

THE NERMAN MUSEUM  
OF  
CONTEMPORARY ART

FINAL THESIS PRESENTATION

JACK RISSE

THE PENNSYLVANIA STATE UNIVERSITY

ARCHITECTURAL ENGINEERING - LIGHTING/ELECTRICAL

ADVISORS - SHAWN GOOD  
LESLIE BEAHM

APRIL 14, 2014



THE NERMAN MUSEUM OF CONTEMPORARY ART

JOHNSON COUNTY COMMUNITY COLLEGE

OVERLAND PARK, KANSAS

MUSEUM | EDUCATION | CAFE

38,190 FT<sup>2</sup>

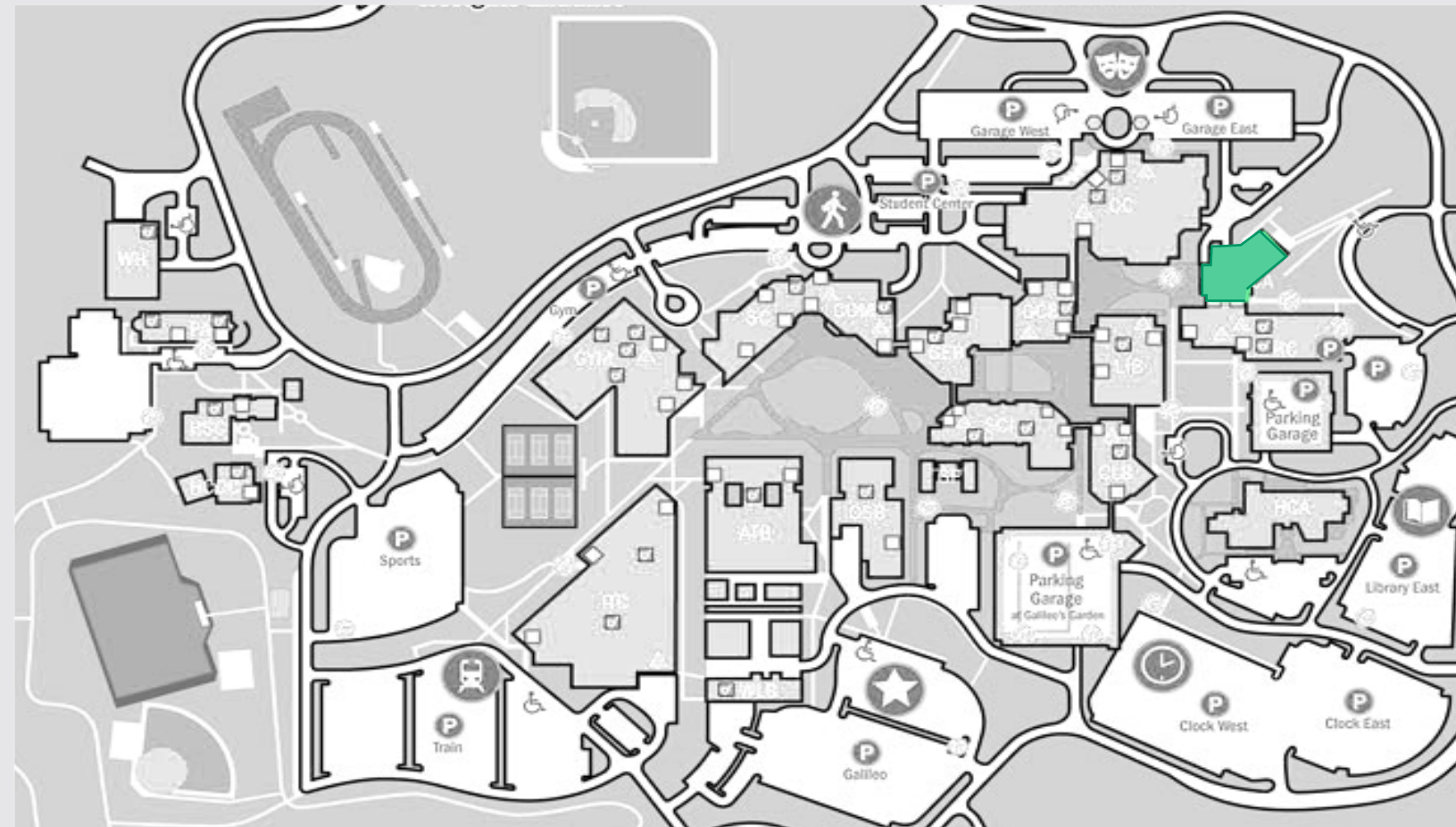
STORIES ABOVE GRADE - 2

APRIL 2005 - AUGUST 2007

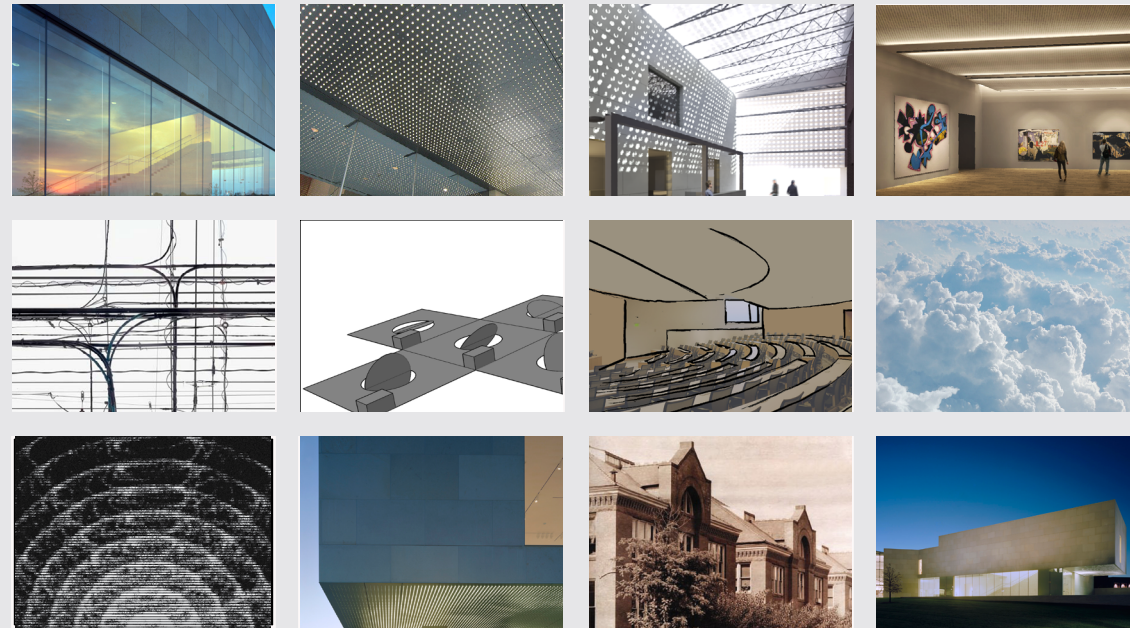


JOHNSON COUNTY COMMUNITY COLLEGE >

OVERLAND PARK, KANSAS &gt;&gt;



# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
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## THESIS SCOPE

### LIGHTING DEPTH

- Grounds
- Solarium
- Cafe
- Auditorium
- Gallery

### ELECTRICAL DEPTH

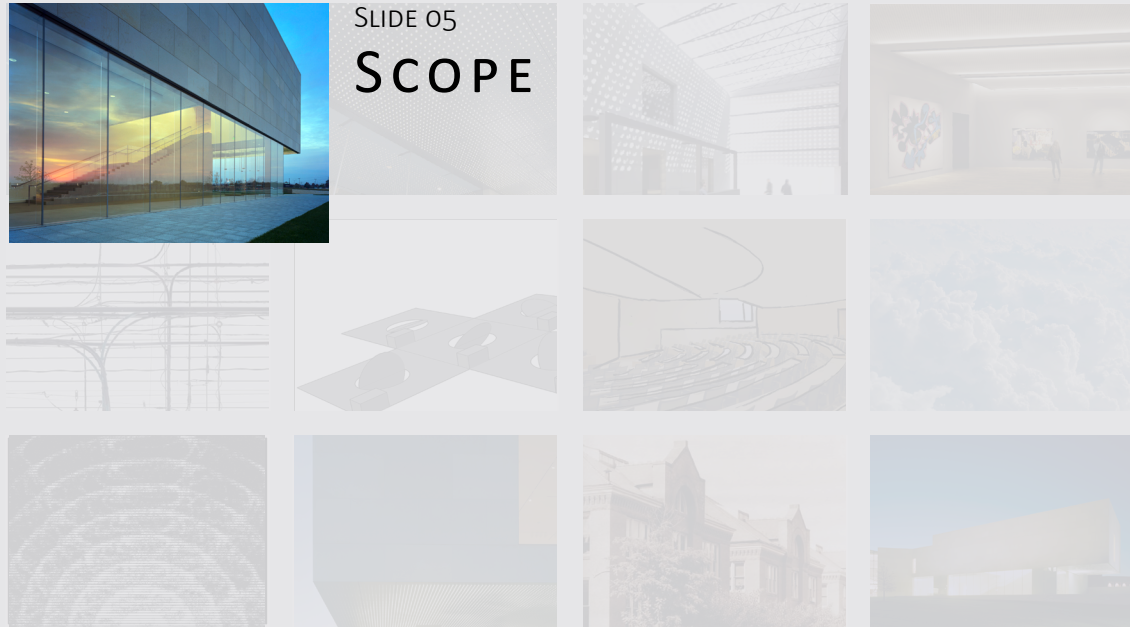
- Branch Circuit Redesign
- Short Circuit Study
- Wind Power Generation System

### STRUCTURAL BREADTH

### ACOUSTICAL BREADTH



# The Nerman Museum of Contemporary Art



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COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
		LIGHTING DEPTH   ELECTRICAL DEPTH   ACOUSTICAL BREADTH											

## PRESENTATION SCOPE

### LIGHTING DEPTH

GROUND

SOLARIUM

CAFE

AUDITORIUM

GALLERY

### ELECTRICAL DEPTH

BRANCH CIRCUIT REDESIGN

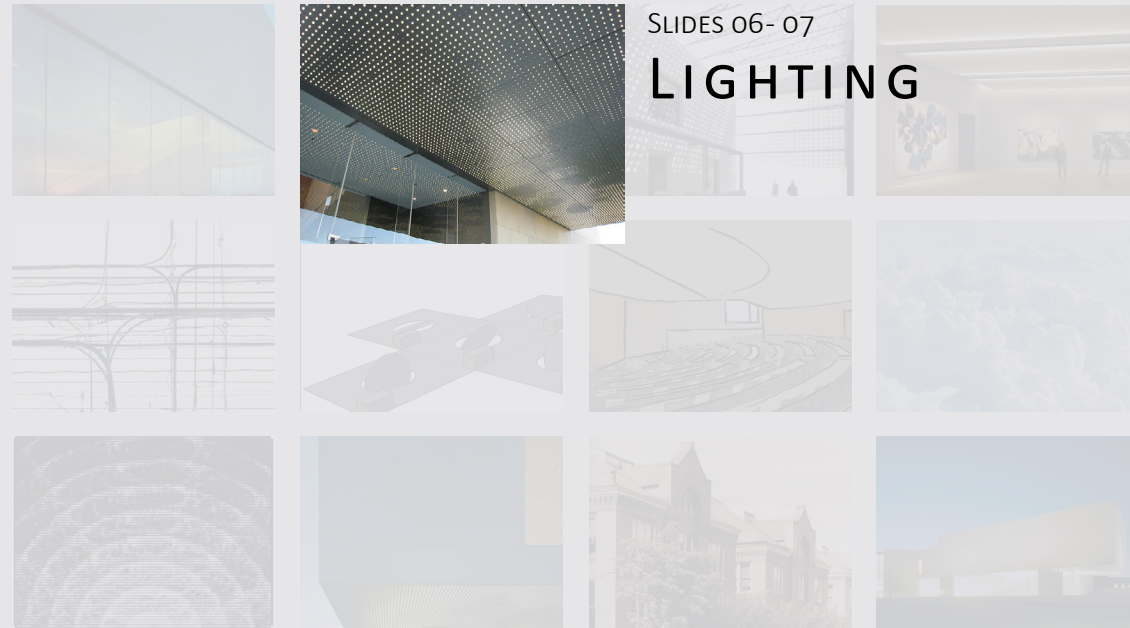
SHORT CIRCUIT STUDY

WIND POWER GENERATION SYSTEM

### STRUCTURAL BREADTH

### ACOUSTICAL BREADTH

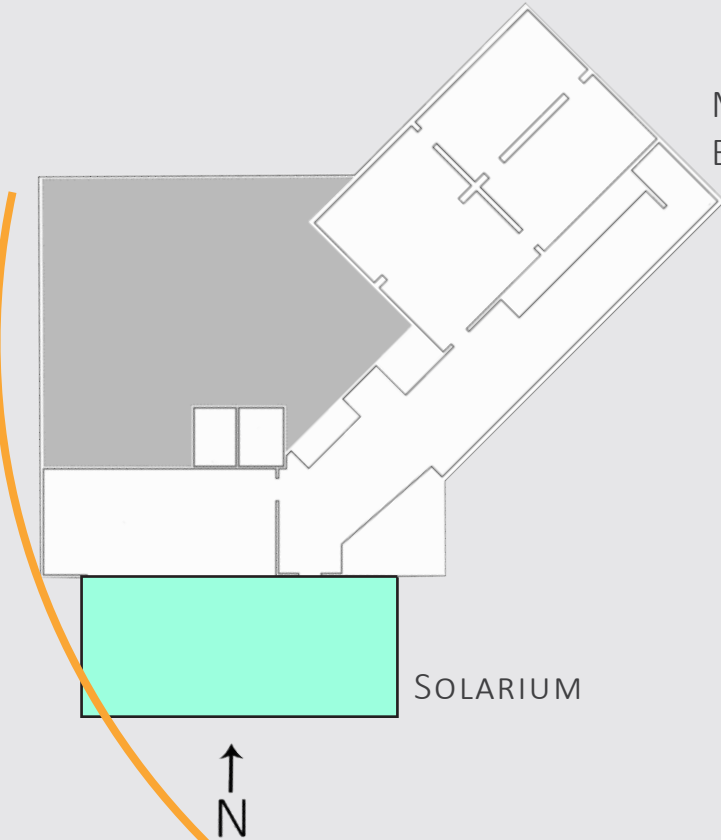
# The Nerman Museum of Contemporary Art



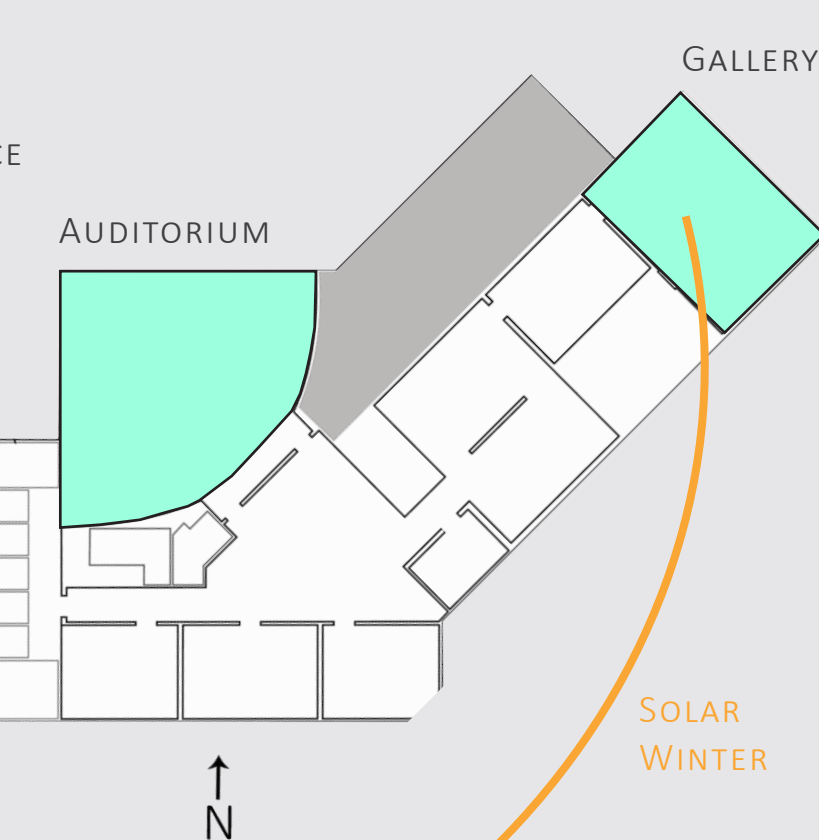
## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
			OVERLAND PARK, KS SOLAR CONDITIONS AREAS OF STUDY										

## 1ST FLOOR



## 2ND FLOOR



## LIGHTING DESIGN

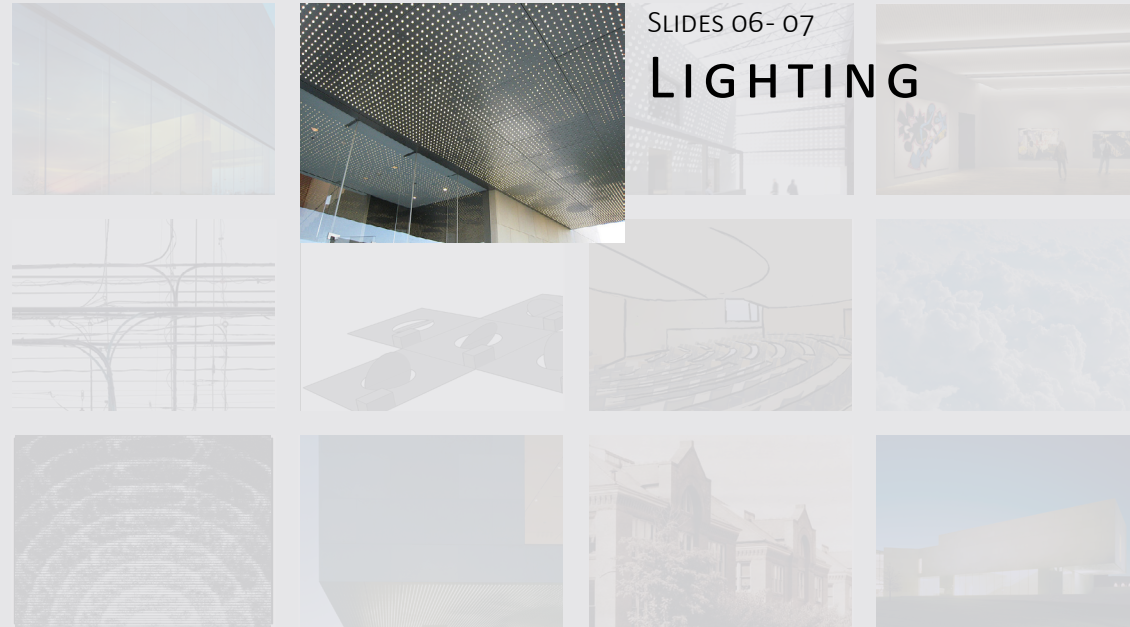
SOLARIUM  
AUDITORIUM (BREADTH)  
2ND FLOOR GALLERY

SOLAR CONDITIONS  
38.98 N , 94.67 W

WINTER ALTITUDE ANGLE  
26.8 DEGREES  
SUMMER ALTITUDE ANGLE  
72.34 DEGREES



# The Nerman Museum of Contemporary Art



## OUTLINE

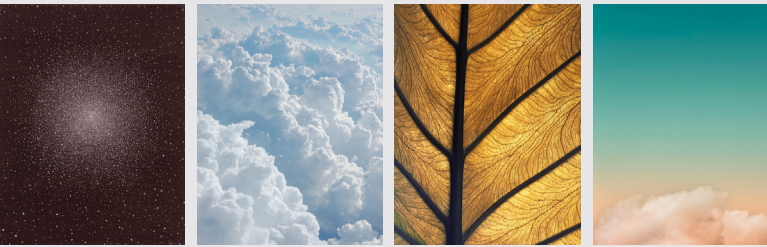
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
			OVERLAND PARK, KS   SOLAR CONDITIONS   AREAS OF STUDY										



## LIGHTING DESIGN

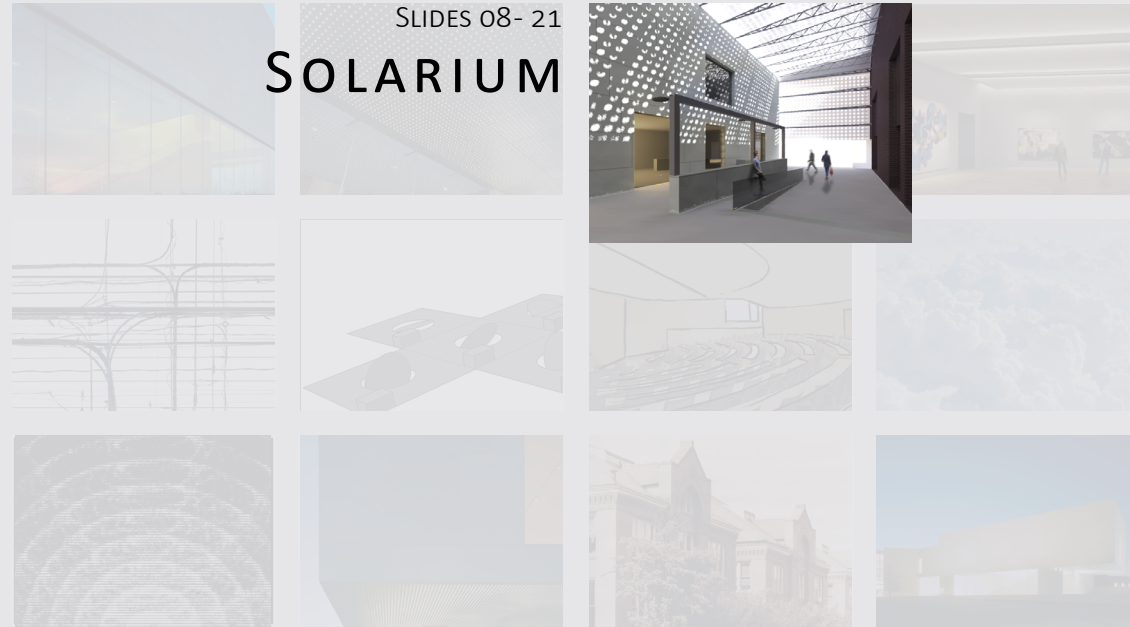
CONCEPT:

EXPERIENTIAL  
REFINED MINIMALISM  
CONNECTION TO NATURE





# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT LIGHTING DESIGN RENDERINGS									



## SOLARIUM

### DESIGN CRITERIA:

- SPACIOUSNESS
- GLARE CONTROL
- VISUAL INTEREST

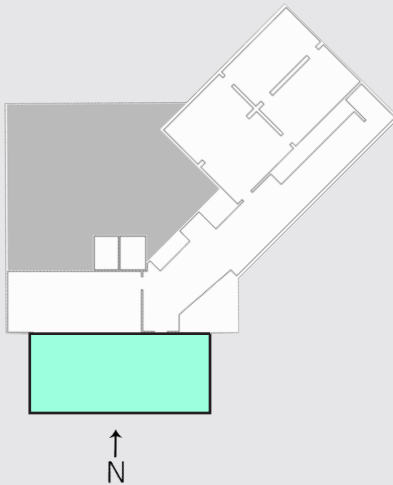
### ILLUMINANCE:

- CIRCULATION: 40 LUX
- SEATING AREA: 150 LUX

### LIGHTING POWER DENSITY

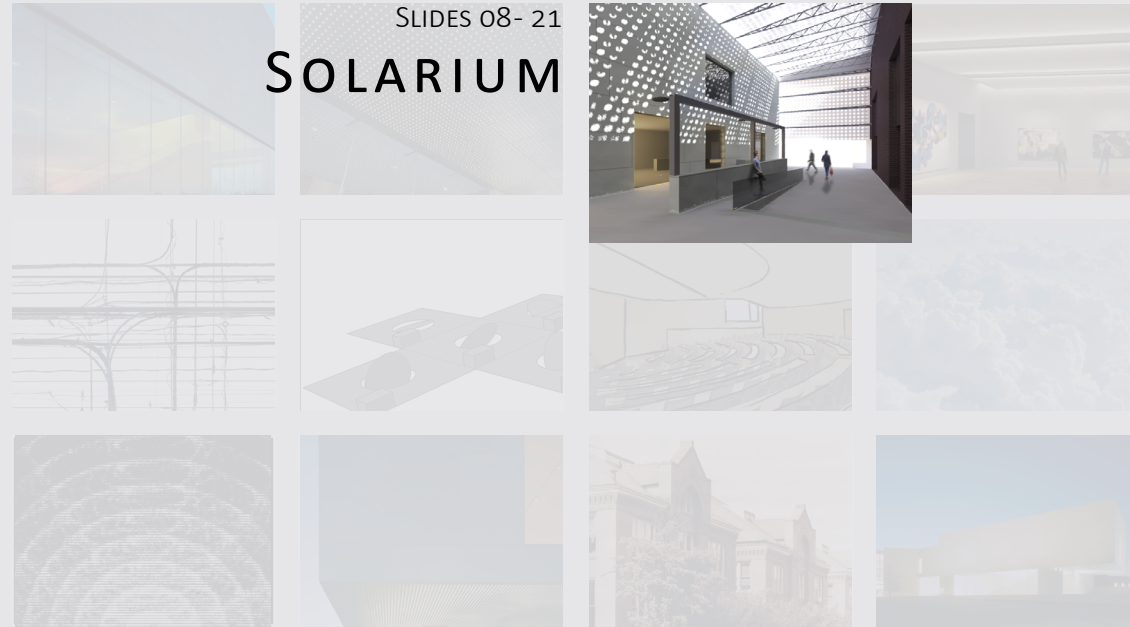
- 0.02 PER FOOT (HEIGHT)
- $0.02 \times 44' = 0.88 \text{ W/SF}$

## 1ST FLOOR



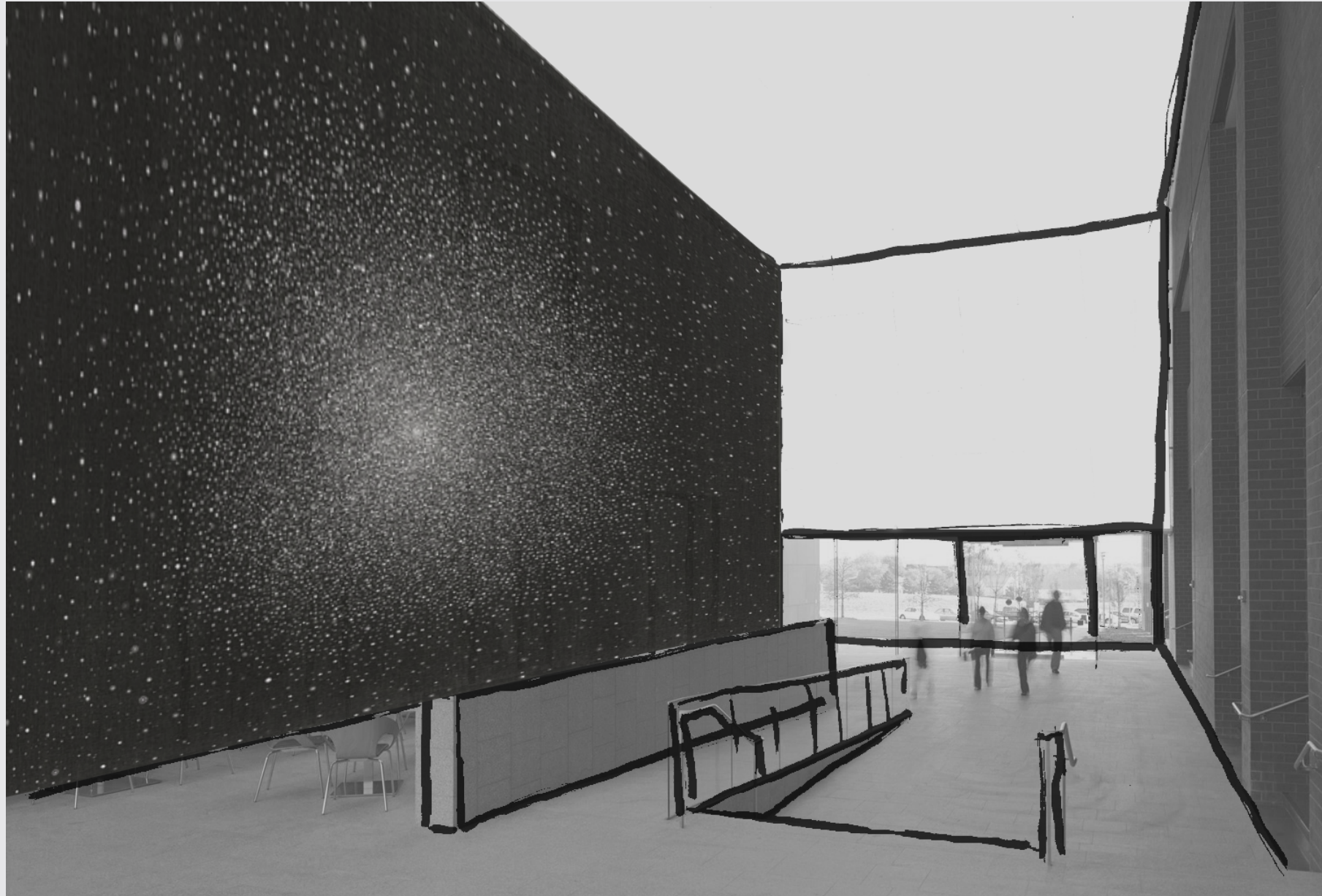


# The Nerman Museum of Contemporary Art



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COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
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## SOLARIUM

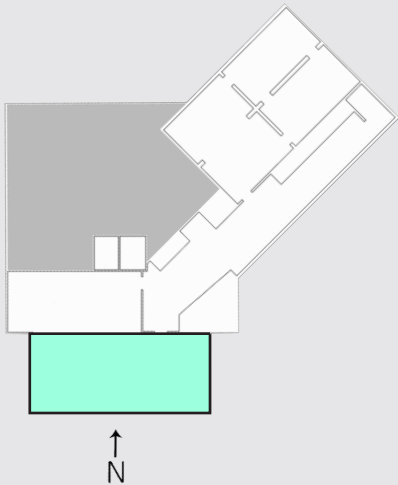
### DAYLIGHT

### STARY NIGHT SCENE

### CONNECTION TO SURROUNDINGS

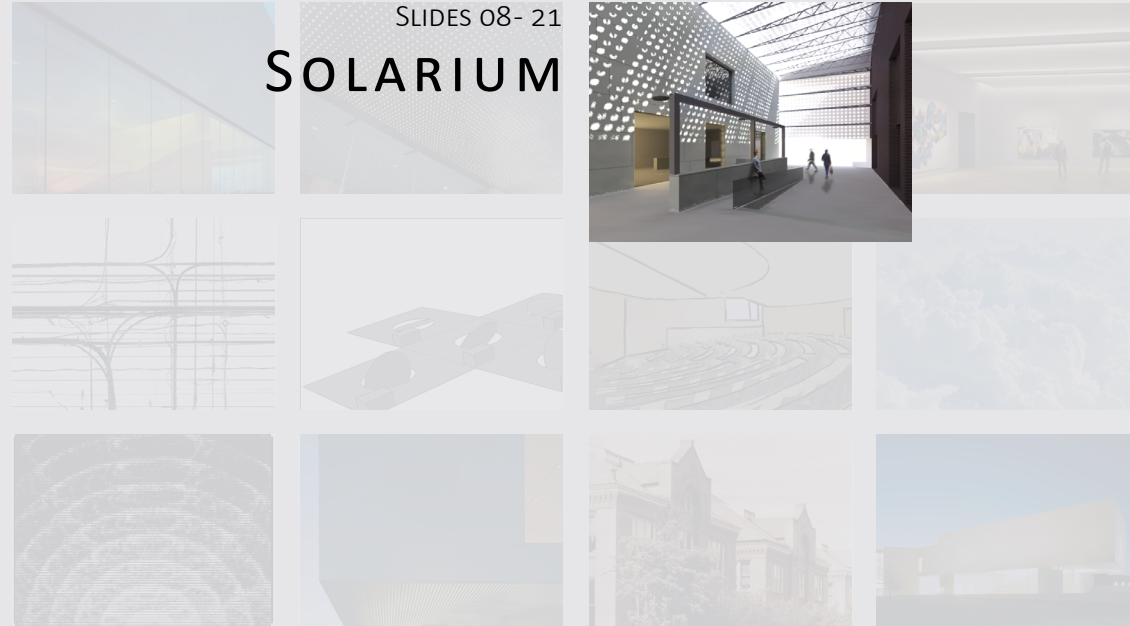


### 1ST FLOOR





# The Nerman Museum of Contemporary Art



OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									

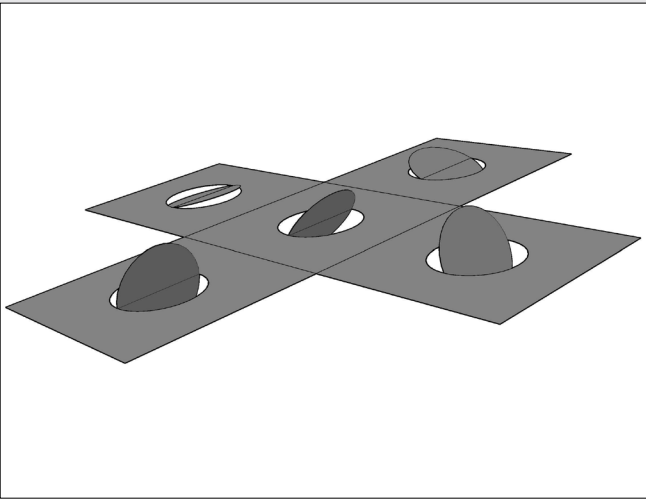


SOLARIUM

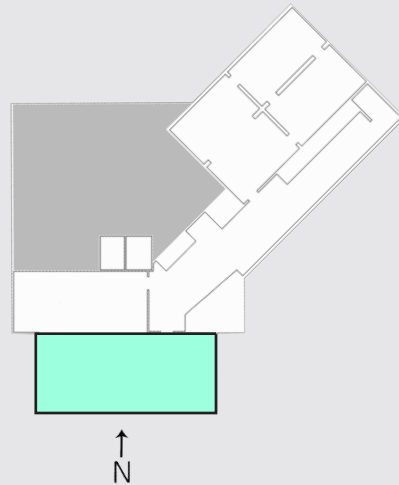
DAYTIME

SOLAR CONTROL DETAIL:

WIND POWERED

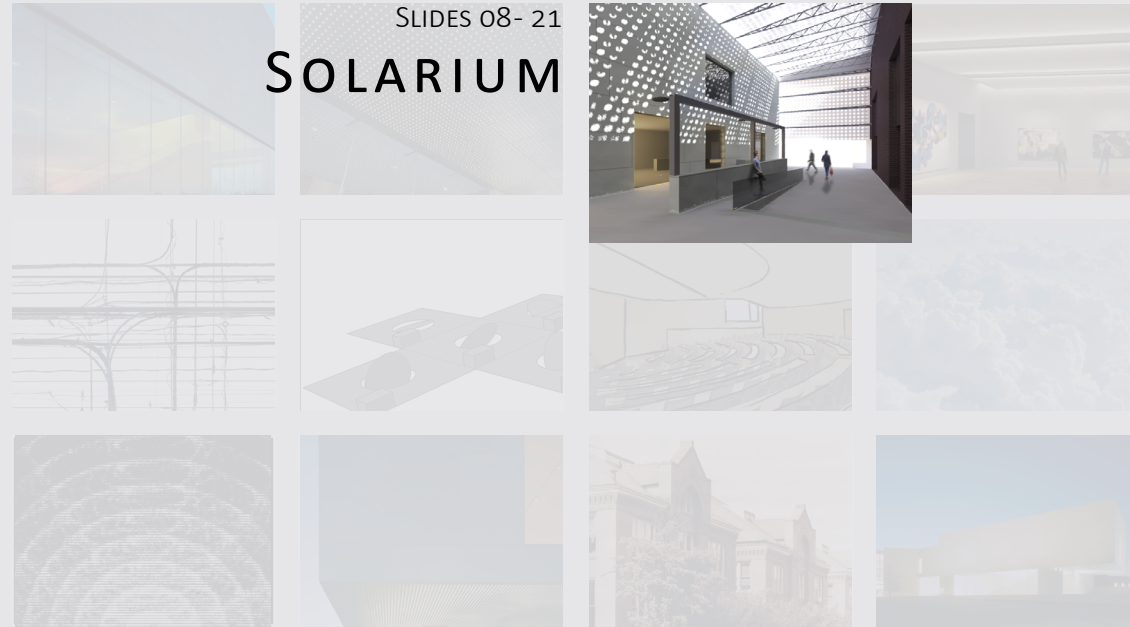


1ST FLOOR





# The Nerman Museum of Contemporary Art



## OUTLINE

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				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									



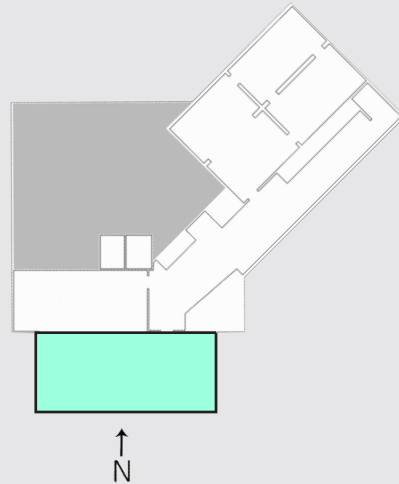
SOLARIUM

NIGHTTIME

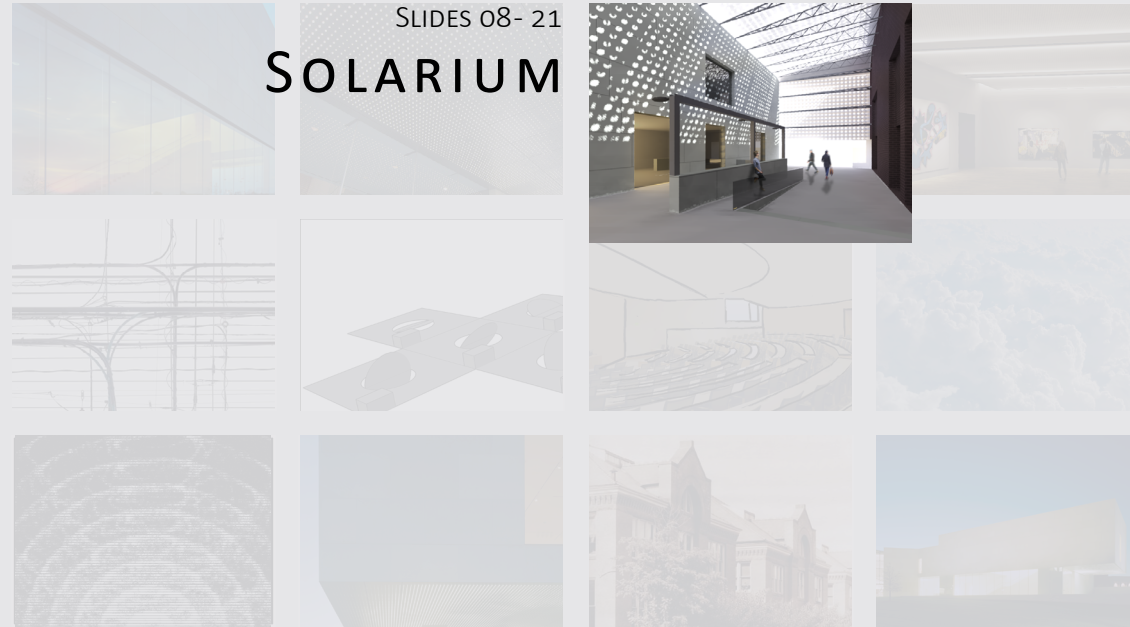
PEDESTRIAN POLE FIXTURES

UPLIGHTING

1ST FLOOR

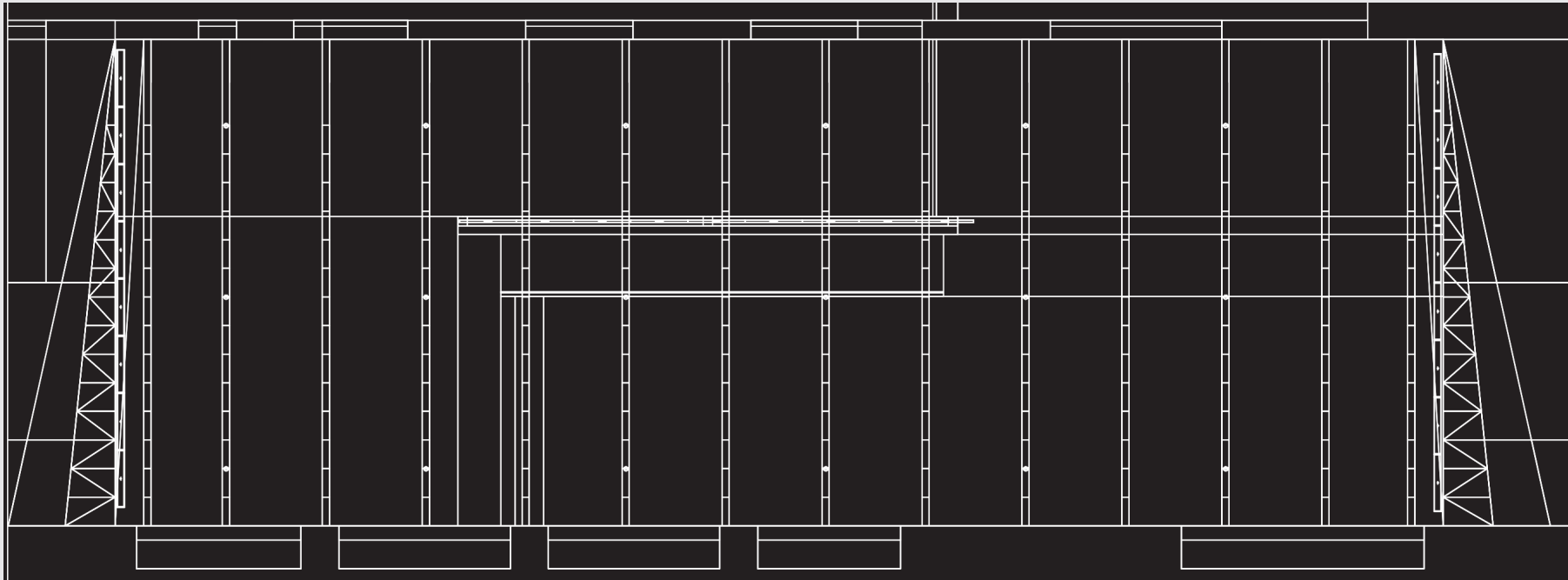


# The Nerman Museum of Contemporary Art

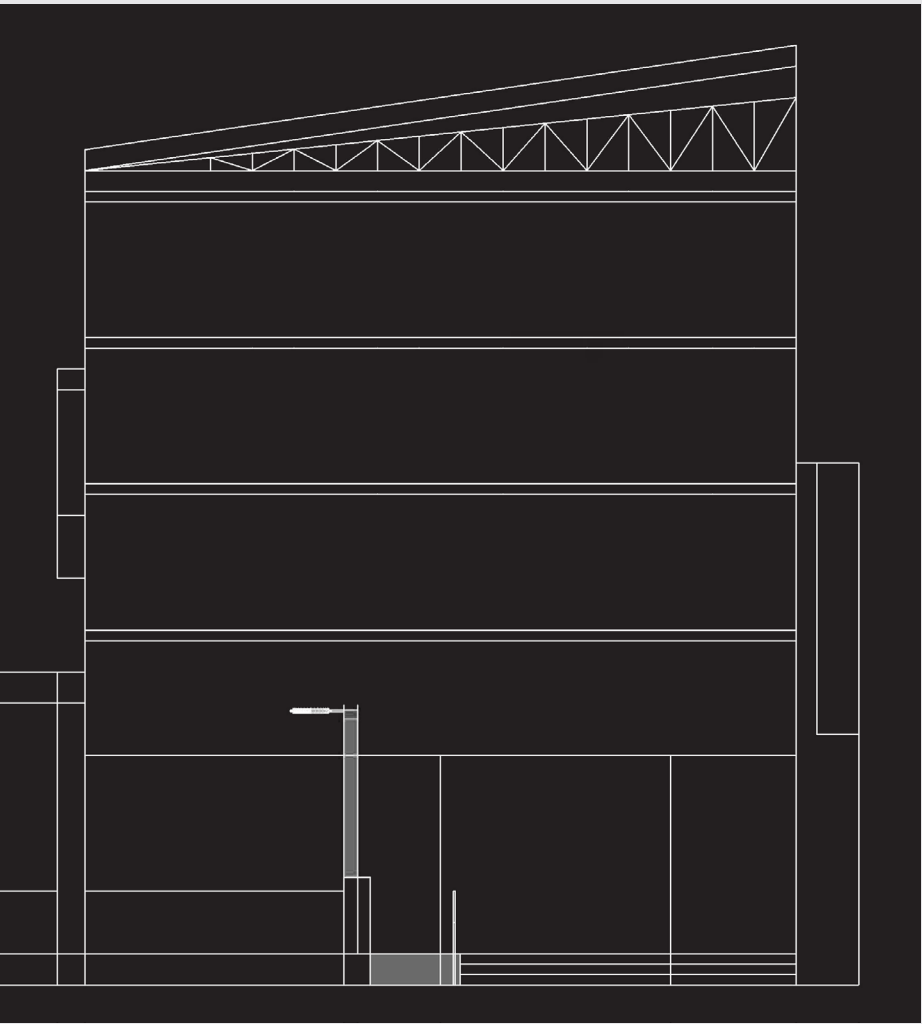


## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									

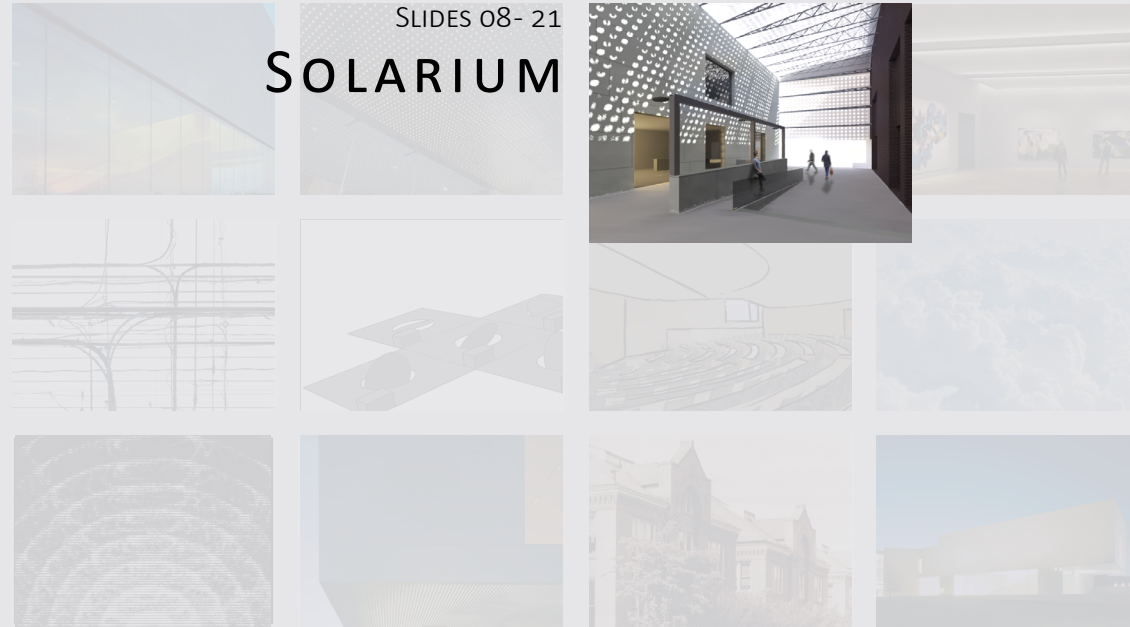


LIGHTING PLAN



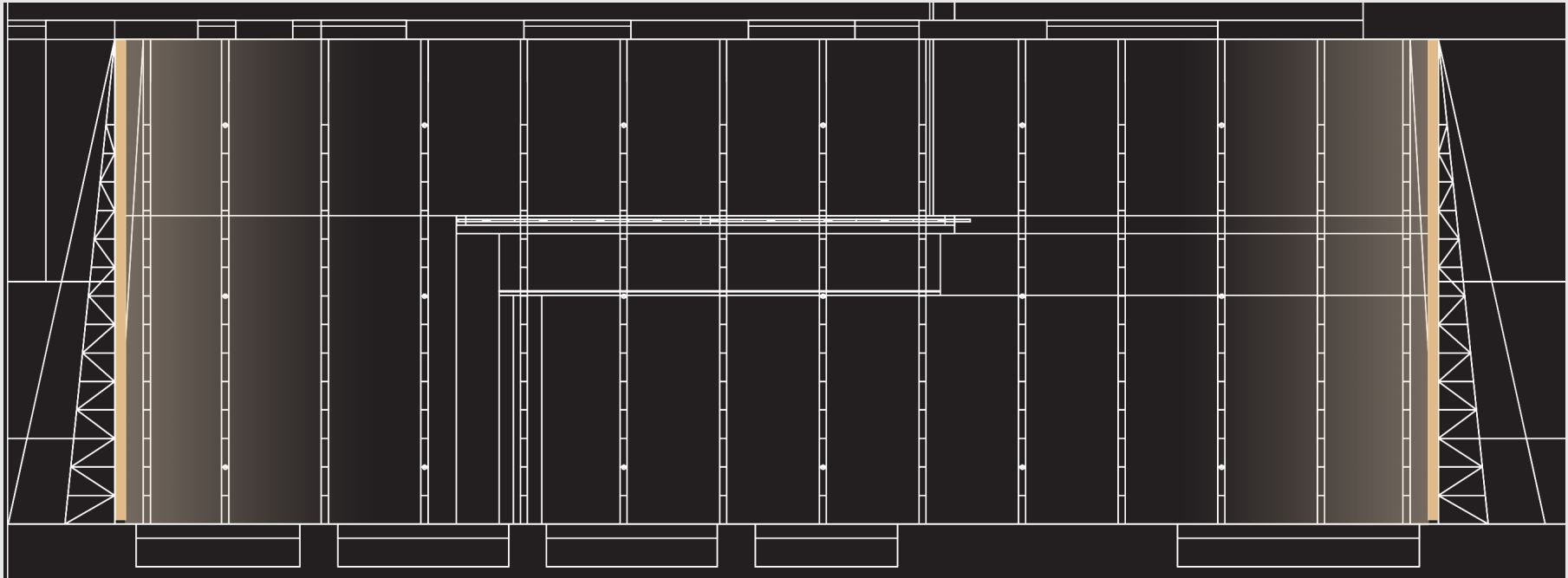
LIGHTING ELEVATION

# The Nerman Museum of Contemporary Art

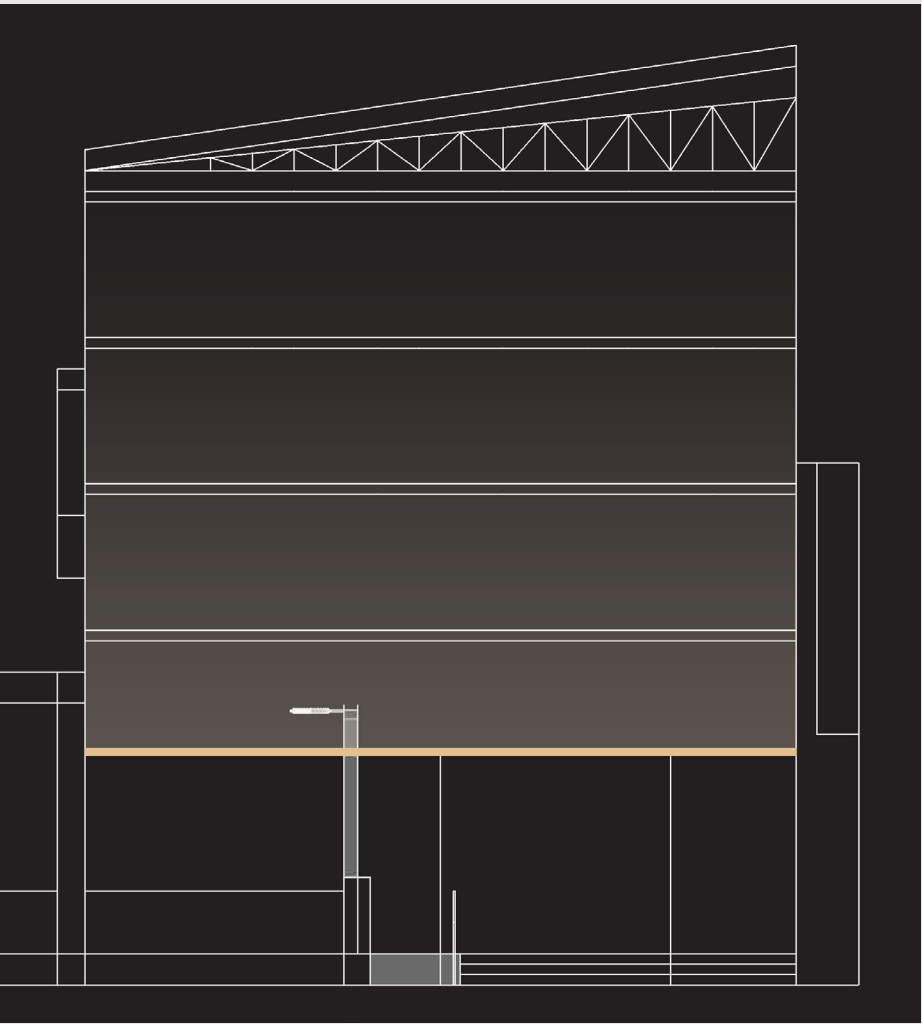


## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
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LIGHTING PLAN

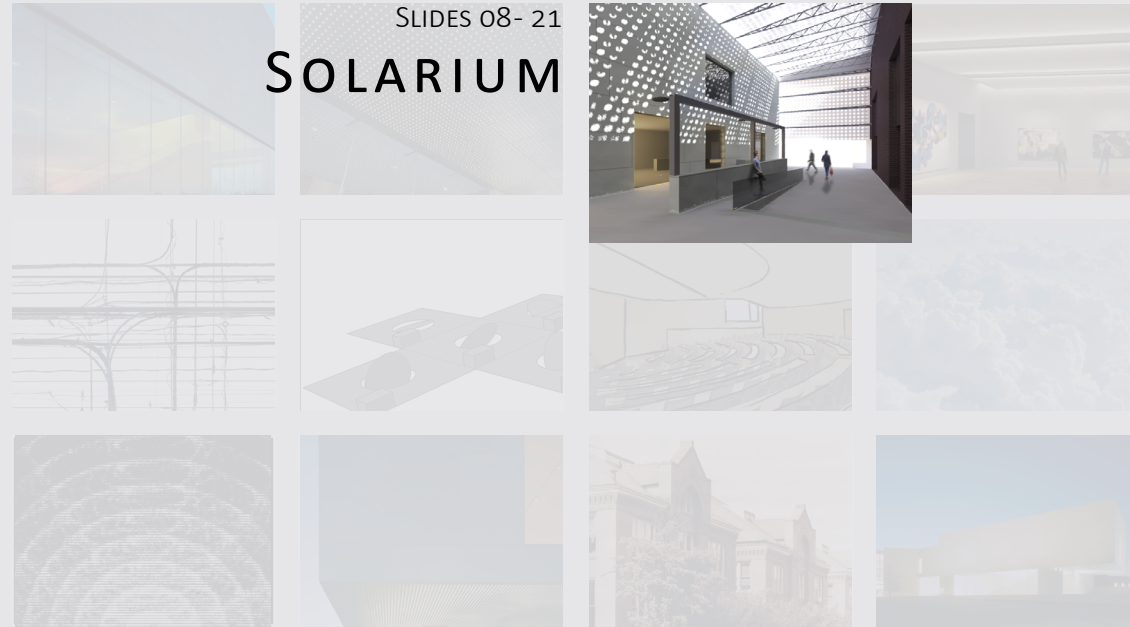


LIGHTING ELEVATION



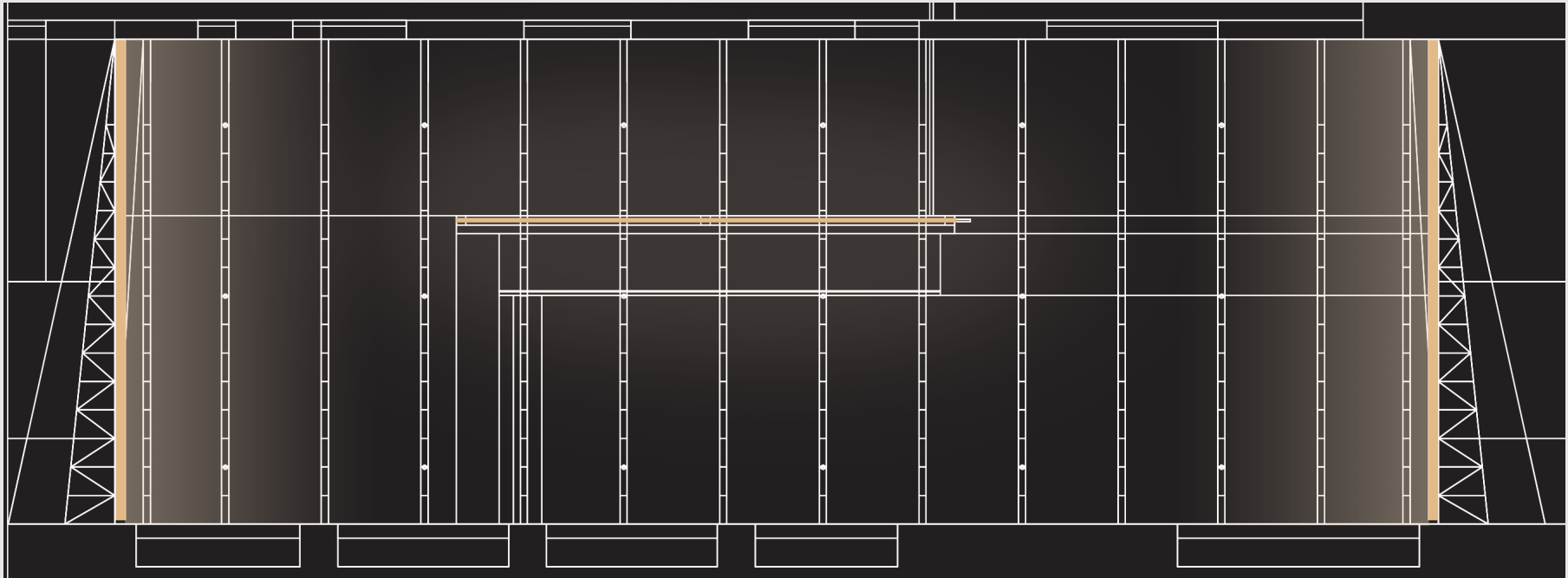


# The Nerman Museum of Contemporary Art

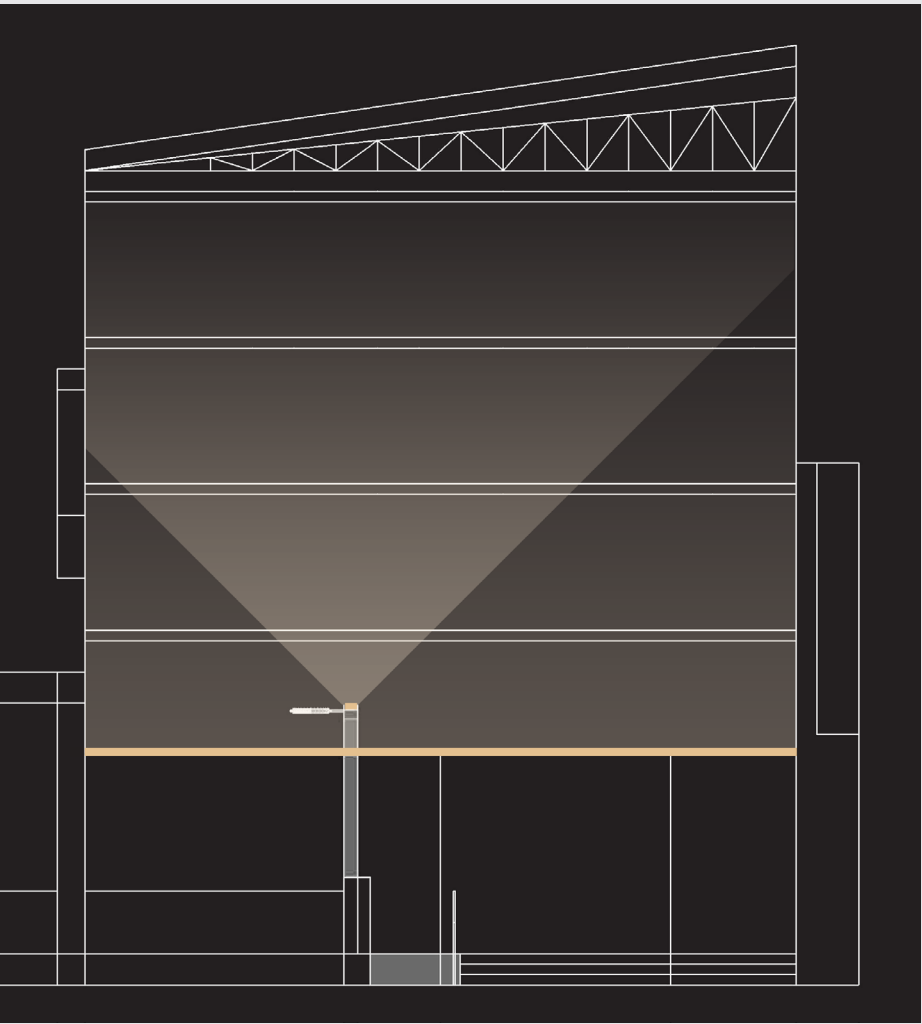


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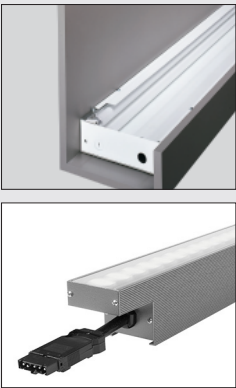
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
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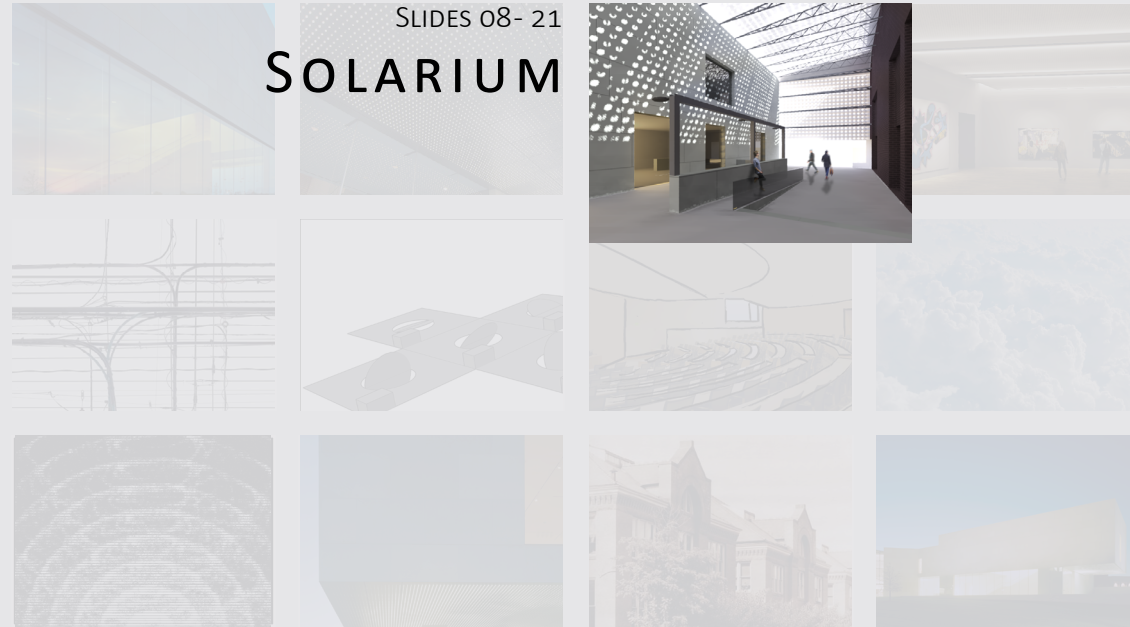
LIGHTING PLAN



LIGHTING ELEVATION

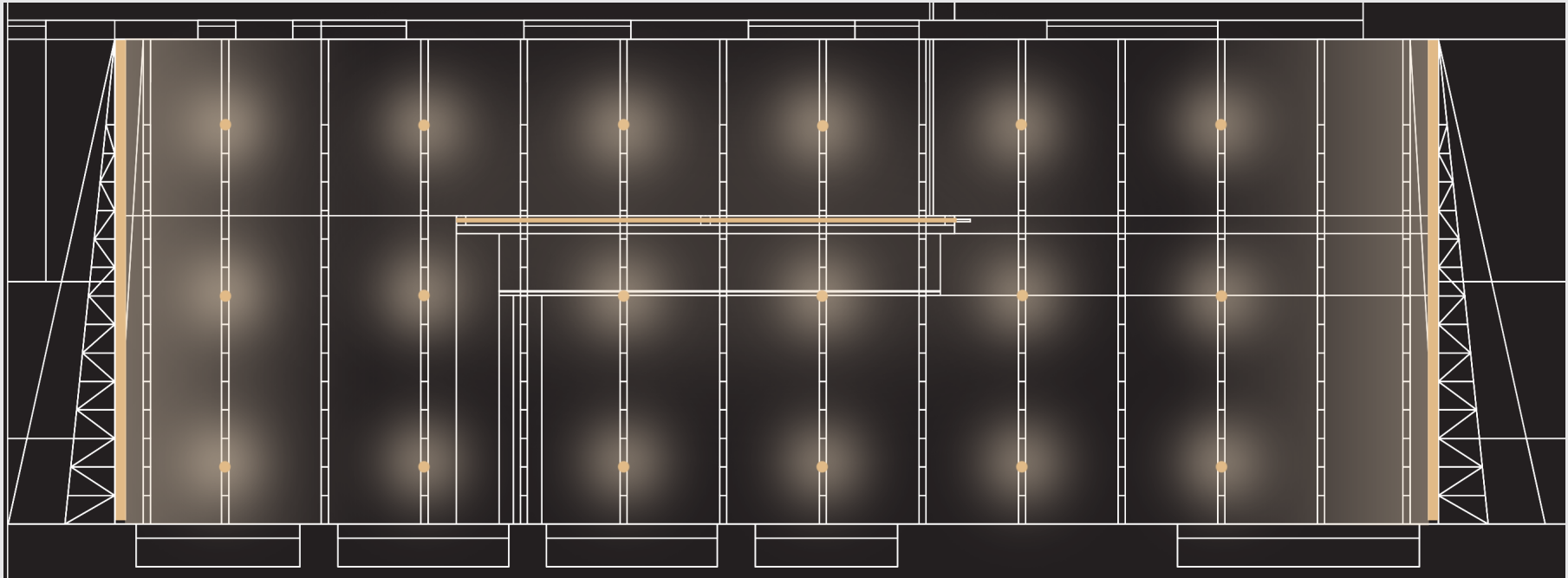


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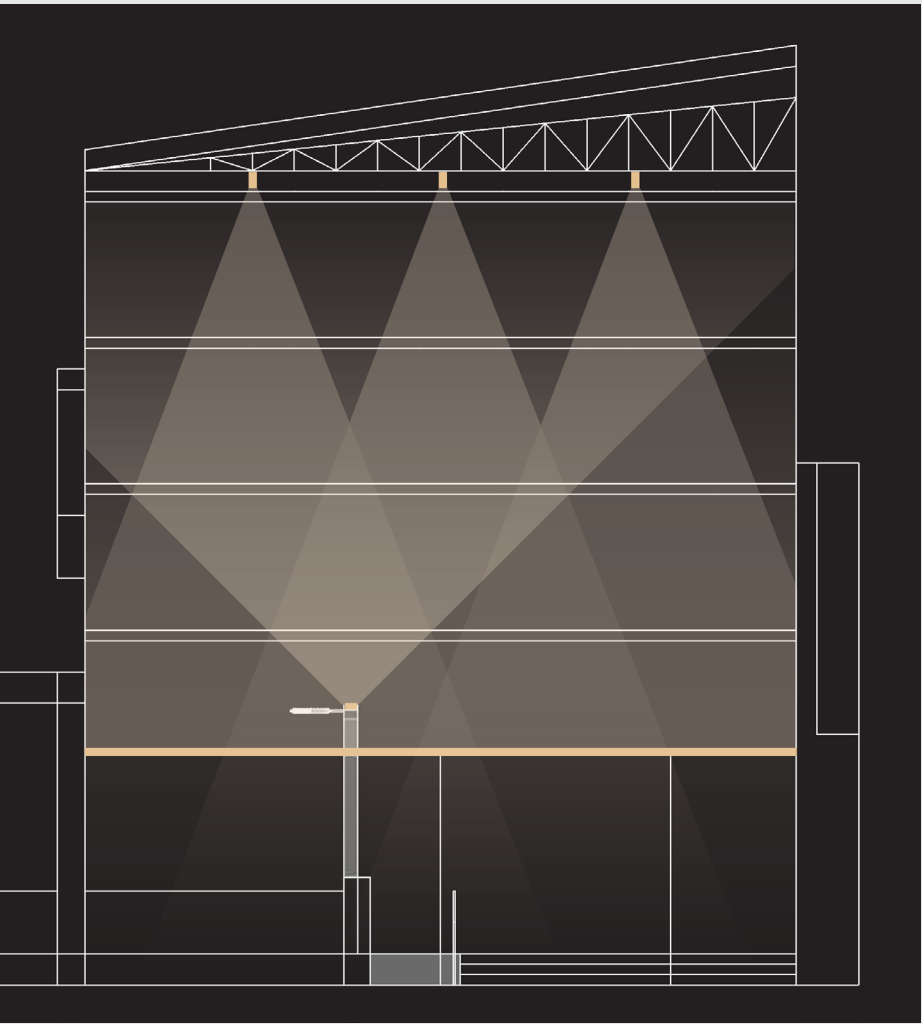


## OUTLINE

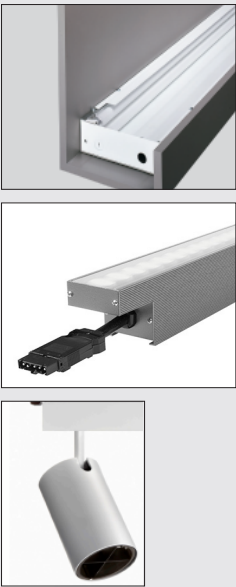
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									



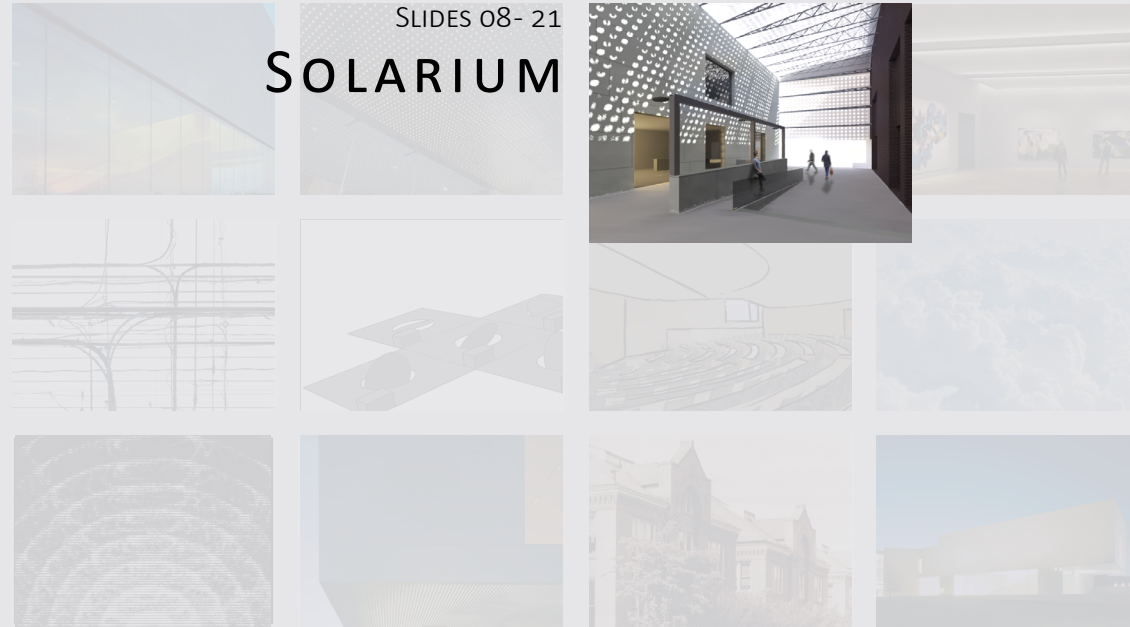
LIGHTING PLAN



LIGHTING ELEVATION

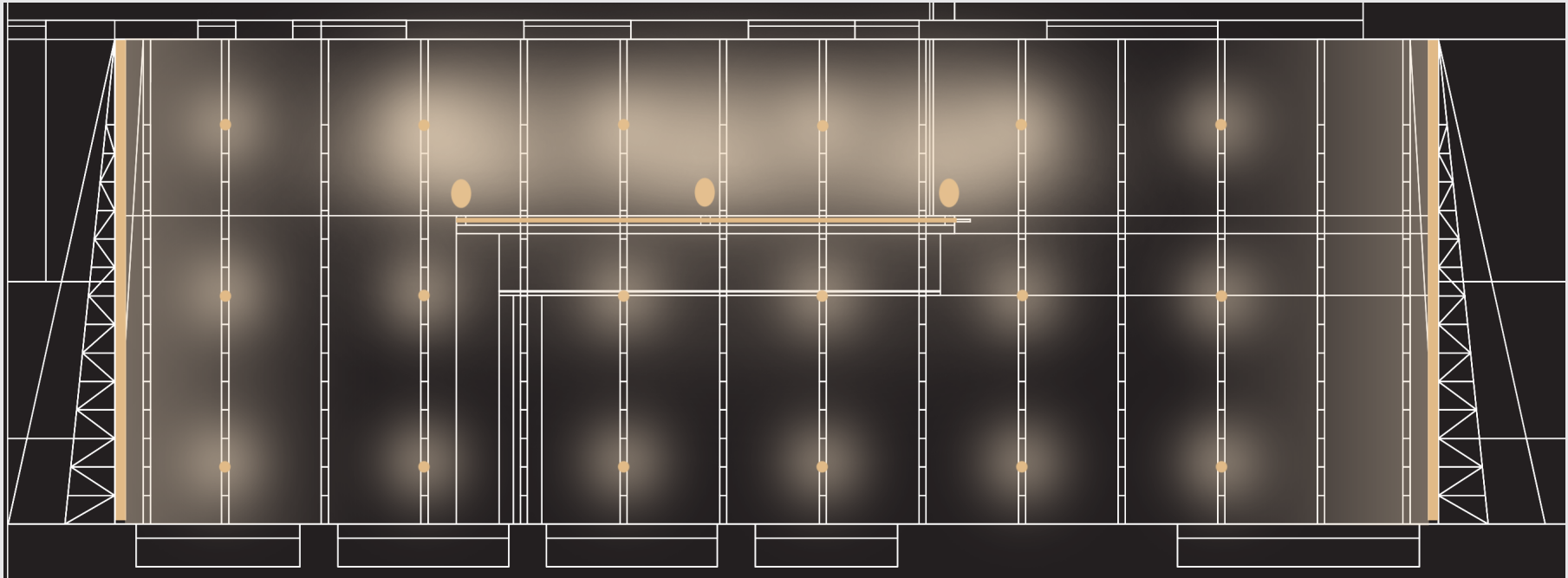


# The Nerman Museum of Contemporary Art

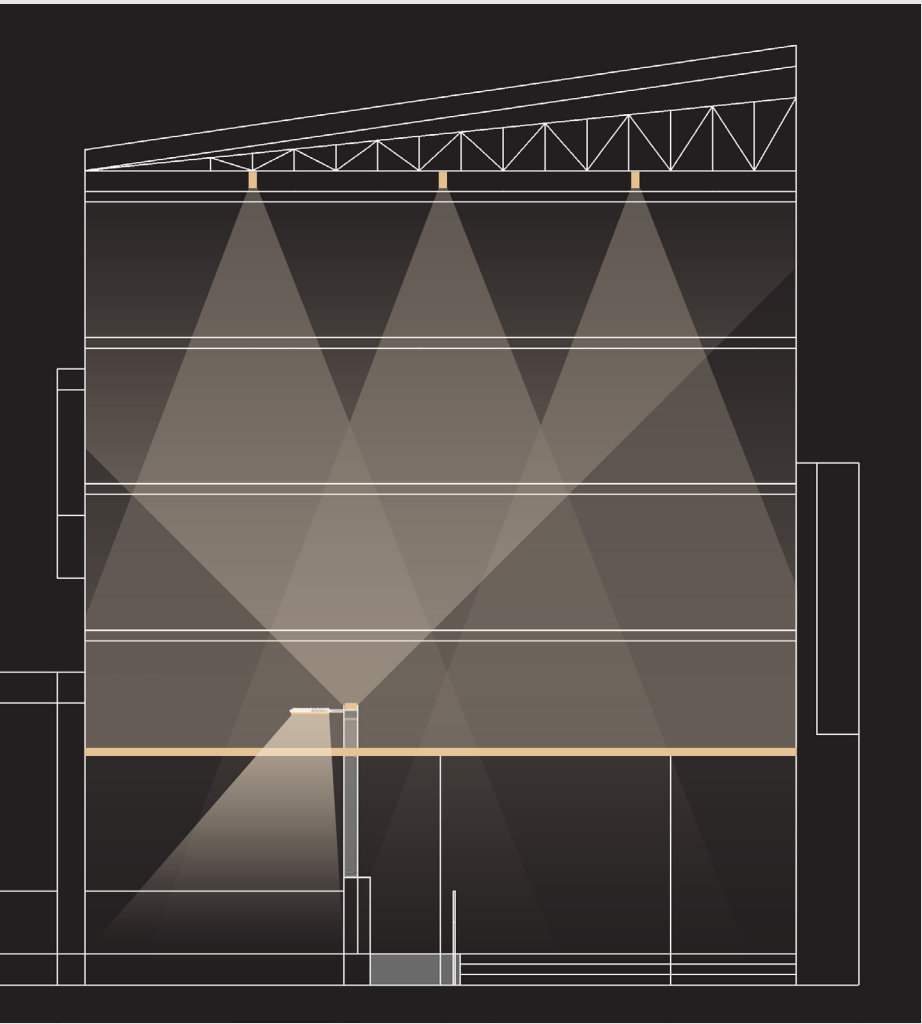


## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									



LIGHTING PLAN

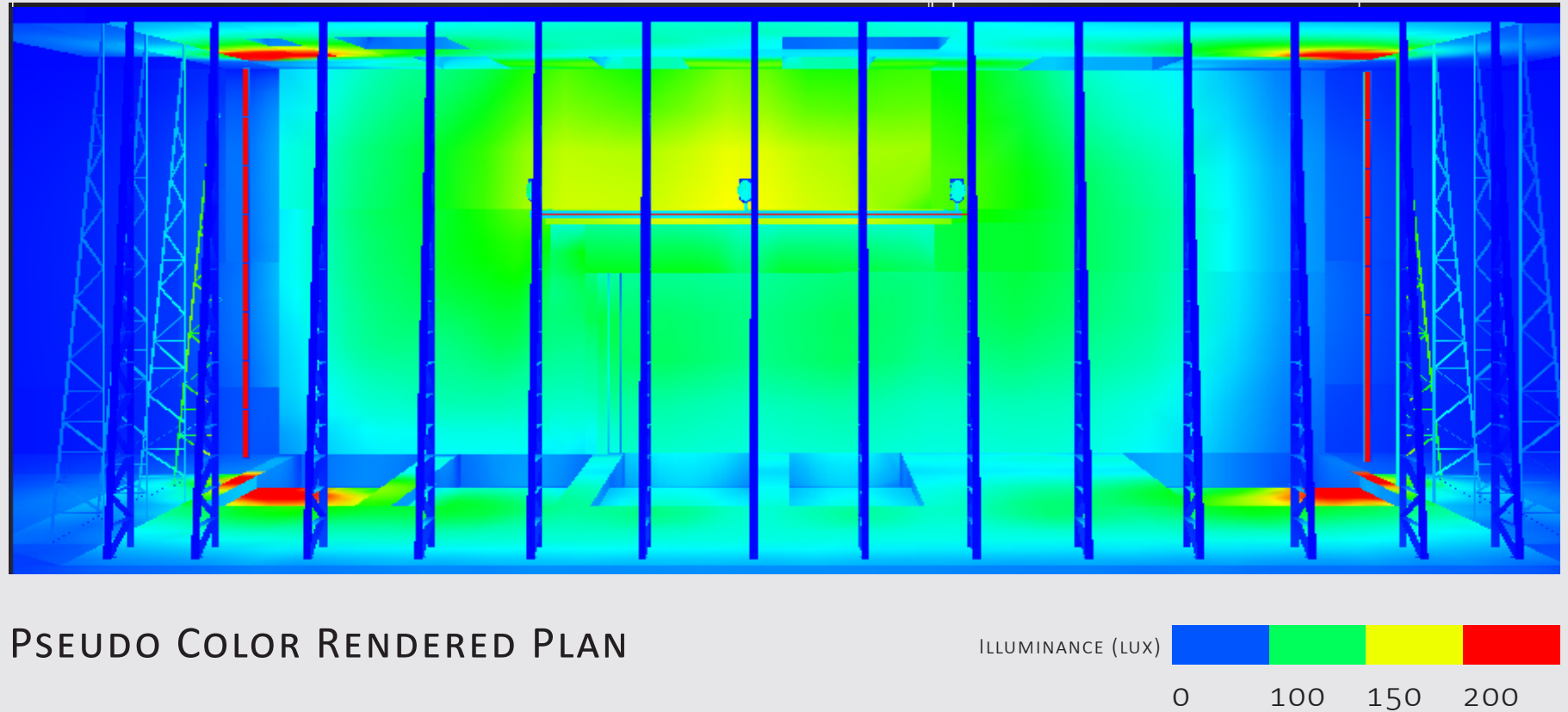
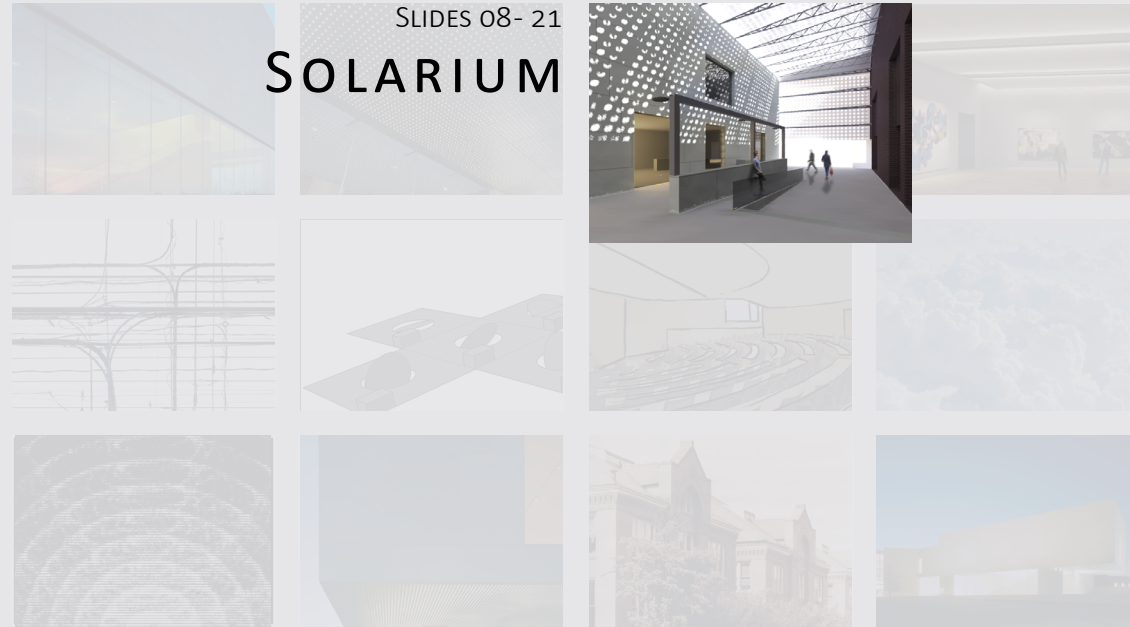


LIGHTING ELEVATION





# The Nerman Museum of Contemporary Art



## ILLUMINANCE

IES RECOMMENDATIONS:

CIRCULATION: 40 LUX

SEATING AREA: 150 LUX

CALCULATED ILLUMINANCE:

CIRCULATION: 68.5 LUX

SEATING AREA: 135 LUX

## OUTLINE

COVER

INTRODUCTION

SCOPE

LIGHTING

SOLARIUM

LIGHTING CONCEPT  
LIGHTING DESIGN  
RENDERINGS

GALLERY

ELECTRICAL

WIND POWER

BREADTH

AUDITORIUM

ACOUSTICS

CONCLUSION

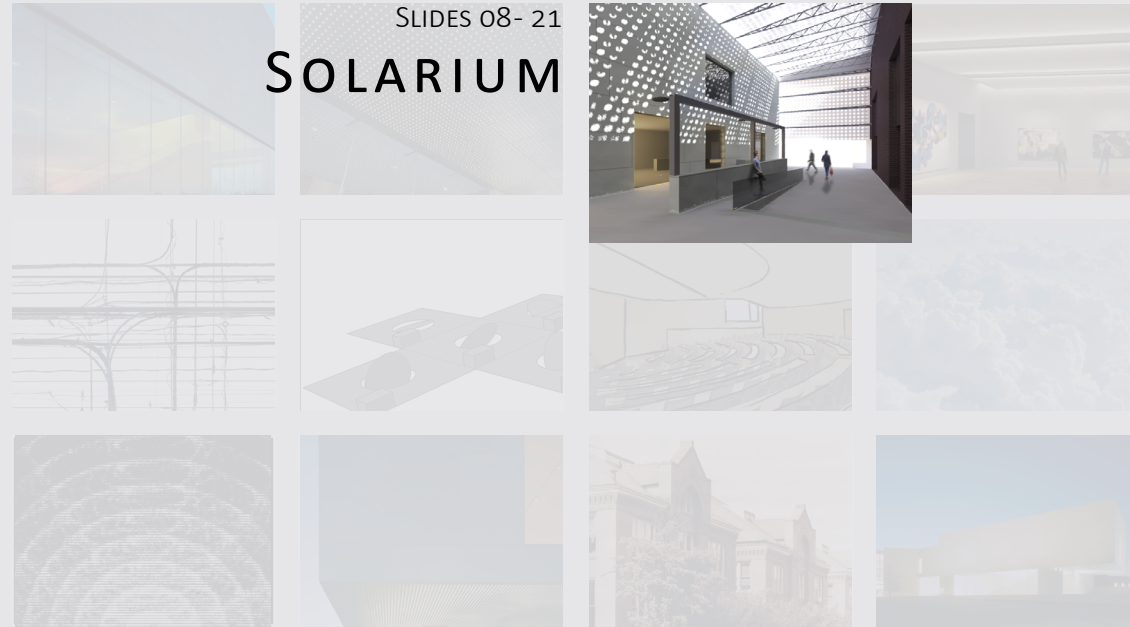
CREDITS

SUPPORT





# The Nerman Museum of Contemporary Art



SLIDES 08- 21  
**SOLARIUM**

## OUTLINE

COVER

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LIGHTING

SOLARIUM

| LIGHTING CONCEPT  
| LIGHTING DESIGN  
| RENDERINGS

GALLERY

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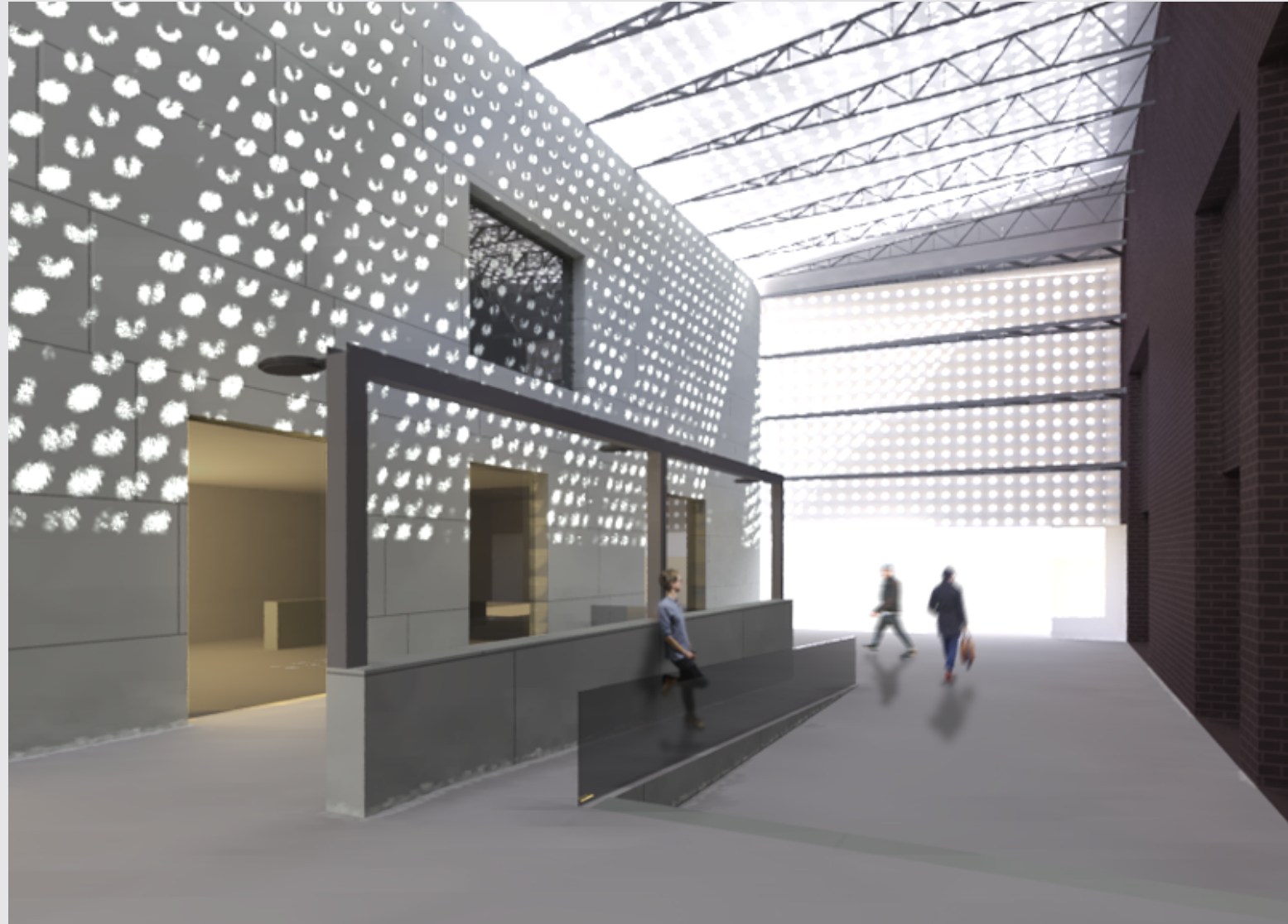
AUDITORIUM

ACOUSTICS

CONCLUSION

CREDITS

SUPPORT

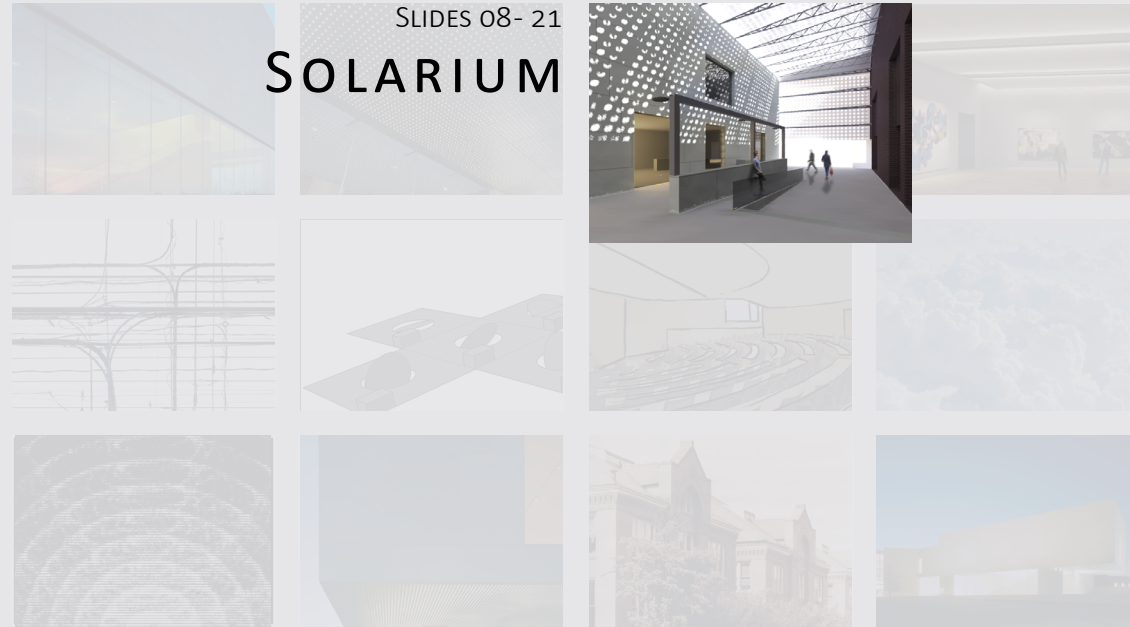


SOLARIUM DAYTIME RENDERING





# The Nerman Museum of Contemporary Art

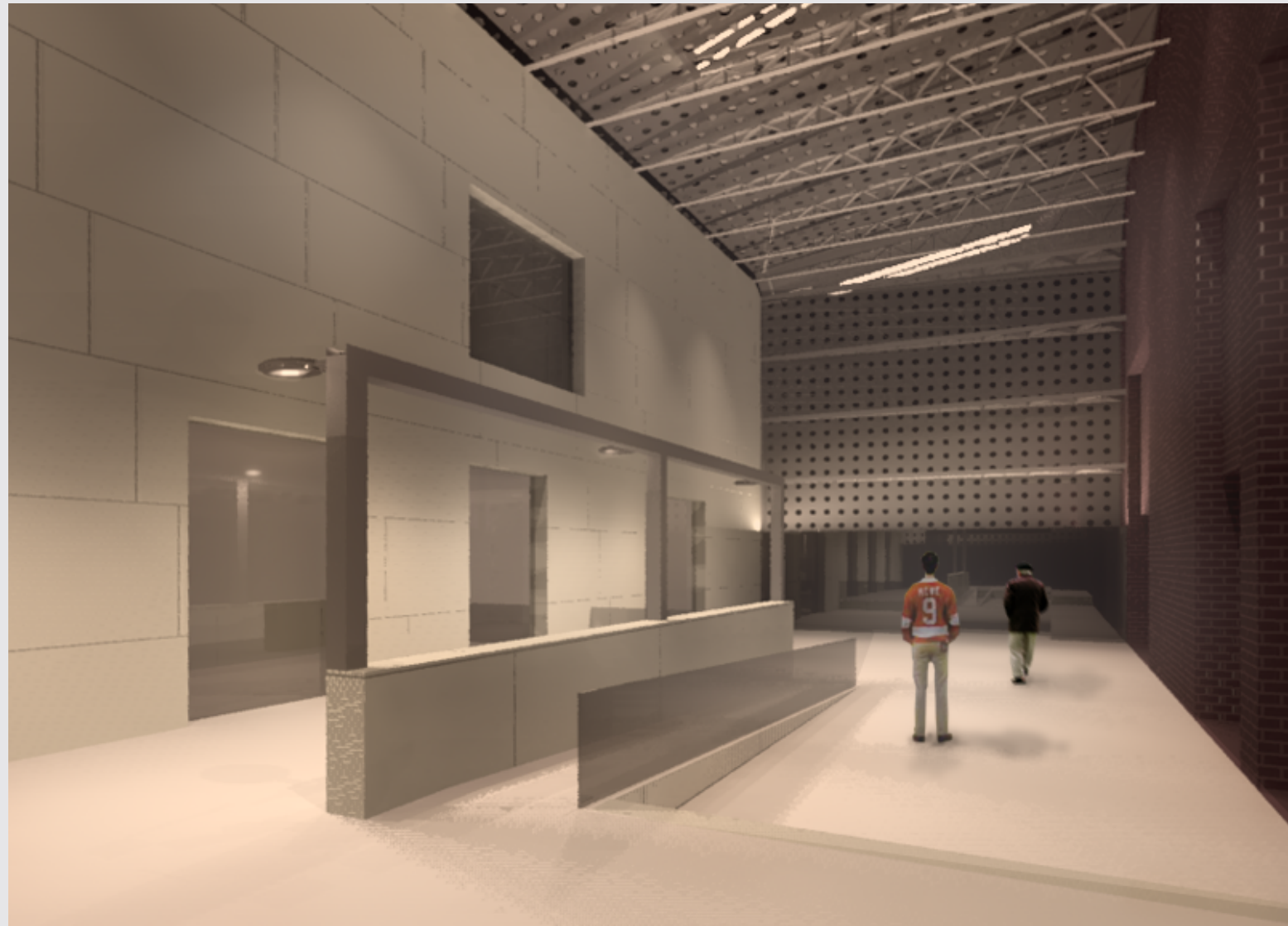


SLIDES 08- 21  
**SOLARIUM**

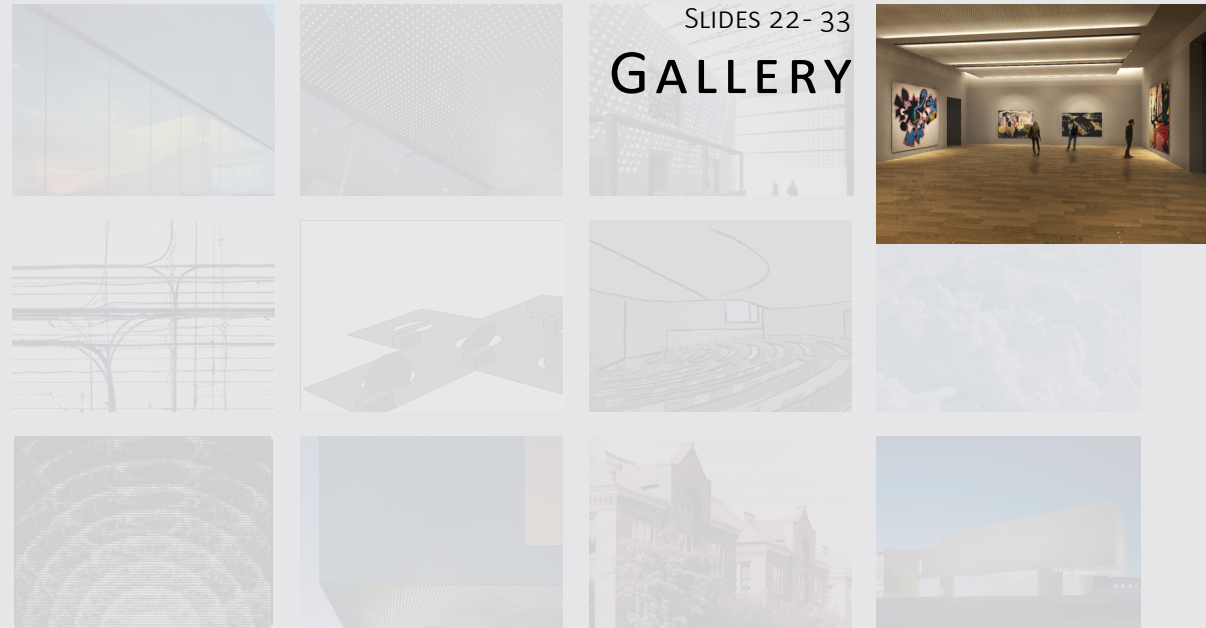
## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
				LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS									

## SOLARIUM NIGHTTIME RENDERING



# The Nerman Museum of Contemporary Art



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					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								



## GALLERY

### DESIGN CRITERIA:

- CONTRAST
- FLEXABILITY
- ARCHITECTURAL FORM

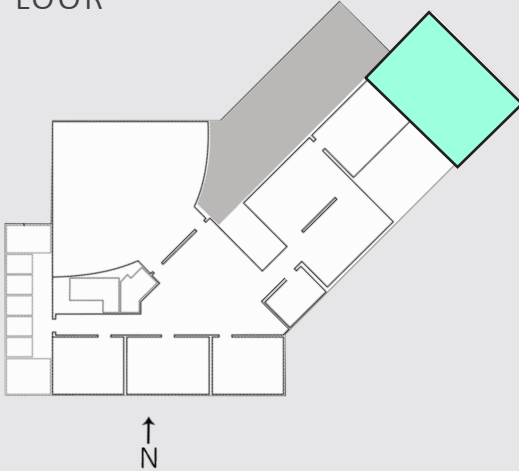
### ILLUMINANCE:

ARTWORK: 200 LUX (VERTICAL)  
FLOOR AREA: 40 LUX (HORIZONTAL)

### LIGHTING POWER DENSITY

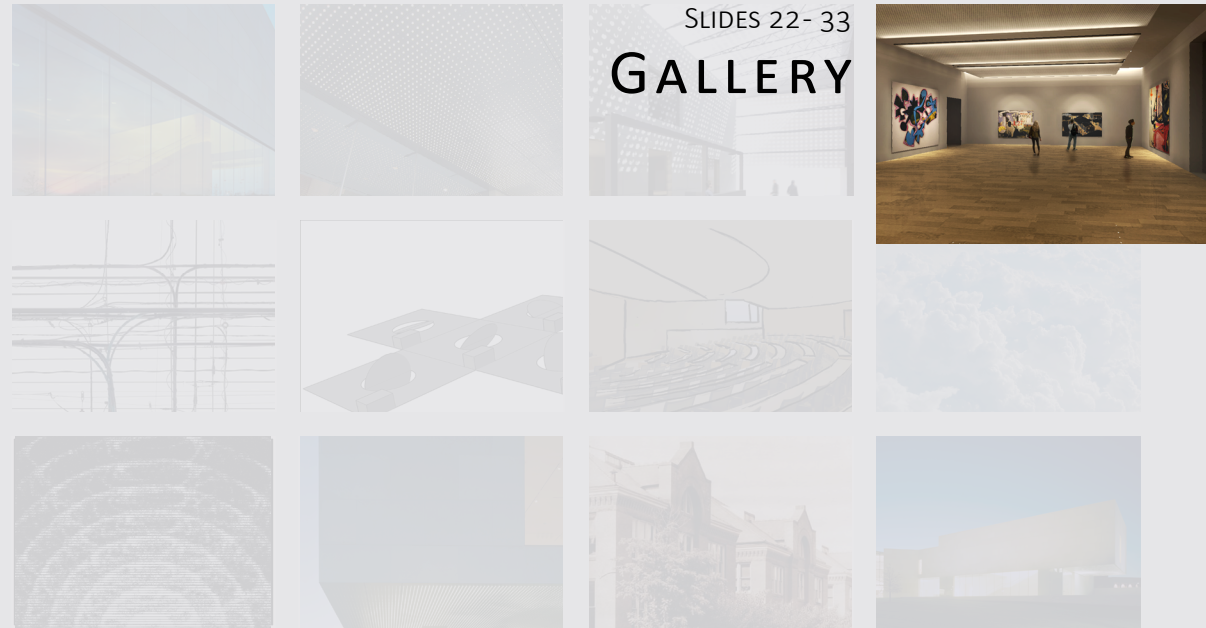
GALLERY - 1.05 W/SF  
ART LIGHTING +1.00 W/SF  
TOTAL = 2.05 W/SF

## 2ND FLOOR





# The Nerman Museum of Contemporary Art



## OUTLINE

COVER

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SOLARIUM

GALLERY

| LIGHTING CONCEPT  
| LIGHTING DESIGN  
| RENDERINGS

ELECTRICAL

WIND POWER

BREADTH

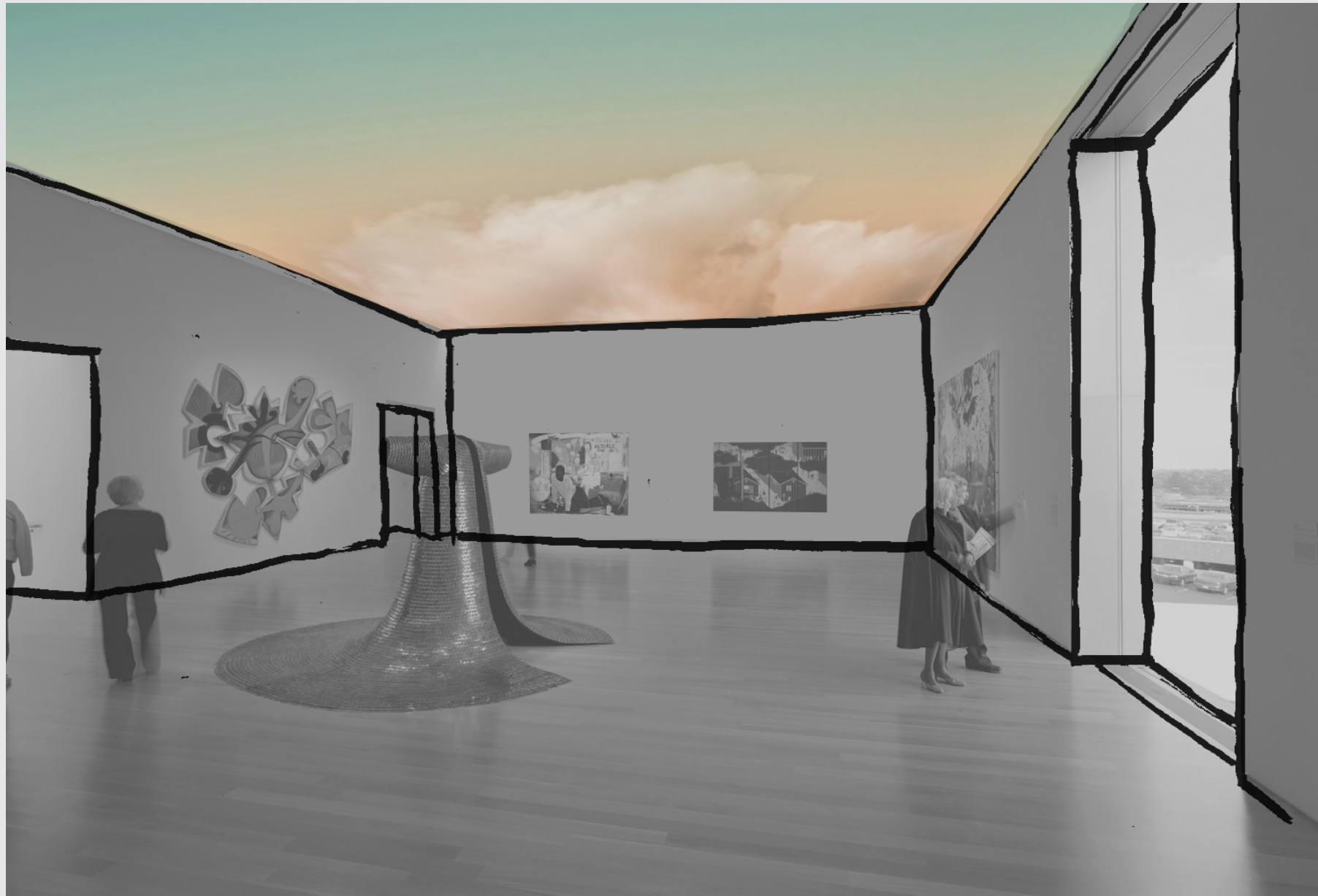
AUDITORIUM

ACOUSTICS

CONCLUSION

CREDITS

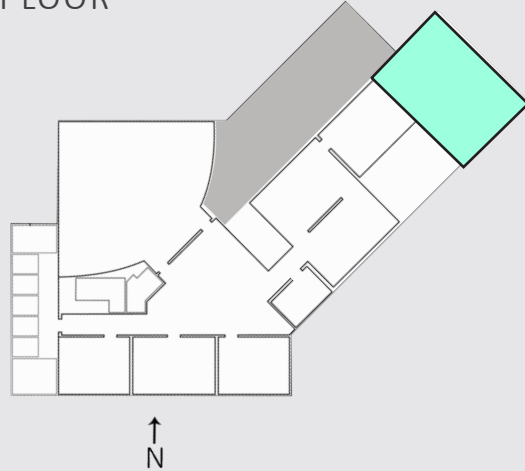
SUPPORT



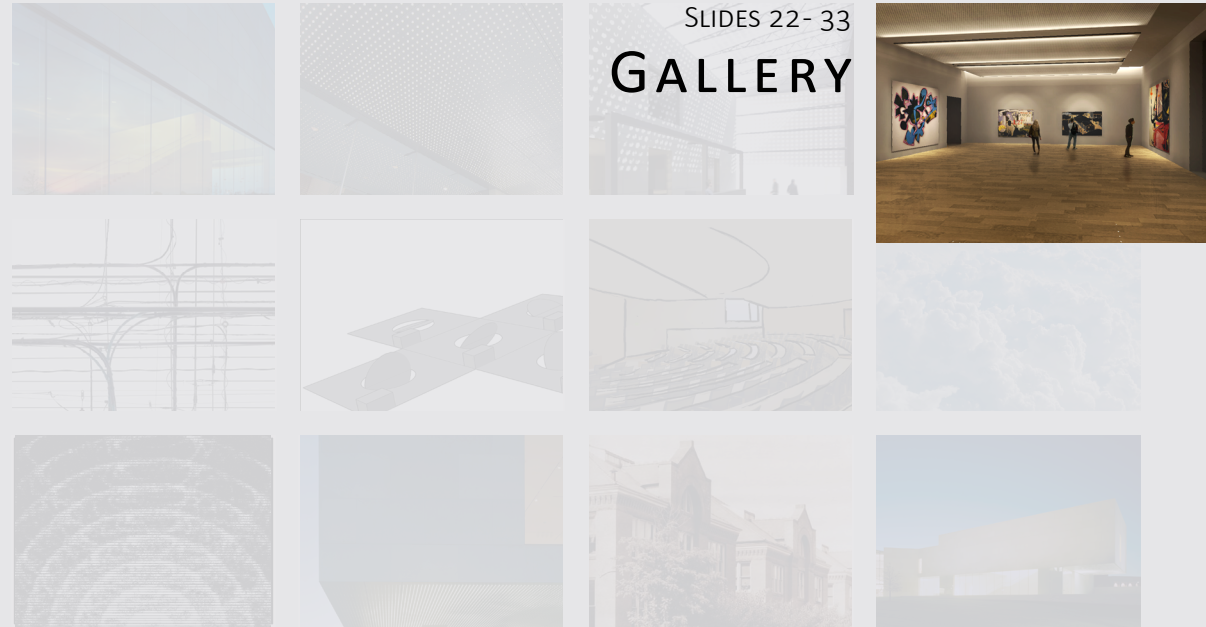
GALLERY

SKY GRADIENT

2ND FLOOR



# The Nerman Museum of Contemporary Art



## OUTLINE

### GALLERY

| LIGHTING CONCEPT  
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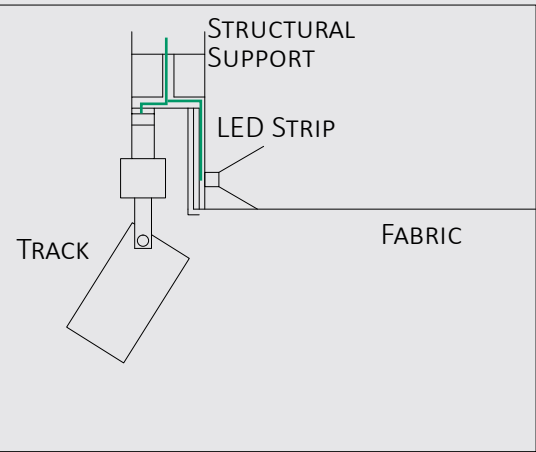
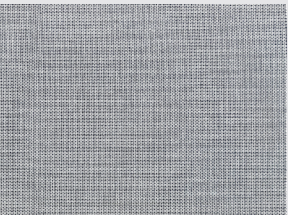


## GALLERY

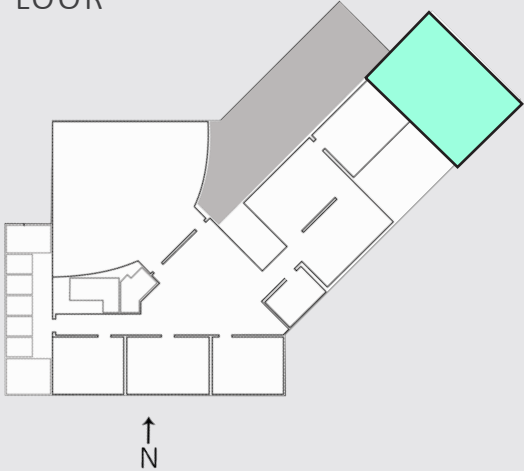
NIGHTTIME

FABRIC PANELS

TRACK SYSTEM INTEGRATION

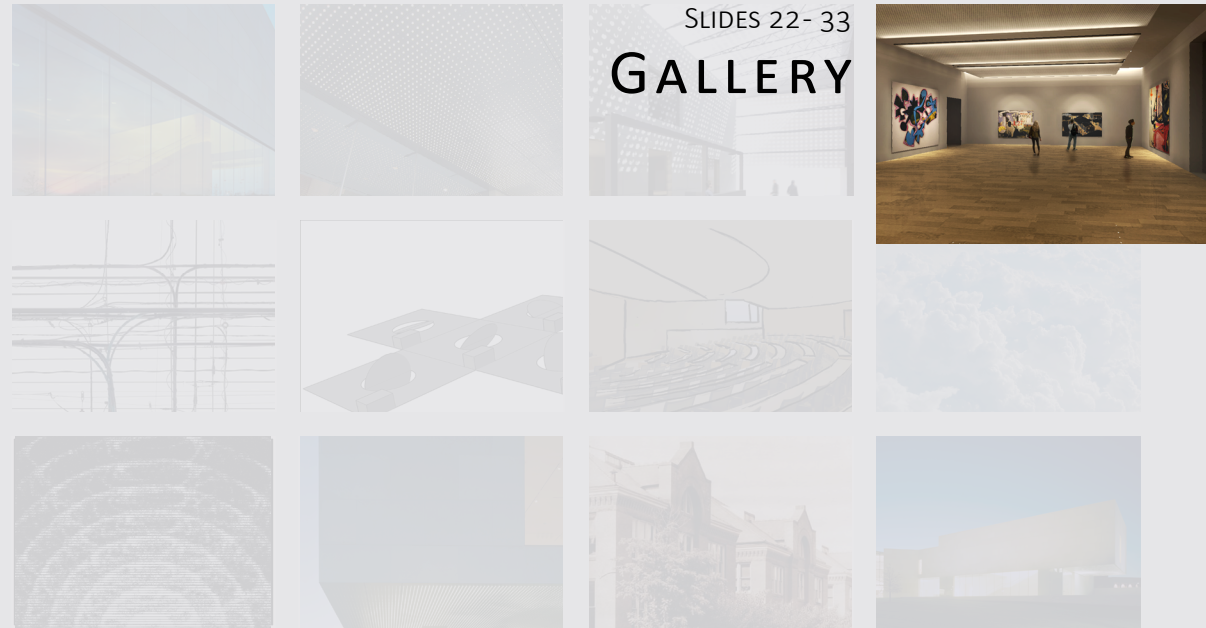


2ND FLOOR





# The Nerman Museum of Contemporary Art



## OUTLINE

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| LIGHTING CONCEPT  
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BREADTH

AUDITORIUM

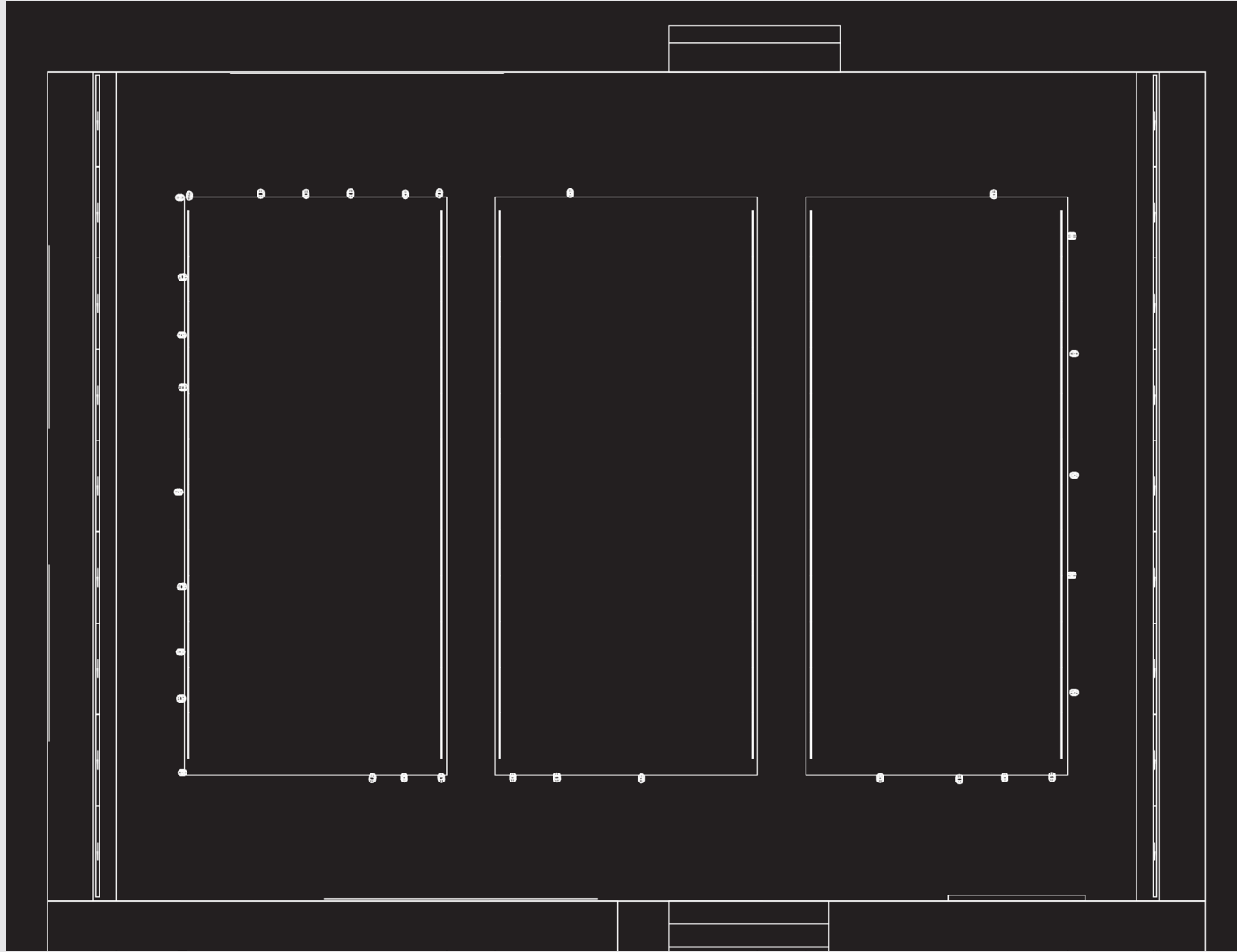
ACOUSTICS

CONCLUSION

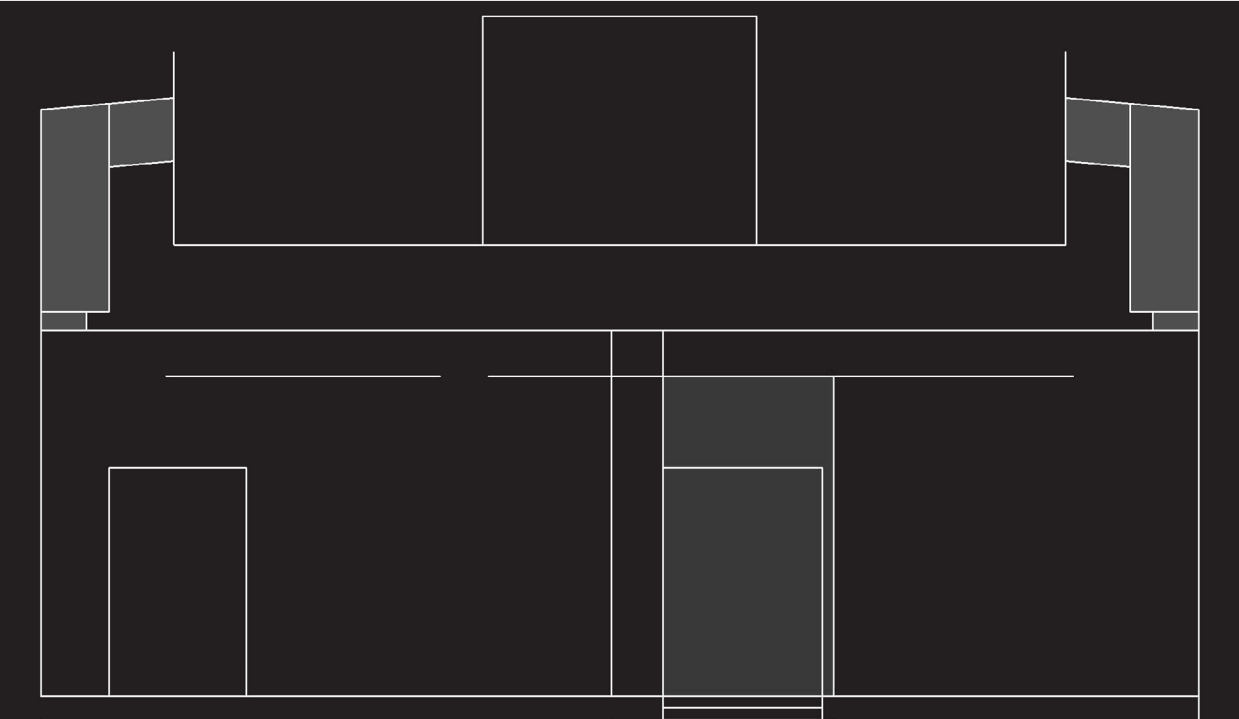
CREDITS

SUPPORT

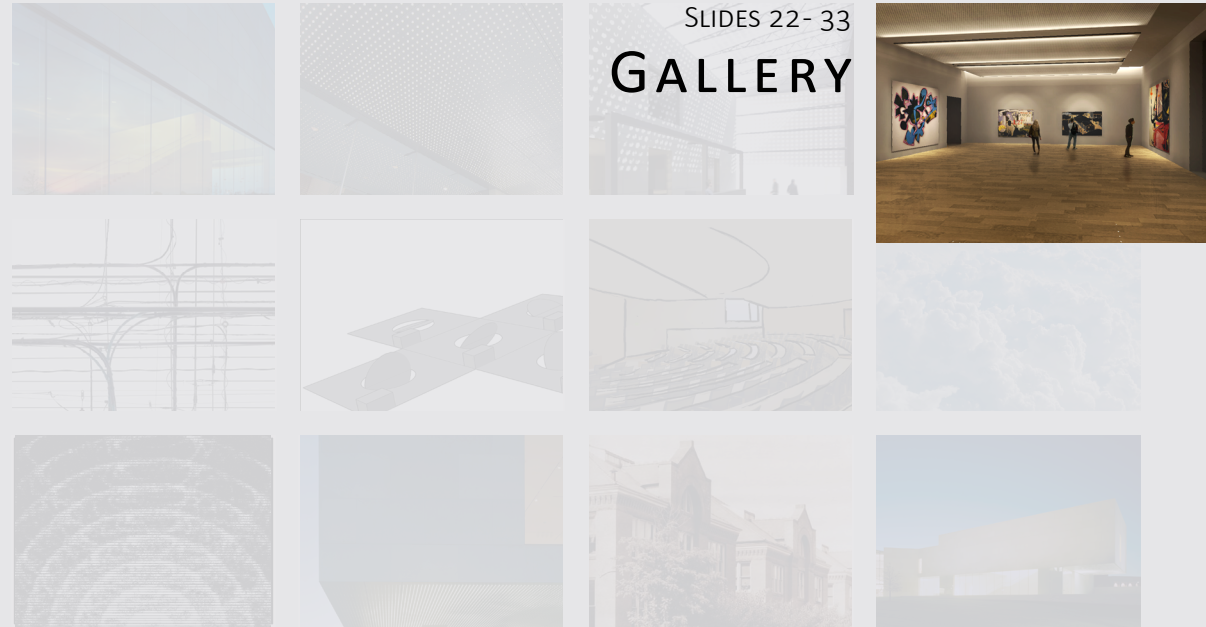
## LIGHTING PLAN



## LIGHTING ELEVATION



# The Nerman Museum of Contemporary Art



## OUTLINE

COVER

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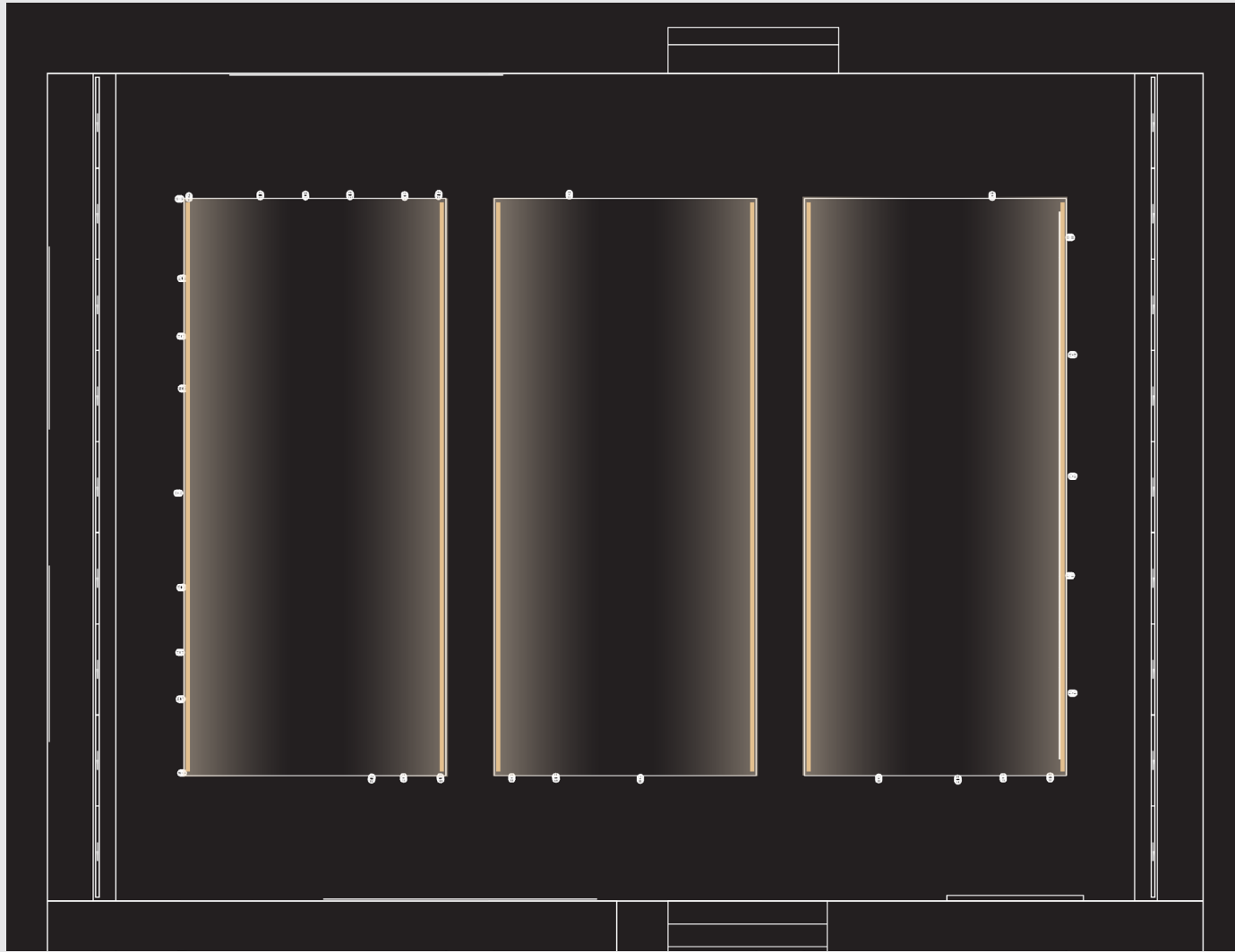
ACOUSTICS

CONCLUSION

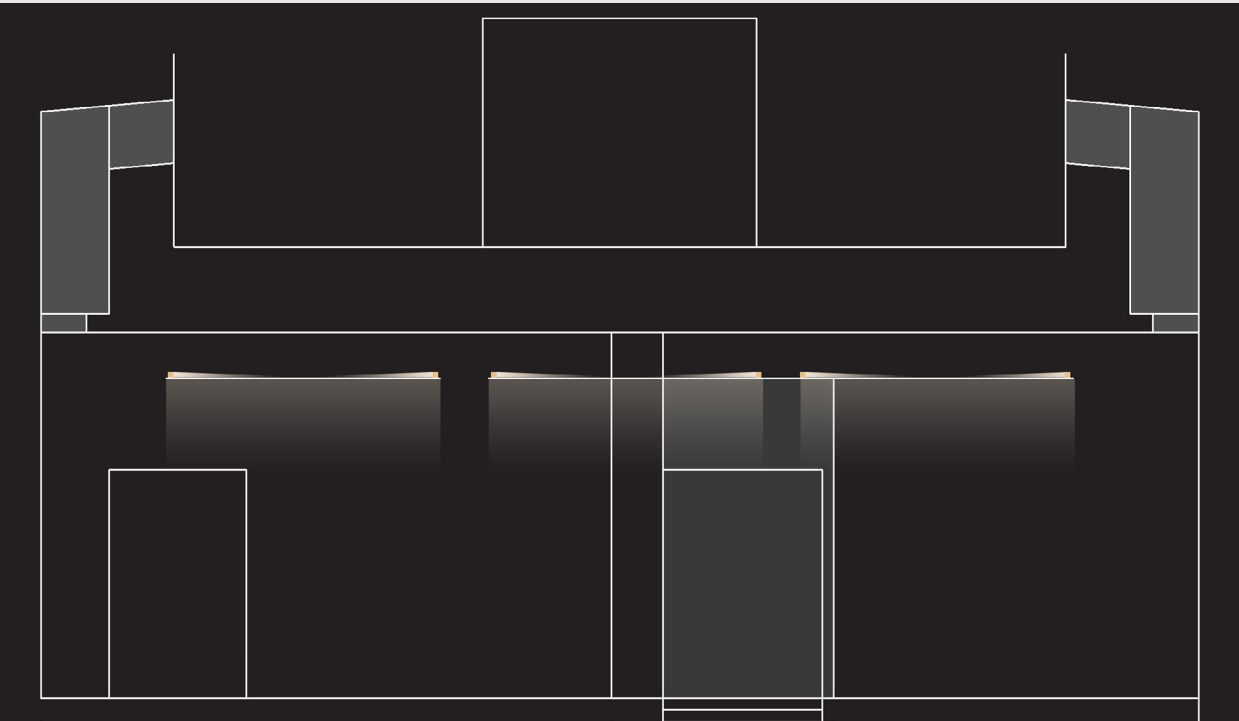
CREDITS

SUPPORT

## LIGHTING PLAN



## LIGHTING ELEVATION

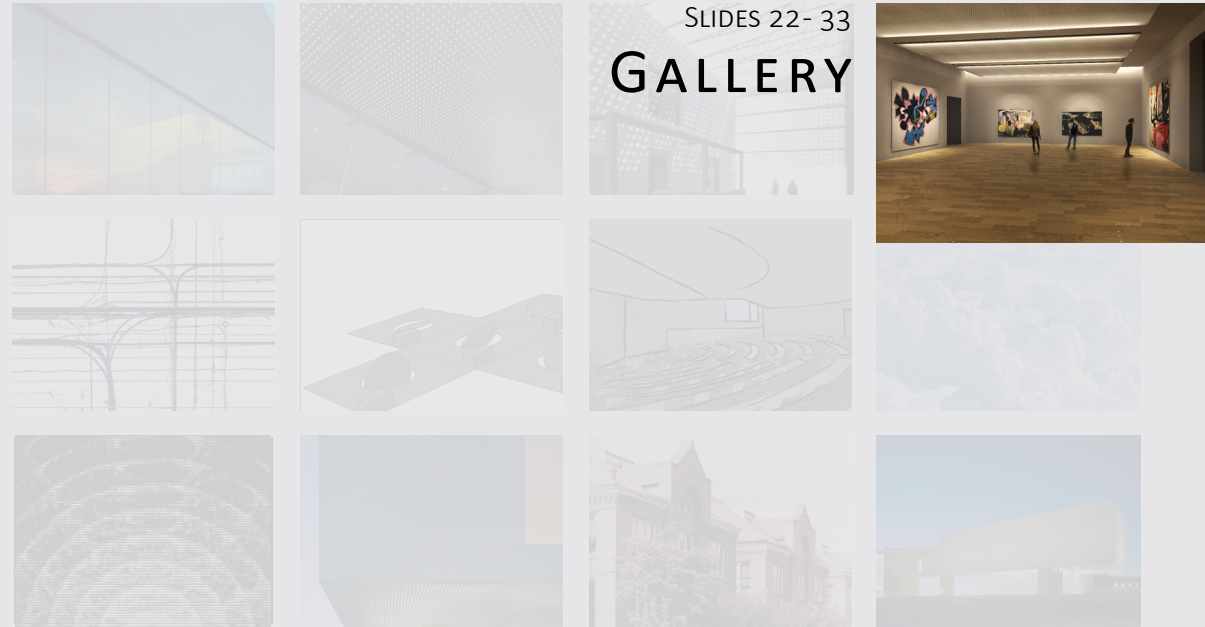




# The Nerman Museum of Contemporary Art

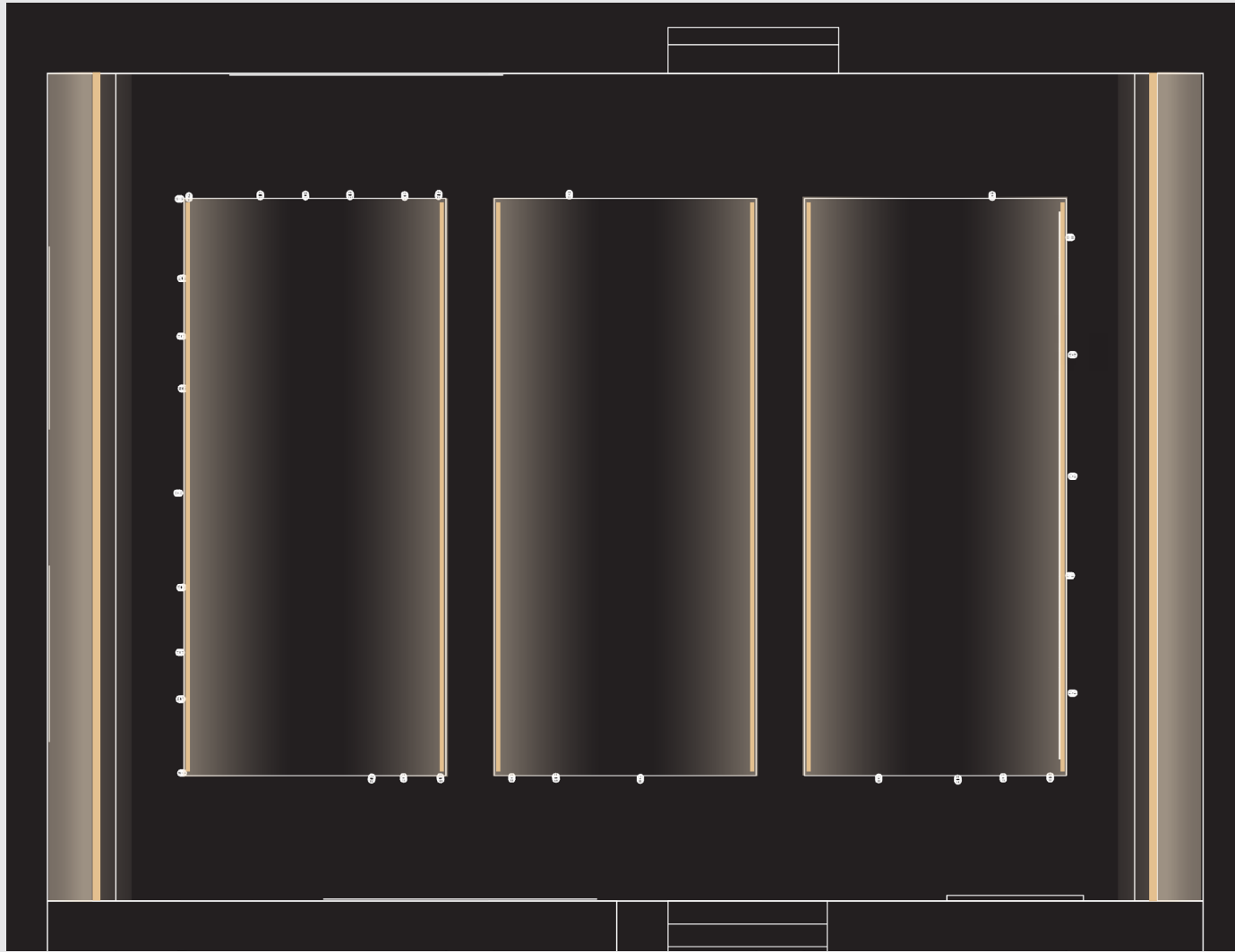
SLIDES 22- 33

GALLERY

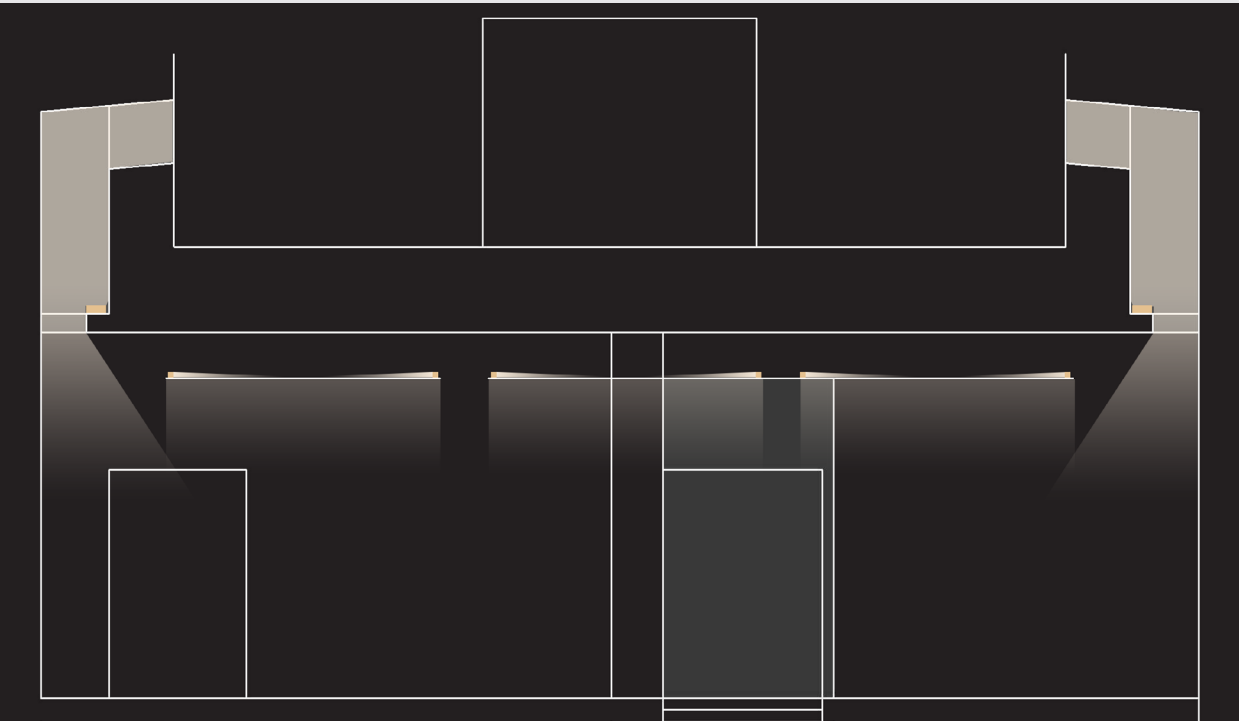


## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								



LIGHTING PLAN



LIGHTING ELEVATION



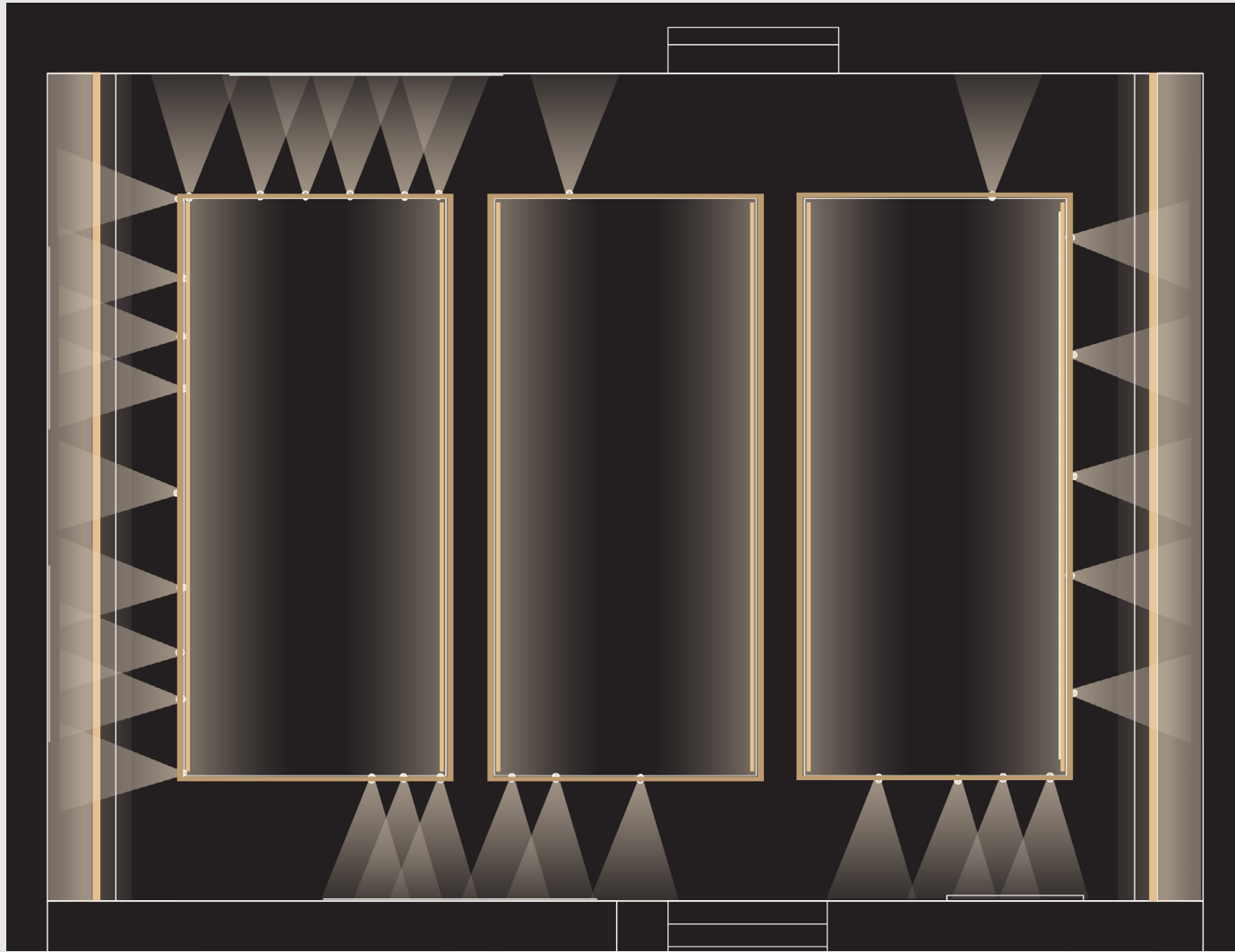
# The Nerman Museum of Contemporary Art

SLIDES 22- 33

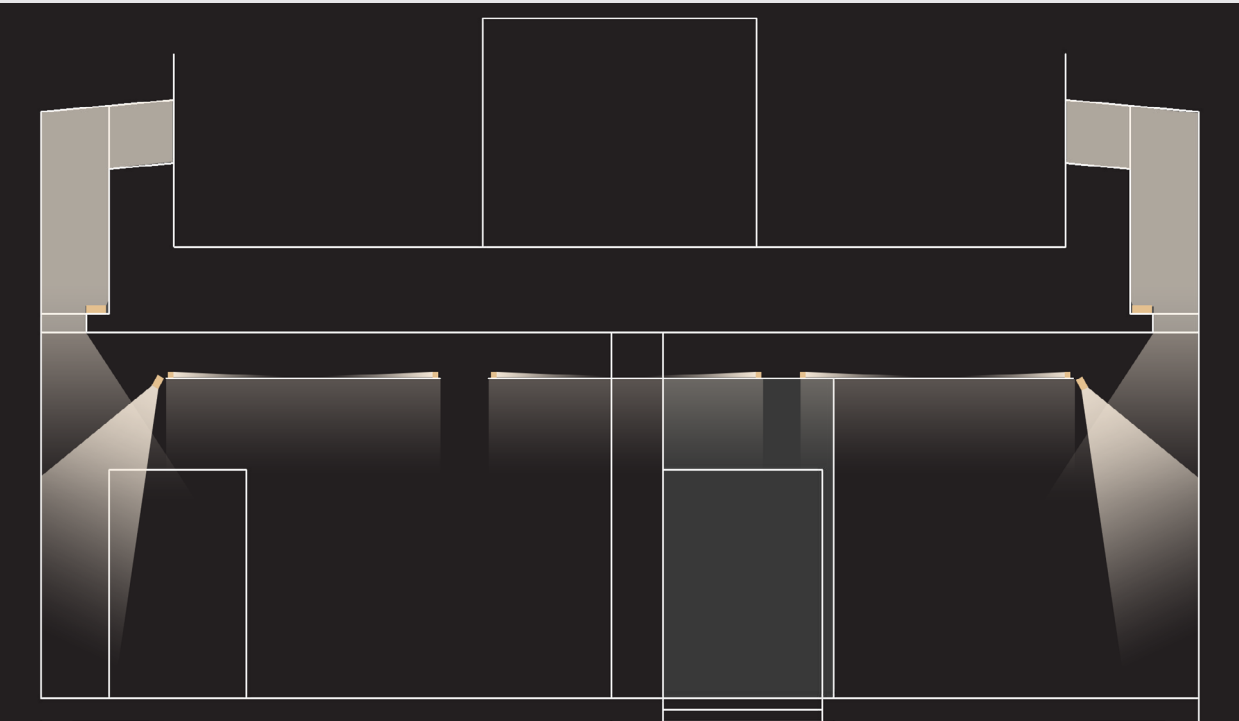
GALLERY

## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								



LIGHTING PLAN

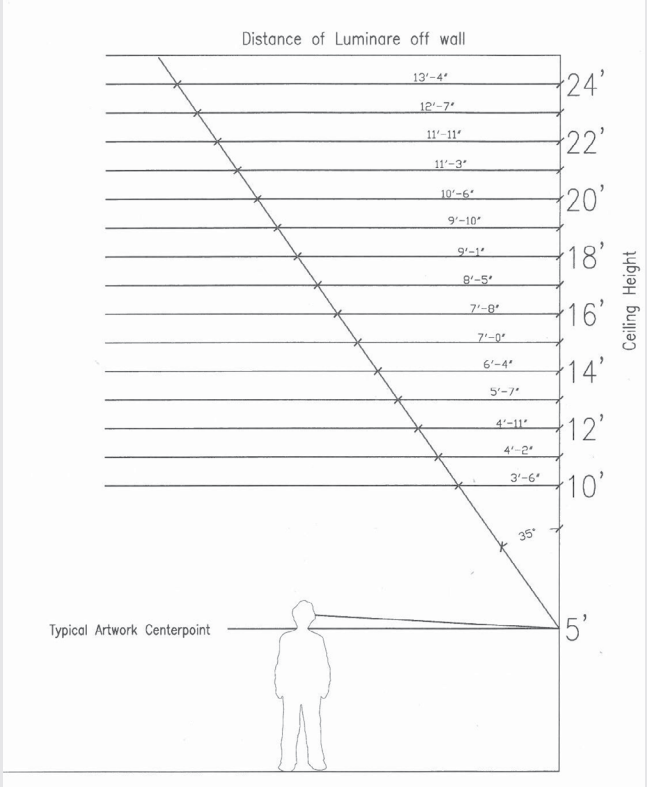
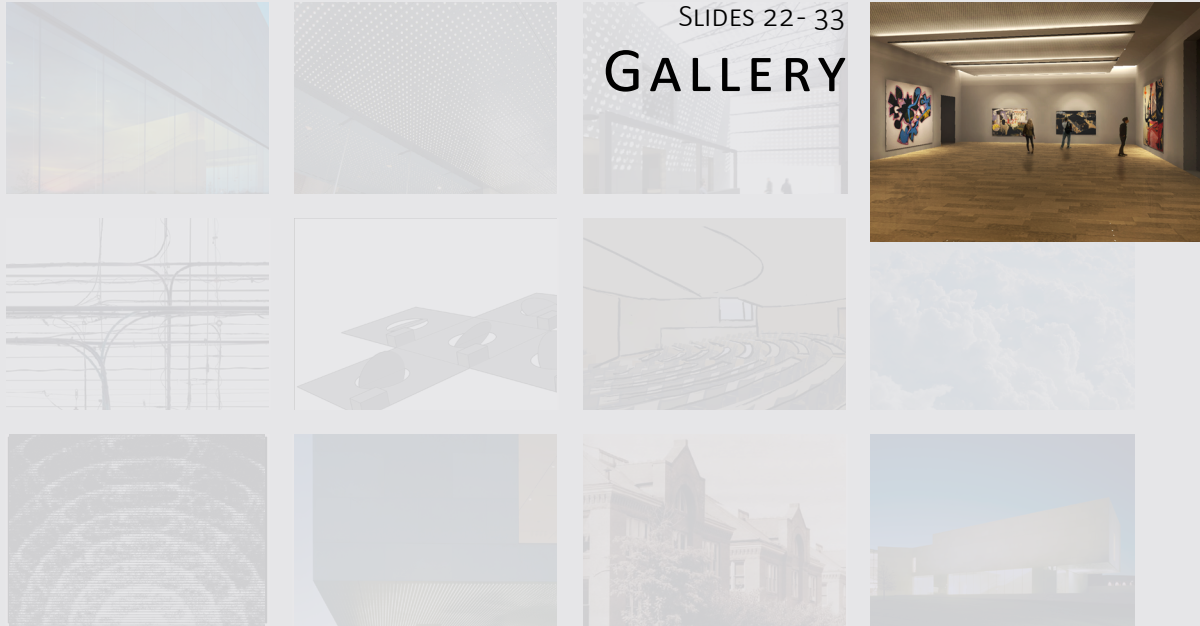


LIGHTING ELEVATION

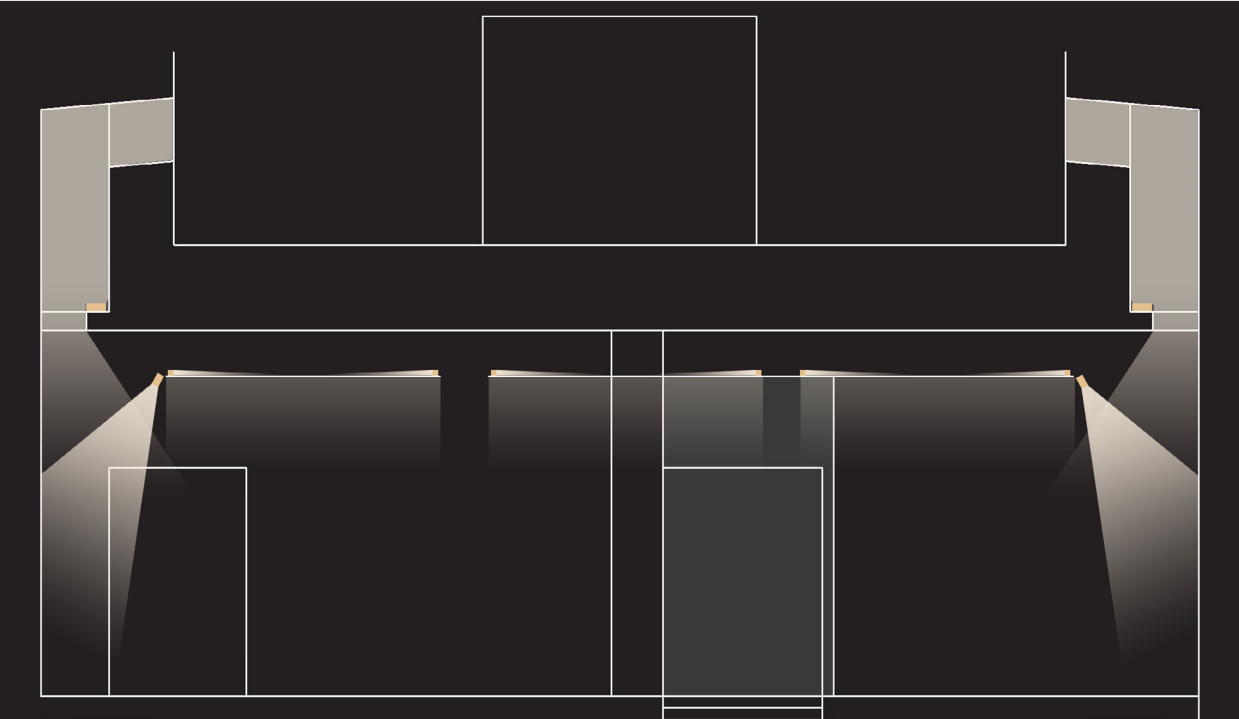




# The Nerman Museum of Contemporary Art



TRACK AIMING ANGLES  
30 DEGREES



LIGHTING ELEVATION



## OUTLINE

COVER

INTRODUCTION

SCOPE

LIGHTING

SOLARIUM

GALLERY

| LIGHTING CONCEPT  
| LIGHTING DESIGN  
| RENDERINGS

ELECTRICAL

WIND POWER

BREADTH

AUDITORIUM

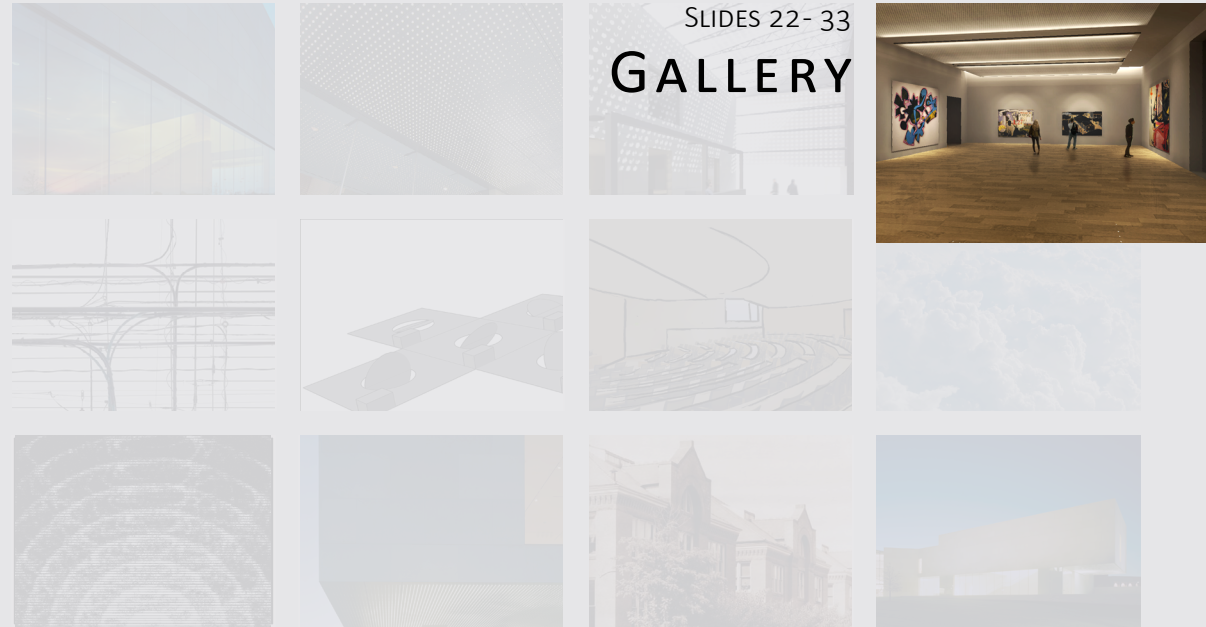
ACOUSTICS

CONCLUSION

CREDITS

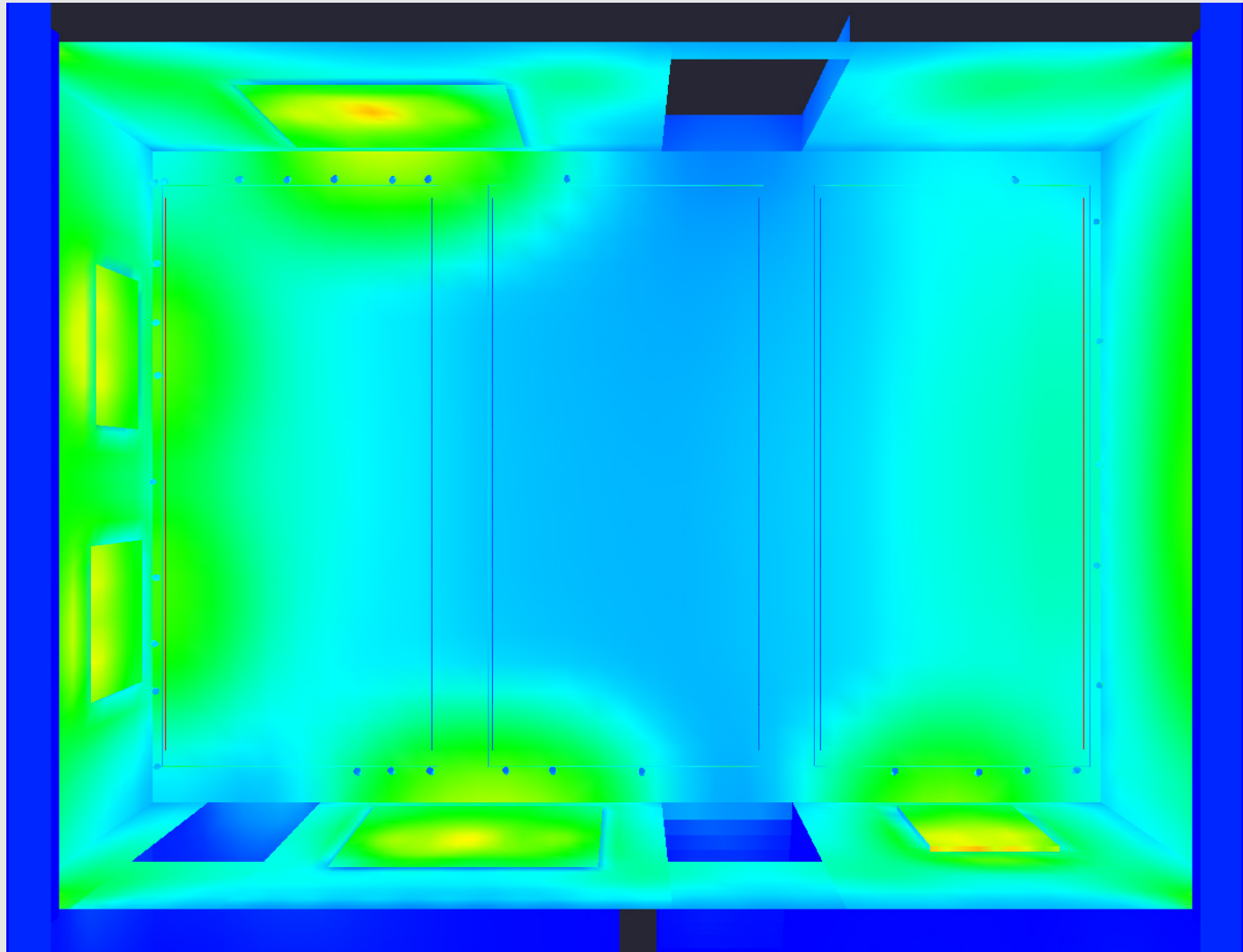
SUPPORT

# The Nerman Museum of Contemporary Art

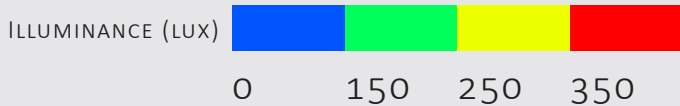


## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								



PSEUDO COLOR RENDERED PLAN



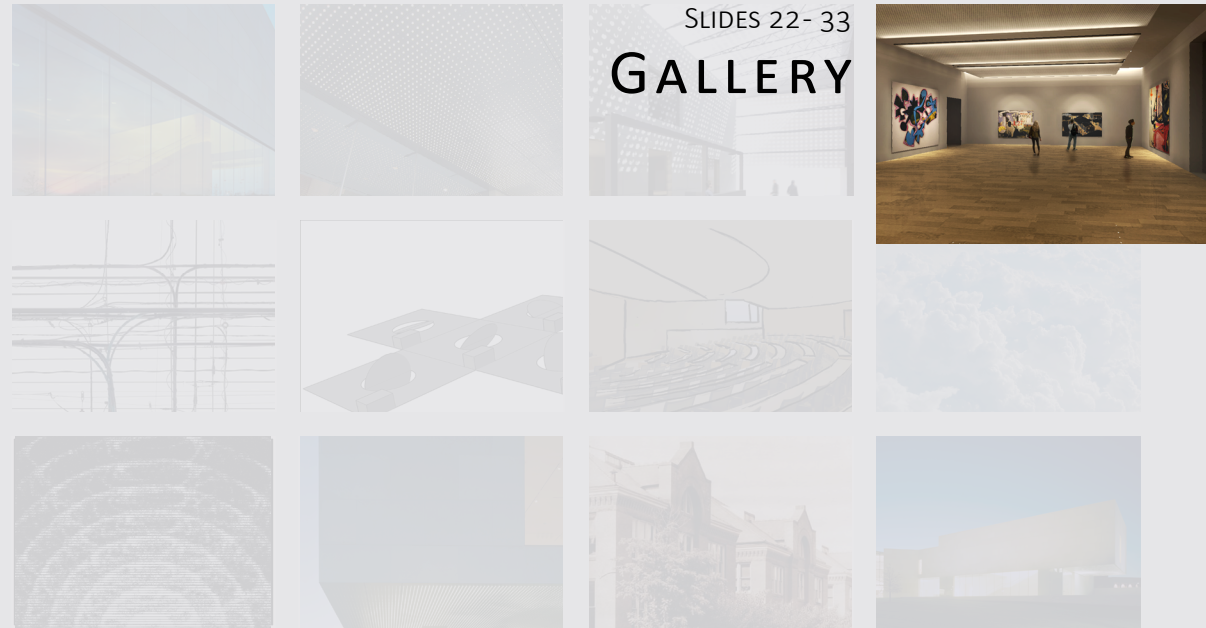
## ILLUMINANCE

IES RECOMMENDATIONS:  
ARTWORK: 200 LUX (VERTICAL)  
FLOOR AREA: 40 LUX (HORIZONTAL)

CALCULATED ILLUMINANCE:  
ARTWORK: 305 LUX  
FLOOR AREA: 115 LUX

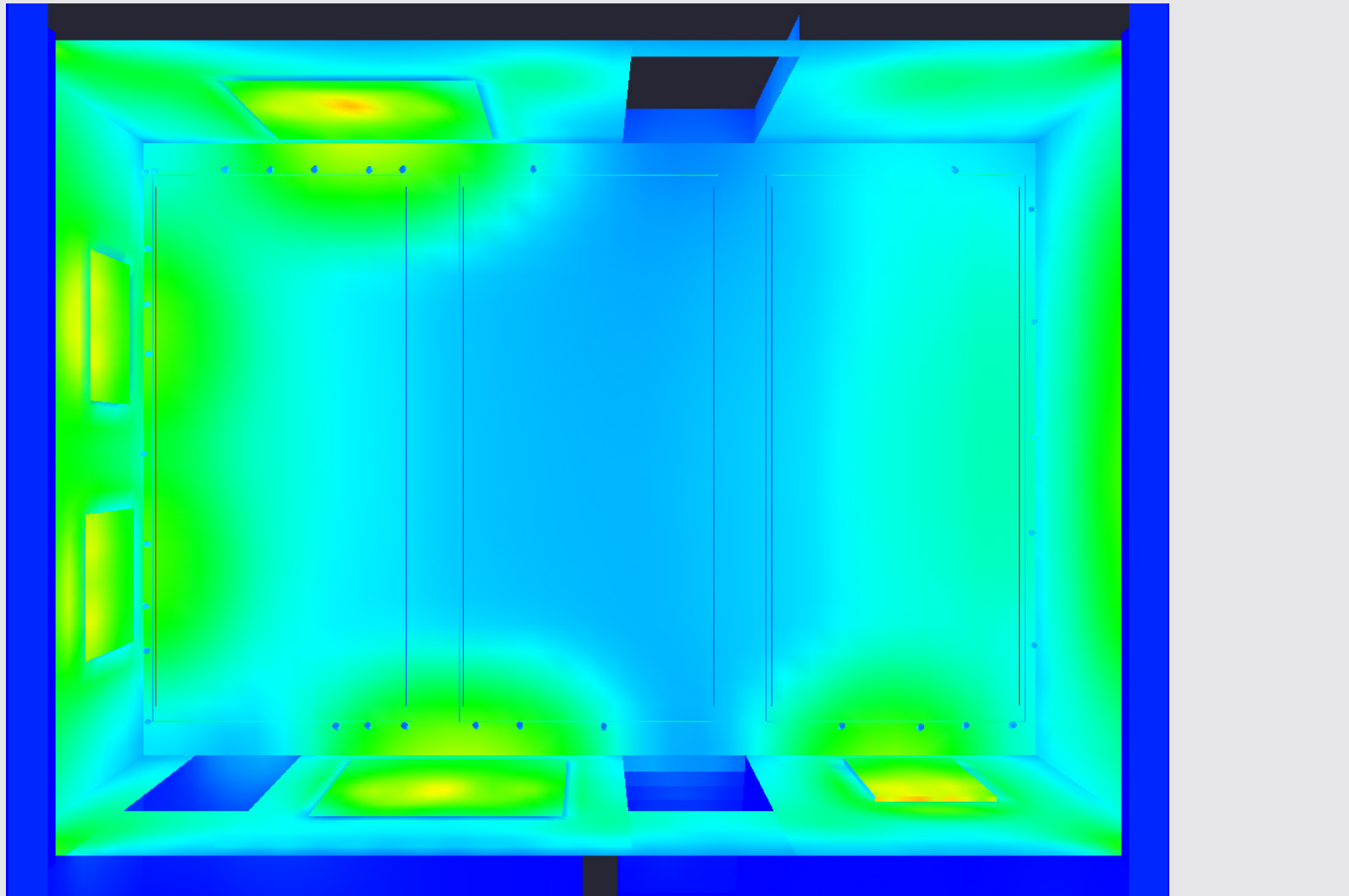


# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								



PSEUDO COLOR RENDERED PLAN



## LIGHTING POWER DENSITY

ASHREA 90.1 COMPLIANCE:  
 $1.05 \text{ W/SF} + 1.00 \text{ W/SF} = 2.05 \text{ W/SF}$

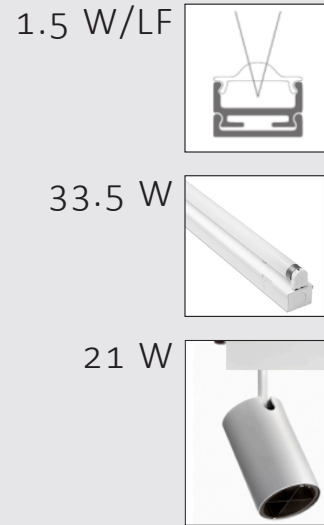
CALCULATED LPD:

LEFT END PANEL- TWO WAY TRACK  
CIRCUIT 1: (1) 5A CURRENT LIMITER = 600 W  
CIRCUIT 2: (1) 5A CURRENT LIMITER = 600 W

MIDDLE PANEL- ONE WAY TRACK  
CIRCUIT 1: (1) 5A CURRENT LIMITER = 600 W

RIGHT END PANEL- TWO WAY TRACK  
CIRCUIT 1: (1) 5A CURRENT LIMITER = 600 W  
CIRCUIT 2: (1) 5A CURRENT LIMITER = 600 W

$1.97 \text{ W/SF} < 2.05 \text{ W/SF}$



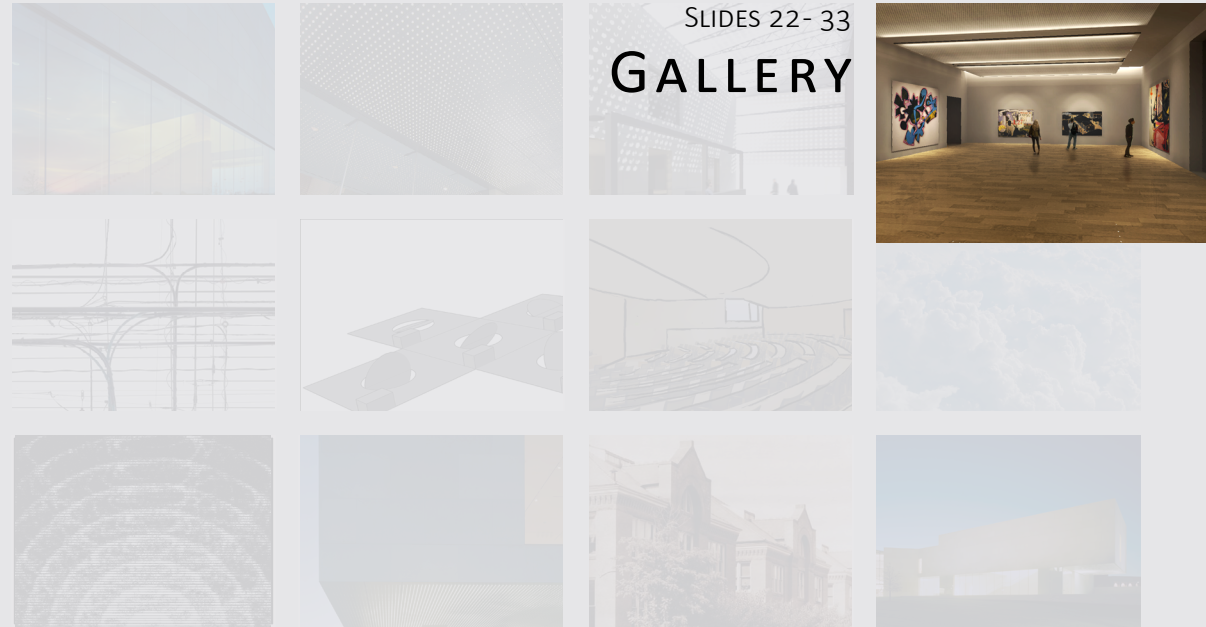
TOTAL TRACK FIXTURES:

AT 21 W/FIXTURE  
FOR 600 A CIRCUIT

28 FIXTURES/CIRCUIT

140 POSSIBLE FIXTURES

# The Nerman Museum of Contemporary Art



## OUTLINE

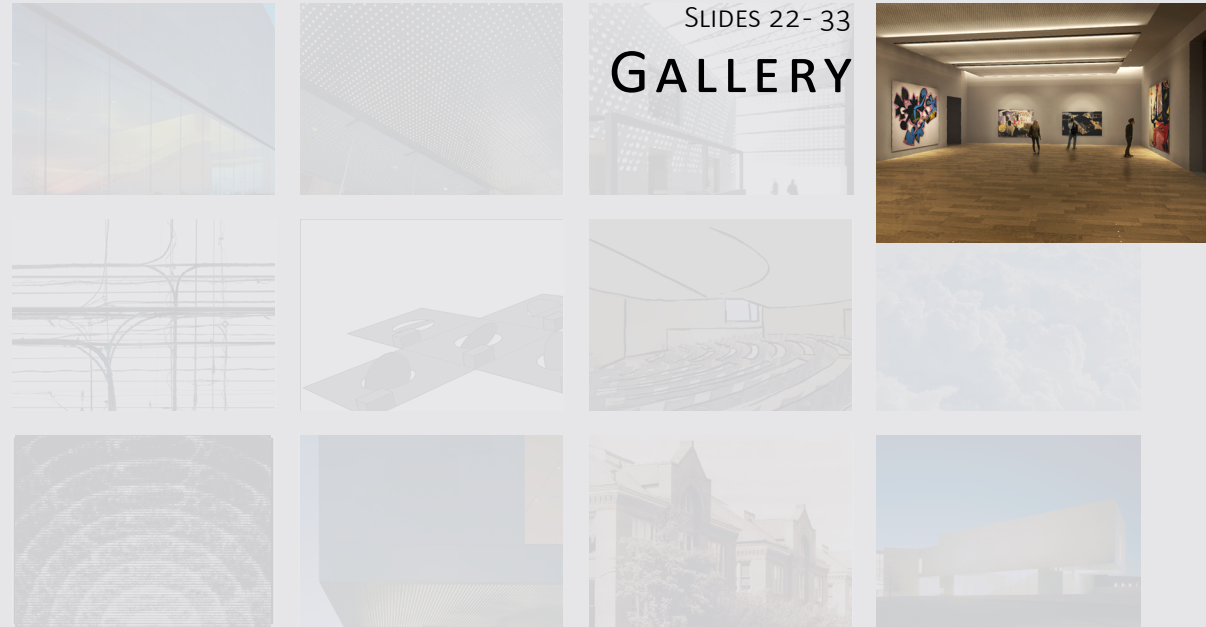
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								

GALLERY DAYTIME RENDERING





# The Nerman Museum of Contemporary Art



## OUTLINE

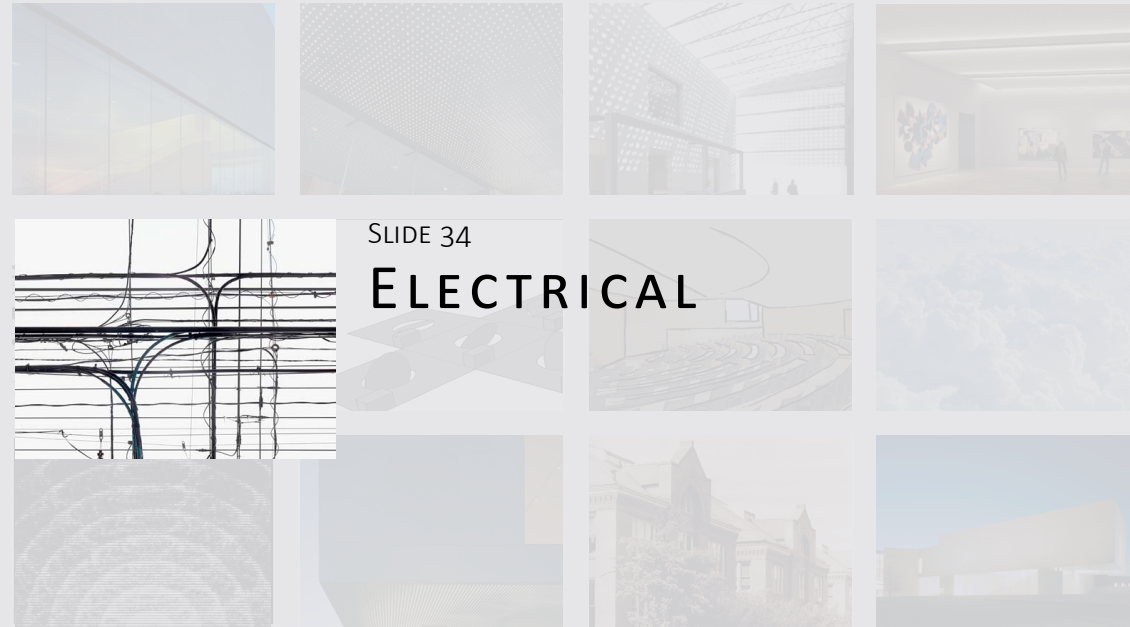
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
					LIGHTING CONCEPT   LIGHTING DESIGN   RENDERINGS								

## GALLERY NIGHTTIME RENDERING





# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
						SOLARIUM   KENETIC > ELECTRICITY							

## ELECTRICAL DESIGN

WIND POWER GENERATION SYSTEM

SOLARIUM

SOLAR PROTECTION DISKS

KENETIC INTO ELECTRICITY



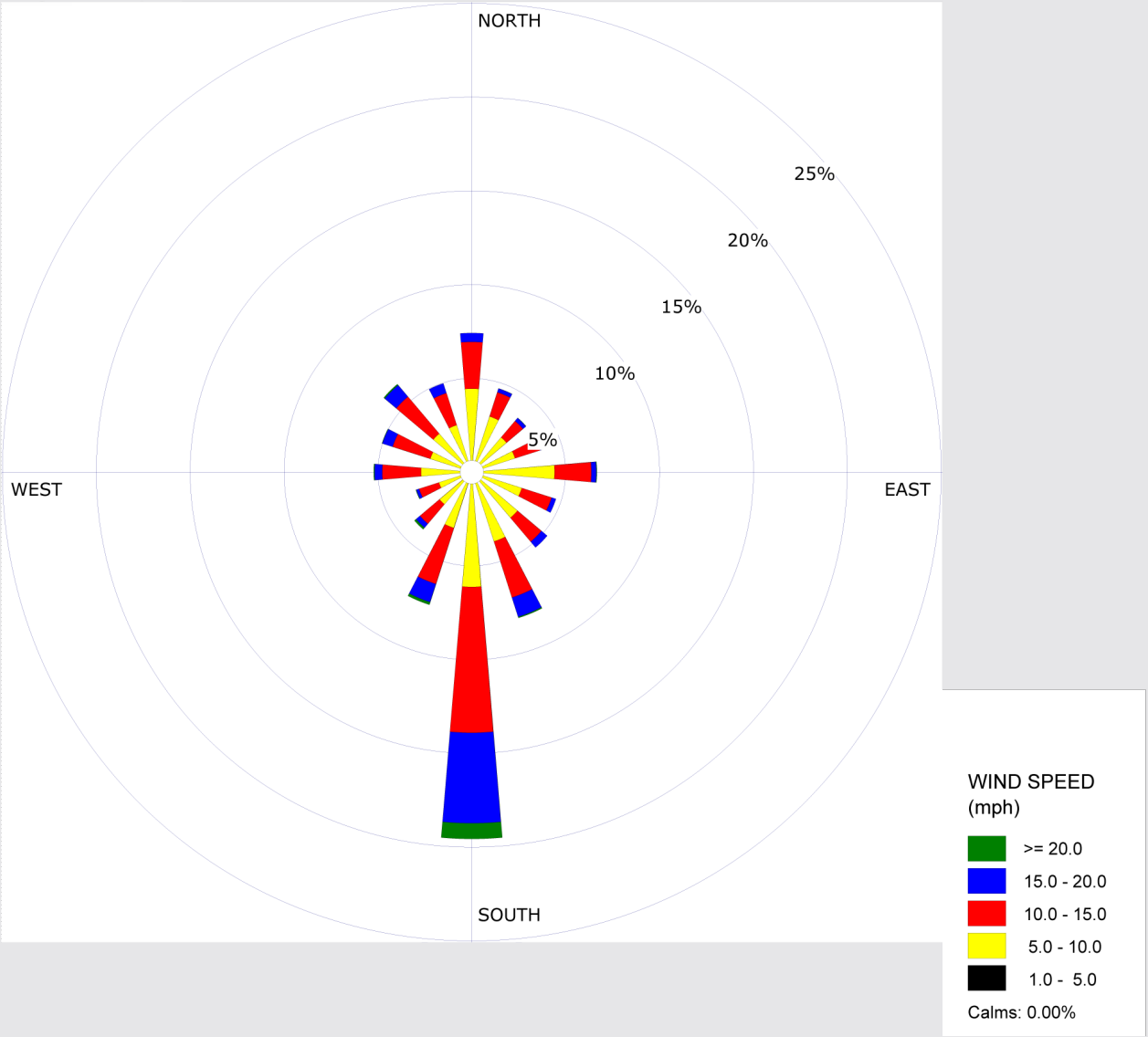


# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
							WIND   INTEGRATION   DISPLAY						



## SOLARIUM

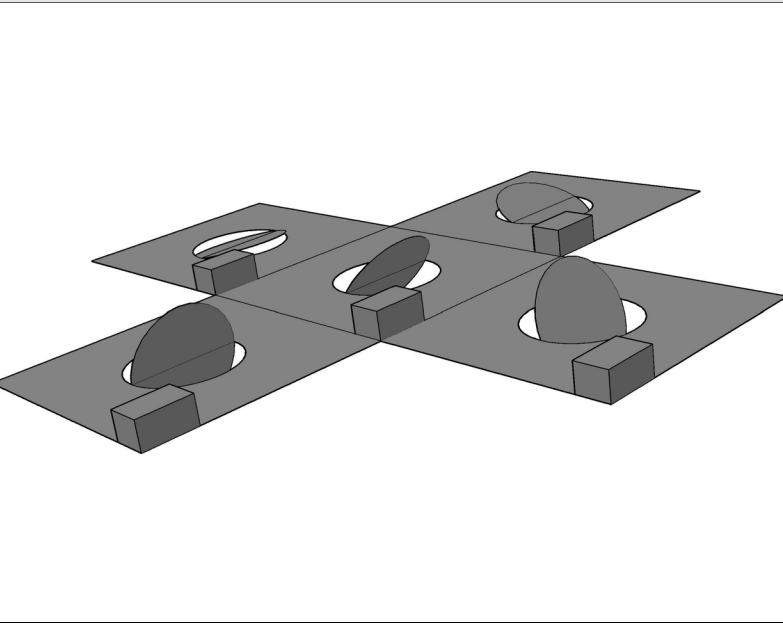
OVERLAND PARK WIND ROSE

AVERAGE WIND SPEED = 10 MPH

EAST + WEST WIND 44% OF DAY  
10.5 HRS/DAY

DISK RADIUS = 4”  
RPM = 220

# The Nerman Museum of Contemporary Art



## SOLARIUM

OVERLAND PARK WIND ROSE

AVERAGE WIND SPEED = 10 MPH

EAST + WEST WIND 44% OF DAY  
10.5 HRS/DAY

DISK RADIUS = 4”  
RPM = 220

### OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
							WIND   INTEGRATION   DISPLAY						

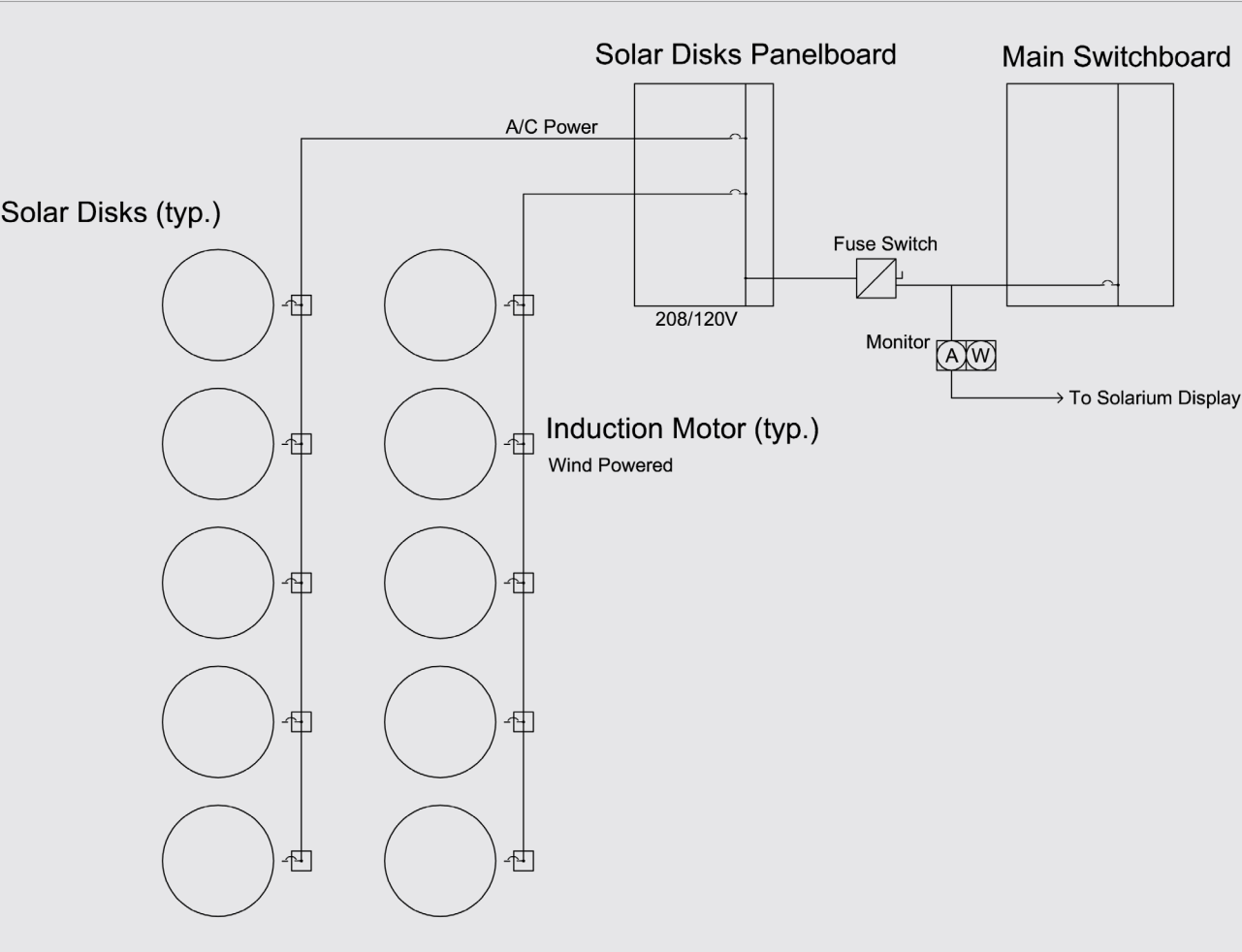


# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
							WIND   INTEGRATION   DISPLAY						



## SINGLE LINE

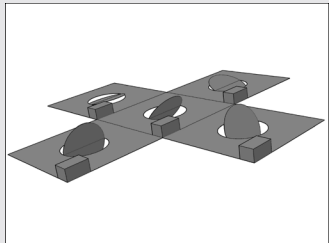
INDUCTION MOTOR > PANELBOARD > SWITCH > MSB

INDUCTION MOTOR OUTPUT = 6W  
1,298 INDIVIDUAL MOTORS  
TOTAL POWER = 7,788 W  
7,788 x 44% = 3,427 W

0.59% OF TOTAL BUILDING ELECTRICITY



# The Nerman Museum of Contemporary Art



SLIDE 35- 38

## WIND POWER

### OUTLINE

#### WIND POWER

| WIND  
| INTEGRATION  
| DISPLAY

BREADTH

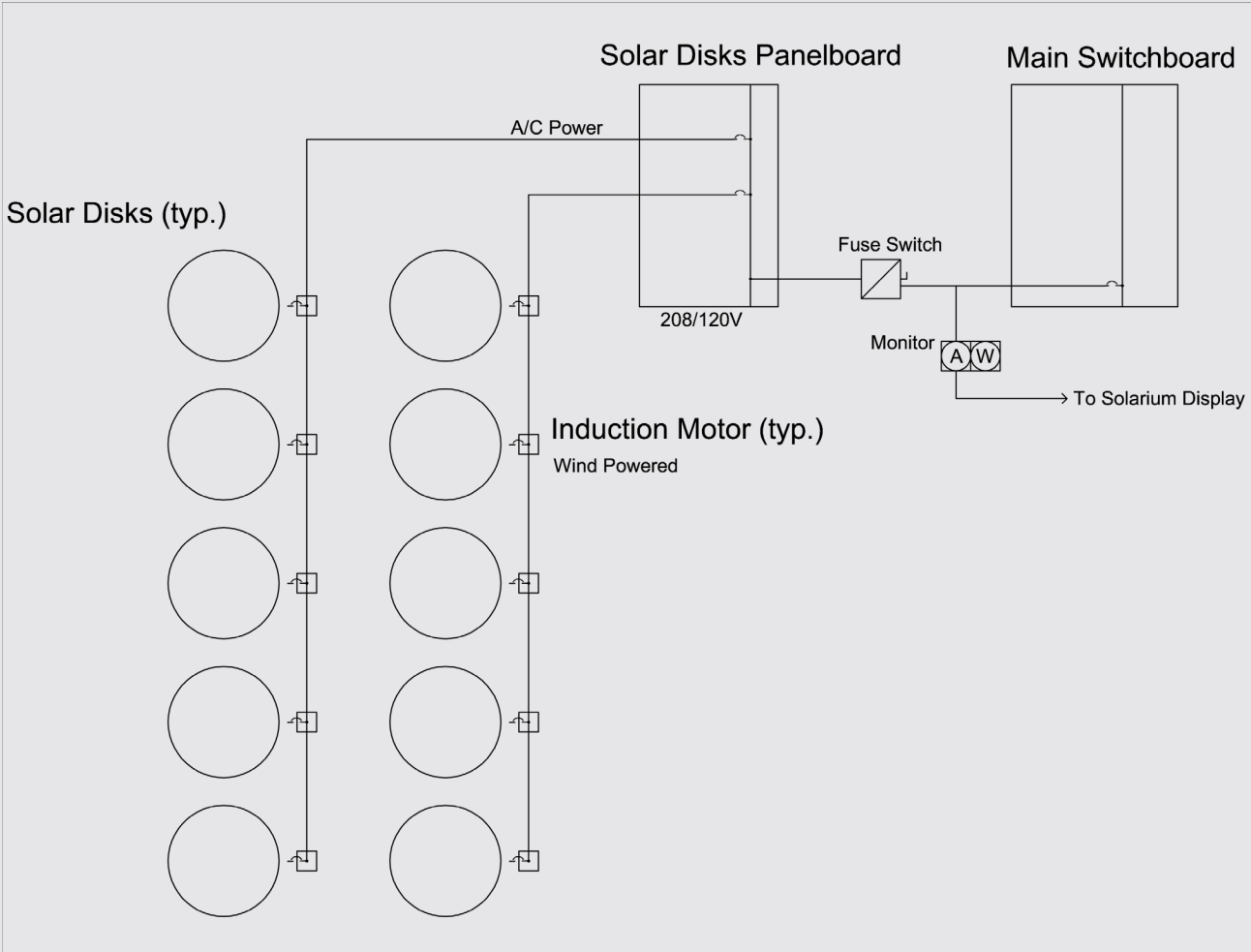
AUDITORIUM

ACOUSTICS

CONCLUSION

CREDITS

SUPPORT

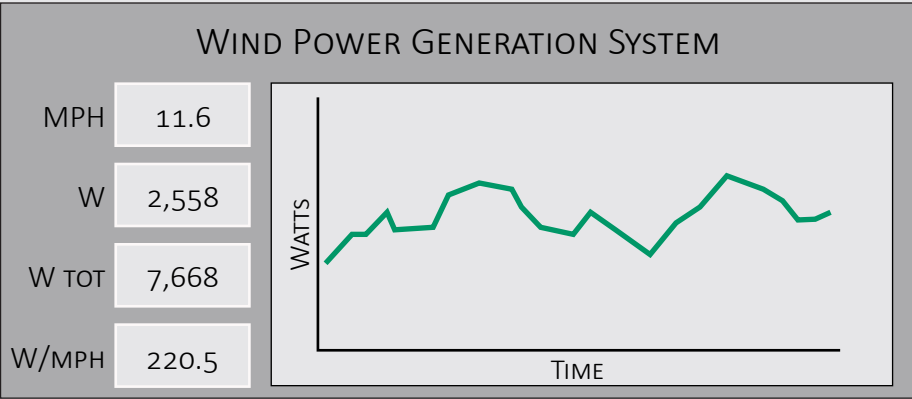


## DISPLAY SCREEN

INDUCTION MOTOR > PANELBOARD > SWITCH > MSB

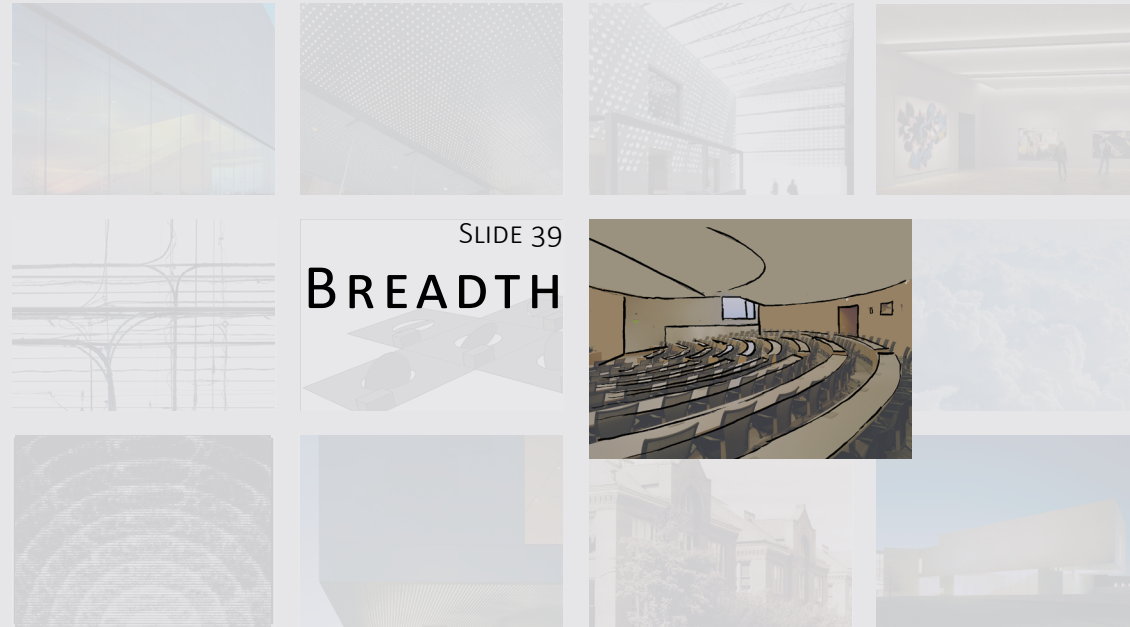
INDUCTION MOTOR OUTPUT = 6W  
1,298 INDIVIDUAL MOTORS  
TOTAL POWER = 7,788 W  
7,788 x 44% = 3,427 W

0.59% OF TOTAL BUILDING ELECTRICITY





# The Nerman Museum of Contemporary Art



SLIDE 39  
**BREADTH**

## OUTLINE

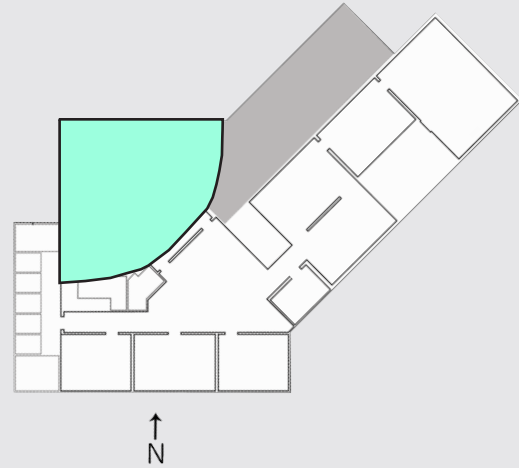
COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
								ACOUSTICAL   AUDITORIUM					



## ACOUSTICAL BREADTH

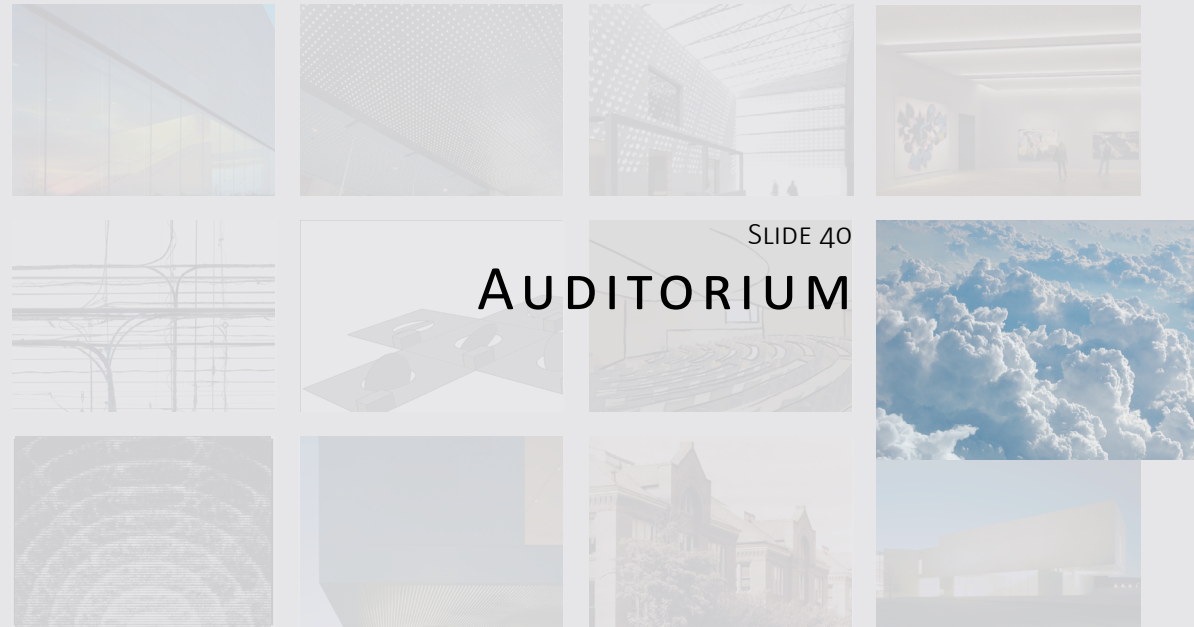
AUDITORIUM

2ND FLOOR





# The Nerman Museum of Contemporary Art



## AUDITORIUM

### OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
									NEW CEILING DESIGN NEWMAT				



## AUDITORIUM

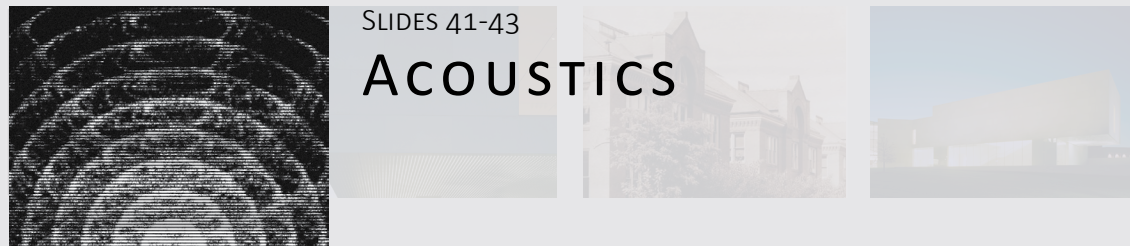
### LIGHTING DESIGN



CEILING PANELS:  
NEWMAT FLEXIBLE PVC MATERIAL



# The Nerman Museum of Contemporary Art



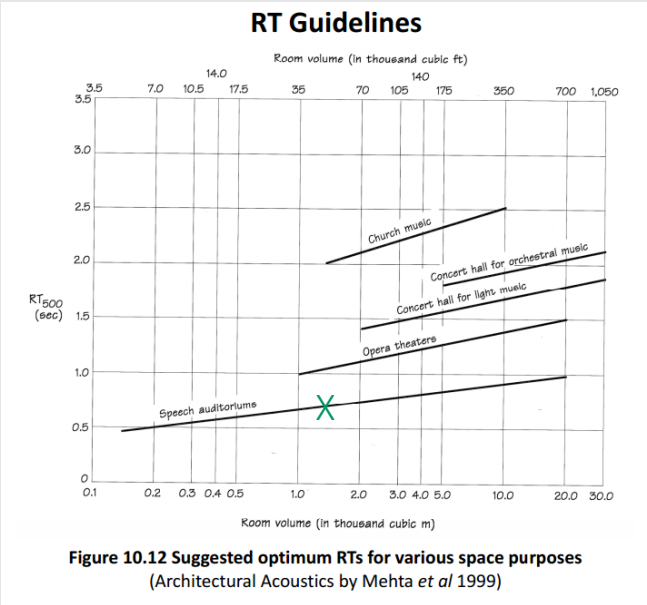
## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
										DESIGN CRITERIA, ANALYSIS   NEW DESIGN   PROFORMANCE			

## ACOUSTICS - PERFORMANCE CRITERIA

Designed Reverberation Time (RT):

$$RT_{500} = 0.7 \text{ s}$$



## ACOUSTICS - PERFORMANCE ANALYSIS

Total Volume  
47,142 ft<sup>3</sup>

Total Surface Area  
10,052 ft<sup>2</sup>

$$\text{Sabine} = A_{\text{surface}} \times \text{absob}$$

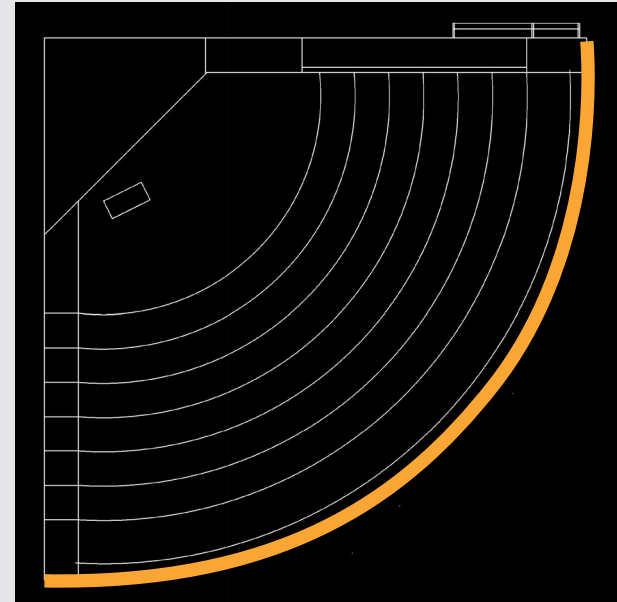
Sabine Equation: (absob < 0.2)  
 $RT = 0.049V / (S_T \text{ absob} + 4mV)$

Norris-Eyring Equation: (absob > 0.2)  
 $RT = 0.049V / (S_T \ln(1 - \text{absob}) + 4mV)$

SLIDES 41-43

# ACOUSTICS

## ACOUSTICS - NEW DESIGN

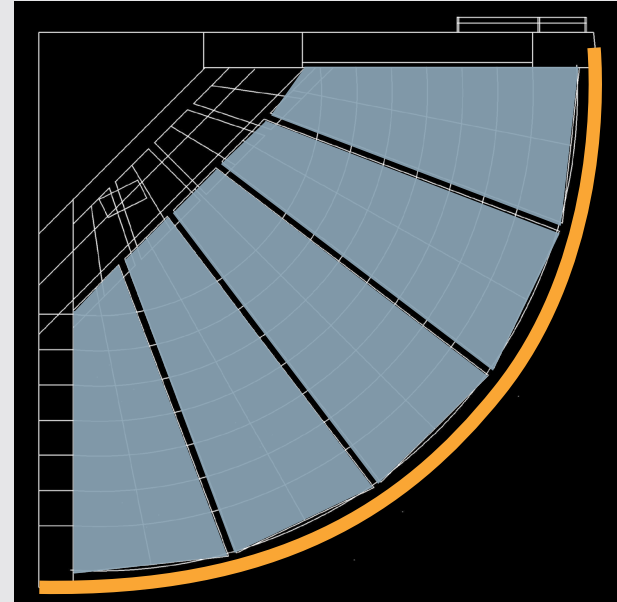


Total Surface Area  
10,052 ft<sup>2</sup>

Description	Thickness	Frequency (Hz)									
		125	250	500	1000	2000	4000	NRC	SAA		
Solo 8-25*	1 5/8 (41mm)	0.1	0.45	1.03	0.96	0.51	0.51	0.75	0.73		
Solo 8-50*	2 5/8 (67mm)	0.36	0.97	1.15	0.92	0.71	0.69	0.95	0.95		
Solo 8**	5/8 (16mm)	0.09	0.12	0.37	0.82	0.68	0.40	0.50	0.50		

\* Type A Mounting (with 1" (Solo 8-25), or 2" (Solo 8-50) fiber glass backer)

\*\* Type F25 Mounting (1" (25mm) furring/airspace - no backer)



Total Surface Area  
9,907 ft<sup>2</sup>

Frequency (HZ)	100	125	250	500	1k	2k	4k
Absorption Coefficient ( )	0.14	0.17	0.63	0.64	0.24	0.19	0.14

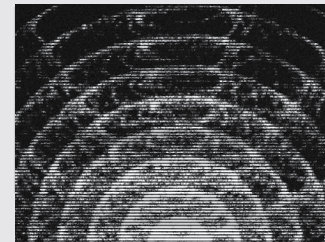
Description	Thickness	Frequency (Hz)							
		125	250	500	1000	2000	4000	NRC	SAA
Solo 8-25*	1 5/8" (41mm)	0.1	0.45	1.03	0.96	0.51	0.51	0.75	0.73
Solo 8-50*	2 5/8" (67mm)	0.36	0.97	1.15	0.92	0.71	0.69	0.95	0.95
Solo 8**	5/8" (16mm)	0.09	0.12	0.37	0.82	0.68	0.40	0.50	0.50

\* Type A Mounting (with 1" (Solo 8-25), or 2" (Solo 8-50) fiber glass backer)

\*\* Type F25 Mounting (1" (25mm) furring/airspace - no backer)



# The Nerman Museum of Contemporary Art



SLIDES 41-43

# ACOUSTICS

## OUTLINE

## ACOUSTICS - INITIAL DESIGN

Room Volume and SA																					
Volume (ft³) [V]		47,142.00																			
Total Surface Area (sqft) [S <sub>tot</sub> ]		10,652.25																			
Surface Description		Surface Area [S] (ft²)		Material Description		Sound Absorption Coefficient (α)								S*α (sabines)							
						Frequency [f] (Hz)								Frequency [f] (Hz)							
						125	250	500	1000	2000	4000	125	250	500	1000	2000	4000				
Front Wall	580.50	Veneer Panel System	0.1	0.11	0.1	0.08	0.08	0.11	58.95	63.86	58.95	46.44	46.44								
Side Wall Right	881.50	Veneer Panel System	0.1	0.11	0.1	0.08	0.08	0.11	88.15	96.97	88.15	70.52	70.52	96							
Side Wall Left	1,307.25		0.22	0.08	0.05	0.04	0.03	0.03	287.60	104.58	65.36	52.29	39.22	39							
Back Wall	2,052.00	Perf HDWD 5/8" Decoustics Solid Board Panels w 1" Acoustical Fiberglass	0.1	0.45	1.03	0.96	0.71	0.69	205.20	923.40	2113.56	1969.92	1456.92	1415							
Window Left	120.00	Window	0.35	0.25	0.18	0.12	0.07	0.04	42.00	30.00	21.60	14.40	8.40	4							
Front Ceiling	286.00	5/8" GWB	0.22	0.08	0.05	0.04	0.03	0.03	62.92	22.88	14.30	11.44	8.58	8							
Middle Ceiling	975.00	5/8" GWB	0.22	0.08	0.05	0.04	0.03	0.03	214.50	78.00	48.75	39.00	29.25	29							
Back Ceiling	550.00	5/8" GWB	0.22	0.08	0.05	0.04	0.03	0.03	121.00	44.00	27.50	22.00	16.50	16							
Floor Carpet	1,320.00	Carpet	0.03	0.05	0.09	0.2	0.3	0.4	39.60	66.00	118.80	264.00	396.00	528							
Floor Desks	990.00	P-Lam Top	0.02	0.03	0.03	0.03	0.03	0.02	19.80	29.70	29.70	29.70	29.70	19							
Floor Seating	990.00	Light upholstered Seating	0.35	0.45	0.57	0.61	0.59	0.55	346.50	445.50	564.30	603.90	584.10	544							
10,652.25																					
Sum S*α=												1485.32	1904.88	3150.07	3123.61	2685.63	2767				
Avg α=												0.147759	0.189498	0.31337	0.310737	0.267167	0.275252				
Air absorption constant for 20 degC and 40% RH (m)²=												0	0.001	0.0003	0.0004	0.009	0.0				
Sabine =												1.555197	1.103423	0.720366	0.722079	0.527058	0.2938				
Norms-Eyring =												1.437239	1.004086	0.602209	0.605303	0.479073	0.277				
Calculated RT(a) =												1.555197	1.103423	0.602209	0.605303	0.479073	0.277				

$$RT_{500} = 0.60 \text{ s}$$

$$0.6 \text{ s} < 0.7 \text{ s}$$

## ACOUSTICS - NEW DESIGN

Room Volume and SA															
Volume (ft³) [V]		43,920.00													
Total Surface Area (sqft) [Stot]		9,907.25													
Surface Description		Surface Area	Material Description	Sound Absorption Coefficient (α)						S'e (sabines)					
				Frequency I] (Hz)						Frequency II] (Hz)					
				125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
Front Wall		580.50	Veneer Panel System	0.1	0.11	0.1	0.08	0.08	0.11	58.05	63.86	58.05	46.44	46.44	63.86
Side Wall Right		881.50	Veneer Panel System	0.1	0.11	0.1	0.08	0.08	0.11	88.15	96.97	88.15	70.52	70.52	96.97
Side Wall Left		1,307.25	50° PTD GIVE	0.22	0.08	0.05	0.04	0.03	0.03	287.60	104.58	65.36	52.29	39.22	39.22
Back Wall		2,052.00	Perf HDVO 5/8" Decoustics Solo Board Panels	0.09	0.12	0.37	0.82	0.68	0.4	184.68	246.24	759.24	1682.64	1395.36	820.80
Window Left		120.00	Window	0.35	0.25	0.18	0.12	0.07	0.04	42.00	30.00	21.60	14.40	8.40	4.80
Front Ceiling		286.00	PVC Neumat stretched film	0.17	0.63	0.64	0.24	0.19	0.14	48.62	180.18	183.04	68.64	54.34	40.04
Middle Ceiling		1,380.00	PVC Neumat stretched film	0.17	0.63	0.64	0.24	0.19	0.14	234.60	869.40	883.20	331.20	262.20	193.20
										0.00	0.00	0.00	0.00	0.00	0.00
Floor Carpet		1,320.00	Carpet	0.03	0.05	0.09	0.2	0.3	0.4	39.60	66.00	118.80	264.00	396.00	528.00
Floor Desks		990.00	P-Lam Top	0.02	0.03	0.03	0.03	0.03	0.02	19.80	29.70	29.70	29.70	29.70	19.80
Floor Seating		990.00	Light upholstered Seating	0.35	0.45	0.57	0.61	0.59	0.55	346.50	445.50	564.30	603.90	584.10	544.50
		9,907.25													
Sum Σα= 1349.60 2132.42 2771.44 3163.73 2886.28 2351.16															
Avg α= 0.136223 0.215238 0.297399 0.319335 0.29133 0.237315															
Air absorpion constant for 20 degC and 40% RH (m⁻¹)= 0 0.001 0.0003 0.0004 0.009 0.027															
Sabine = 1.594612 0.932403 0.762028 0.665454 0.49173 0.303343															
Norris-Eyring = 1.48335 0.835126 0.651418 0.554454 0.431034 0.289745															
Calculated RT(s) = 1.594612 0.835126 0.651418 0.554454 0.431034 0.289745															

Newmat: PVC

$$RT_{500} = 0.65 \text{ s}$$

$$0.65 < 0.7$$

Frequency (HZ)	100	125	250	500	1k	2k	4k
Absorption Coefficient ( )	0.14	0.17	0.63	0.64	0.24	0.19	0.14

+

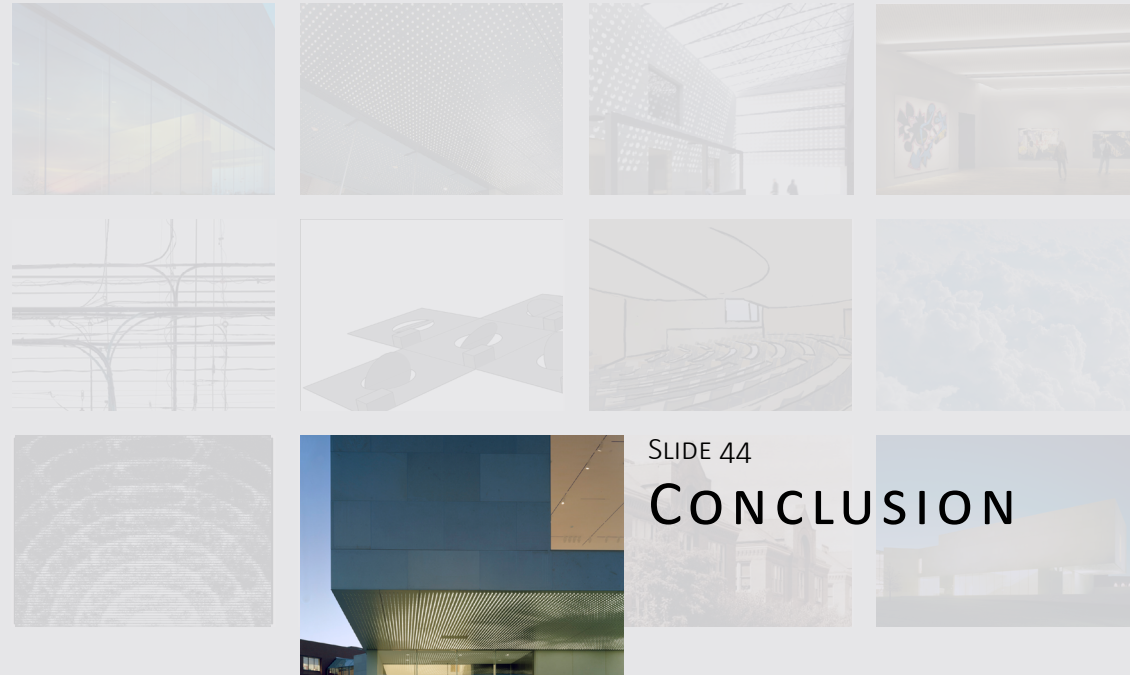
Decoustics: Solo 8

Description	Thickness	Frequency (Hz)							
		125	250	500	1000	2000	4000	NRC	SAA
Solo 8-25*	1 5/8 (41mm)	0.1	0.45	1.03	0.96	0.51	0.51	0.75	0.73
Solo 8-50*	2 5/8 (67mm)	0.36	0.97	1.15	0.92	0.71	0.69	0.95	0.95
Solo 8**	5/8 (16mm)	0.09	0.12	0.37	0.82	0.68	0.40	0.50	0.50

\* Type A Mounting (with 1" (Solo 8-25), or 2" (Solo 8-50) fiber glass backer)

\*\* Type T25 Mounting (1" (25mm) furring/airspace - no backer)

# The Nerman Museum of Contemporary Art



SLIDE 44  
**CONCLUSION**

## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
						LIGHTING DEPTH   ELECTRICAL DEPTH   ACOUSTICAL BREADTH							



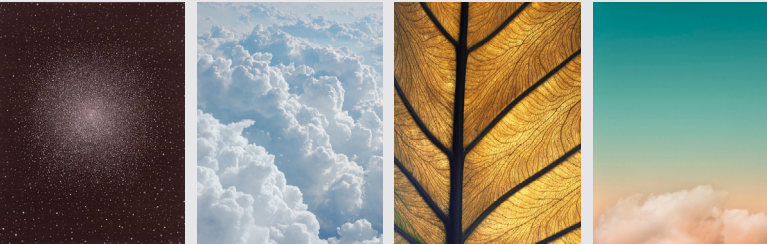
## CONCLUSION

LIGHTING DESIGN:

SOLARIUM  
GALLERY

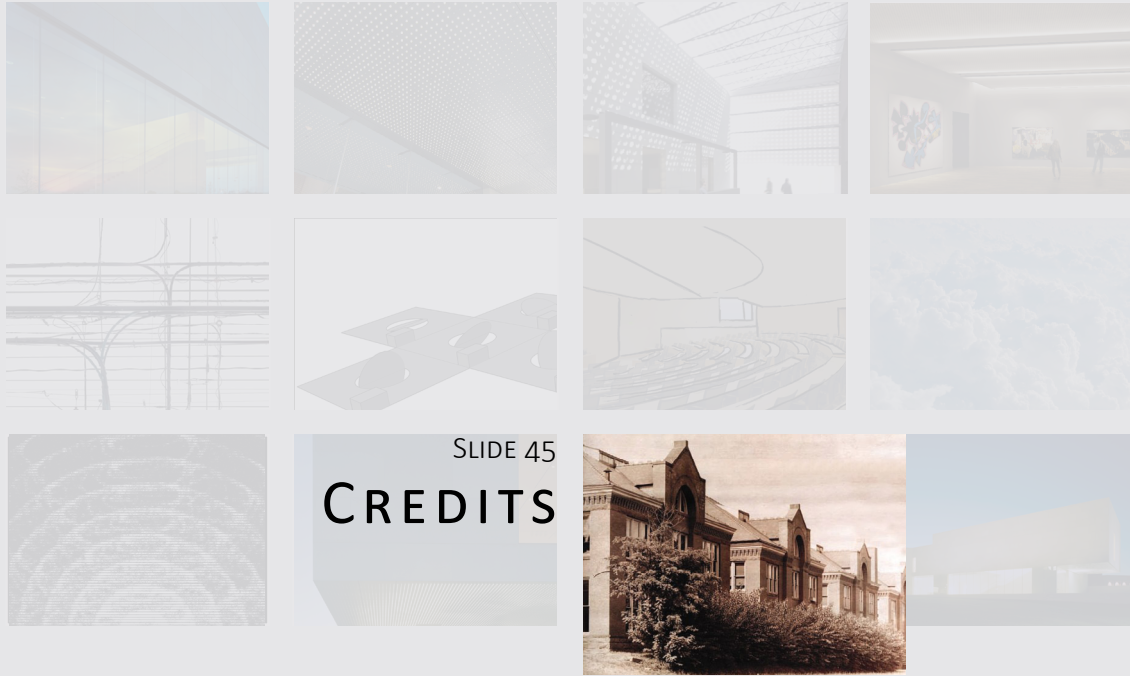
ELECTRICAL DESIGN  
WIND POWER GENERATION SYSTEM

ACOUSTICAL BREADTH  
AUDITORIUM





# The Nerman Museum of Contemporary Art



## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS	SUPPORT
												PROFESSORS   LAM PARTNERS   FAMILY + FRIENDS	

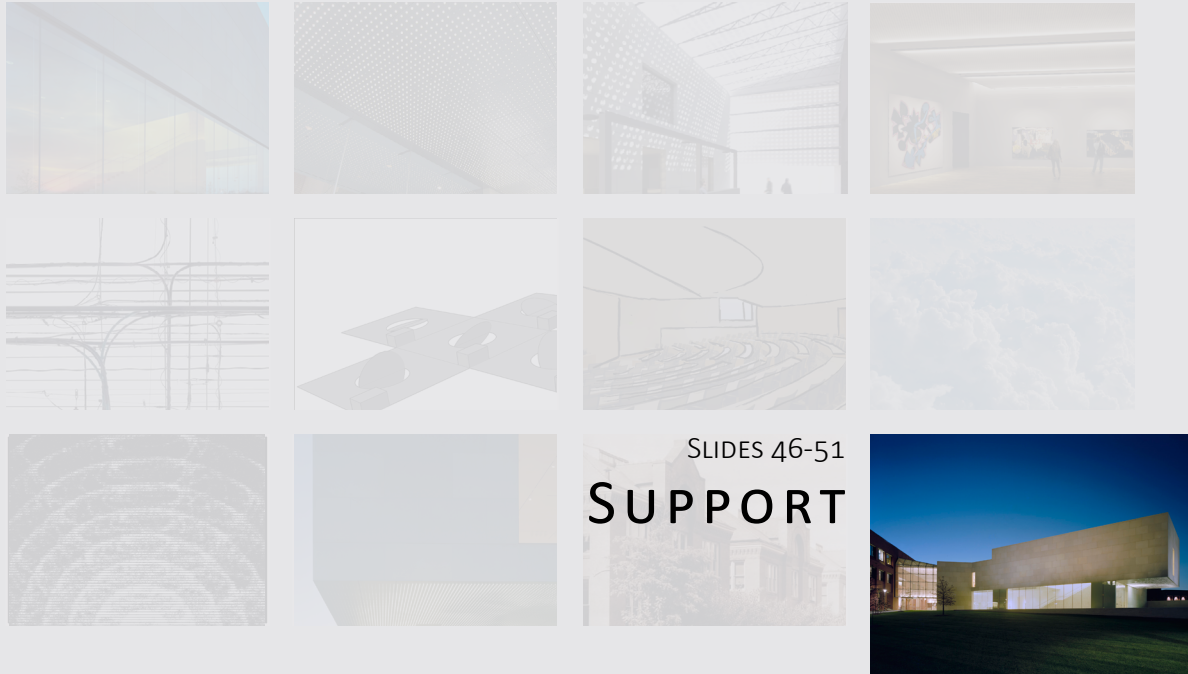
## THANK YOU!

AE DEPARTMENT  
DR. MISTRICK  
SHAWN GOOD  
LESLIE BEAHM  
DR. HOUSER  
PROFESSOR PARFITT  
PROFESSOR COX  
CRAIG CASEY

LAM PARTNERS

MY FAMILY & FRIENDS

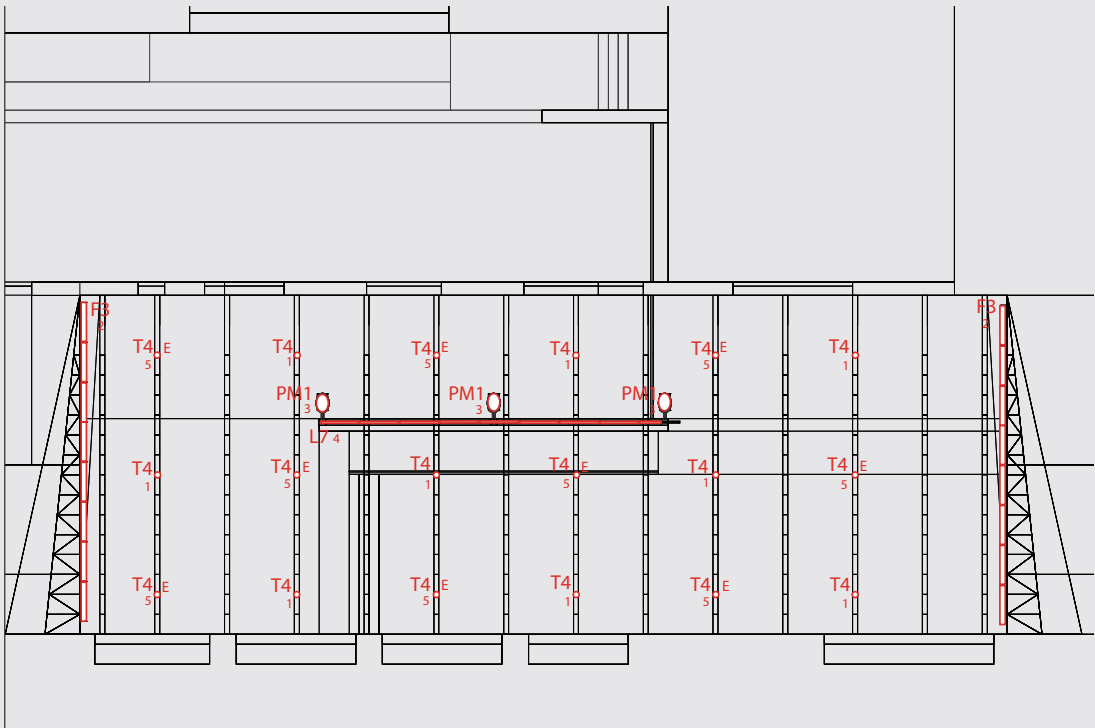
# The Nerman Museum of Contemporary Art



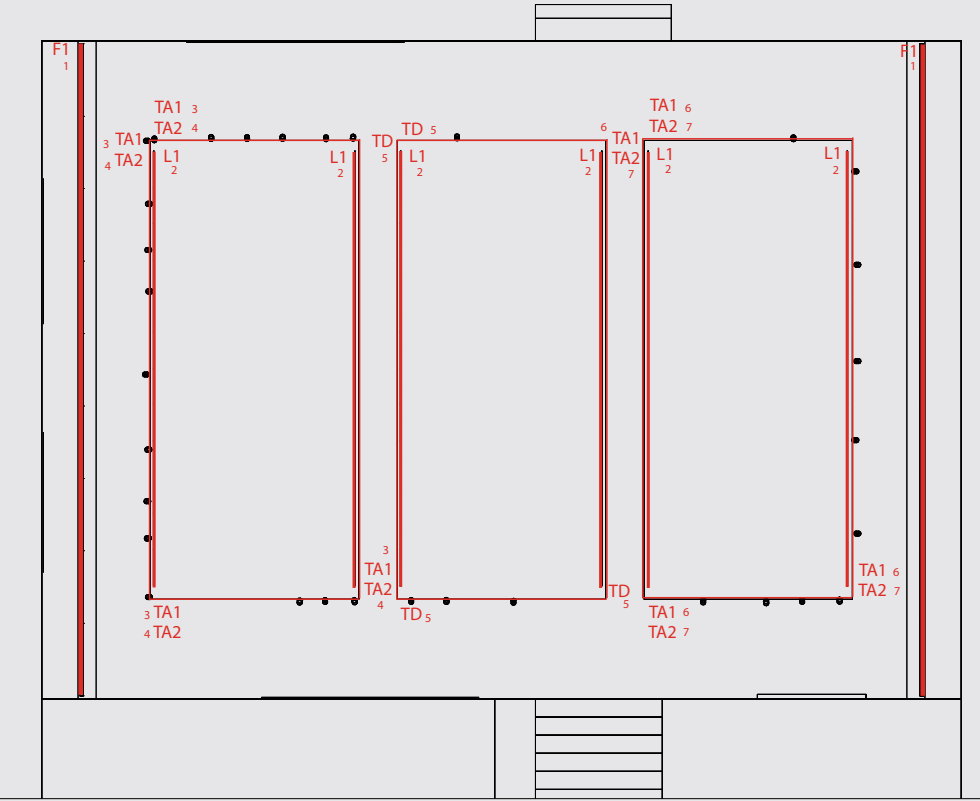
## OUTLINE

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## SOLARIUM LIGHTING PLAN

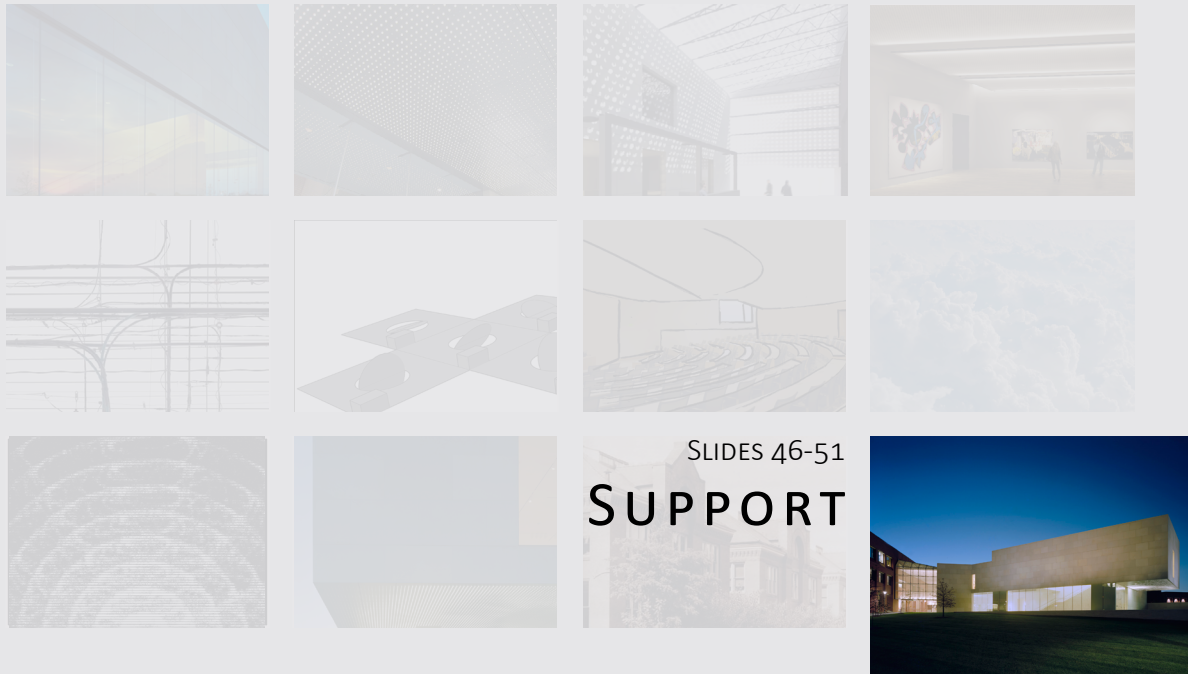


## GALLERY LIGHTING PLAN





# The Nerman Museum of Contemporary Art



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## SOLARIUM LPD

Fixture Type	System Wattage	Quantity	Total Watts
L6	29	9	261
F4	56	16	896
TC	60	18	1080
PM1	57	3	171
Total Watts			2,408
Area (SF)			3,500
Watts/SF			0.69
ASHRAE 90.1 compliant?			0.88- <b>Yes</b>

## INDUCTION MOTOR STATS

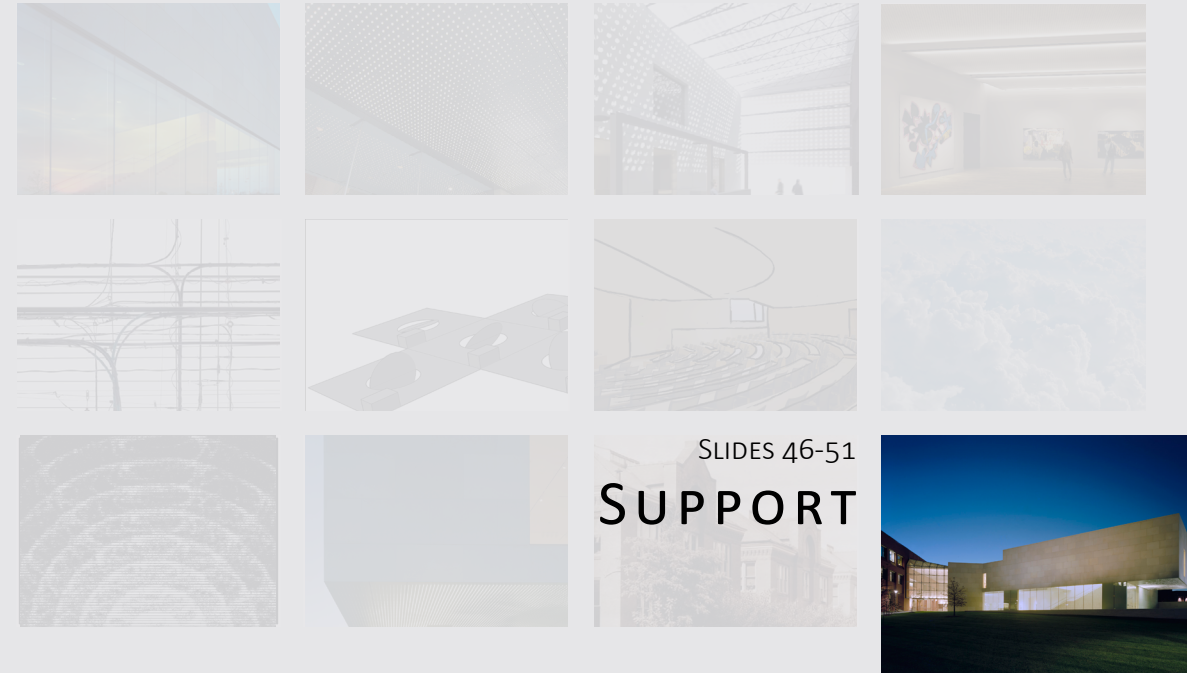
Frequency	Ratio		3	3.6	5	6	7.5	9	10	12.5	15	18	20	25
50HZ	Output Speed	r/min	500	417	300	250	200	166	150	120	100	83	75	60
	Allow Toruqe	N.m	0.13	0.15	0.21	0.21	0.32	0.38	0.42	0.53	0.63	0.76	0.76	0.95
		kgf.cm	1.3	1.5	2.1	2.1	3.2	3.9	4.3	5.4	6.4	7.7	7.7	9.7
Frequency	Ratio		30	36	40	50	60	75	90	100	120	150	180	200
50HZ	Output Speed	r/min	50	41	37	30	25	20	16	15	12	10	8	7.5
	Allow Toruqe	N.m	1.14	1.36	1.52	1.72	2.06	2.57	2.94	2.94	2.94	2.94	2.94	2.94

## GALLERY LPD

Fixture Type	System Wattage	Quantity	Total Watts
F1	33.5	18	603
L1	4.4	72	316.8
TA	1200	1	1200
TA	600	1	600
TA	1200	1	1200
Total Watts			3919.8
Area (SF)			1,990
Watts/SF			1.97
ASHRAE 90.1 compliant?			2.05- <b>Yes</b>

track: TA	LF	W	W/LF	# of Fixtures	# of Fixtures
end panel1	72	600	8.3	28.6	28
end panel2	72	600	8.3	28.6	28
middle panel	72	600	8.3	28.6	28
end panel1	72	600	8.3	28.6	28
end panel2	72	600	8.3	28.6	28
total	360	3000		total	140
total W		603			
		316.8			
		3919.8			

# The Nerman Museum of Contemporary Art



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## ASHRAE 90.1 - TRACK LIGHTING

## SECTION 9.1.4

**Exception:** Lighting power calculations for *ballasts* with adjustable *ballast* factors shall be based on the *ballast* factor that will be used in the *space* provided that the *ballast* factor is not user changeable.

- c. For line-voltage lighting track and plug-in busway, designed to allow the addition and/or relocation of *luminaires* without altering the wiring of the *system*, the wattage shall be
  1. the specified wattage of the *luminaires* included in the *system* with a minimum of 30 W/lin ft or
  2. the wattage limit of the *system's circuit breaker* or
  3. the wattage limit of other permanent current-limiting device(s) on the *system*.

## SECTION 9.6.2

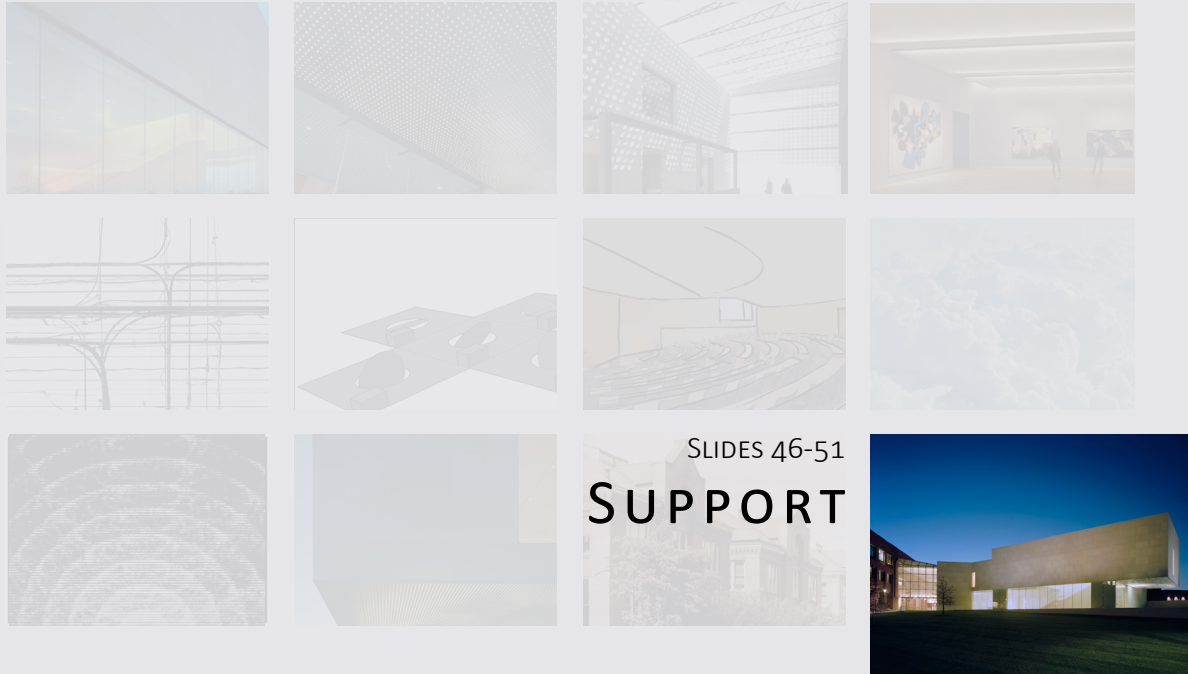
**9.6.2 Additional Interior Lighting Power.** When using the Space-by-Space Method, an increase in the *interior lighting power allowance* is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed and automatically controlled, separately from the *general lighting*, to be turned off during nonbusiness hours. This additional power shall be used only for the specified *luminaires* and shall not be used for any other purpose, unless otherwise indicated.

An increase in the *interior lighting power allowance* is permitted in the following cases:

- a. For *spaces* in which lighting is specified to be installed in addition to the *general lighting* for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft<sup>2</sup> of such *spaces*.

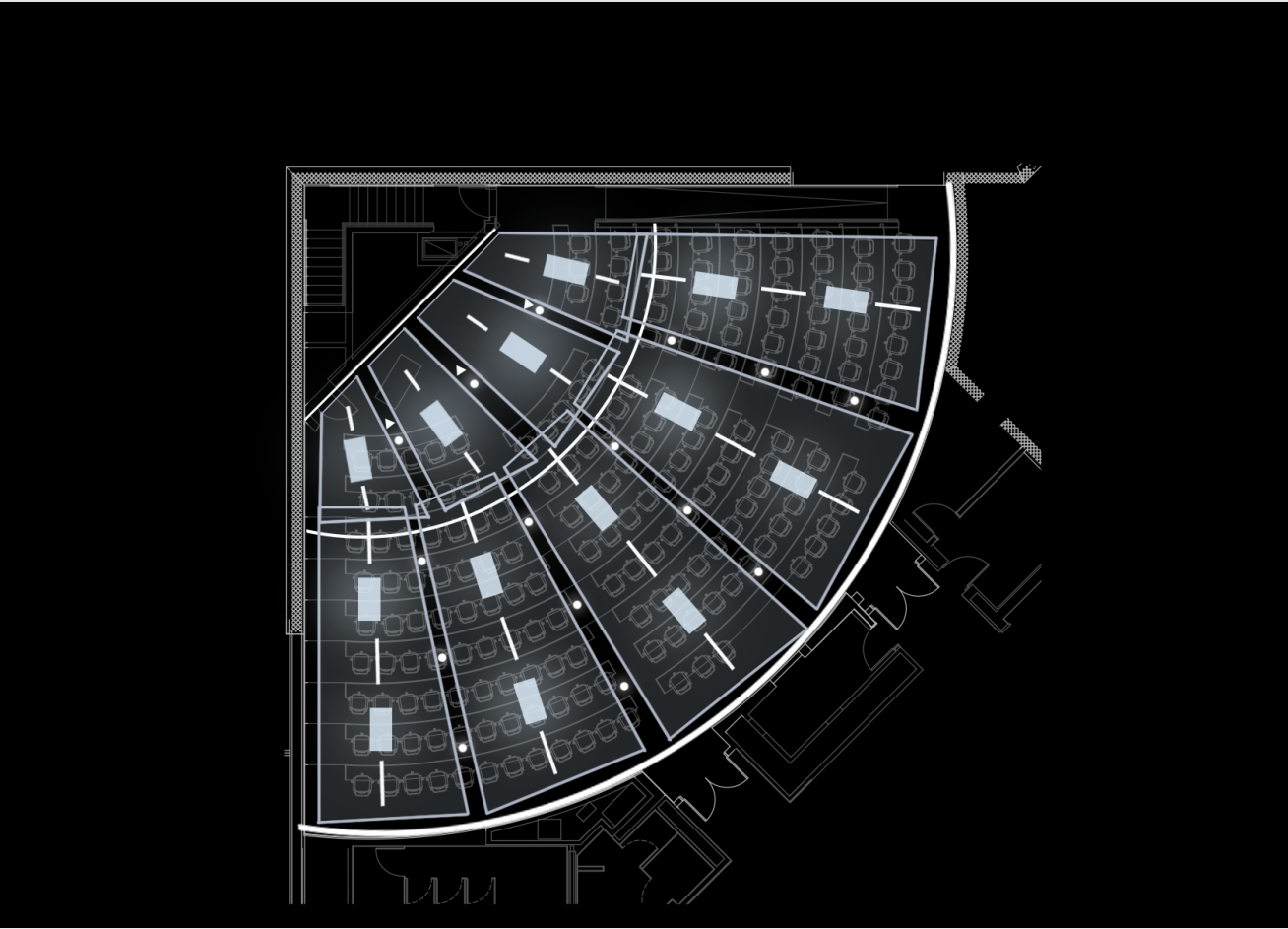
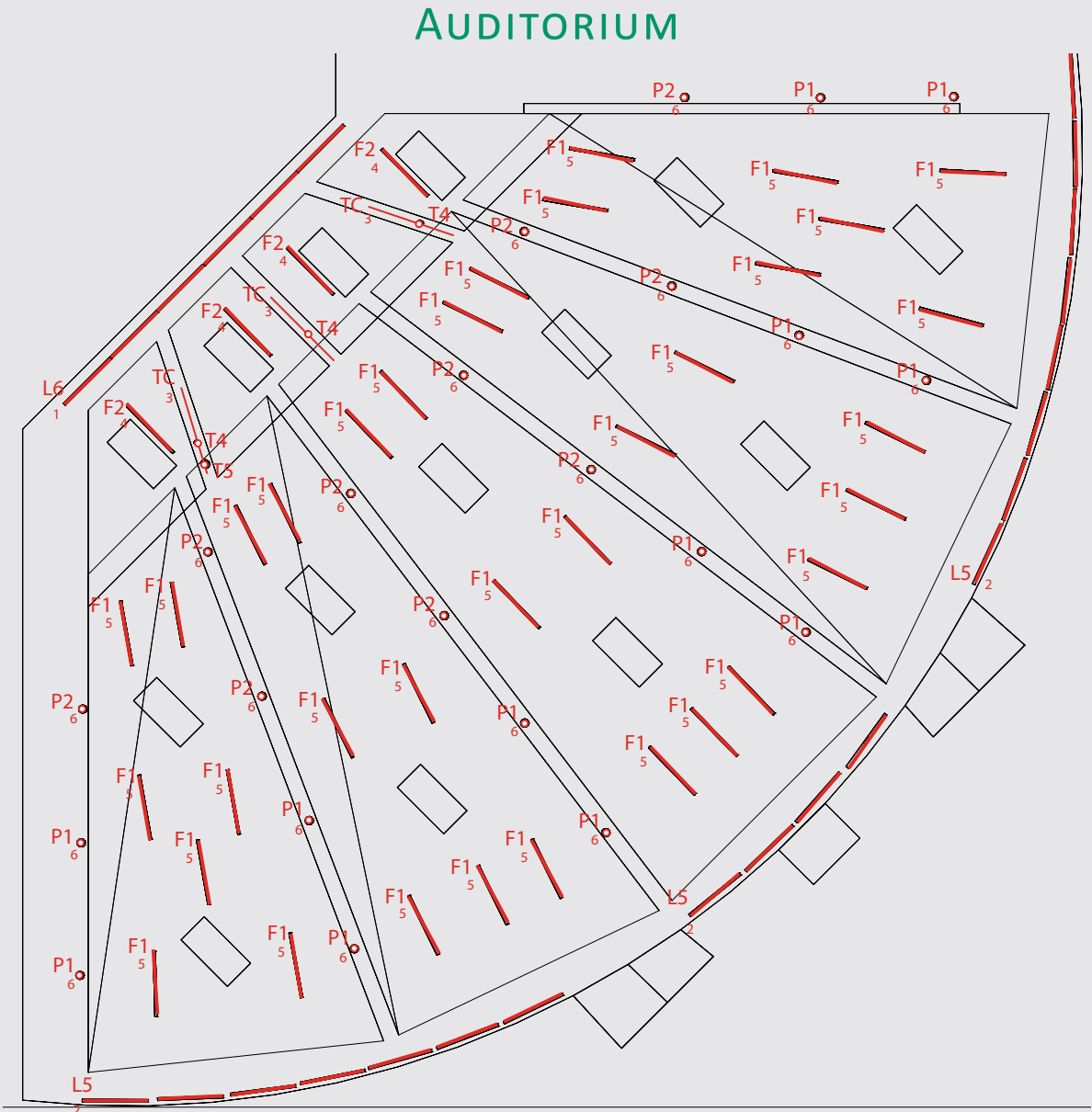


# The Nerman Museum of Contemporary Art

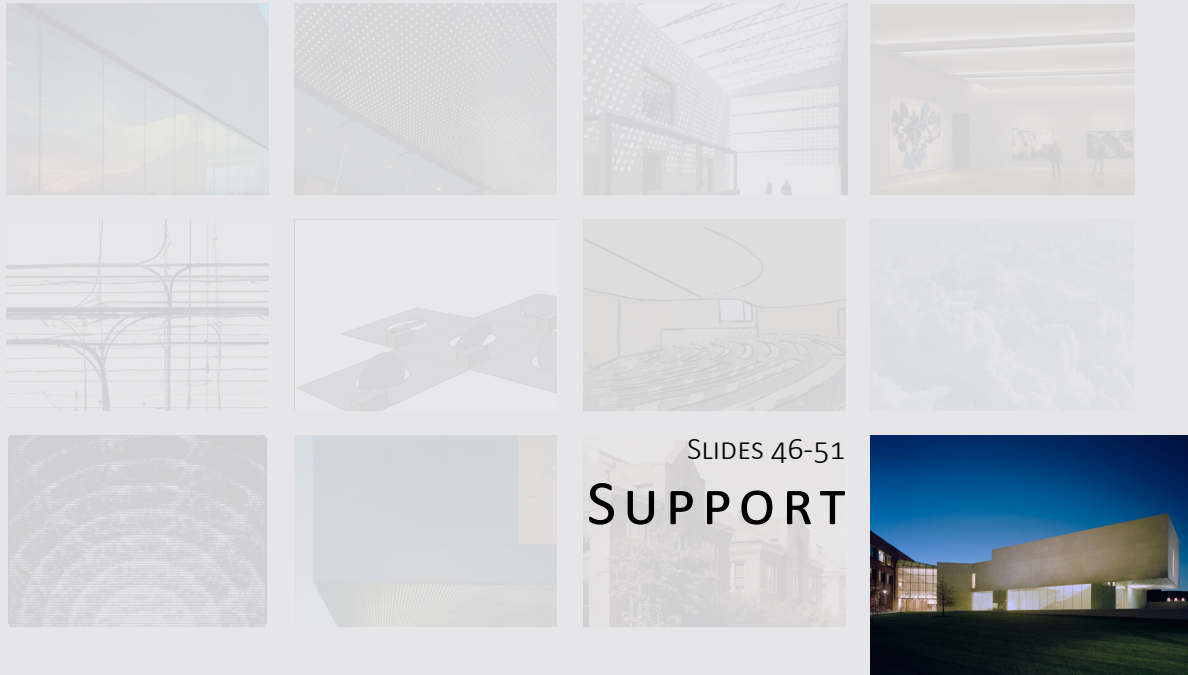


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# The Nerman Museum of Contemporary Art







SLIDES 46-51

SUPPORT

## OUTLINE

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## SOLARIUM LUMINAIRES

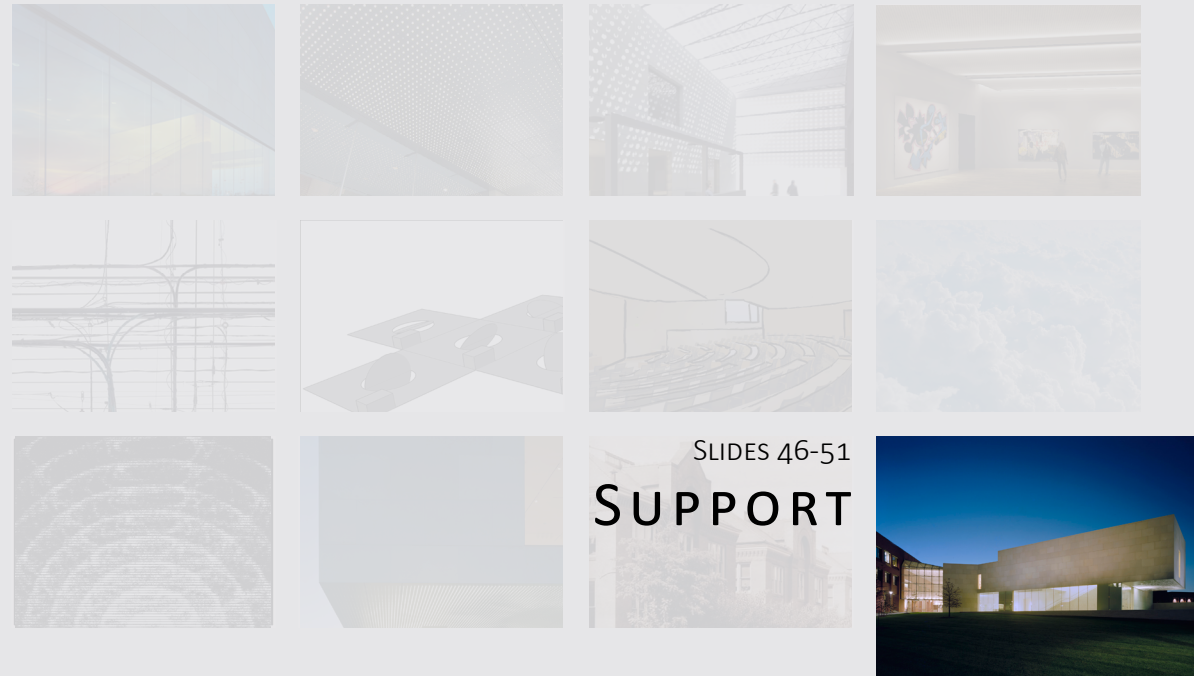
Type		Manufacturer	Description
	L7	Lumenpulse	4 foot LED strip. 8.5 watts/foot, Regular Output. 60x60 degree beam spread. Remote driver with standard dimming.
	F3	Litecontrol	(2) T8 fluorescent 4' length. Concealed cove fixture. 3500K 81CRI. 64W
	T4	Edison Price	Hanging LED tack system, integrated with fabric panel system, 1500 lumen package, 80+ CRI. 20 degree beam spread. Dimmable standard driver. 3500K
	PM1	Bega	52W LED pole mounted fixture. Clear acrylic diffused light distribution optic with 3500K. 4,900 lumen package. Type IV (IES classification).

## GALLERY LUMINAIRES

Type		Manufacturer	Description
	F1	Bartco	4 foot linear fluorescent strip. Integral ballast. (1) T8 lamp.
	L1	Acolyte	LED RibbonLyte static white 3500K. AT3 Channel with 30 degree beam spread. 1.5 watts per foot.
	T1	Edison Price	Hanging LED tack system, integrated with fabric panel system, 1000 lumen package, artist series 97 CRI. 20 degree beam spread. Dimmable standard driver. 3500K
	T2	Edison Price	Hanging LED tack system, integrated with fabric panel system, 1000 lumen package, artist series 97 CRI. 40 degree beam spread. Dimmable standard driver. 3500K
	T3	Edison Price	Hanging LED tack system, integrated with fabric panel system, 1000 lumen package, artist series 97 CRI. 60 degree beam spread wall washer. Dimmable standard driver. 3500K



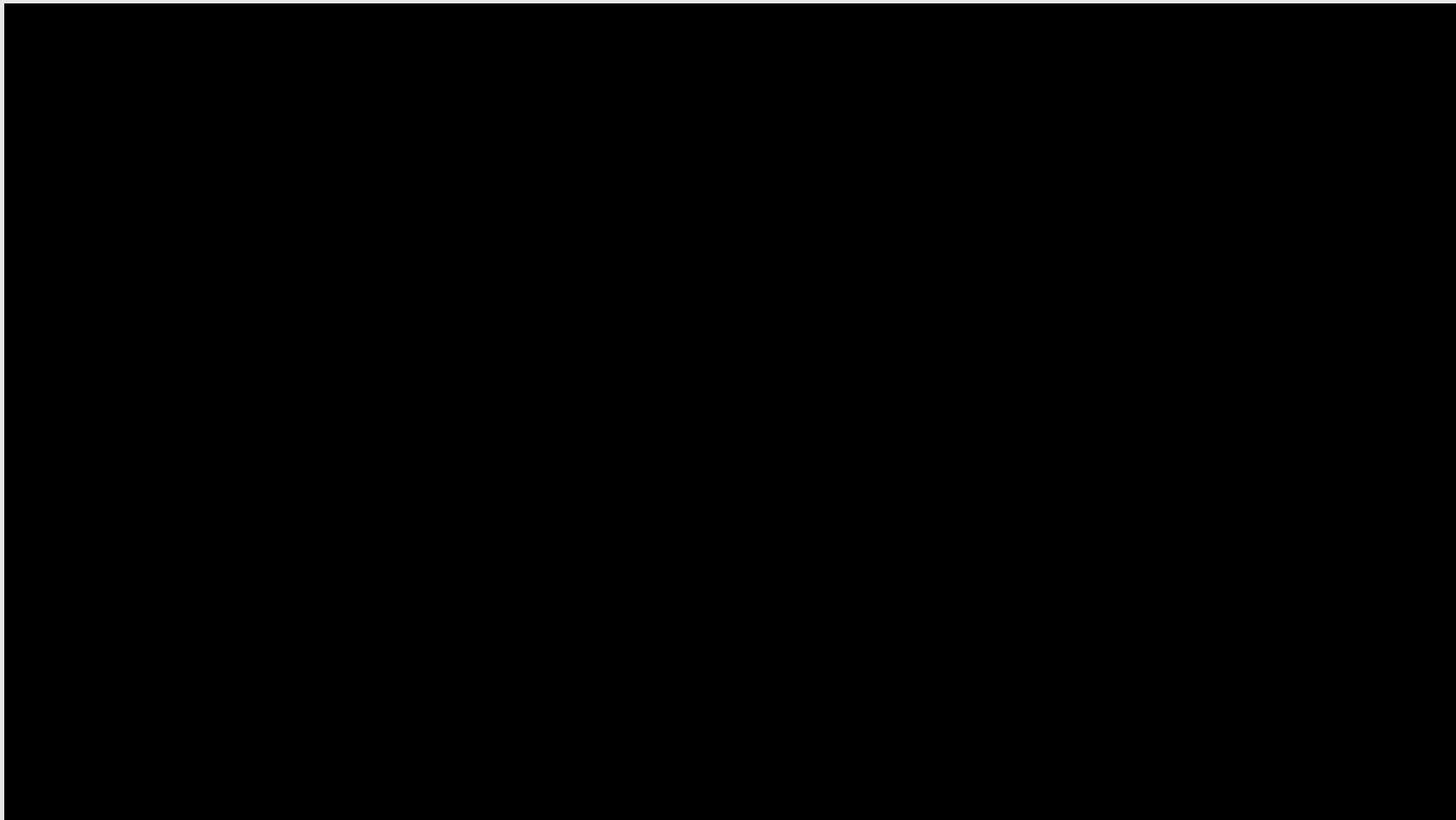
# The Nerman Museum of Contemporary Art



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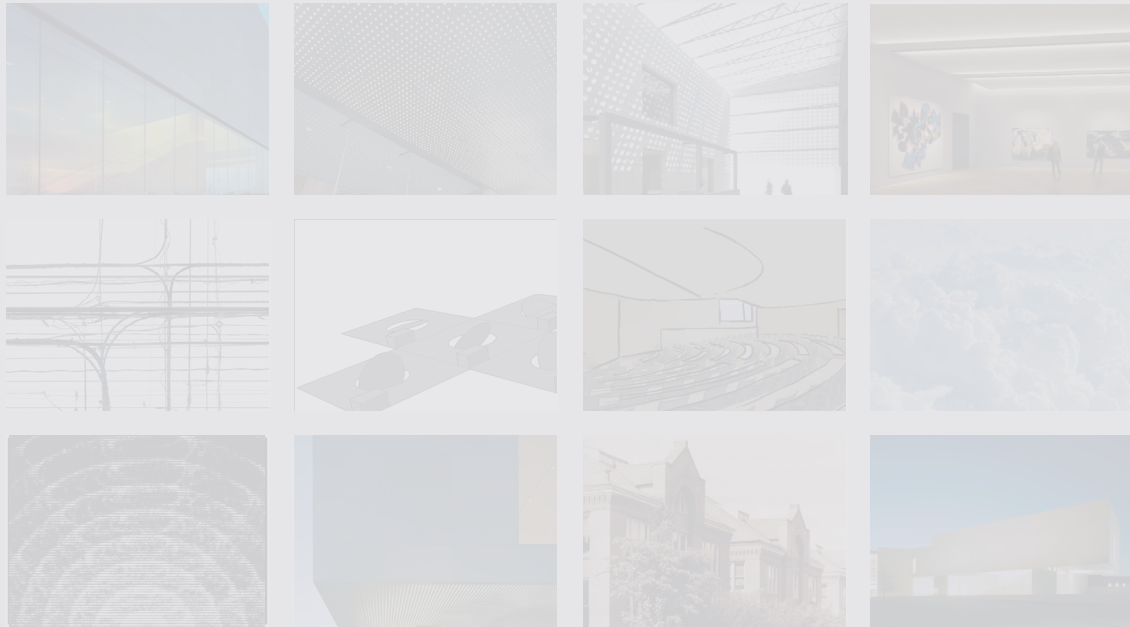
## SOLARIUM PRECEDENCE “WINDSWEPT” BY CHARLES SOWERS



## AUDITORIUM PRECEDENCE NEWMAT



# The Nerman Museum of Contemporary Art



## REFERENCES

[HTTP://STATIC.DESIGNSPIRATION.NET/DATA/L/90227414649\\_XFFSWITR\\_L.JPG](http://static.designspiration.net/data/L/90227414649_XFFSWITR_L.JPG)  
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## OUTLINE

COVER	INTRODUCTION	SCOPE	LIGHTING	SOLARIUM	GALLERY	ELECTRICAL	WIND POWER	BREADTH	AUDITORIUM	ACOUSTICS	CONCLUSION	CREDITS
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