

NATIONAL INTREPID CENTER OF EXCELLENCE (NICoE)  
National Naval Medical Center | Bethesda, MD



Christine Clowes | May 1, 2009 | Lighting/Electrical | Professors Dannerth and Mistrick

## NATIONAL INTREPID CENTER OF EXCELLENCE (NICoE)

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Building Overview

Electrical Depth

- Wire Sizing/Voltage Drop Analysis

- SKM

Lighting Depth

- Exterior Facade

- Lobby

- Auditorium

  - Architectural Breadth

PT/OT

  - Mechanical Breadth

  - M.A.E. Focus

Conclusion

## NATIONAL INTREPID CENTER OF EXCELLENCE (NICoE)

## BUILDING OVERVIEW

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#### Conclusion

- Location
- Size
- Budget
- Construction Period
- Design Team



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## BUILDING OVERVIEW

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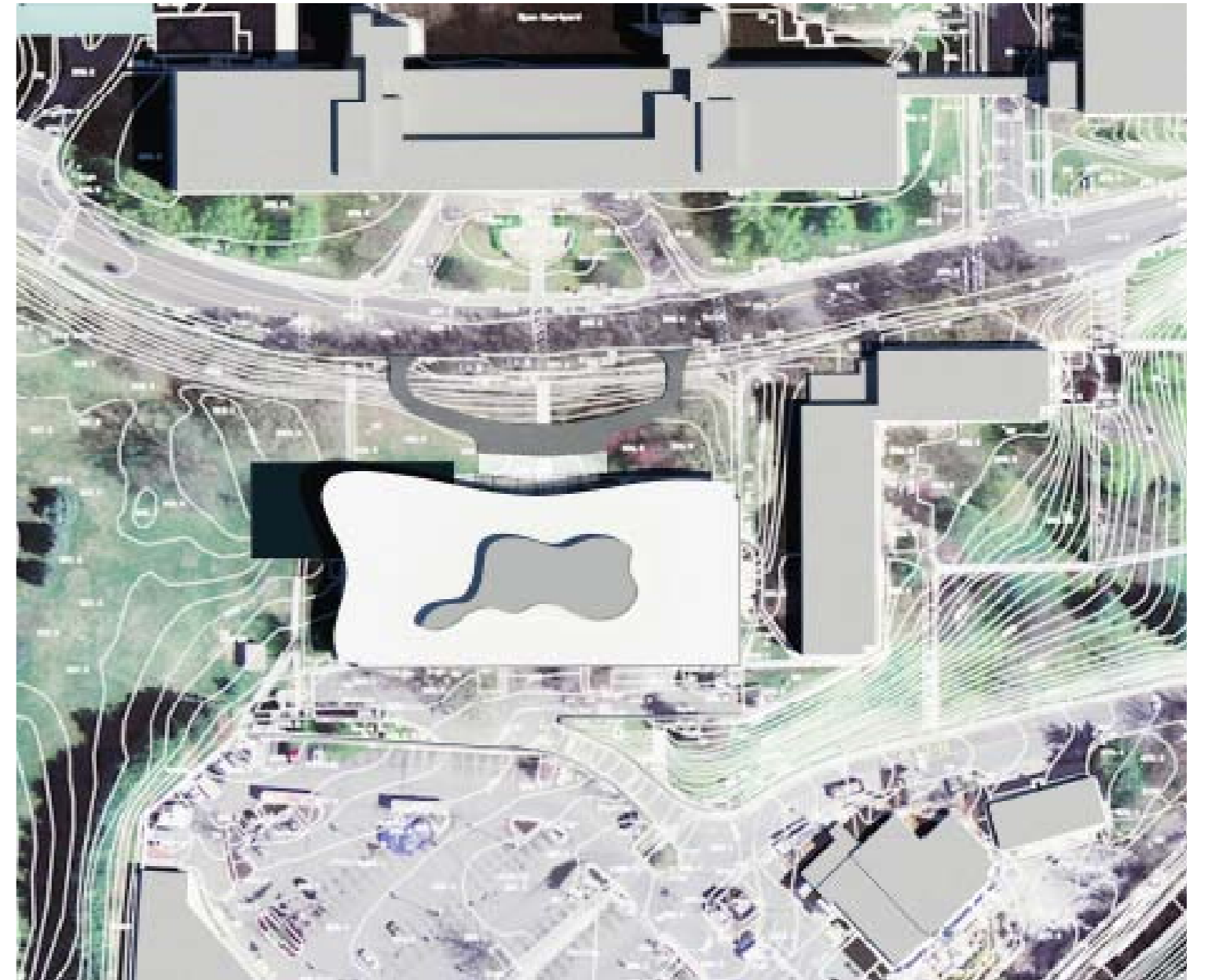
Architectural Breadth

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**Overview**

- Greater impedance with smaller wire size
  - More energy loss
  
- Cost comparison
  - Energy loss
  - Initial cost

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Procedure

- Voltage drop for each feeder

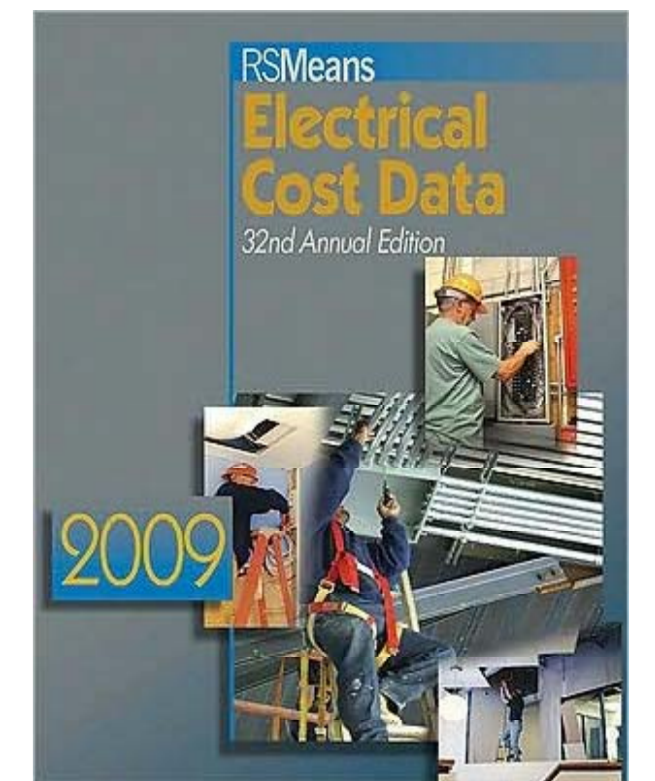
$$\text{Voltage Drop (V)} = \text{Current (A)} \times \text{Length of Feeder (ft.)} \times \text{Voltage Drop Factor} / 100$$

- Calculate cost of energy loss, conductors, and conduit
- Increase wires by 1, 2, and 3 sizes
- Increase number of sets from utility to switchboard

Eaton 2006 Consulting Application Guide



RS Means Electrical Cost Data



NATIONAL INTREPID CENTER OF EXCELLENCE (NICoE)

WIRE SIZING / VOLTAGE DROP ANALYSIS

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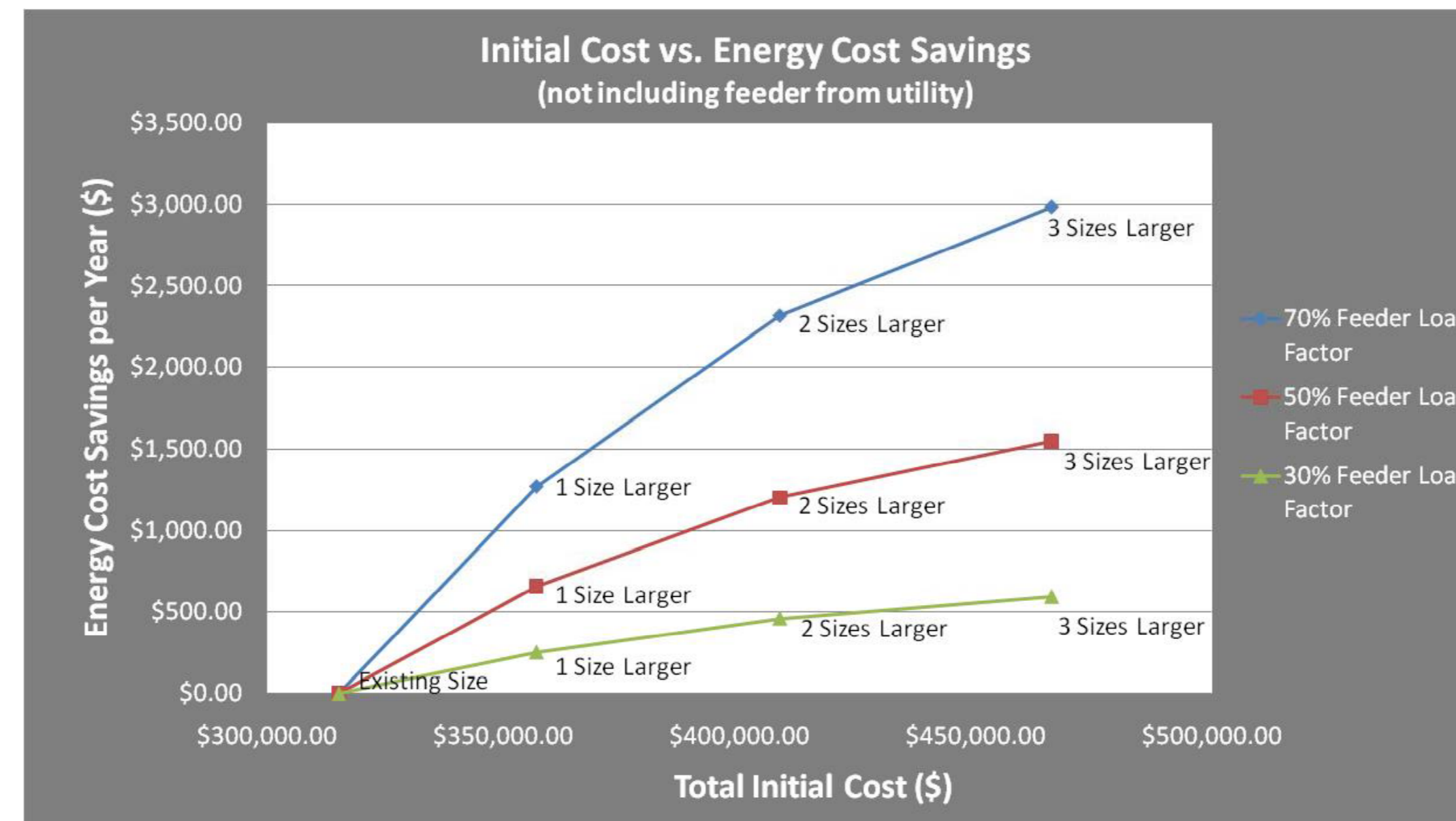
PT/OT

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Results



Simple Payback Period			
	1 Size Larger	2 Sizes Larger	3 Sizes Larger
30% Feeder Load Factor for 12hr/day + 10% Feeder Load Factor fo 12 hr/day	164.08	201.19	252.30
50% Feeder Load Factor for 12hr/day + 10% Feeder Load Factor fo 12 hr/day	63.11	77.38	97.04
70% Feeder Load Factor for 12hr/day + 10% Feeder Load Factor fo 12 hr/day	32.82	40.24	50.46

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**Short Circuit Analysis**

- Provides maximum allowable fault current

**Arc Fault Study**

- Full report of incident energy and arc flash boundary
  
- Required protective clothing category
  - Category 0 – Non-melting, flammable materials
  - Category 1 – Arc-rated FR shirt and pants
  - Category 3 – Arc-rated FR shirt and pants, arc flash suit

**Protective Device Coordination**

- Ensure circuit breakers capable of clearing fault



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## LIGHTING DEPTH

### Concept

- Characteristics/Qualities of a Soldier

### Goals

- Portray strength, focus, unity, and leadership
- Calm, comfortable, and healing atmosphere
- Articulation of architectural features
- Integrate daylight
- Avoid:
  - High brightness
  - High contrast
  - Direct glare



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## EXTERIOR FACADE

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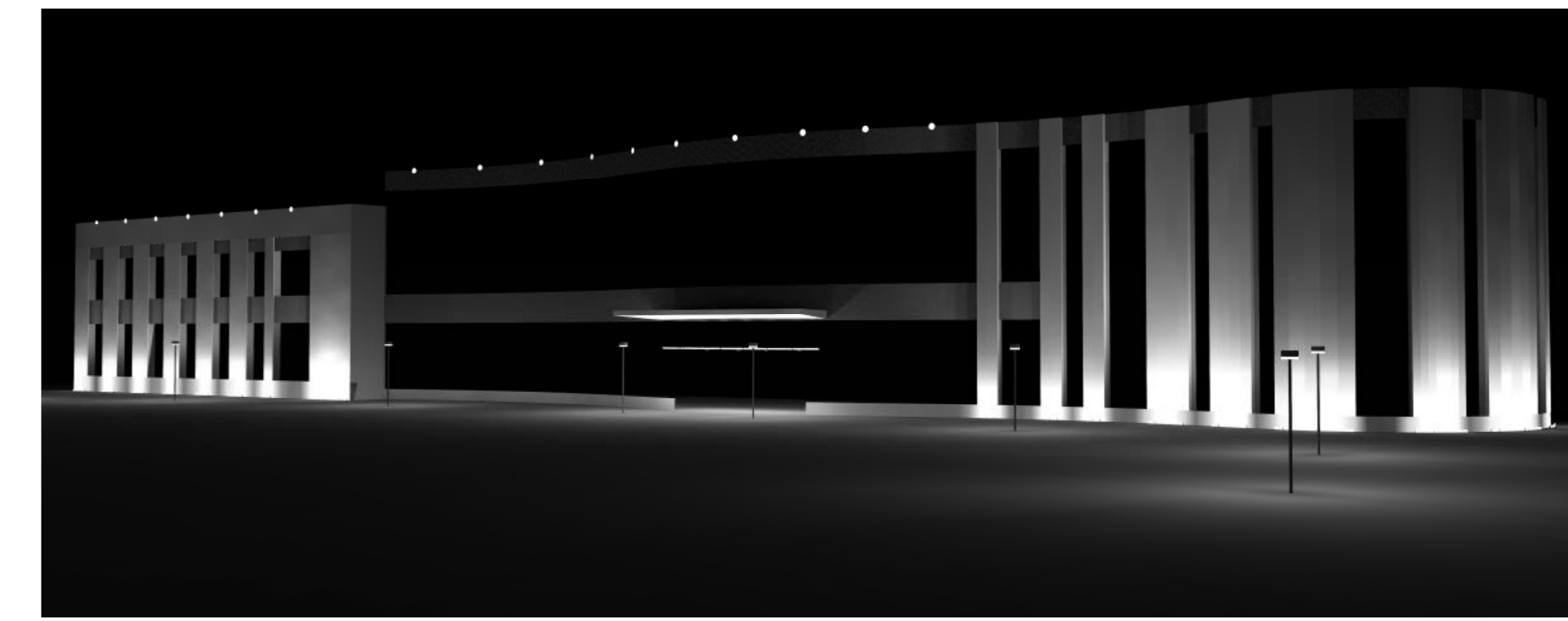
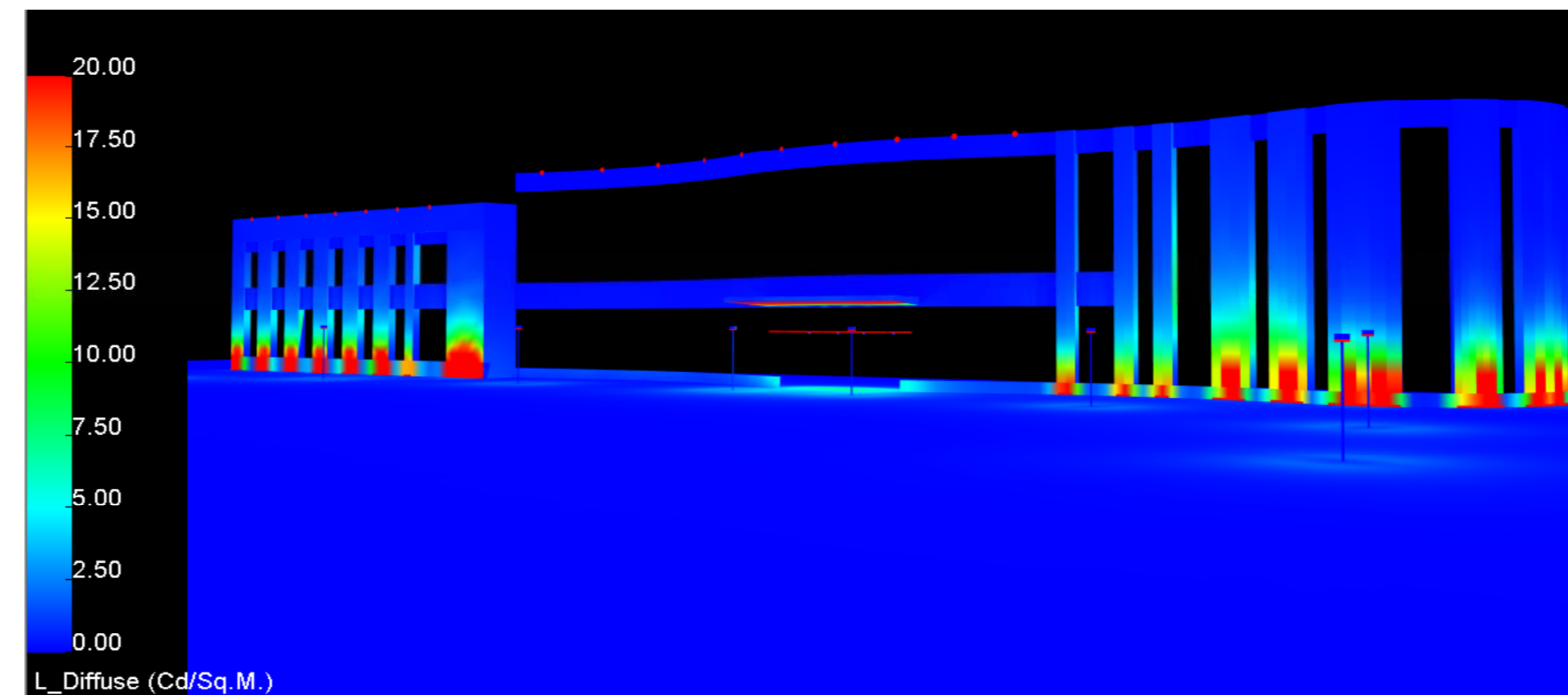
Architectural Breadth

PT/OT

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### Concept

- Unity

### Criteria

- Visual clarity
- Highlight entrance
- Accentuate building shape

Grid Name	Achieved Average (fc)	Target Average (fc)
Sidewalk (horizontal ground)	1.8	0.6
Sidewalk (vertical)	2.1	1.1
Entrance (horizontal ground)	4.47	5
Entrance (vertical)	2.38	3

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## LOBBY

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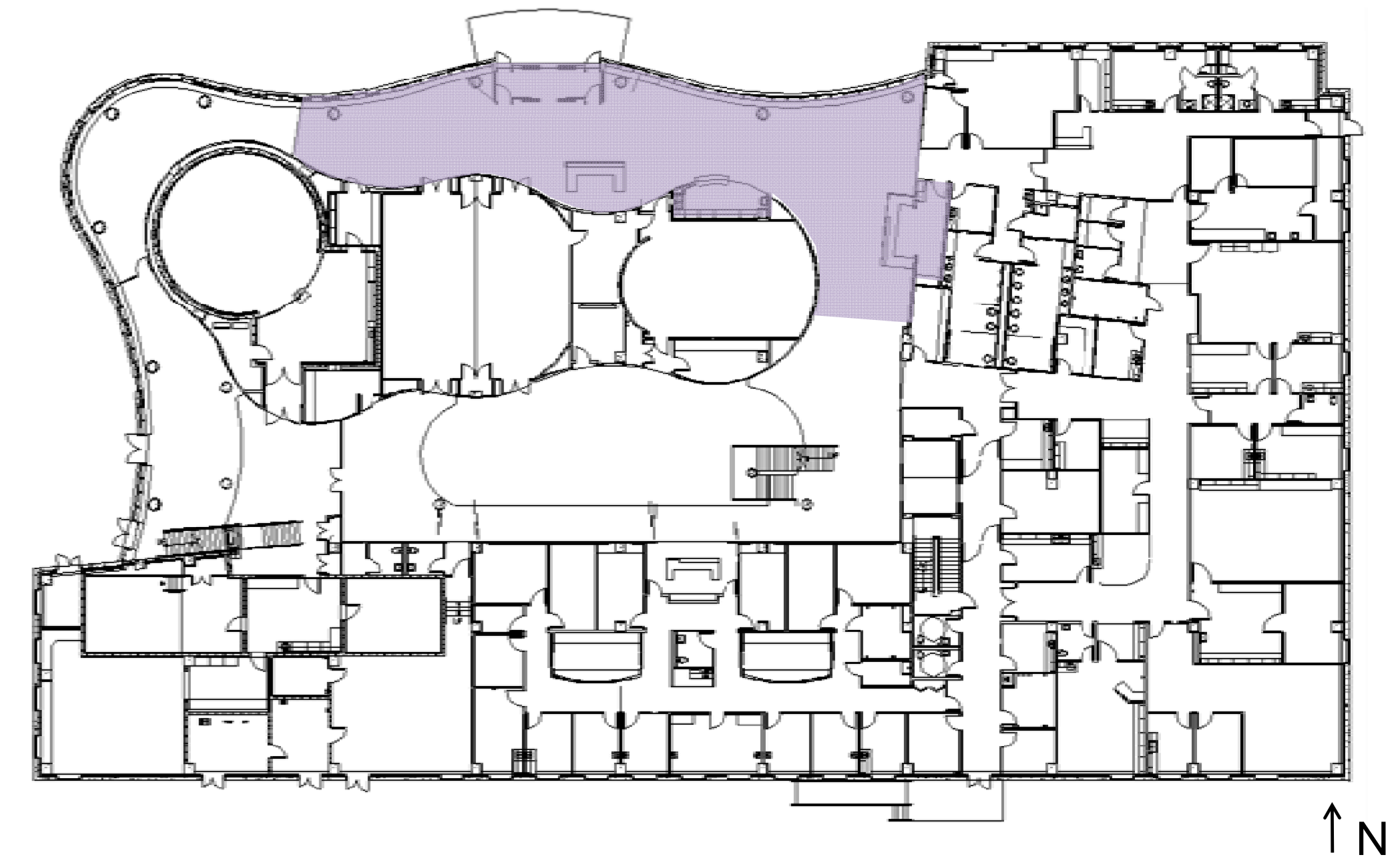
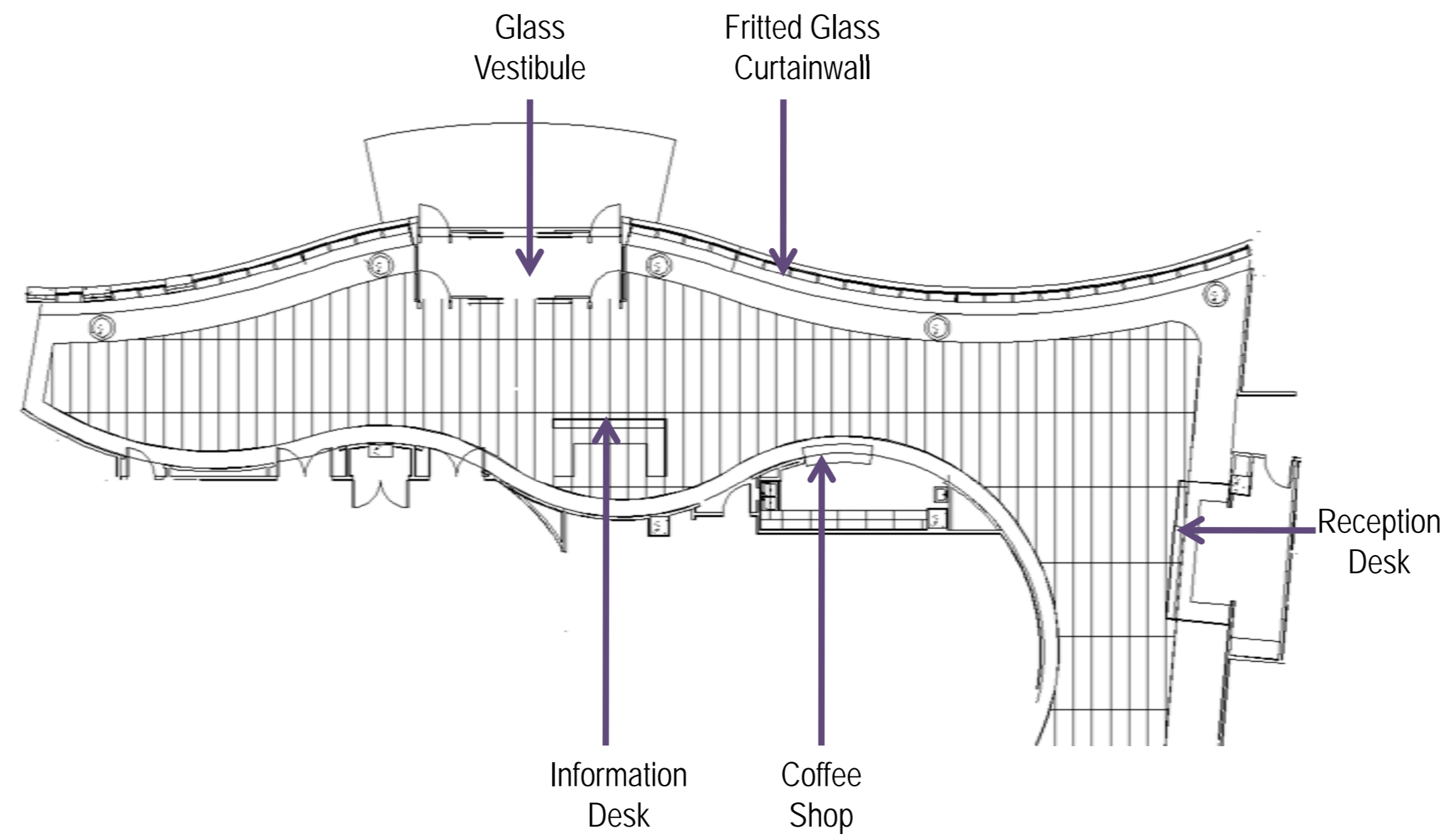
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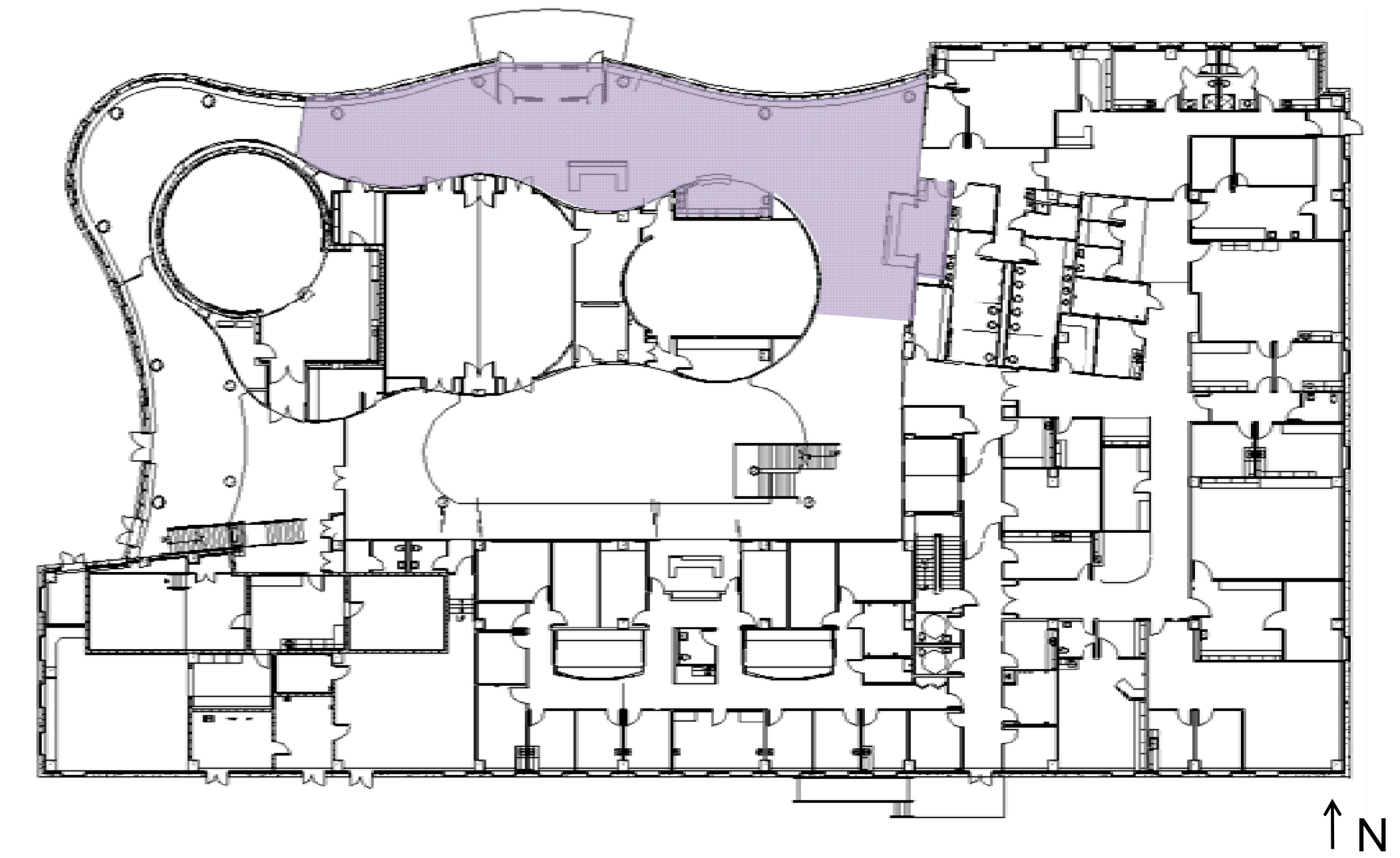
Conclusion

### Concept

- Leadership

### Criteria

- Spaciousness
- Uniform **peripheral** emphasis
- **Uniform** task planes
- Focus on desk, countertop, and floor



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Conclusion

### Always On

- Security

### Photosensors

- Open loop dimming of indirect ceiling cove

### Time Clock

- On during normal operating hours

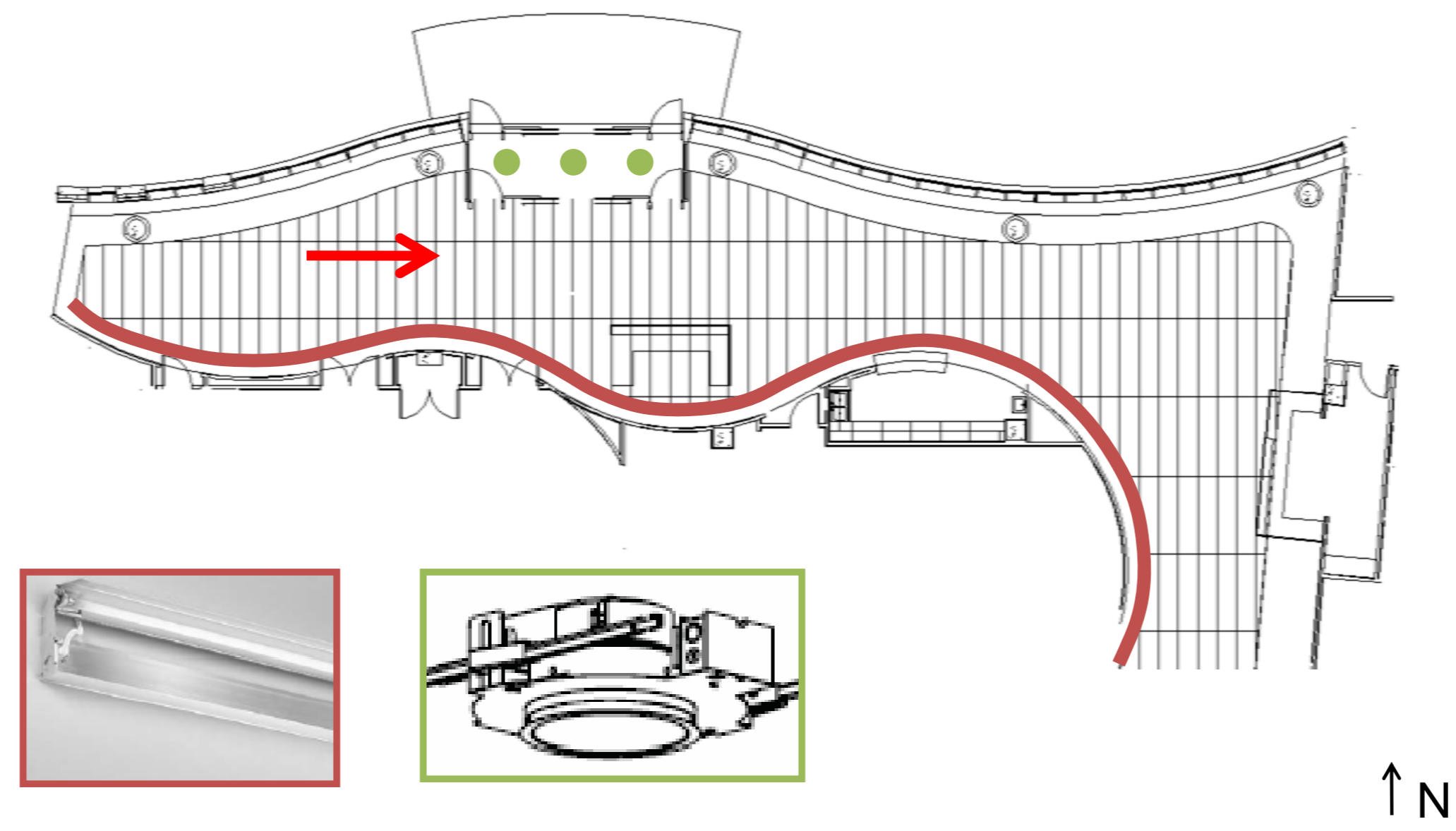


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Always On

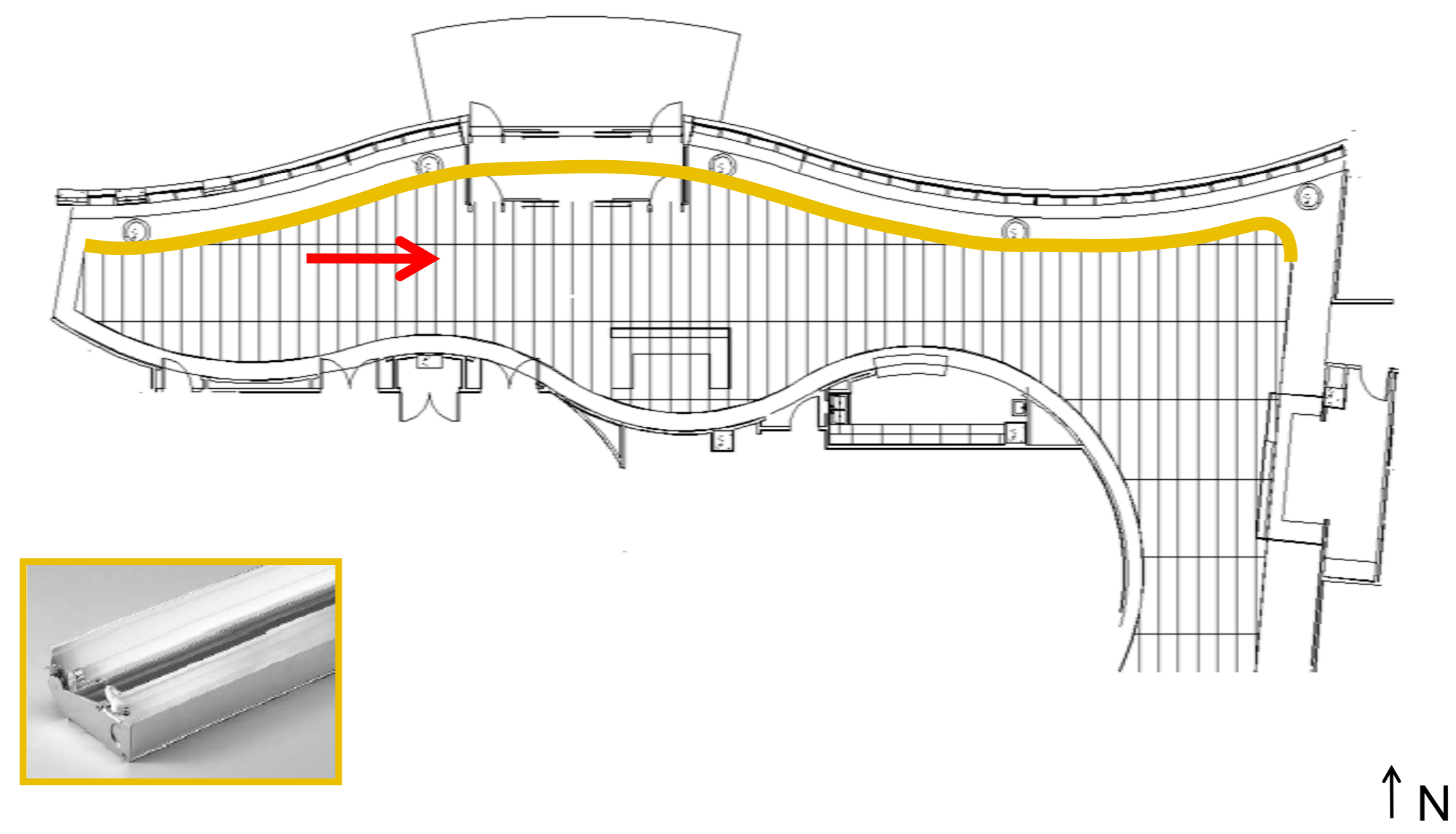


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Dimming Photosensor

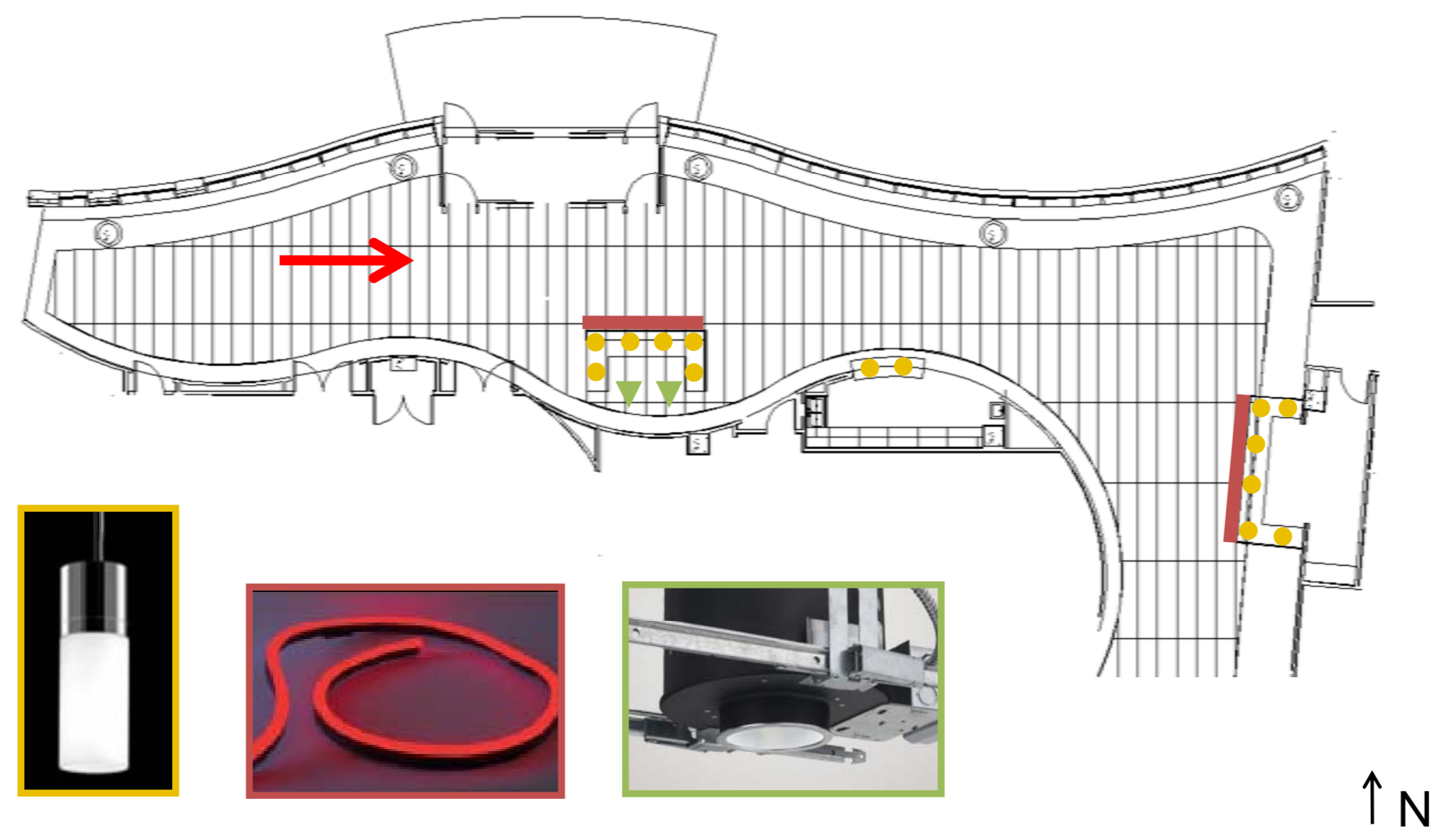


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Time Clock





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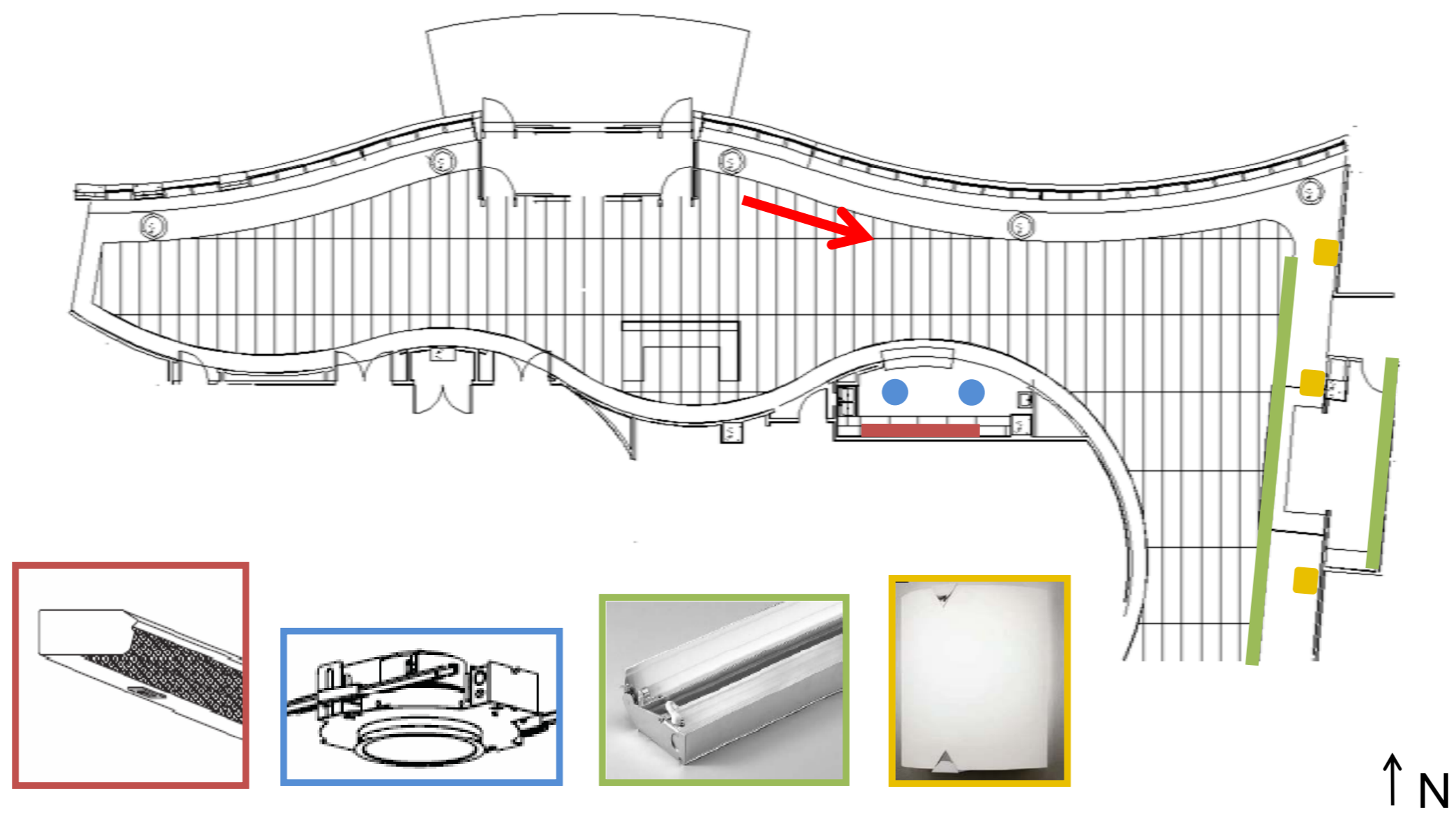
PT/OT

Mechanical Breadth

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Achieved vs. Target Illuminance Calculations

Grid Name	Achieved Average (fc)	Target Average (fc)
Lobby Workplane (floor)	14.22	10
Vestibule Workplane (floor)	8.77	5
Desk Workplane (horizontal 2.5' AFF)	30.1	30
Countertop Workplane (horizontal 3' AFF)	58.38	50



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## AUDITORIUM

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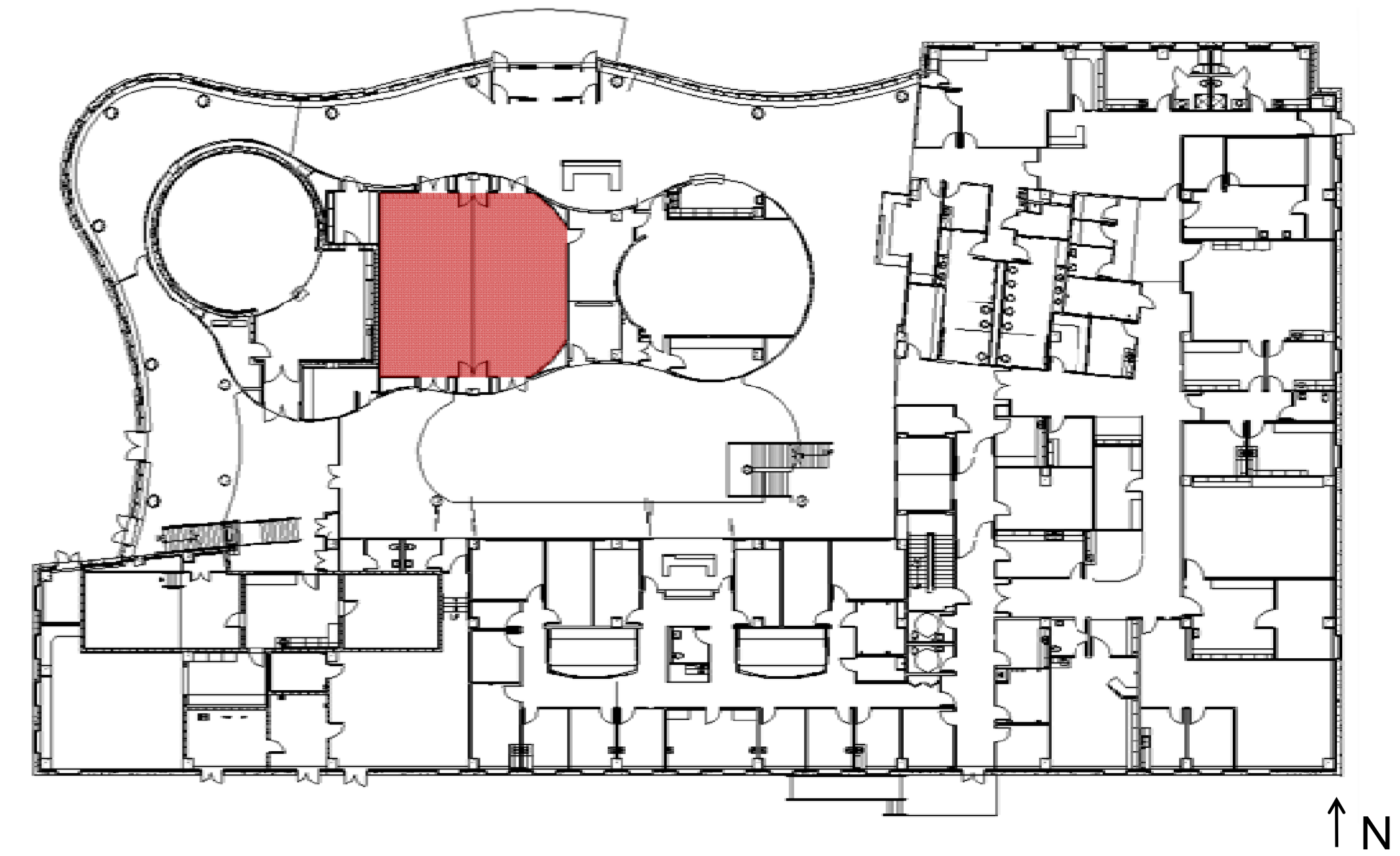
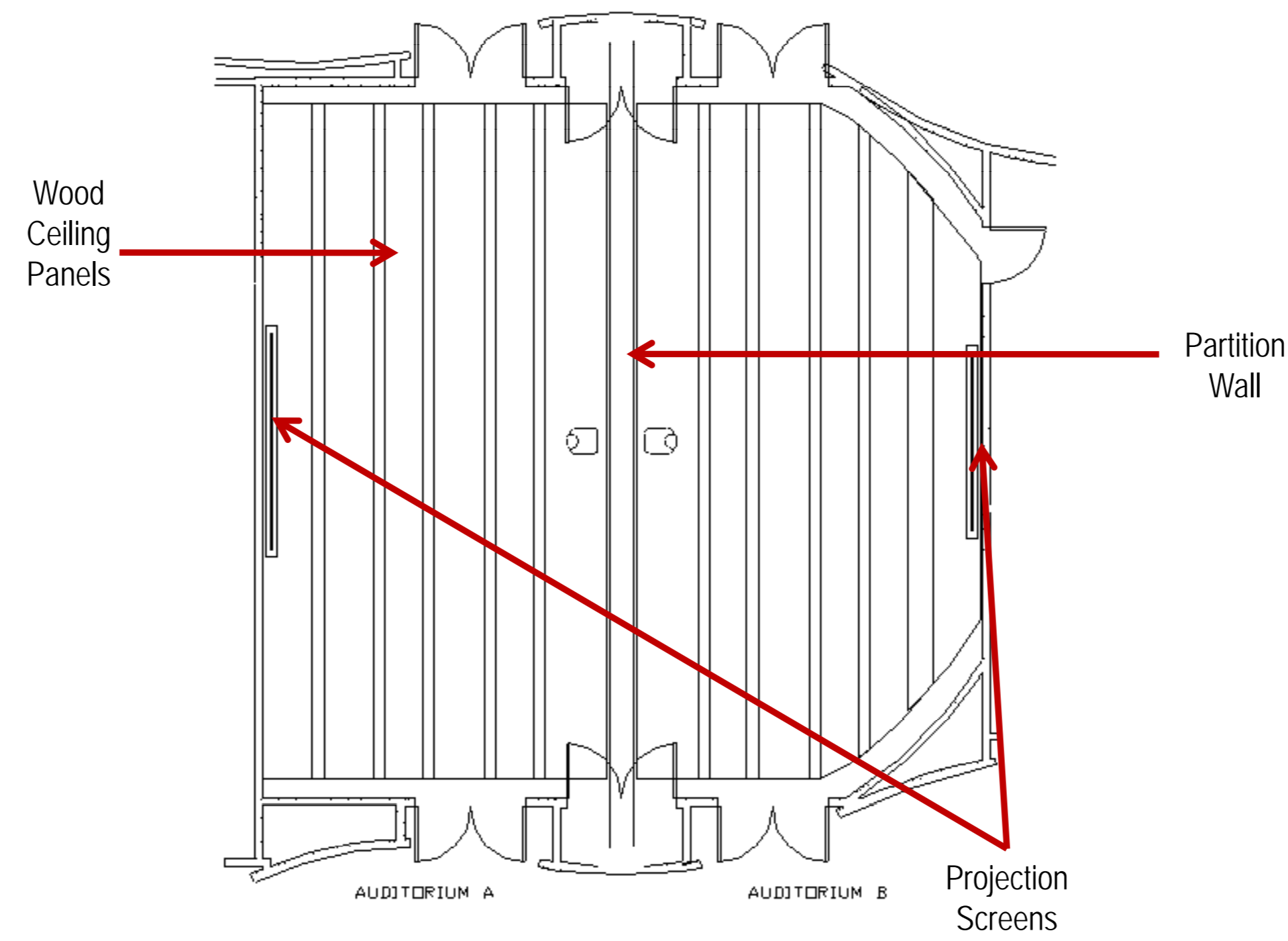
Architectural Breadth

PT/OT

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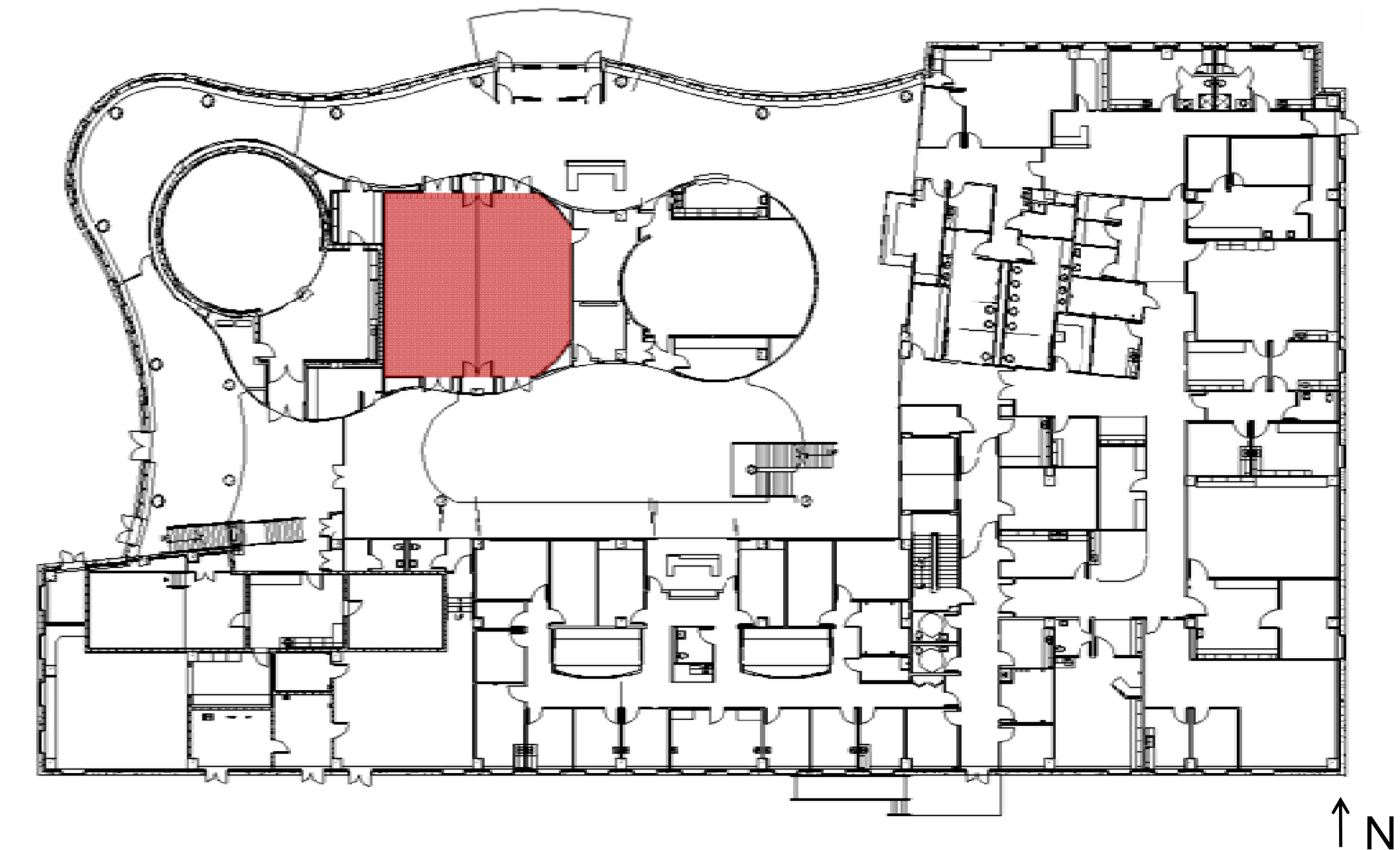
## AUDITORIUM

### Concept

- Focus

### Criteria

- Visual clarity
- **Uniform** lighting on task plane
- Various scene **controls**
- Focus on tables, podium, and projection screen



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### Occupancy Sensors

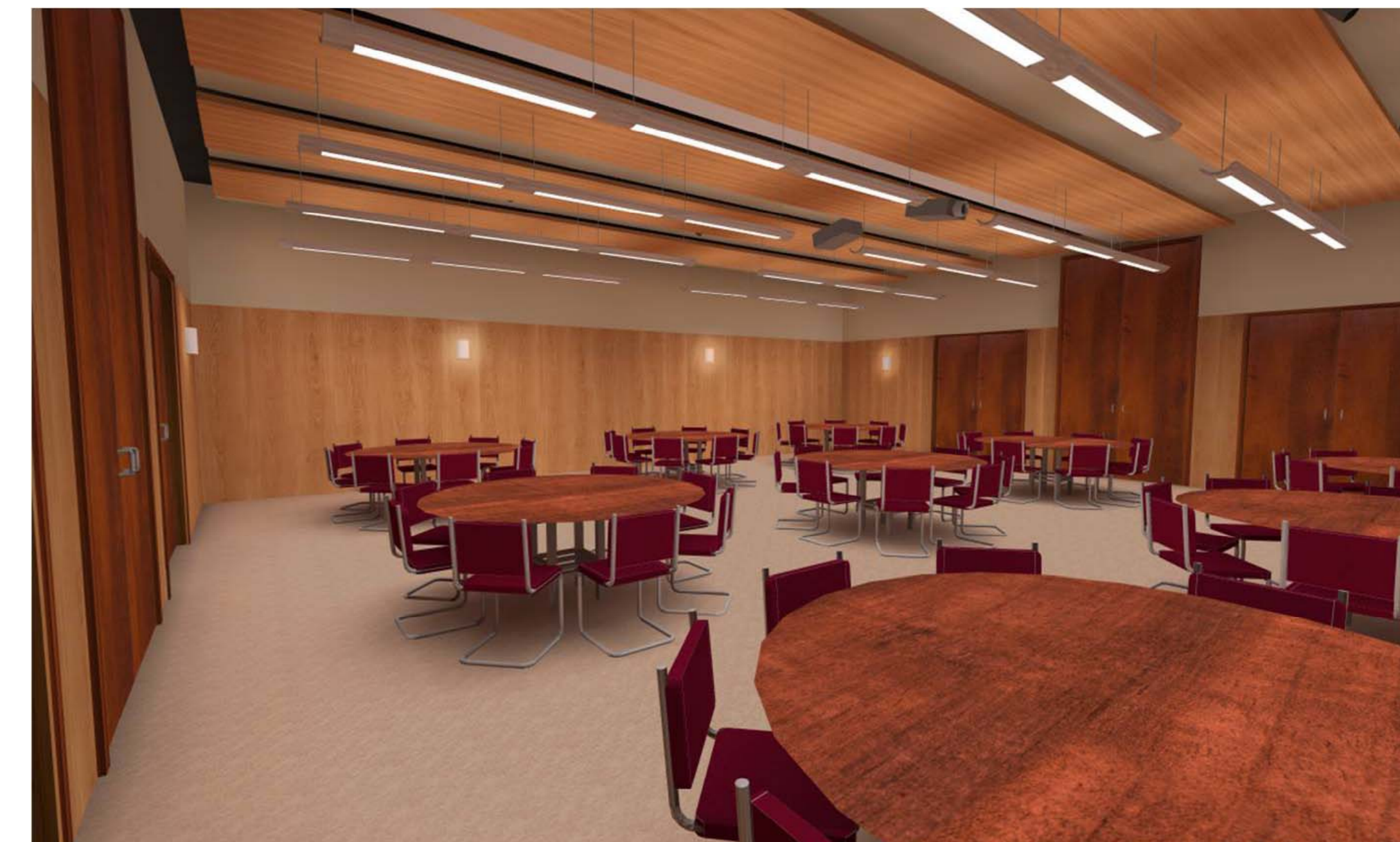
- Automatic Shut Off

### Preset Dimming Control System

- 12 Zones
- 4 Scenes
  - Meeting
  - Presentation
  - Lecture
  - All Off

### Partition Sensors

- Room Division



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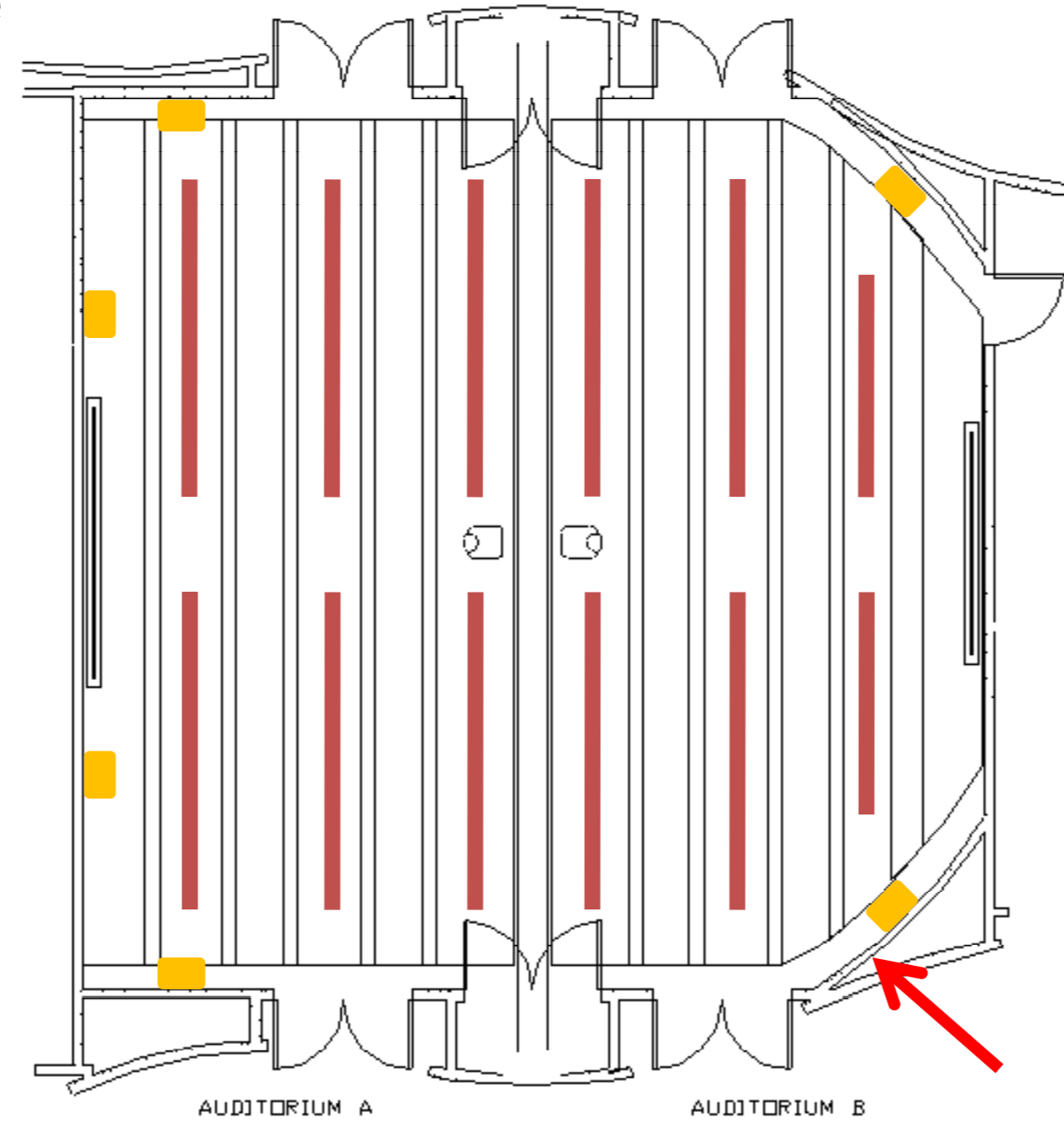
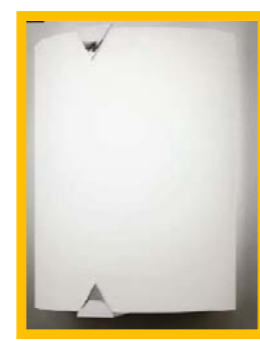
PT/OT

Mechanical Breadth

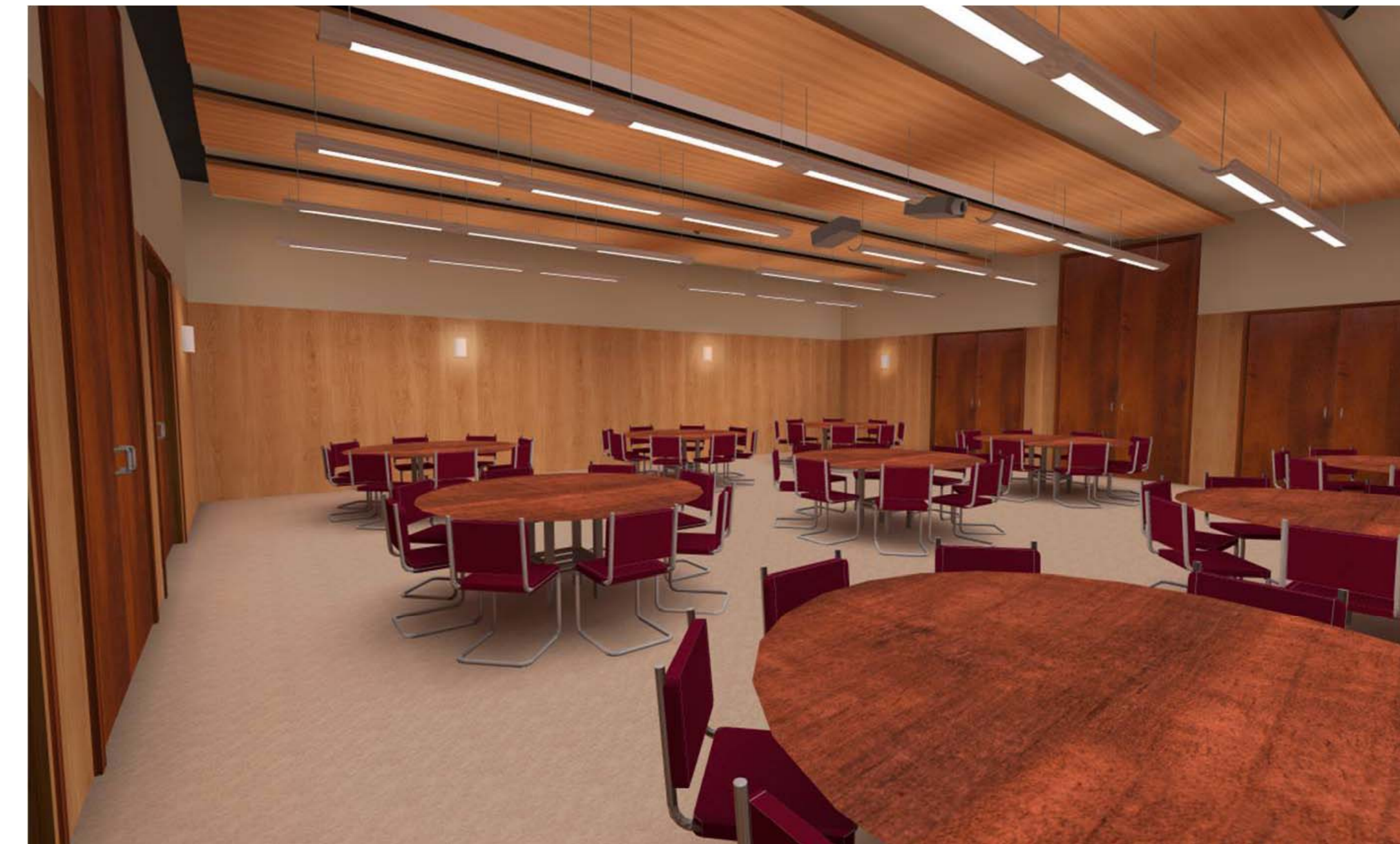
M.A.E. Focus

Conclusion

Meeting Space



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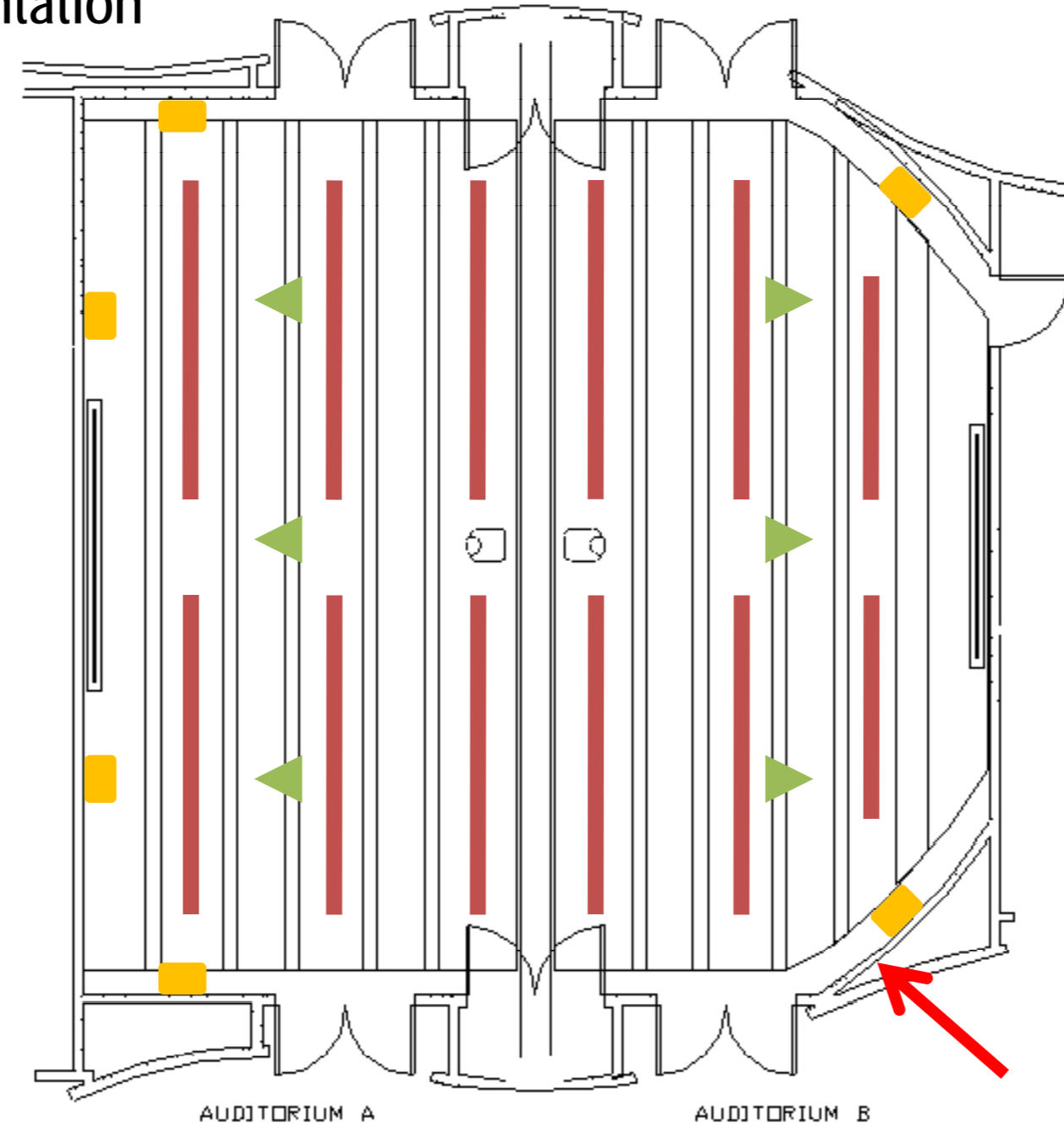
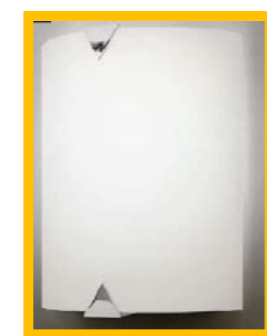
PT/OT

Mechanical Breadth

M.A.E. Focus

Conclusion

Lecture/Presentation  
Space



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AUDITORIUM

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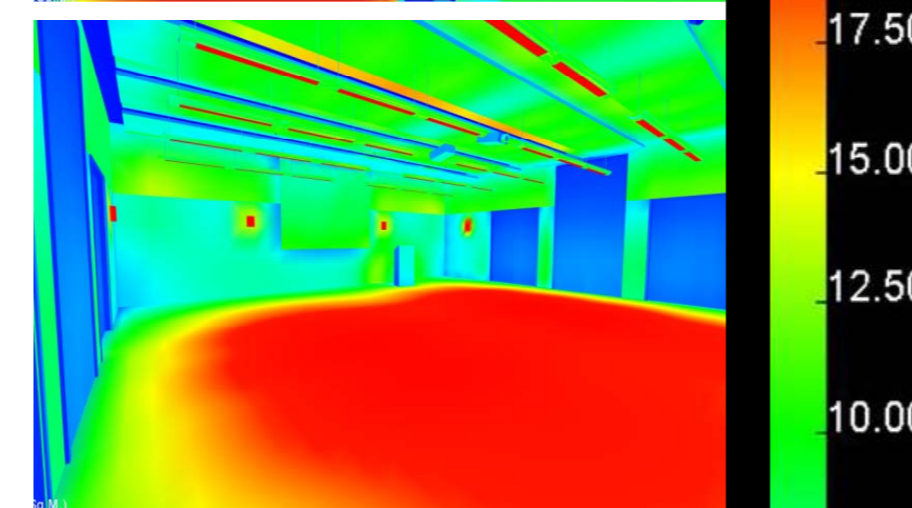
M.A.E. Focus

Conclusion

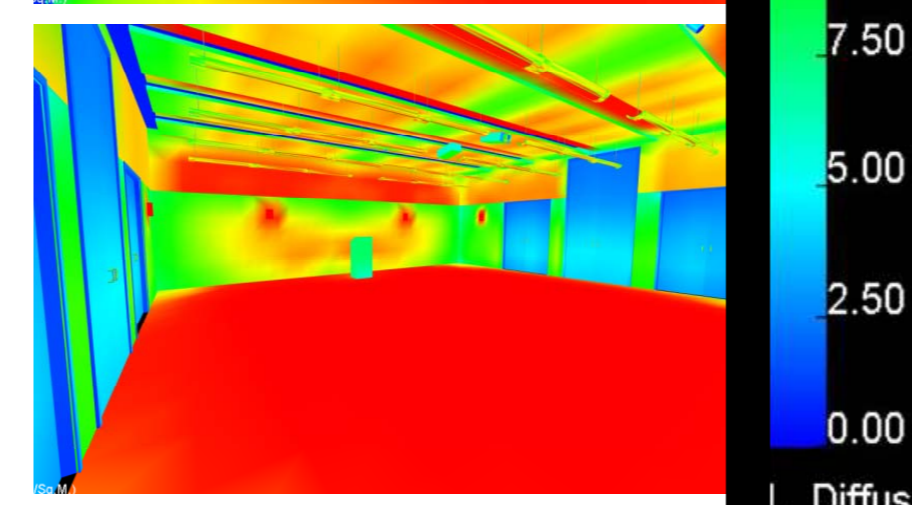
Meeting Space - Full



Presentation Space - Full



Lecture Space - Full



Grid Name	Achieved Average (fc)	Target Average (fc)
Workplane (horizontal 2.5' AFF)	36.6	30
Vertical	10.2	5

Grid Name	Achieved Average (fc)	Target Average (fc)
Workplane (horizontal 2.5' AFF)	19.52	10-30
Projection Screen (vertical)	3.3	< 5
Auditorium A Side Podium (vertical)	32.02	30

Grid Name	Achieved Average (fc)	Target Average (fc)
Workplane (horizontal 2.5' AFF)	36.39	10-30
Auditorium A Center Podium (vertical)	30.19	30



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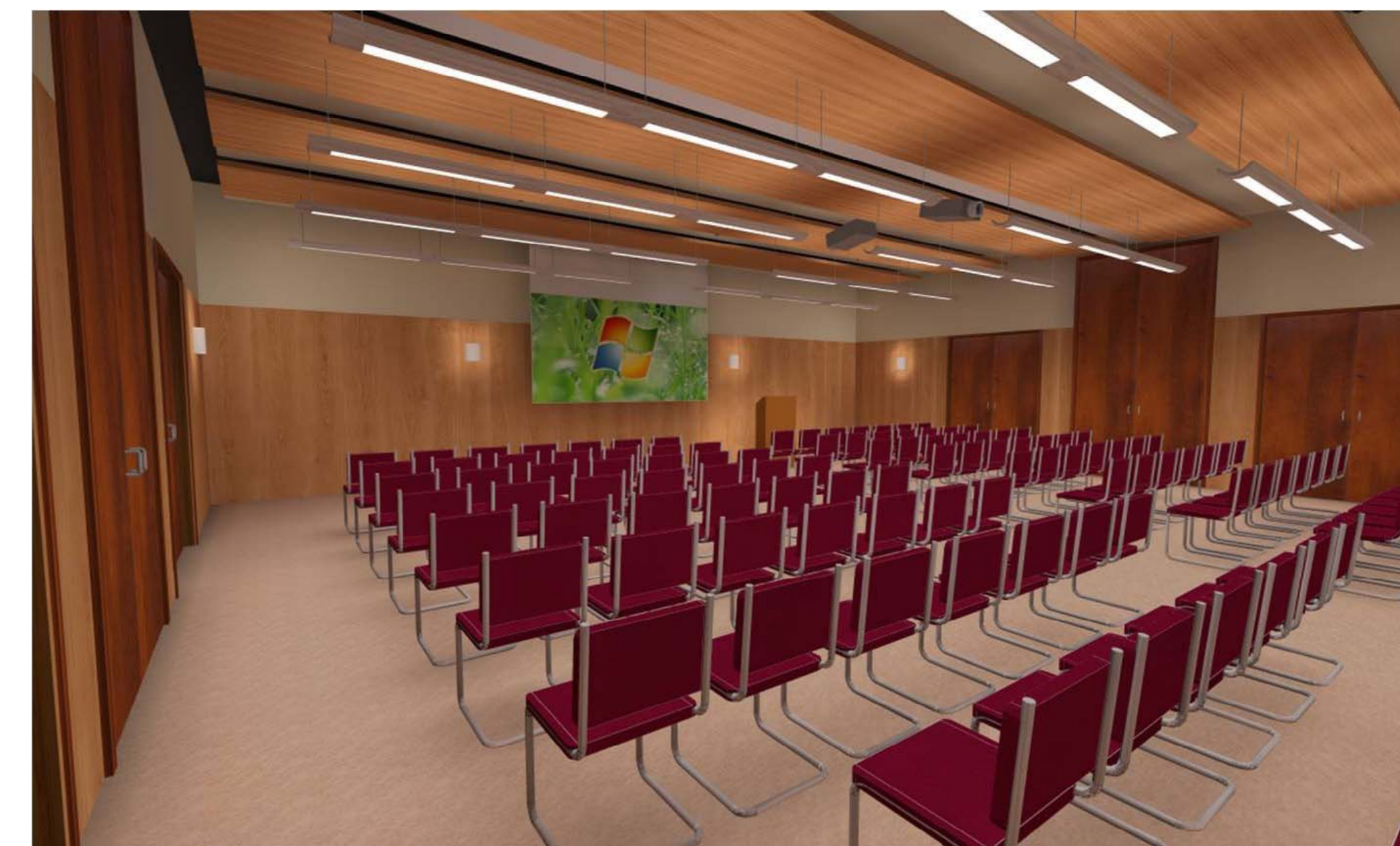
Conclusion

## AUDITORIUM: ARCHITECTURE BREADTH

Existing Design



Redesign



# NATIONAL INTREPID CENTER OF EXCELLENCE (NICoE)

## PHYSICAL THERAPY / OCCUPATIONAL THERAPY

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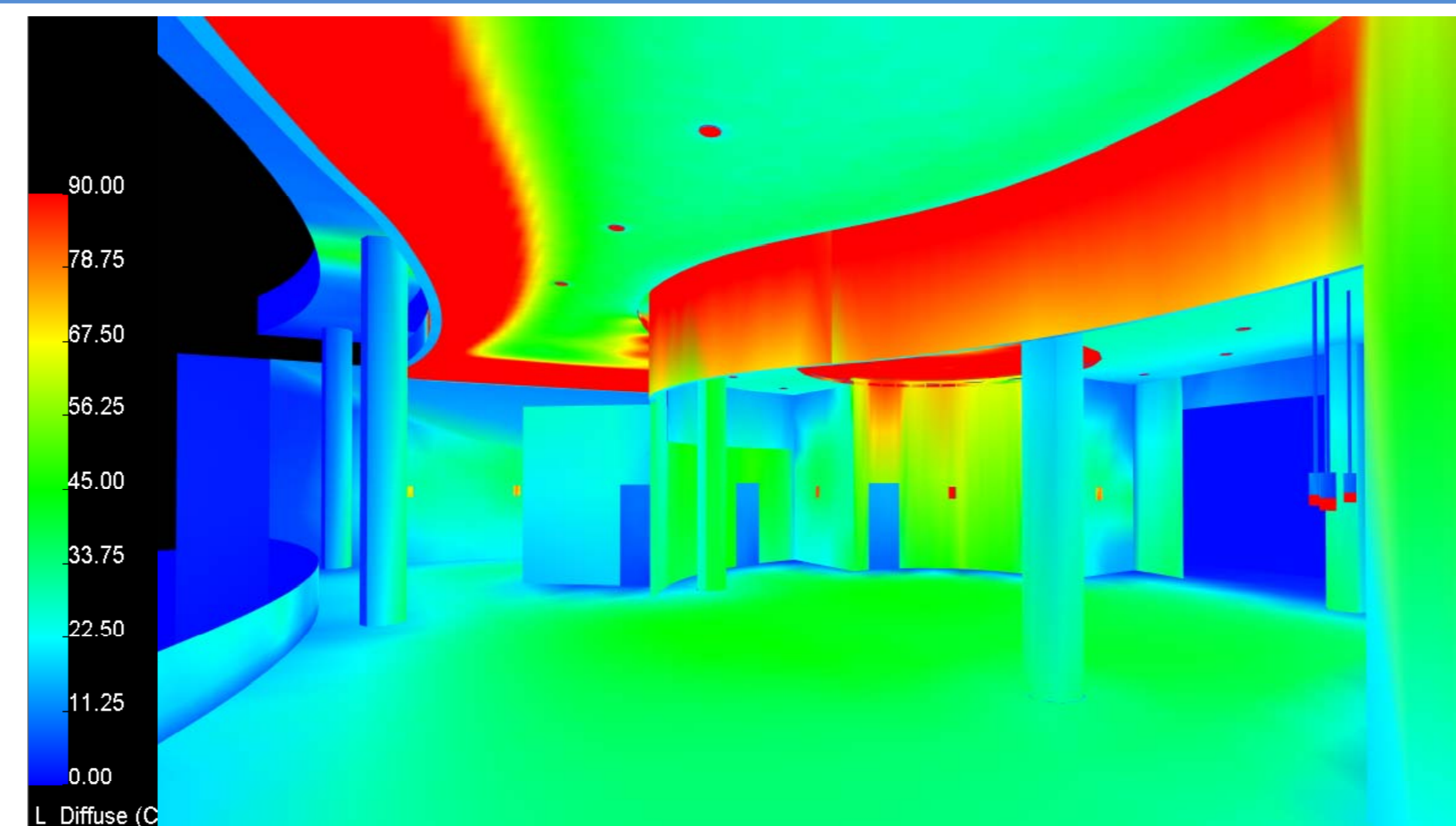
Architectural Breadth

**PT/OT**

Mechanical Breadth

M.A.E. Focus

Conclusion



### Concept

- Strength

### Criteria

- Relaxation and visual clarity
- Accentuate walls and structure



Grid Name	Achieved Average (fc)	Target Average (fc)
PT/OT Workplane (horizontal 2.5' AFF)	26.53	30
OT Countertop (horizontal 3.5' AFF)	26.08	30
Therapy Waiting Area (horizontal 2.5' AFF)	18.28	10

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## CLERESTORY DAYLIGHT STUDY

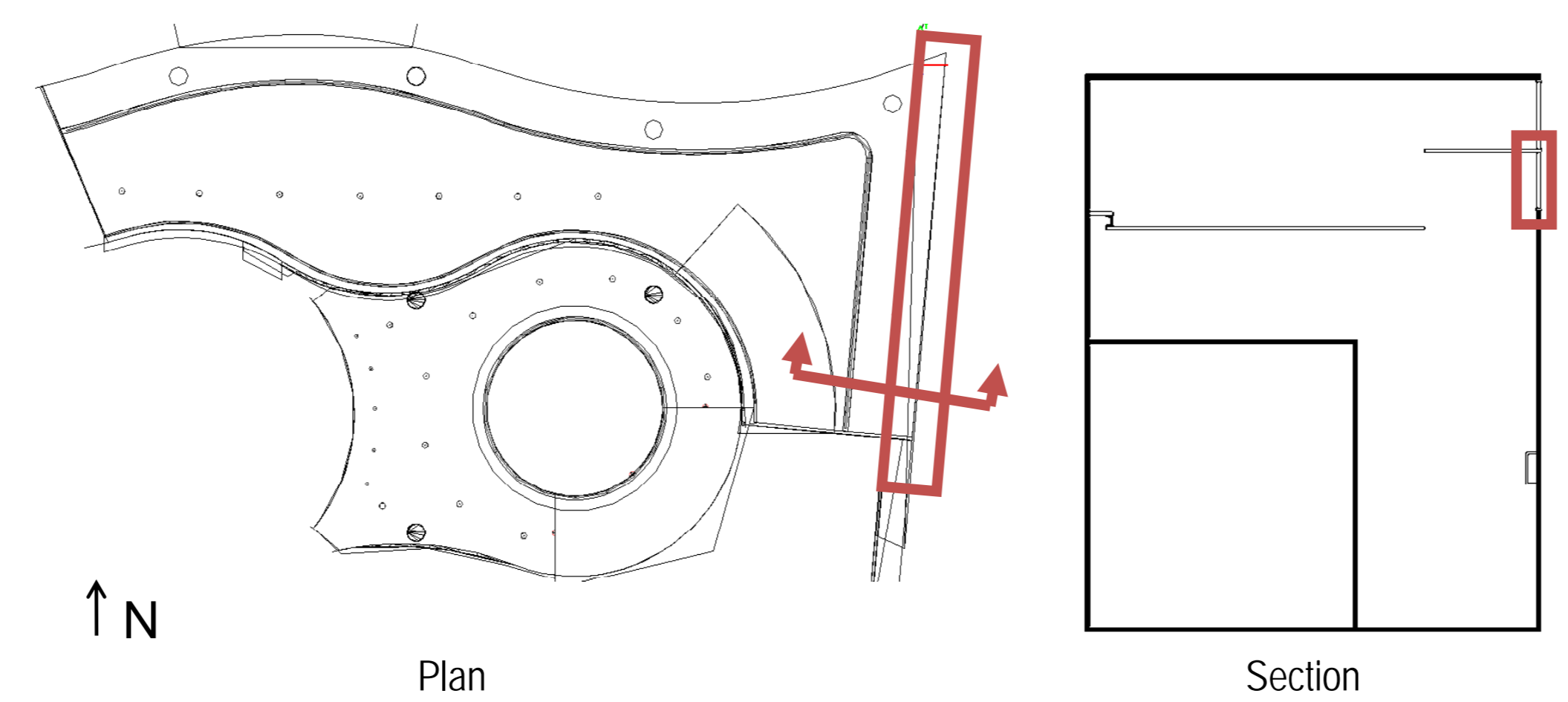
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### Process

- Studied clear and overcast skies
- Determined clerestory contribution

### Results

- Average range of 1.5 to 5.6 fc contributed to space from clerestory
- Clerestory not necessary



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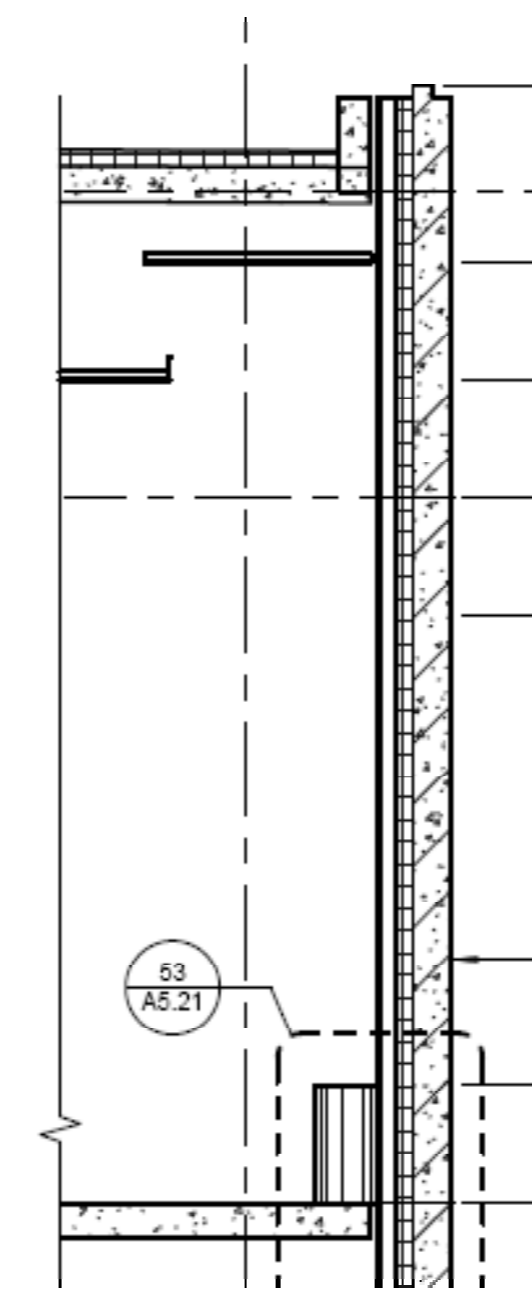
**Mechanical Breadth**

M.A.E. Focus

Conclusion

**Overview**

- Clerestory creates significant cooling load
- Glass clerestory vs. standard wall system (pre-cast concrete, insulation, gypsum wall board)
- Cooling Load Temperature Difference / Solar Cooling Load / Cooling Load Factor Calculation Procedure
  - 1997 ASHRAE Fundamentals Handbook



Wall Composition

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**PT/OT**

**Mechanical Breadth**

M.A.E. Focus

Conclusion

- Clerestory glass window vs. standard wall structure
  - Window conduction and solar load gain
  - Wall conduction load
- Other load contributions
  - Exterior Walls
  - Occupants
  - Lighting
- 24 hr/day in July

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Spatial Loads

Load Type	Clerestory Window	Wall
	Total Load (Btu/hr)	Total Load (Btu/hr)
Exterior Clerestory	<b>149,811</b>	-
Exterior Wall	-	<b>10,722</b>
Exterior Curtainwall	524,797	524,797
Occupants	221,098	221,098
Lighting	350,060	350,060
<b>TOTAL</b>	<b>1,245,765</b>	<b>1,106,677</b>

SAVINGS: 11.16%

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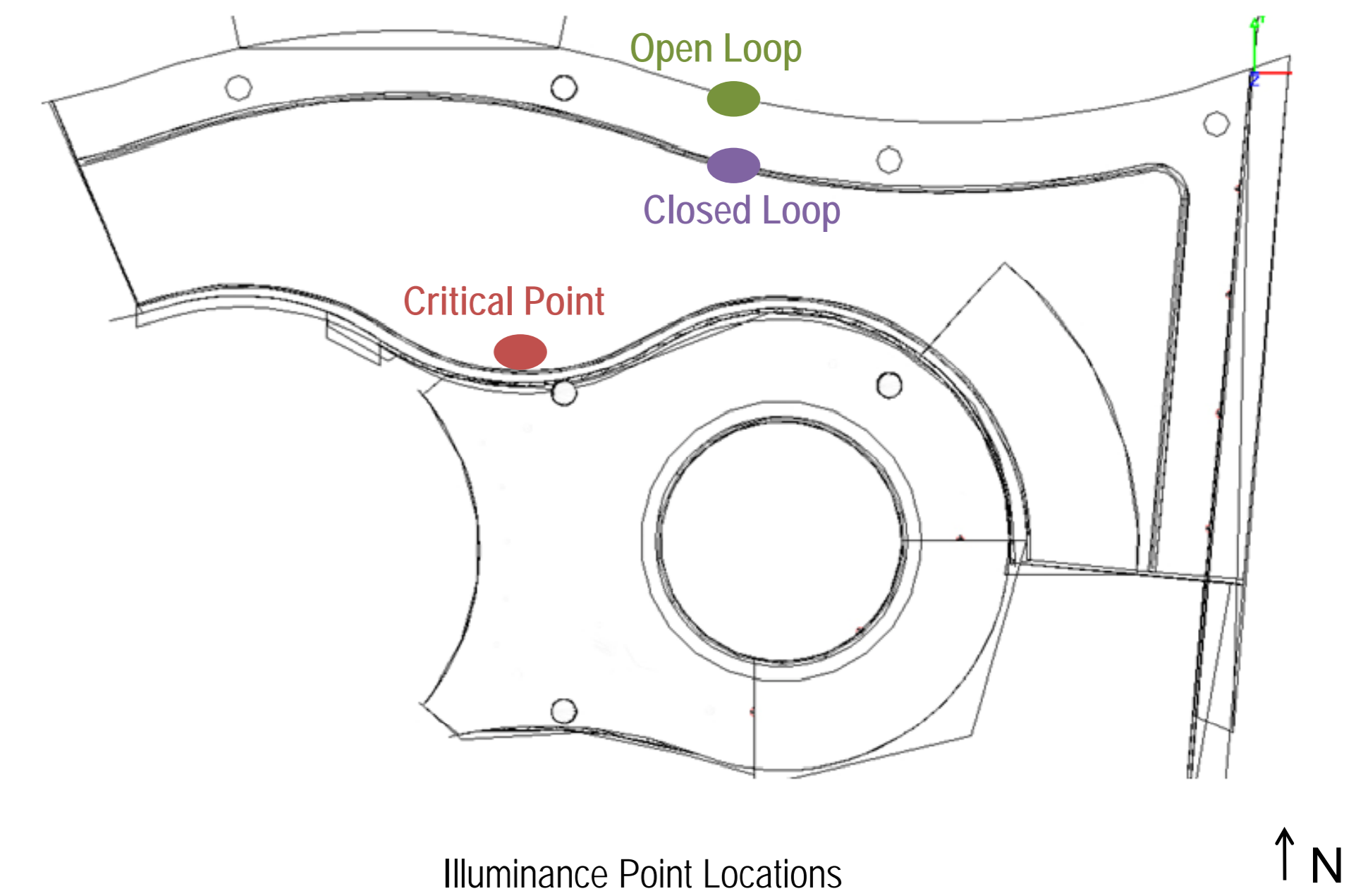
Conclusion

Goal

- Closed loop vs. open loop photosensor in Lobby and PT/OT

Procedure

- Found critical point to determine location of largest dimmed level
- Calculate daylight illuminance at points
- Determine sensor to illuminance ratio for closed and open loop

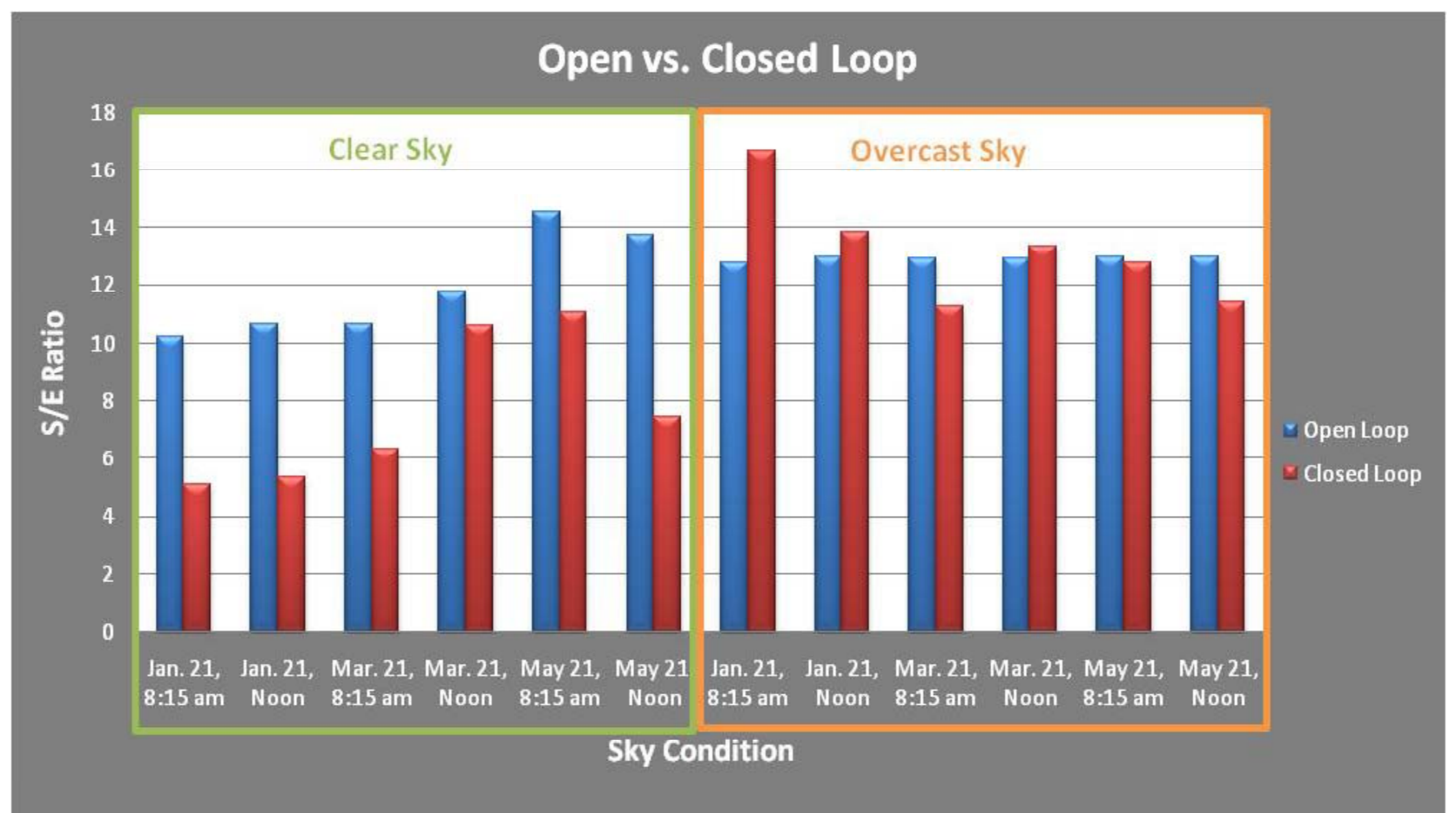


Illuminance Point Locations

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## M.A.E. FOCUS

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### Conclusion

#### Electrical

- Larger load and length of feeder will increase energy and cost savings with increased wire sizes

#### Lighting

- "Qualities of a soldier" concept provides comfortable, visually pleasing atmosphere meeting all design criteria

#### Architectural

- Changes to ceiling geometry and materials make the auditorium more comfortable and visually pleasing through entire systems integration

#### Mechanical

- Decreased cooling load by eliminating clerestory, lowering energy usage



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Christine Clowes | May 1, 2009 | Lighting/Electrical

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  - Ken Davidson and Scott McCall
  - Lutron Industries, Inc.
  - Mike Barber, Shawn Good, Andrea Hartranft
- **Fellow AE classmates**
- **Family and Friends**



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Questions?

