



SEAN KIM |  
L/E option  
AE Thesis Presentation



David Logan, and Reva Logan

[From: <http://arts.uchicago.edu/logan-center/about-logan-center>]

*“The Logan family sees the center not as a building project... but as a way to improve the quality of life for students and faculty of the University, as well as the community.”*

- David Logan

# Reva and David Logan Center for the Arts

**Building Type:** Multidisciplinary arts center

**Owner:** University of Chicago

**Size:** 184,000 square foot

**Design Architect:** Tod Williams Billie Tsien Architects

**Stories:** 11-story tower with 3-story adjacent building

**Lighting Design:** Refro Design Group

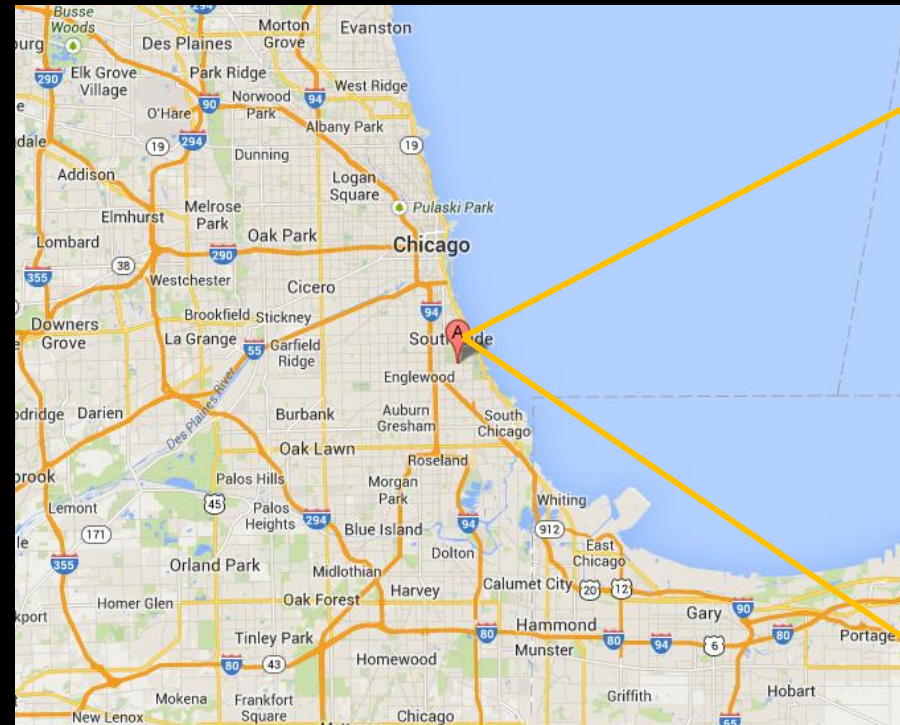
**MEP Engineer:** Ambrosino Depinto & Schmieder Consulting Engineering

**Construction Manager:** Turner Construction, LLC

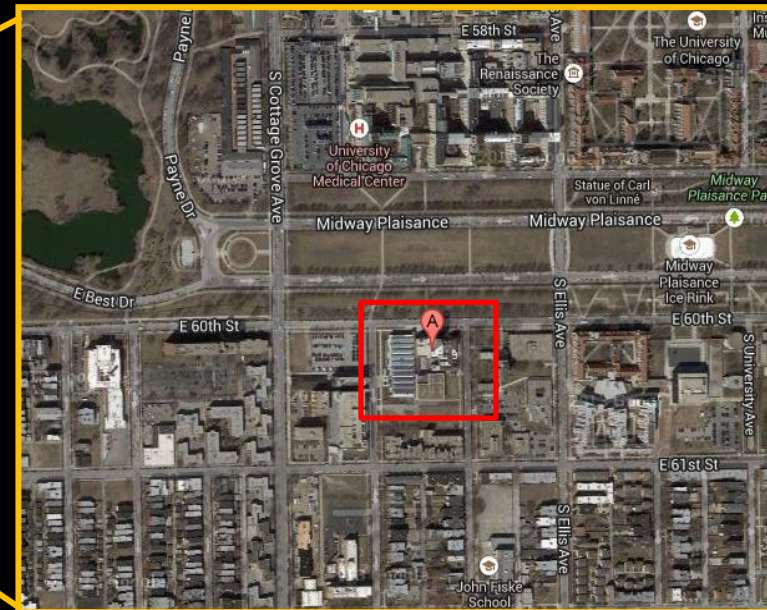


[From: <http://arts.uchicago.edu/logan-center/about-logan-center>]

[From: <http://arts.uchicago.edu/logan-center/about-logan-center>]



[From: google map]



**Lighting Depth** | Main Lobby  
| Performance Hall  
| Performance Penthouse  
| Courtyard

**Electrical Depth** | Size reduction of Emergency Generator  
| MCB for Main Distribution Switchboard  
| High-Efficiency dry-type Transformer

**Acoustical Breadth** | Reverberation Time & Bass Ratio  
for Performance Hall

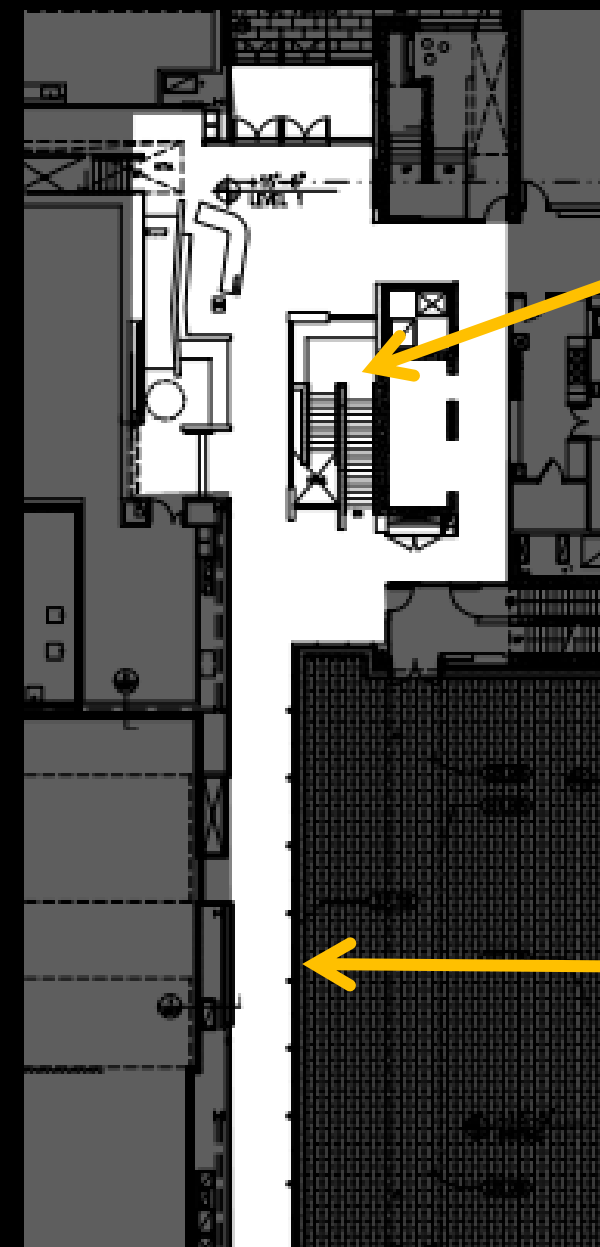
**Mechanical Breadth** | Solar Heat Gain & Cooling Load of Different  
Glazing type on the Corridor

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**Entry Lobby**

**Corridor**



[From: <http://facilities.uchicago.edu/construction/performing-arts/>]

### Design Goal

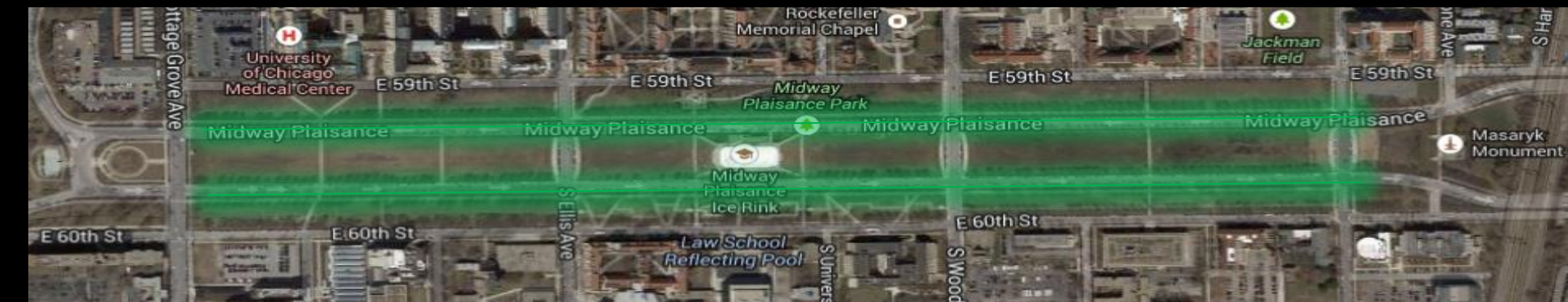
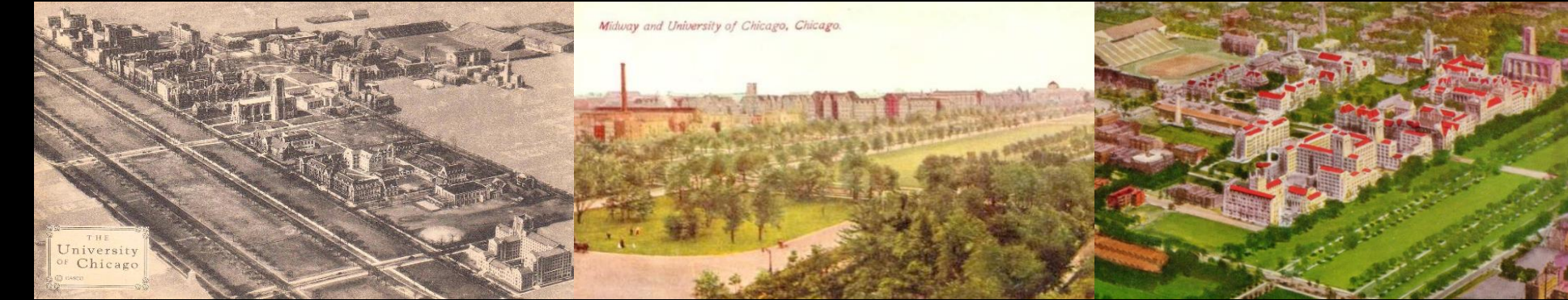
- Powerful atmosphere
- Create welcoming environment
- Way finding
- Public impressions



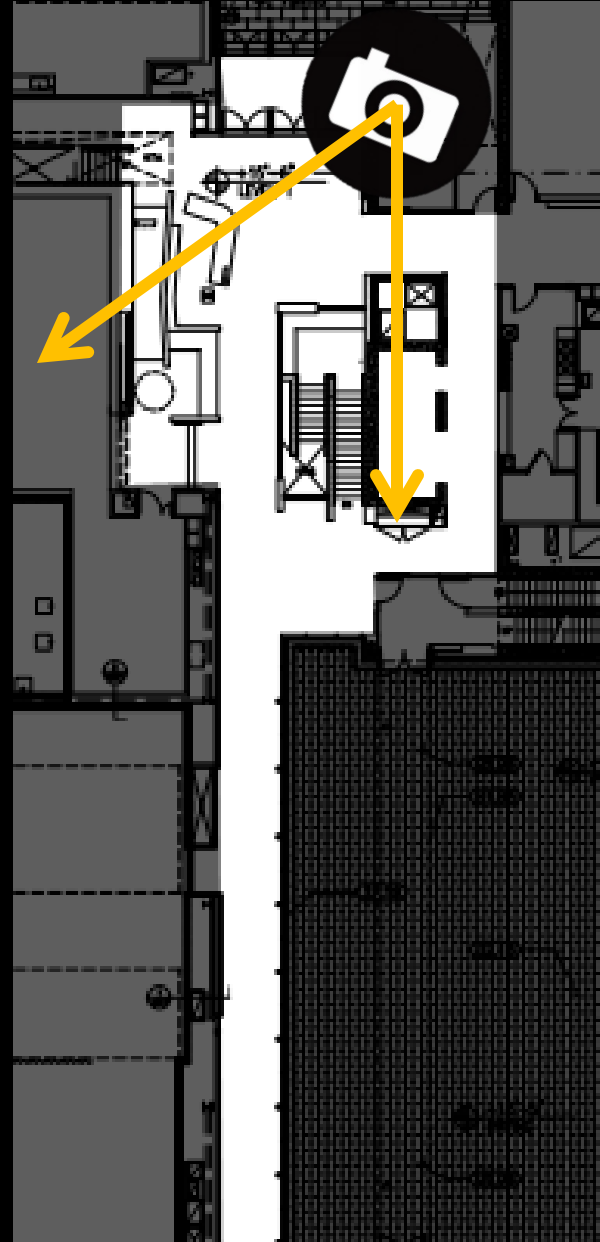
<http://arts.uchicago.edu/logan-center/about/about-logan-center-0>

*“The idea of the low, sky lit building of studios and theaters, and the tower of the arts came from imagining the flat prairies of the Midwest and the great towers of Chicago.”*

- Tod Williams & Billie Tsien, Architects

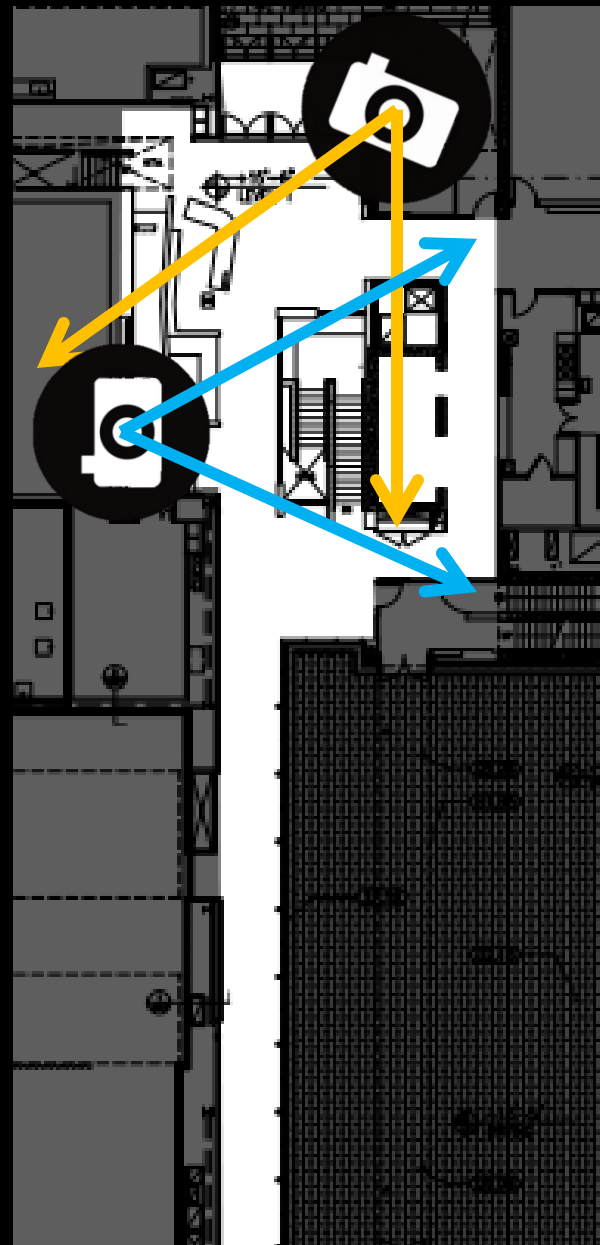


[From: google map, University of Chicago, ]



LED Cove Lighting



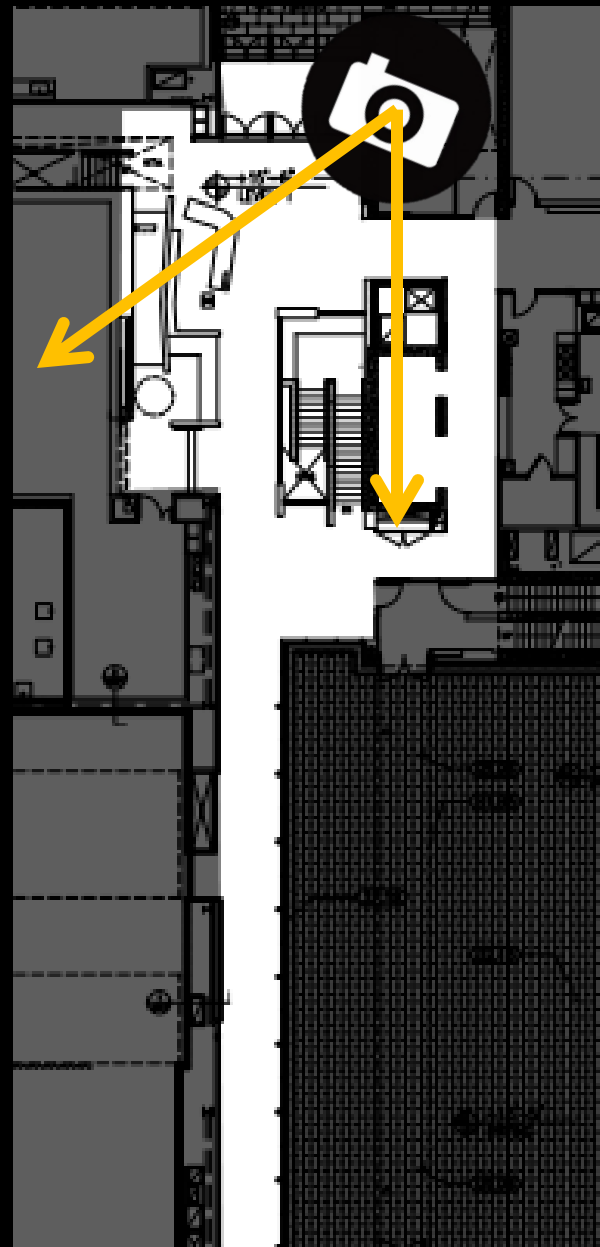


LED Cove Lighting



LED Wall glazing





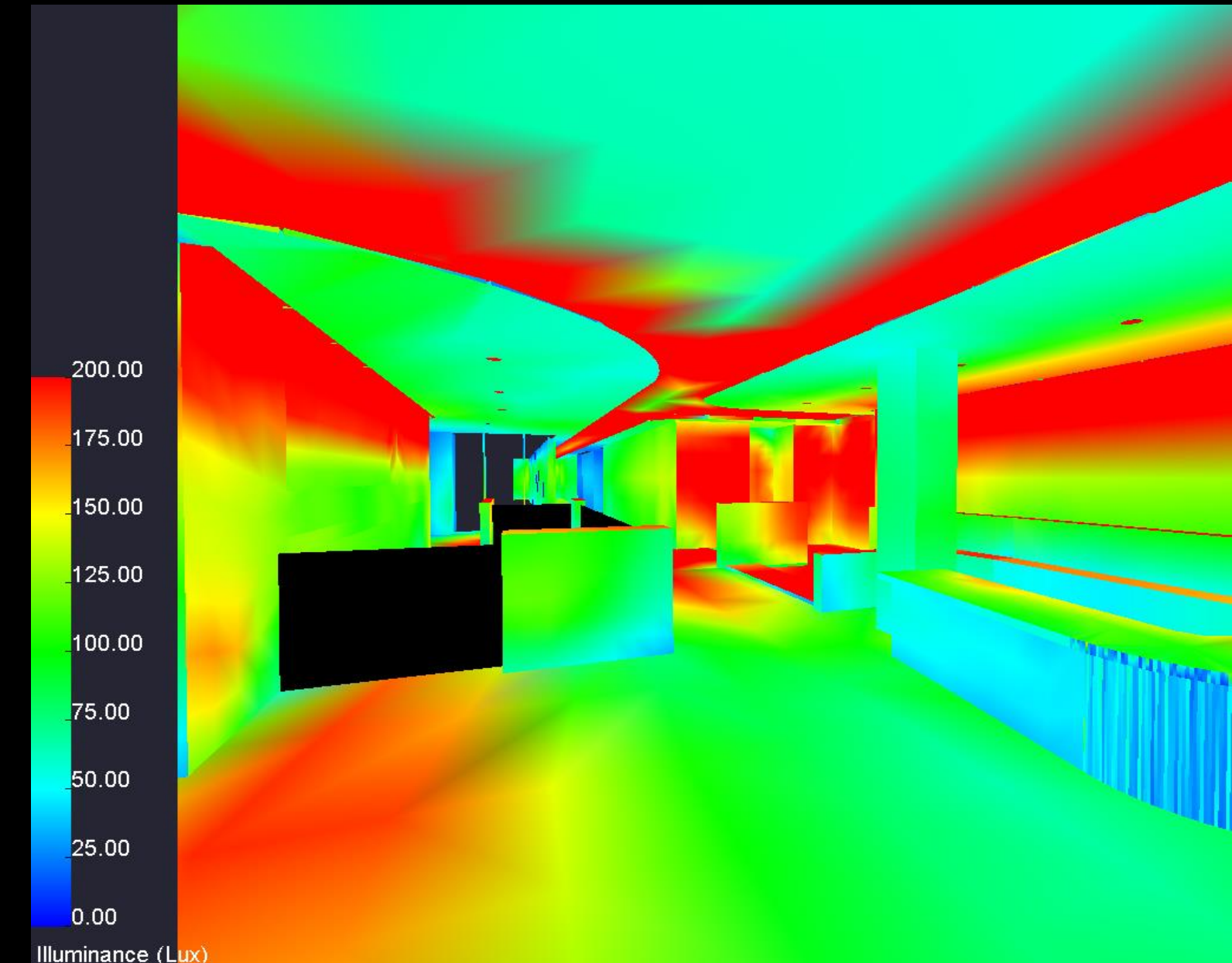
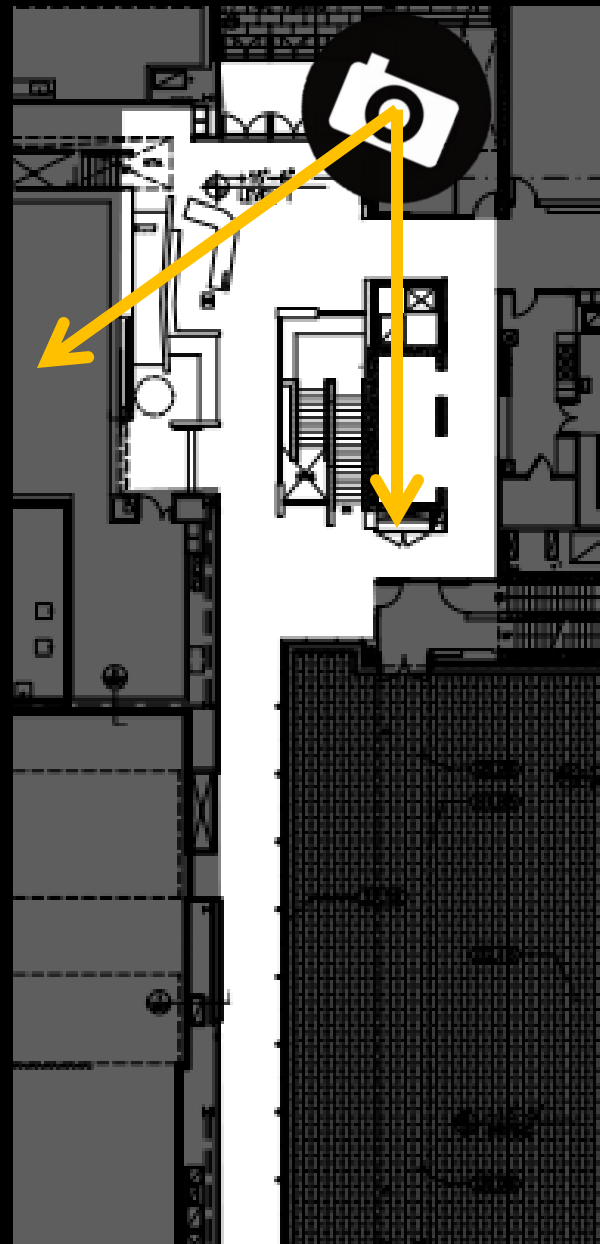
LED Cove Lighting

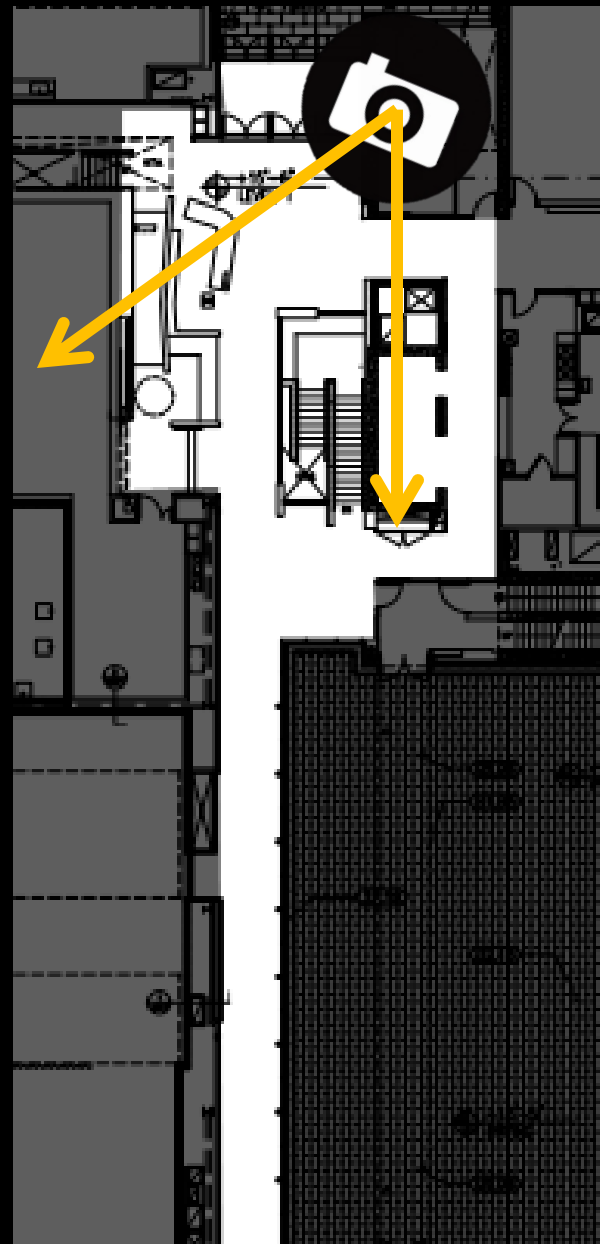


LED Wall glazing

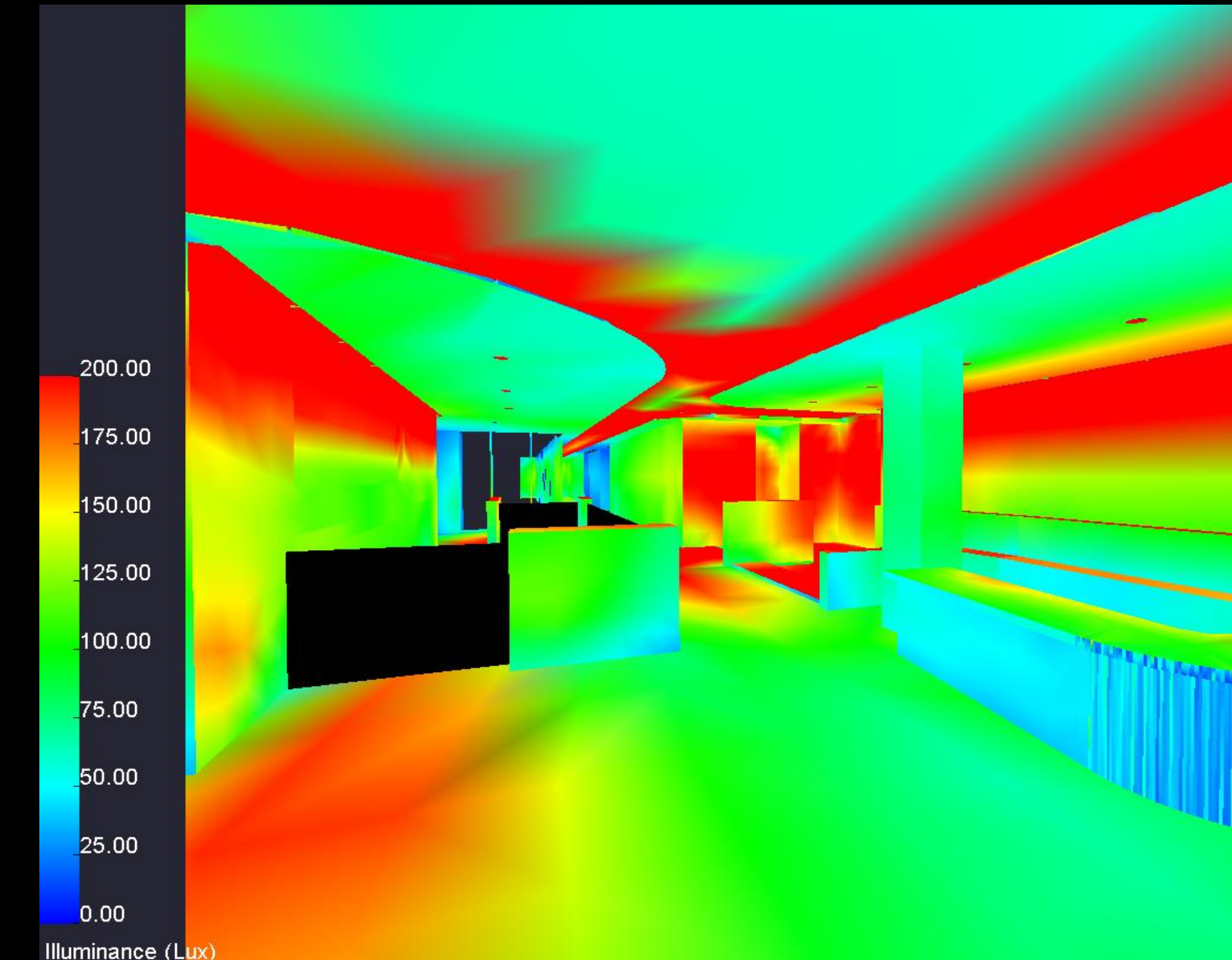


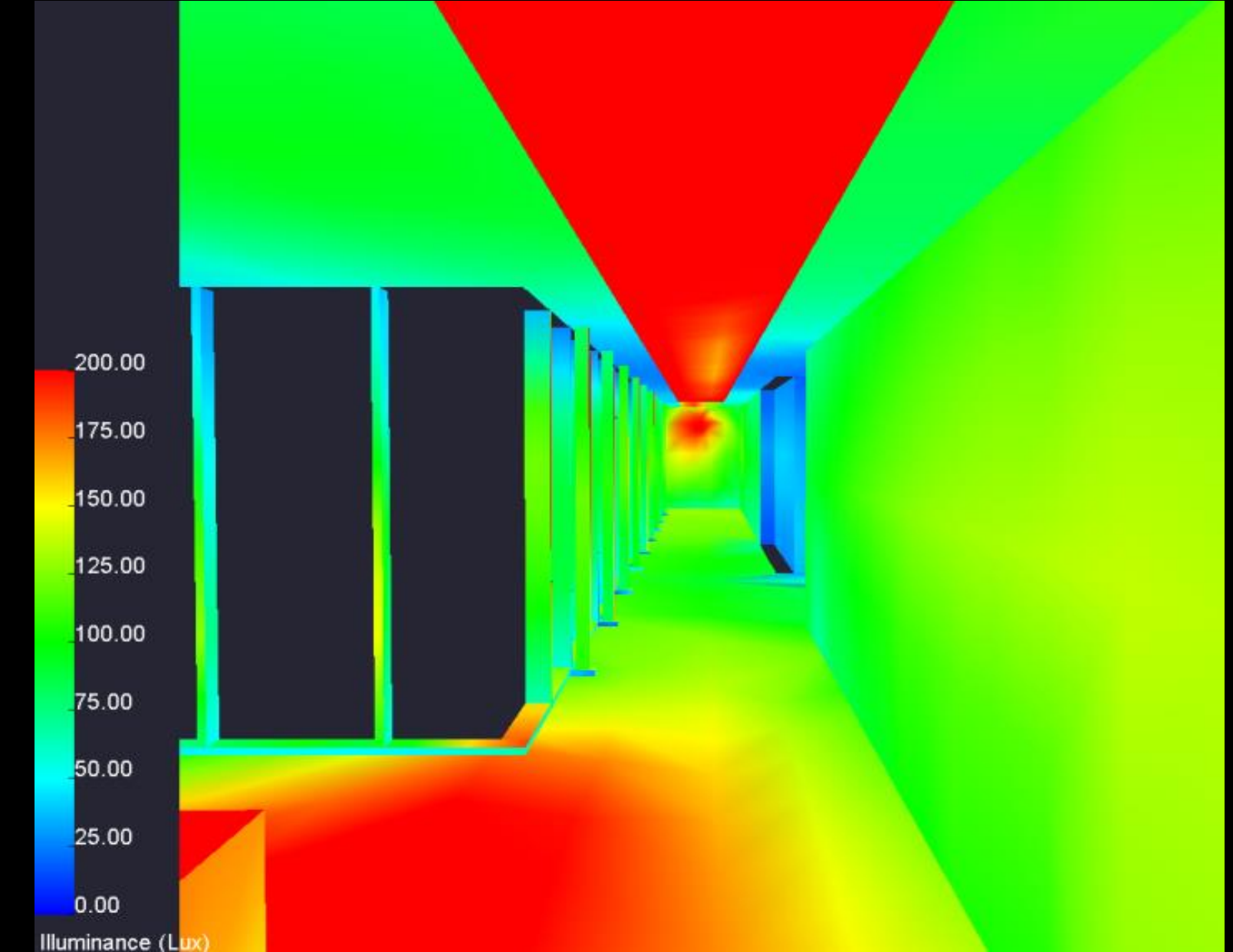
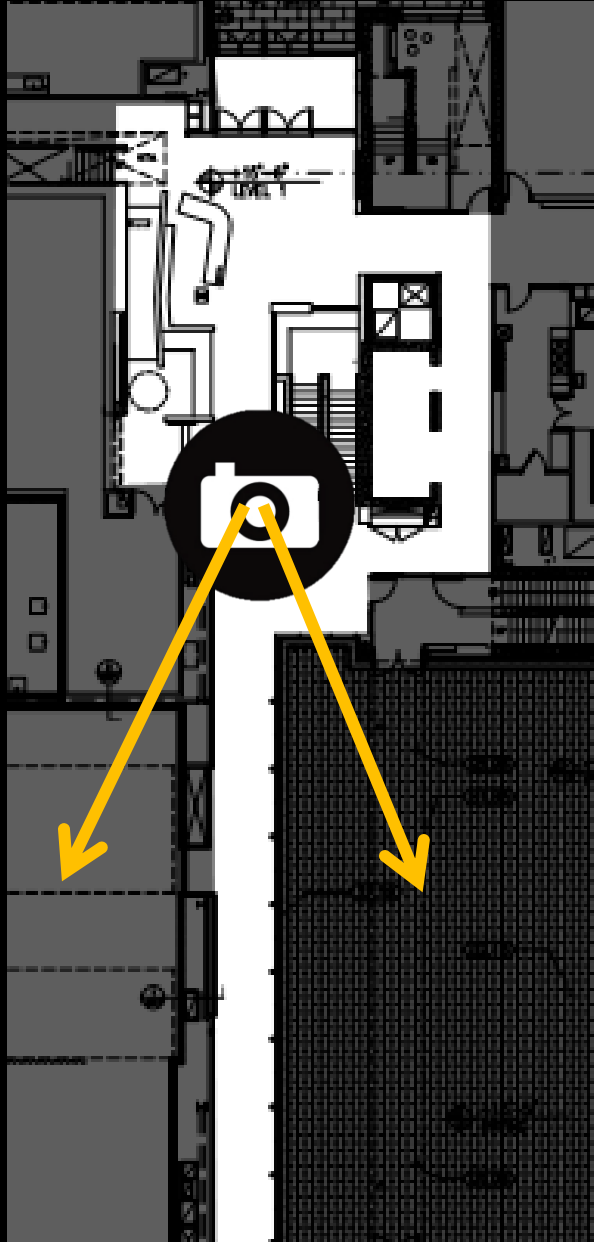
Compact Fluorescent Downlight

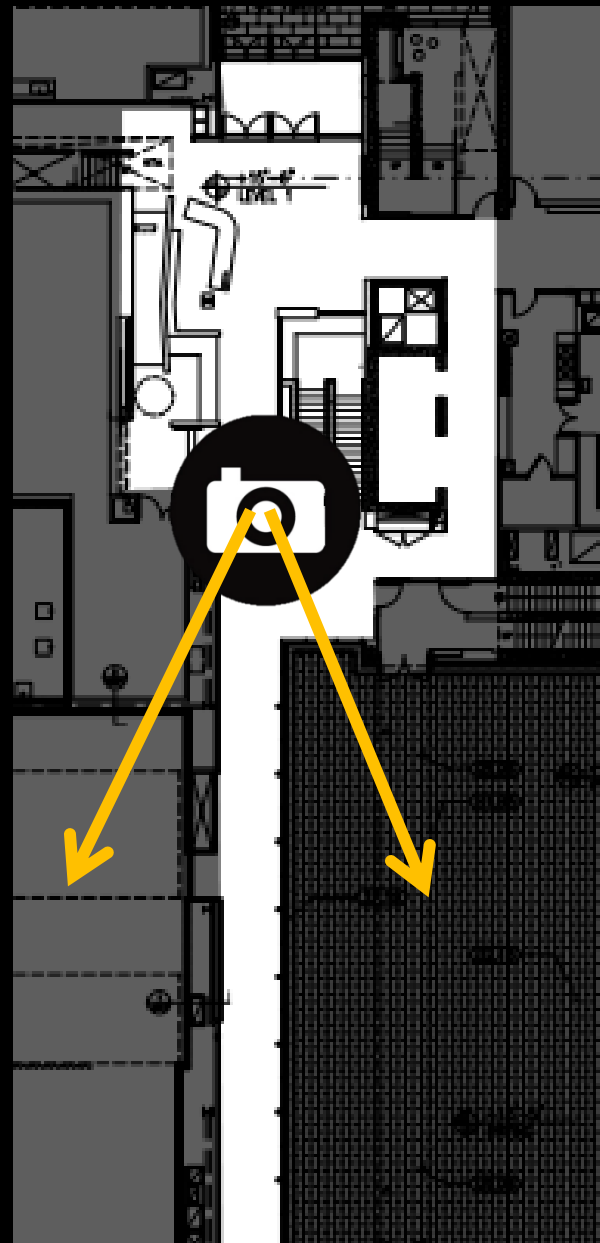




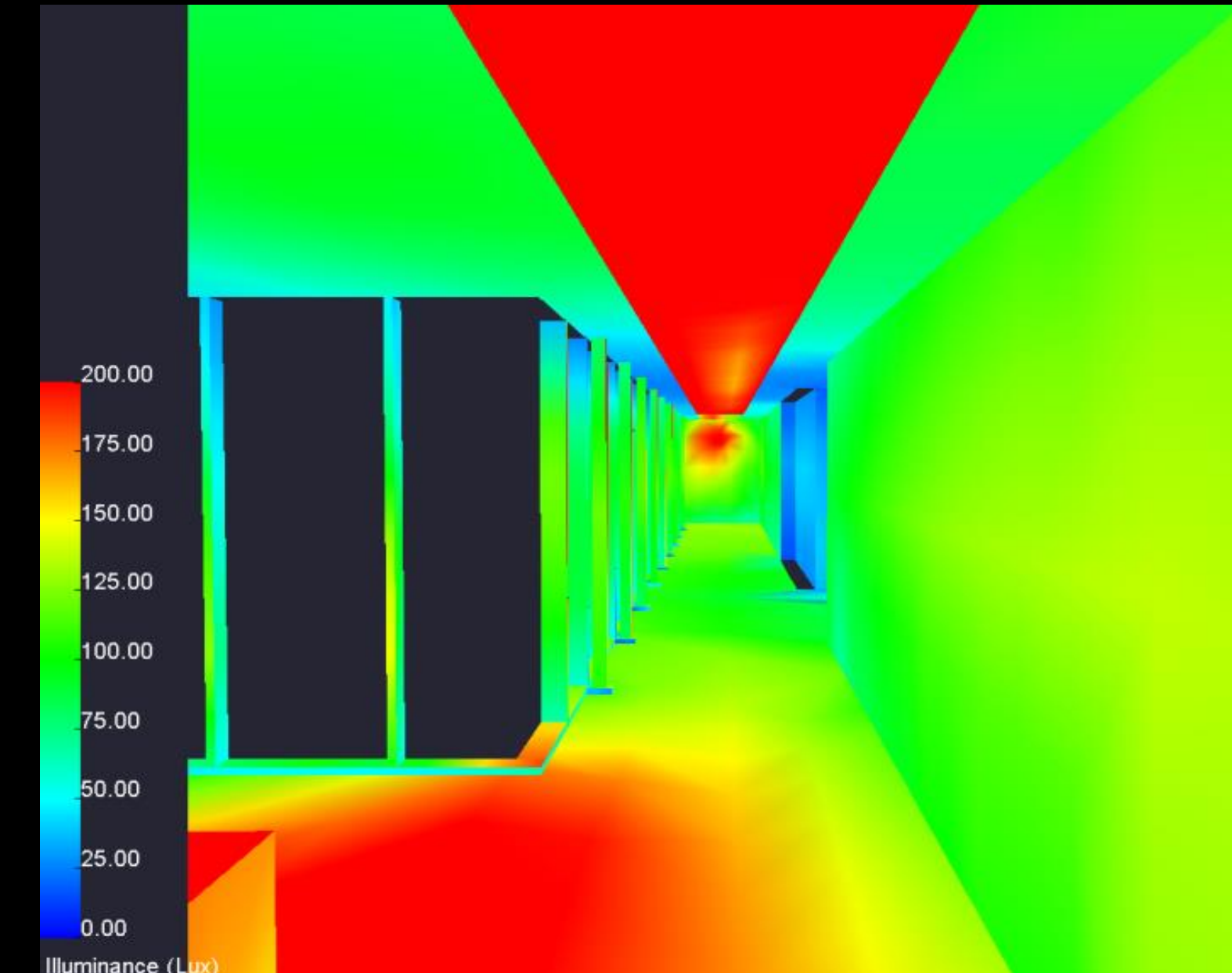
	Eh (lux)	Avg:Min
IES Criteria: Lobby	50	4:1
Design Proposed: Lobby	95.19	1.92:1
IES Criteria: Reception Desk	150	4:1
Design Proposed: Reception Desk	164.6	2.2:1
<b>Power Density (W/ft<sup>2</sup>)</b>		
ASHRAE 90.1 (2010): Lobby	1.3	
Design Proposed: Lobby	0.64	

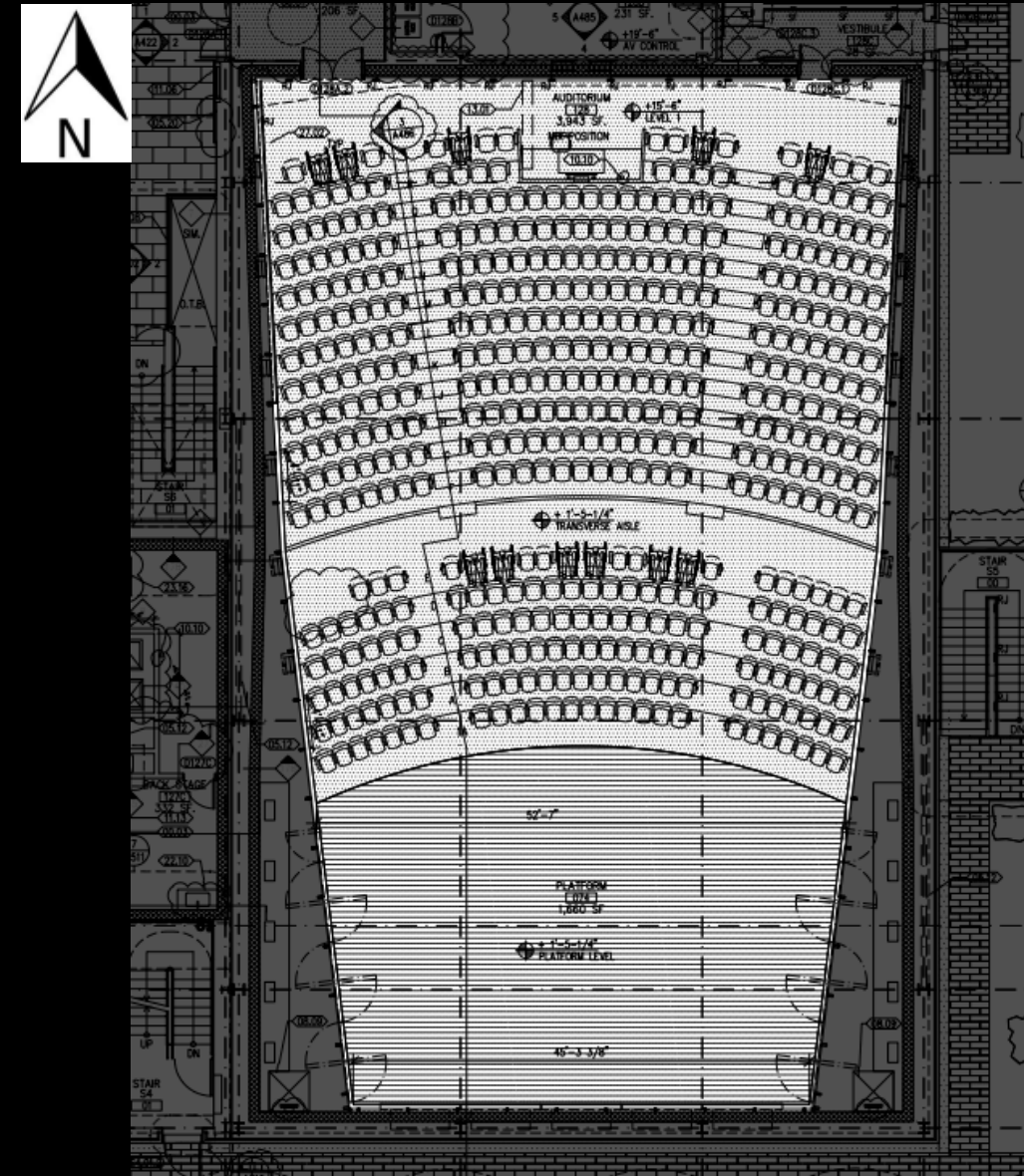






	Eh (lux)	Avg:Min
IES Criteria: Corridor	50	4:1
Design Proposed: Corridor	95.8	1.85:1
Power Density (W/ft <sup>2</sup> )		
ASHRAE 90.1 (2010): Lobby	0.5	
Design Proposed: Lobby	0.87	





### Design Goal

- Uniform Light Distribution with Comfort
- Pleasant Environment with Relax Atmosphere
- Avoid Visual Distraction
- Three Design Concepts



**Modernism**

Dynamic with Linear



**Sophisticated**

Intense glare but simple

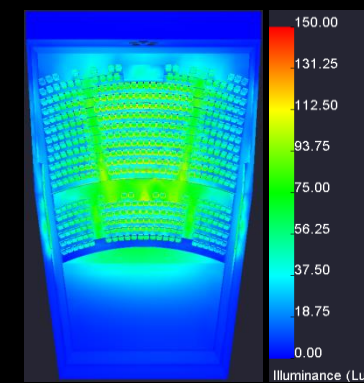
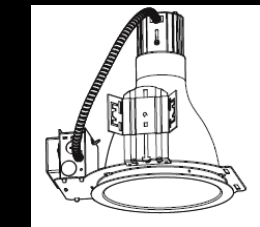
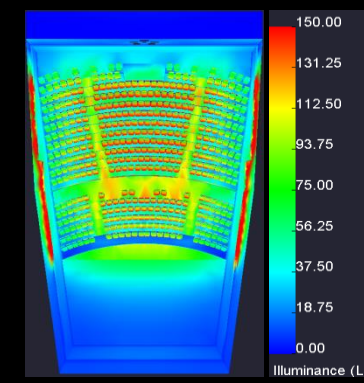
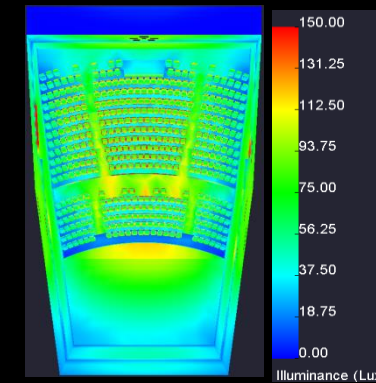
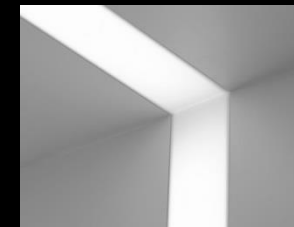
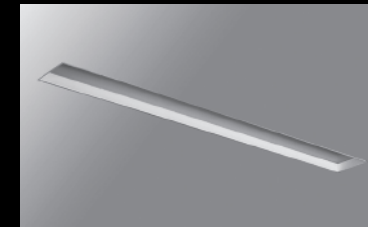


**Classical**

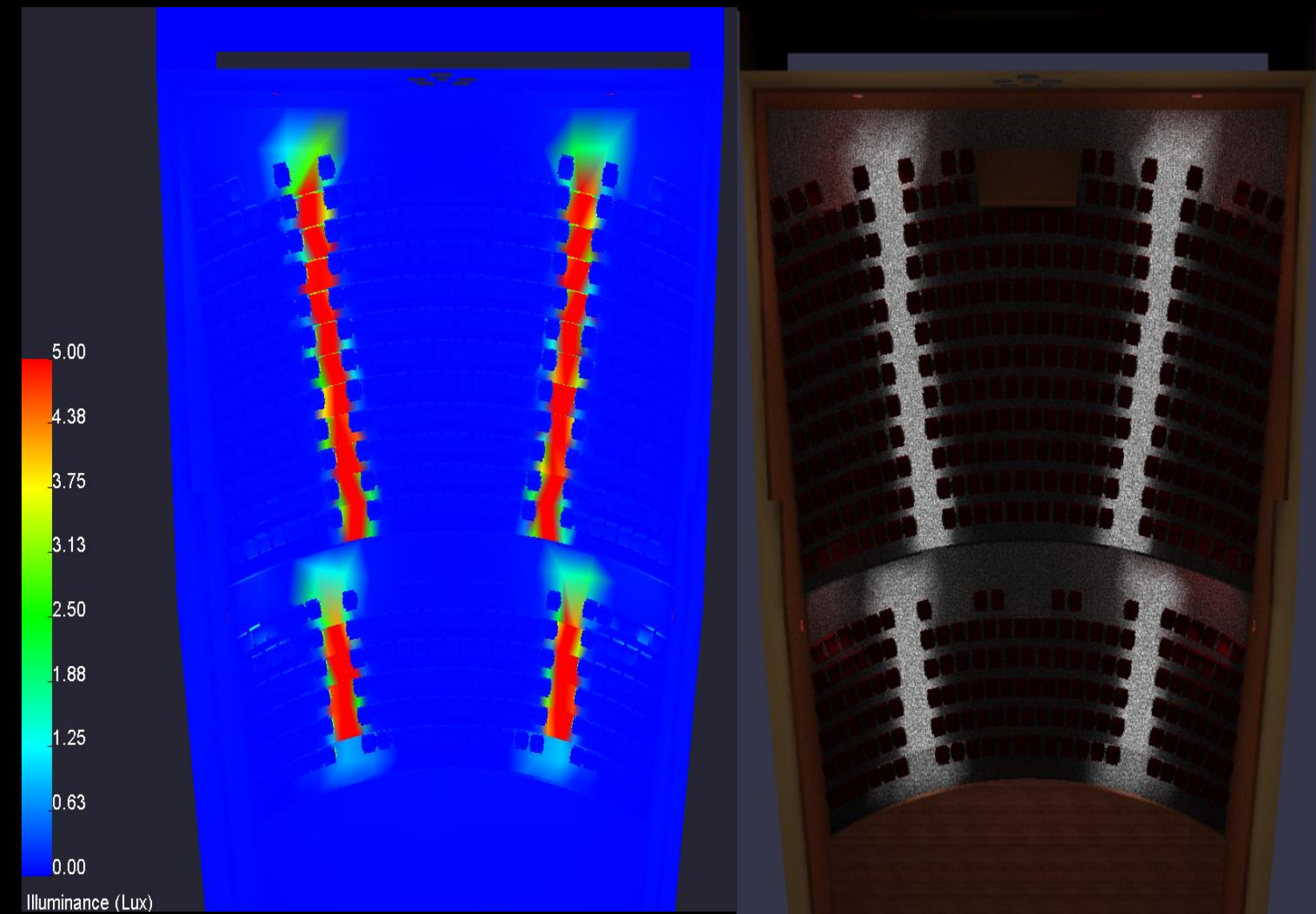
Greek Doric Columns











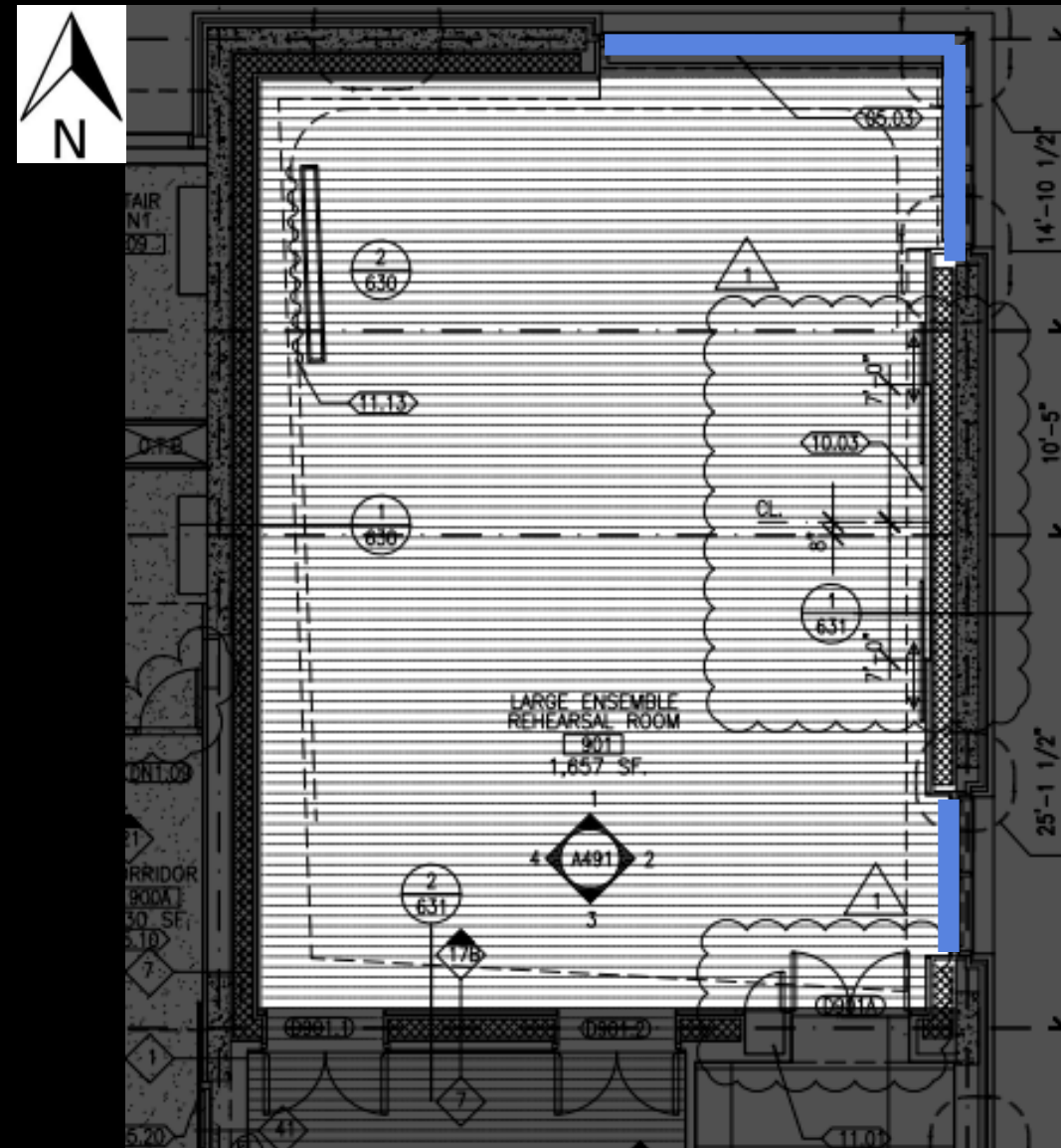
Egress Lighting

	Eh
N.F.P.A. Code Minimum	0.2 fc
Design Proposed	0.38 fc



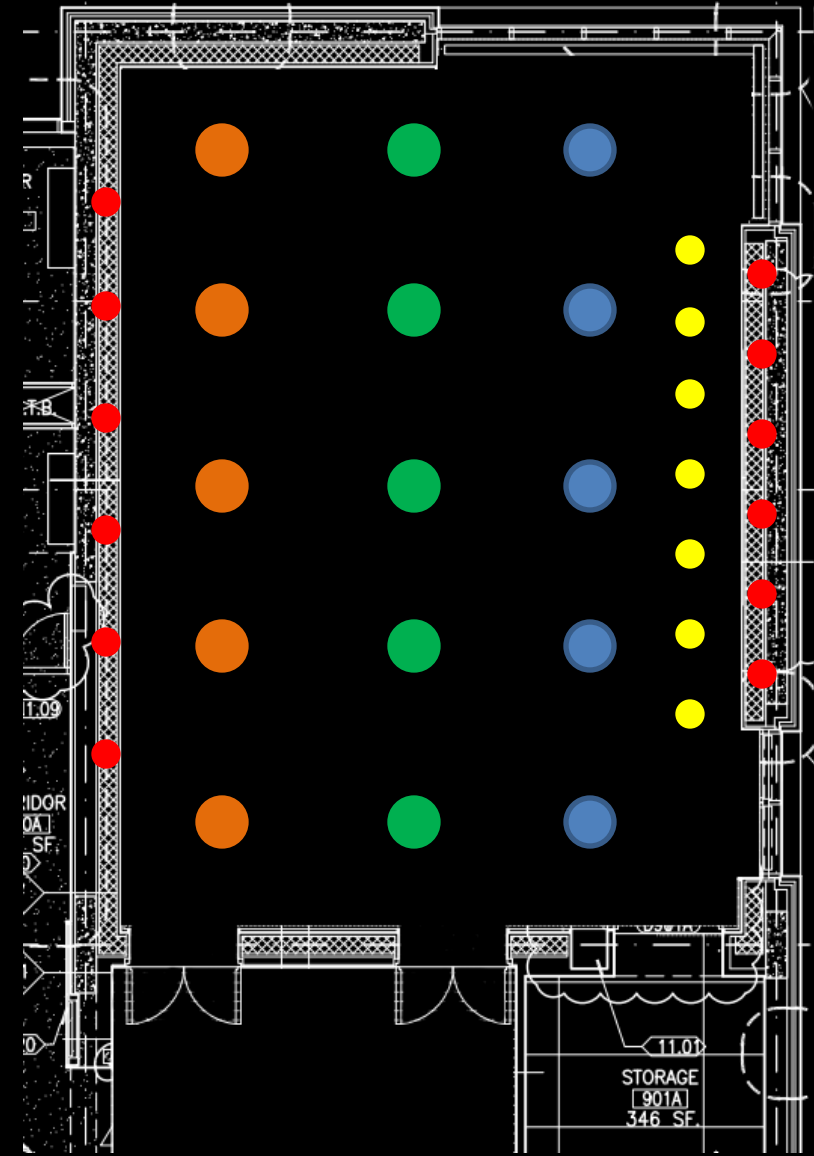
LED Seat Light

Wall Surface "Exit" panel



### Design Goal

- Uniform Light Distribution
- Flexible lighting
- Provide different Scenes for various activities



Zone 1

Zone 2

Zone 3

Zone 4

Zone 5



Custom LED Pendant Light  
(2) for down, (1) for Up

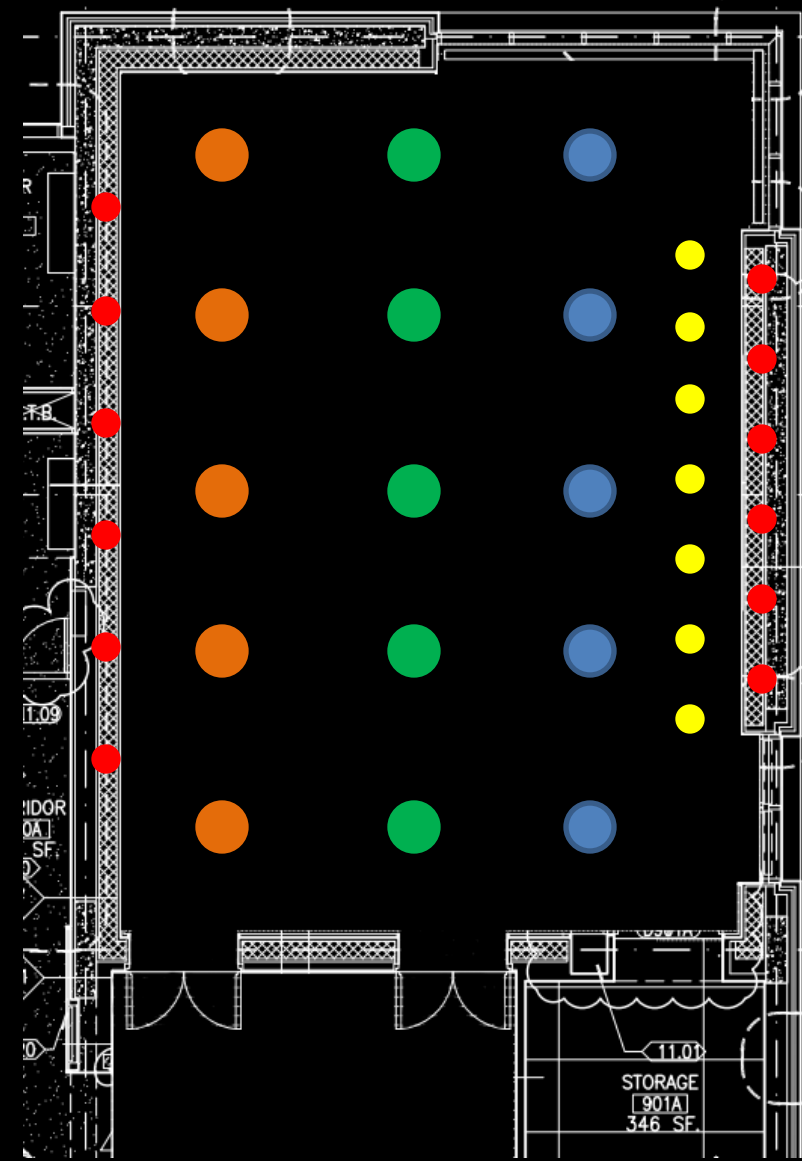


LED Spot Light



3" aperture Recessed Downlight





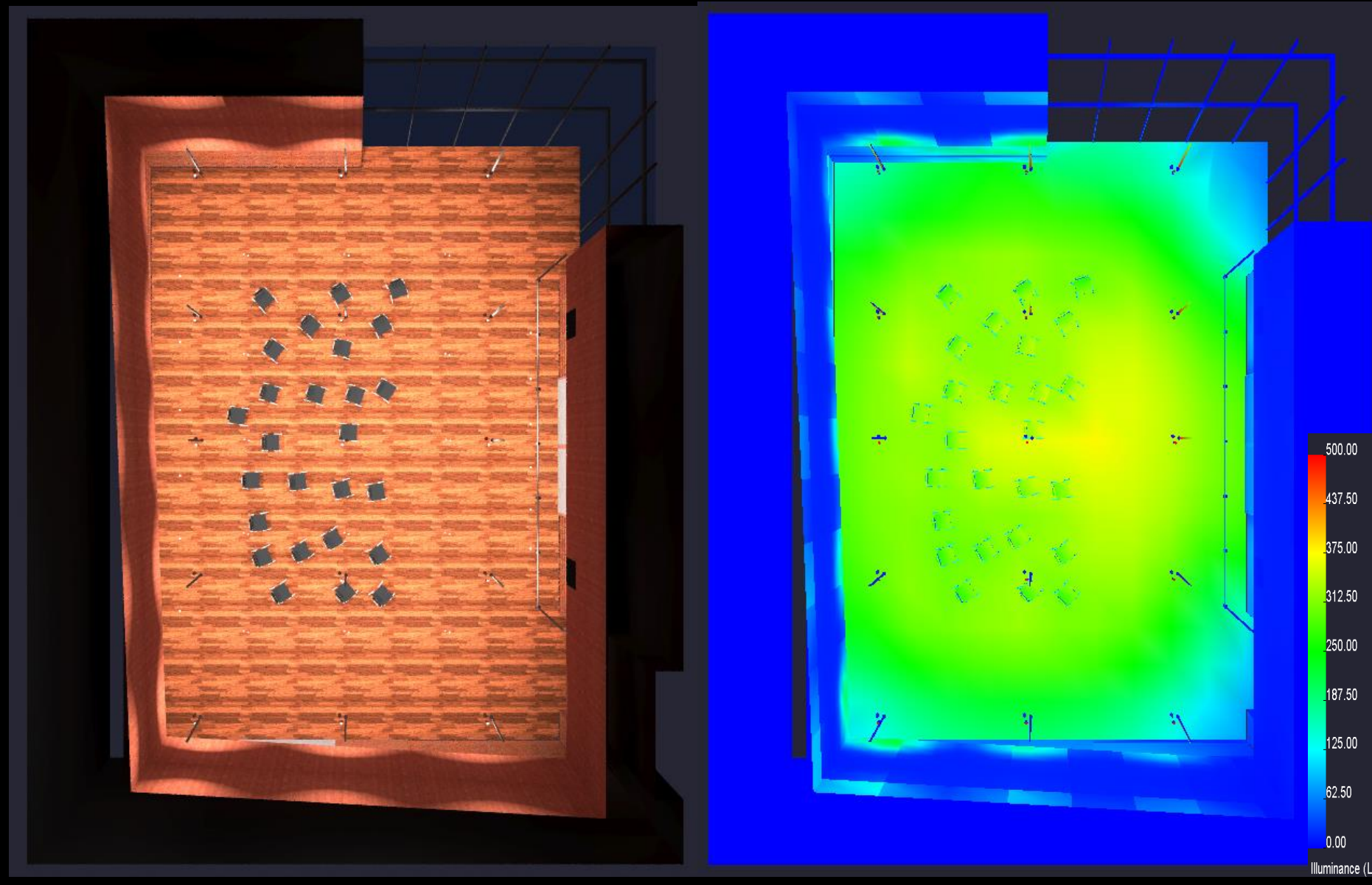
Zone 1 – 100% Output

Zone 2 – 100% Output

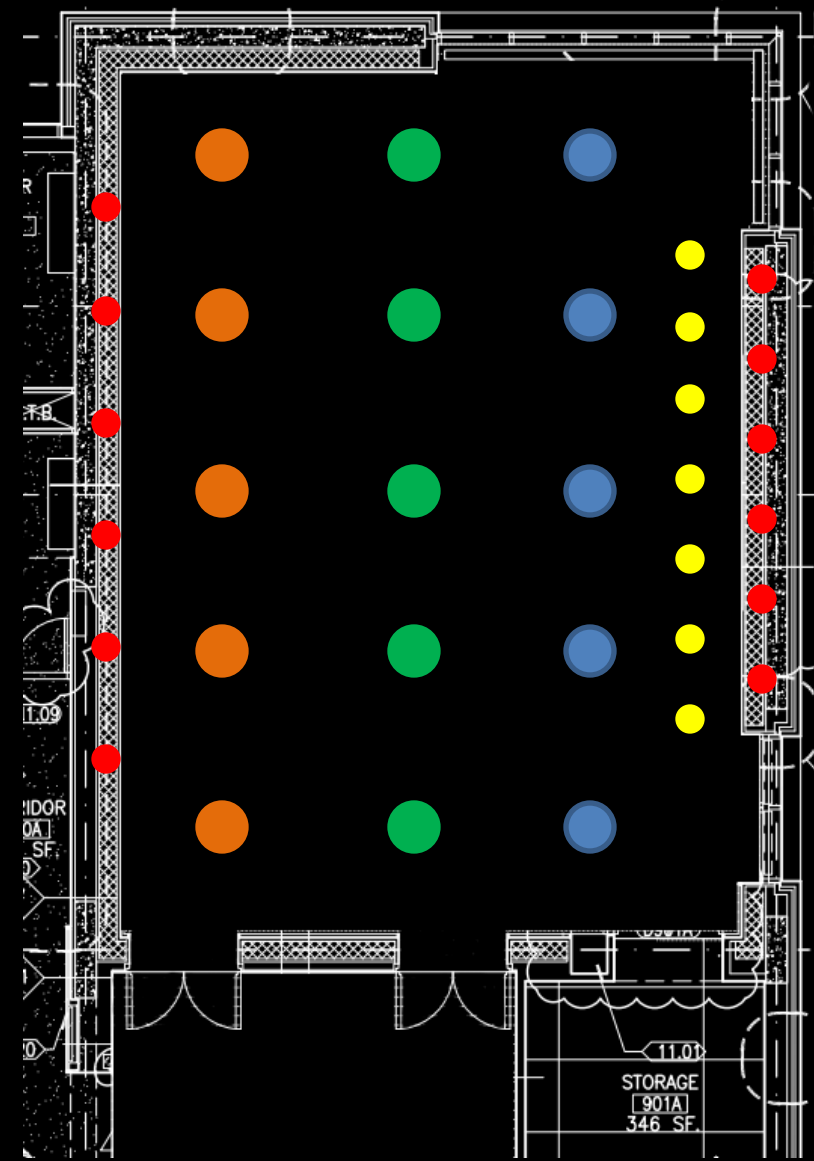
Zone 3 – 100% Output

Zone 4 – ON

Zone 5 – ON



	Eh (lux)	Avg:Min
<b>IES Criteria: Dance (Performance)</b>	<b>300</b>	<b>1.5:1</b>
<b>Design Proposed: All Lights On</b>	<b>338.26</b>	<b>1.6:1</b>
	Power Density (W/ft <sup>2</sup> )	
<b>ASHRAE 90.1 (2010)</b>	<b>1.4</b>	
<b>Design Proposed: Lobby</b>	<b>1.1</b>	



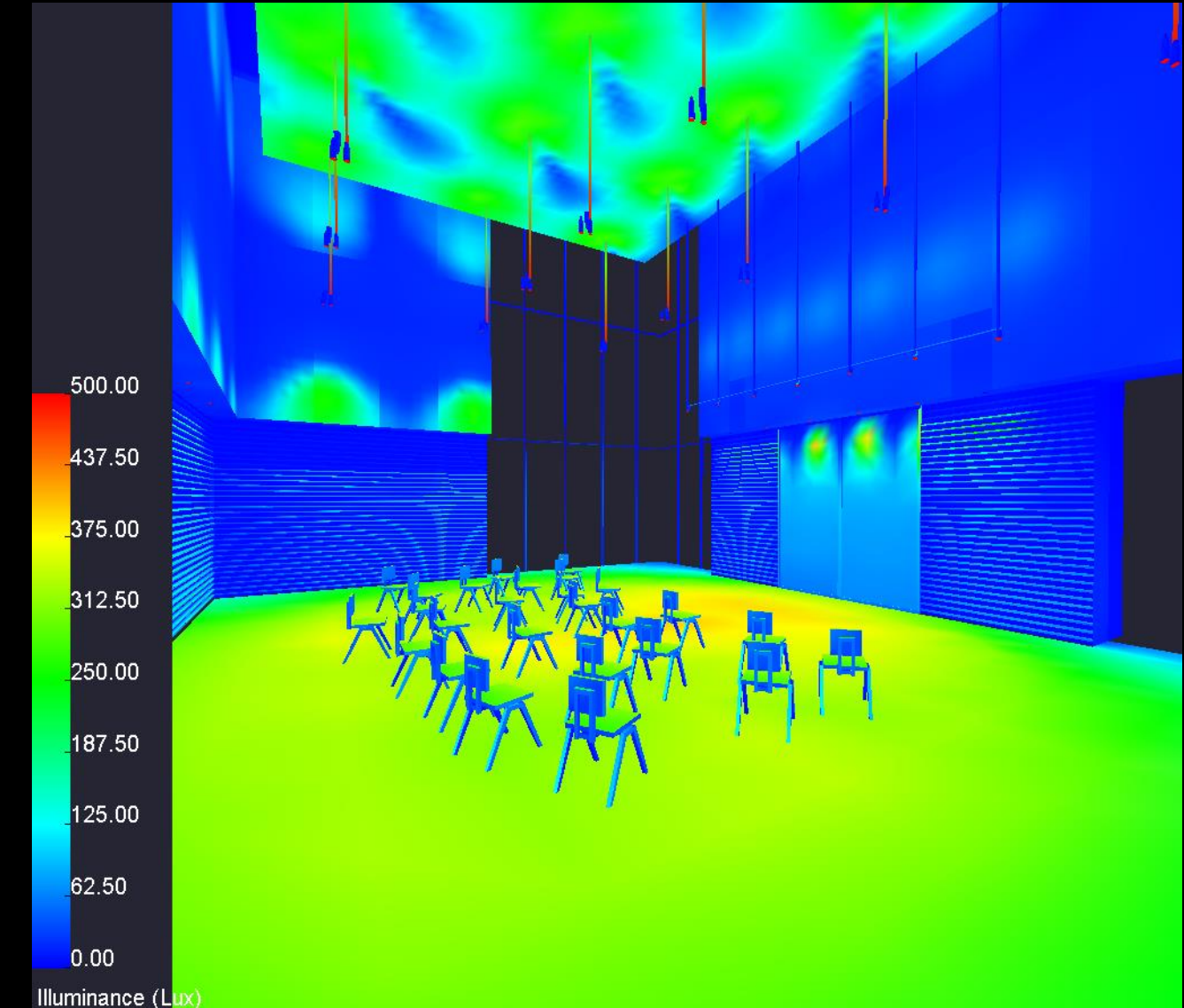
Zone 1 – 100% Output

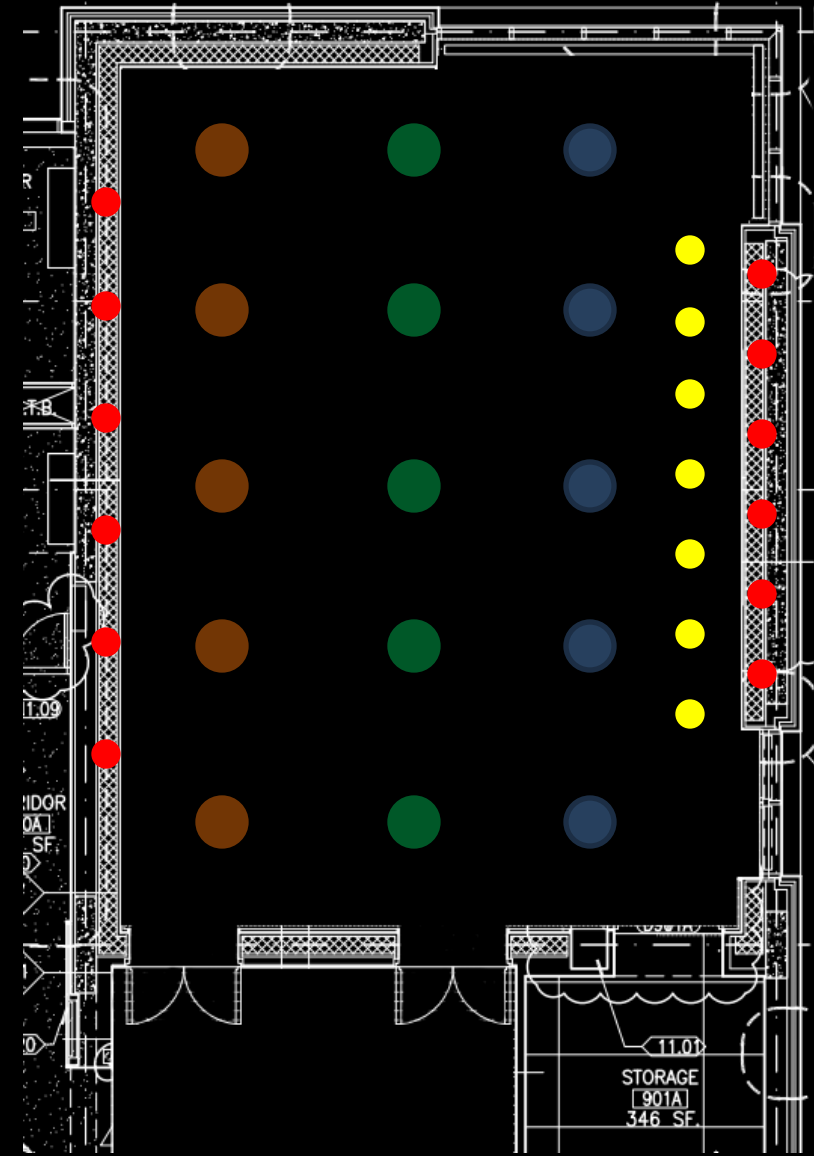
Zone 2 – 100% Output

Zone 3 – 100% Output

Zone 4 – ON

Zone 5 – ON





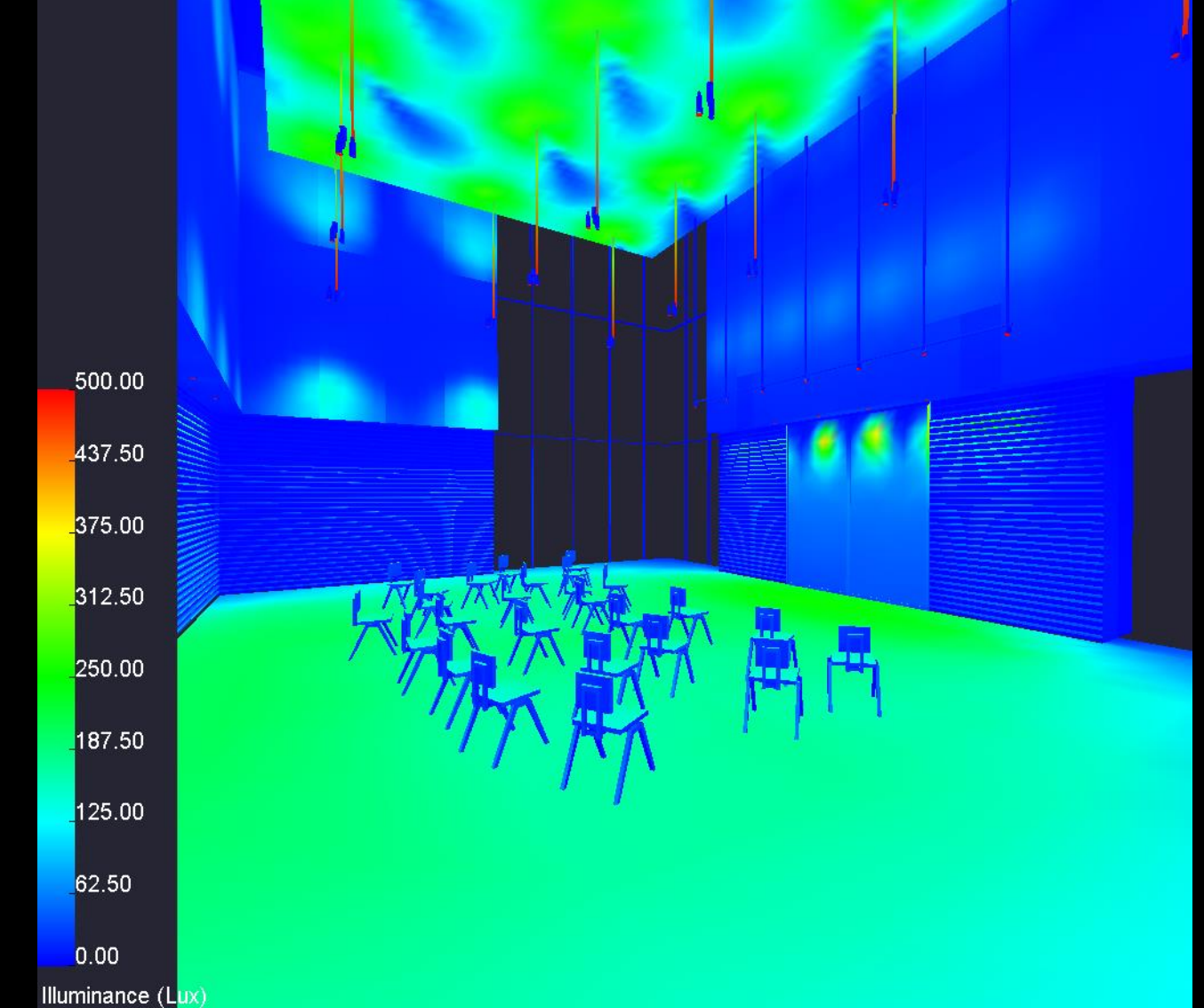
Zone 1 – 50% Output

Zone 2 – 50% Output

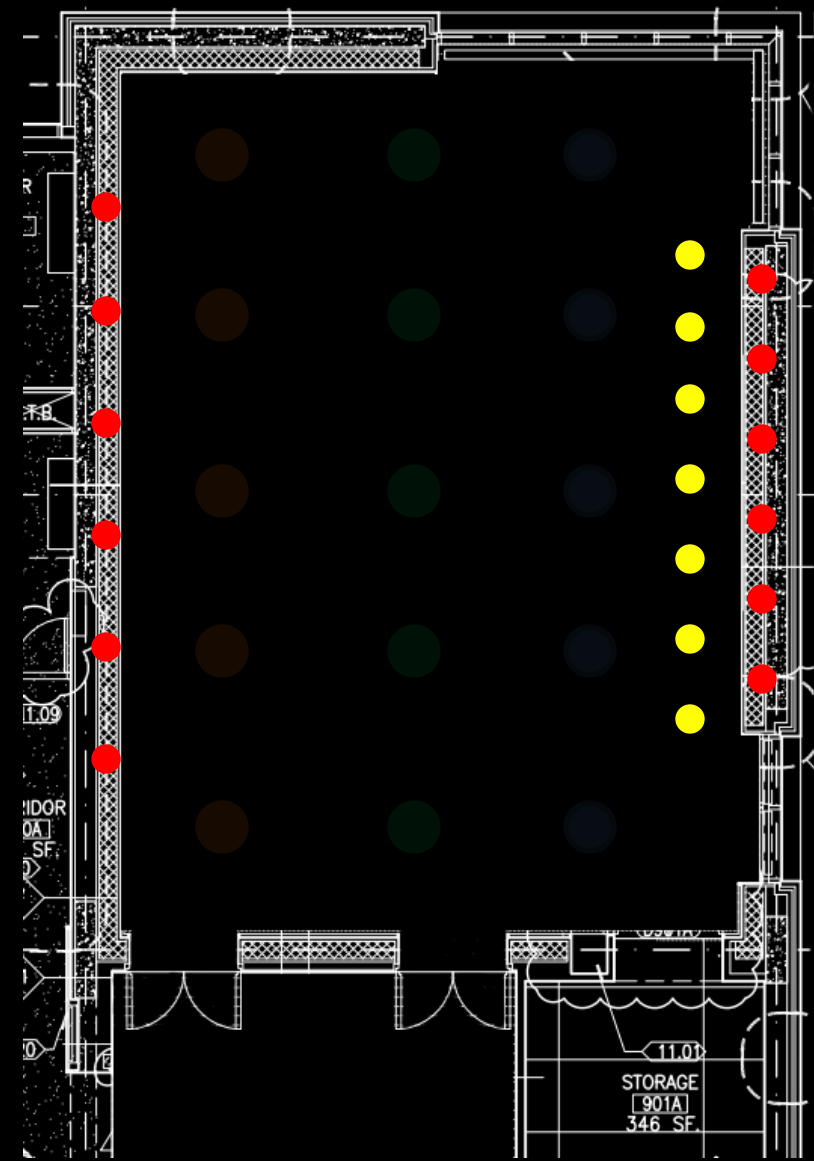
Zone 3 – 50% Output

Zone 4 – ON

Zone 5 – ON







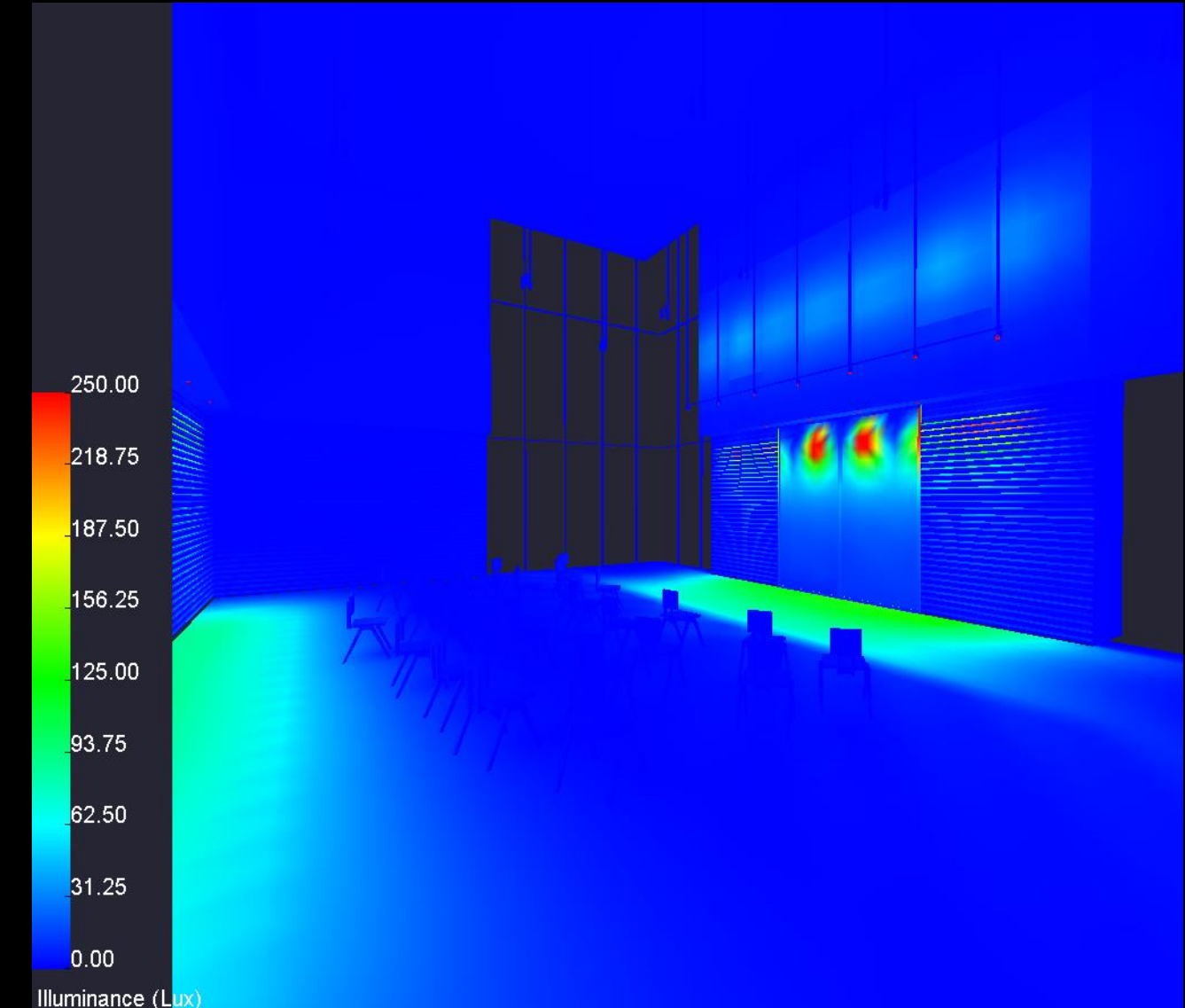
Zone 1 – OFF

Zone 2 – OFF

Zone 3 – OFF

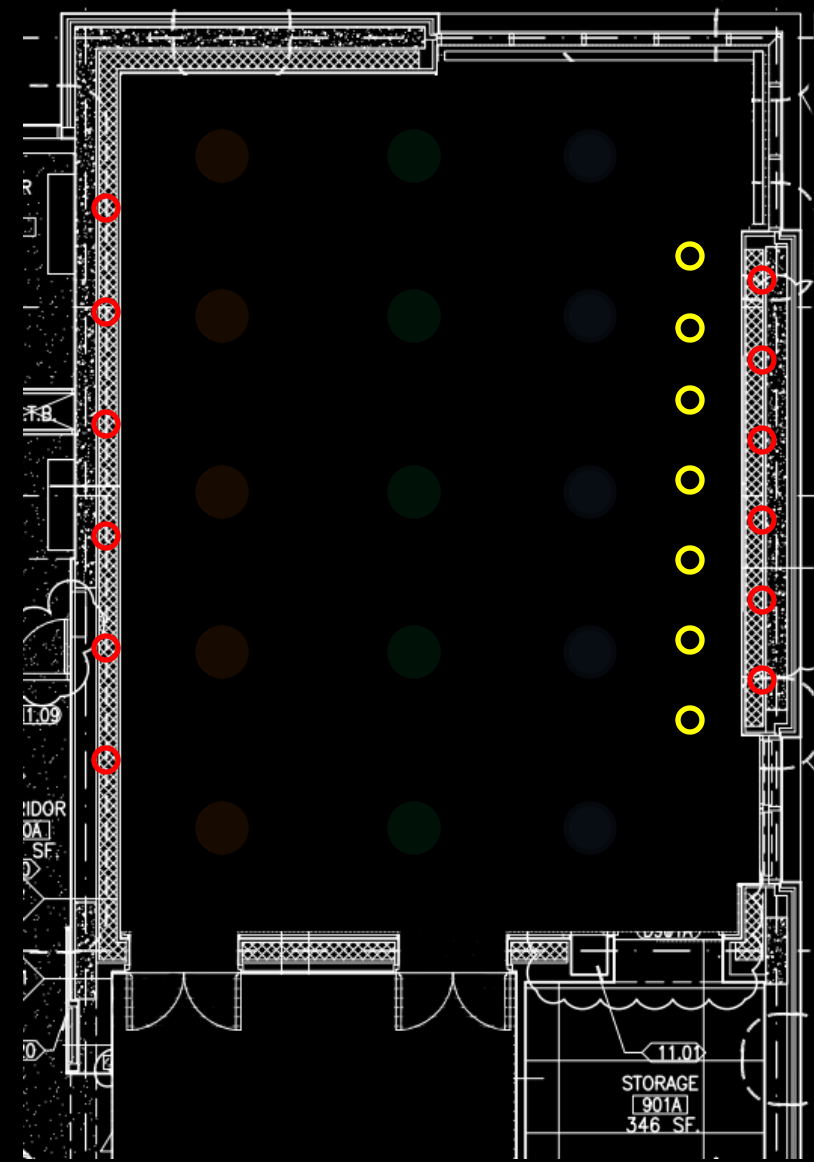
Zone 4 – ON

Zone 5 – ON



250.00  
 218.75  
 187.50  
 156.25  
 125.00  
 93.75  
 62.50  
 31.25  
 0.00

Illuminance (Lux)



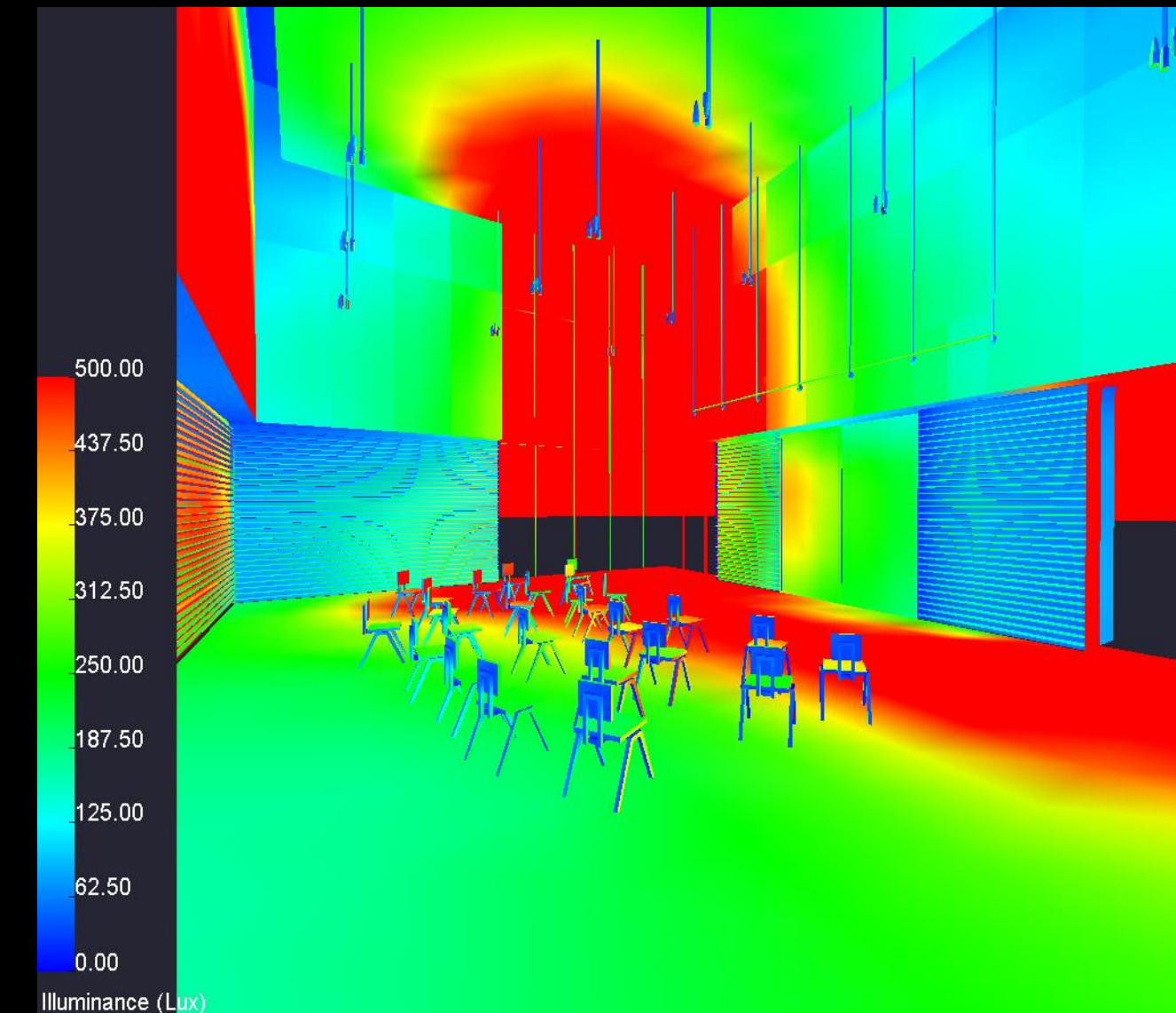
Zone 1 – OFF

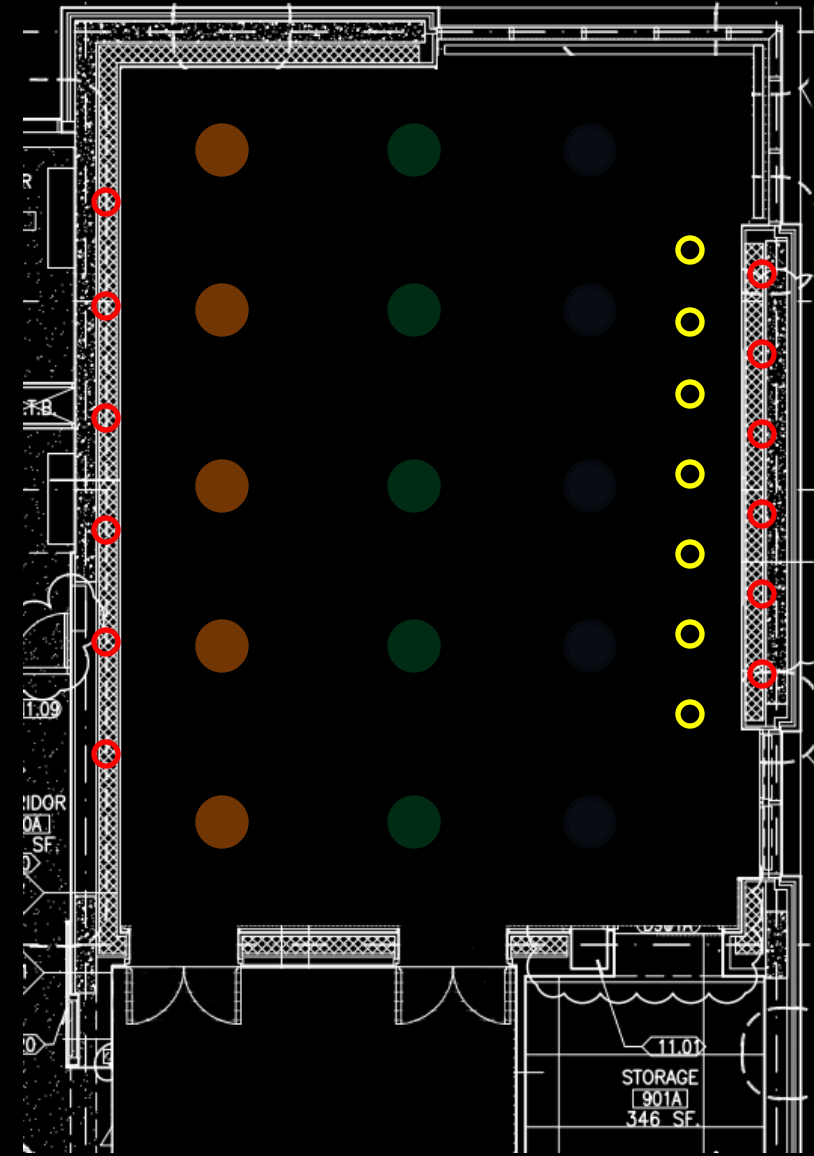
Zone 2 – OFF

Zone 3 – OFF

Zone 4 – OFF

Zone 5 – OFF





Zone 1 – OFF

Zone 2 – OFF

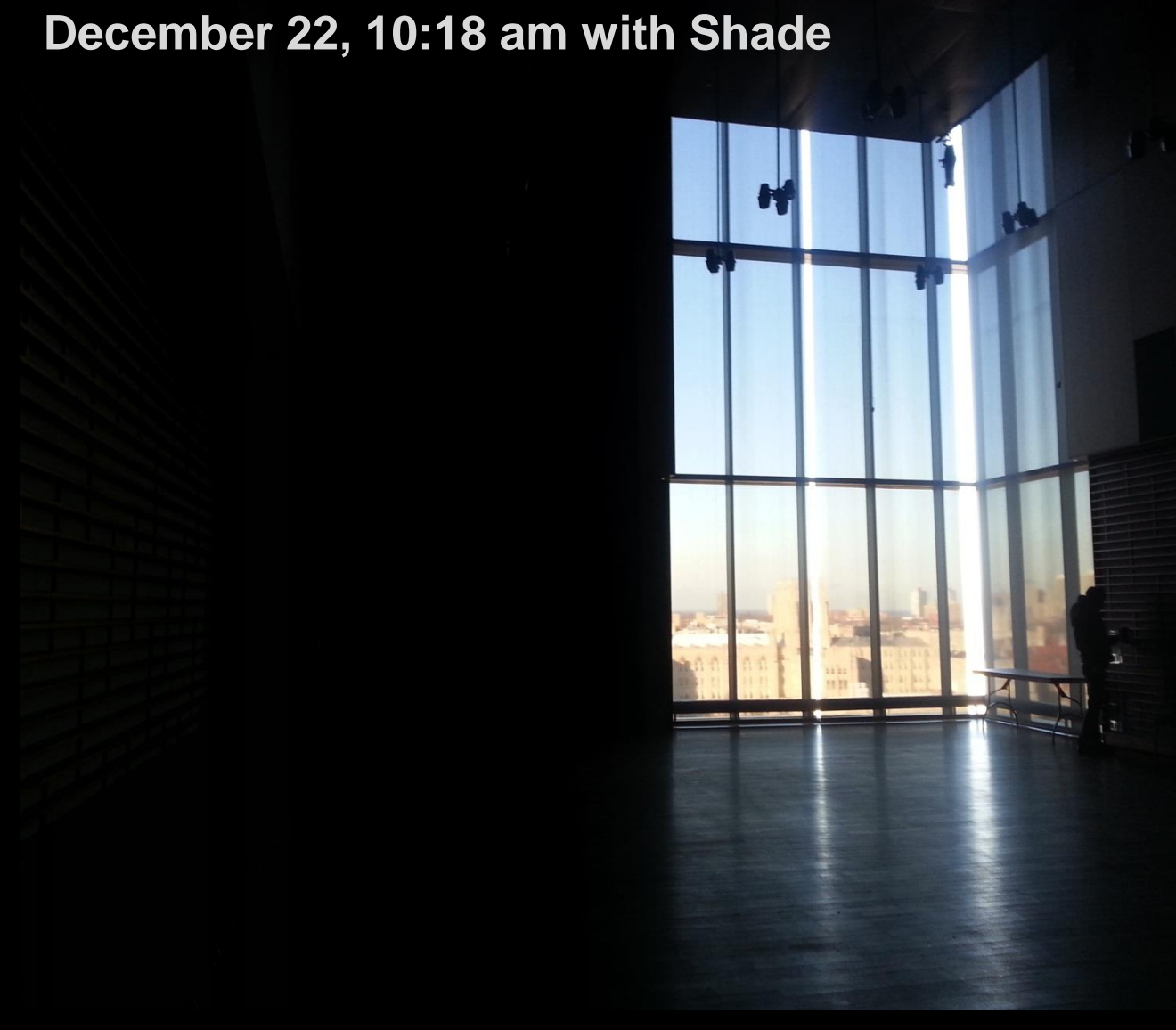
Zone 3 – OFF

Zone 4 – OFF

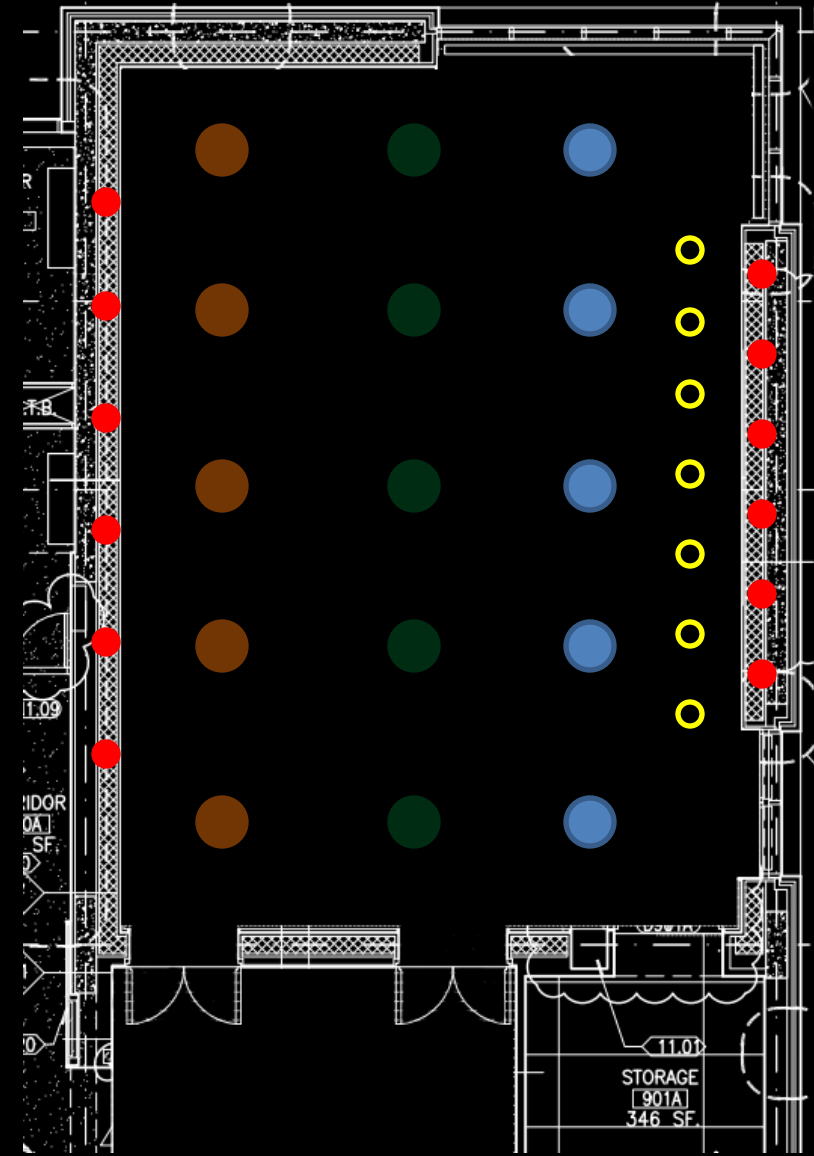
Zone 5 – OFF



December 22, 10:00 am with Shade



December 22, 10:18 am with Shade



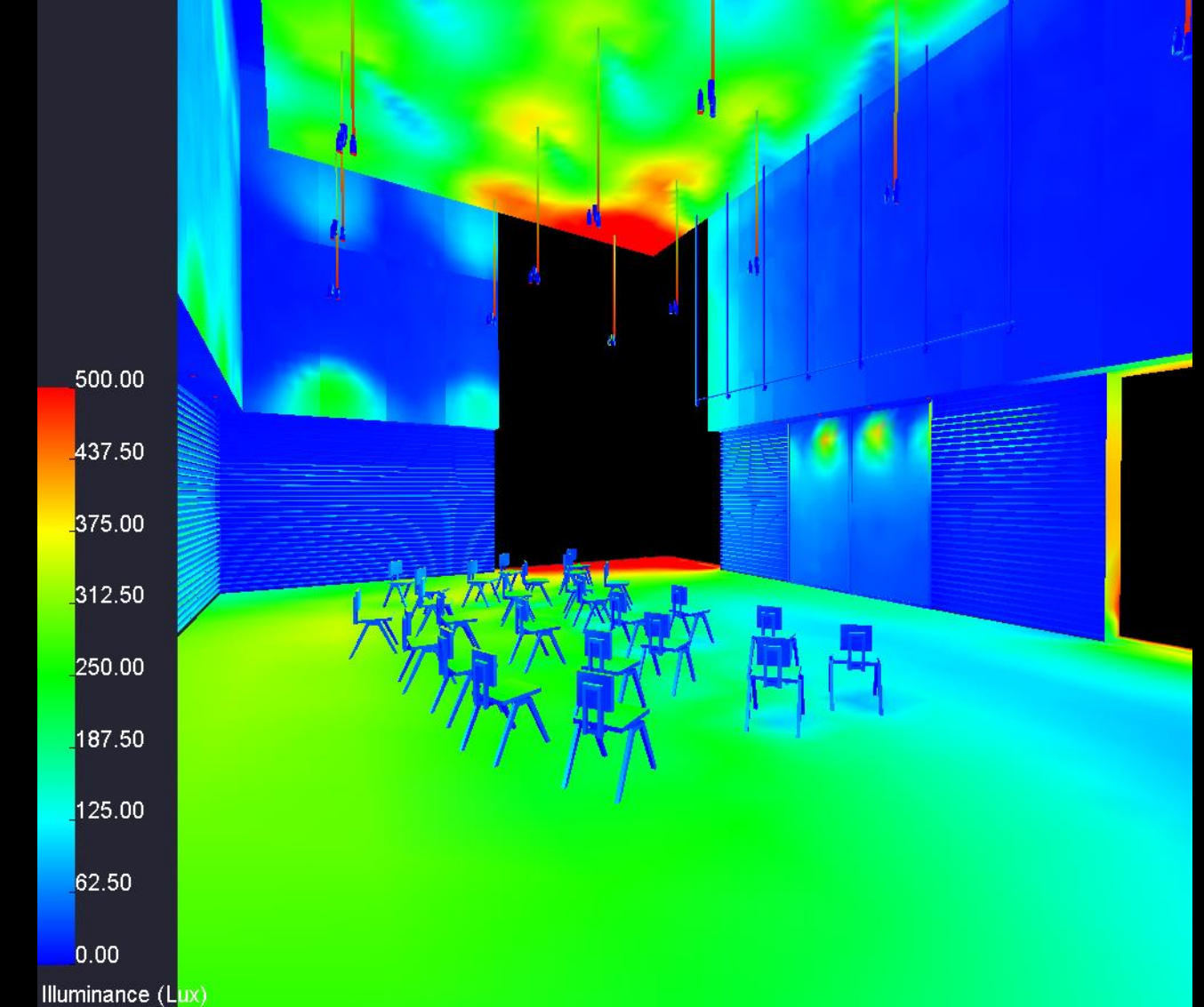
Zone 1 – 50% Output

Zone 2 – 25% Output

Zone 3 – Only Uplight

Zone 4 – OFF

Zone 5 – ON



Introduction

Building Overview

Lighting Depth

| Main Lobby

Performance Hall

Performance Penthouse

**Electrical Depth**

Mechanical Breadth

Conclusion

**Study of High Efficiency transformer  
with Energy cost saving**

Schedule of Existing Transformers in Logan Center for the Arts						
No.	Rating of Unit	Primary V	Secondary V	Location	Feeding to	Note
T-1	150 kVA	277/480	120/208	Lower Level	to LV-EM-LL	Switchboard
T-2	57 kVA	277/480	120/208	Lower Level	to EM-PP-LL	Panelboard
T-3	45 kVA	277/480	120/208	First Floor	to PP-TH-1	Panelboard
T-4*	30 kVA	277/480	120/208	Lower Level	to LP-AV-LL	Panelboard
T-5*	30 kVA	277/480	120/208	First Floor	to LP-AV-1	Panelboard
T-6	76 kVA	277/480	120/208	Eleventh Floor	to TLP-7-11	Panelboard
T-7	300 kVA	277/480	120/208	Lower Level	to LV-DP-LL-N	Switchboard
T-8	112.5 kVA	277/480	120/208	Second Floor	to TLP-3-6	Panelboard
T-9	75 kVA	277/480	120/208	Second Floor	to PNL-#1	THEATRICAL BRK at 245
T-10	45 kVA	277/480	120/208	Second Floor	to PP-TH-2B	Panelboard
T-11	225 kVA	277/480	120/208	Lower Level	to SP-201, Dimmer Racks 201,202	at 245
T-12	150 kVA	277/480	120/208	First Floor	to SP-101, Dimmer Racks 101,102	at 245
T-13	75 kVA	277/480	120/208	Second Floor	to PNL-#2	THEATRICAL BRK at 245
T-14	45 kVA	277/480	120/208	Second Floor	to PP-TH-2A	Panelboard
T-15	not shown in Single-Line Diagram					
T-16	45 kVA	277/480	120/208	Third Floor	to PP-SR	Panelboard
T-17	75 kVA	277/480	120/208	Second Floor	to PNL-#1	THEATRICAL BRK at 210B
T-18	75 kVA	277/480	120/208	Second Floor	to PNL-#2	THEATRICAL BRK at 210B
T-19	225 kVA	277/480	120/208	Second Floor	to Dimmer Racks 1,2,3	at 210B
T-20	500 kVA	277/480	120/208	Lower Level	to LV-SB-SS-S	Switchboard
T-21	45 kVA	277/480	120/208	Lower Level	to Courtyard Projection	
T-22	30 kVA	277/480	120/208	Eleventh Floor	to Dimmer Racks 301	at 301
T-23	45 kVA	277/480	120/208	Lower Level	to LP-LL-NA	Panelboard

Existing Transformers

Rating of Unit	# of Unit
30 kVA	3
45 kVA	6
57 kVA	1
75 kVA	4
76 kVA	1
112.5 kVA	1
150 kVA	2
225 kVA	2
300 kVA	1
500 kVA	1
<b>Total</b>	<b>22</b>

- Total 22 K-rated transformers
- NEMA TP-1 for energy efficiency
- T-4 and T-5 are designed as Isolation transformer
- T-20 with 500KVA is designed K-factor of 13

Proposed Solution



- EATON: Premium efficient transformer
- 30% less losses than NEMA TP- 1 for energy consumption
- Reduced operating costs
- Available as K-factor or harmonic mitigating

Total Loss Per Year

Selected BOM				NEMA-TP1	NEMA Premium
Qty	KVA	Mat'l	Type	Total Loss	Total Loss
3	30	Copper	K-Rated*	5.83 MWH	3.54 MWH
6	45	Copper	K-Rated*	14.84 MWH	8.68 MWH
5	75	Copper	K-Rated*	19.15 MWH	12.57 MWH
2	112.5	Copper	K-Rated*	9.57 MWH	5.98 MWH
2	150	Copper	K-Rated*	12.87 MWH	8.19 MWH
2	225	Copper	K-Rated*	16.34 MWH	11.68 MWH
1	300	Copper	K-Rated*	10.85 MWH	7.49 MWH
1	500	Copper	K-Rated*	18.31 MWH	10.68 MWH
<b>Total Energy Lost by Transformers</b>				<b>107.76 MW</b>	<b>68.8 MW</b>
<b>Energy Lost to Heat</b>				<b>367.7 MBTU</b>	<b>234.75 MBTU</b>

Energy Life Cycle Costs

Per Year	\$11,390	\$7,271
Over 1 Year and 2.5% Inflation	\$11,389	\$7,270
Over 1 Year and 1% Inflation	\$11,390	\$7,271

Proposed Solution

Summary

- Energy Cost Savings: **\$4,119** per year
- Reduction in Power Lost by Transformer: **38.96** MW per year
- HVAC Savings: **19.48** MBT per year



- EATON: Premium efficient transformer
- 30% less losses than NEMA TP- 1 for energy consumption
- Reduced operating costs
- Available as K-factor or harmonic mitigating

Introduction

Building Overview

Lighting Depth

| Main Lobby

Performance Hall

Performance Penthouse

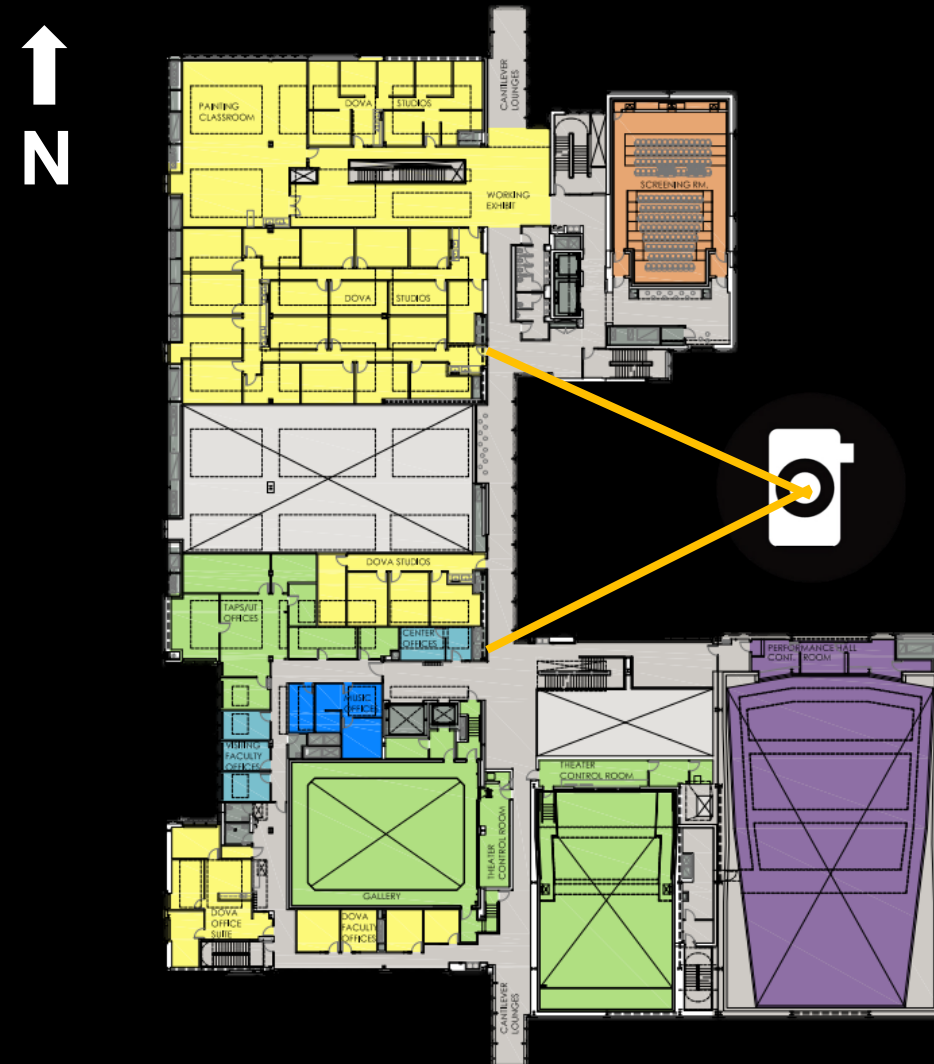
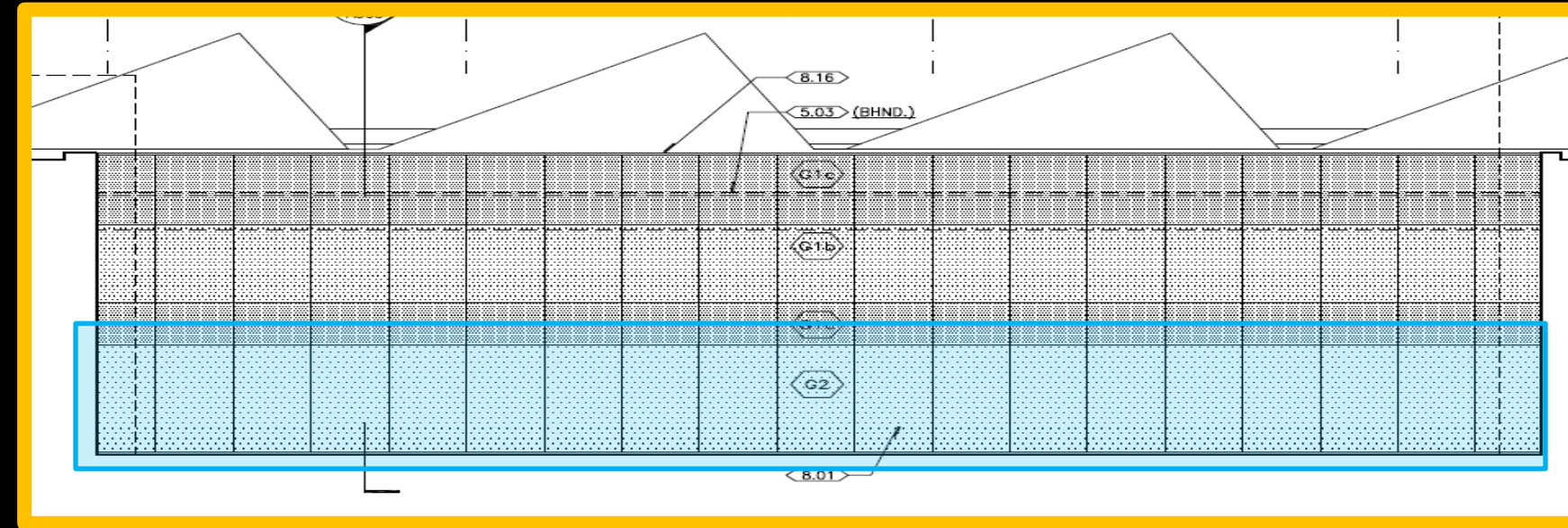
Electrical Depth

**Mechanical Breadth**

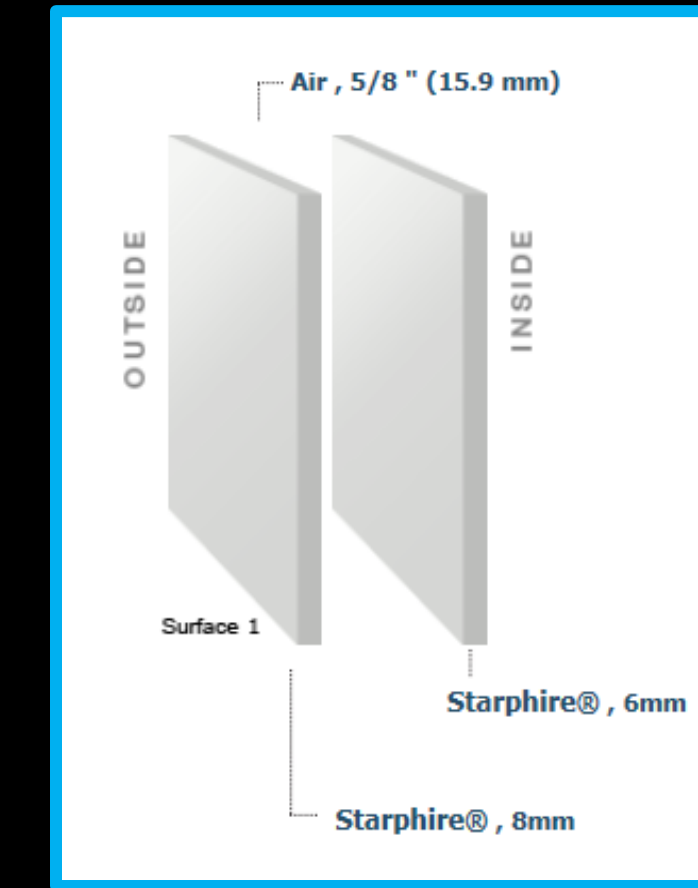
Conclusion

## Study of Solar Heat Gain & Cooling Loads with Different glazing type

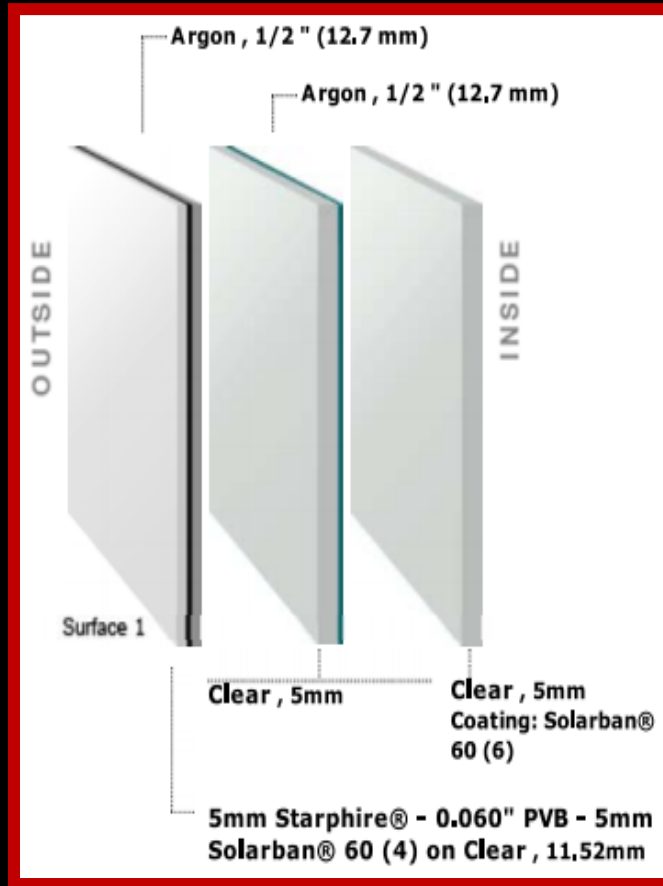


First Floor Plan ViewElevation View

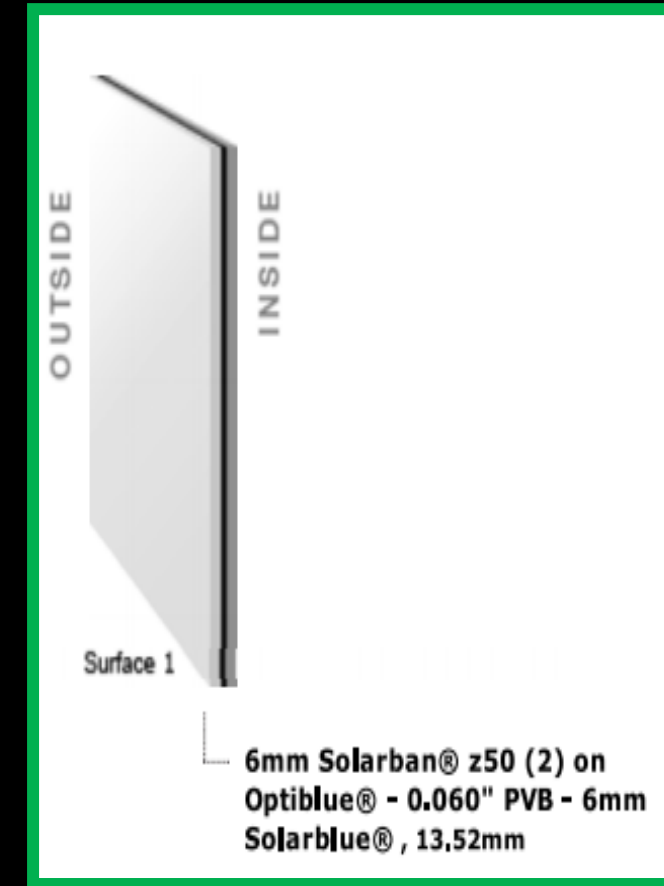
- Dimension: 90.88' L x 10' H
- Area: 908.8 sq.ft
- East-facing window

Existing Glazing type

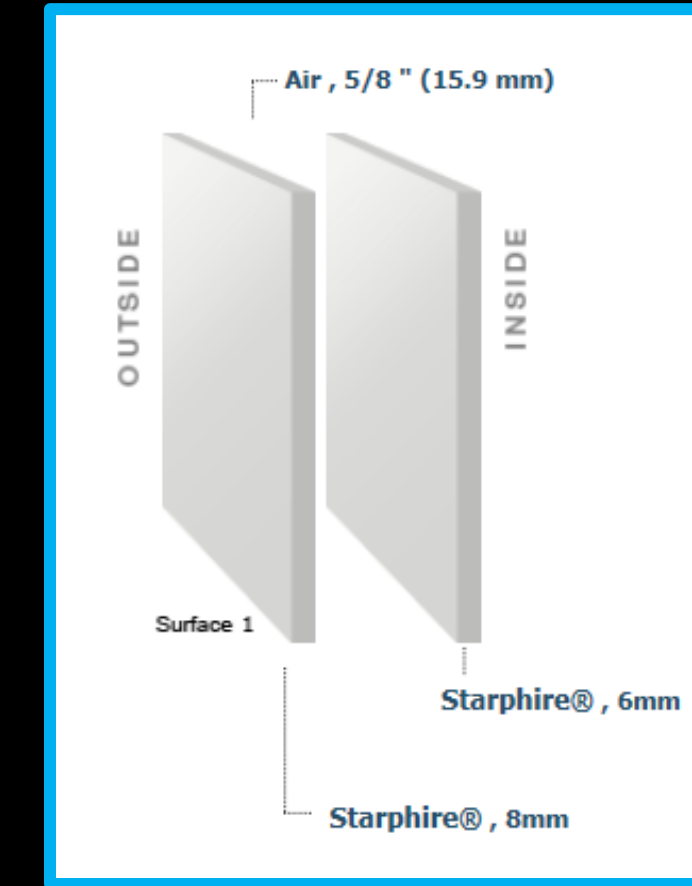
- Double Glazing type
- Thickness: 1 3/16"
- SHGC: 0.41
- U-Value (winter): 0.3 Btu/hr\*Sqft\*F

Proposed 1

- Triple Glazing type
- Thickness: 1 13/16"
- SHGC: 0.23
- U-Value (winter): 0.12 Btu/hr\*Sqft\*F

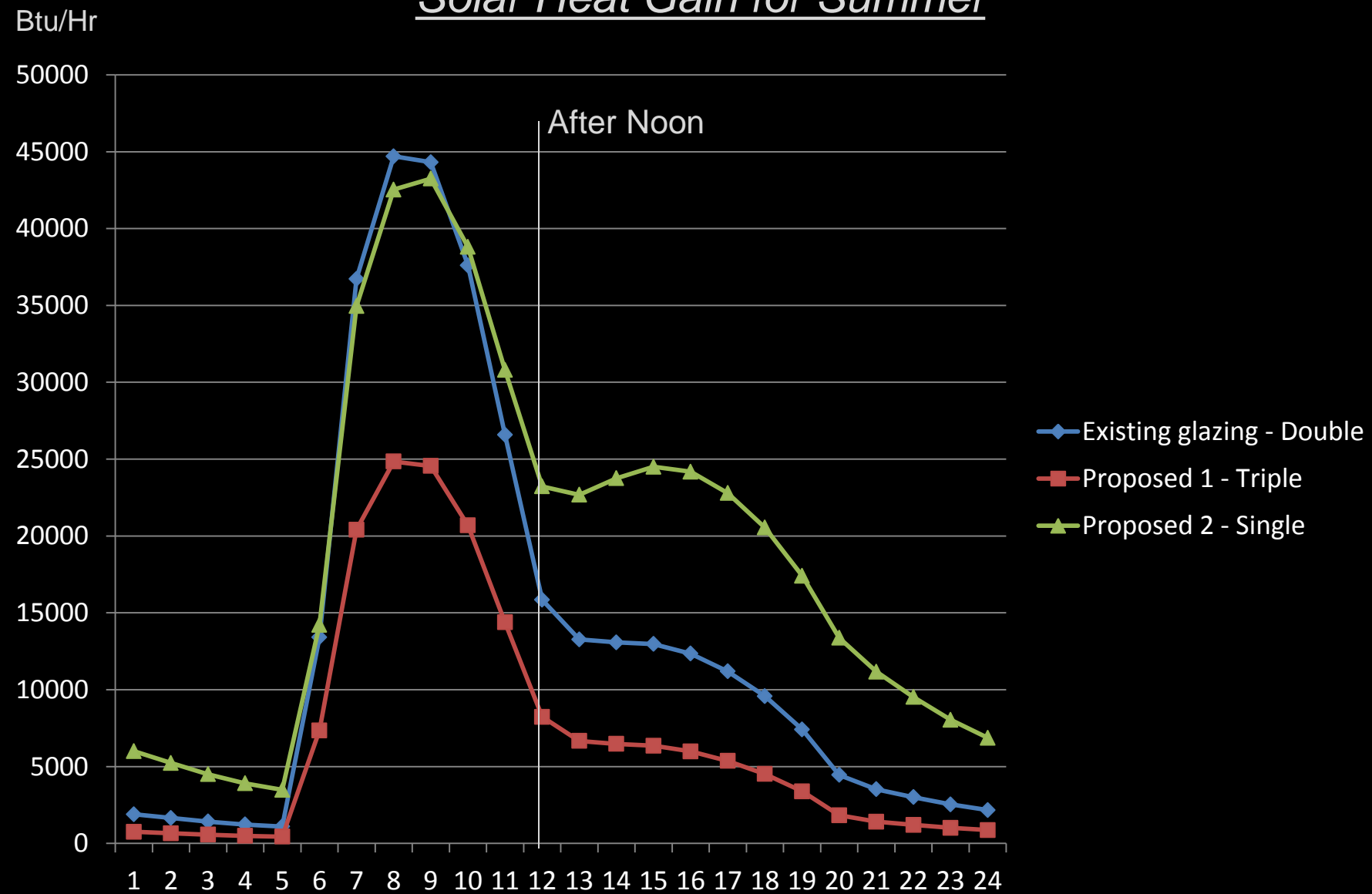
Proposed 2

- Single Glazing type
- Thickness: 1/2"
- SHGC: 0.36
- U-Value (winter): 0.95 Btu/hr\*Sqft\*F

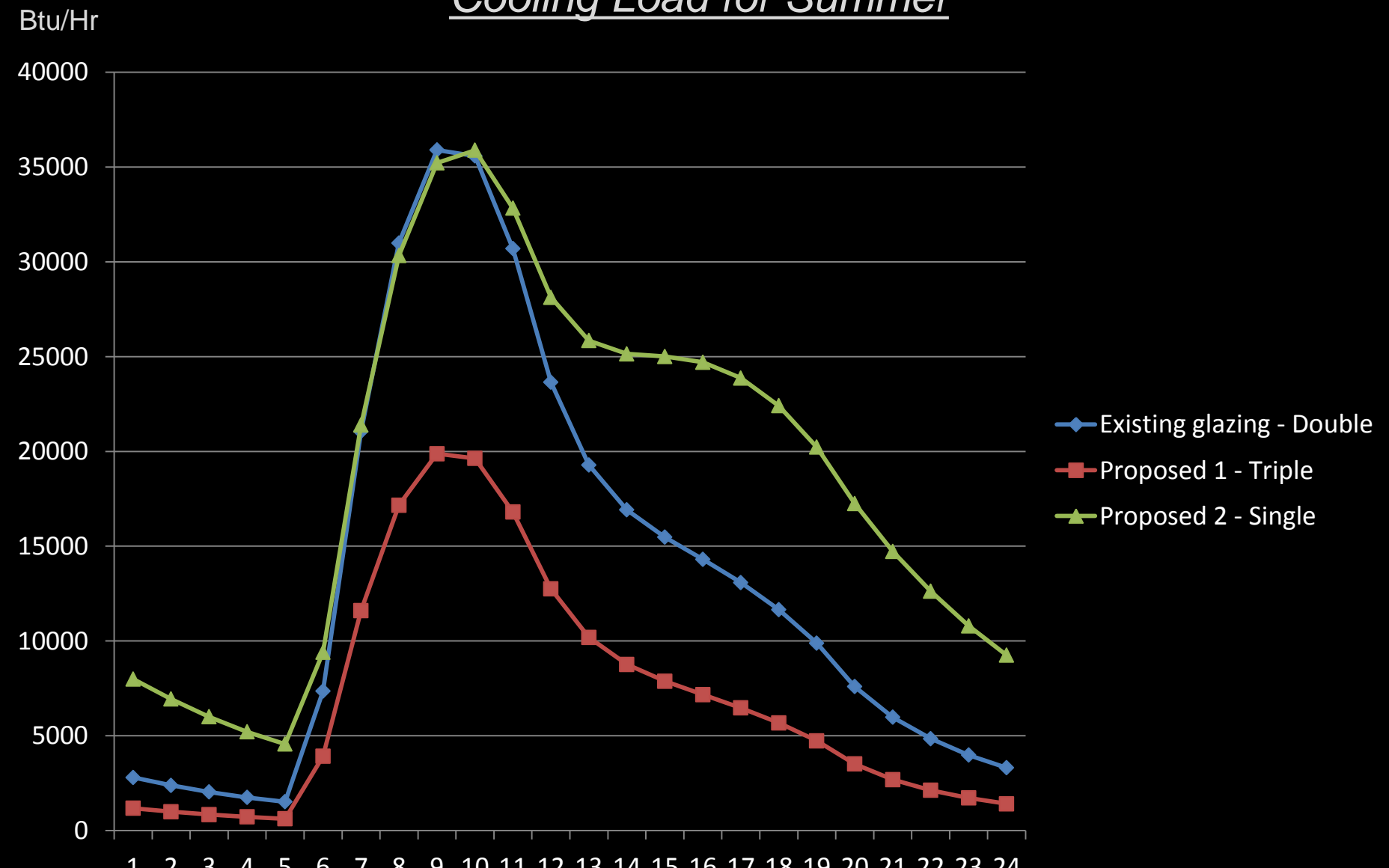
Existing Glazing type

- Double Glazing type
- Thickness: 1 3/16"
- SHGC: 0.41
- U-Value (winter): 0.3 Btu/hr\*Sqft\*F

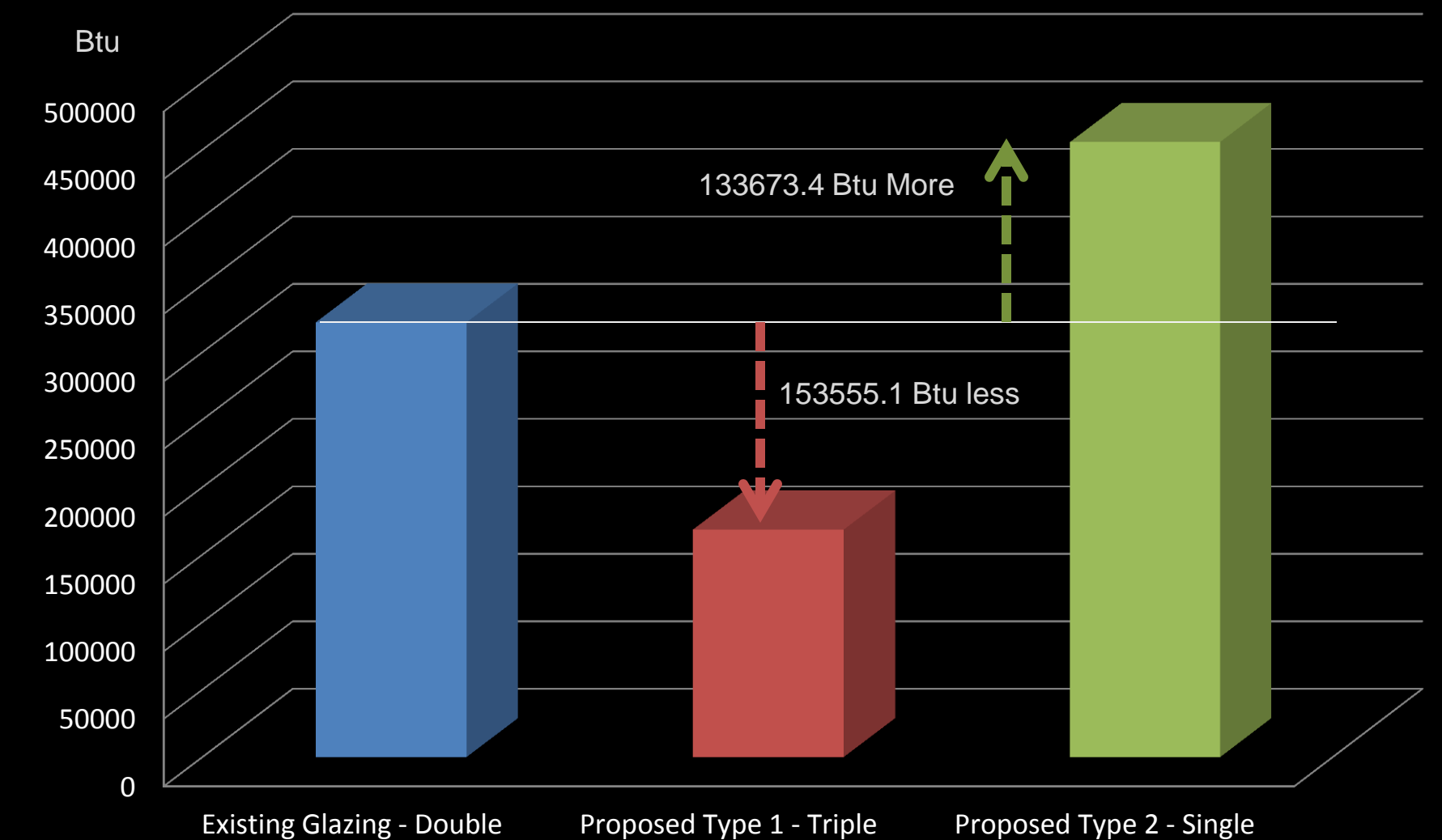
Solar Heat Gain for Summer



Cooling Load for Summer

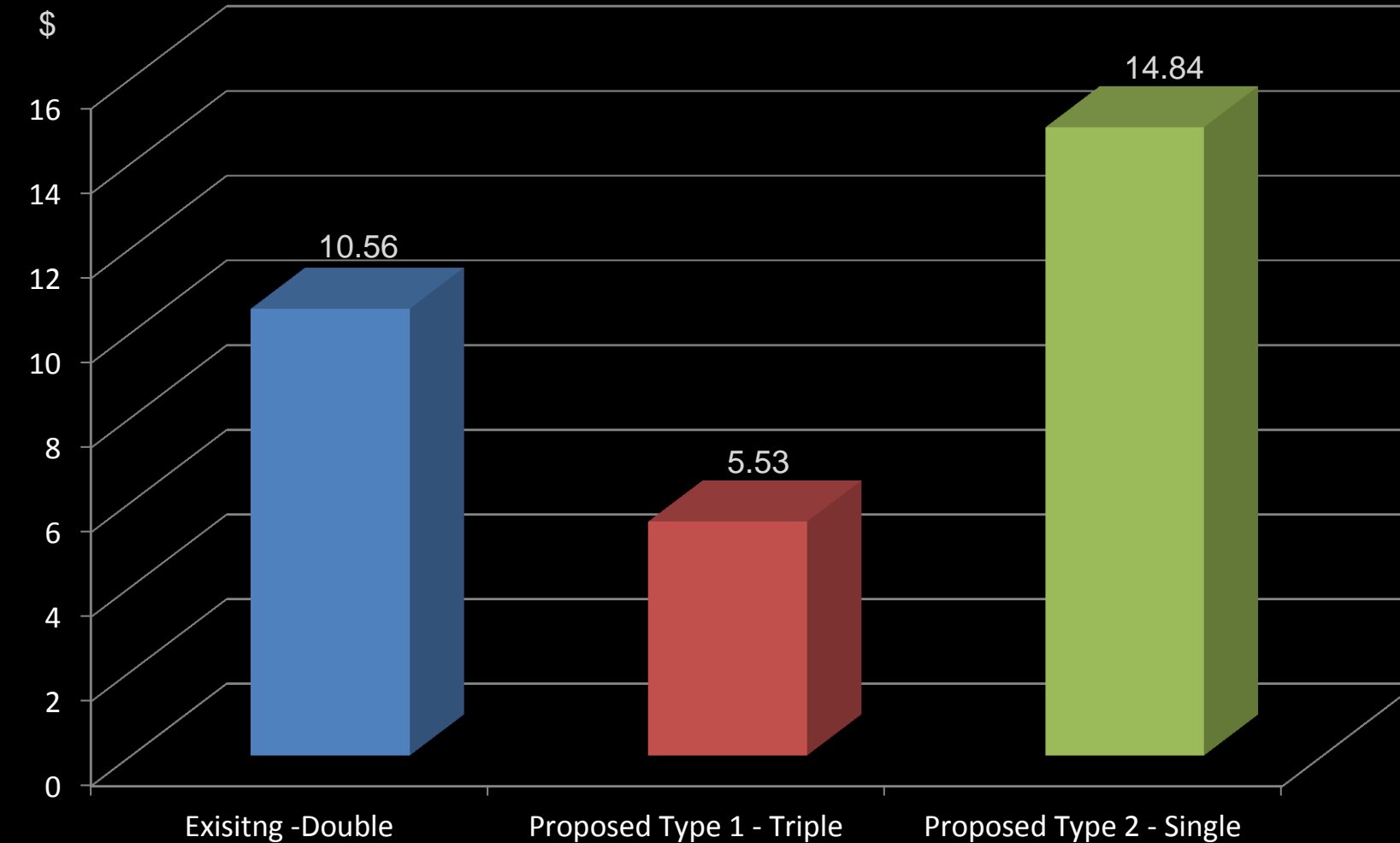


Total Cooling Load

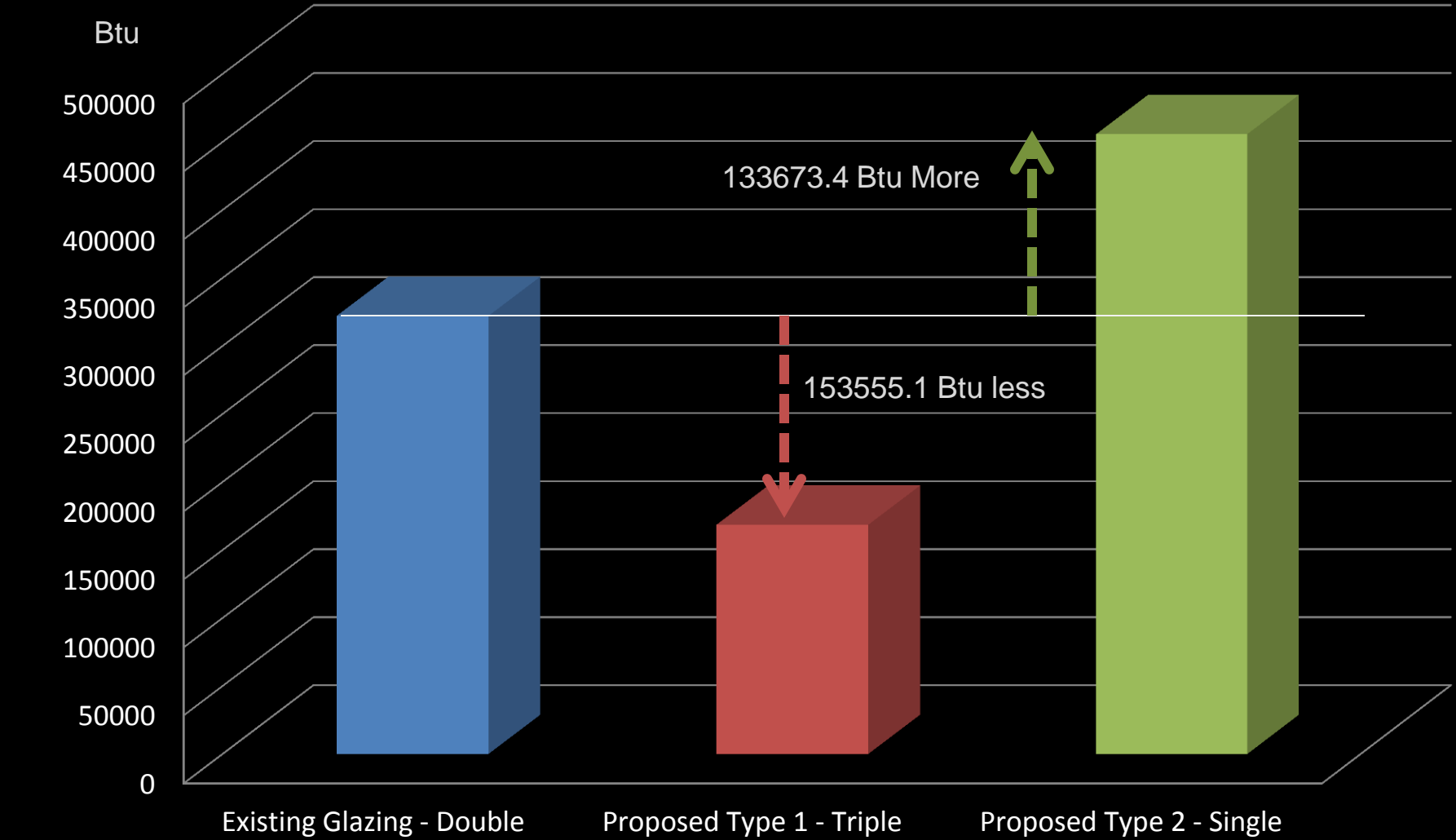


Summary

(June, 21 in the Corridor) (\* 0.112 \$/Kwh)



Total Cooling Load



## Conclusion

**Lighting:** Provided various lighting designs reflecting the purpose of the space

**Electrical:** Saved \$4,119 per year in energy cost with High-efficiency transformer

**Mechanical:** Triple pane in the corridor provides 47% of cooling load cost saving during the summer.

## Thank you!

### Acknowledgements

**Dr. Houser**

**Dr. Mistrick**

**Professor Parfitt**

**W. Blair Malcom**

**Eric Eichler**

## References

- DiLaura DL, Houser KW, Mistrick RG, Steff GR. Illuminating Engineering Society The Lighting HandBook 10<sup>th</sup> Edition.
- ASHRAE Standard 90.1, 2007 – Energy Standard for Building Except Low-Rise Residential Buildings.
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