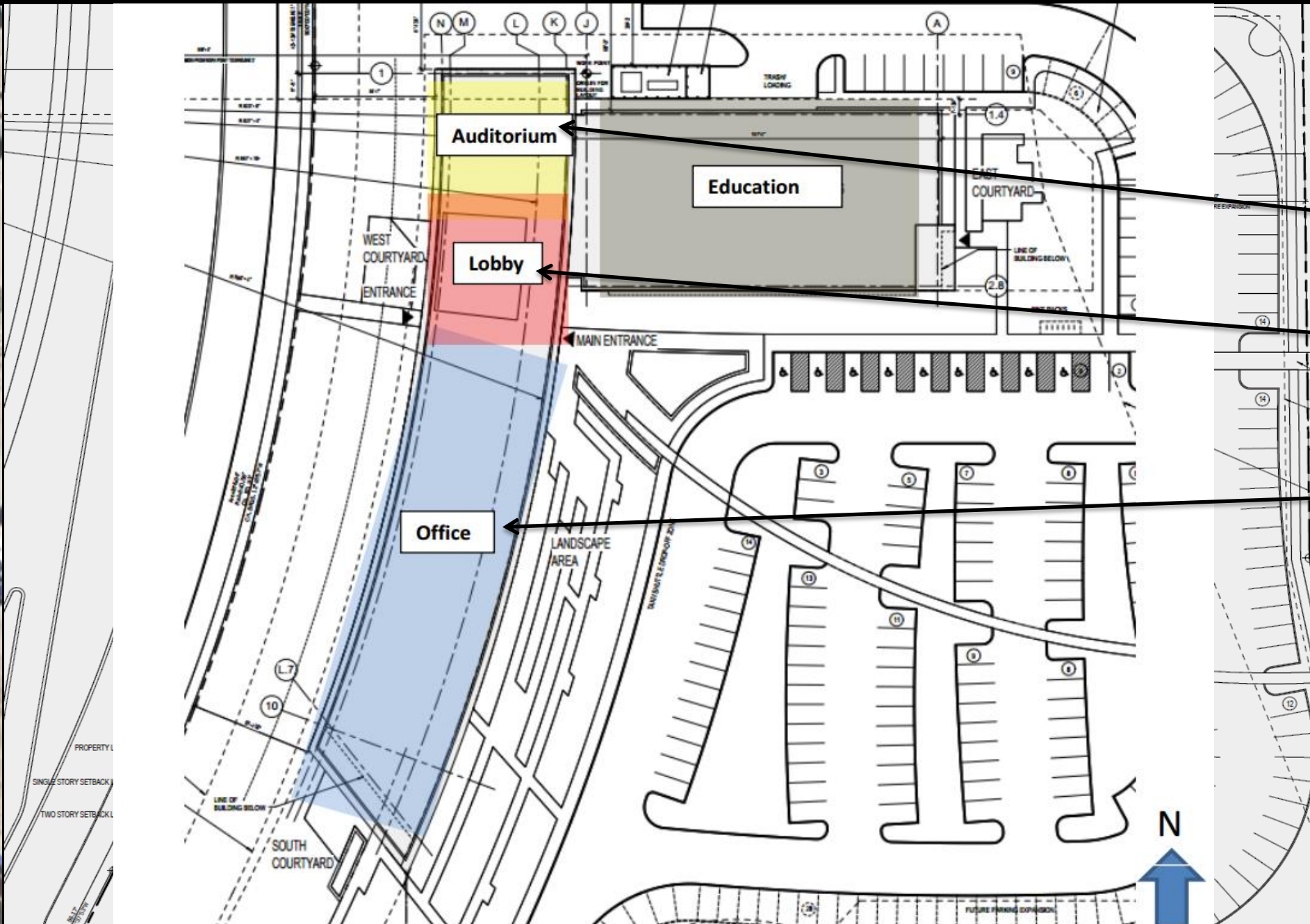
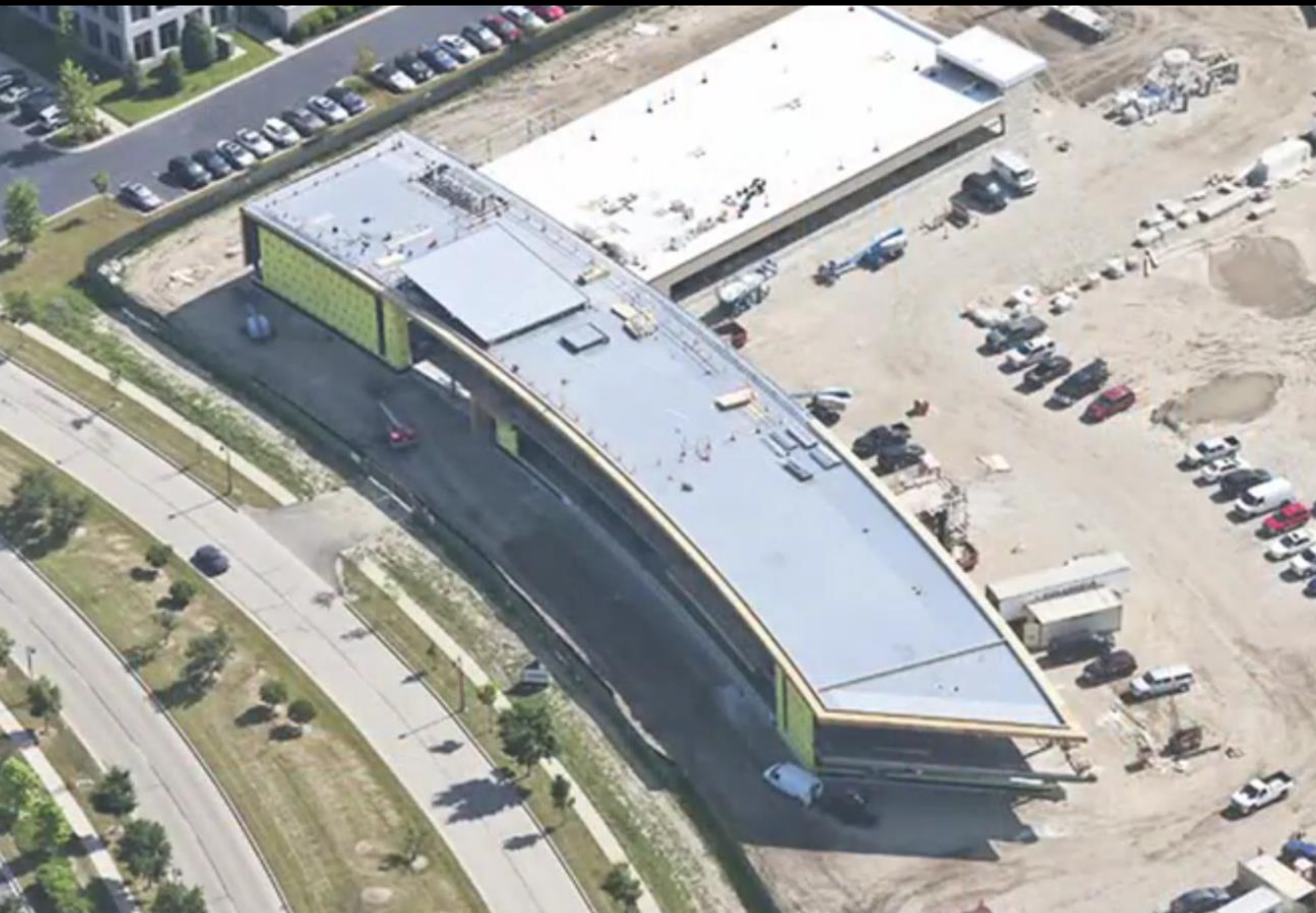


# The Frederick College of Cardiology

Arlington Heights, IL



HELLO 😊  
Welcome to  
**Rob Currie's**  
Thesis Presentation



# Spaces

- 1. Auditorium
- 2. Lobby
- 3. Open Office
- 4. Exterior/Grounds

# The Frederick College of Cardiology

Arlington Heights, IL



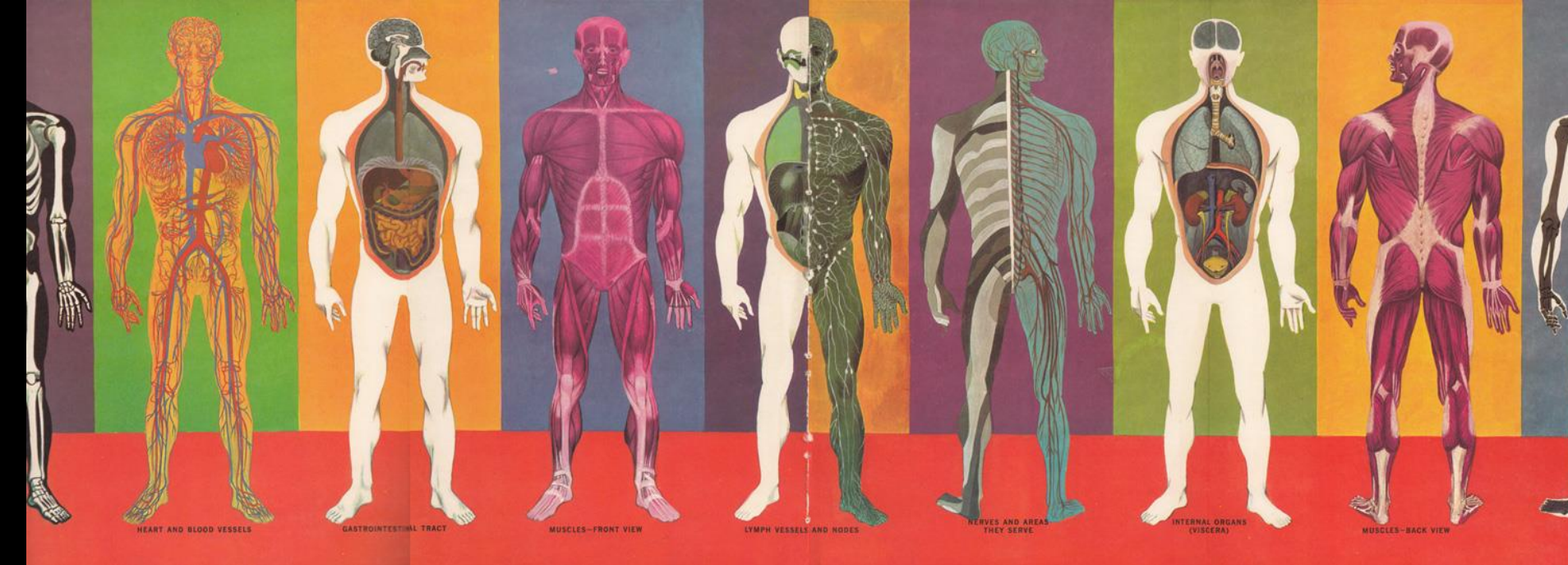
- Education
- Demonstration
- Administration



# The Frederick College of Cardiology

Arlington Heights, IL

EVERYTHING



# Thesis Outline

## DEPTHS

### Lighting Design Depth

- Auditorium
- Open Office (+ Shade Study)
- Lobby (+Shade Study)
- Exterior

### Electrical Design Depth

- Panel Board Design
- Aluminum Vs. Copper Cost Analysis
- Short Circuit Analysis

## BREADTHS

### Acoustic Breadth

- Auditorium Reverberation Analysis

### Energy Breadth

- Glazing Energy Impact Analysis:  
ROI

## **Covered Today**

### **Introduction**

### **Lighting Design Depth**

- > Auditorium
- > Open Office (+ Shade Study)
- > Lobby: Color Wall

### **Electrical Design Depth**

- > Aluminum Vs. Copper Cost Analysis

### **Acoustic Breadth**

- > Auditorium Reverberation Analysis

### **Conclusion**

# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

How Does It Feel? | Plan | Section | Fixtures

2671s.f., 24ft. ceiling  
150 occupants

### Concept | Structure:

Building > Body  
Structure of Body > Rib Cage

Ambient Lighting > Revealed Forms

## Auditorium: Lighting Design



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

How Does It Feel? | Plan | Section | Fixtures

2671s.f., 24ft. ceiling  
150 occupants

### Lighting | 3 Layers:

Ambient > Relaxing  
Hidden Source > Mystery

Direct > Task

Focused > Demonstrations

## Auditorium: Lighting Design





# Covered Today

- Introduction
- Lighting Design Depth**

- > Auditorium
- > Open Office
- > Lobby: Color Wall

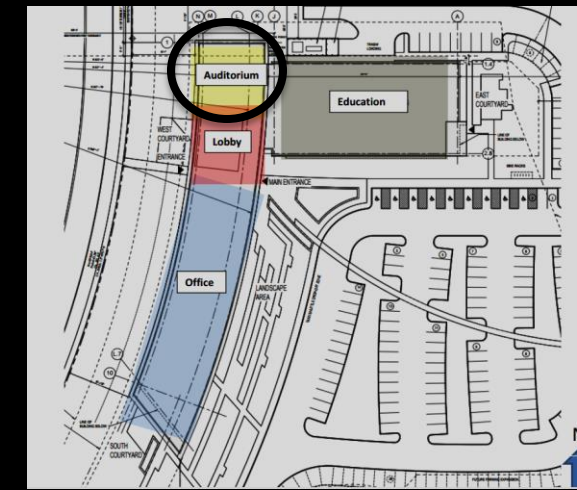
## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

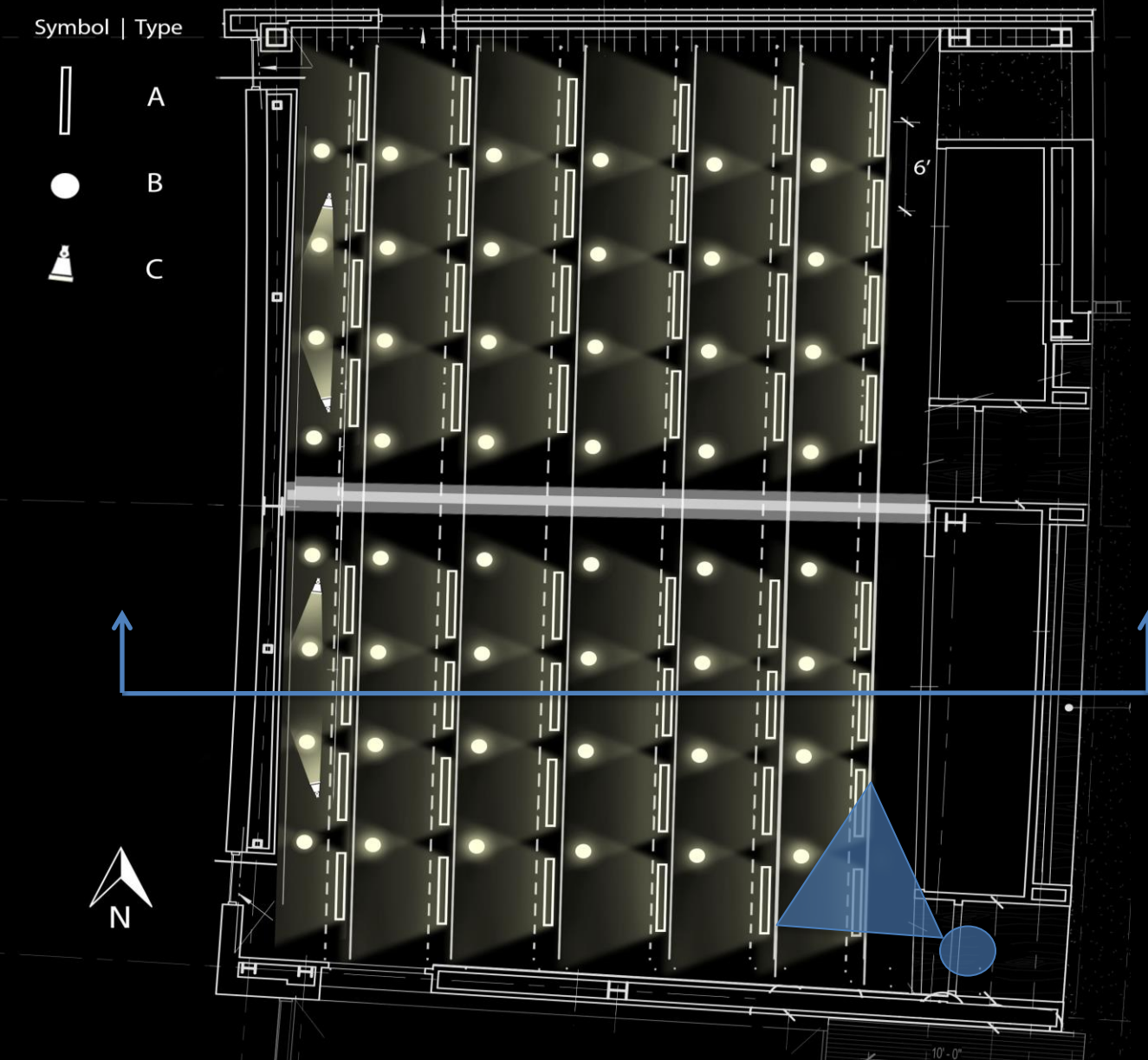
## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion



# How Does It Feel? | Plan | Section | Fixtures



# Auditorium: Lighting Design



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

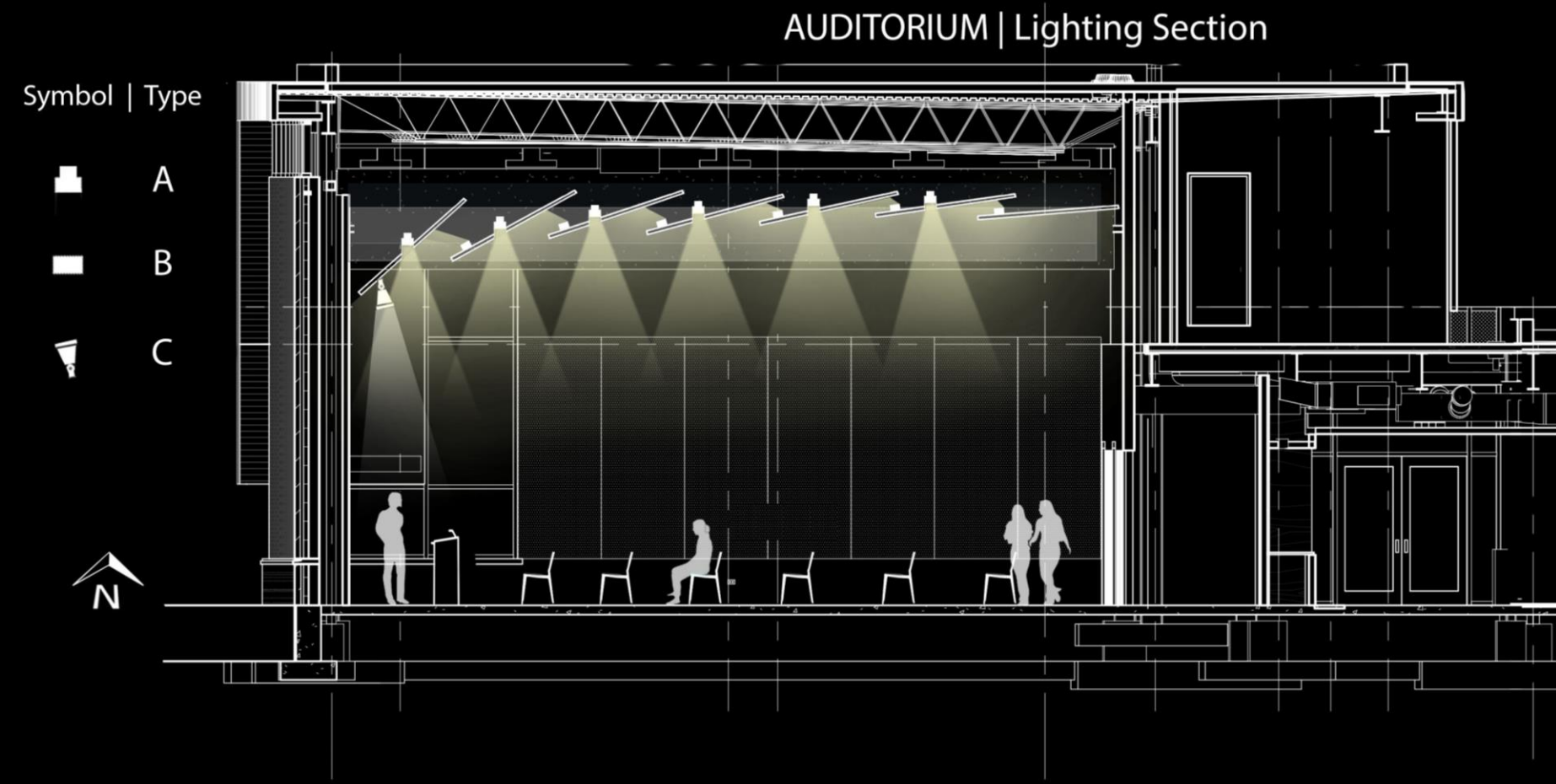
## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

How Does It Feel? | Section | Plan | **Fixtures**

**A**



Linear Cove | T8 | 32W | 3000K

**B**



Recessed Downlight | LED | 14W | 3000K

**C**



Spot Light | MH | 80W | 3500K

## Auditorium: Lighting Design



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

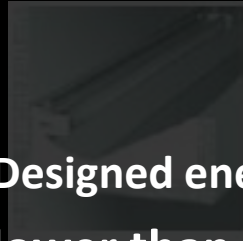
## Acoustic Breadth

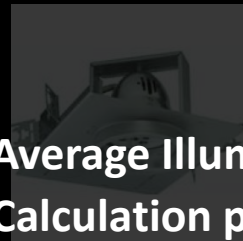
- > Auditorium Reverberation Analysis

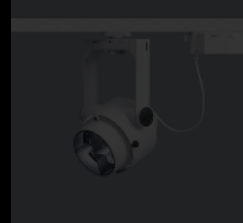
## Conclusion

How Does It Feel? | Section | Plan | **Fixtures**

Auditorium: Lighting Design

**A**  Linear Cove | T8 | 32W | 3000K  
Designed energy usage is **.939 w/ft<sup>2</sup>** which is **33% lower than 1.4 w/ft<sup>2</sup>** (ASHRAE 90.1 2007)

**B**  Recessed Downlight | LED | 14W | 3000K  
Average Illuminance **140 lux** for lecture setting on 4' a.f.f. Calculation plane.

**C**  Spot Light | MH | 80W | 3500K



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion

## How Does It Feel? | Section | Plan | Fixtures

4320 s.f., 13' ft. ceiling, 10' drop ceiling  
66 workstations  
Daylight Integration

**Concept | Structure:**  
Open Ceiling > Spacious

Ceiling Panels and Exposed Structure > Bones and Skin of the Space

Architectural System > Systems of the Body

## Open Office: Lighting Design



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion

## How Does It Feel? | Section | Plan | Fixtures

4320 s.f., 13' ft. ceiling, 10' drop ceiling  
66 workstations  
Daylight Integration

### Lighting | 3 Layers

Ambient > Soft Up lighting

Direct > General Illumination

Task > Focus

## Open Office: Lighting Design



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

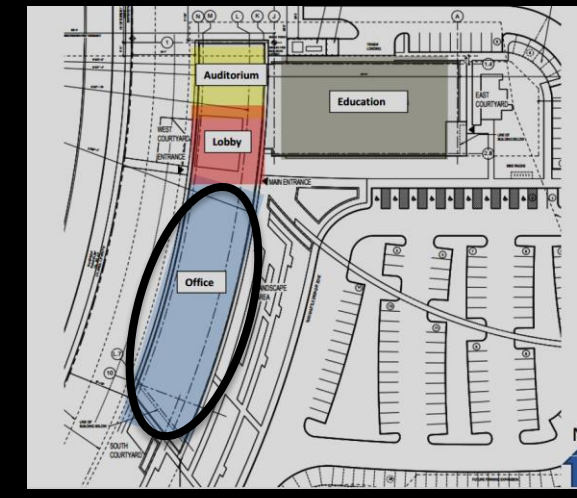
## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

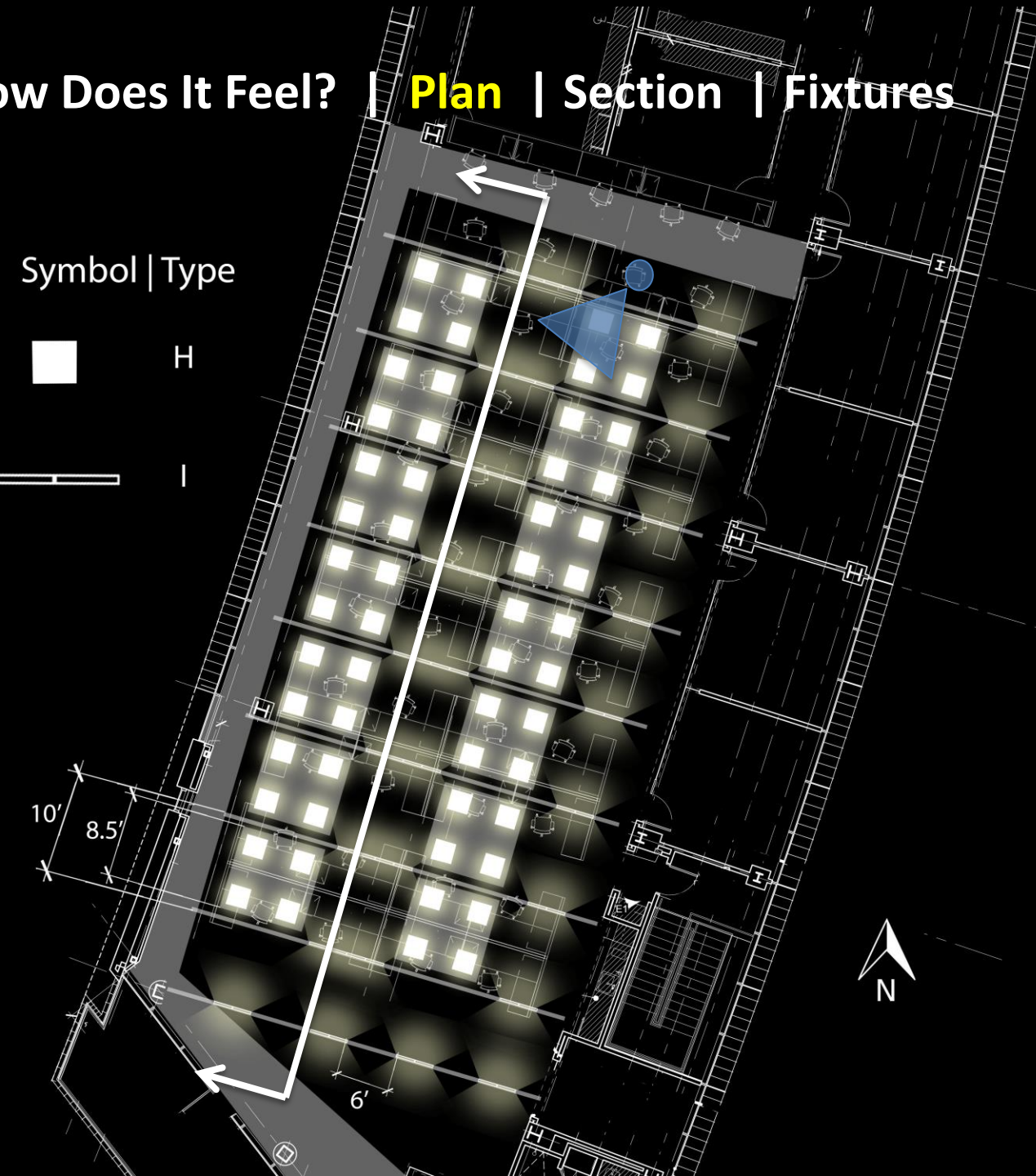
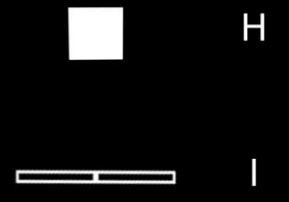
- > Auditorium Reverberation Analysis

## Conclusion



How Does It Feel? | **Plan** | Section | Fixtures

Symbol | Type



Open Office: Lighting Design



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

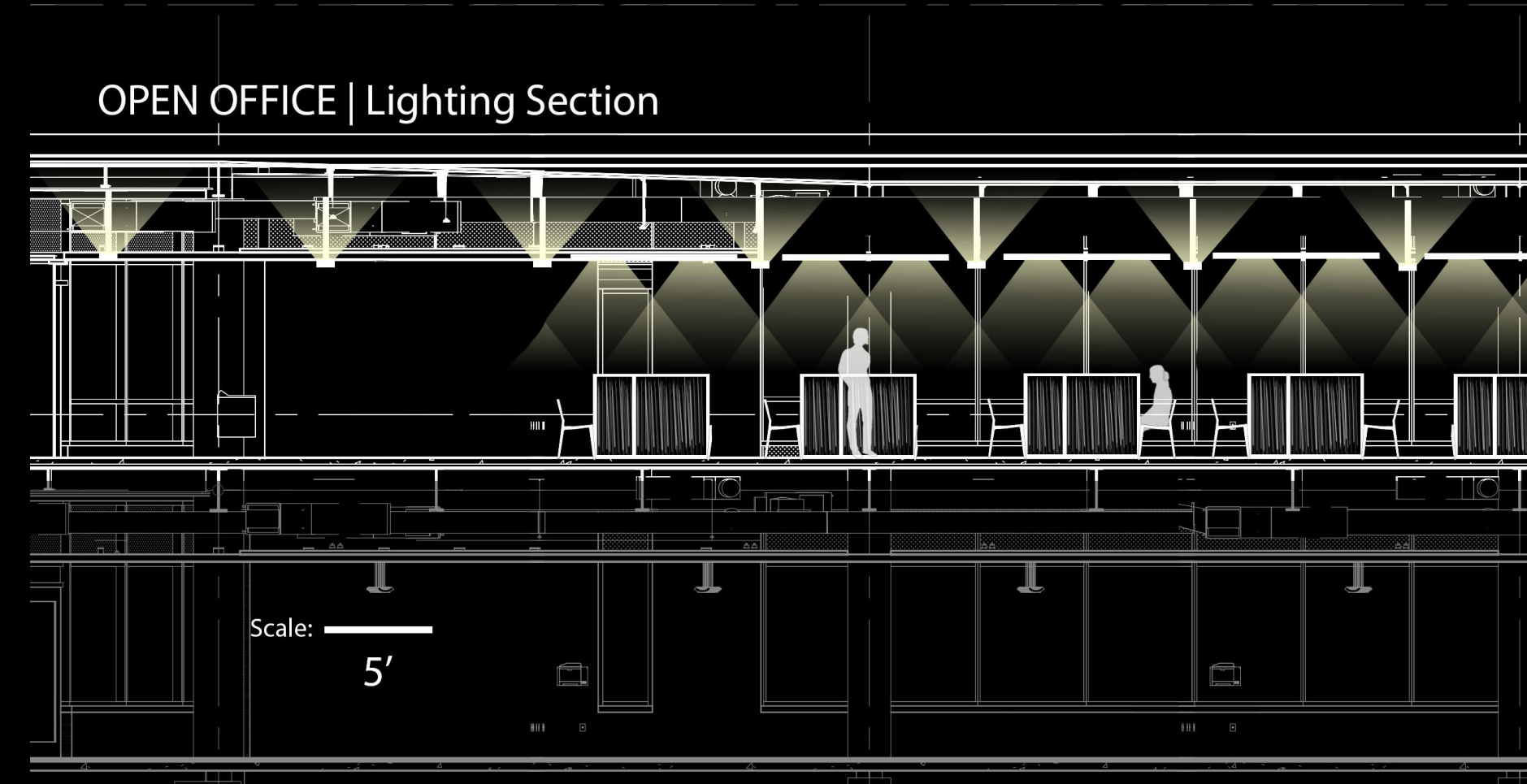
### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion

How Does It Feel? | Plan | **Section** | Fixtures

Open Office: Lighting Design





## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > **Open Office**
- > Lobby: Color Wall

### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

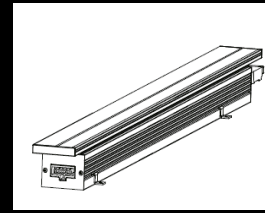
### Conclusion

A



Linear Cove | T8 | 32W | 3000K

B



Recessed Downlight | LED | 14W | 3000K

C



Task Light



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > **Open Office**
- > Lobby: Color Wall

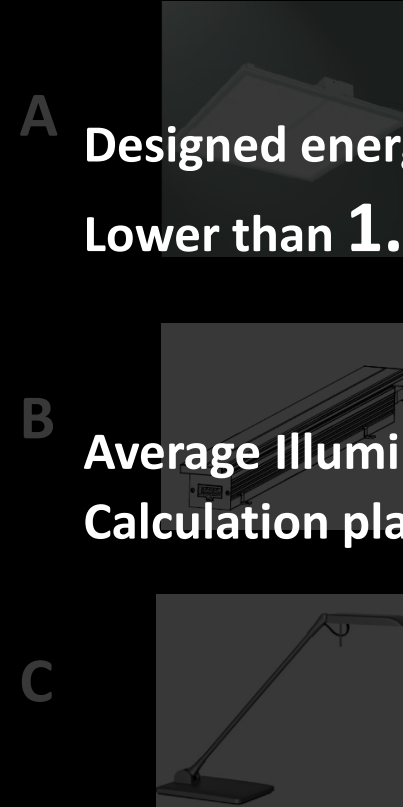
### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion



**A** Linear Cove | T8 | 22W | 3000K  
Designed energy usage is **.618 w/ft<sup>2</sup>** which is **44%**  
Lower than **1.4 w/ft<sup>2</sup>** (ASHRAE 90.1 2007)

**B** Recessed Downlight | LED | 14W | 3000K  
Average Illuminance **370 lux** for lecture setting on 4' a.f.f.  
Calculation plane.

**C** Spot Light | MH | 80W | 3500K



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

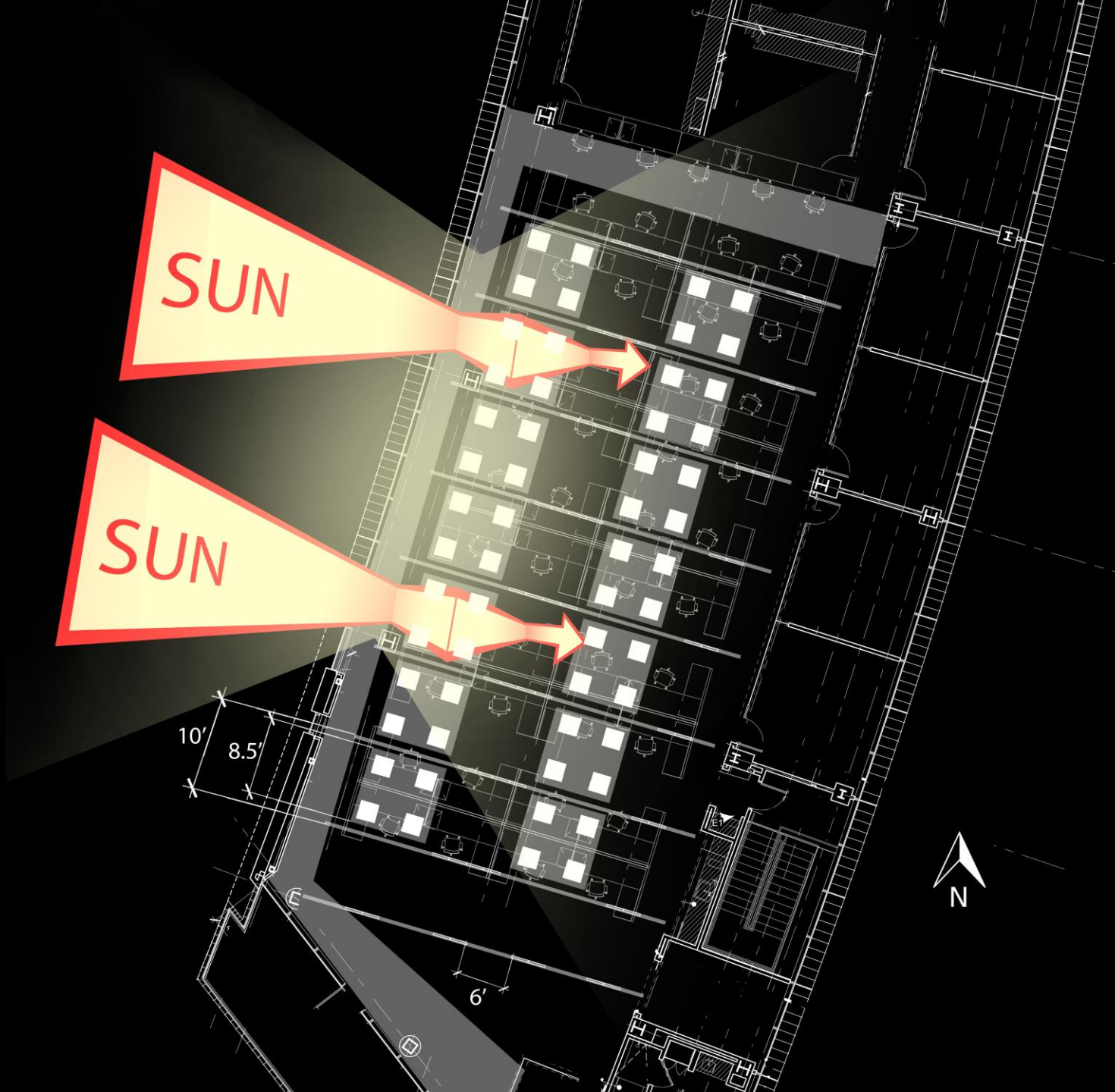
### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion



## SHADE STUDY



## Covered Today

### Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

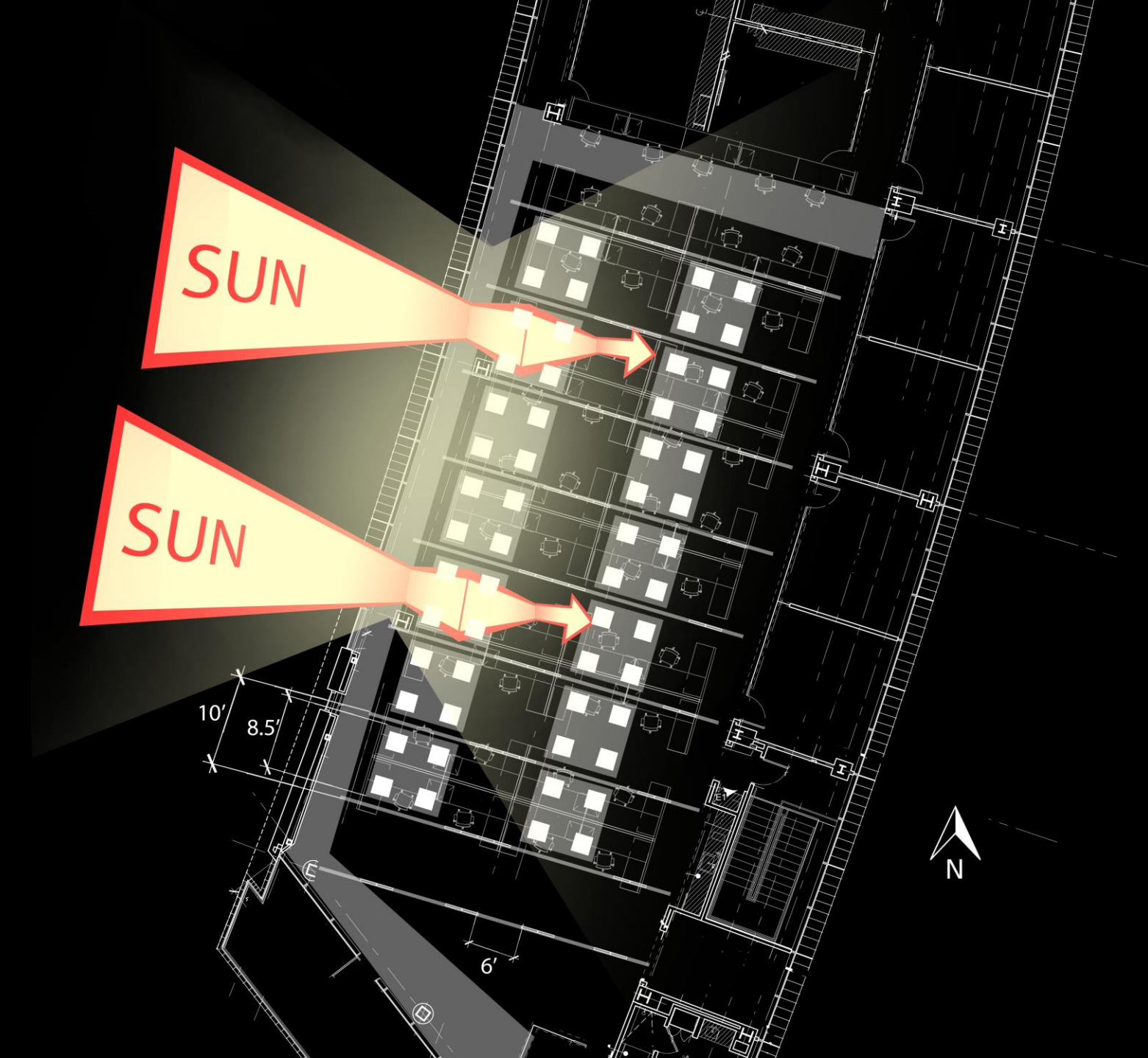
### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

### Conclusion



## SHADE STUDY

**Goals** | Increase UDI & cDA, Save Energy, Preserve Views

**Method** | 2 Shading Groups > East & West

2 Shade Positions full and half

Individual Photosensor Control

# Covered Today

## Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

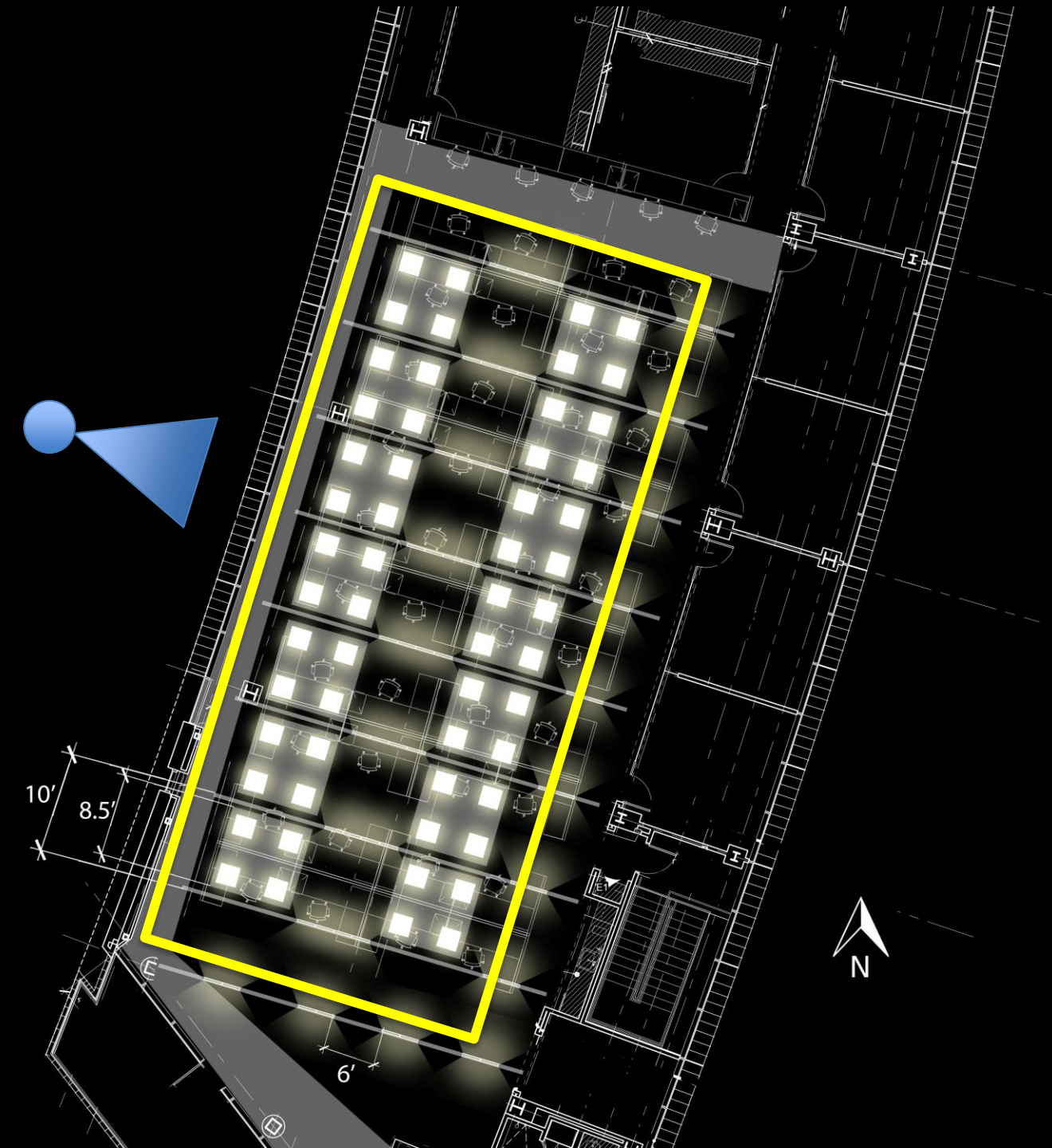
### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

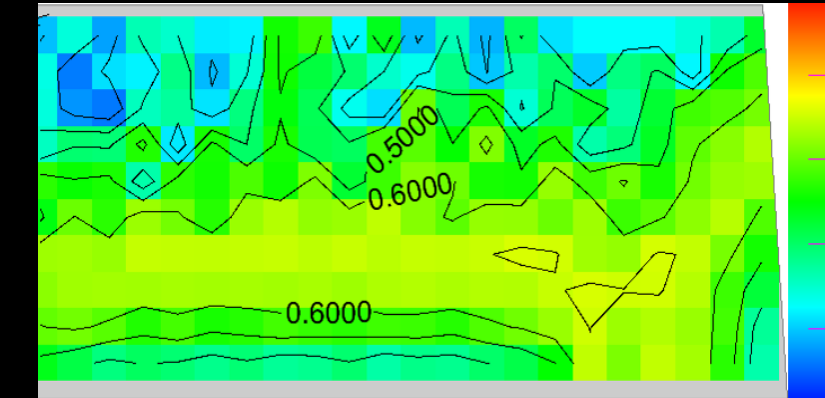
### Conclusion



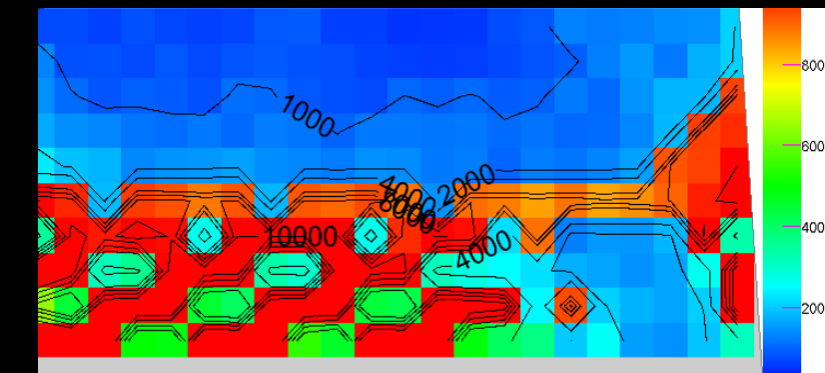
## SHADE STUDY

### Without Shading

UDI: 500-3000lux



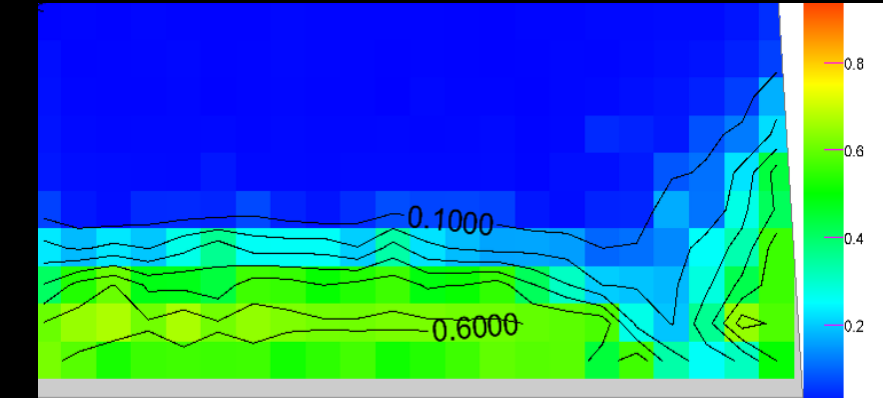
Illuminance March 20<sup>th</sup> 4:30pm



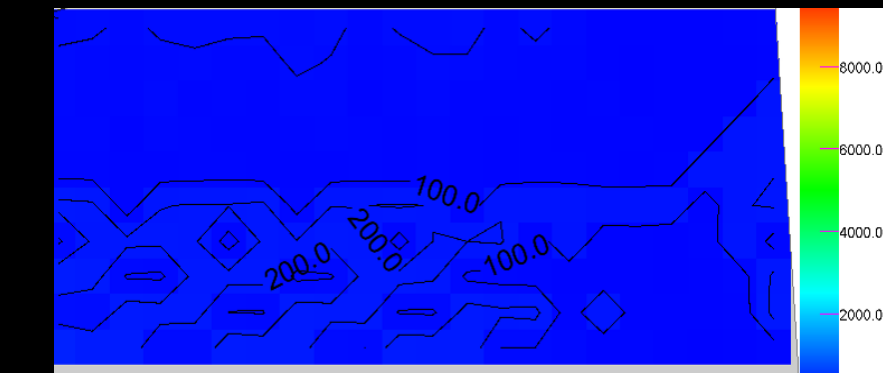
Mecho Shade 1008 Shadow Green  
Shade Cloth > 3% O.F.

### With Shading

UDI: 500-3000lux



Illuminance March 20<sup>th</sup> 4:30pm



# Covered Today

## Introduction

### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

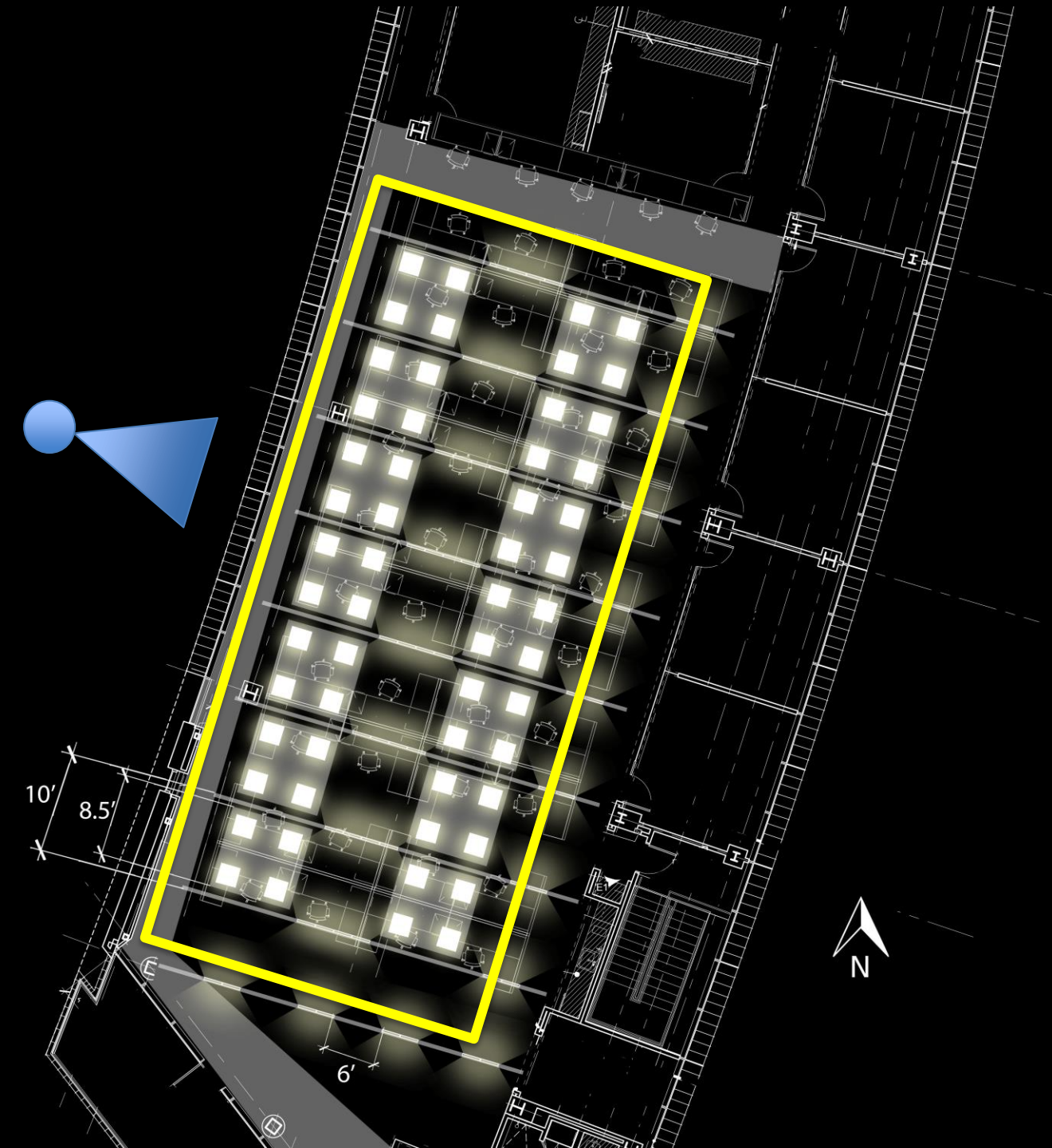
### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

### Acoustic Breadth

- > Auditorium Reverberation Analysis

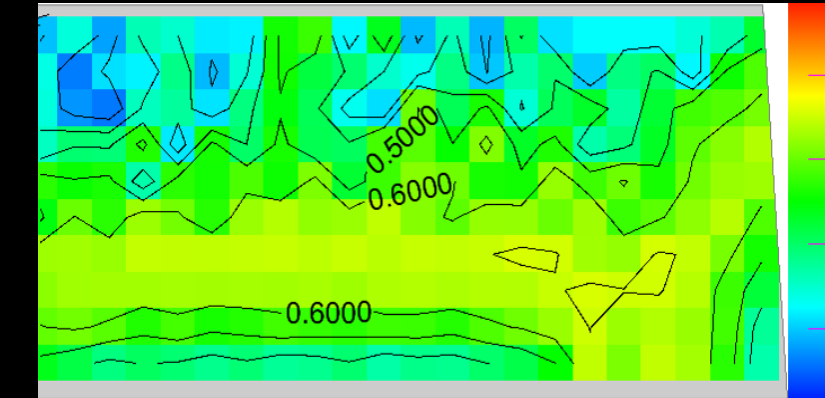
### Conclusion



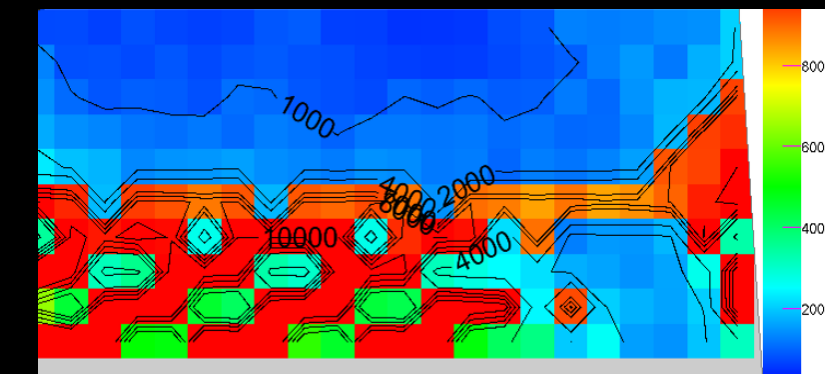
## SHADE STUDY

### Without Shading

UDI: 500-3000lux



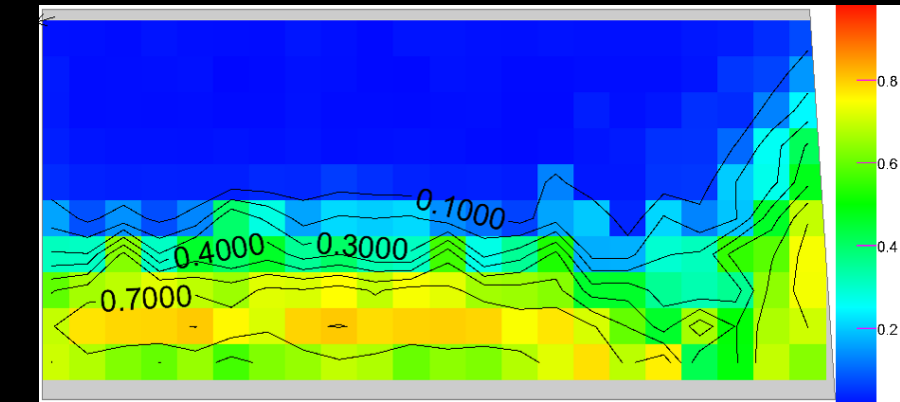
Illuminance March 20<sup>th</sup> 4:30pm



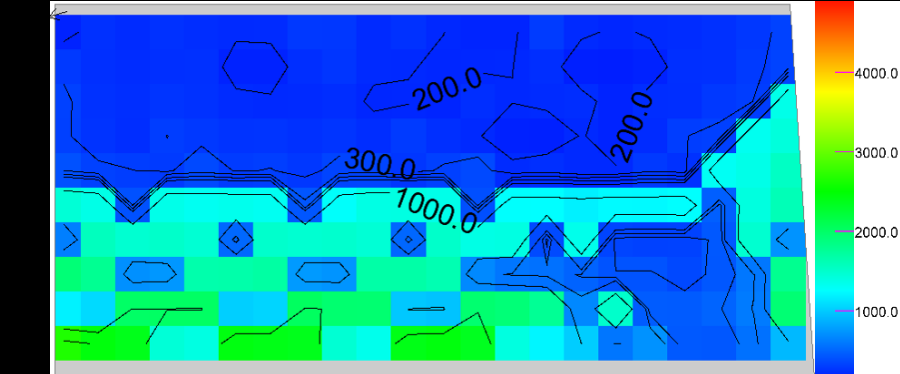
Mecho Shade 2119 *Silver Birch*  
Shade Cloth > 13% O.F.

### With Shading 50% DA (target 300lux)

UDI: 500-3000lux



Illuminance March 20<sup>th</sup> 4:30pm



## Lobby: Color Wall

### Covered Today

#### Introduction

#### Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

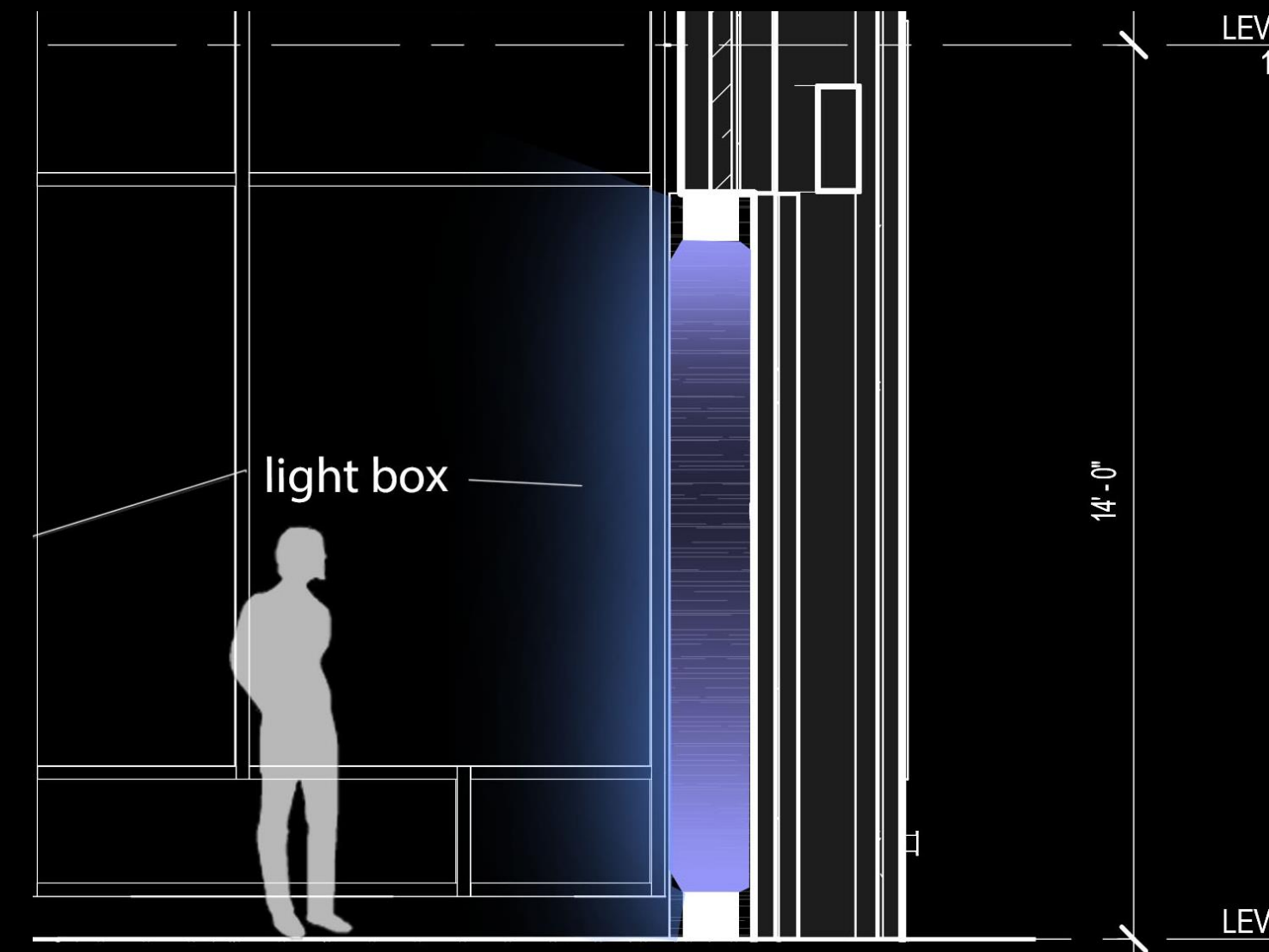
#### Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

#### Acoustic Breadth

- > Auditorium Reverberation Analysis

#### Conclusion



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

## Properties of Aluminum Feeders

**Factors |** increased wire size  
 increased conduit size  
 increased labor cost

decreased material cost

**Method |** Replace copper feeders of size greater than..

1/0

	Size		Conduit Size (THWN)	Cost Difference per Foot	Feet	Total
	PH&N	G				
Case 1	3/O	6	2"	7.96498	460	3663.8908
	250	1/O	3"			
Case 2	1	8	1 1/2"	11.59413	20	231.8826
	1/O	6	2"			
Case 3	500	3	3.5"	20.60142	20	412.0284
	900 (or 2 sets 500)	3/O	4"			
Case 4	350	4	2.5"	27.46648	20	549.3296
	500	1/O	3"			
Case 5	3/O	6	2"	10.91498	15	163.7247
	250	2	2.5"			
Case 6	1/O	6	1.5"	8.68435	20	173.687
	3/O	4	2"			
Case 7	250	3	2.5"	21.94554	60	1316.7324
	350	1/O	3"			
Case 8	400	N/A	3"	28.85	180	5193
	900 (or 2 sets 500)		4"			
Case 9	1/O	N/A	.5"	-9.24	50	-462
	250		2.5"			
<b>Total</b>						<b>11242.2755</b>

\*PDF says: use aluminlighted



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

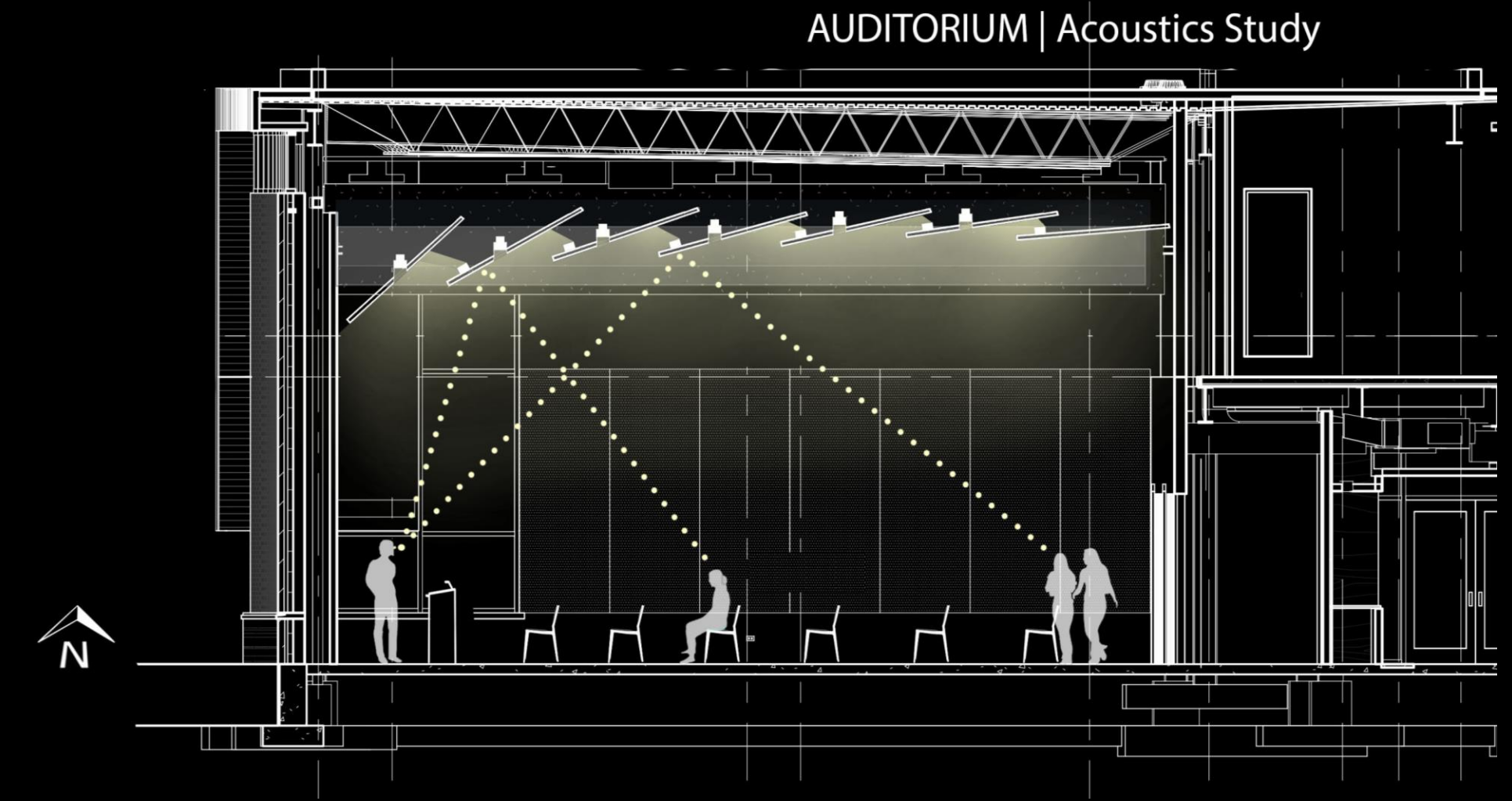
- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

# Acoustics Study |



# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

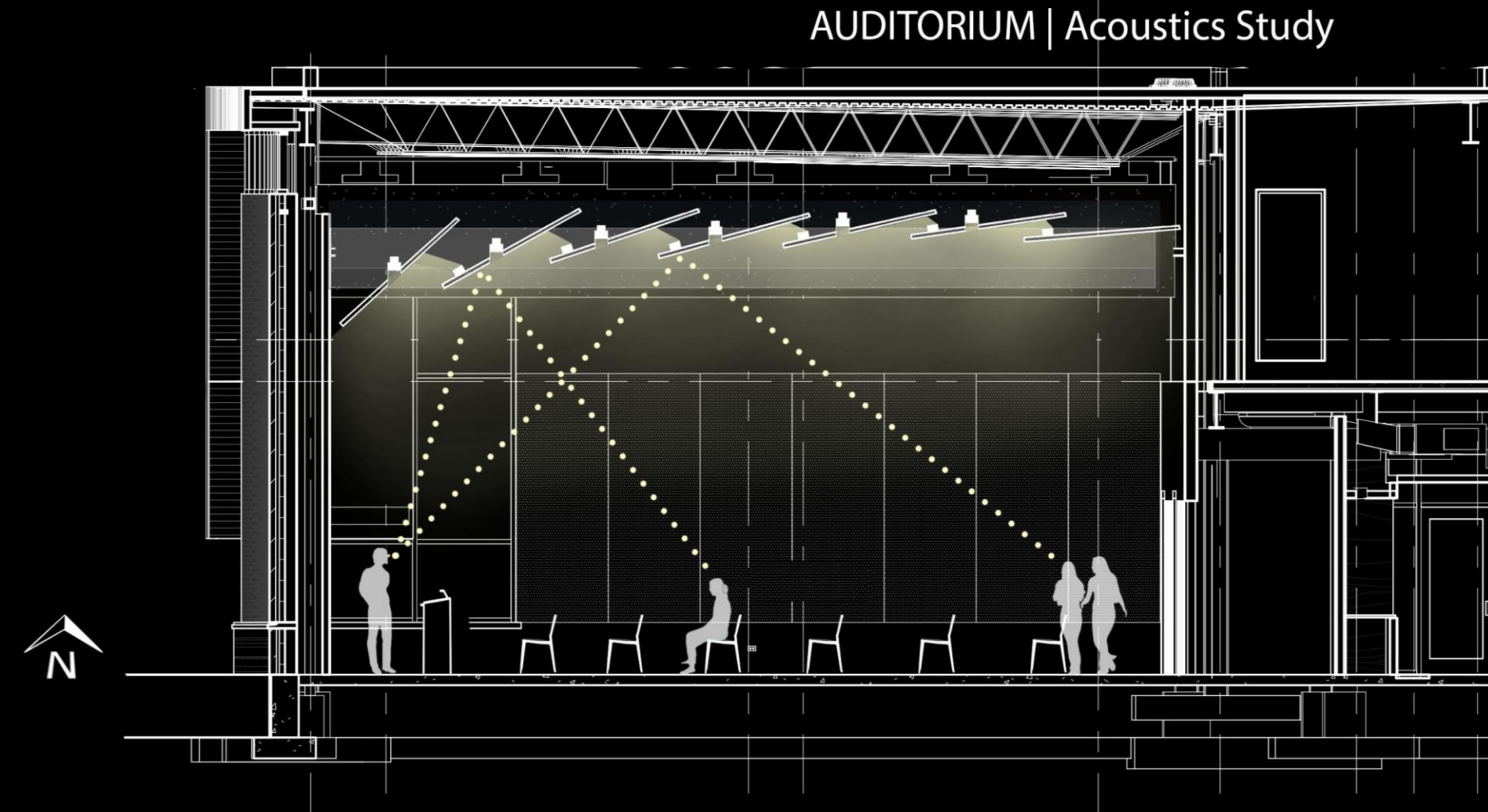
- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

# Calculation |



# Goal |

Optimum T60 for Room Volume: 1461 m<sup>3</sup>

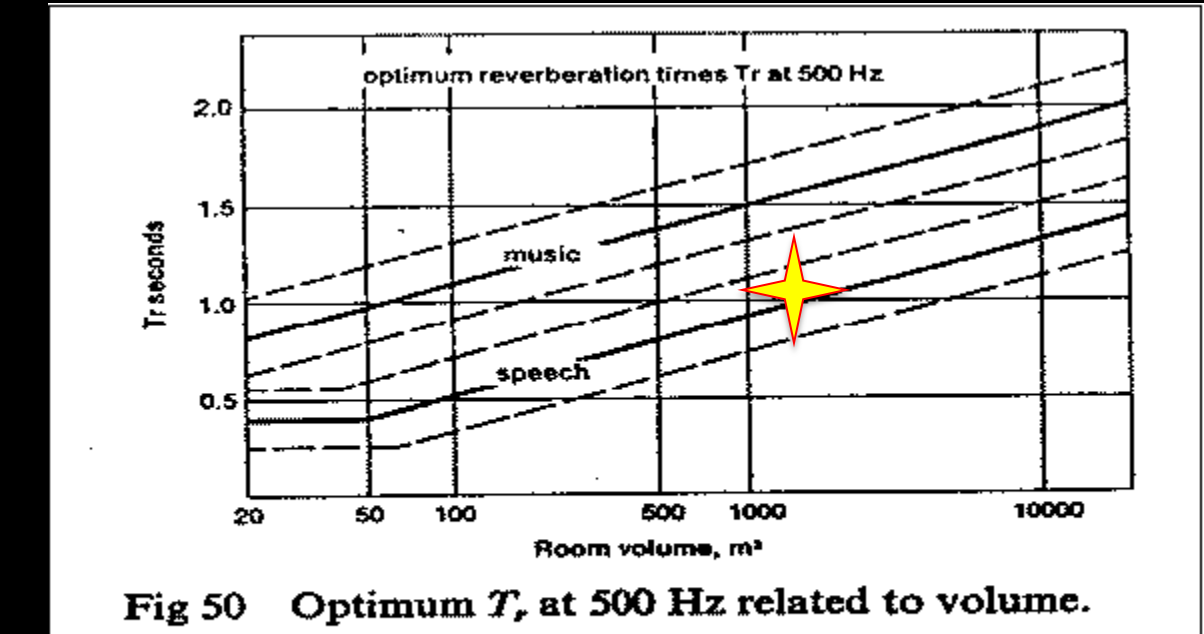


Figure 50 of DES 51

T60 = .6 to 1.2 seconds for speech.

# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion

# Method |

Compare **Acoustic Ceiling Tile** vs. **Ordinary Plaster** vs. **Acoustical Plaster**

Auditorium - Plaster Architectural Ceiling				Assumptions - Double Space, Fully Seated			
Surface	Area (m <sup>2</sup> )	Absorptivity Coef.	Effective Area	Absorptivity Coef.	Effective Area	Absorptivity Coef.	Effective Area
Wall Gyp.	2912.97	0.05	145.6485	0.04	116.5188	0.07	203.9079
Wall Absorption Panels	728	0.7	509.6	0.8	582.4	0.6	436.8
Doors	632.5	0.04	25.3	0.04	25.3	0.04	25.3
Windows	217.43	0.2	43.486	0.1	21.743	0.07	15.2201
Floor (- seating)	1629.68	0.15	244.452	0.4	651.872	0.6	977.808
Architectural Ceiling	3700	0.1	370	0.04	148	0.05	185
Upolstered Seating Occupied	2304	0.8	1843.2	0.9	2073.6	0.9	2073.6
<b>Total</b>			<b>3181.6865</b>		<b>2610.4338</b>		<b>3917.636</b>
Frequency	500	1000	2000	4000			
Reverb Time	<b>0.7946729</b>	<b>0.6985623</b>	<b>0.645389209</b>	<b>0.6625956</b>			

T60 @ 1000HZ fully occupied = .69 sec.

(original design .4 sec.)

T60 @ 1000HZ unoccupied = 1.1 sec.

(original design .7 sec.)

# Goal |

Optimum T60 for Room Volume: 1461 m<sup>3</sup>

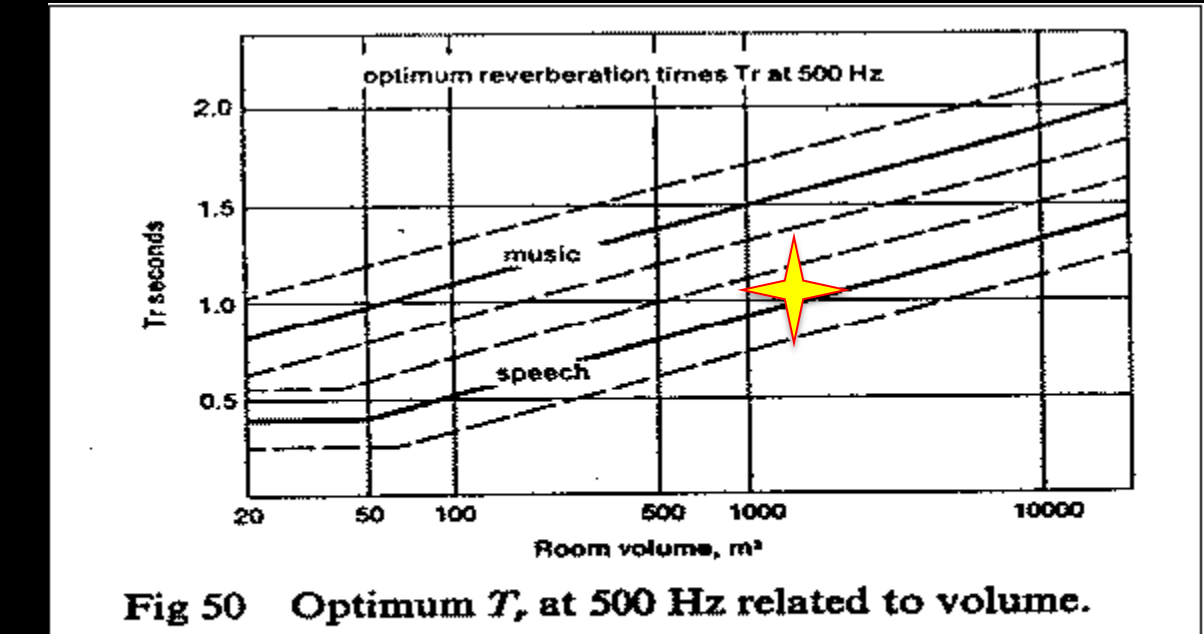


Figure 50 of DES 51

T60 = .6 to 1.2 seconds for speech.

# Covered Today

## Introduction

## Lighting Design Depth

- > Auditorium
- > Open Office
- > Lobby: Color Wall

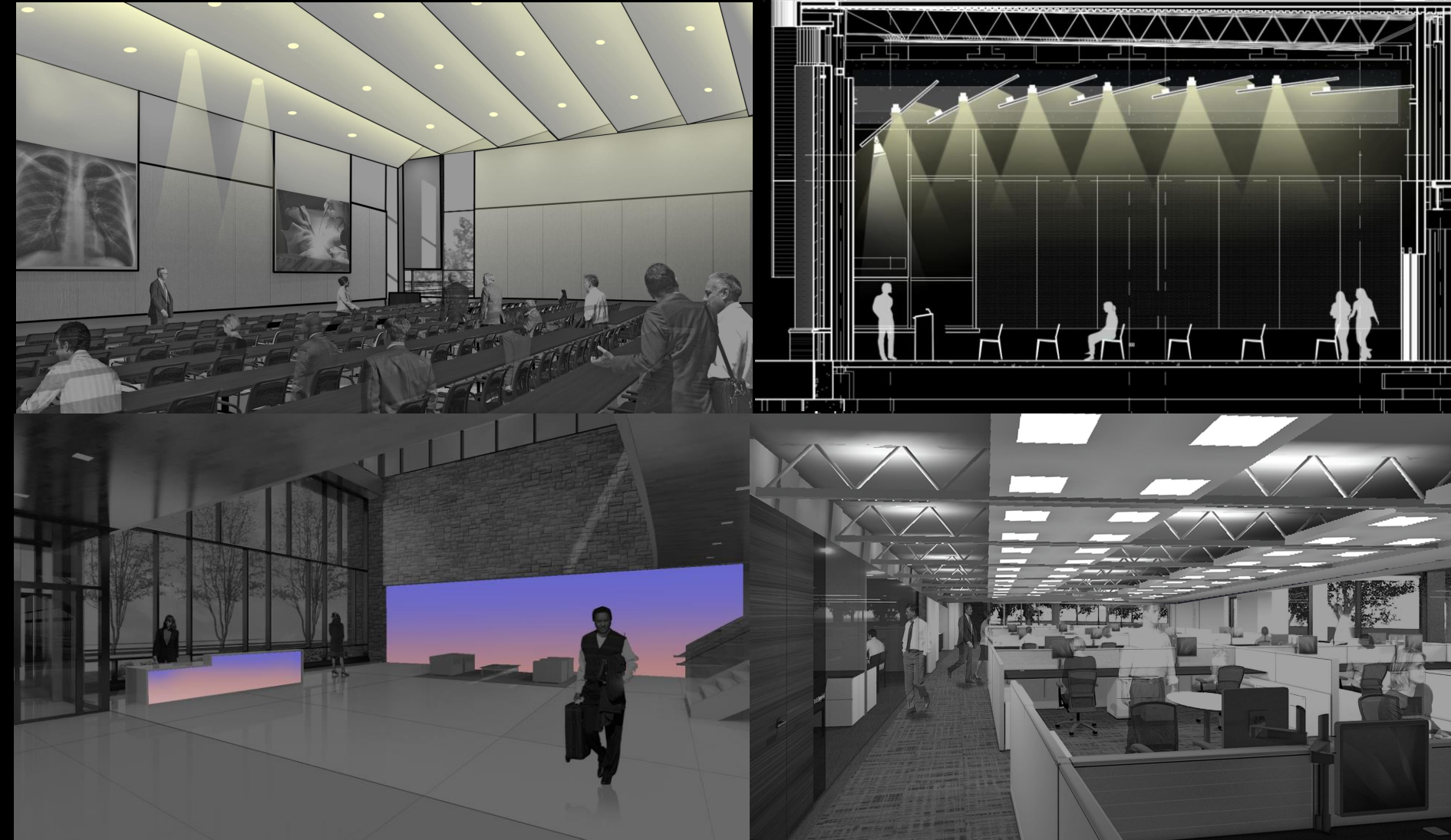
## Electrical Design Depth

- > Aluminum Vs. Copper Cost Analysis

## Acoustic Breadth

- > Auditorium Reverberation Analysis

## Conclusion



## Recommendation

**Savings** | Total energy usage of lighting designed to be **55%** of code.

Electricity savings due to shading (office & lobby) **\$490/yr.**

Aluminum vs. copper cost analysis : **\$11,000** al. savings

**Design** | 4 spaces – **auditorium, office, lobby, exterior**

Acoustic analysis – **plaster** ceiling finish

Shading study - **13% O.F. shade cloth , 50% DA**

**Thank you!**

