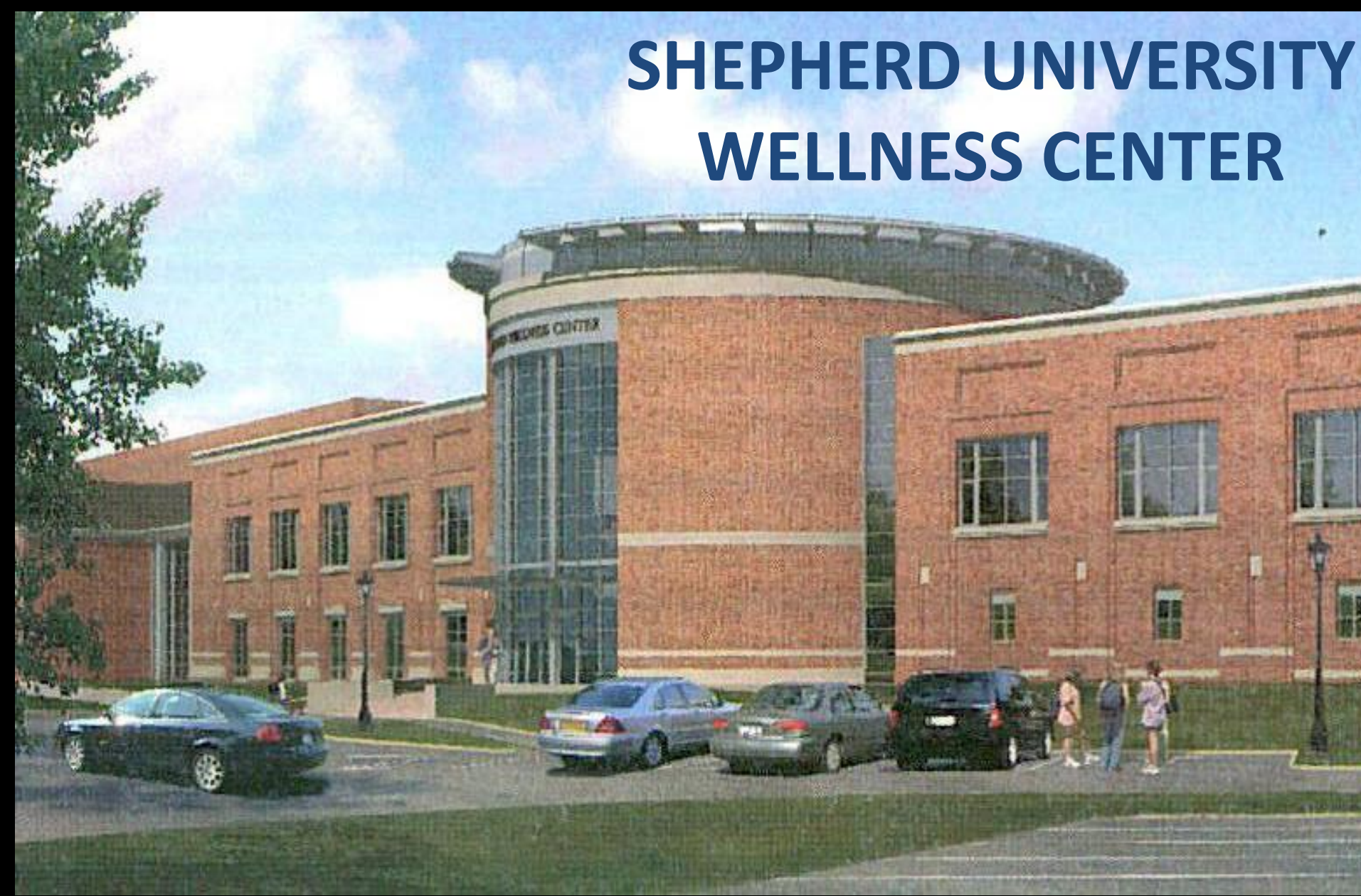


# SHEPHERD UNIVERSITY WELLNESS CENTER



Lisha A Brown | Lighting + Electrical  
AE Senior Thesis | April 13, 2011

# OUTLINE

## INTRODUCTION

PROJECT OVERVIEW

SCOPE OF RE-DESIGN

ELECTRICAL DEPTH

PHOTOVOLTAIC ARRAY STUDY

LIGHTING DEPTH

CONCEPT

ROTUNDA

FITNESS ROOM

MULTI-PURPOSE ROOM

ARCHITECTURAL BREADTH

CONCLUSION

SUMMARY OUTCOME

ACKNOWLEDGEMENTS

# PROJECT OVERVIEW



LOCATION SHEPHERDSTOWN, WEST VIRGINIA

OCCUPANT FITNESS AND EDUCATION CENTER

SIZE 73,400 SQUARE FEET

LEVELS TWO

ARCHITECT HUGHES GROUP ARCHITECTS

LIGHTING AND BRINJAC ENGINEERS

MEP ENGINEER

OUTLINE	SCOPE OF RE-DESIGN	
<b>INTRODUCTION</b>		
PROJECT OVERVIEW	LIGHTING	OUTDOOR ENTRY
<b>SCOPE OF RE-DESIGN</b>		ROTUNDA
ELECTRICAL DEPTH		FITNESS ROOM
PHOTOVOLTAIC ARRAY STUDY		MULTI-PURPOSE ROOM
LIGHTING DEPTH		ELECTRICAL
CONCEPT	ELECTRICAL	FOUR SPACES
ROTUNDA		PHOTOVOLTAIC ARRAY STUDY
FITNESS ROOM		GENERATOR VS. DISTRIBUTED BATTERIES
MULTI-PURPOSE ROOM		
ARCHITECTURAL BREADTH	ARCHITECTURAL	MULTI-PURPOSE ROOM
CONCLUSION	ACOUSTICAL	MULTI-PURPOSE ROOM
SUMMARY OUTCOME		
ACKNOWLEDGEMENTS		

OUTLINE	PRESENTED TODAY	
<b>INTRODUCTION</b>		
PROJECT OVERVIEW	LIGHTING	OUTDOOR ENTRY
<b>SCOPE OF RE-DESIGN</b>		ROTUNDA
ELECTRICAL DEPTH		FITNESS ROOM
PHOTOVOLTAIC ARRAY STUDY		MULTI-PURPOSE ROOM
LIGHTING DEPTH		ELECTRICAL
CONCEPT		FOUR SPACES
ROTUNDA		PHOTOVOLTAIC ARRAY STUDY
FITNESS ROOM		GENERATOR VS. DISTRIBUTED BATTERIES
MULTI-PURPOSE ROOM	ARCHITECTURAL	MULTI-PURPOSE ROOM
ARCHITECTURAL BREADTH		
CONCLUSION	ACOUSTICAL	MULTI-PURPOSE ROOM
SUMMARY OUTCOME		
ACKNOWLEDGEMENTS		

# OUTLINE

## INTRODUCTION

- PROJECT OVERVIEW
- SCOPE OF RE-DESIGN

## ELECTRICAL DEPTH

### PHOTOVOLTAIC ARRAY STUDY

## LIGHTING DEPTH

- CONCEPT
- ROTUNDA
- FITNESS ROOM
- MULTI-PURPOSE ROOM

## ARCHITECTURAL BREADTH

## CONCLUSION

- SUMMARY OUTCOME
- ACKNOWLEDGEMENTS

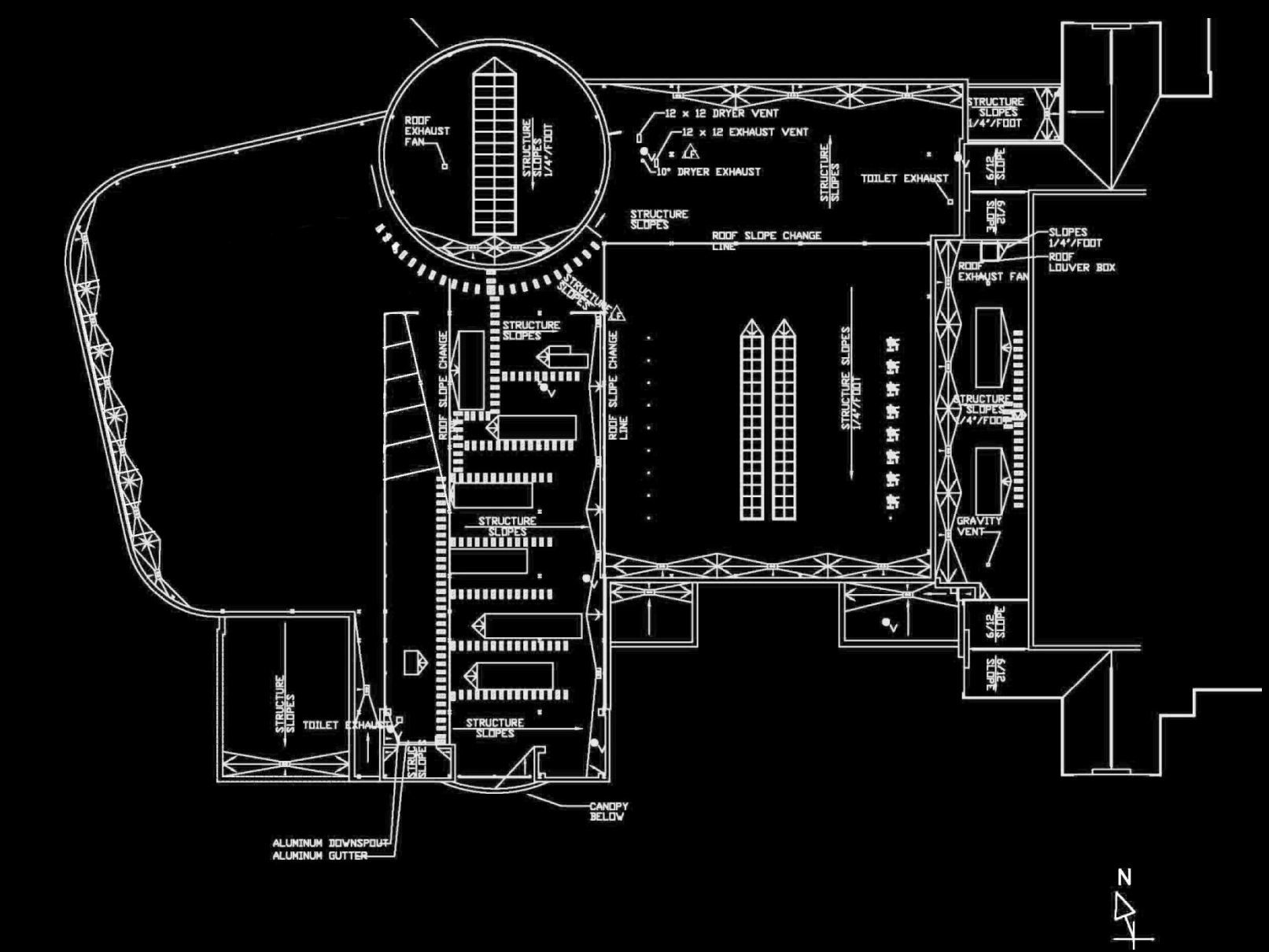
# PHOTOVOLTAIC ARRAY STUDY

## OBJECTIVE

TO INCORPORATE SOLAR POWER AND REDUCE THE BUILDING'S ENERGY COSTS

## CONSIDERATIONS

- LOCATION | SHEPHERDSTOWN, WEST VIRGINIA
- USABLE SUNLIGHT | 4.4 KW-HRS



# PHOTOVOLTAIC ARRAY STUDY

- OUTLINE
- INTRODUCTION
  - PROJECT OVERVIEW
  - SCOPE OF RE-DESIGN
- ELECTRICAL DEPTH
- PHOTOVOLTAIC ARRAY STUDY
- LIGHTING DEPTH
- CONCEPT
- ROTUNDA
- FITNESS ROOM
- MULTI-PURPOSE ROOM
- ARCHITECTURAL BREADTH
- CONCLUSION
- SUMMARY OUTCOME
- ACKNOWLEDGEMENTS

**SOLUTION**

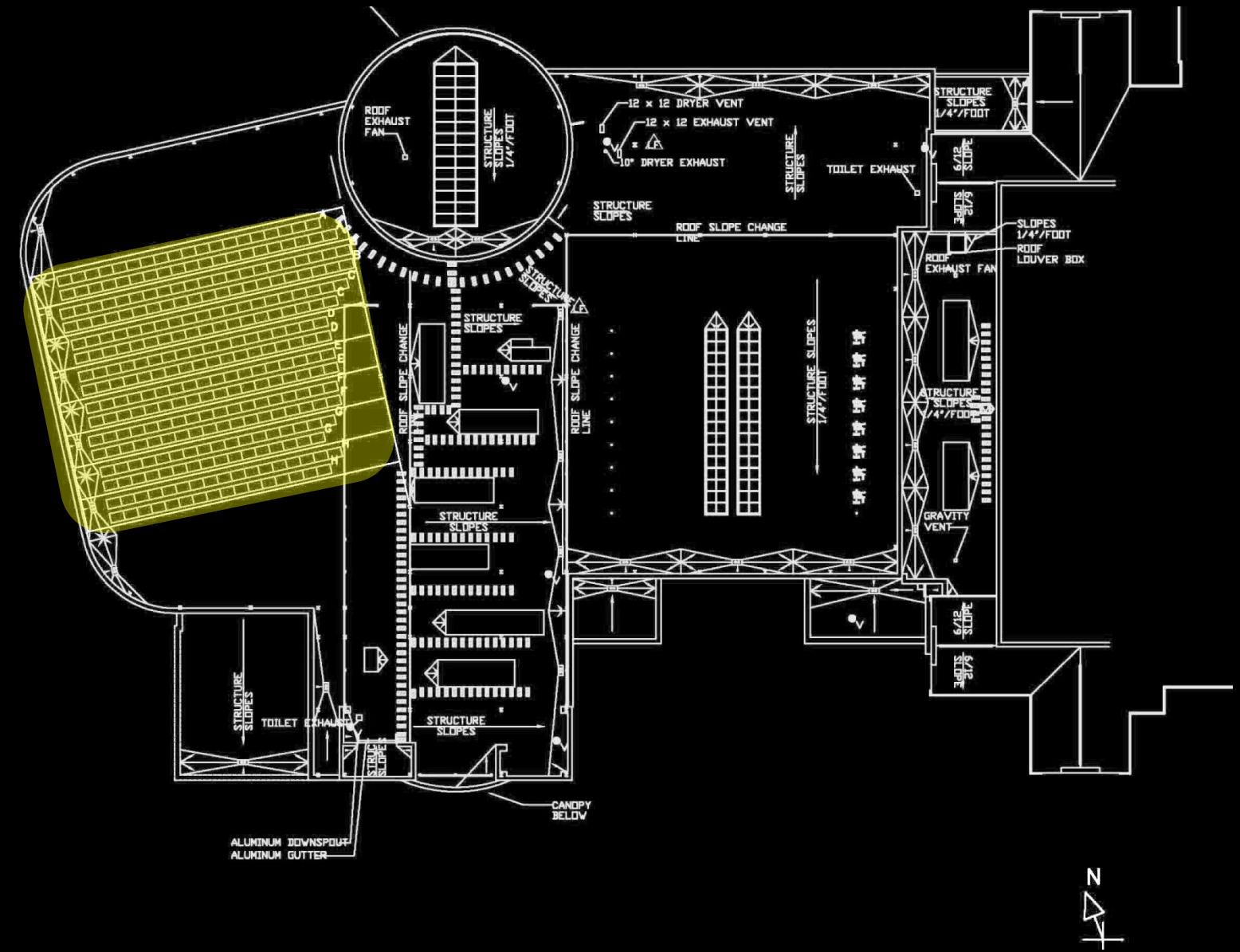
MOUNTING SYSTEM | UNIRAC

SOLAR MODULE TYPE | SHARP, MONOCRYSTALLINE

SIZE | 39.1" X 64.4"

INVERTER | SHARP

Array	System Size	Panel Quantity	Inverter Tag	Inverter Model
A	9.17 kW	39	IA	SB8000US
B	9.87 kW	42	IB	IGPlus10.0
C	9.17 kW	39	IC	SB8000US
D	8.46 kW	36	ID	IGPlus7.5
E	8.46 kW	36	IE	IGPlus7.5
F	8.46 kW	36	IF	IGPlus7.5
G	7.76 kW	33	IG	SB7000US
H	7.76 kW	33	IH	SB7000US
<b>Total</b>	<b>69.11</b>	<b>294</b>	<b>--</b>	<b>--</b>



# OUTLINE PHOTOVOLTAIC ARRAY STUDY

- INTRODUCTION
  - PROJECT OVERVIEW
  - SCOPE OF RE-DESIGN
- ELECTRICAL DEPTH**
  - PHOTOVOLTAIC ARRAY STUDY**
- LIGHTING DEPTH
  - CONCEPT
  - ROTUNDA
  - FITNESS ROOM
  - MULTI-PURPOSE ROOM
  - ARCHITECTURAL BREADTH
- CONCLUSION
  - SUMMARY OUTCOME
  - ACKNOWLEDGEMENTS

## RESULTS

### KEY FIGURES

Constant	Quantity
Initial Cost of Arrays	\$267,734.00
Initial Cost of Mounting	\$53,214.00
Initial Cost of Installation	\$100,000.00
Federal Offset of Initial Cost	30.0%
Cost of Electricity in West Virginia	\$0.137/ kW/hr
Electricity Generated by System	69.11 kW/hr
<b>Value of Electricity Generated by System</b>	<b>\$15,205.72</b>
Usable Hours in West Virginia	4.4 kWhr

### YEARLY PAYBACK

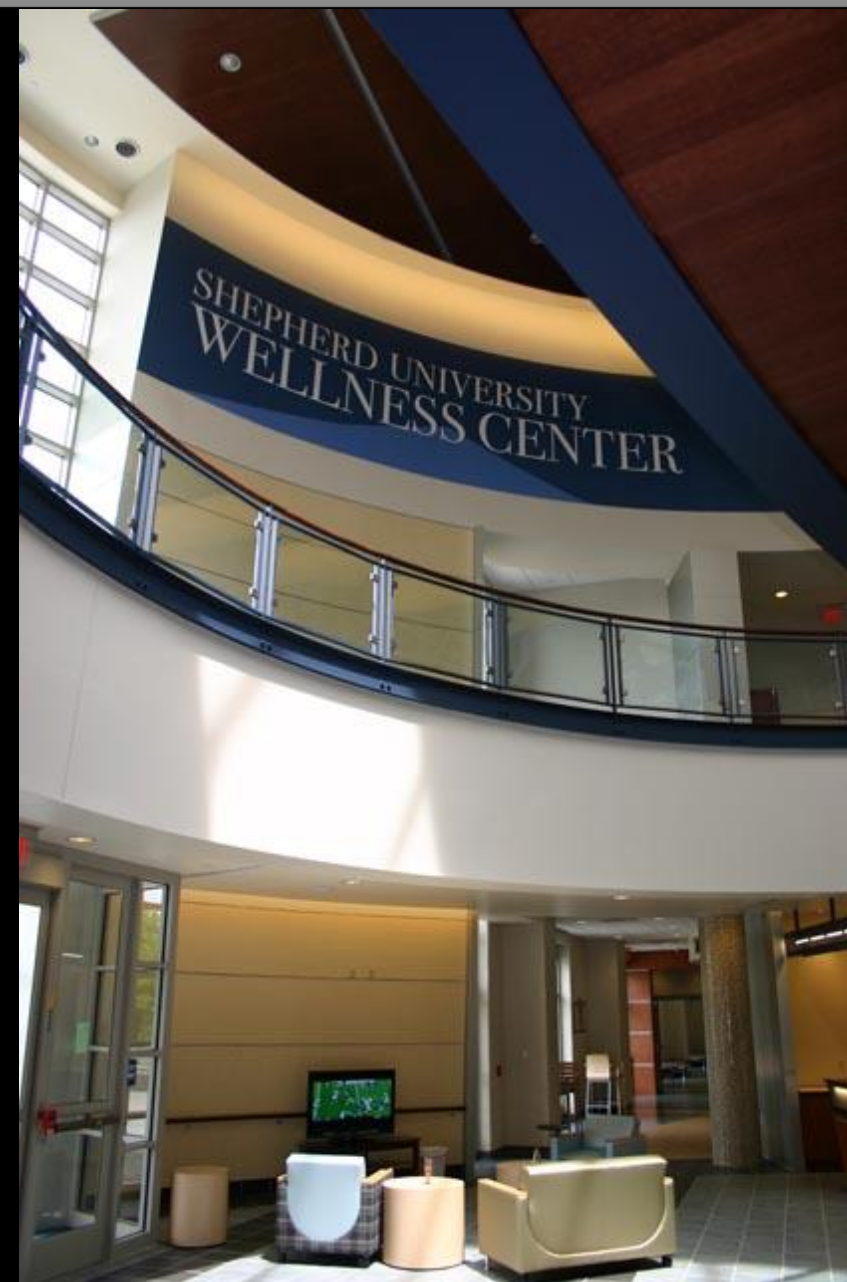
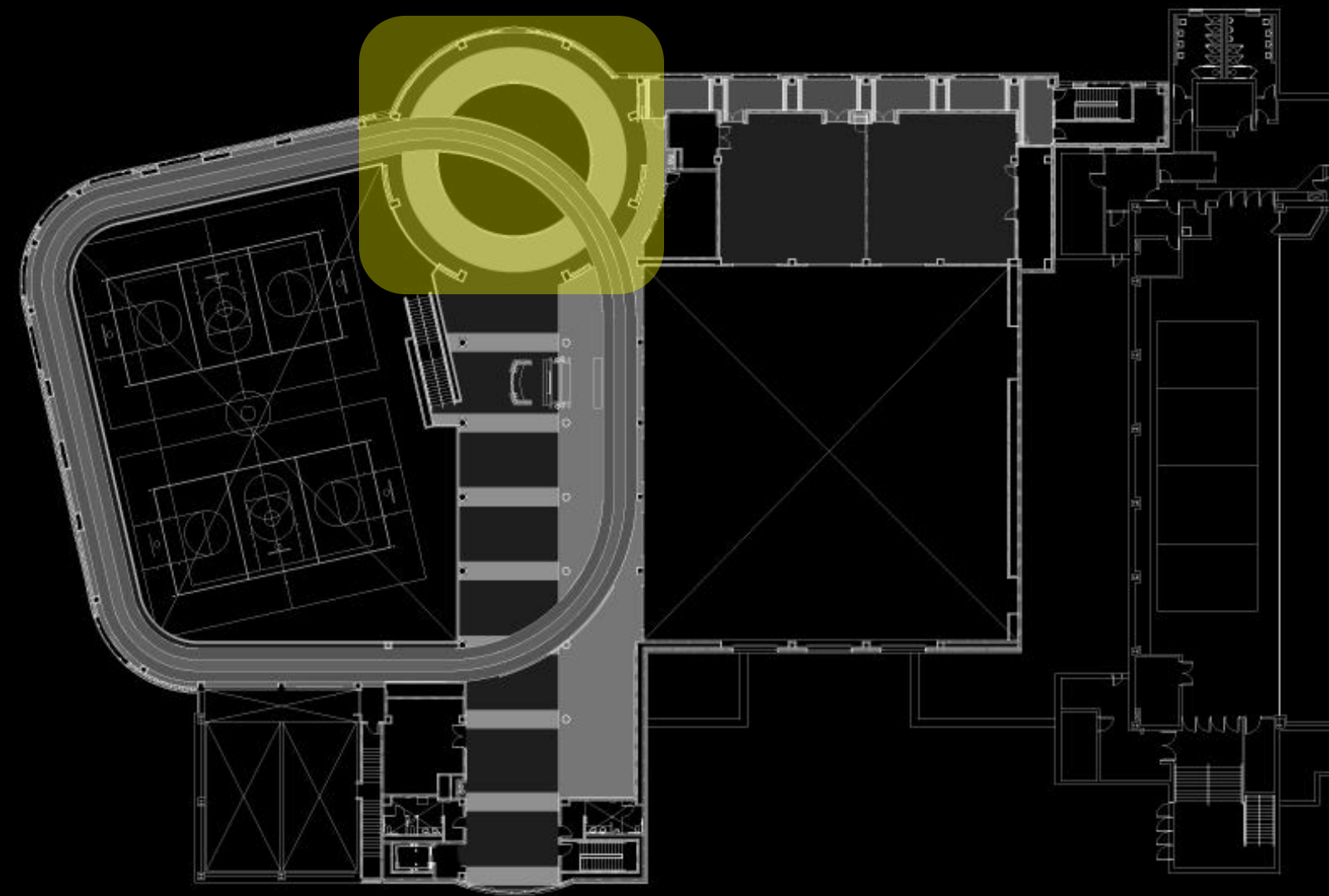
Year	Cost of System/ Year
Year 1	\$279,457.88
Year 2	\$264,252.16
Year 3	\$249,046.44
Year 4	\$233,840.72
Year 5	\$218,635.00
Year 6	\$203,429.28
Year 7	\$188,223.56
Year 8	\$173,017.84
Year 9	\$157,812.12
Year 10	\$142,606.40
Year 11	\$127,400.68
Year 12	\$112,194.96
Year 13	\$96,989.24
Year 14	\$81,783.52
Year 15	\$66,577.80
Year 16	\$51,372.08
Year 17	\$36,166.36
Year 18	\$20,960.64
Year 19	\$5,754.92
<b>Year 20</b>	<b>-\$9,450.80</b>

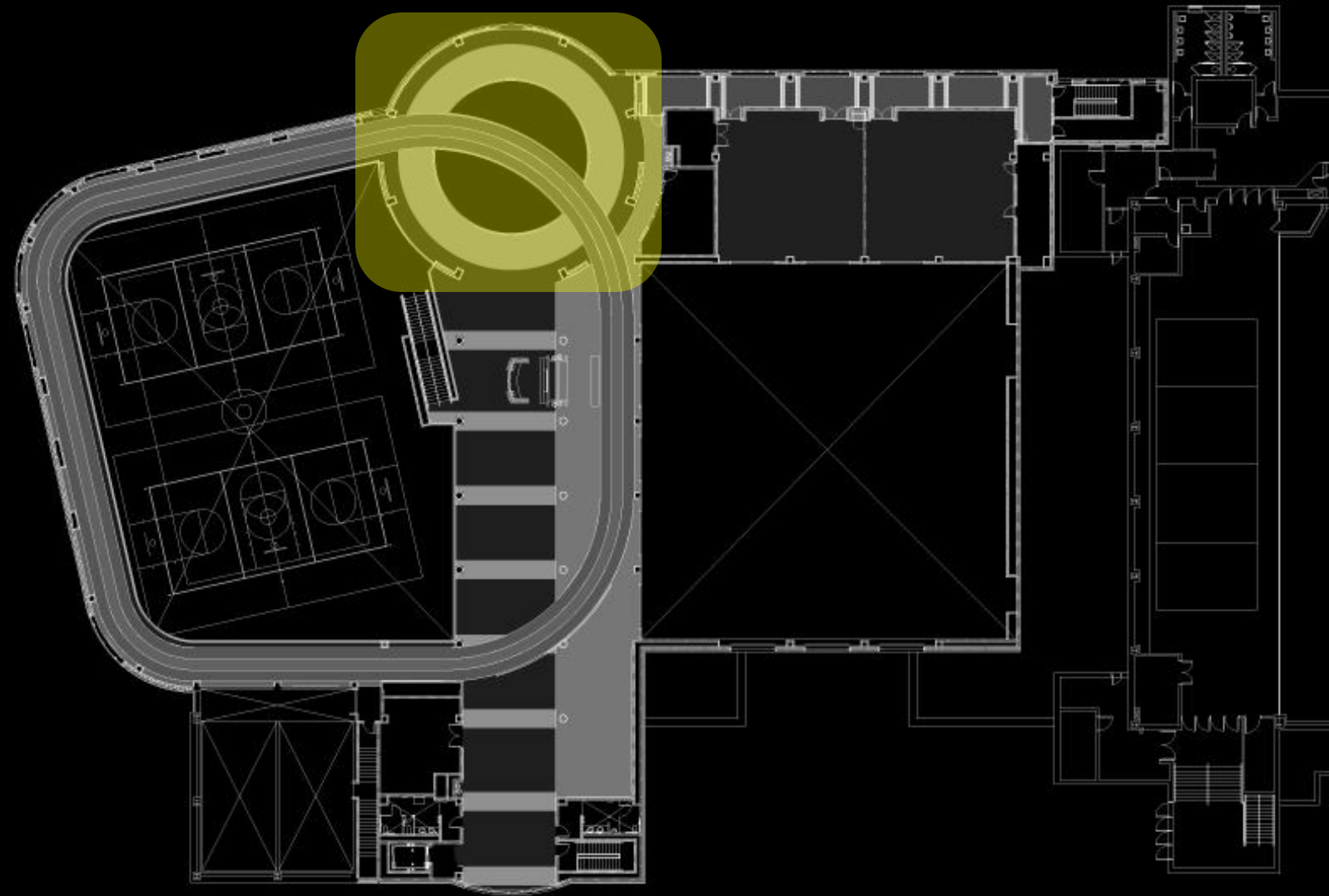
OUTLINE	LIGHTING CONCEPT
INTRODUCTION	
PROJECT OVERVIEW	
SCOPE OF RE-DESIGN	
ELECTRICAL DEPTH	
PHOTOVOLTAIC ARRAY STUDY	
<b>LIGHTING DEPTH</b>	<p><b>“THREE KEY ELEMENTS PROVIDE A BALANCED RECREATION PROGRAM: FITNESS ZONE, NEW POOL, AND A MULTI-FUNCTION GYMNASIUM.”</b></p>
<b>CONCEPT</b>	
ROTUNDA	
FITNESS ROOM	
MULTI-PURPOSE ROOM	<p>HUGHES GROUP ARCHITECTS</p>
ARCHITECTURAL BREADTH	
CONCLUSION	
SUMMARY OUTCOME	
ACKNOWLEDGEMENTS	



OUTLINE	LIGHTING CONCEPT
INTRODUCTION	
PROJECT OVERVIEW	
SCOPE OF RE-DESIGN	
ELECTRICAL DEPTH	
PHOTOVOLTAIC ARRAY STUDY	
<b>LIGHTING DEPTH</b>	
<b>CONCEPT</b>	<b>“THREE KEY ELEMENTS PROVIDE A BALANCED</b>
ROTUNDA	<b>RECREATION PROGRAM: FITNESS ZONE, NEW POOL,</b>
FITNESS ROOM	<b>AND A MULTI-FUNCTION GYMNASIUM.”</b>
MULTI-PURPOSE ROOM	
ARCHITECTURAL BREADTH	HUGHES GROUP ARCHITECTS
CONCLUSION	
SUMMARY OUTCOME	<b>MOVEMENT   NAVIGATION   SAFETY</b>
ACKNOWLEDGEMENTS	

# ROTUNDA

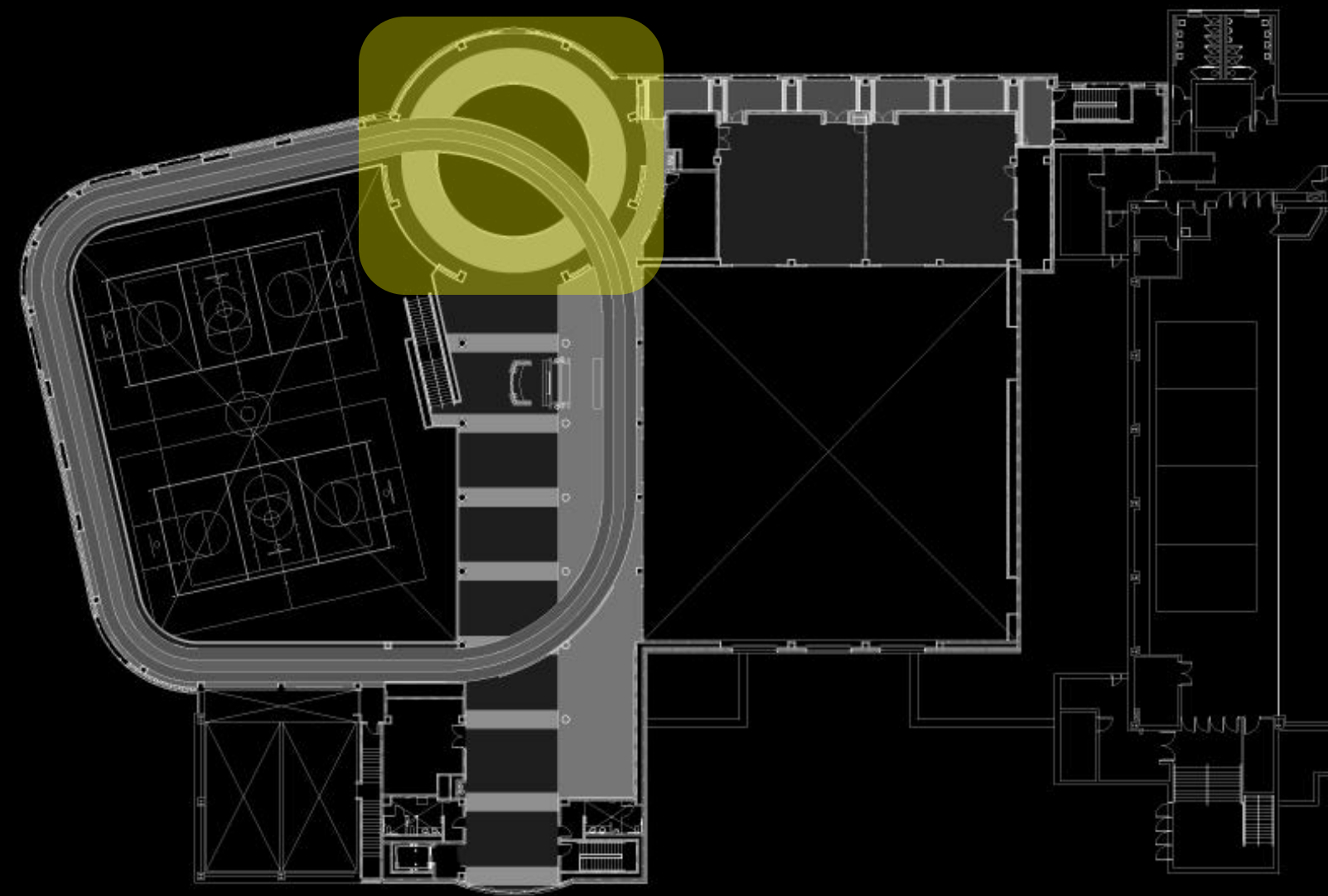




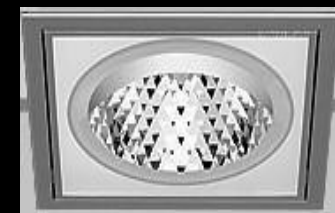
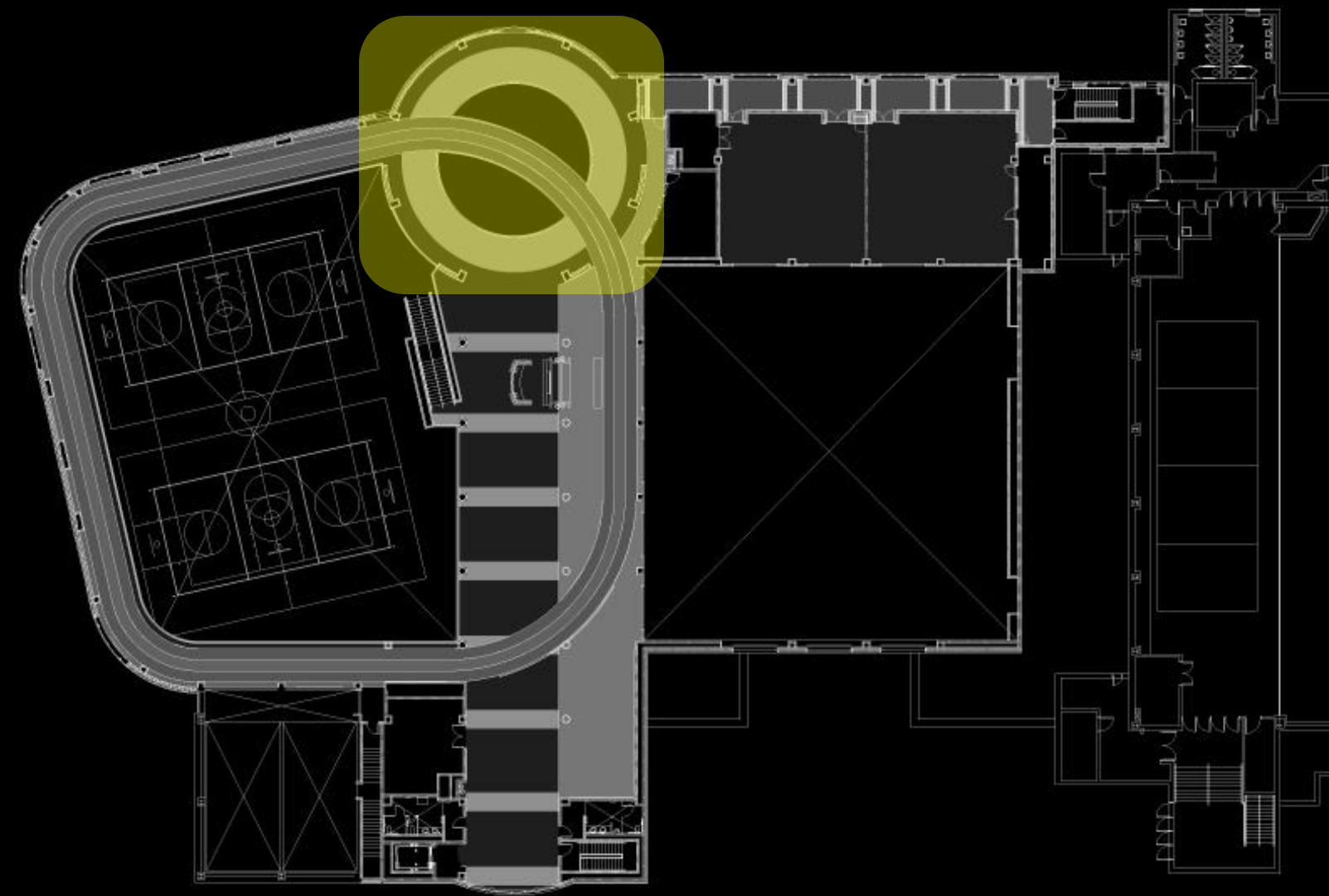
## DESIGN CRITERIA AND CONSIDERATIONS

- ACCENTUATE THE GRAND ENTRANCE
- ENHANCE THE ARCHITECTURE AND MATERIALS
- PROVIDE A PATHWAY OF LIGHT
- LIGHTING POWER DENSITY OF 1.3 WATTS/ SQ. FT.

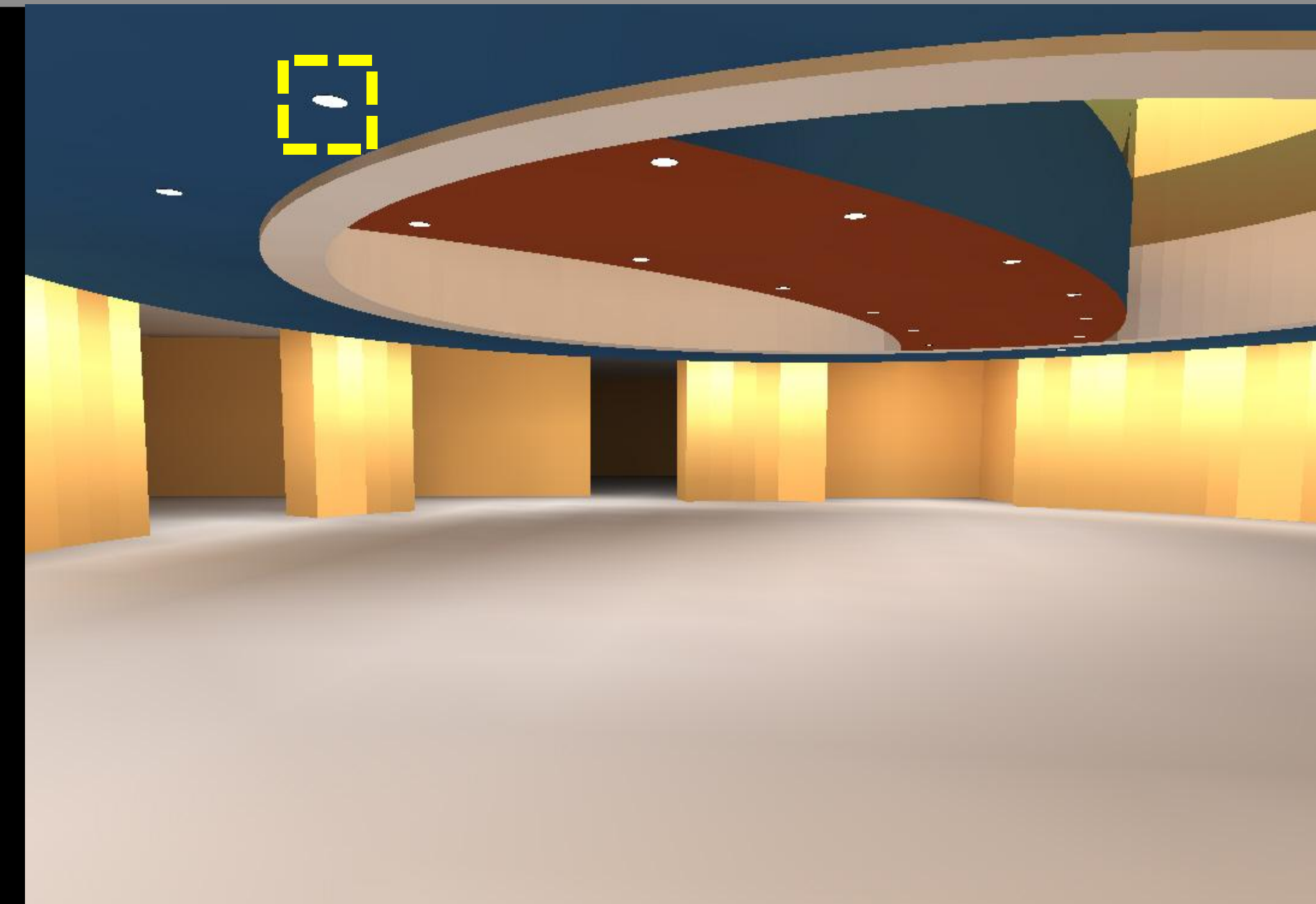
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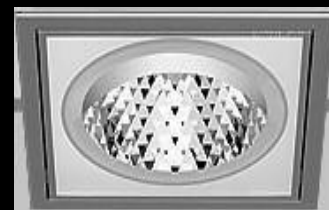
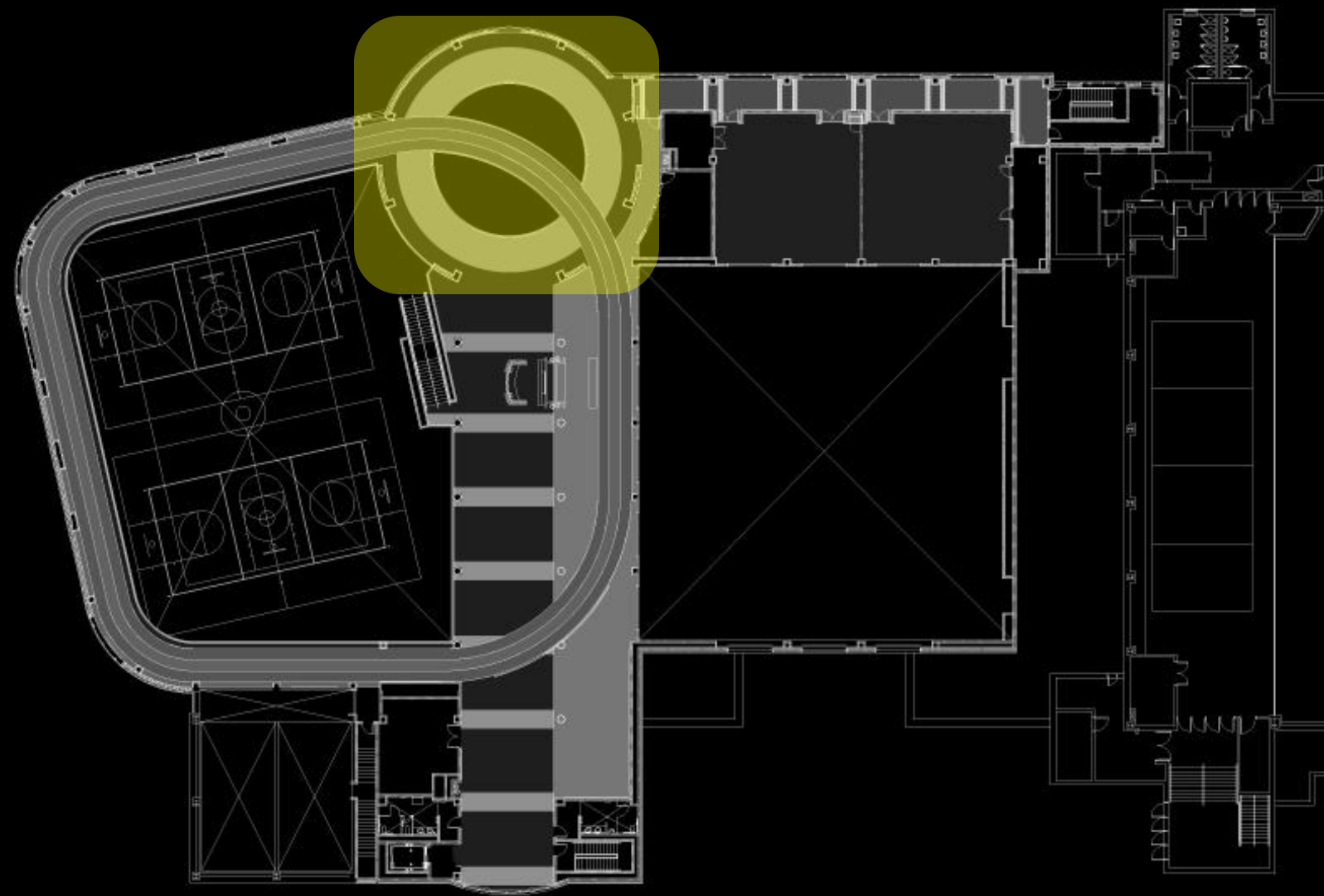
# ROTUNDA



(1) 32W CFL RECESSED DOWNLIGHT



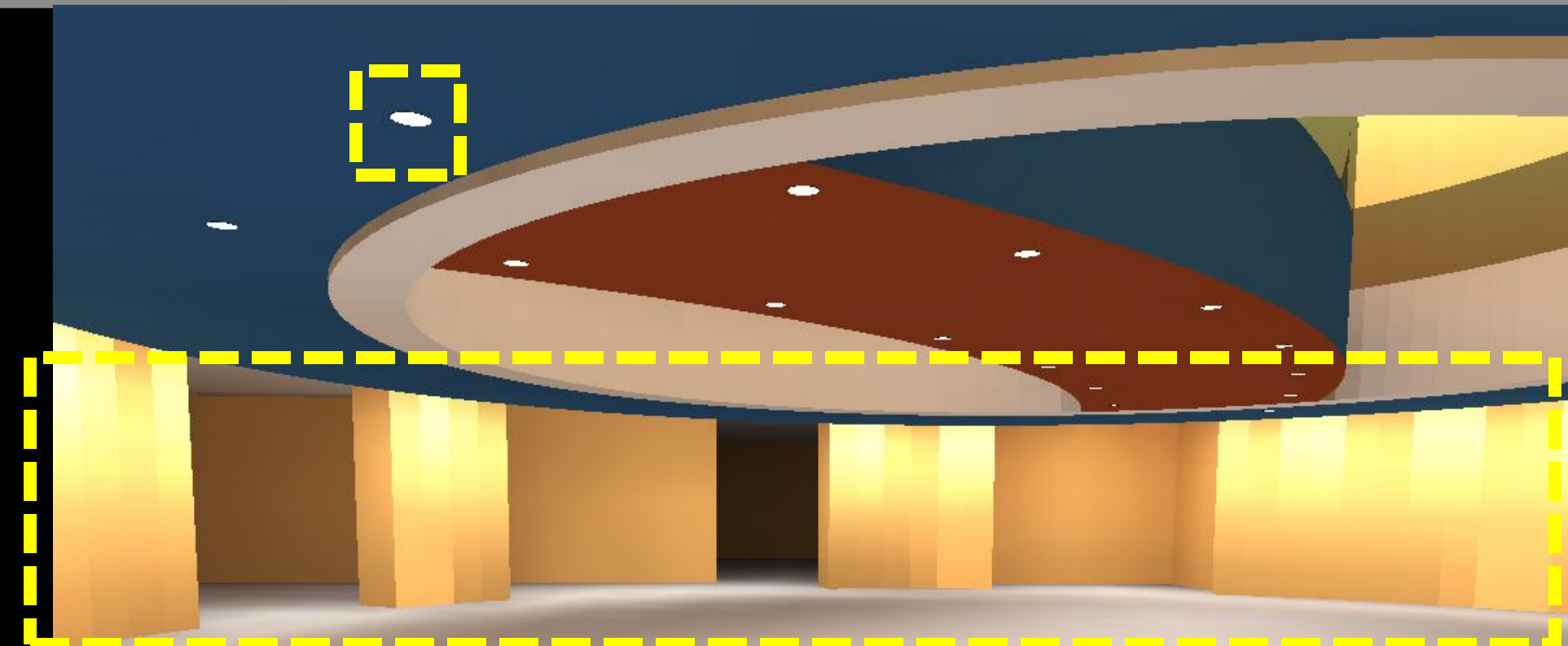
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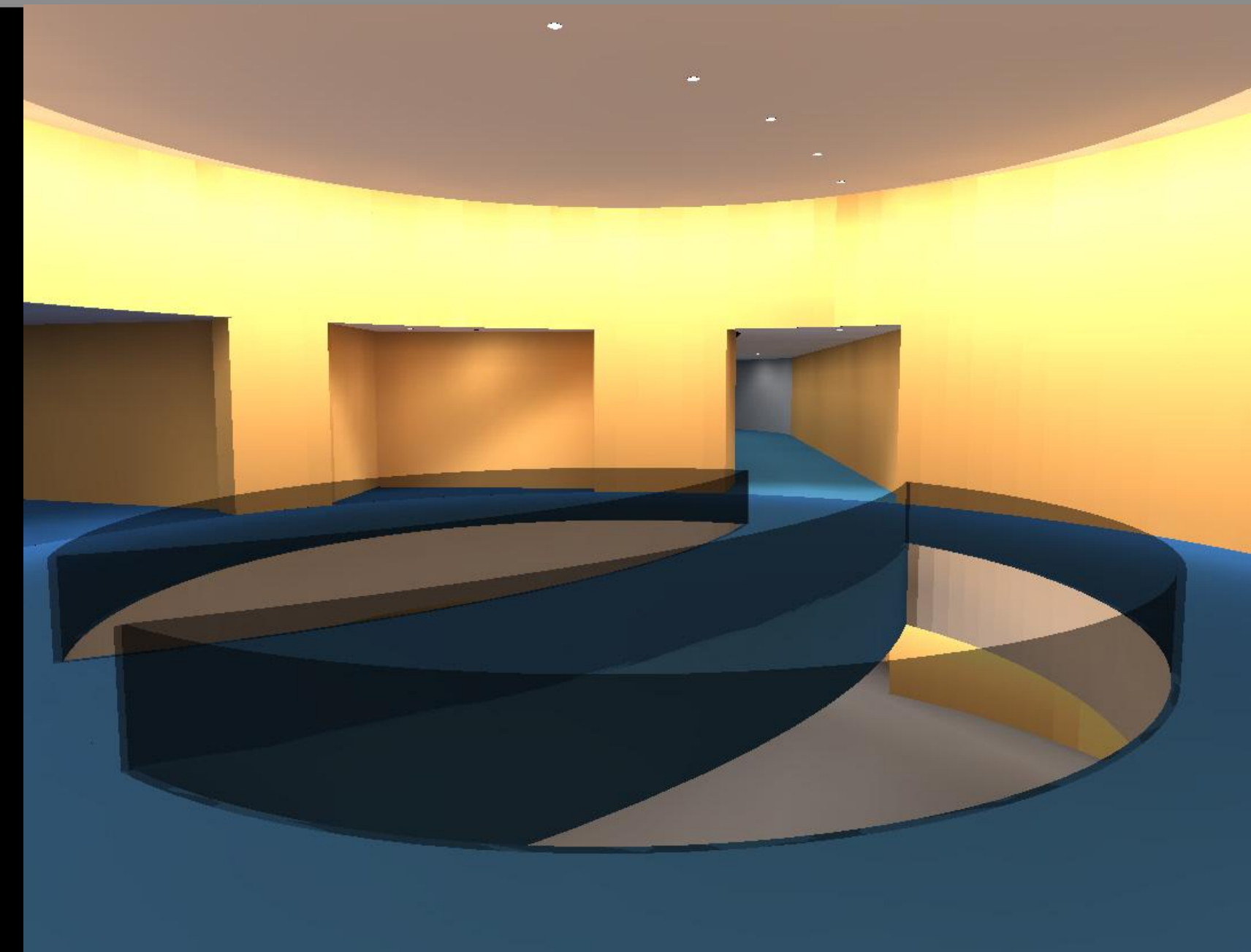
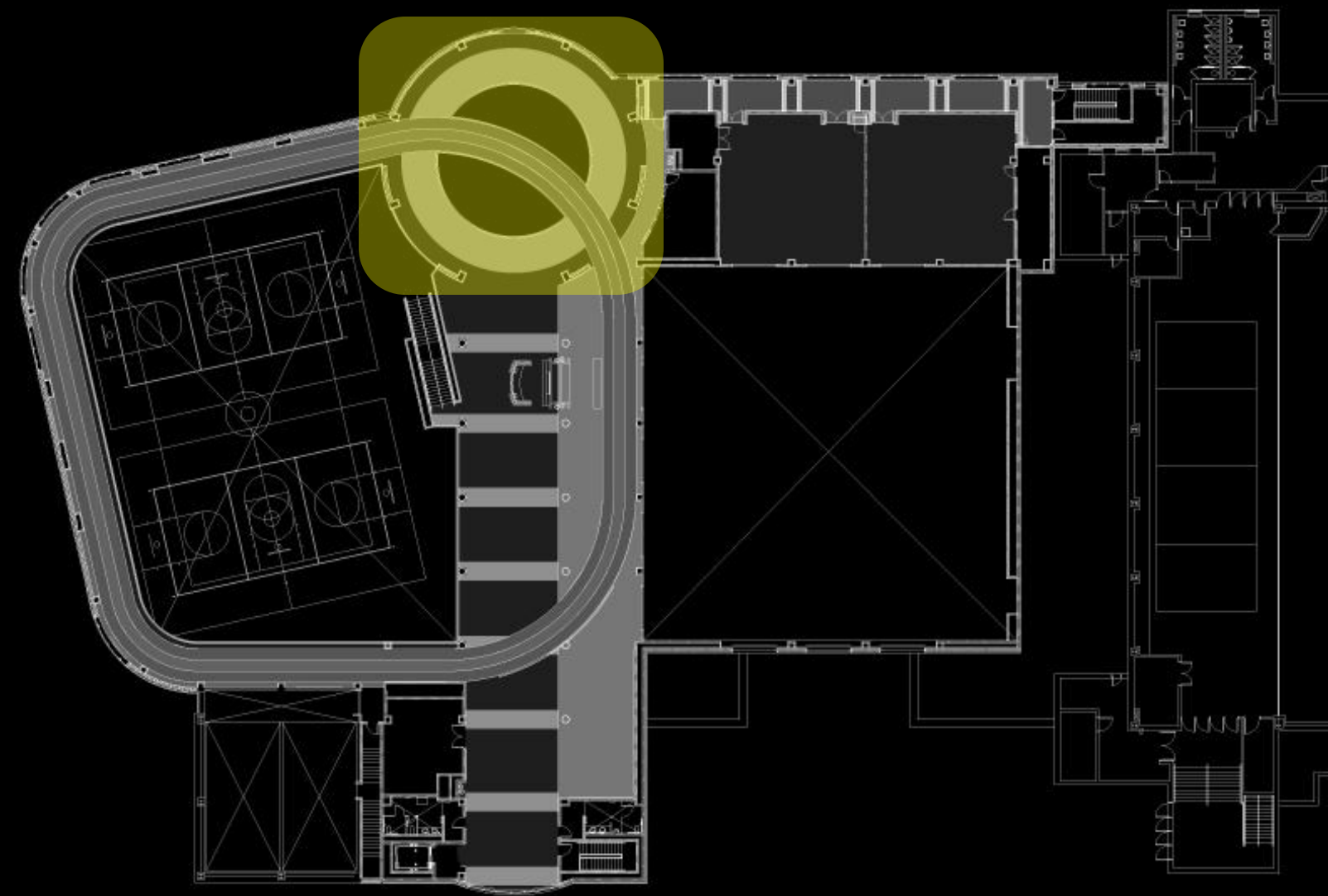
(1) 32W CFL RECESSED DOWNLIGHT



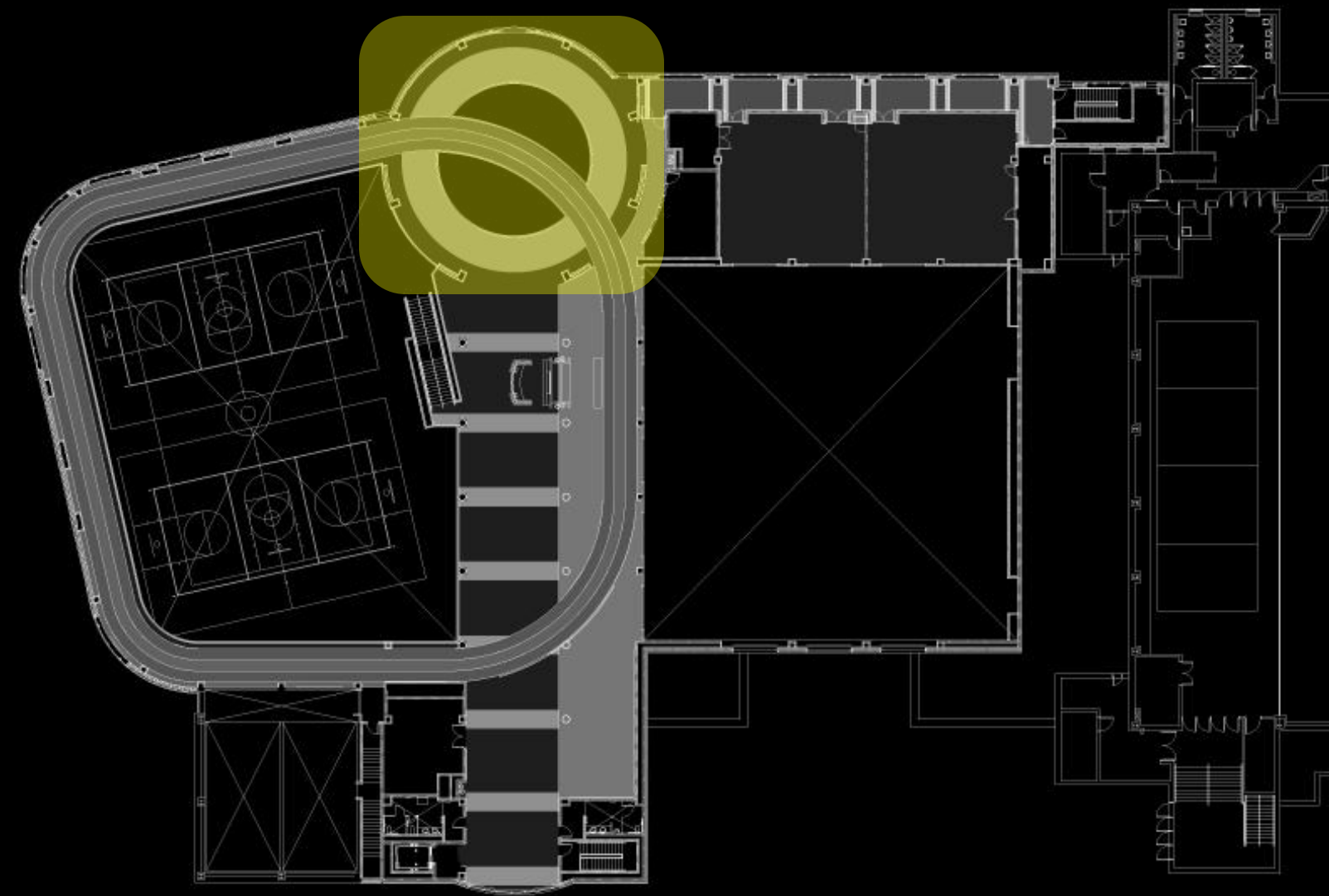
(1) 42W CFL SEMI-RECESSED WALLWASHER



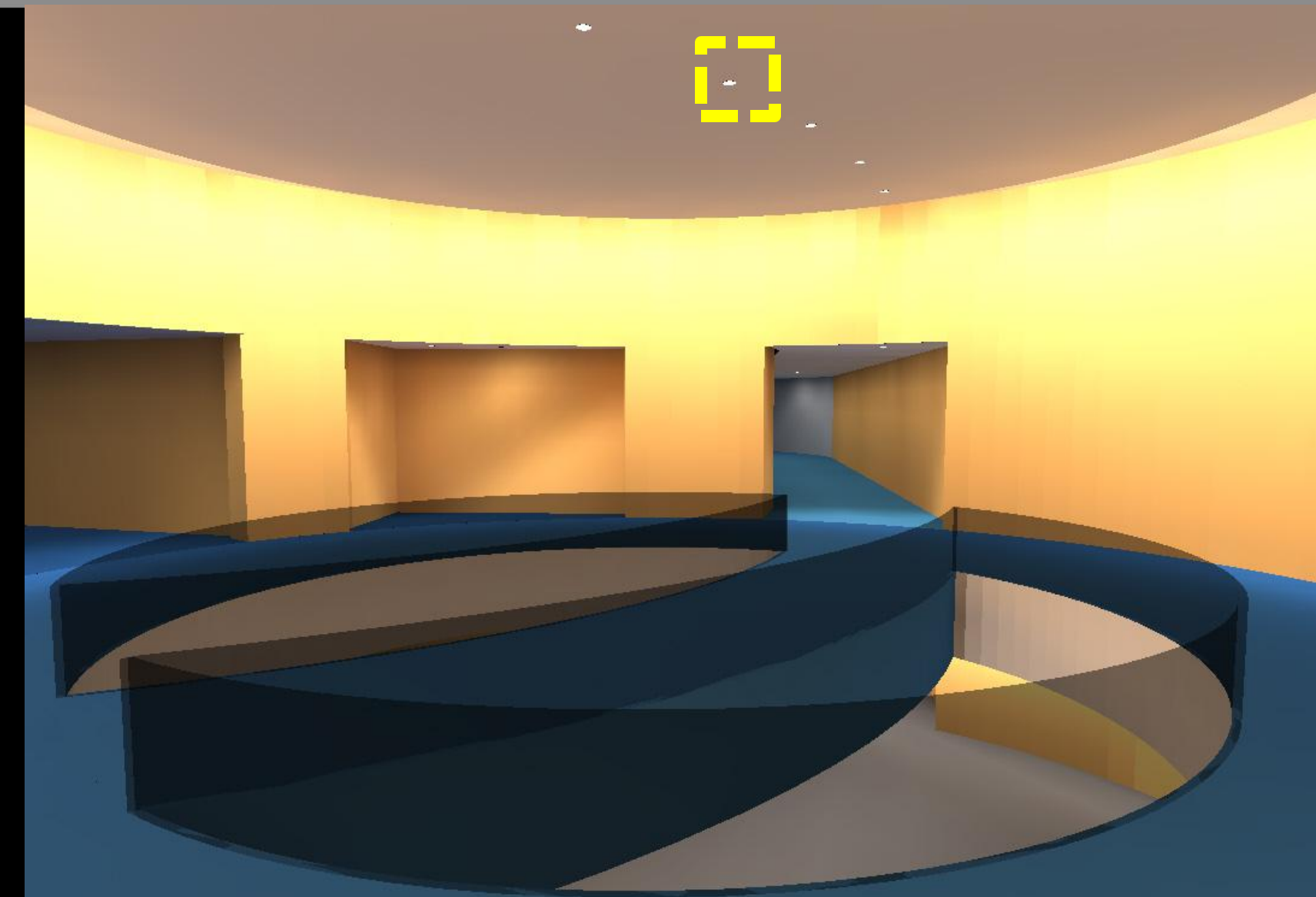
# ROTUNDA



# ROTUNDA

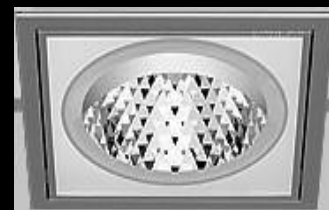
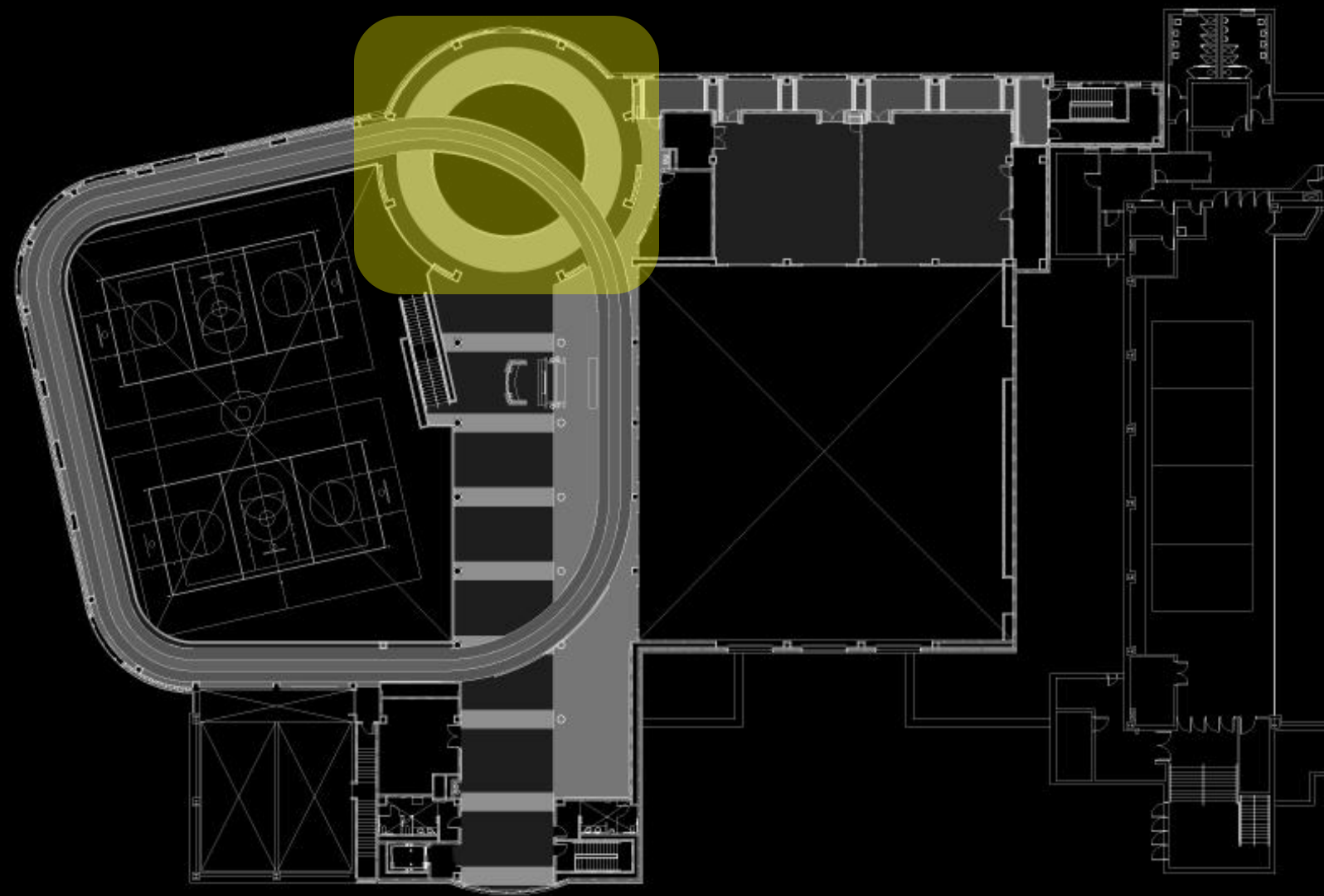


(1) 32W CFL RECESSED DOWNLIGHT





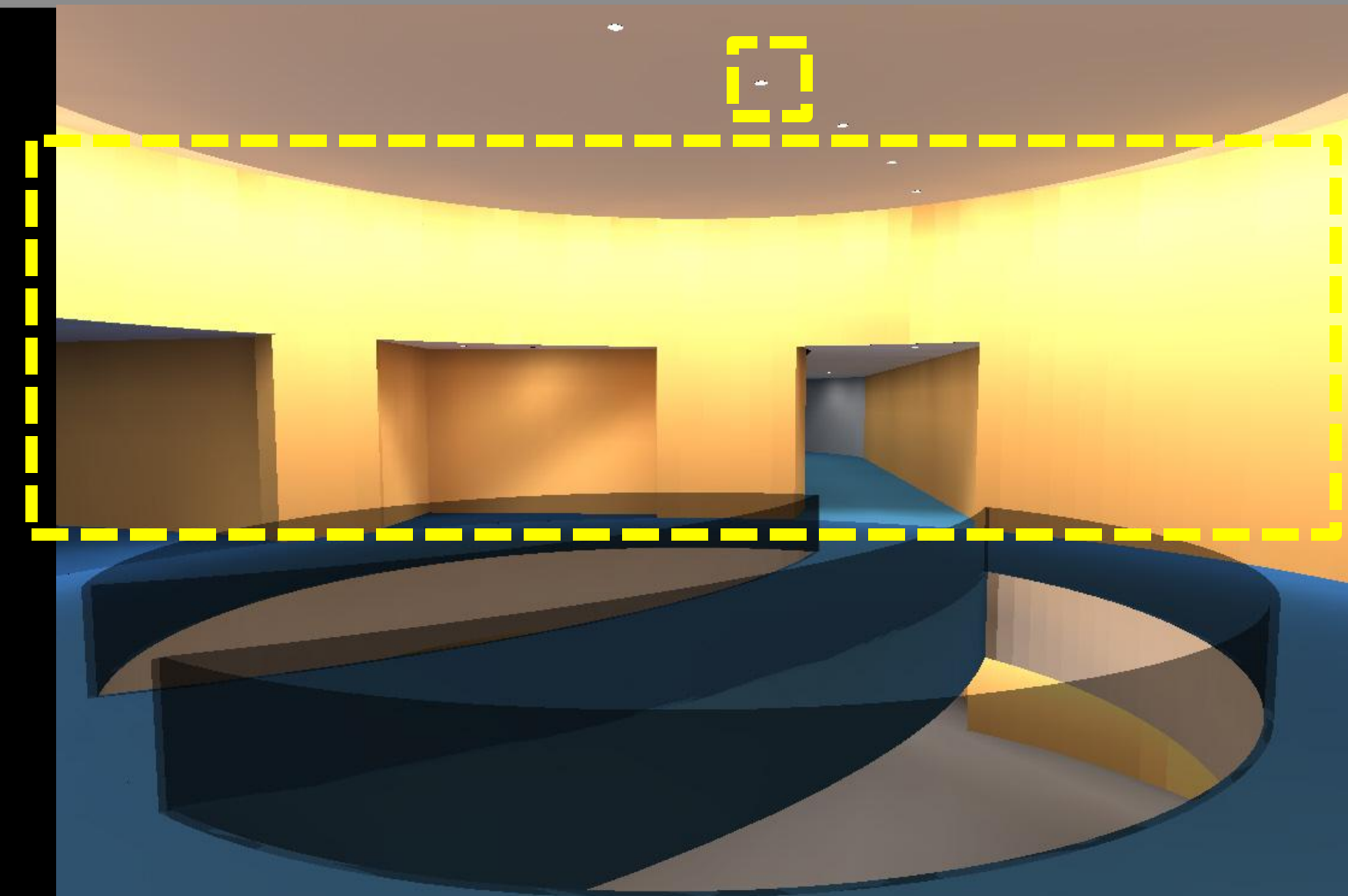
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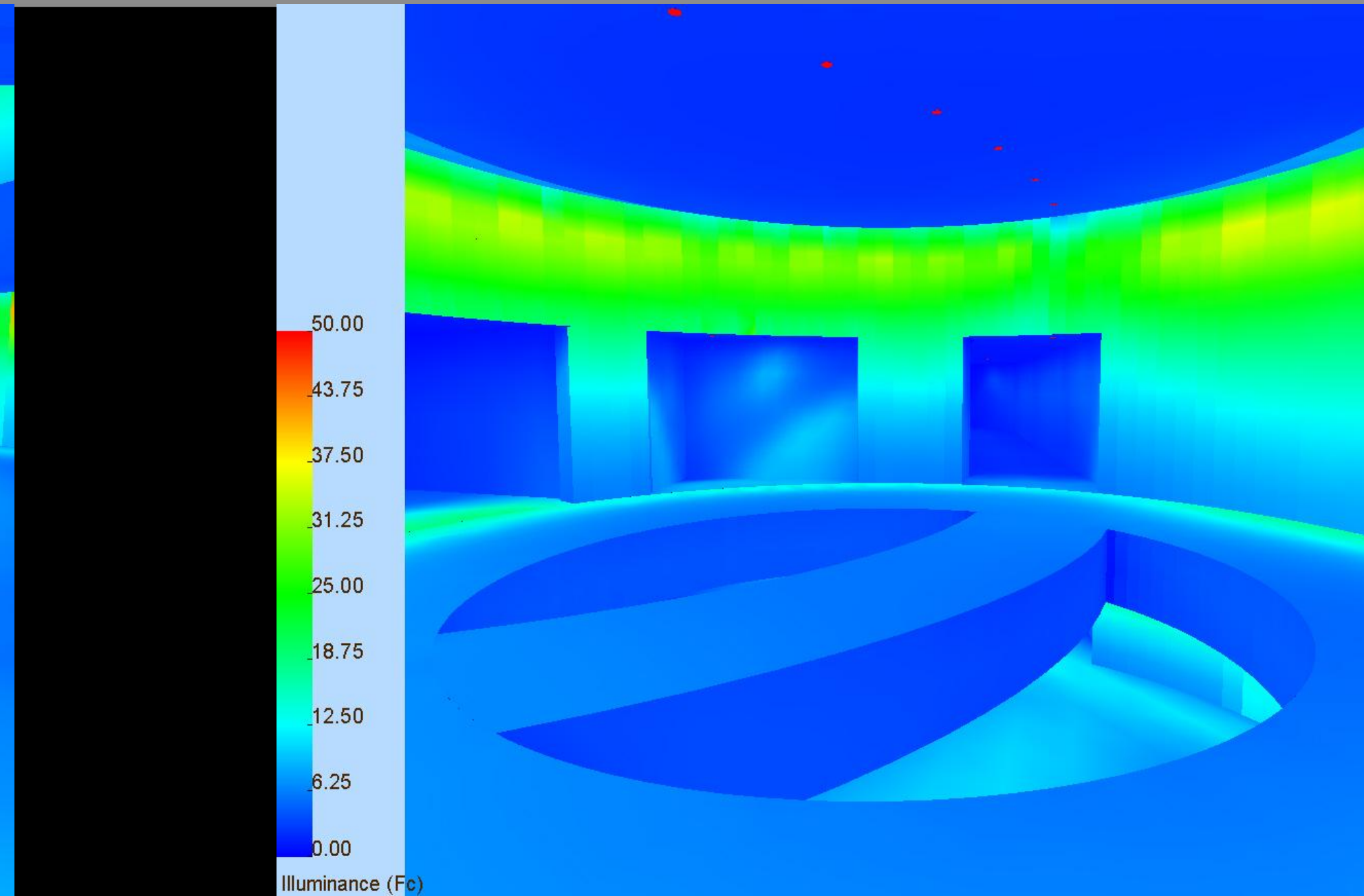
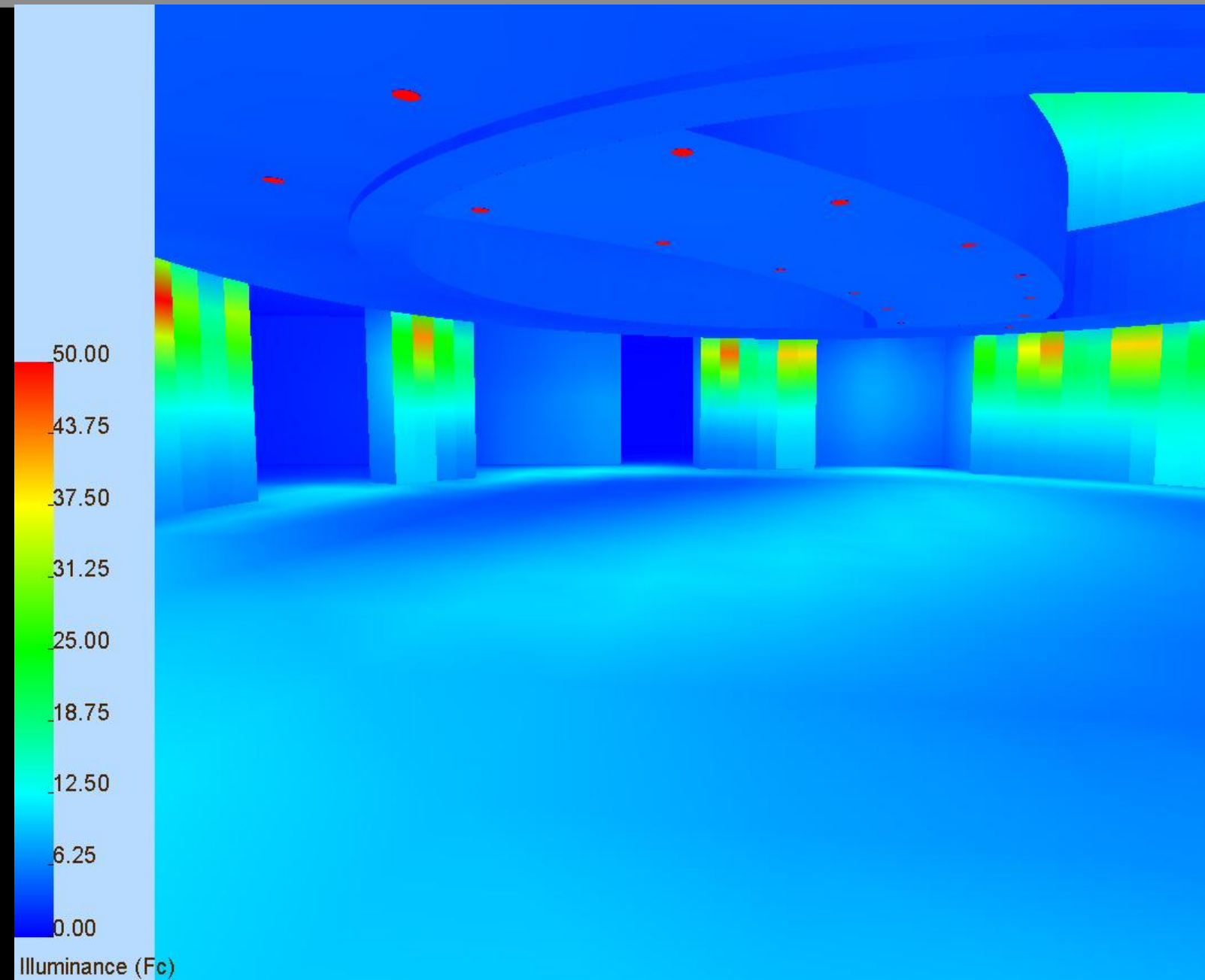
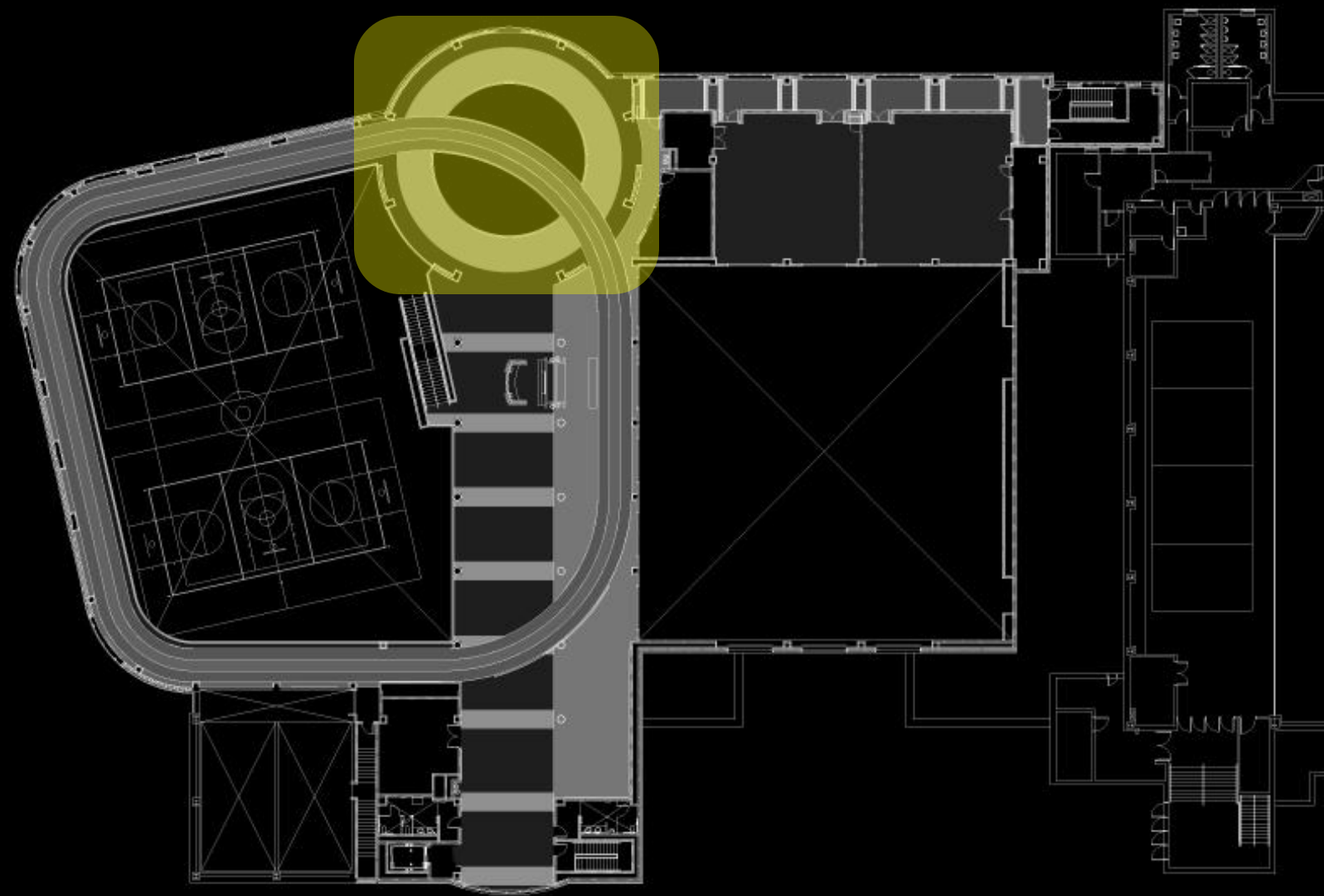
(1) 32W CFL RECESSED DOWNLIGHT

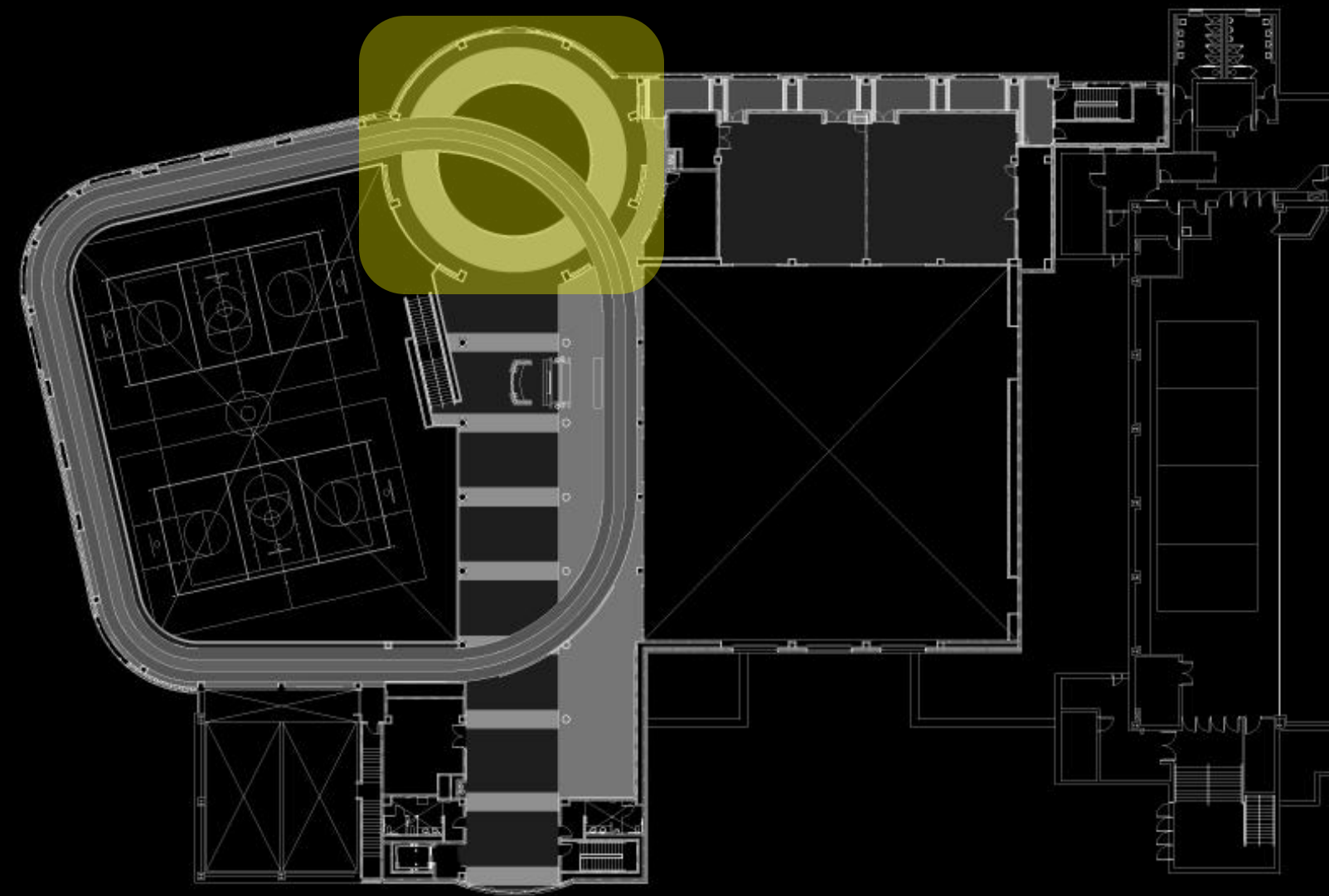


(1) 35W MH T6 SEMI-RECESSED WALLWASHER



# ROTUNDA



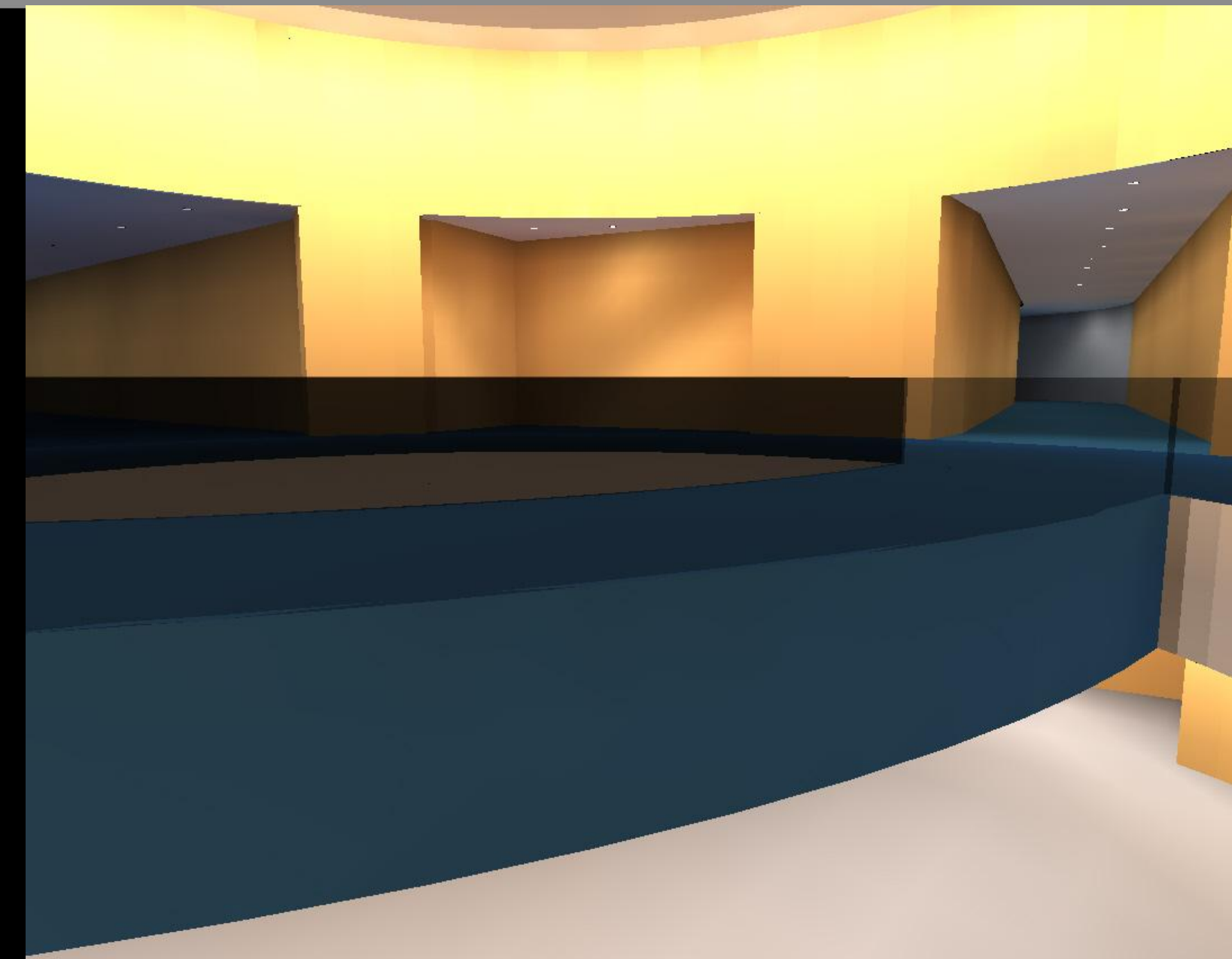


## DESIGN SUMMARY

- DEFINES BOUNDARIES USING PERIMETER LIGHTING
- HIGHLIGHT WALKWAYS

Area	Size	Power Density Allowable	Power Density Designed
Rotunda	3780 sq. ft.	1.3 W/sq. ft.	1.256 W/sq. ft.

Area	Average Illuminance	Maximum Illuminance	Minimum Illuminance
Rotunda 1 <sup>st</sup> level	7.98 fc	17 fc	2 fc
Rotunda 2 <sup>nd</sup> level	8.93 fc	19 fc	4 fc



# OUTLINE

## INTRODUCTION

PROJECT OVERVIEW

SCOPE OF RE-DESIGN

## ELECTRICAL DEPTH

PHOTOVOLTAIC ARRAY STUDY

## LIGHTING DEPTH

CONCEPT

ROTUNDA

**FITNESS ROOM**

MULTI-PURPOSE ROOM

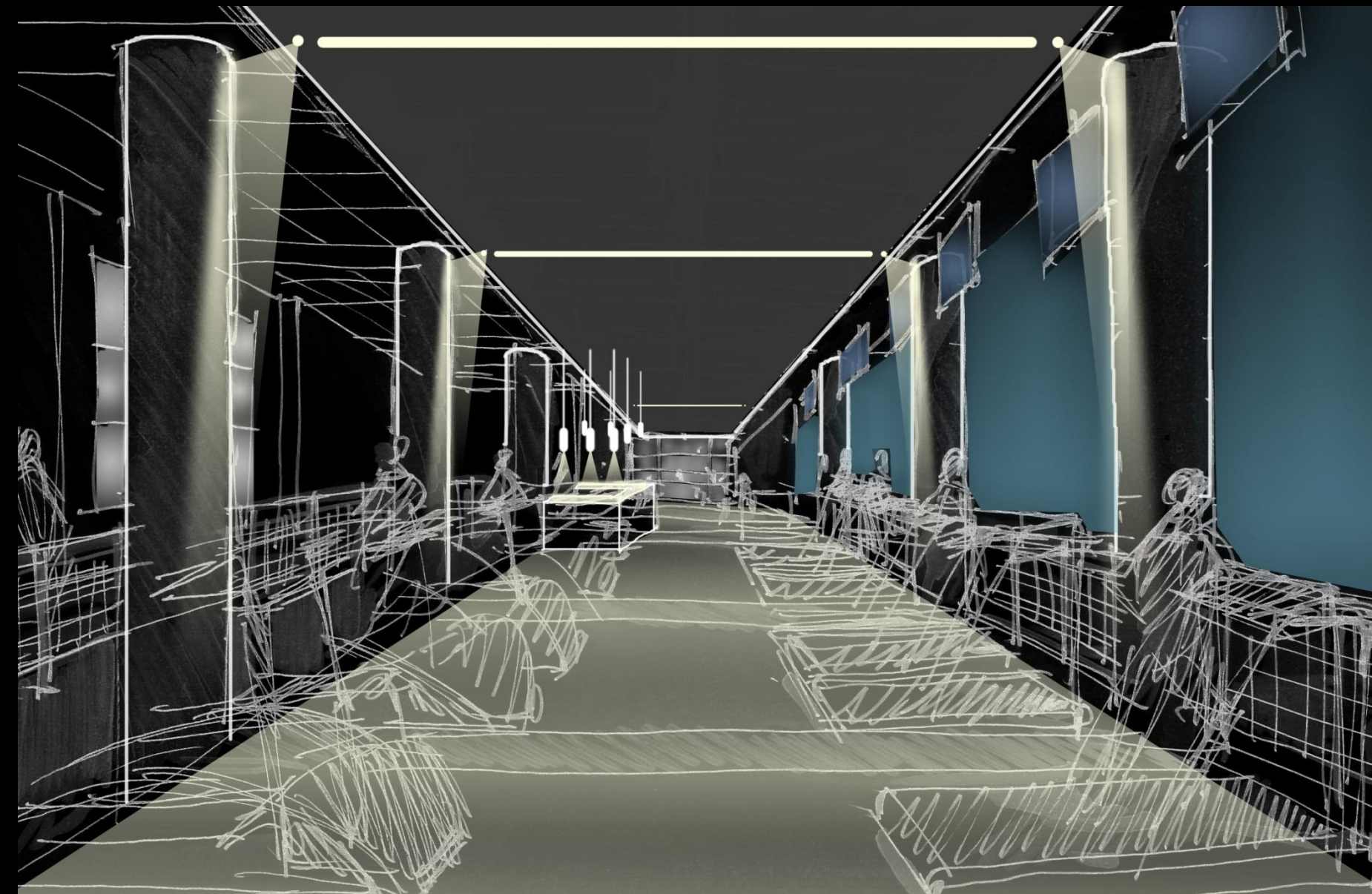
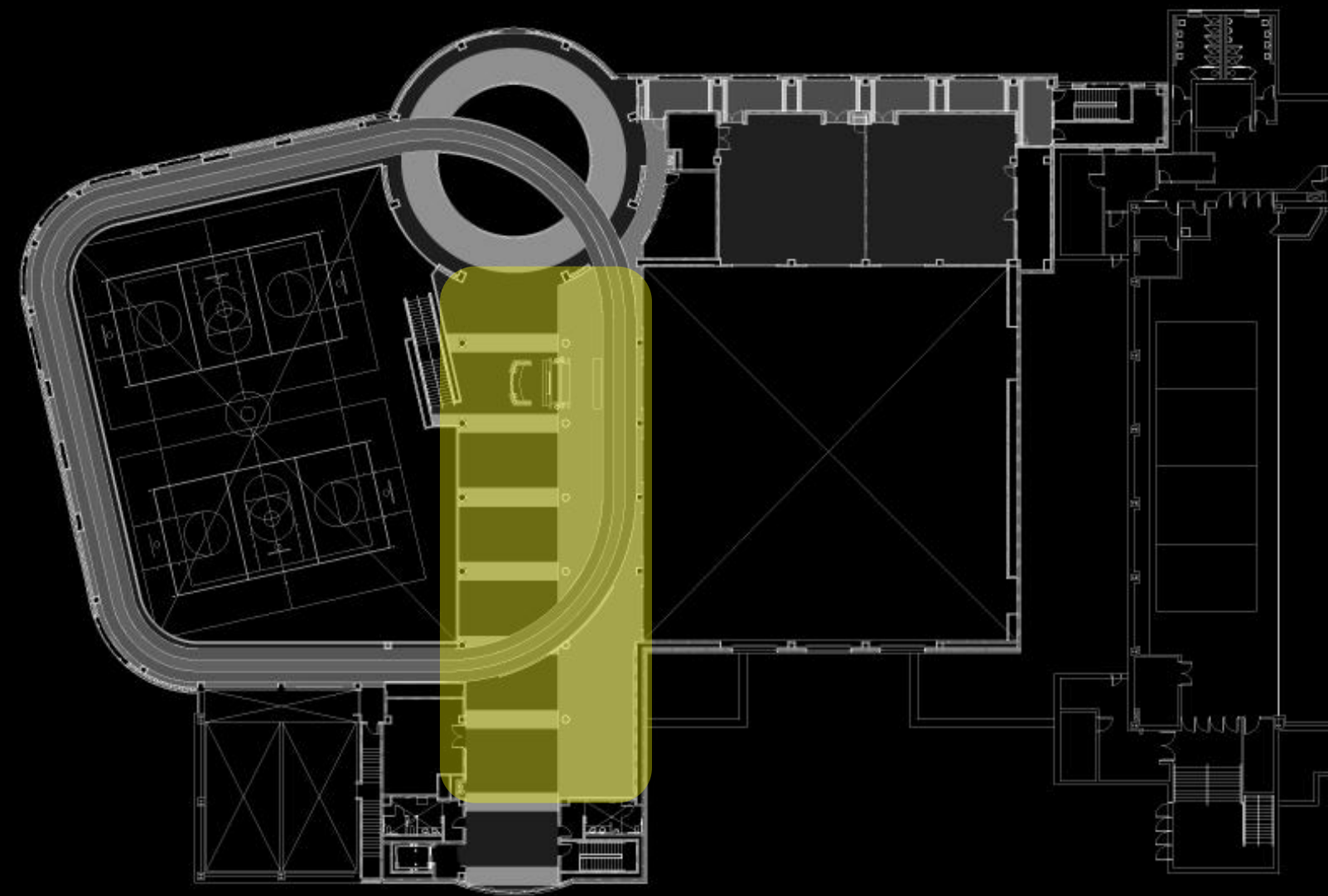
ARCHITECTURAL BREADTH

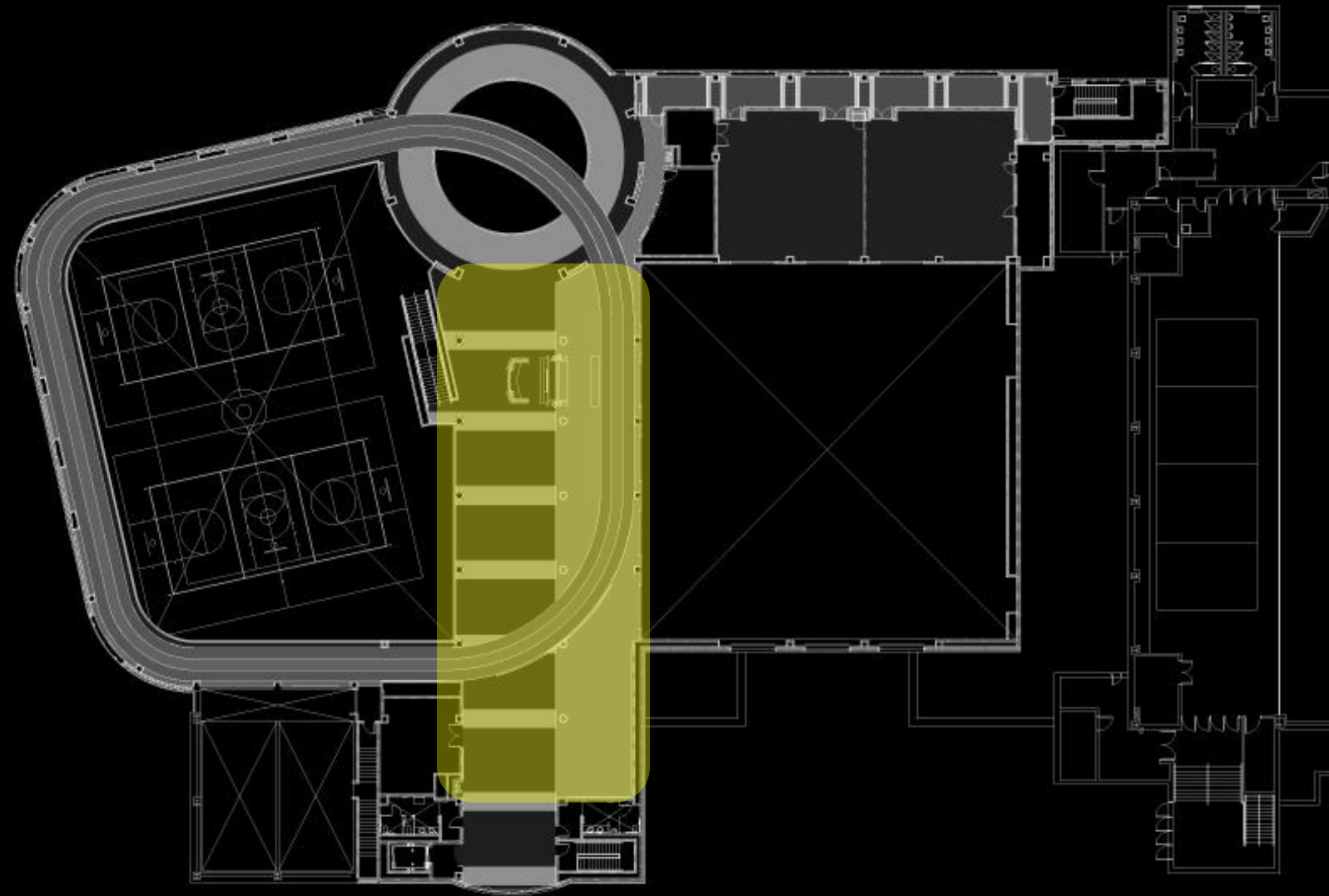
## CONCLUSION

SUMMARY OUTCOME

ACKNOWLEDGEMENTS

# FITNESS ROOM

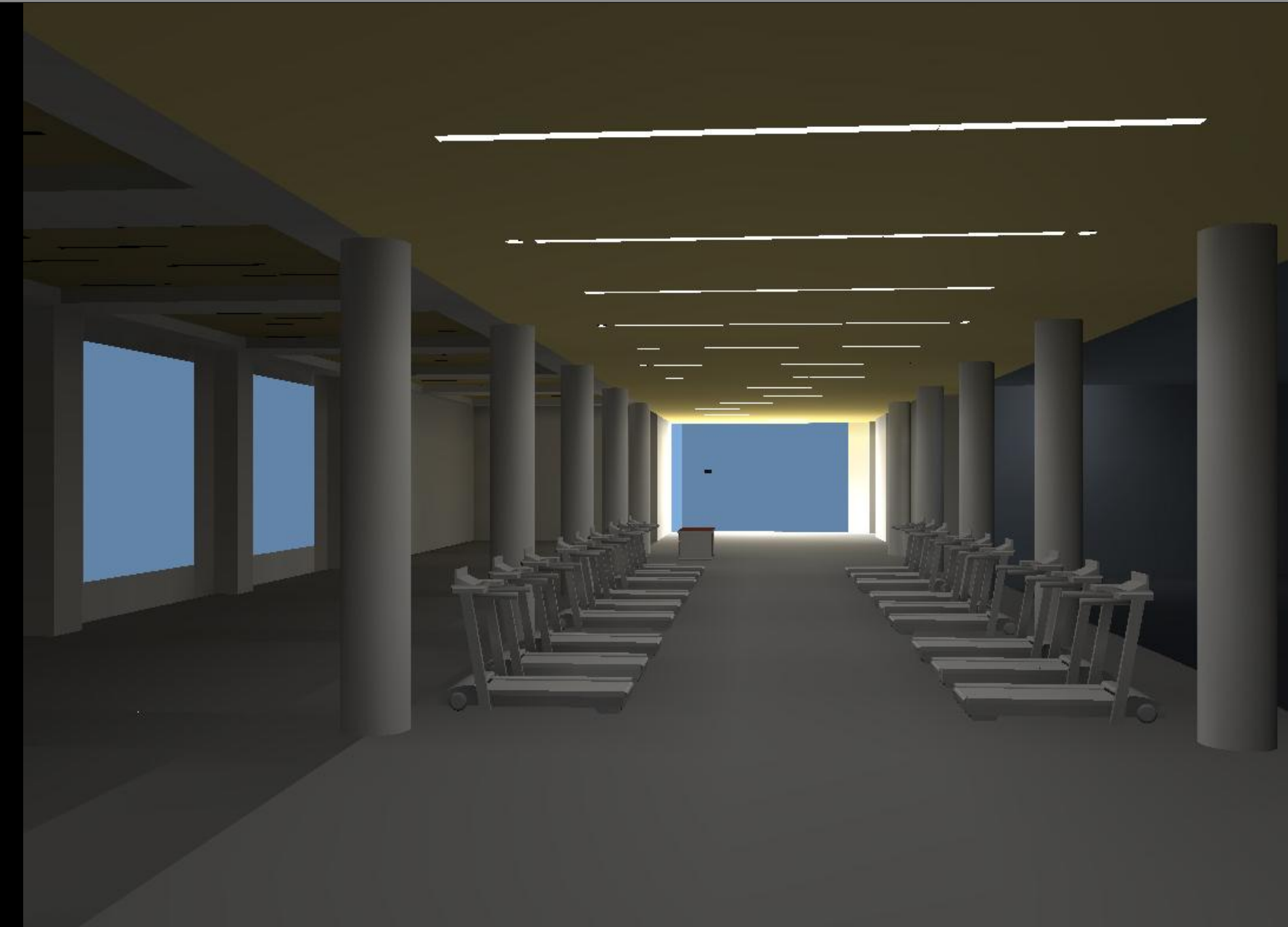
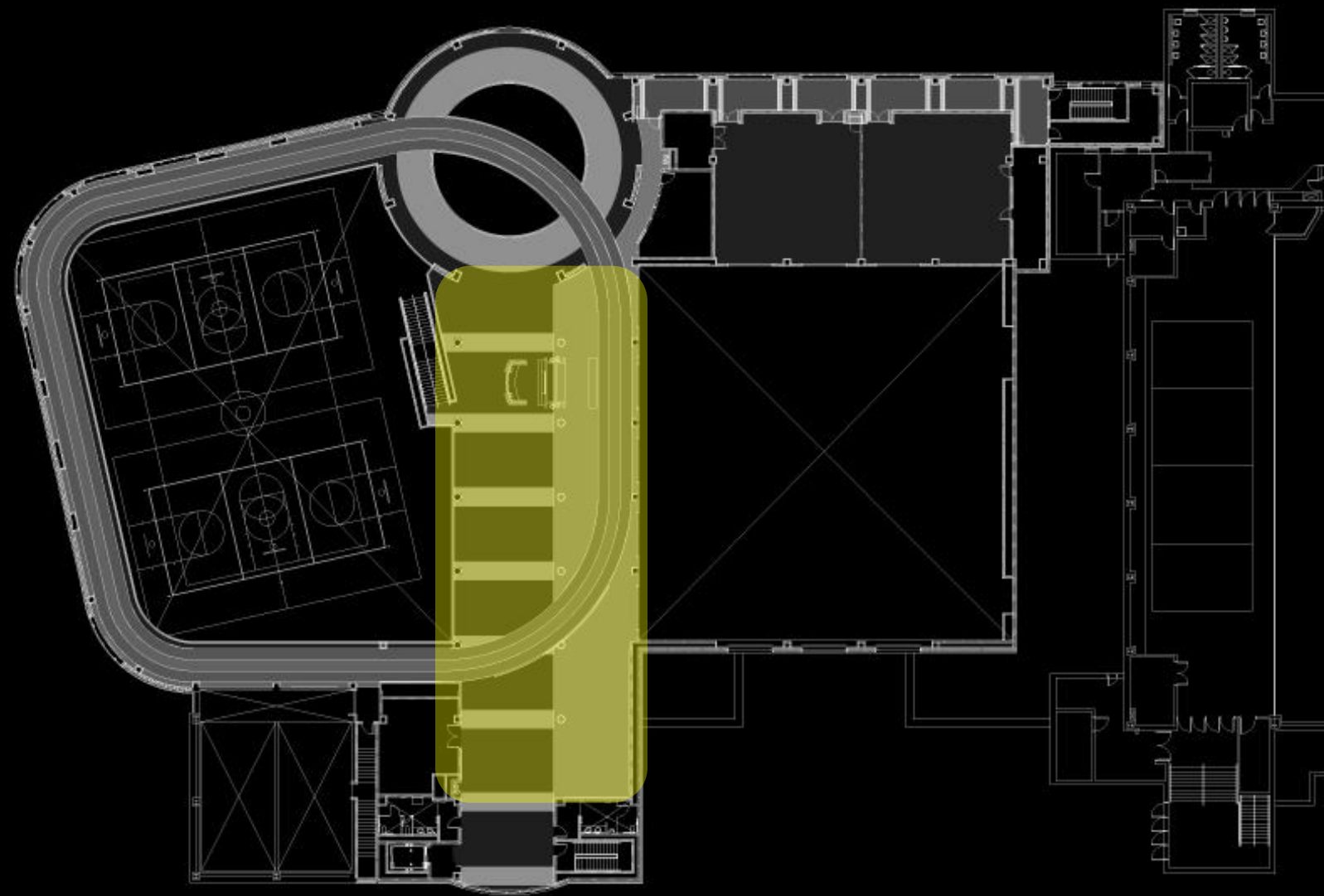




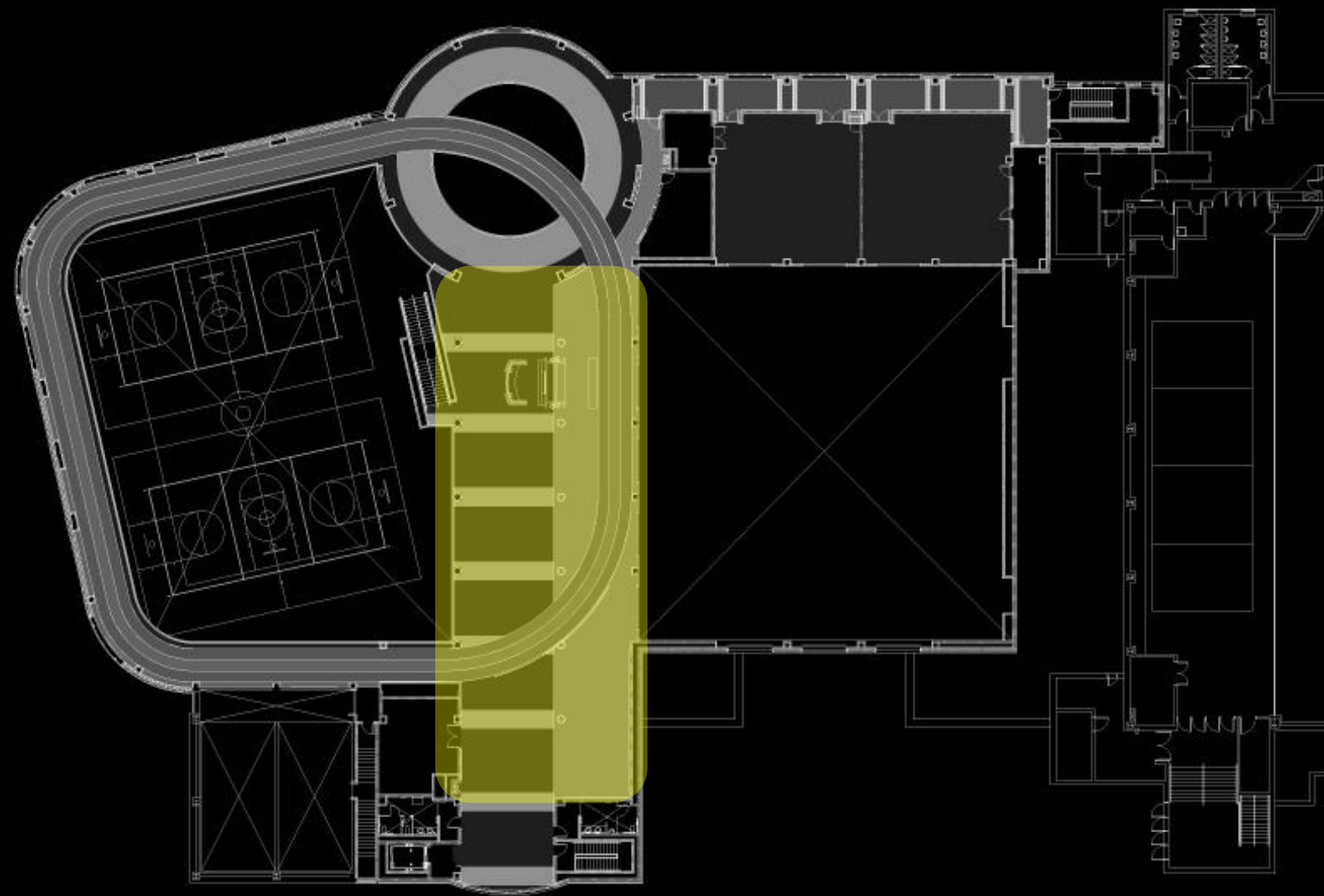
## DESIGN CRITERIA AND CONSIDERATIONS

- DIRECT AND REFLECTED GLARE
- UNIFORM LIGHT DISTRIBUTION ON TASK PLANE
- VISUAL CLARITY
- MOVEMENT THROUGHOUT SPACE
- RECREATIONAL SPORTS ILLUMINATION OF 30 FC
- LIGHTING POWER DENSITY OF 0.9 WATTS/ SQ. FT.

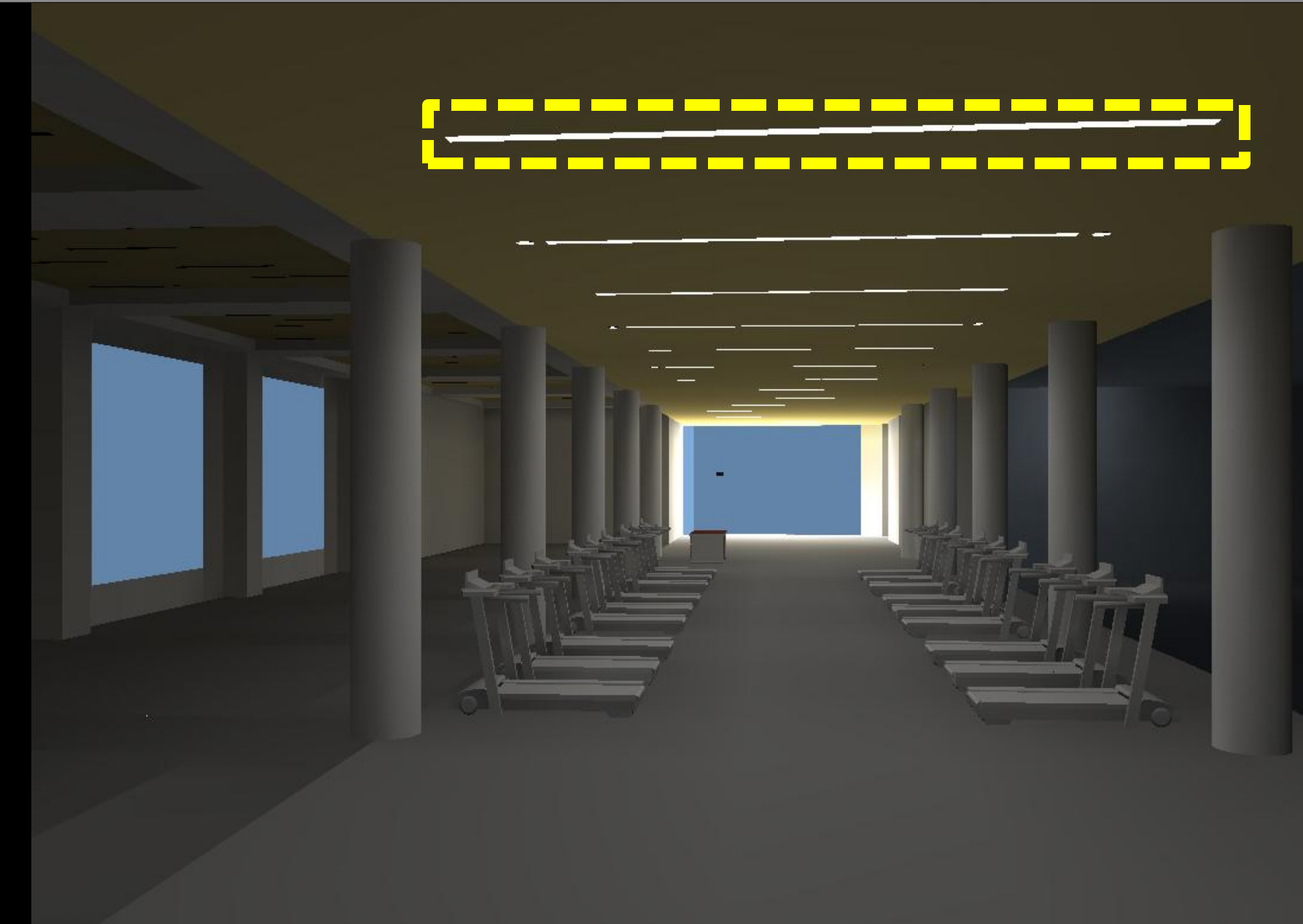
# FITNESS ROOM



# FITNESS ROOM

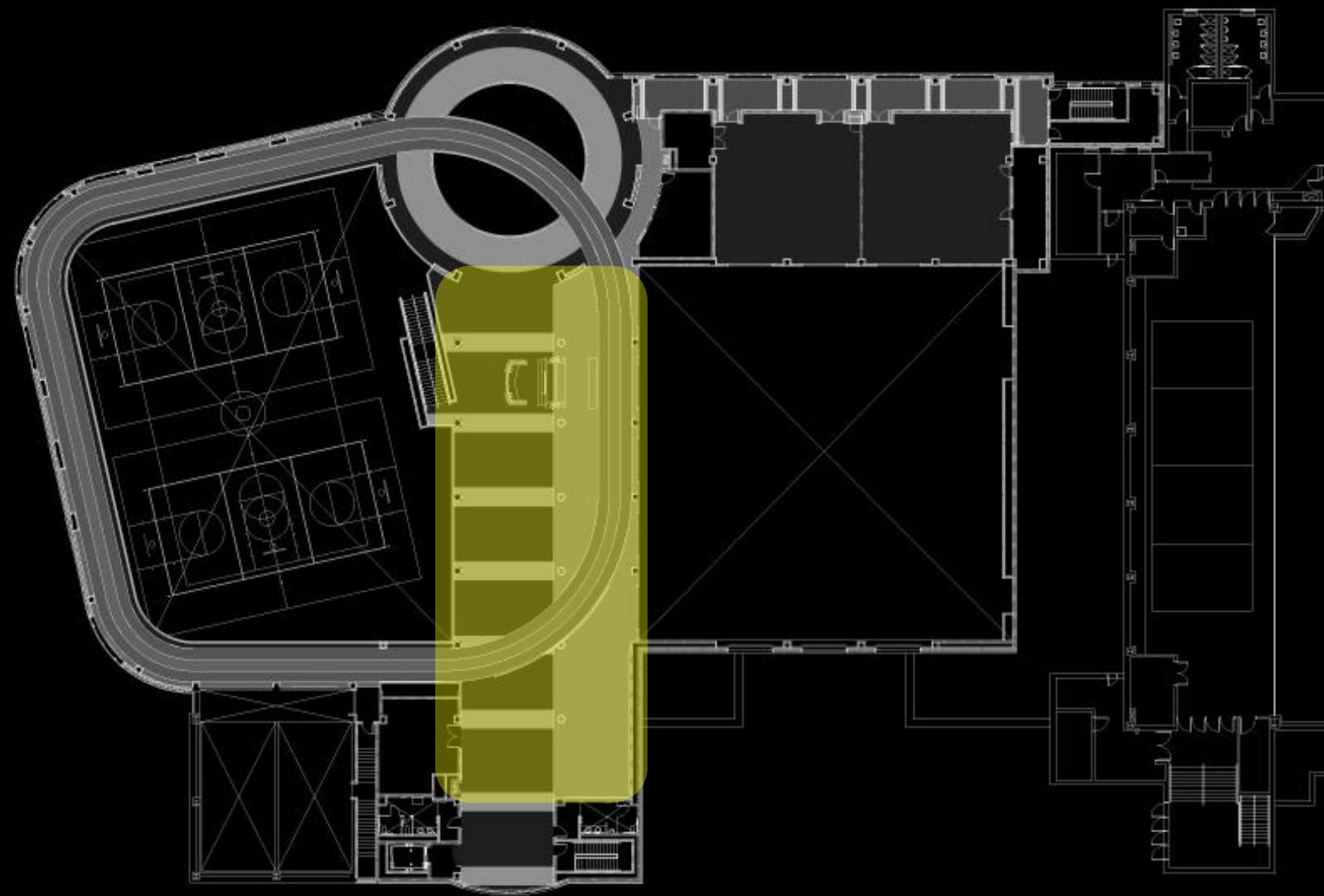


(1) 80W T5HO LENSED DOWNLIGHT





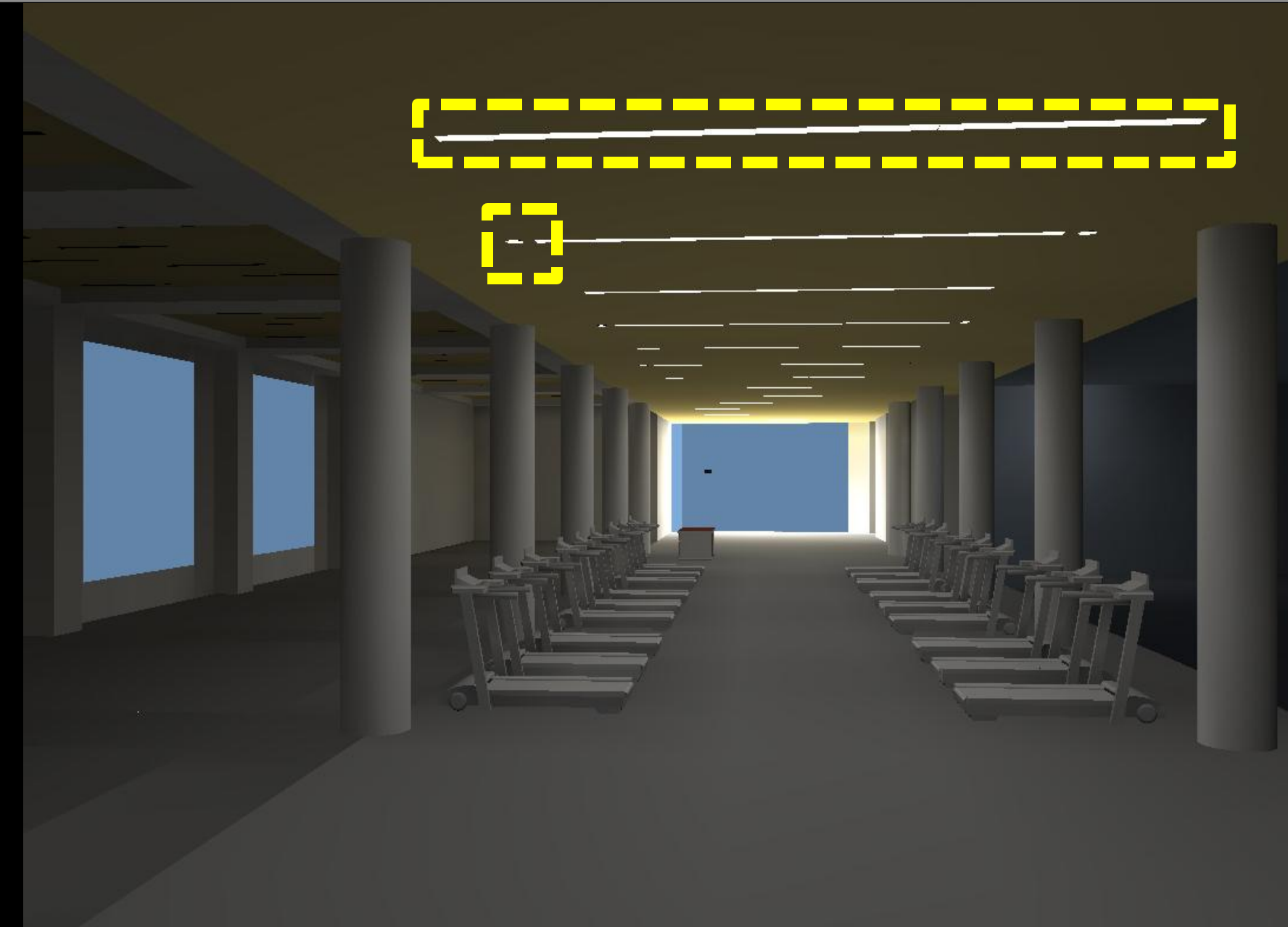
# FITNESS ROOM



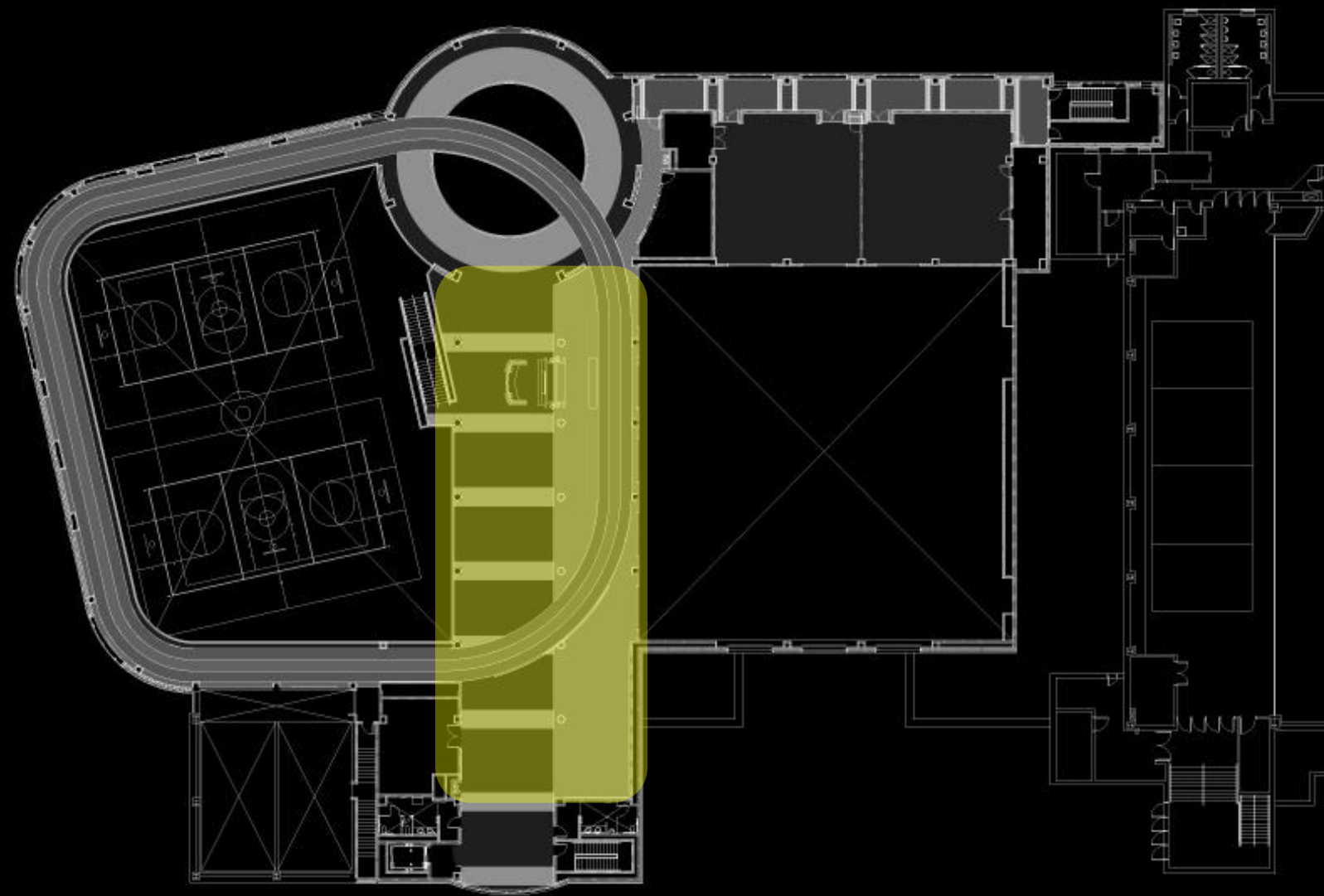
(1) 80W T5HO LENSED DOWNLIGHT



(1) 32W CFL RECESSED DOWNLIGHT



# FITNESS ROOM



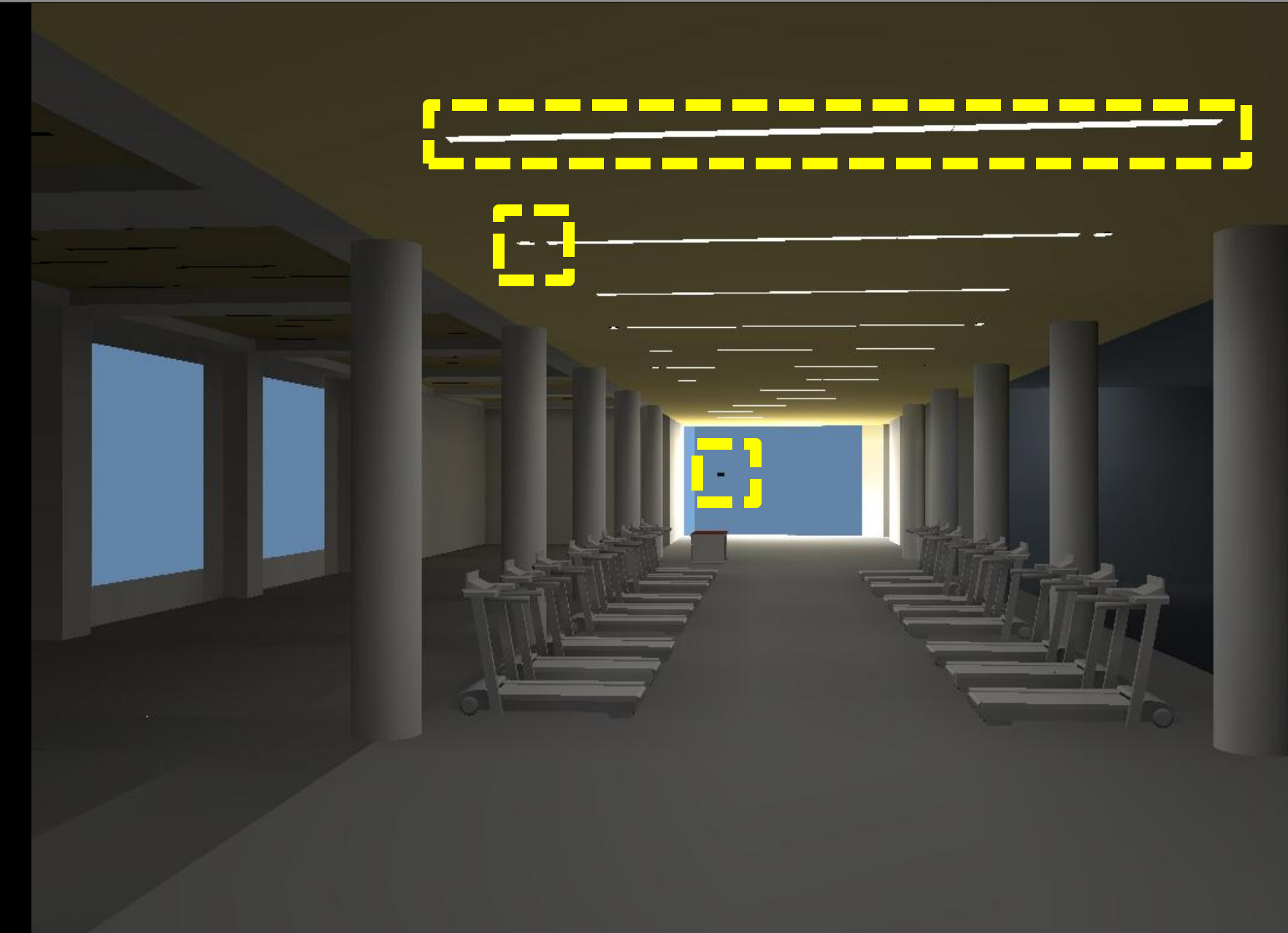
(1) 80W T5HO LENSED DOWNLIGHT



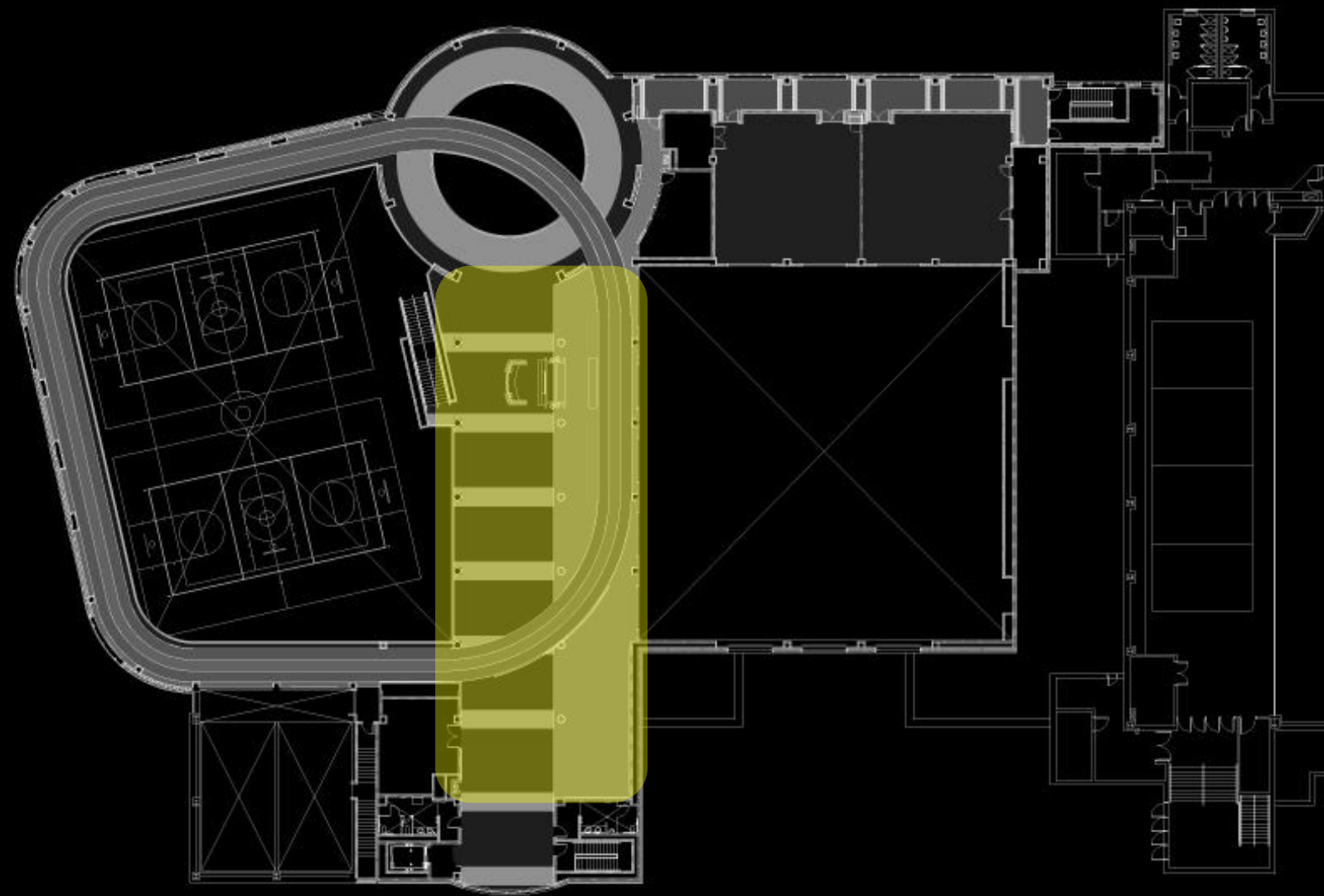
(1) 32W CFL RECESSED DOWNLIGHT



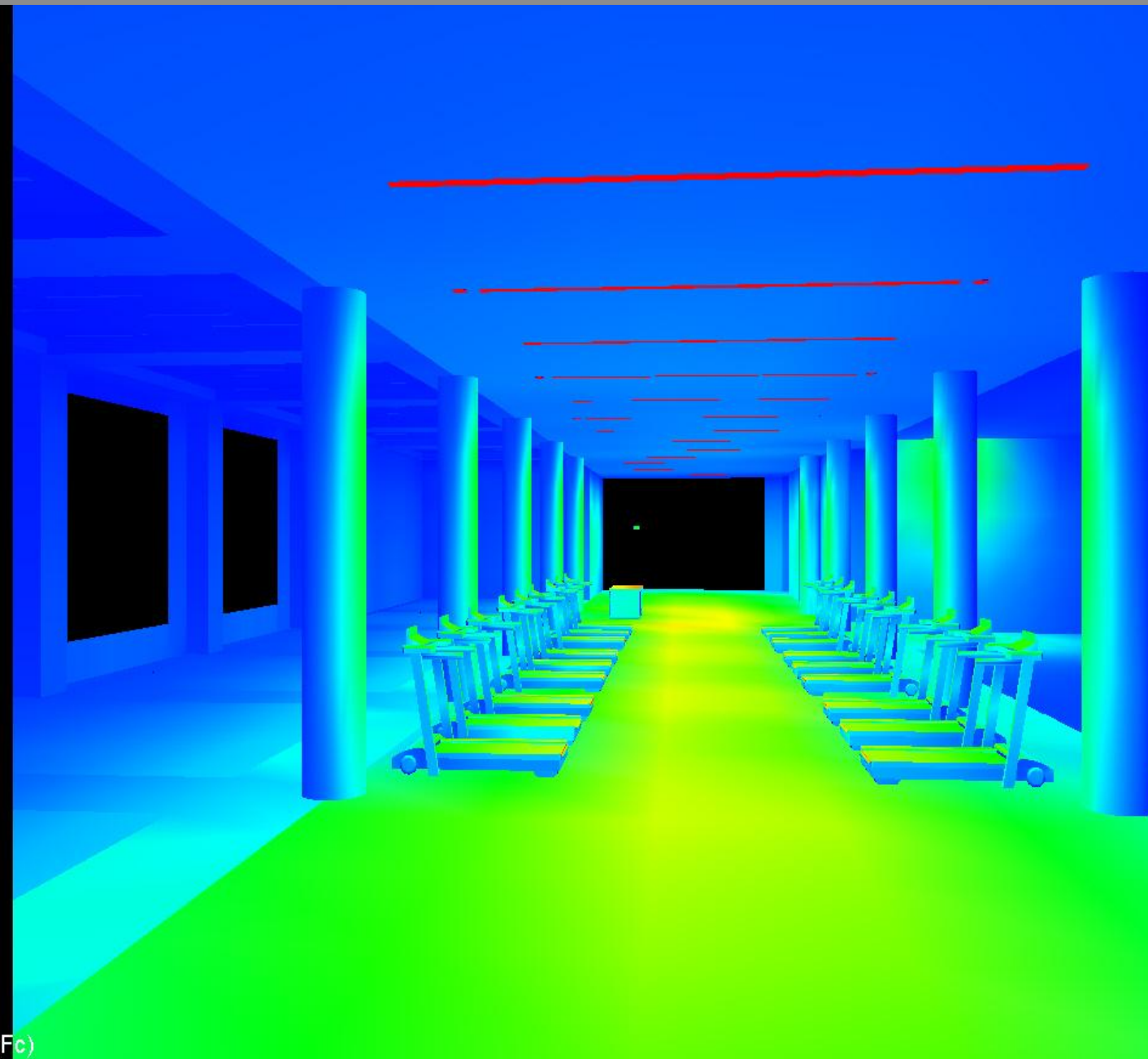
(1) 5W LED SUSPENDED PENDANT



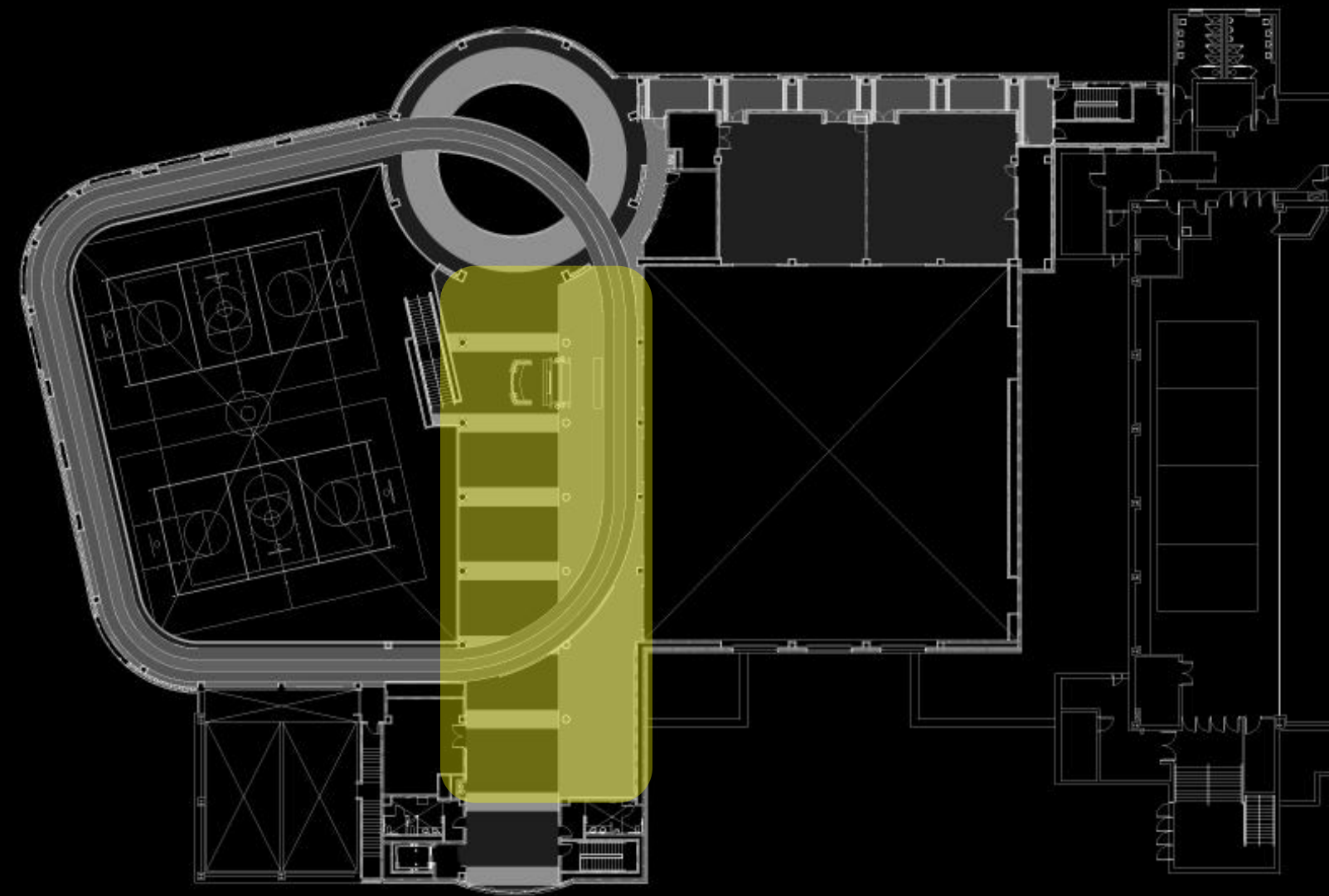
# FITNESS ROOM



Illuminance (Fc)



# FITNESS ROOM



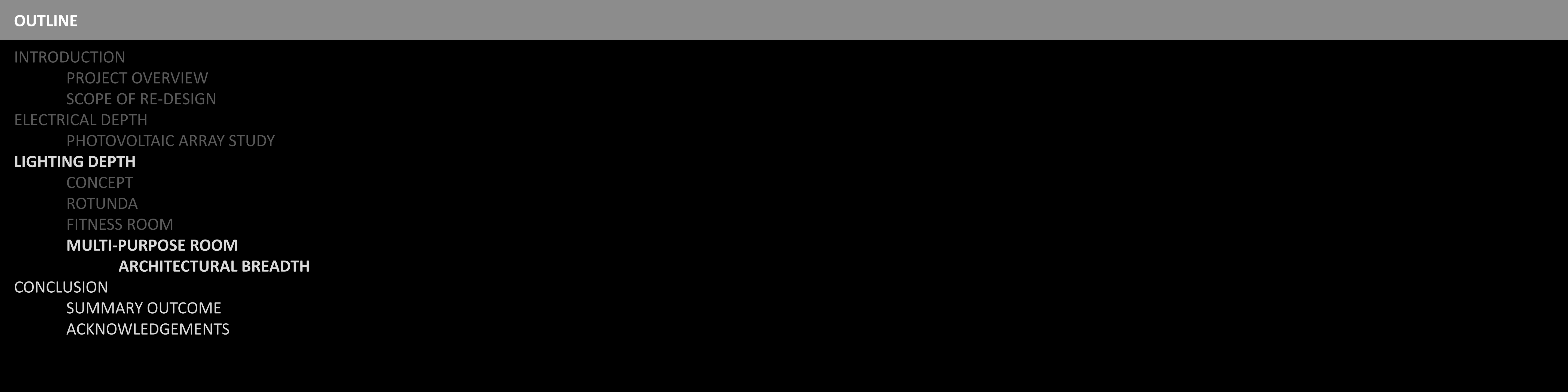
## DESIGN SUMMARY

- CLARITY AND MOVEMENT USING THREE LIGHT LEVELS
- ADEQUATE AND UNIFORM LIGHT LEVELS MET

Area	Size	Power Density Allowable	Power Density Designed
Exercise	4278 sq. ft.	0.9 W/sq. ft.	0.88 W/sq. ft.

Area	Average Illuminance	Maximum Illuminance	Minimum Illuminance
Exercise	31.7 fc	46.9 fc	5.3 fc





# OUTLINE

## INTRODUCTION

PROJECT OVERVIEW

SCOPE OF RE-DESIGN

## ELECTRICAL DEPTH

PHOTOVOLTAIC ARRAY STUDY

## LIGHTING DEPTH

CONCEPT

ROTUNDA

FITNESS ROOM

**MULTI-PURPOSE ROOM**

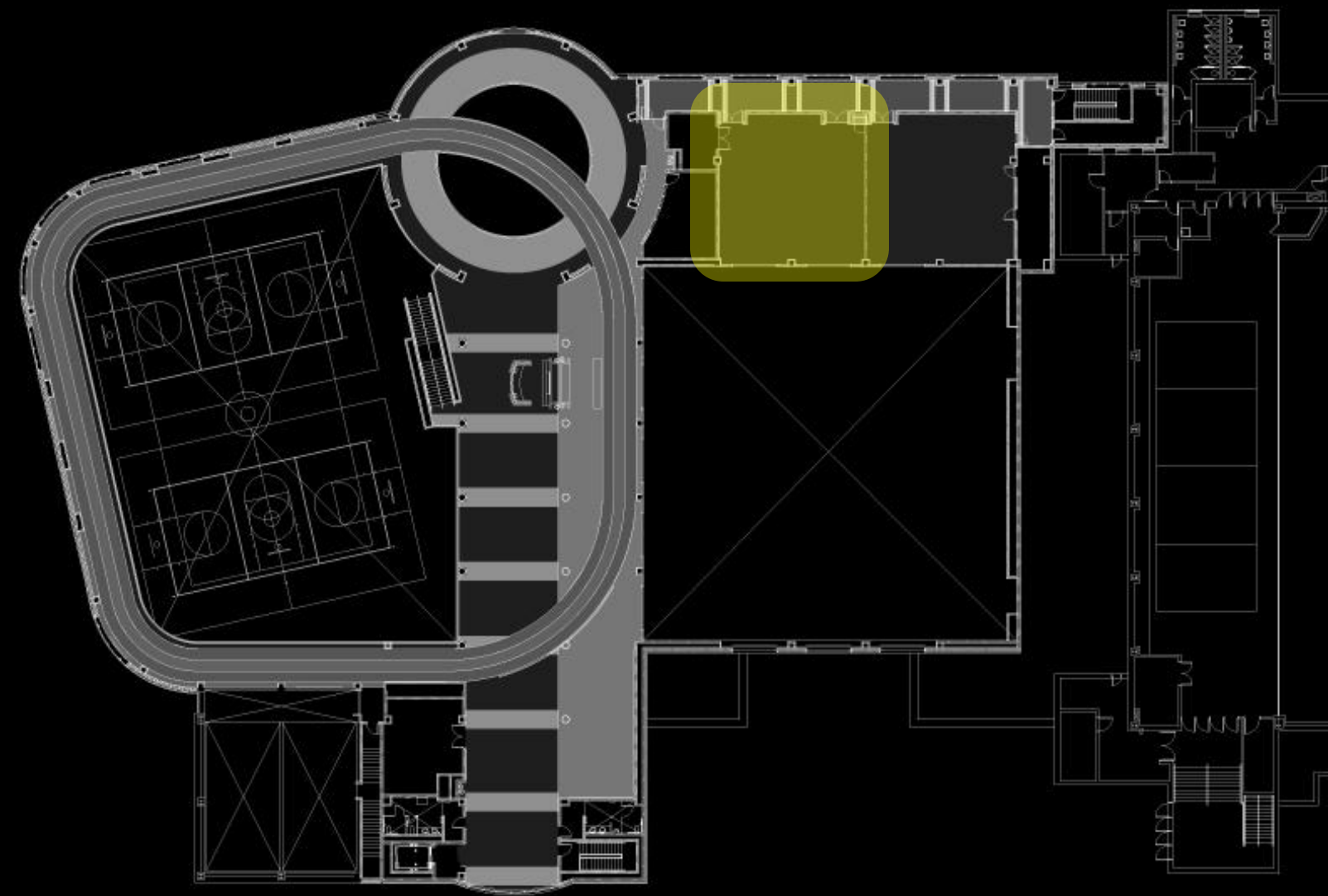
**ARCHITECTURAL BREADTH**

## CONCLUSION

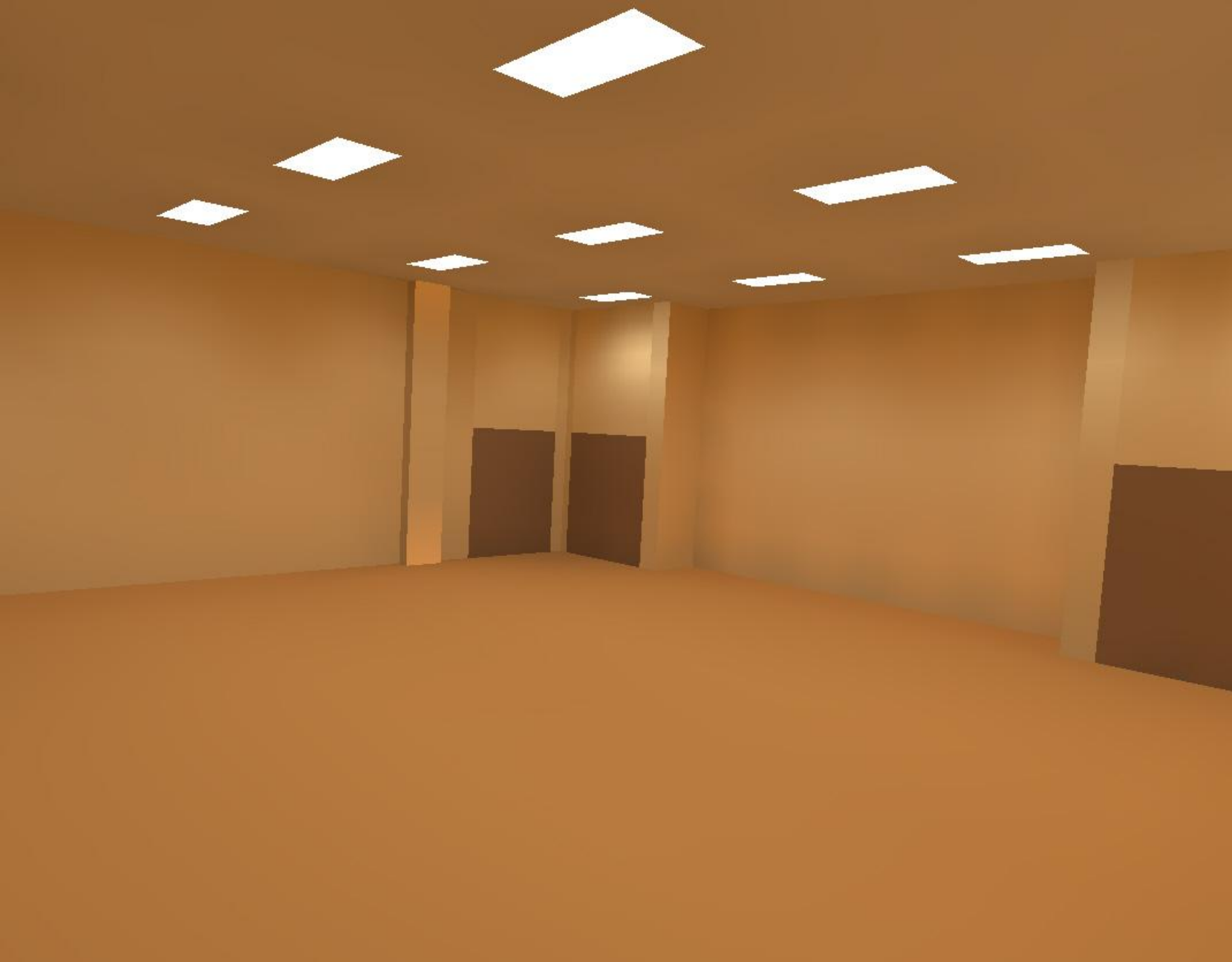
SUMMARY OUTCOME

ACKNOWLEDGEMENTS

# MULTI-PURPOSE ROOM



## MULTI-PURPOSE ROOM



## ARCHITECTURAL BREADTH

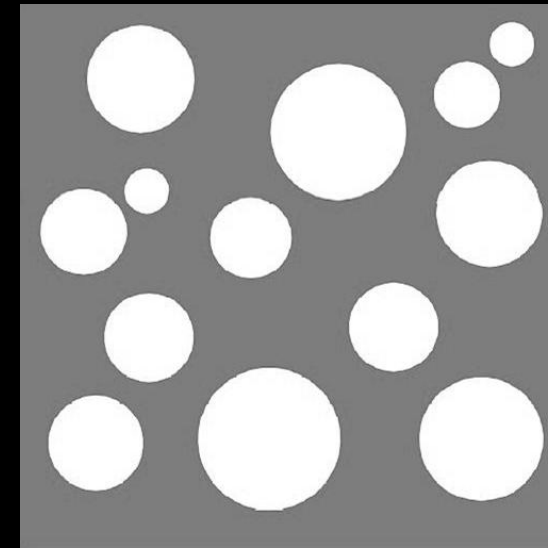
### DESIGN GOALS

- MIRROR THE HIGH INTENSITY OF ACTIVITIES
- ENHANCE THE PLAYFULNESS OF THE SPACE
- WORK WITH THE LIGHTING SCHEME



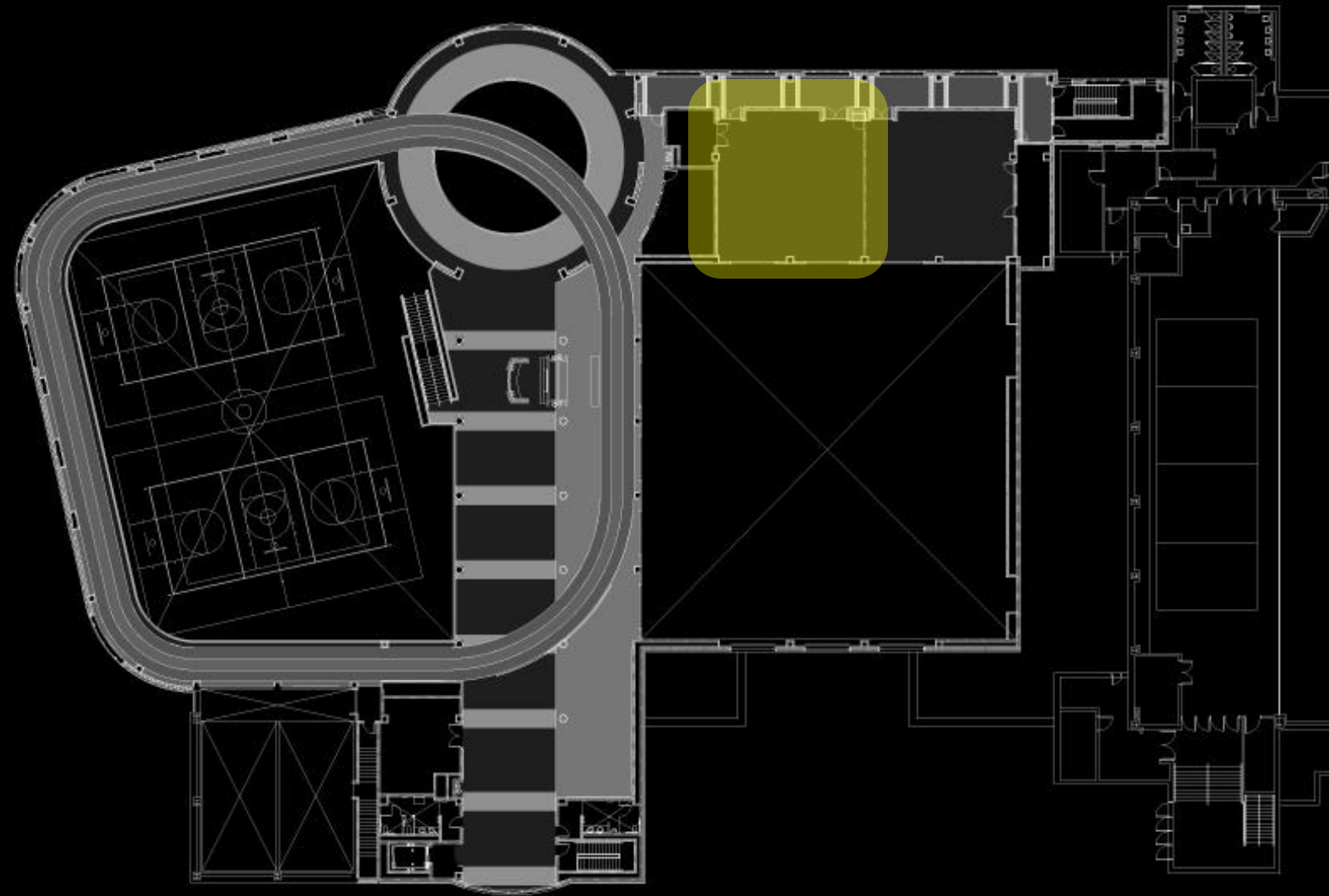
SOLUTION

- 4 PERFORATED METAL PANELS
- SUSPENDED 2 FEET FROM CABLE CORDS
- METAL L-SHAPED ANGLES FOR SUPPORT





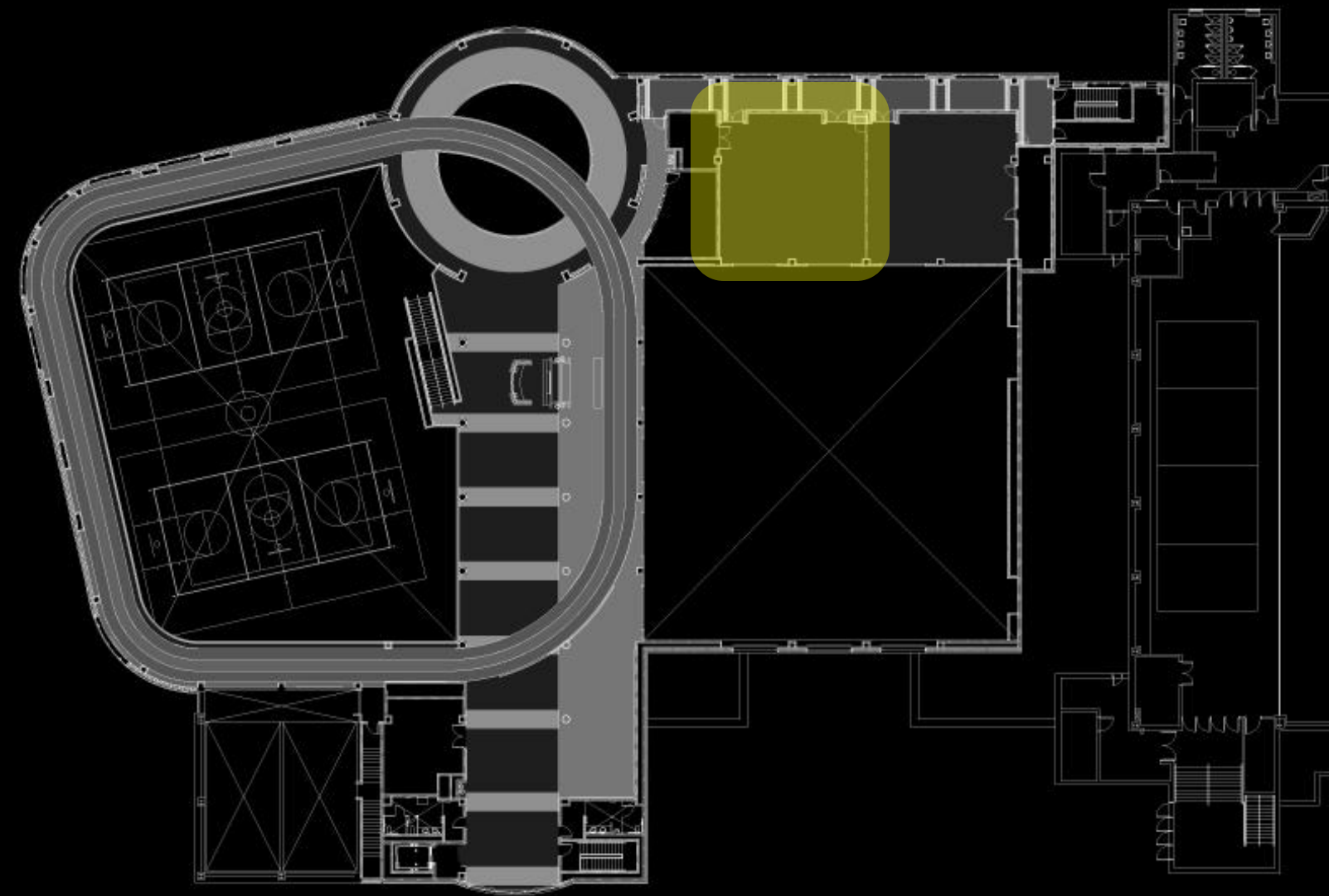
## MULTI-PURPOSE ROOM



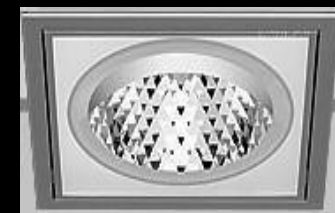
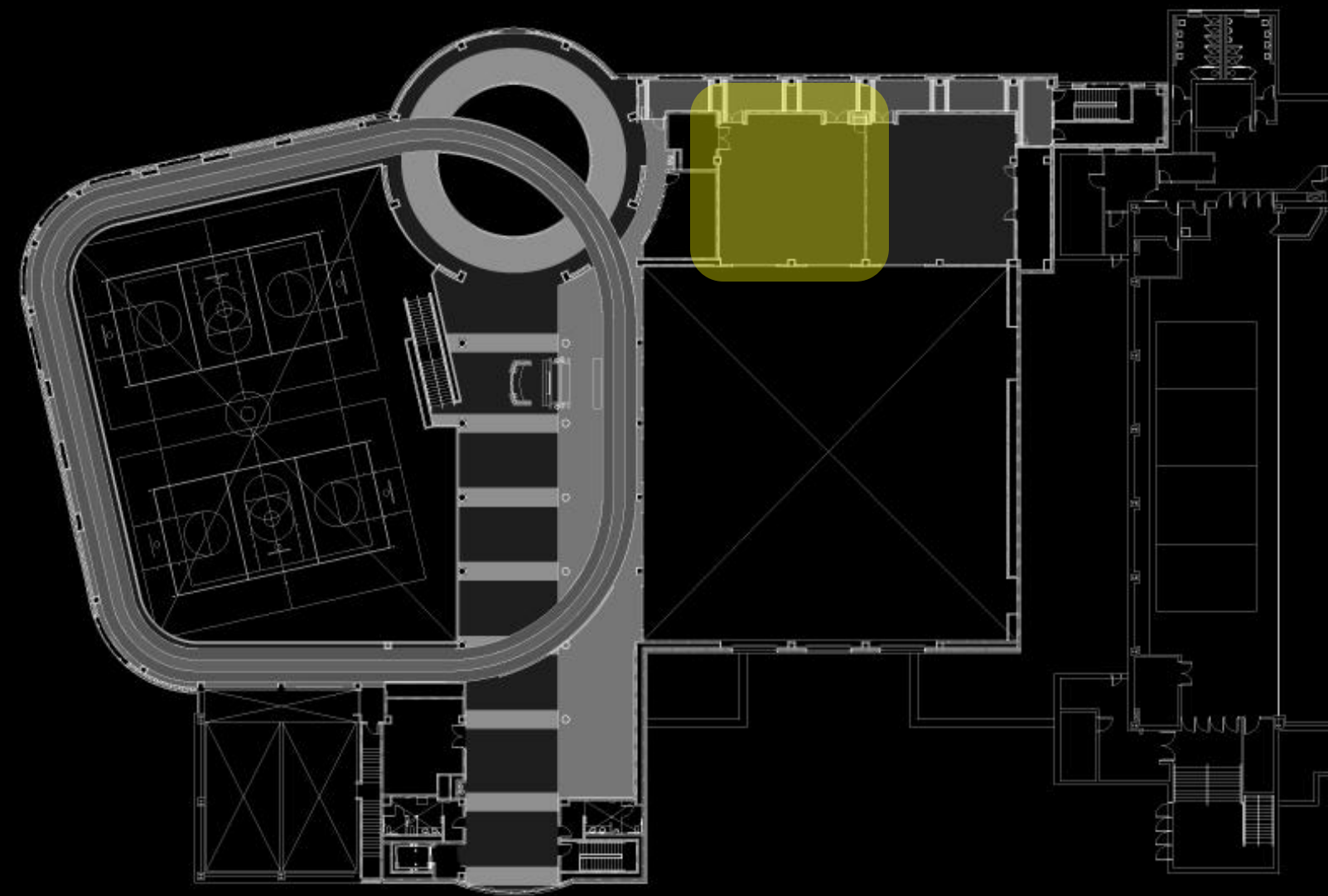
## DESIGN CRITERIA AND CONSIDERATIONS

- FESTIVE IMPRESSION
- SPARKLE AND REFLECTED HIGHLIGHTS
- COLOR APPEARANCE
- LIGHTING POWER DENSITY OF 1.3 WATTS/ SQ. FT.

# MULTI-PURPOSE ROOM



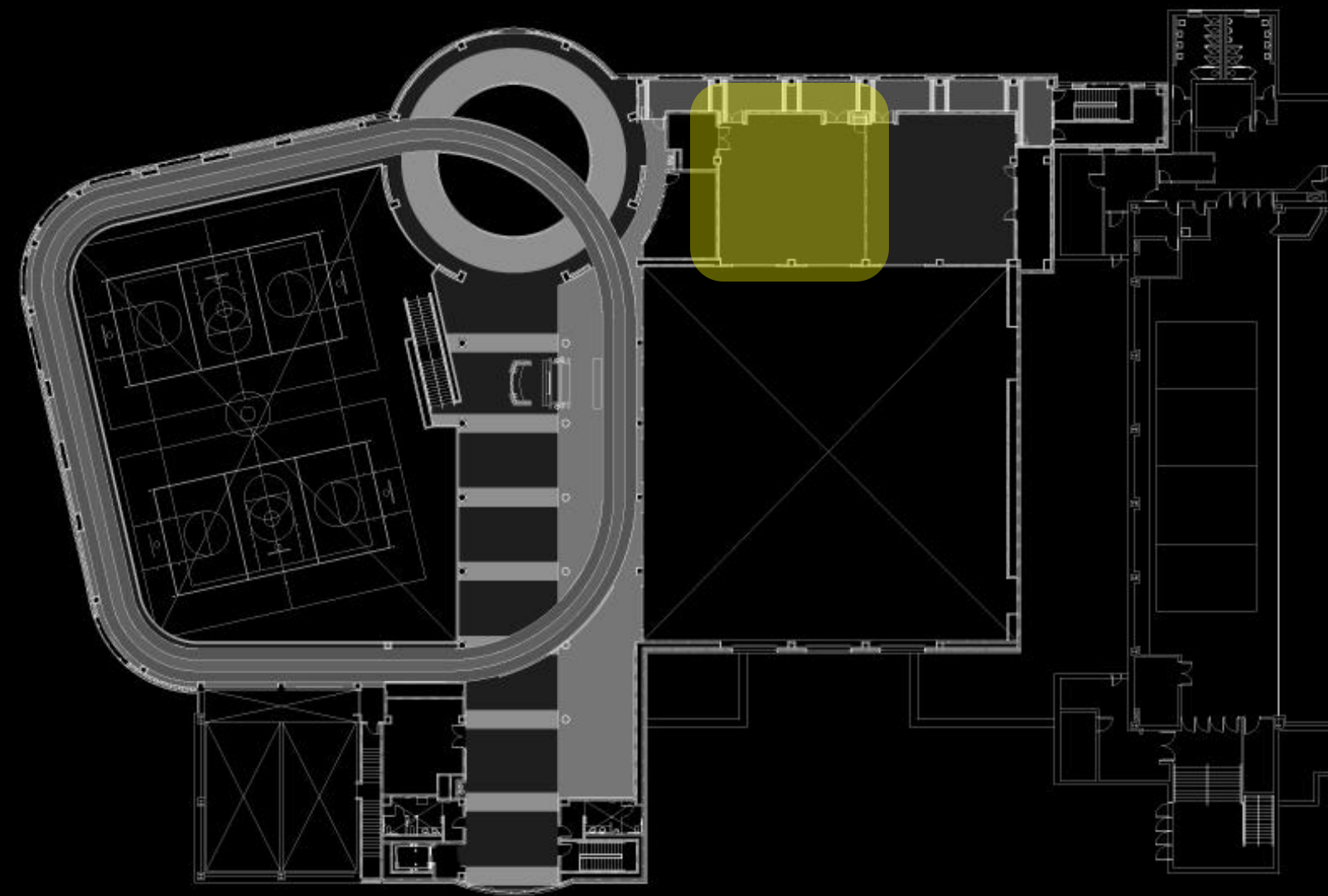
# MULTI-PURPOSE ROOM



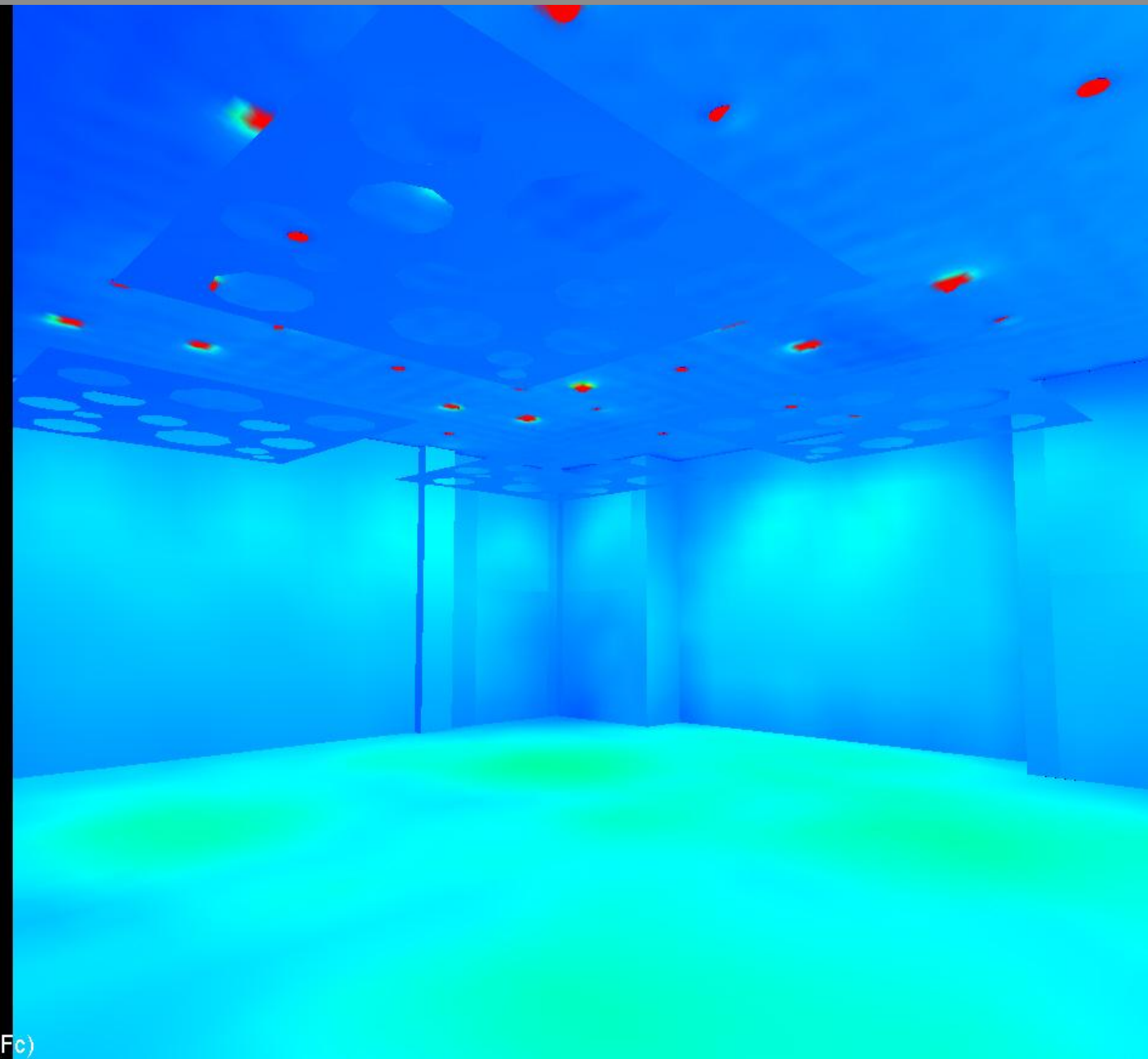
(1) 32W CFL RECESSED DOWNLIGHT



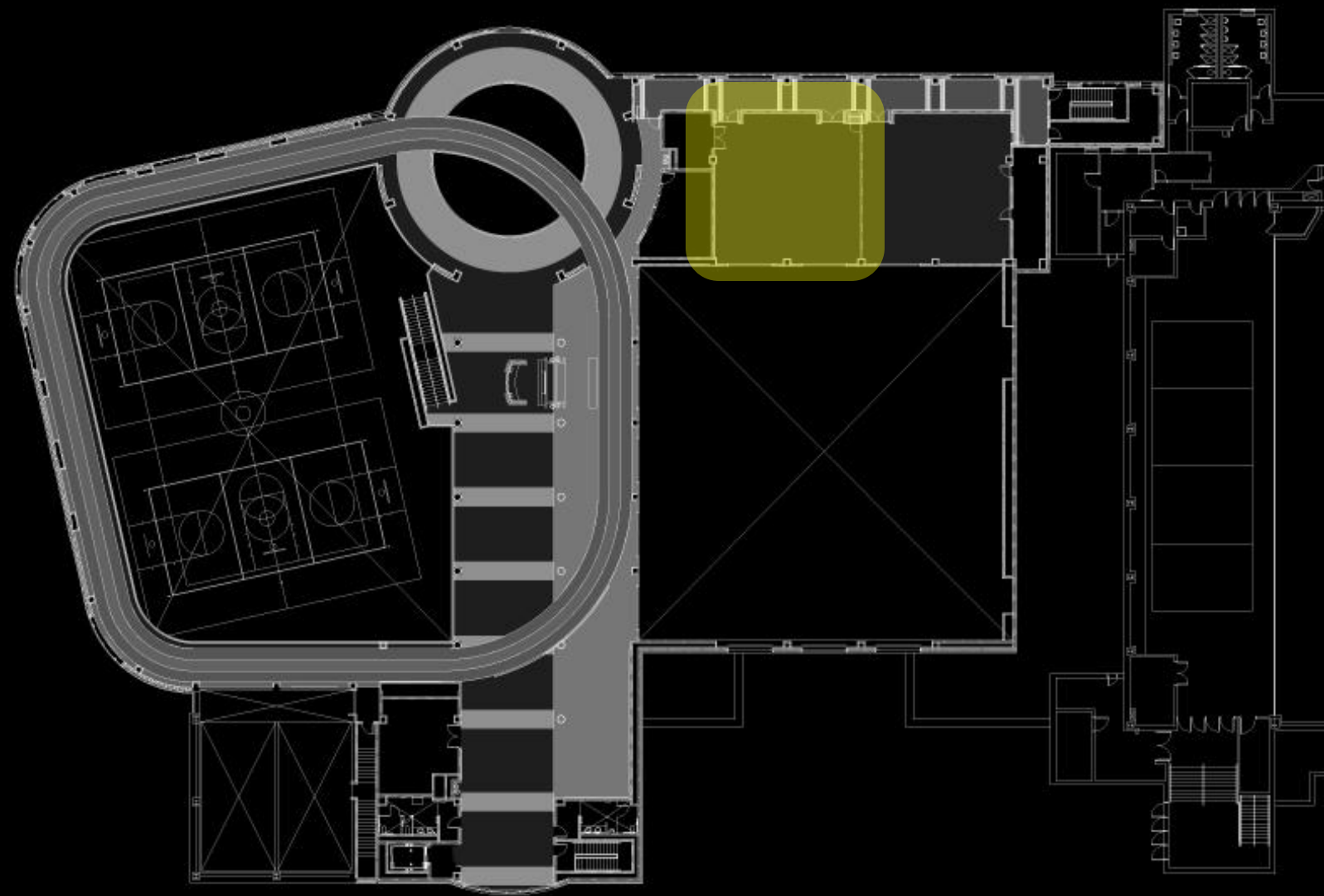
# MULTI-PURPOSE ROOM



Illuminance (Fc)



# MULTI-PURPOSE ROOM



## DESIGN SUMMARY

- RANDOM PATTERNS OF LIGHT
- WARM COLOR TEMPERATURE

Area	Size	Power Density Allowable	Power Density Designed
Multi-Purpose	1512 sq. ft.	1.3 W/sq. ft.	0.938 W/sq. ft.

Area	Average Illuminance	Maximum Illuminance	Minimum Illuminance
Multi-Purpose	14.61 fc	25.5 fc	9.2 fc



OUTLINE	SUMMARY OUTCOME
INTRODUCTION PROJECT OVERVIEW SCOPE OF RE-DESIGN	ELECTRICAL PHOTOVOLTAIC ARRAYS PAYBACK AFTER 20 YEARS
ELECTRICAL DEPTH PHOTOVOLTAIC ARRAY STUDY	LIGHTING RE-DESIGN PROMOTES MOVEMENT, NAVIGATION, AND SAFETY
LIGHTING DEPTH CONCEPT ROTUNDA FITNESS ROOM MULTI-PURPOSE ROOM ARCHITECTURAL BREADTH	COMPLY WITH IESNA AND ASHRAE  ARCHITECTURAL MULTI-PURPOSE ROOM IS AESTHETICALLY PLEASING
<b>CONCLUSION</b> SUMMARY OUTCOME ACKNOWLEDGEMENTS	

OUTLINE	ACKNOWLEDGEMENTS
INTRODUCTION	
PROJECT OVERVIEW	AE FACULTY    PROFESSOR DANNERTH
SCOPE OF RE-DESIGN	PROFESSOR HOUSER
ELECTRICAL DEPTH	PROFESSOR MISTRICK
PHOTOVOLTAIC ARRAY STUDY	PROFESSOR HOLLAND
LIGHTING DEPTH	BRINJAC ENGINEERS    SHAWN GOOD
CONCEPT	FAMILY, FRIENDS, AND FELLOW AE
ROTUNDA	
FITNESS ROOM	
MULTI-PURPOSE ROOM	
ARCHITECTURAL BREADTH	
<b>CONCLUSION</b>	
SUMMARY OUTCOME	
<b>ACKNOWLEDGEMENTS</b>	

# QUESTIONS | COMMENTS



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AE Senior Thesis | April 13, 2011