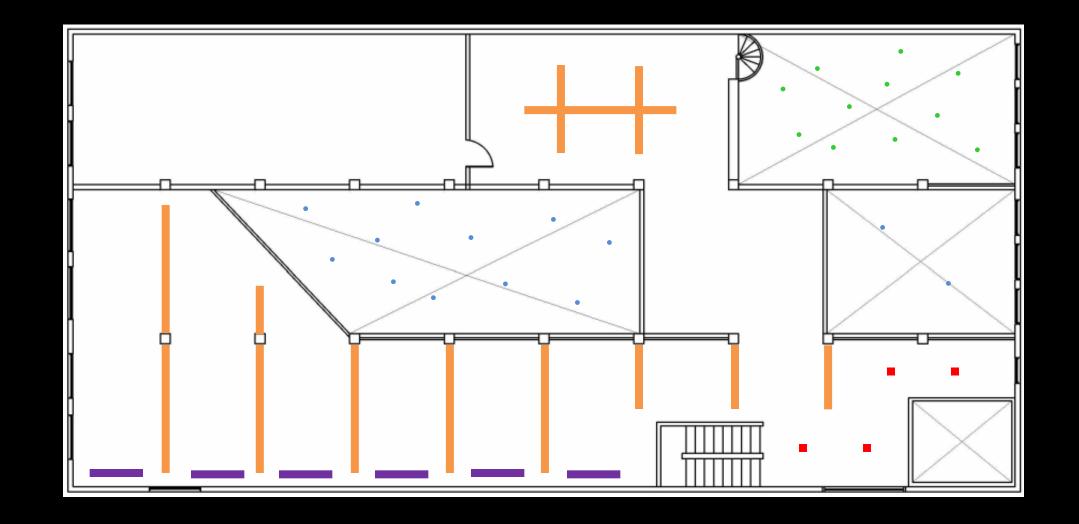
scope of work

lobby lighting design

Office architecture breadth Lighting design

electrical depth















LUMINAIRES

design concept

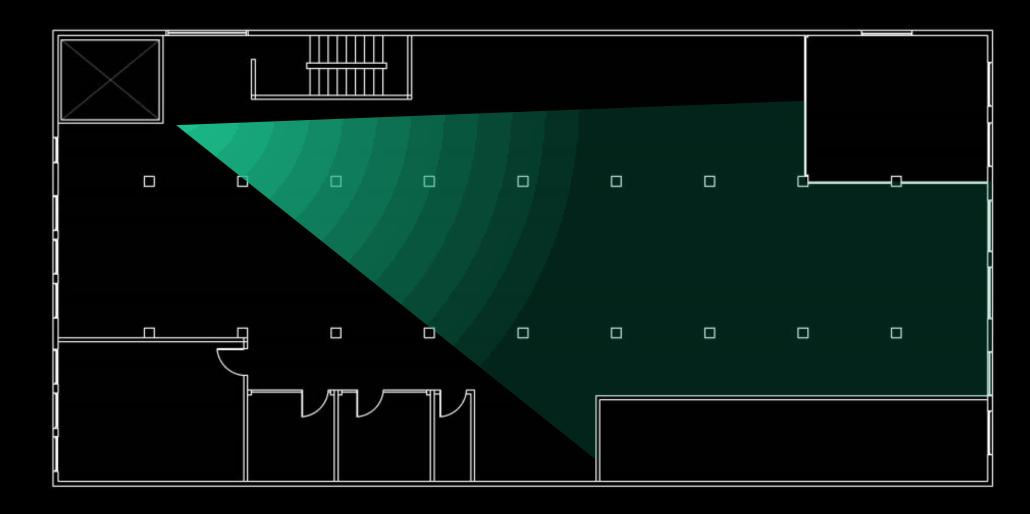
scope of work

lobby lighting design

Office architecture breadth Lighting design

electrical depth







RENDERINGS + CALCULATIONS

design concept

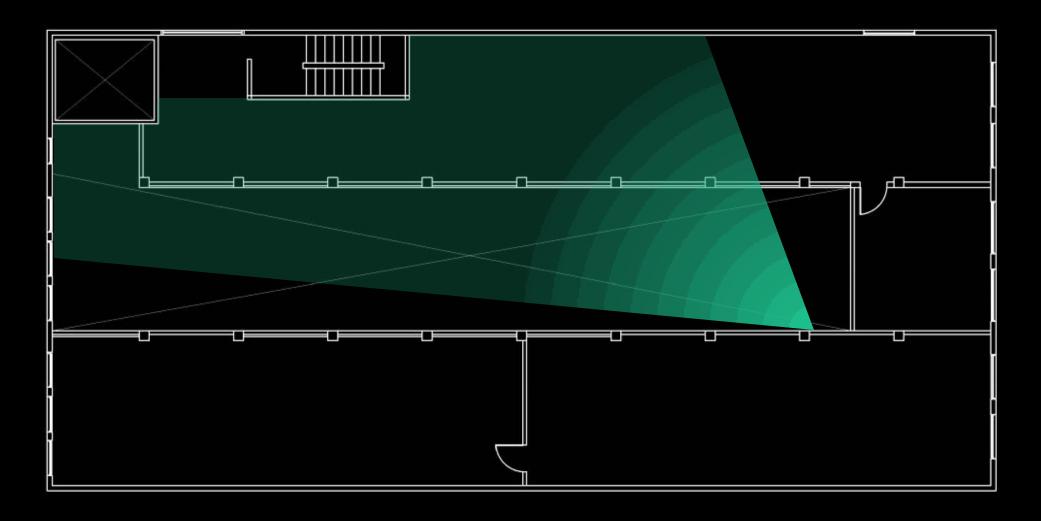
scope of work

lobby lighting design

Office architecture breadth Lighting design

electrical depth





2nd level side office

Average Illuminance 22.8Fc Max Illuminance 33Fc Max/Min 1.6

RENDERINGS + CALCULATIONS

design concept

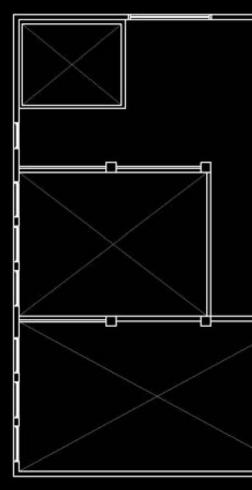
scope of work

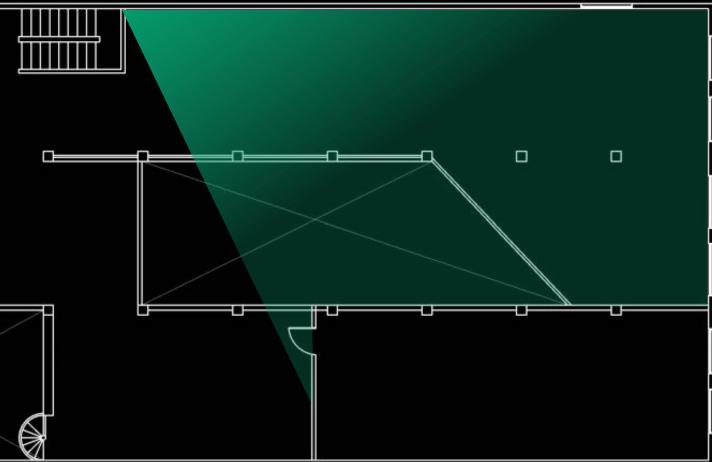
lobby lighting design

Office architecture breadth Lighting design

electrical depth







3rd level side office

Average Illuminance 22.4Fc Max Illuminance 33.5Fc Max/Min 1.8

RENDERINGS + CALCULATIONS

design concept

scope of work

lobby lighting design

office architecture breadth lighting design

Electrical Depth



ELECTRICAL SYSTEM

ELECTRICAL DEPTH

design concept

scope of work

lobby lighting design

office architecture breadth lighting design

Electrical Depth



To NS Pe Ele

nal Board	Lighting (VA)	Receptacle (VA)	Equipment (VA)	
P2B	0	27000	4576	
P22	770	31000	15476	
P23	883	21140	24400	
P21B	8233	12140	12504	
P24	4524	800	0	
P25	800	0	2400	
P26	1800	36500	21080	
L42	20920	0	0	
L44	4299	0	0	
P32	0	0	11200	
P22A	0	0	40292	
EP4B	12033	0	92520	
P21A	0	0	600	
P2P	0	1800	8700	
EP2B	1080	1500	6584	
tal (kVA)	55.342	131.88	240.332	427.554

NSTAR

Peak Demand Rate = \$28.62/kW (per month) Electric Rate: \$0.08145/kWh Delivery Charge = \$115/month (flat rate)

Array Area
PV rate
Total watt per array
Total Load usage per year
PV cost/watt
PV cost per year
Watt save per year
Conventional Power

1300 sf	
100w/sf	
130kw	
14.8kw	
\$1.4/w	
\$14800	
130kw	
\$17619	
(\$2819)	

ELECTRICAL DEPTH

SPECIAL THANKS TO:

Fruanhofer CSE Dr. Kurt Roth

Philips Ms. Dorene Mannicia Mrs. Carol Jones Ms. Meg Smith

DiMella Shaffer Mr. J. Cruz

ACKNOWLEDGEMENTS



Penn State Mr. Shawn Good Ms. Leslie Beahm Dr. Kevin Houser Dr. Rickard Mistrick Dr. Charles Cox Professor Kevin Parfitt And thanks to my parents, fellow AEs and friends for the best support I could ask for

SUMMARY

Lighting redesign of the spaces achieved the design goals of providing the spaces quality lighting as well as a modern new appearance while saving energy the same time.

The electrical part is altered according to the new design of lighting and control load. Since the building is not completely finished of the retrofit process, the load is slightly higher than the current load due to the vacant of two stories.

The architecture breadth has a cohesive design with the lighting design in the office space. And it accomplished the goal of creating a better working environment.





QUESTIONS?

ΤΙΩΝΙς2

APPENDICES

\$18.19 Distribution Ene Each additional (per kWh) \$0.01727 Transition Ener Next 150 hours of (per kWh) \$0.00783 Transmission De Greater than 10 (per kW) \$5.54 Transmission E Each additional



Customer (per month) \$18.19	Distribution Energy First 2,000 kWh (per kWh) \$0.02419	Distribution Energy Next 150 hours of kW (per kWh) \$0.01914
vistribution Energy ach additional kWh (per kWh) \$0.01727	Distribution Demand Greater than 10 kW (per kW) \$9.43	Transition Energy First 2,000 kWh (per kWh) \$0.00783
Transition Energy ext 150 hours of kW (per kWh) \$0.00783	Transition Energy Each additional kWh (per kWh) \$0.00783	Transition Demand (per kW) No Charge
ansmission Demand Greater than 10kW (per kW) \$5.54	Transmission Energy First 2,000 kWh (per kWh) No Charge	Transmission Energy Next 150 hours of kW (per kWh) No Charge
ransmission Energy ach additional kWh (per kWh) No Charge	Energy Conservation (per kWh) \$0.00250	Renewable Energy (per kWh) \$0.00050

Customer (per month) \$18.19	Distribution Energy First 2,000 kWh (per kWh) \$0.03412	Distribution Energy Next 150 hours of kW (per kWh) \$0.02087
Distribution Energy Each additional kWh (per kWh) \$0.01776	Distribution Demand Greater than 10 kW (per kW) \$20.22	Transition Energy First 2,000 kWh (per kWh) \$0.00783
Transition Energy Next 150 hours of kW (per kWh) \$0.00783	Transition Energy Each additional kWh (per kWh) \$0.00783	Transition Demand (per kW) No Charge
Transmission Demand Greater than 10kW (per kW) \$14.68	Transmission Energy First 2,000 kWh (per kWh) No Charge	Transmission Energy Next 150 hours of kW (per kWh) No Charge
Transmission Energy Each additional kWh (per kWh) No Charge	Energy Conservation (per kWh) \$0.00250	Renewable Energy (per kWh) \$0.00050

APPENDICES



http://www.nrel.gov/