

The Bronx Community College  
North Instructional Building

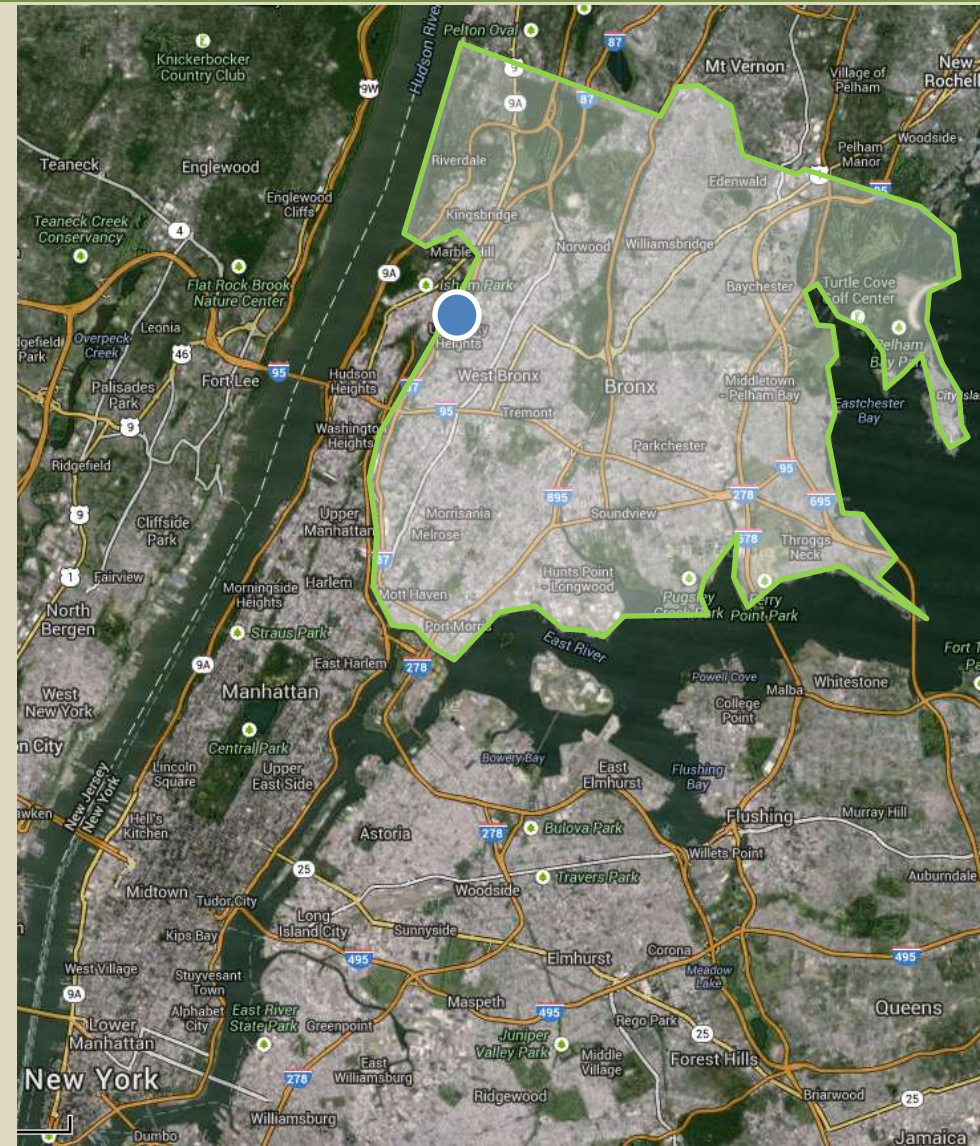
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Jarret J. Clark | Final Presentation | 4.14.14

- Introduction
- Lighting Design Concept
- Main Lobby
- Law Classroom
  - Architectural Breadth
- Electrical Depth
  - Photo-voltaic Breadth
- Conclusions



Google Maps



## Location and Site

- Bronx Community College, Bronx, New York

## Size

- 98,600 square feet

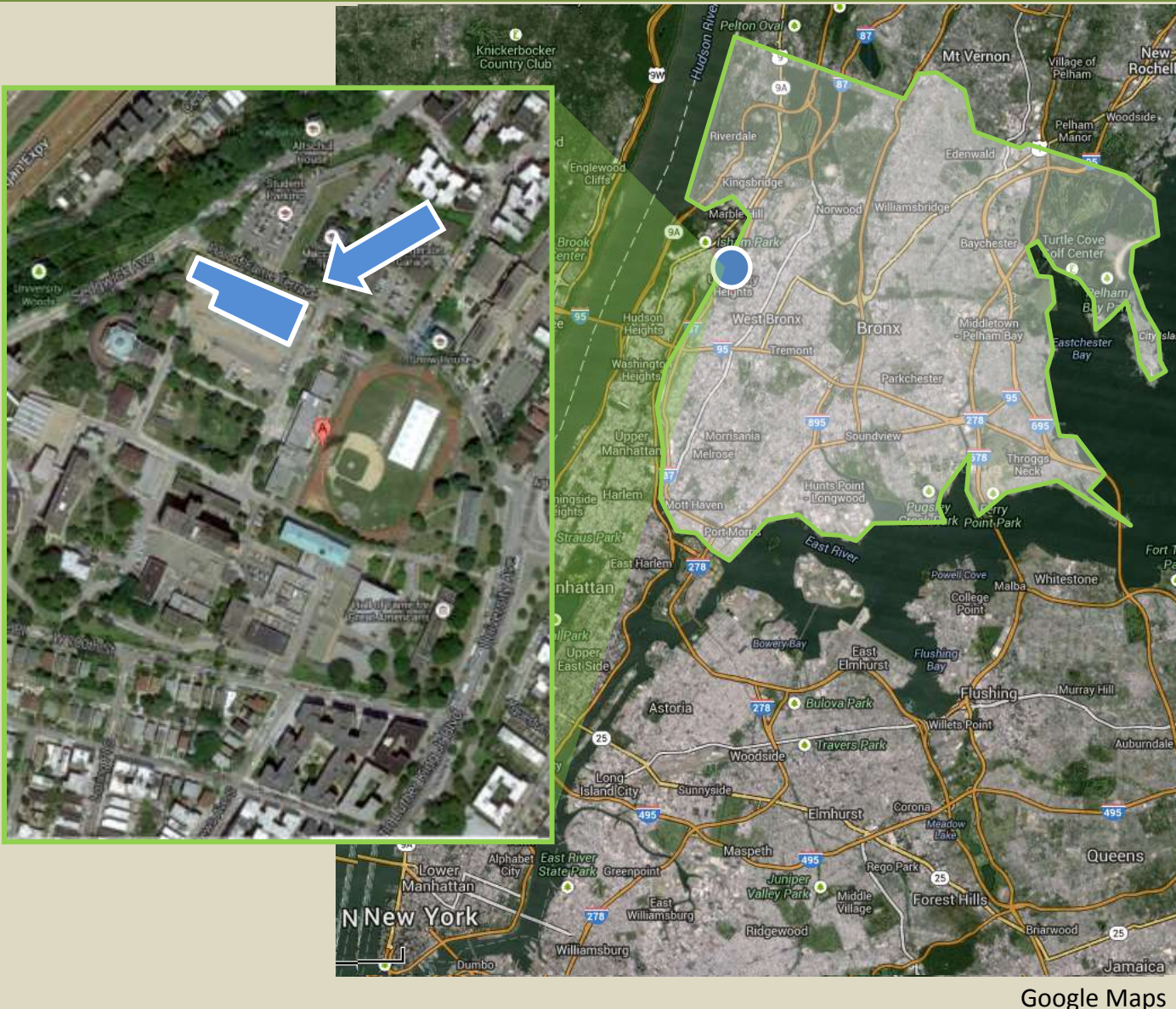
## Building Cost

- \$74 million (\$104 million budget)

## Address

- University Avenue West 181 Street Bronx Community College, Bronx, New York

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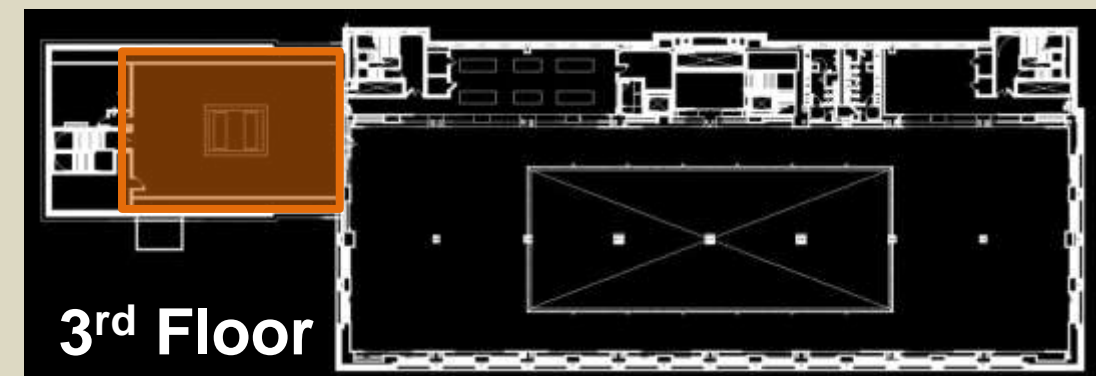
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**Information Lobby**

**Main Lobby**

**Corridor**

**Law Classroom**



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# Concept

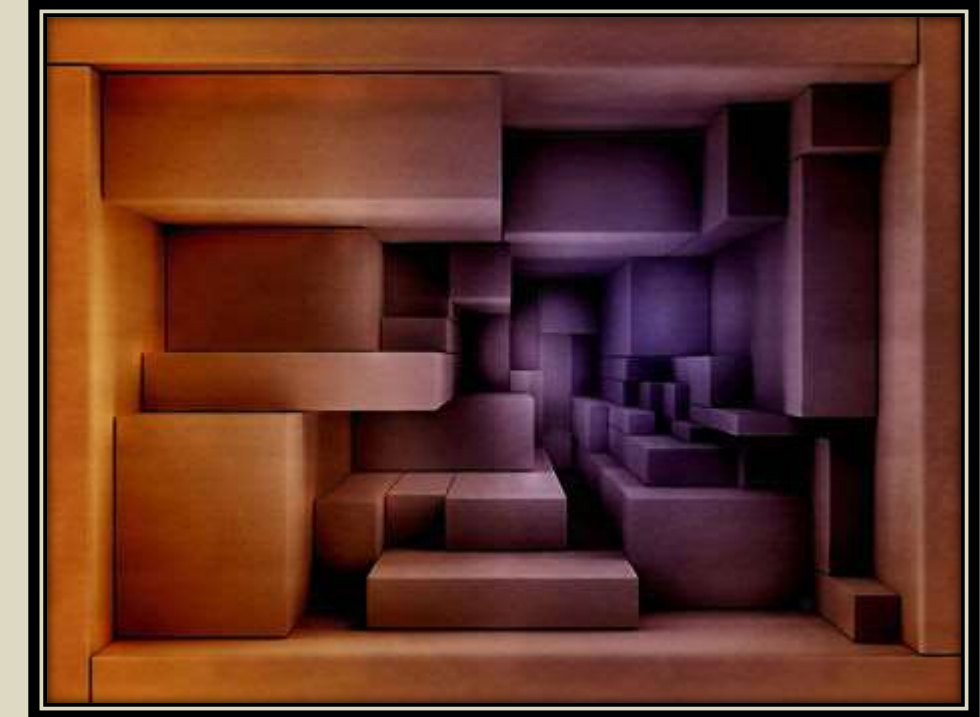


## Overall Lighting Concept

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## Lighting Concept

**Utilize Light to Create *Depth* and  
*Dimension* Among the  
*Architectural Features***



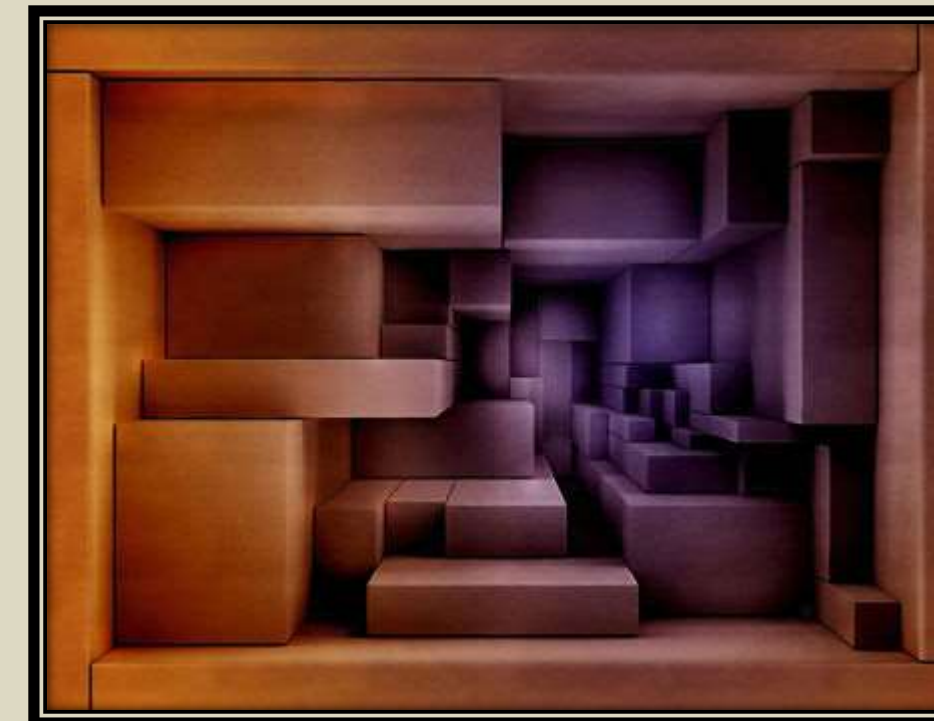
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### *Design Criteria*

- ***Use light to add depth and dimension to the space***
- ***Visual interconnection between spaces***
- ***Guide occupants to their destination***
- ***Maintain Symmetry and Visual Clarity***

### *Lighting Concept*

***Utilize Light to Create **Depth** and **Dimension** Among the Architectural Features***



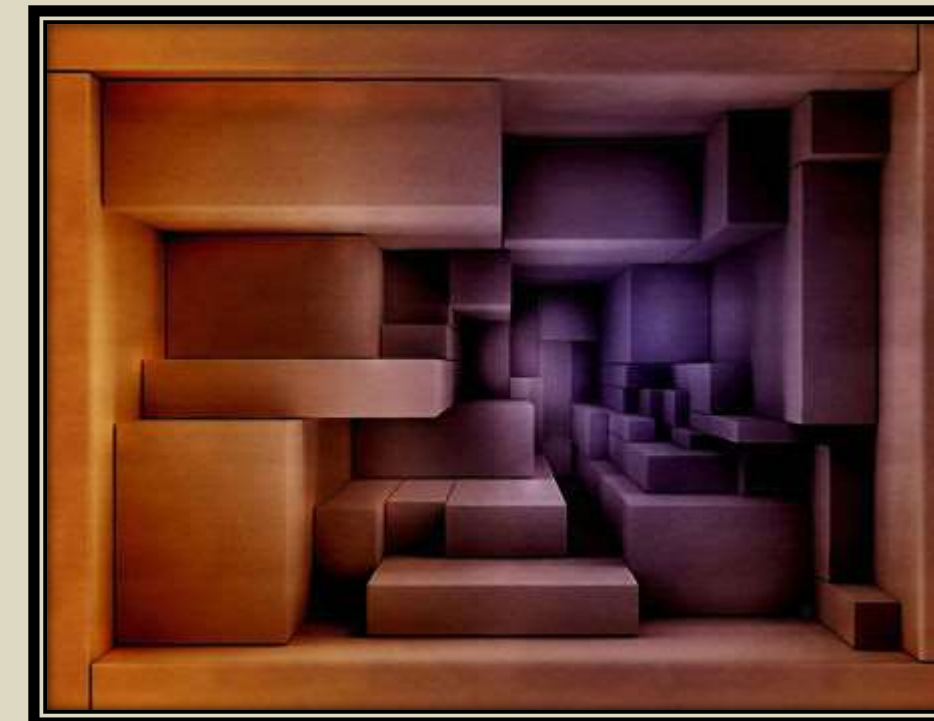
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**Utilize Light to Create *Depth* and *Dimension* Among the Architectural Features**

### Solutions

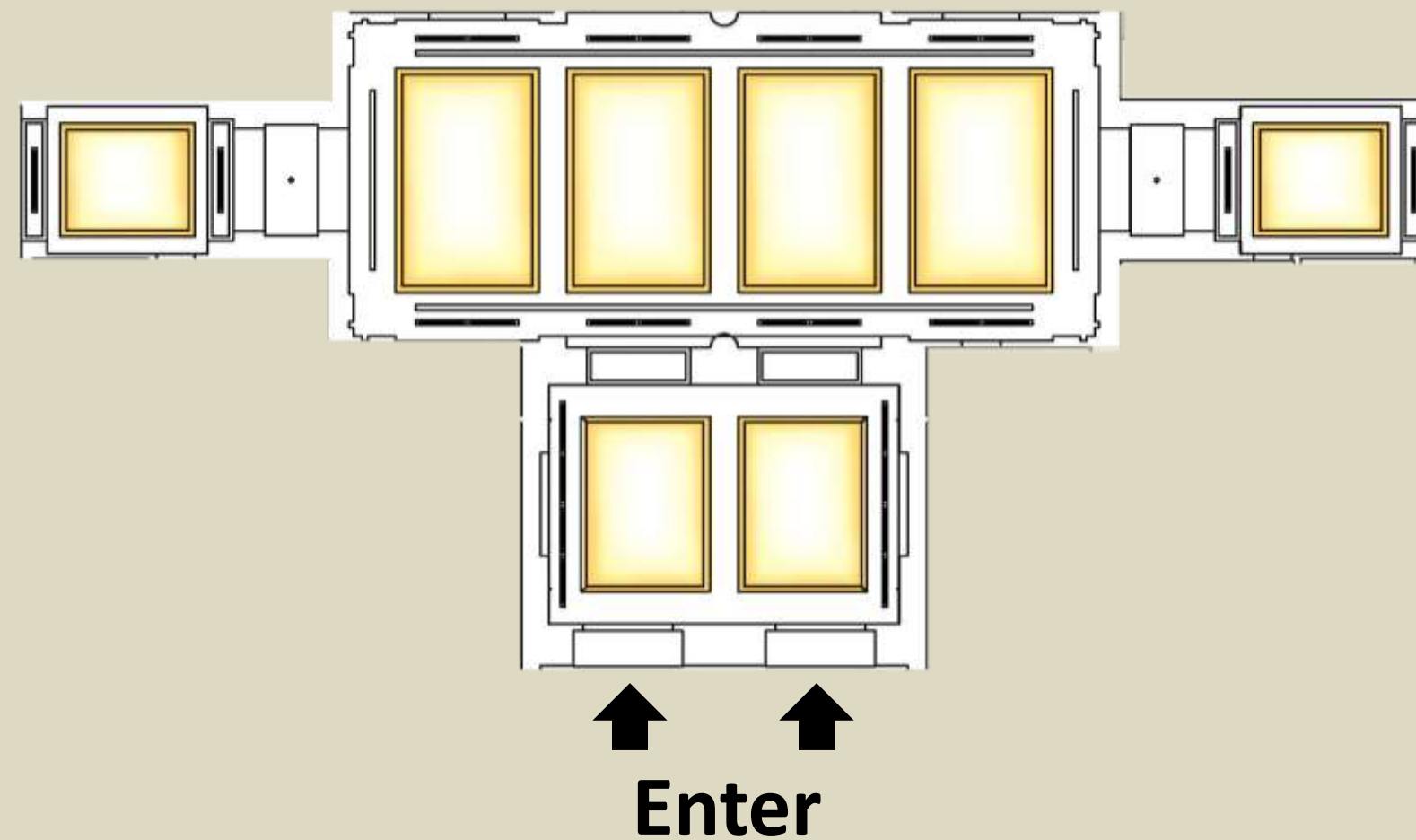
- **Architectural Cove Lighting**
  - **Adds Depth and Visual Interest**
  - **Creates Visually Interconnected Transition**
- **Minimalistic Lighting Fixtures to Eliminate Distraction**
- **Decorative Fixtures unify with Architectural Style**

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### Cove Lighting Ceiling Design



### Solutions

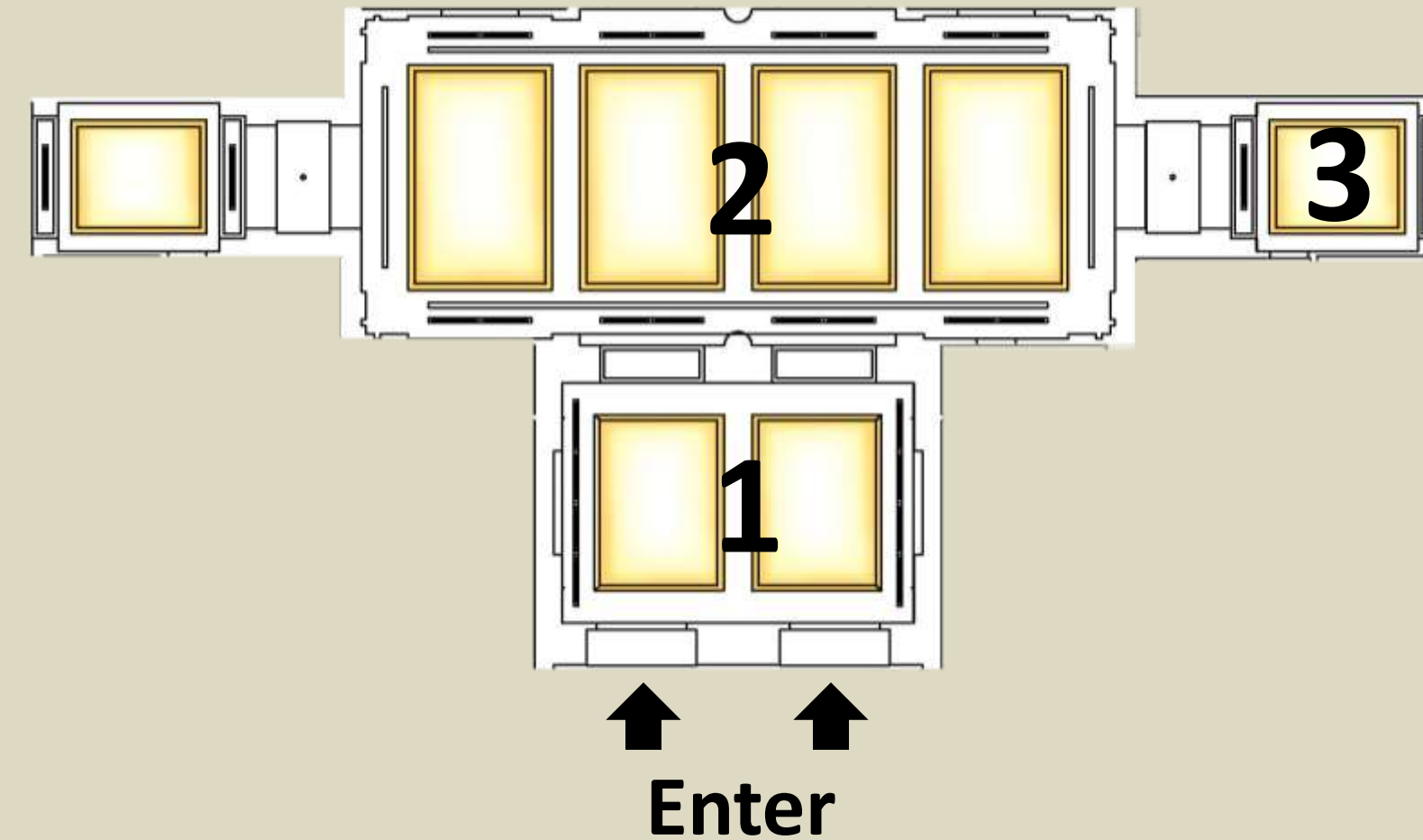
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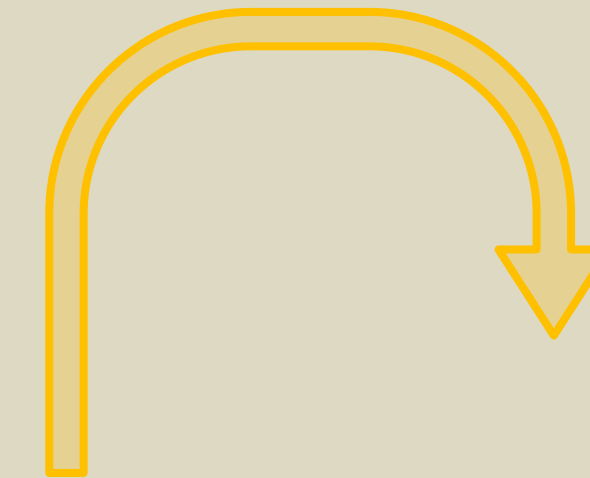
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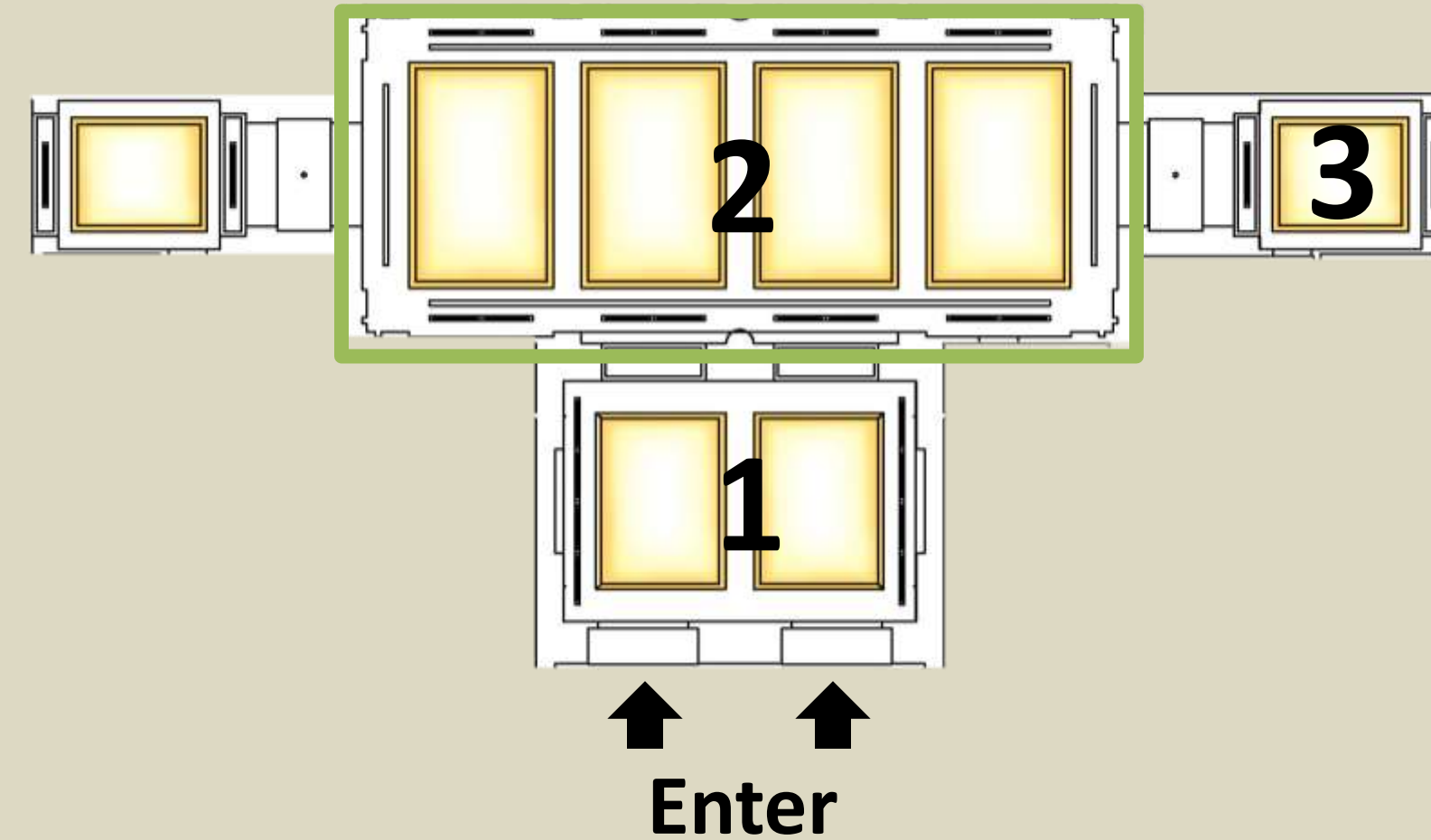


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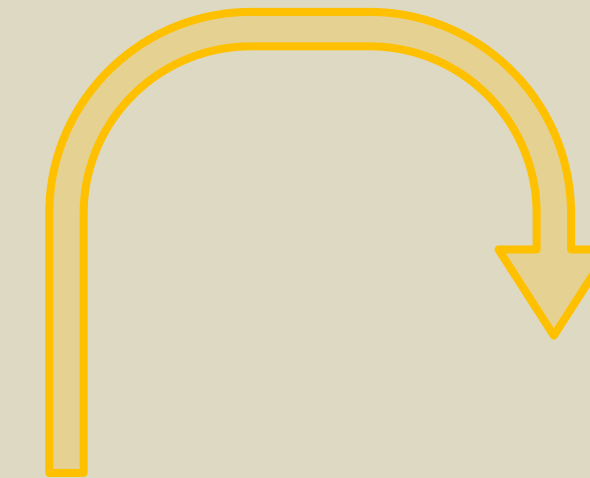
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# Lighting Depth



**Main Lobby**

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### *Space Dimensions*

Area – 531 sq. ft.

Ceiling Height – 11’

Approximate Length– 28’

Approximate Width– 18’



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### Design Criteria

- **Spacious Social Environment**
  - **Bright Uniform Perimeter**
- **Way-finding**
- **Clean Minimalistic Lighting**
- **Maintain Symmetry & Context of Architecture**

### Space Dimensions

Area – 531 sq. ft.

Ceiling Height – 11'

Approximate Length– 28'

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### Additional Criteria

Common Applications | Reading and Writing | Print Media | 12pt Font | Matte Paper

#### Recommended Maintained Illuminance Levels

Avg. Horizontal @ 2.5'	Avg: Min
100 lux	2:1

ANSI/ASHRAE/IES Standard 90.1-2010 Space by Space Method

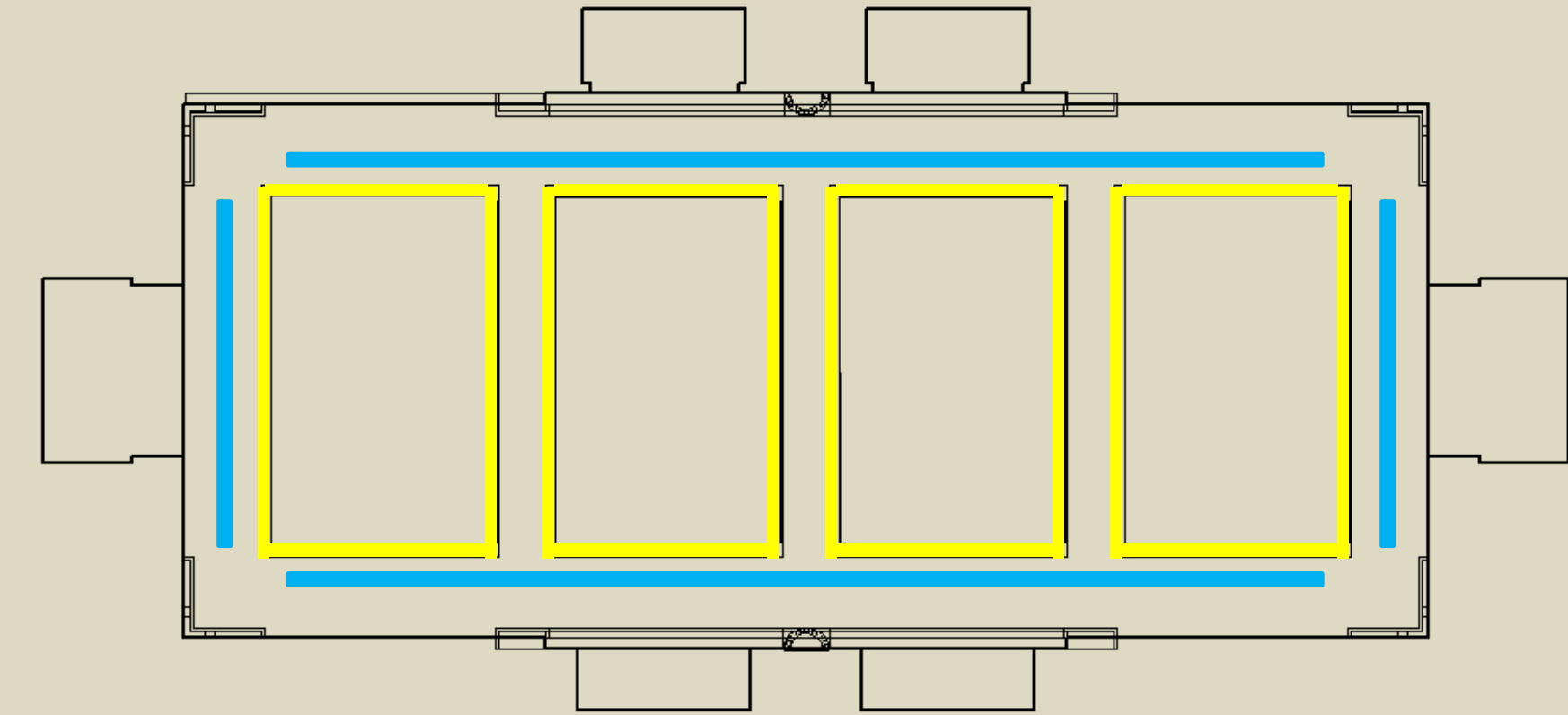
#### Lighting Power Density

Space Type	Max Allowable LPD
Lobby	0.9 W/sq.ft.

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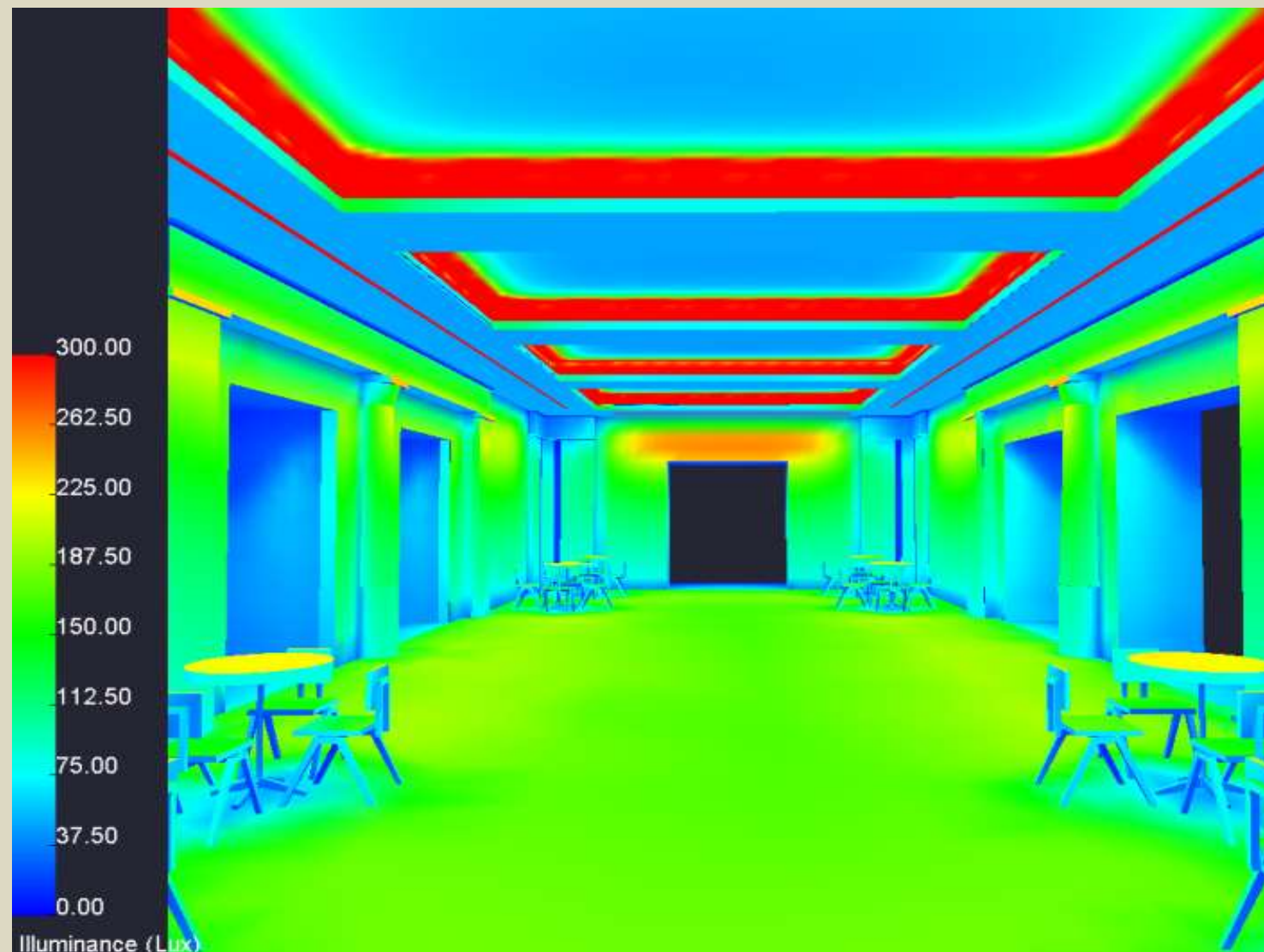




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Illuminance Data		
Calculation	Target (lux)	Horizontal @ 2.5' (lux)
Average Illuminance	100	194
Max. Illuminance	-	233
Min. Illuminance	-	116
Average/Minimum	1.5	1.67

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L3	LED Rec.Linear	128 ft	7 W/ft	896
L6	Cove Ribbon	208 ft	1.5 W/ft	312

ANSI/ASHRAE/IESNA 90.1 - 2010		
Category	Allowable	Actual
Area (ft <sup>2</sup> )	-	1533
Input Watts (W)	-	1208
Power Density (W/ ft <sup>2</sup> )	0.9	<b>0.79</b>

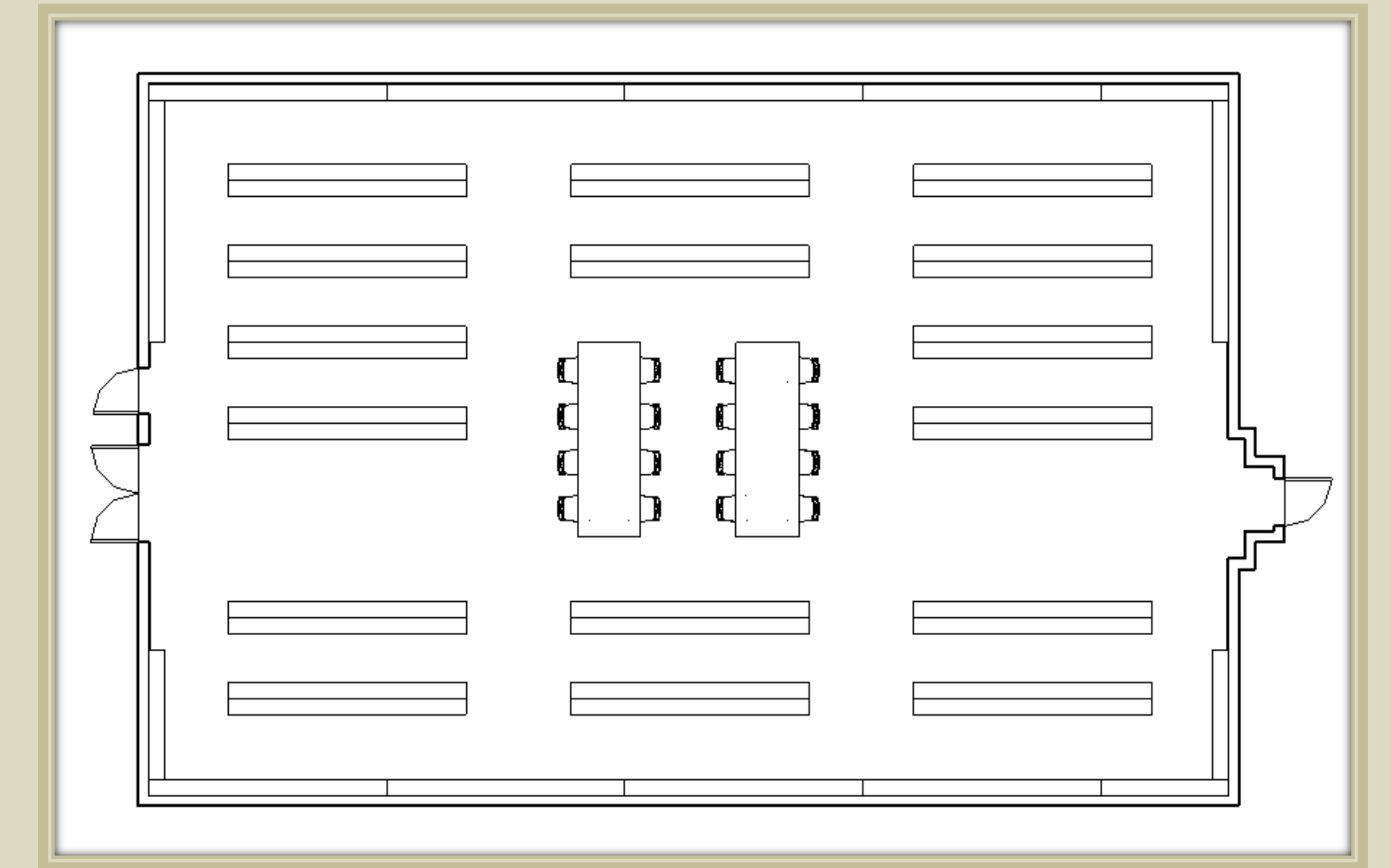
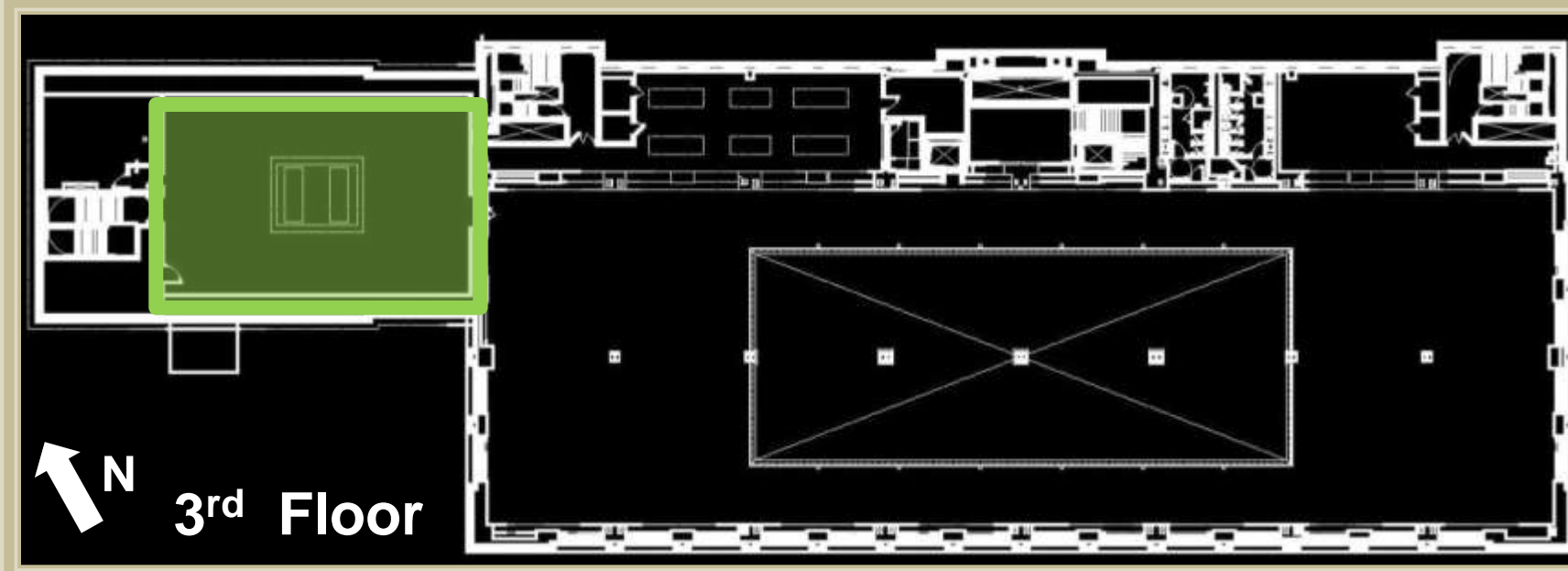
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# Architectural Breadth



Law Classroom and Stacks

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**Existing Floor Plan**

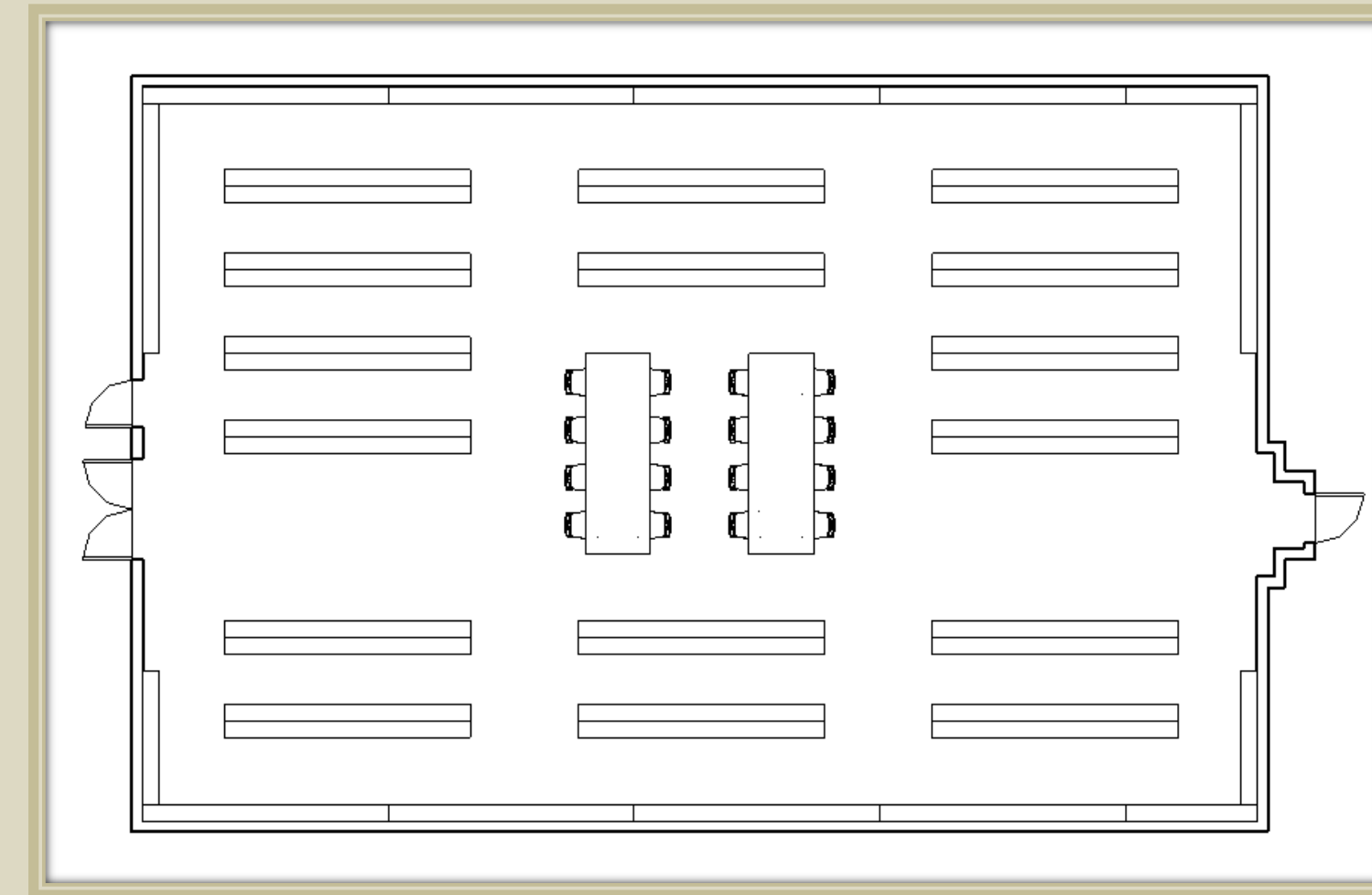
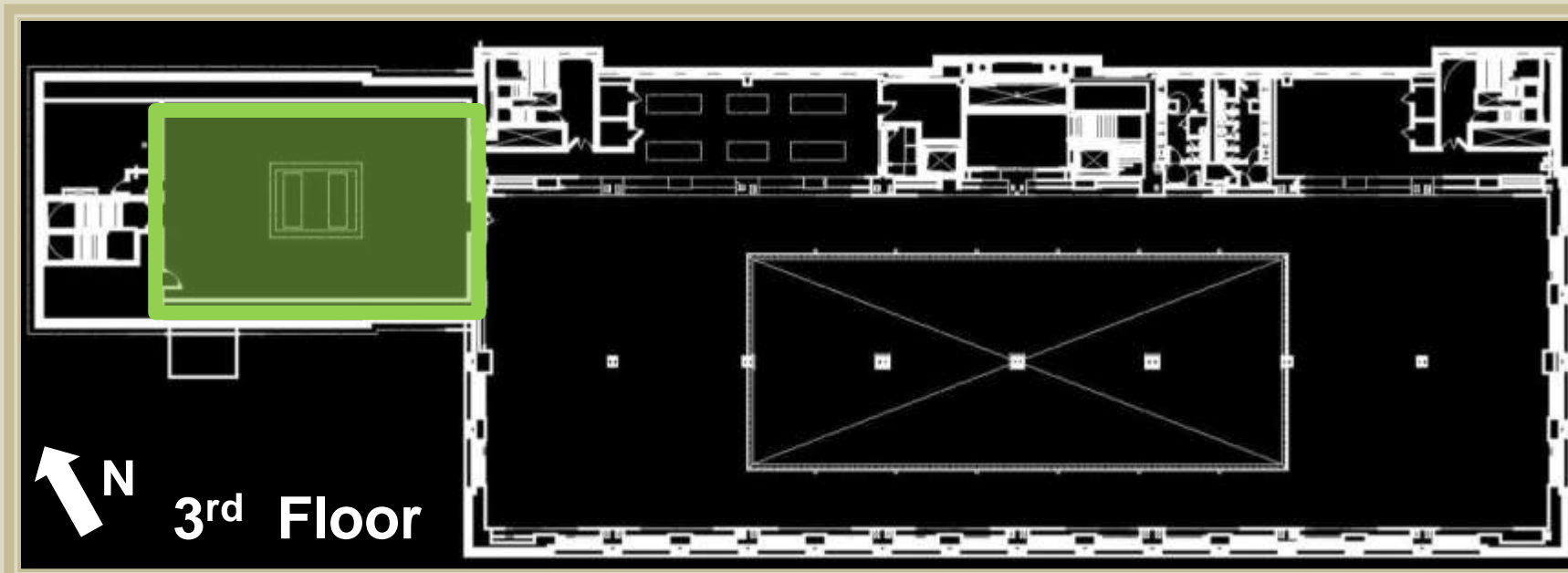
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### Inspirational Quotes

*“Social interactions, discussion, debate, and teamwork encourage learning and prompt a design requirement for rooms that can be **reconfigured quickly**”*

*“Natural motivation to learn can be rekindled by supportive environments, meaningful activities, by being **freed of anxiety**, fear, and other negative mental states.”*

*“Intrinsic motivation... is assisted by a level of familiarity and **absence of distraction.**”*

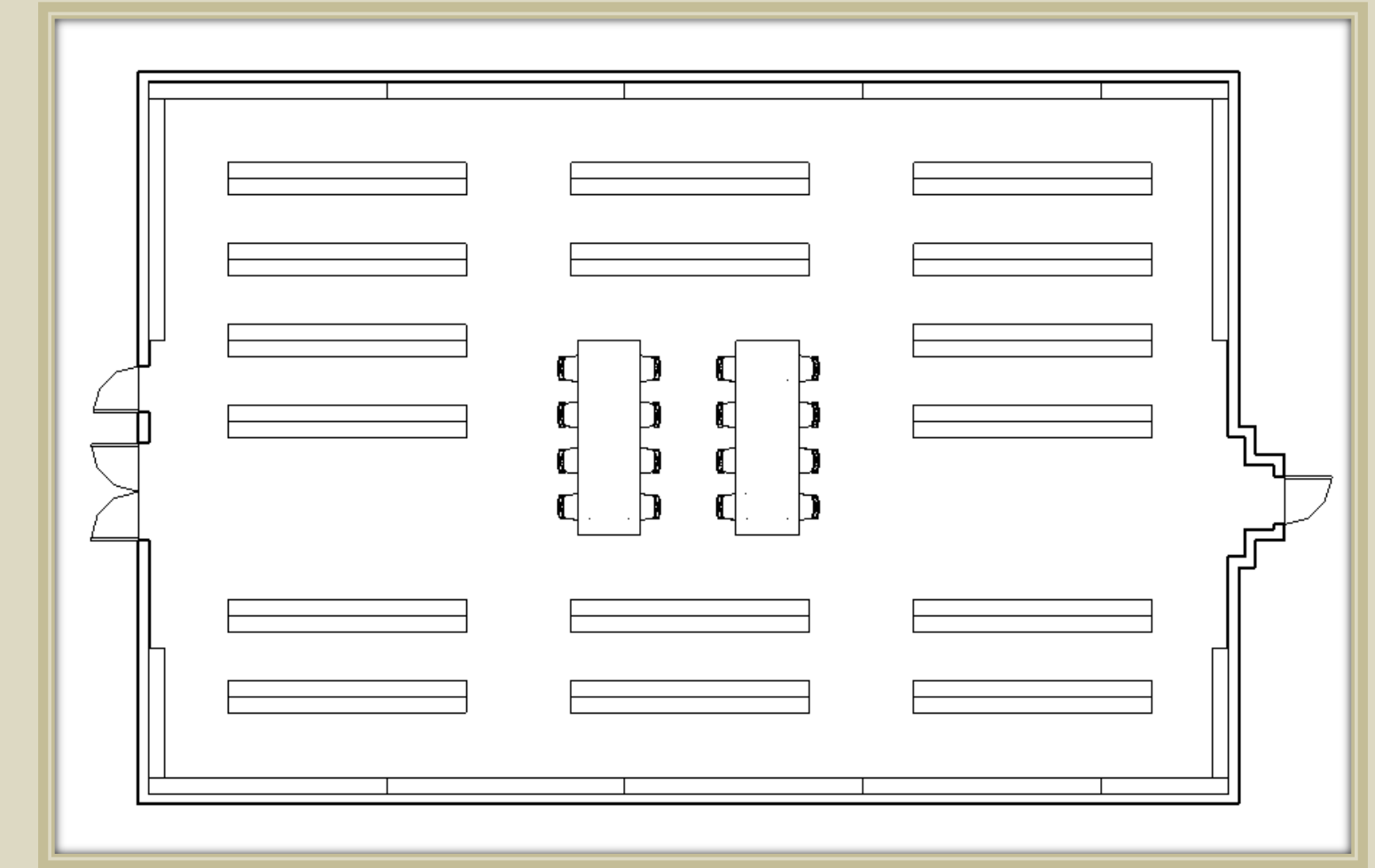
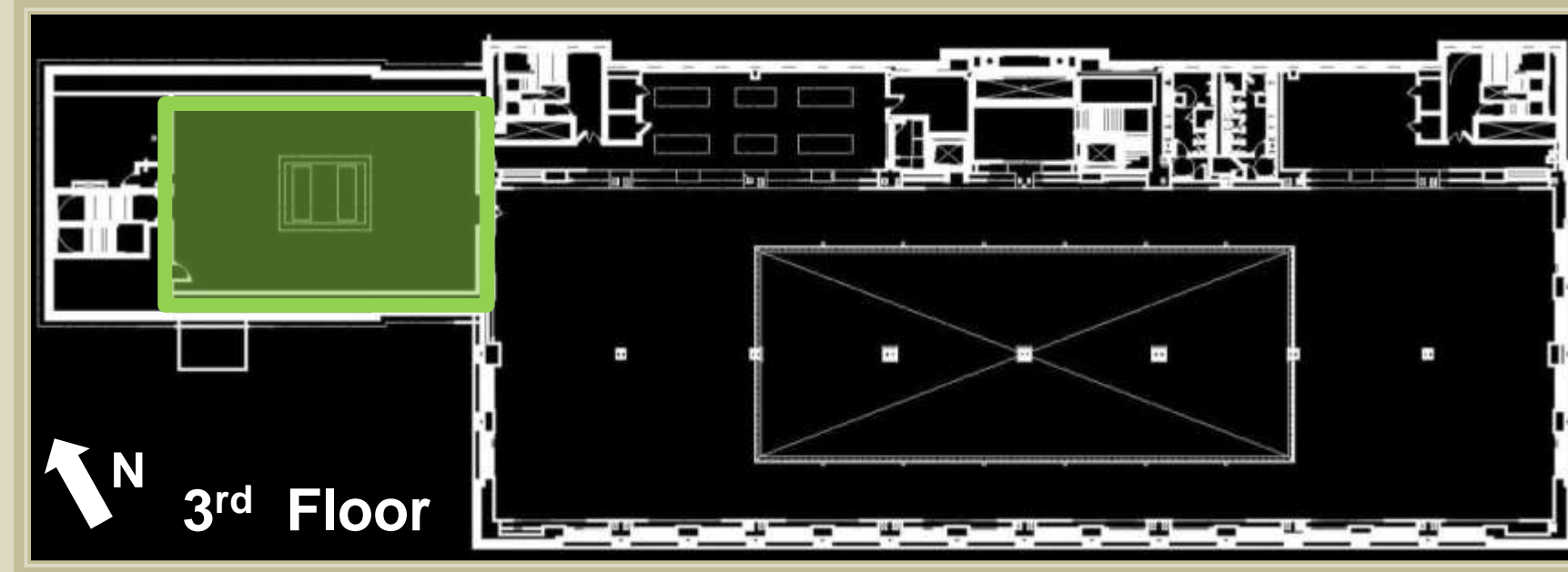


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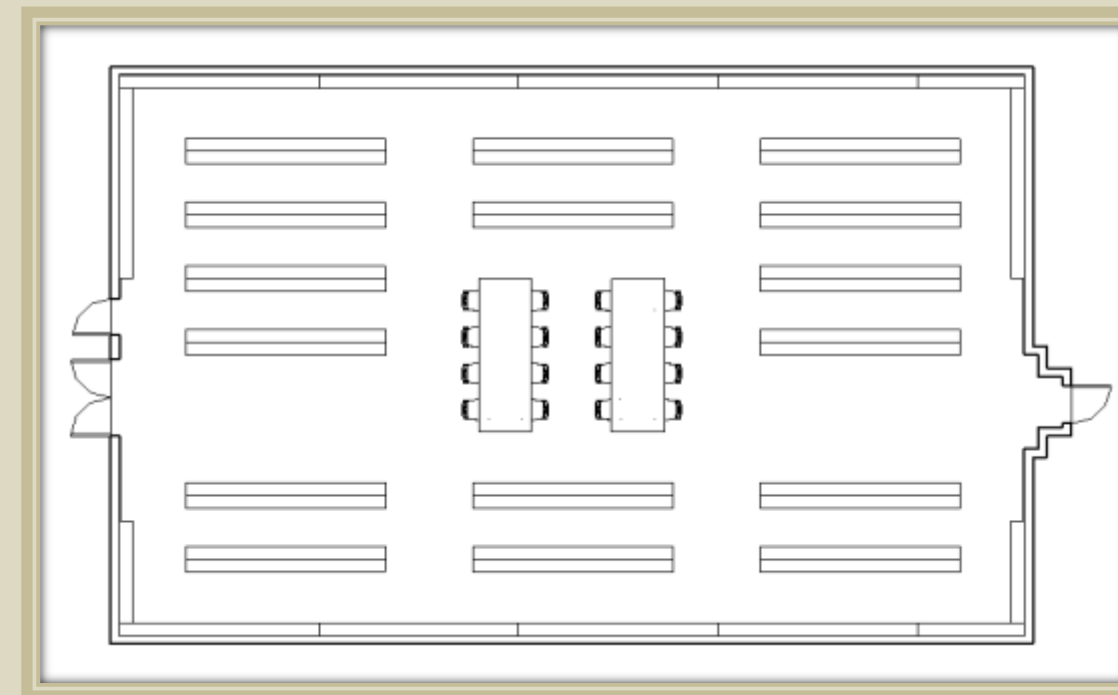
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Original Stack Design Data		
Area	sq. ft.	% of Area
<b>Total</b>	3042	-
<b>Stacks</b>	2443	81 %
<b>Workspace</b>	564	19 %

### **Room Dimensions**

Area – 3042 sq. ft.  
 Ceiling Height – 15’  
 Approximate Width – 44’  
 Approximate Length – 68’



### Solution

## **Space Saver High Density Mobile Shelving**



SpaceSaver.com

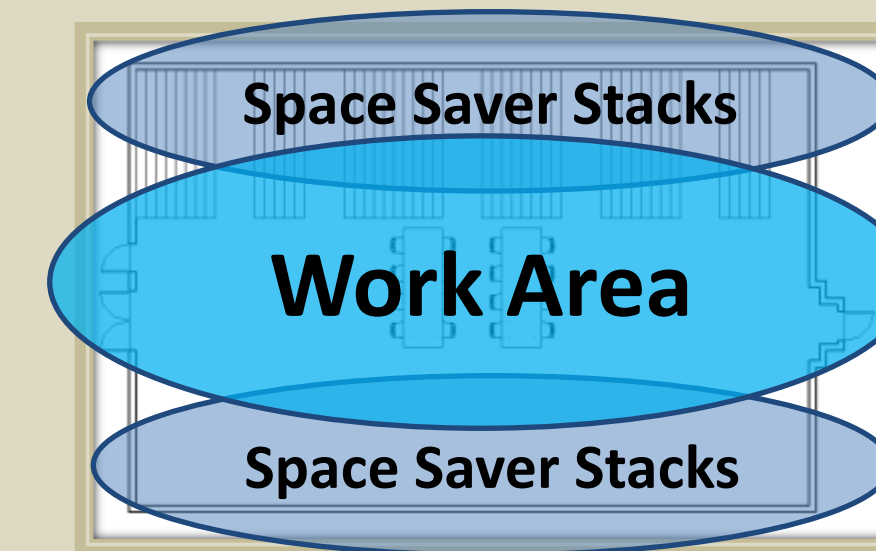
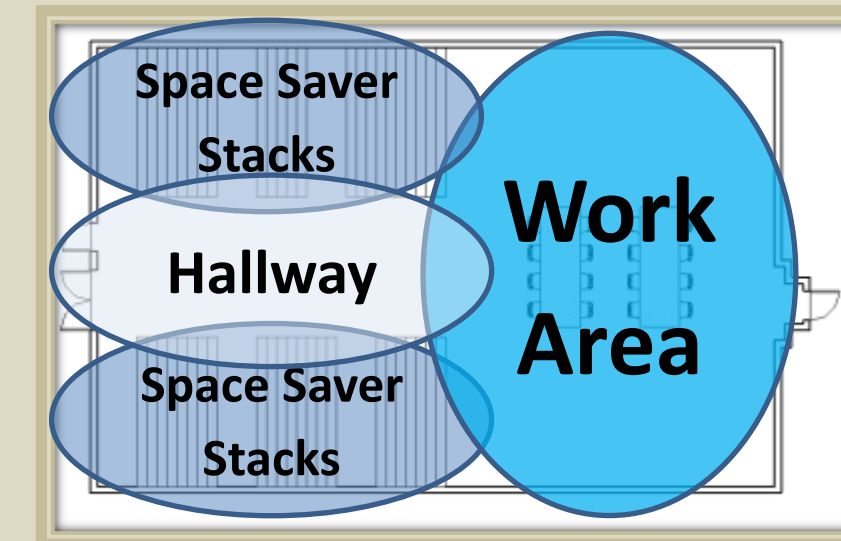
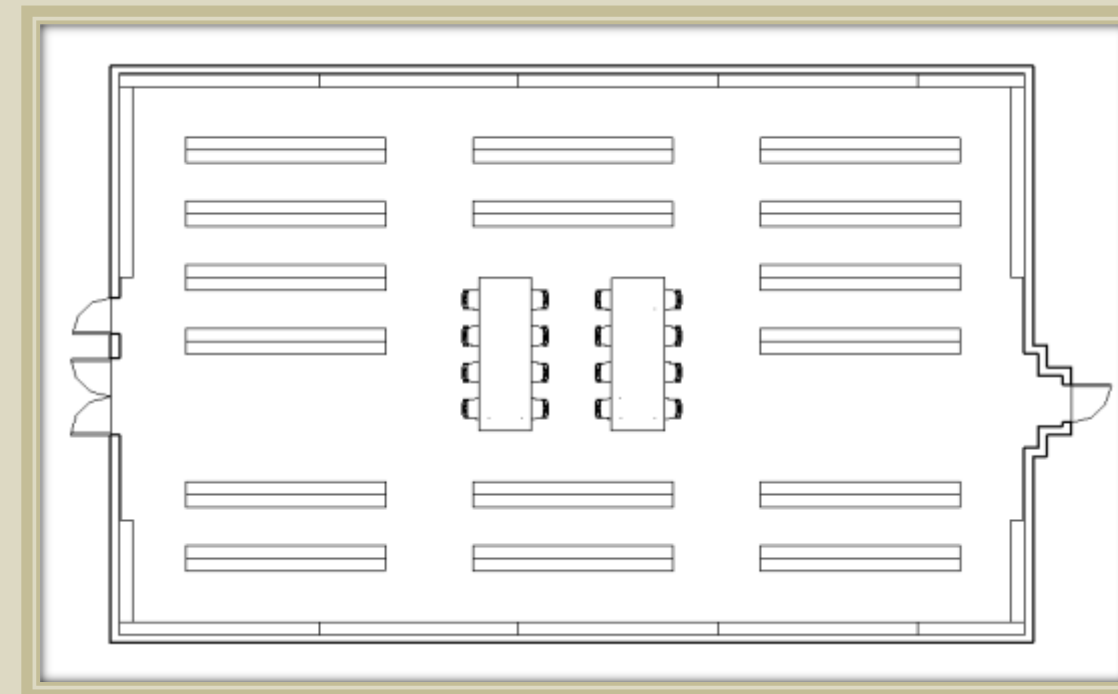
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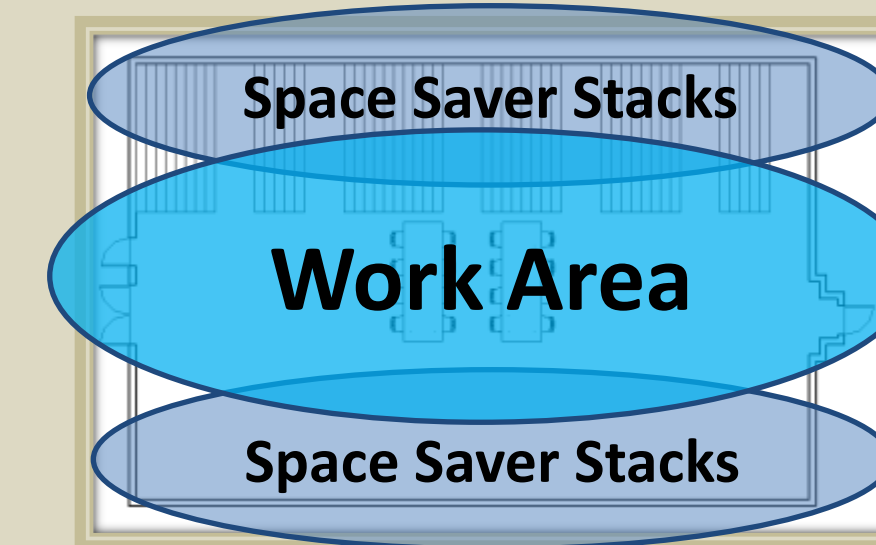
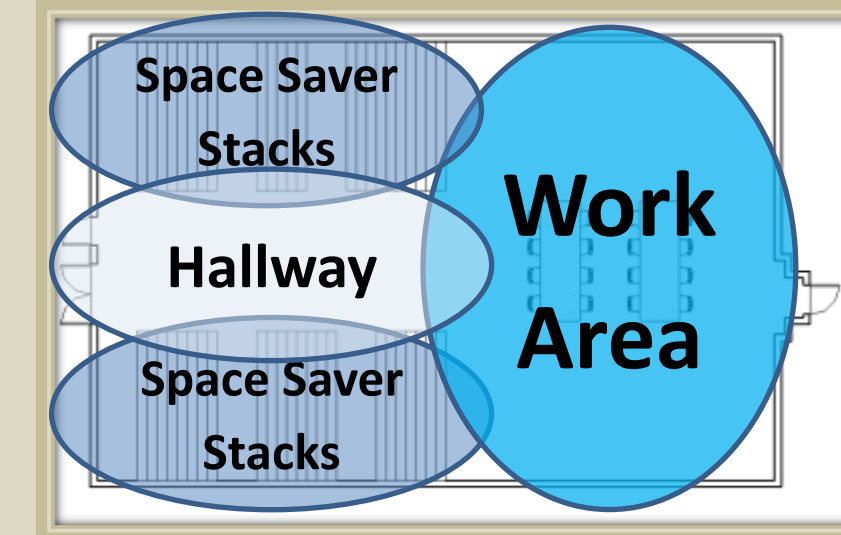
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Original Room Profile

Space Saver Mobile Stacks

Redesigned Room Profile





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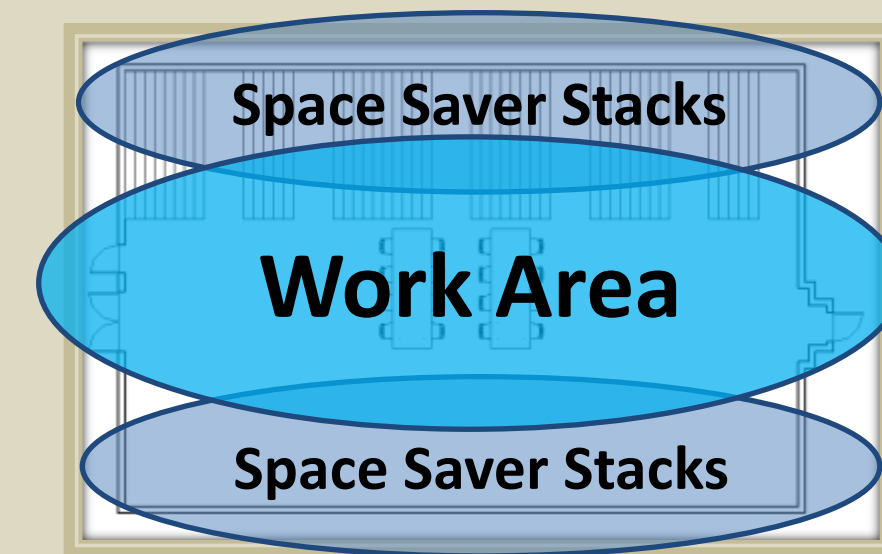
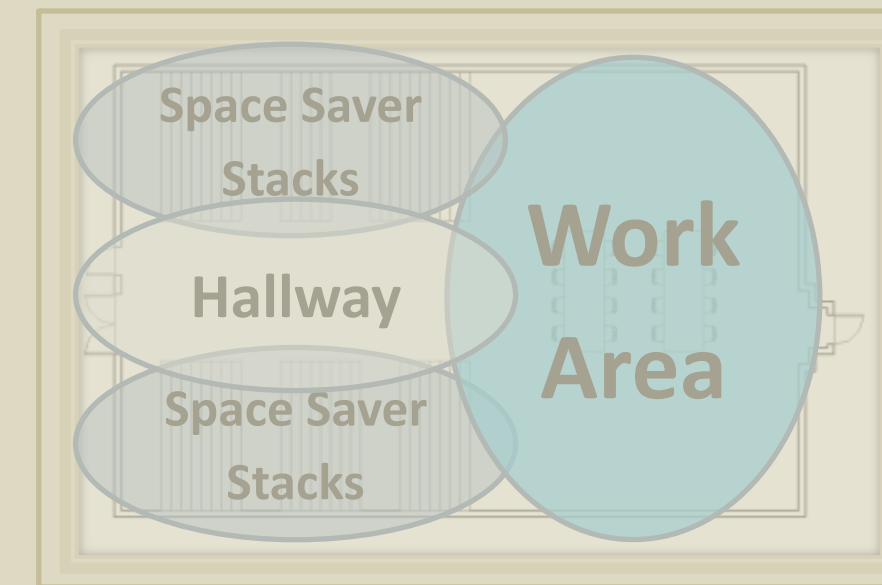
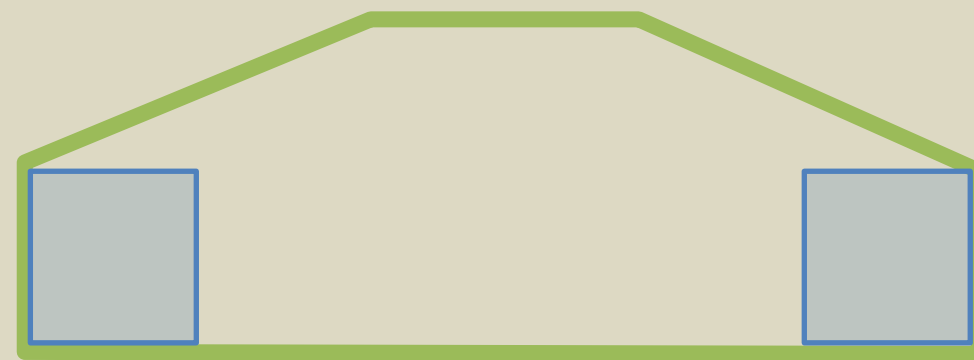
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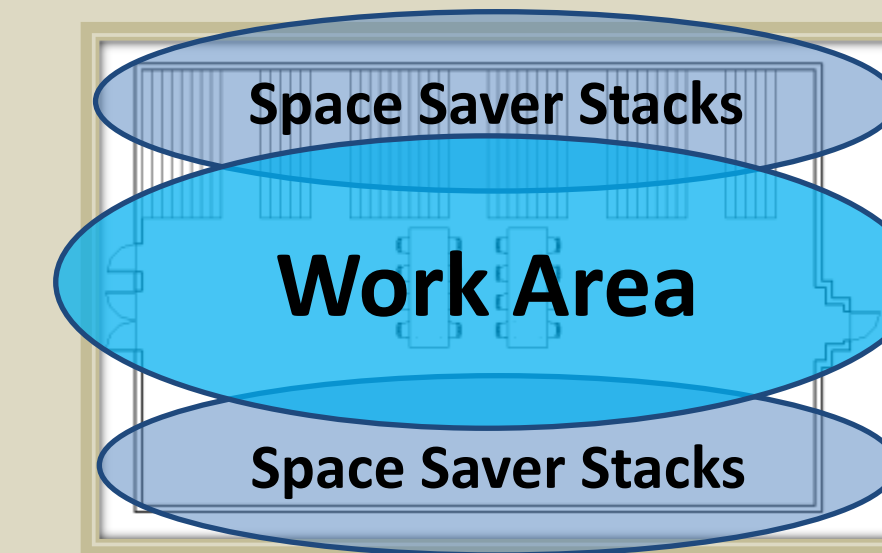
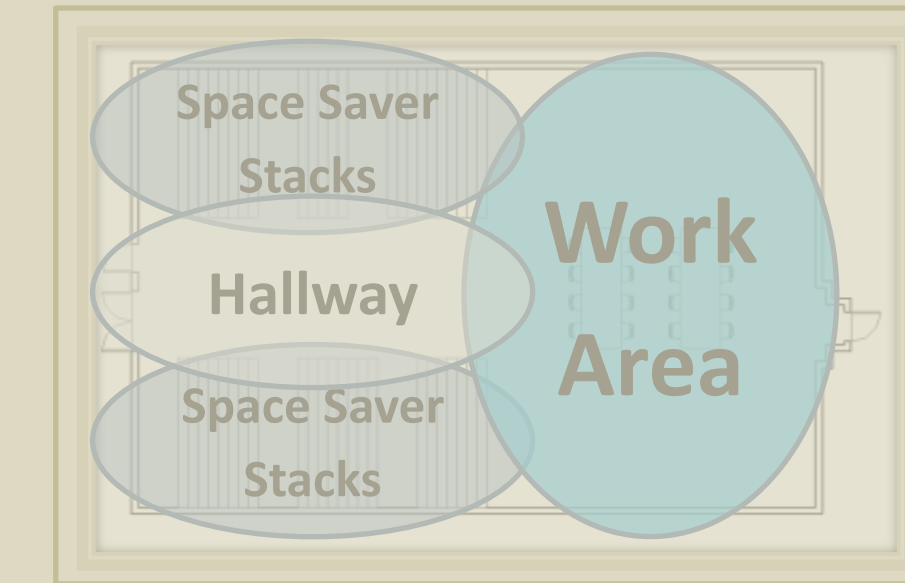
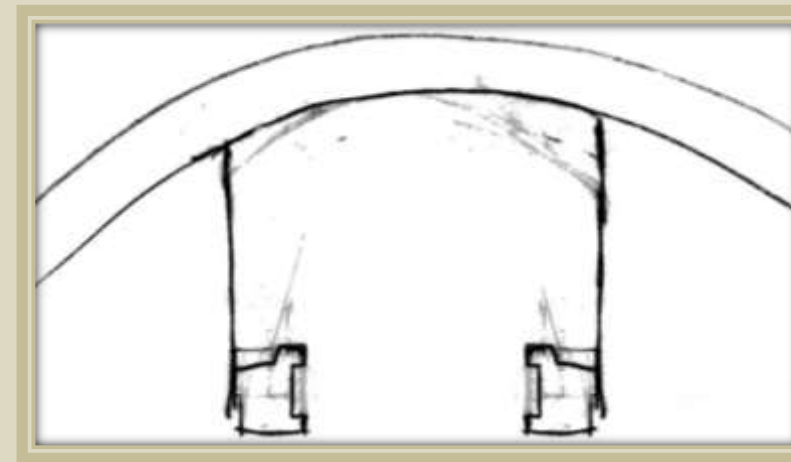
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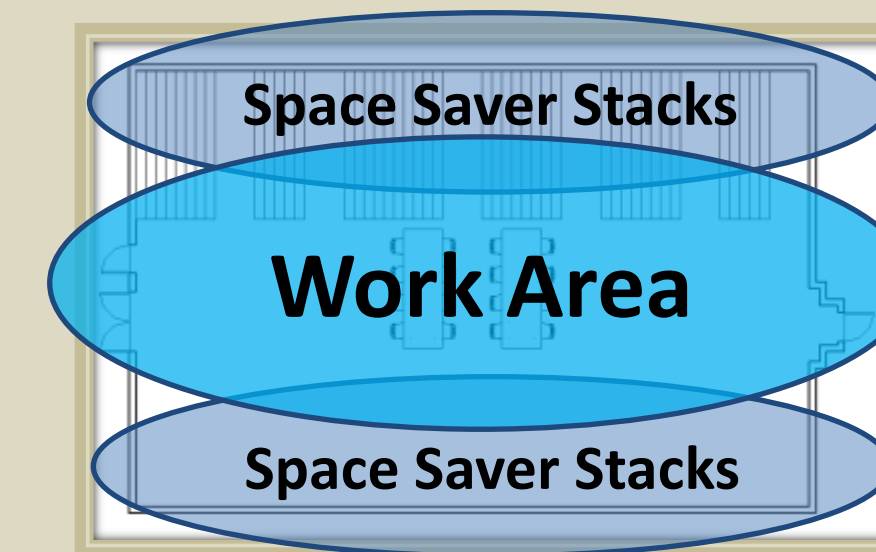
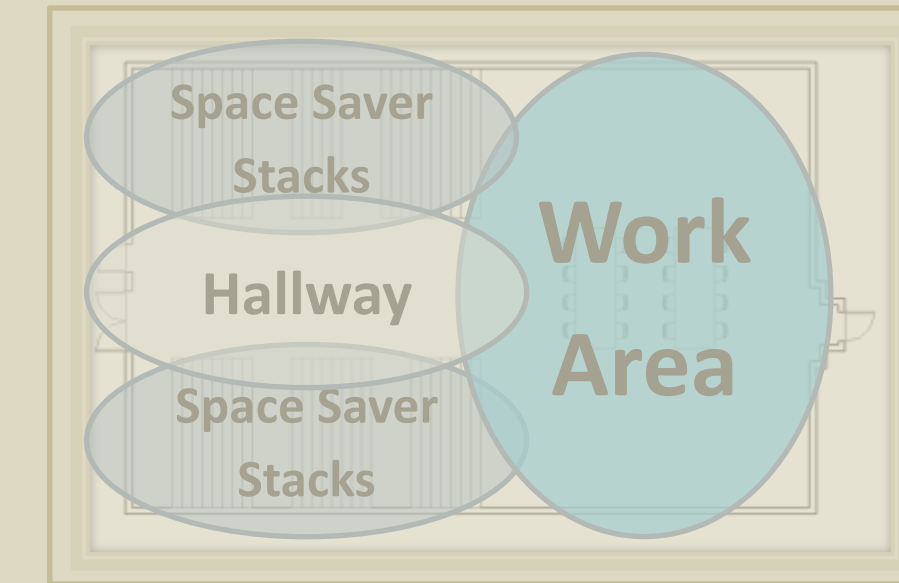
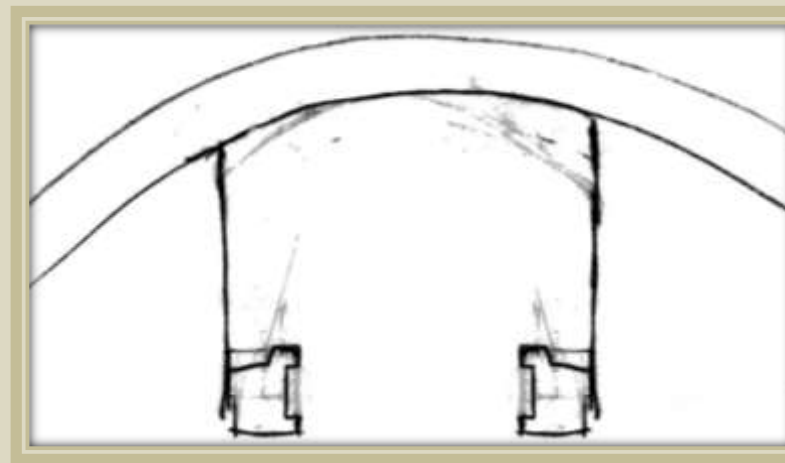
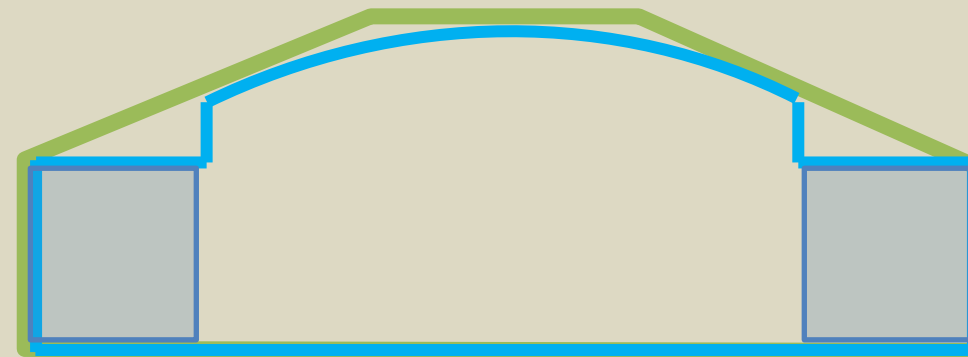
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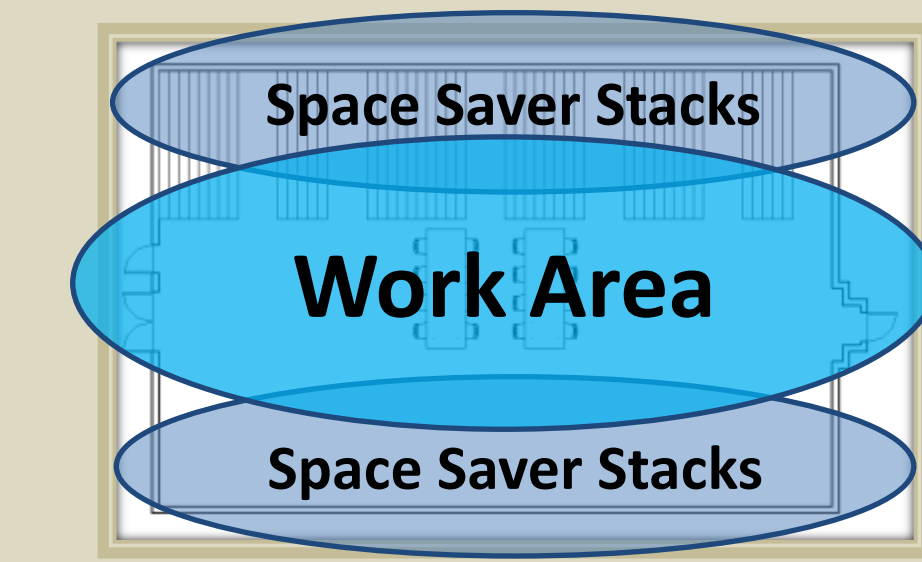
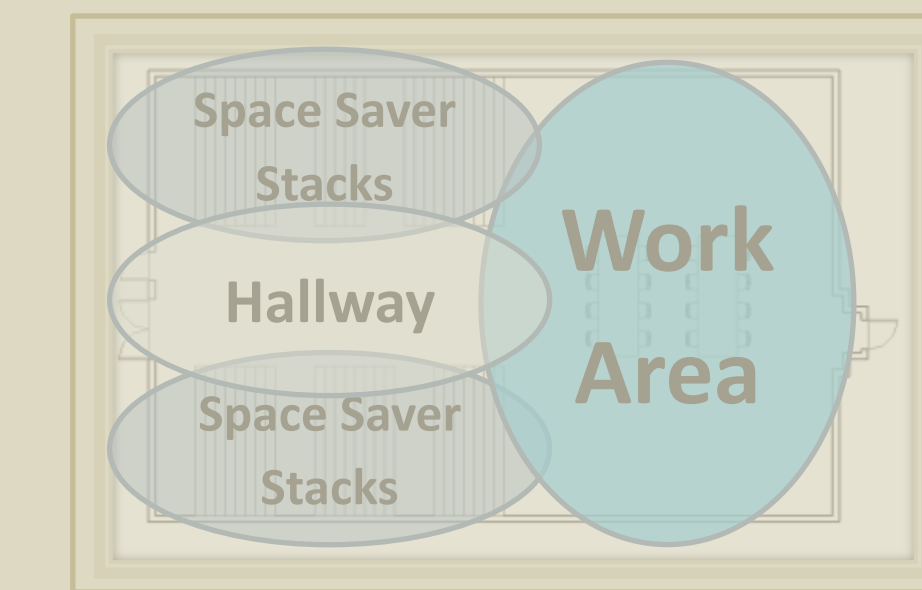
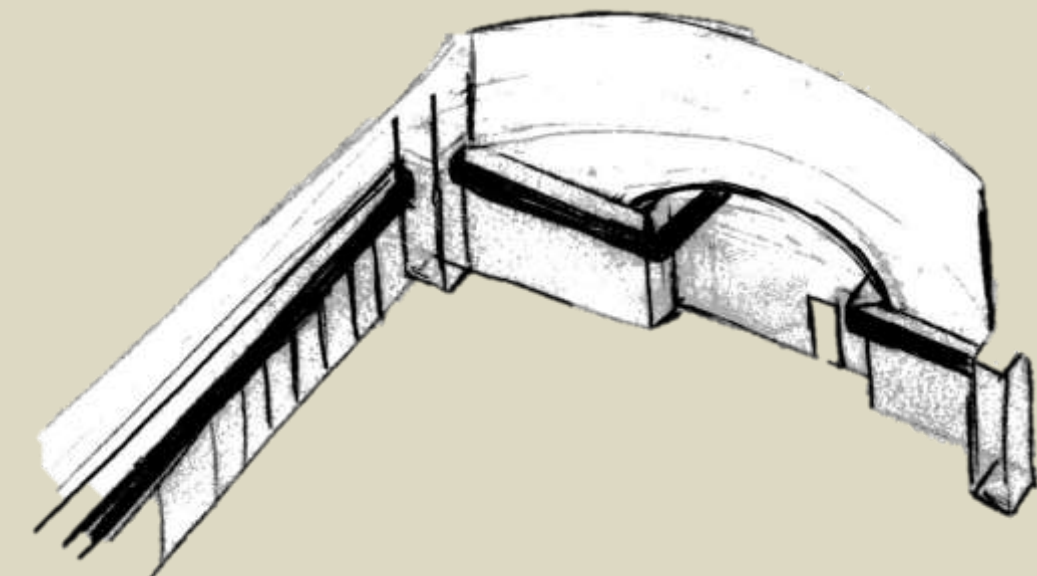
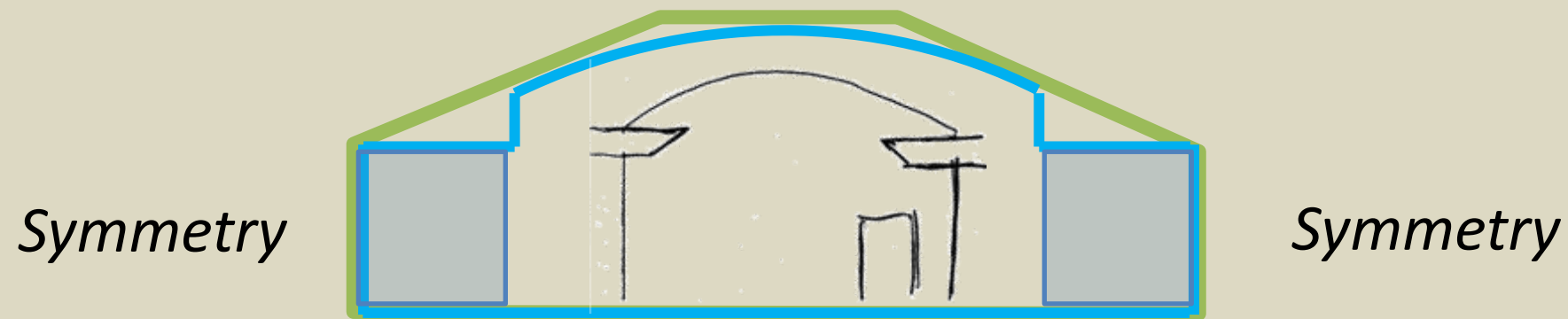


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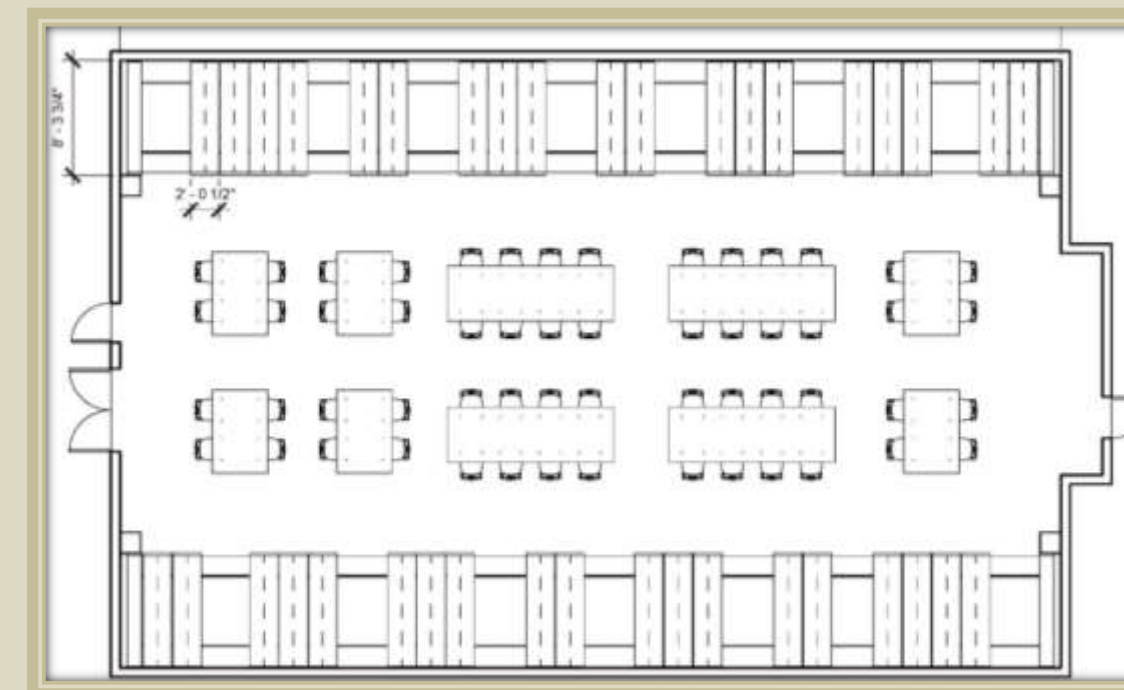
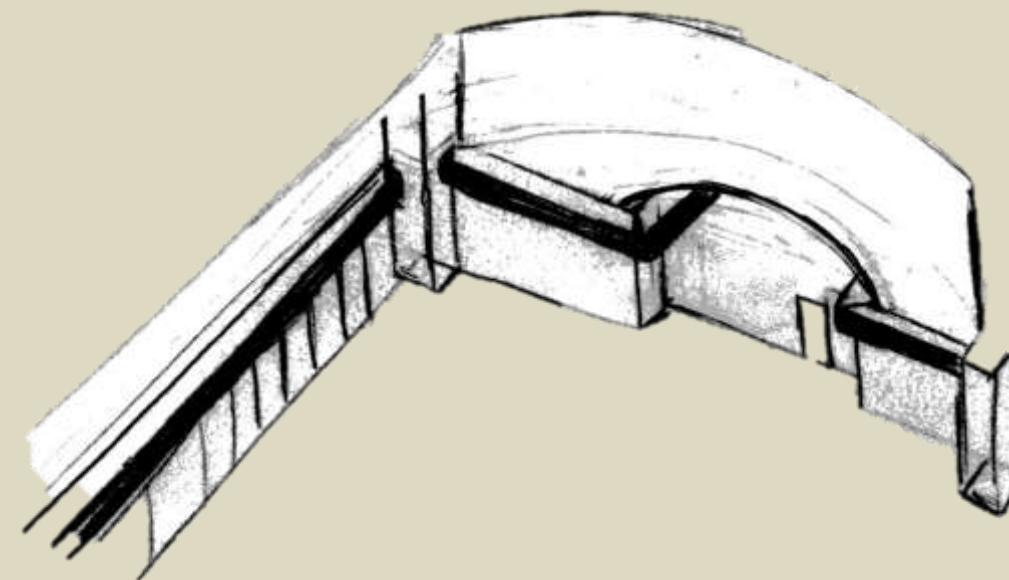
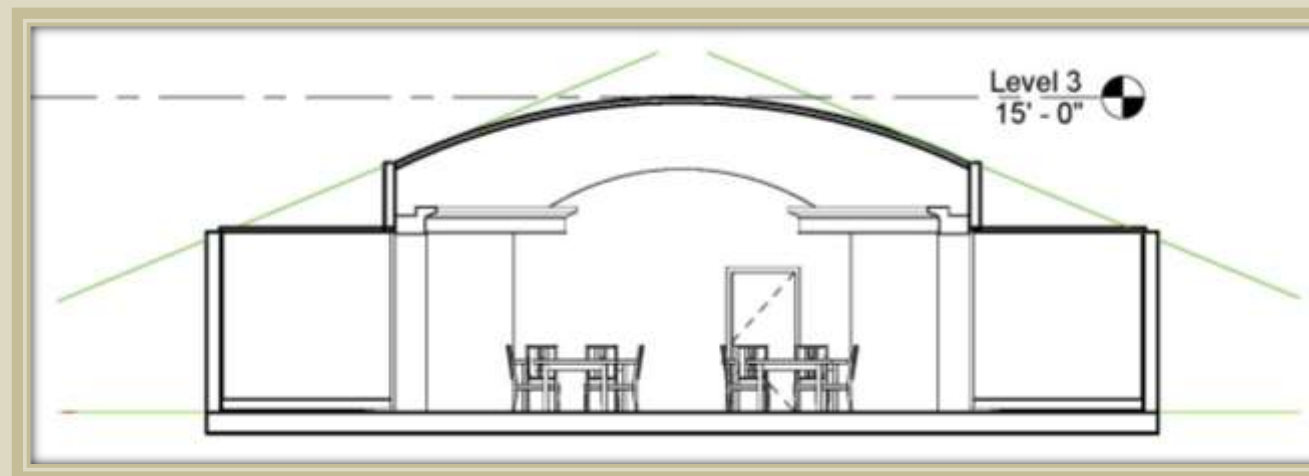
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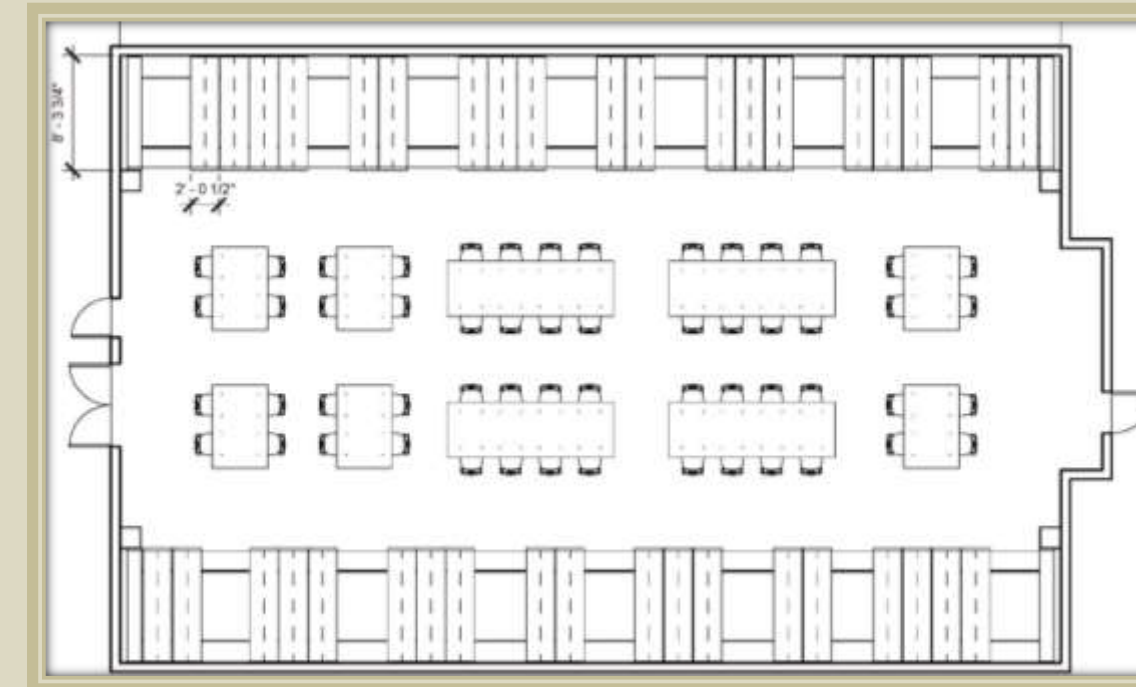


Original Design vs. Space Saver Design Data				
Original Design			Space Saver Design	
Area	Ft <sup>2</sup>	% of Area	Ft <sup>2</sup>	% of Area
Total	3042	-	3042	-
Stacks	2443	81 %	1130	38 %
Workspace	564	19 %	1862	62 %*
* 43% more workspace				

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# Lighting Depth



Law Classroom and Stacks



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- **Integrated Lighting** to Add **Depth** and Accentuate **Architectural Features**
- Maintain **Symmetry** and **Visual Clarity**



**Additional Criteria**

Educational Facilities | Classrooms | Study Halls

Recommended Maintained Illuminance Levels	
Avg. Horizontal @ 2.5'	Avg: Min
100 lux	2:1

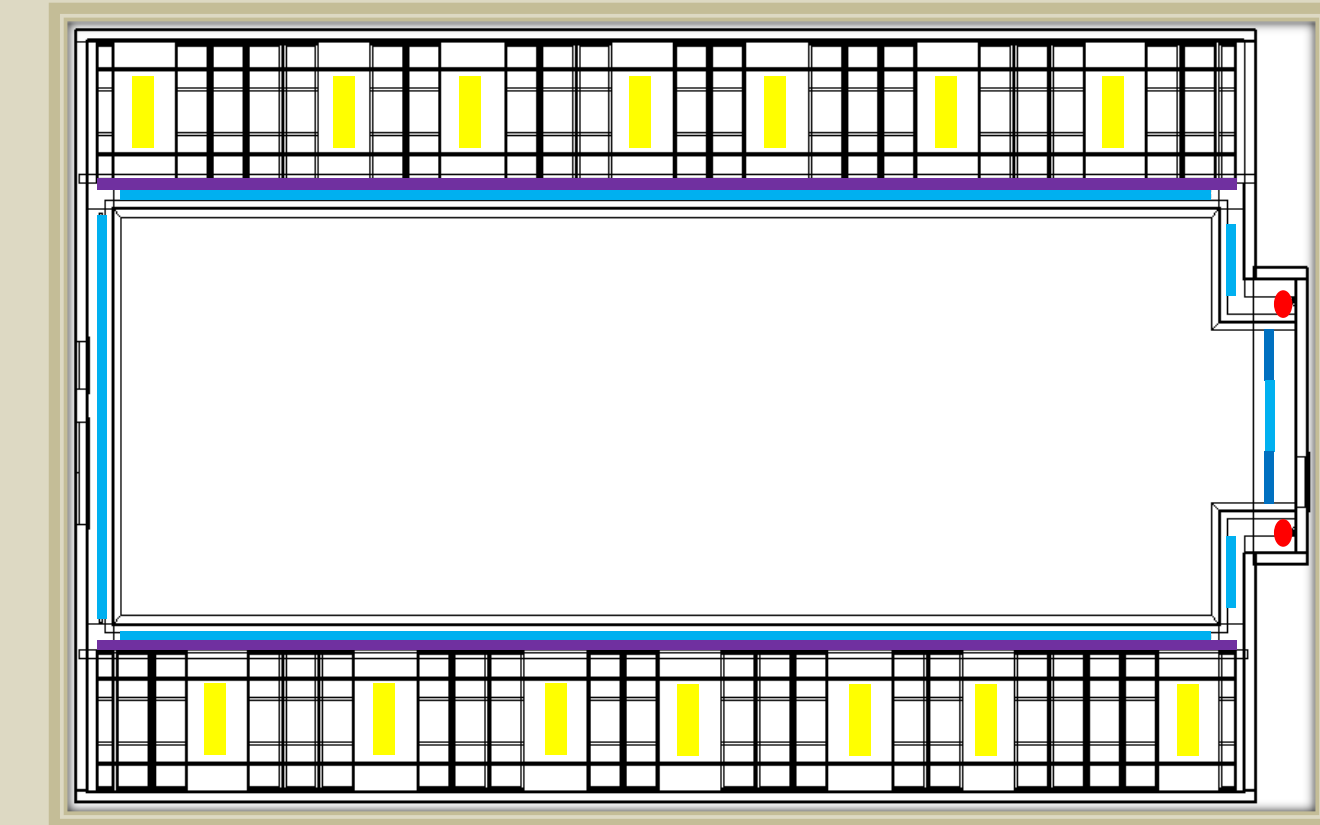
ANSI/ASHRAE/IES Standard 90.1-2010 Space by Space Method

Lighting Power Density	
Space Type	Max Allowable LPD
Classroom/Lecture/Training	1.23 W/sq.ft.

- Introduction
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- Law Classroom
  - Architectural Breadth
- Electrical Depth
  - Photo-voltaic Breadth
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### Design Criteria

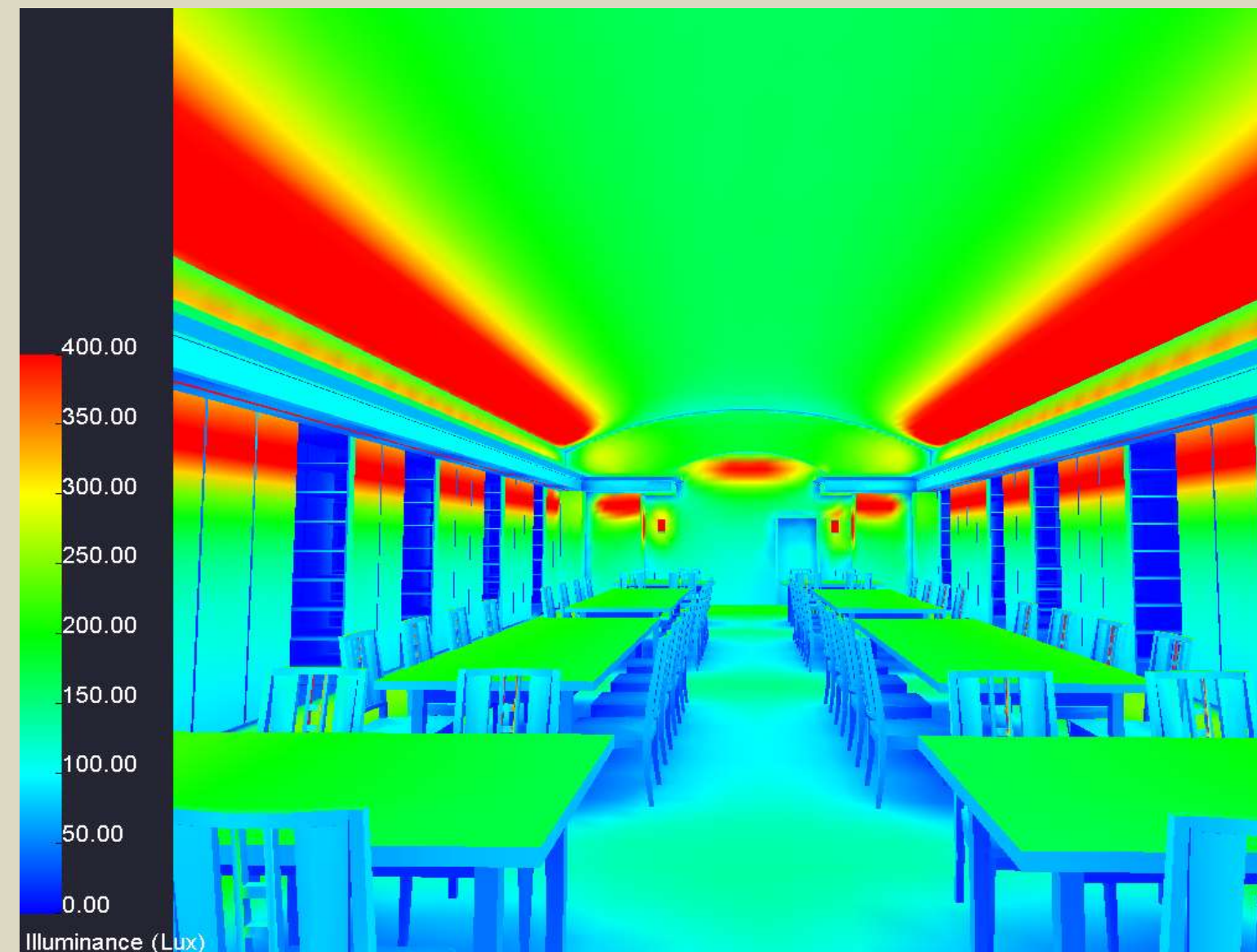
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### Design Criteria

- *Design within the **Classical Architectural Context***
- *Quickly **Adaptable and Social Environment***
- ***Integrated Lighting to Add Depth and Accentuate Architectural Features***
- *Maintain **Symmetry and Visual Clarity***



Illuminance Data		
Calculation	Target (lux)	Horizontal @ 2' 6" (lux)
Average Illuminance	150-250	<b>232</b>
Max. Illuminance	-	348
Min. Illuminance	-	158
Average/Minimum	2	1.47

Type	Lamp/Fixture	Fixture Quantity	Input Watts	Total Watts
L3	LED Rec. Linear	41	28	1148
L3A	LED Rec. Linear	2	21	42
L4	LED Wall Sconce	2	16	32
L9	LED Linear Cove	32	45	1440
L10	FL. Stack Light	14 (of 40)	74	1036

#### ANSI/ASHRAE/IESNA 90.1 - 2010

Category	Allowable	Actual
Area (sqft)	-	3042
Input Watts (W)	-	3698
Power Density (W/sqft)	1.23	<b>1.21</b>

- Introduction
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  - Photo-voltaic Breadth
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# Electrical Depth



## Branch Circuit Analysis

- Introduction
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- Law Classroom
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  - Photo-voltaic Breadth
- Conclusions

Amps	Voltage	VA	Cont. Load X 1.25	Max kVA/ Ckt	Target kVA / Ckt X 0.8 Growth Factor
20	277	5540	4432	4.432	3.546

LOCATION:		GROUND FLOOR ELEC CLOSET B					REMARKS:					PANEL DESIGNATION:	
SERVICE:		480/277 VOLTS, 3 PHASE, 4 WIRE					22KAIC, SIEMENS TYPE I3 PANEL					<b>LP-GB EXISTING</b>	
MAINS:		225 AMPS					MAIN OVERCURRENT PROTECTION						
MOUNTING TYPE:		SURFACE					M.C.B.: 175 AMPS						
GROUNDING:		GROUND BUS: YES ISOLATED GRD. BUS: NO					M.L.O.: NO POLES: 30						
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C	SERVICE TO:	
CLASSROOM 130, 131, 133 LTG	3.95			20	1	-	2	125	19.84			RP-GB VIA TRANSFORMER	
CLASSROOM 141, 137 LTG		3.05		20	3		4		20.72				
GND FLR VEST & CORR LTG			1.95	20	5		6			20.64			
GND FLR DISPLAY LTG	1.45			20	7	-	8	20	2.91			FAN POWERED VAV BOXES	
CAFÉ LTG		0.47		20	9		10	20		3.82		FAN POWERED VAV BOXES	
CLASSROOM 136 LTG			1.72	20	11		12	20			3.82	FAN POWERED VAV BOXES	
SPARE				20	13	-	14	20				SPARE	
SPARE				20	15		16	20				SPARE	
SPARE				20	17		18	20				SPARE	
SPARE				20	19	-	20	20				SPARE	
SPARE				20	21		22	20				SPARE	
SPARE				20	23		24	20				SPARE	
SPARE				20	25	-	26	20				SPARE	
SPARE				20	27		28	20				SPARE	
SPARE				20	29		30	20				SPARE	
SUBTOTALS		5.40	3.52	3.67					22.75	24.54	24.46		
TOTAL LOADS:		28.15	KVA PHASE A	101.6	A PHASE A	CONNECTED LOAD (LTG):		84.34	KVA				
		28.06	KVA PHASE B	101.3	A PHASE B	DEMAND FACTOR (LTG):		100%					
		28.13	KVA PHASE C	101.6	A PHASE C	DEMAND LOAD:		84.34	KVA				
TOTAL CONNECTED LOAD:		84.34	KVA			DEM. LOAD x 1.25 SPARE		105.425	KVA				
						AMP: (at 480 V)		127	A				

LP-GB	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
<b>CKT 5</b>						
NEW						
L4	4	277	16	20	0.08	
L5	4	277	16	20	0.08	
L3	13	277	7	8.75	0.11375	
L6	196	277	1.5	1.875	0.3675	
L5	4	277	16	20	0.08	
EXISTING						
L8	4	277	128	160	0.64	
L16	2	277	18	22.5	0.045	
L3	2		32	40	0.08	
L4	6		32	40	0.24	<b>1.73</b>
REMOVED						
L8	3	277	128	160	0.48	
<b>CKT 7</b>						
NEW						
L3	128	277	7	8.75	1.12	
EXISTING						
L3	2	277	32	40	0.08	<b>1.2</b>
REMOVED						
L3	8	277	32	40	0.32	
L8	8	277	128	160	1.28	
<b>CKT 13</b>						
NEW						
L1	8	277	5	6.25	0.05	<b>0.05</b>

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Amps	Voltage	VA	Cont. Load X 1.25	Max kVA/ Ckt	Target kVA / Ckt X 0.8 Growth Factor
20	277	5540	4432	4.432	3.546

LOCATION: GROUND FLOOR ELEC CLOSET B						REMARKS: 22KAIC, SIEMENS TYPE I3 PANEL						PANEL DESIGNATION:	
SERVICE: 480/277 VOLTS, 3 PHASE, 4 WIRE						MAIN OVERCURRENT PROTECTION						LP-GB NEW	
MAINS: 225 AMPS						M.C.B.: 175 AMPS							
MOUNTING TYPE: SURFACE						M.L.O.: NO						SERVICE TO:	
GROUNDING: GROUND BUS: YES ISOLATED GRD. BUS: NO						POLES: 30							
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C		
CLASSROOM 130, 131, 133 LTG	3.95			20	1	-	2	125	19.84			RP-GB VIA TRANSFORMER	
CLASSROOM 141, 137 LTG		3.05		20	3		4			20.72			
GND FLR VEST & CORR LTG			1.73	20	5		6	3P			20.64		
CAFÉ LTG	0.47			20	7	-	8	20	2.91			FAN POWERED VAV BOXES	
GND FLR DISPLAY LTG		1.20		20	9		10	20		3.82		FAN POWERED VAV BOXES	
CLASSROOM 136 LTG			1.72	20	11		12	20			3.82	FAN POWERED VAV BOXES	
NEW EXT. CANOPY LTG	0.05			20	13	-	14	20				SPARE	
SPARE				20	15		16	20				SPARE	
SPARE				20	17		18	20				SPARE	
SPARE				20	19	-	20	20				SPARE	
SPARE				20	21		22	20				SPARE	
SPARE				20	23		24	20				SPARE	
SPARE				20	25	-	26	20				SPARE	
SPARE				20	27		28	20				SPARE	
SPARE				20	29		30	20				SPARE	
SUBTOTALS	4.47	4.25	3.45						22.75	24.54	24.46		

<b>TOTAL LOADS:</b>	27.22 KVA PHASE A	98.3 A PHASE A	28.79 KVA PHASE B	103.9 A PHASE B	27.91 KVA PHASE C	100.8 A PHASE C	<b>CONNECTED LOAD (LTG):</b>	83.92 KVA
<b>TOTAL CONNECTED LOAD:</b>	83.92 KVA						<b>DEMAND FACTOR (LTG):</b>	100%
							<b>DEM. LOAD x</b>	1.25
							<b>AMP: (at 480 V)</b>	126
							<b>SPARE</b>	104.9 KVA
								126 A

LP-GB	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
<b>CKT 5</b>						
NEW						
L4	4	277	16	20	0.08	
L5	4	277	16	20	0.08	
L3	13	277	7	8.75	0.11375	
L6	196	277	1.5	1.875	0.3675	
L5	4	277	16	20	0.08	
EXISTING						
L8	4	277	128	160	0.64	
L16	2	277	18	22.5	0.045	
L3	2		32	40	0.08	
L4	6		32	40	0.24	1.73
REMOVED						
L8	3	277	128	160	0.48	
<b>CKT 7</b>						
NEW						
L3	128	277	7	8.75	1.12	
EXISTING						
L3	2	277	32	40	0.08	1.2
REMOVED						
L3	8	277	32	40	0.32	
L8	8	277	128	160	1.28	
<b>CKT 13</b>						
NEW						
L1	8	277	5	6.25	0.05	0.05

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Amps	Voltage	VA	Cont. Load X 1.25	Max kVA/ Ckt	Target kVA / Ckt X 0.8 Growth Factor
20	277	5540	4432	4.432	3.546

LOCATION: GROUND FLOOR ELEC CLOSET B						REMARKS: 22KAIC, SIEMENS TYPE I3 PANEL						PANEL DESIGNATION: <b>LP-GB NEW</b>	
SERVICE: 480/277 VOLTS, 3 PHASE, 4 WIRE						MAIN OVERCURRENT PROTECTION							
MOUNTING TYPE: SURFACE						M.C.B.: 175 AMPS							
GROUNDING: GROUND BUS: YES ISOLATED GRD. BUS: NO						M.L.O.: NO						SERVICE TO:	
POLES: 30													
SERVICE TO:	A	B	C	SIZE	NO.		NO.	SIZE	A	B	C		
CLASSROOM 130, 131, 133 LTG	3.95			20	1	-	2	125	19.84			RP-GB VIA TRANSFORMER	
CLASSROOM 141, 137 LTG		3.05		20	3		4			20.72			
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CAFÉ LTG	0.47			20	7	-	8	20	2.91			FAN POWERED VAV BOXES	
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CLASSROOM 136 LTG			1.72	20	11		12	20			3.82	FAN POWERED VAV BOXES	
NEW EXT. CANOPY LTG	0.05			20	13	-	14	20				SPARE	
SPARE				20	15		16	20				SPARE	
SPARE				20	17		18	20				SPARE	
SPARE				20	19	-	20	20				SPARE	
SPARE				20	21		22	20				SPARE	
SPARE				20	23		24	20				SPARE	
SPARE				20	25	-	26	20				SPARE	
SPARE				20	27		28	20				SPARE	
SPARE				20	29		30	20				SPARE	
SUBTOTALS	4.47	4.25	3.45						22.75	24.54	24.46		

<b>TOTAL LOADS:</b>	27.22 KVA PHASE A	98.3 A PHASE A	83.92 KVA
	28.79 KVA PHASE B	103.9 A PHASE B	100% DEMAND FACTOR (LTG):
	27.91 KVA PHASE C	100.8 A PHASE C	83.92 KVA DEMAND LOAD:
<b>TOTAL CONNECTED LOAD:</b>	83.92 KVA		DEM. LOAD x 1.25 SPARE 104.9 KVA
			AMP: (at 480 V) 126 A

**\*Balanced Phase Loads \*Equivalent Demand Loads**

LP-GB	QTY	VOLTAGE	VA	1.25 CONT. LOAD FACT.	kVA	TOTAL
<b>CKT 5</b>						
NEW						
L4	4	277	16	20	0.08	
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REMOVED						
L3	8	277	32	40	0.32	
L8	8	277	128	160	1.28	
<b>CKT 13</b>						
NEW						
L1	8	277	5	6.25	0.05	0.05

- Introduction
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# Electrical Depth



## Photo-Voltaic Breadth



- Introduction
- Lighting Design Concept
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  - Photo-voltaic Breadth
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## Orientation



Image from Google Earth



### Goal:

***Maximize the Solar Utility for a client in a given locale***

### ***PV Panel Roof Location***

- *Sloped Roof on South-Southwest Facade*
- *31.5 ° Tilt (Ideal for NY)*
- *No Surrounding Shading Structures*

- Introduction
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## *Design Criteria*

- ***Aesthetic Value***
- ***Avoid Panel Shading***
- ***PV Panel Cost/Watt***
- ***PV Panel Efficiency***

## *Orientation*



Image from Google Earth



## *Goal:*

***Maximize the Solar Utility for a client in a given locale***

## ***PV Panel Roof Location***

- ***Sloped Roof on South-Southwest Facade***
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## Design Criteria

- *Aesthetic Value*
- *Avoid Panel Shading*
- *PV Panel Cost/Watt*
- *PV Panel Efficiency*

## PV Array Design



## PV Array Details

- ***(12) 3x4 & (2) 3x3 panel arrays***
- ***(162) Total Panels and (5) Inverters***
- ***Assessment Maximizes Performance to Aesthetic Value***
- ***Aligned with Large Library Windows***

- Introduction
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## *Design Criteria*

- *Aesthetic Value*
- *Avoid Panel Shading*
- *PV Panel Cost/Watt*
- *PV Panel Efficiency*

## *PV Panel Type*



Canadiansolar.com

## ***Mono-Crystalline Solar Panel***

- ***Aesthetic Design***
- ***Black Cell Color***
- ***Highest Efficiency***

## *PV Array Details*

- ***(12) 3x4 & (2) 3x3 panel arrays***
- ***(162) Total Panels and (5) Inverters***
- ***Assessment Maximizes Performance to Aesthetic Value***
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## Design Criteria

- *Aesthetic Value*
- *Avoid Panel Shading*
- *PV Panel Cost/Watt*
- *PV Panel Efficiency*

## Equipment Selection

Solar Panel Selection Data					
Manufacturer	Product Code	Watts	\$/Panel	\$/Watts	Efficiency
Canadian Solar	CS6P-255M	255	259	<b>1.02</b>	<b>15.85</b>
Suniva	OPT255-60-4-100	255	256	1.00	15.71
Eoply	EP156MB-60-240W	240	260	1.08	14.75
Eoply	EP156M-60-250W	250	275	1.10	15.37
SolarWorld	SW250	265	285	1.08	14.91

Inverter Selection Data							
Manufacturer	Product Code	System Capacity(W)	Max W(DC)	Units Req.	\$/Unit	Total Cost	Efficiency
SunnyBoy	7000US	41310	8750	5	2770	<b>\$13,850</b>	<b>96</b>
SunnyBoy	8000US	41310	10000	5	3000	\$15,000	96
SunnyBoy	6000US	41310	7500	6	2550	\$15,300	95.5
SunnyBoy	5000US	41310	6250	7	2300	\$16,100	95.5

## PV Array Details

- ***(12) 3x4 & (2) 3x3 panel arrays***
- ***(162) Total Panels and (5) Inverters***
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SunnyBoy	6000US	41310	7500	6	2550	\$15,300	95.5
SunnyBoy	5000US	41310	6250	7	2300	\$16,100	95.5

## Tax Incentives

### Solar Tax Incentives (New York)

#### Federal

**30% Tax Credit**

#### State Rebate Program

**\$1.00/W for first 50kW of installed capacity per meter**

#### Sales Tax Incentive

**100% exemption from sales tax**

#### Property Tax Incentive (local option)

**100% exemption for 15 years**

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## Design Criteria

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- *Avoid Panel Shading*
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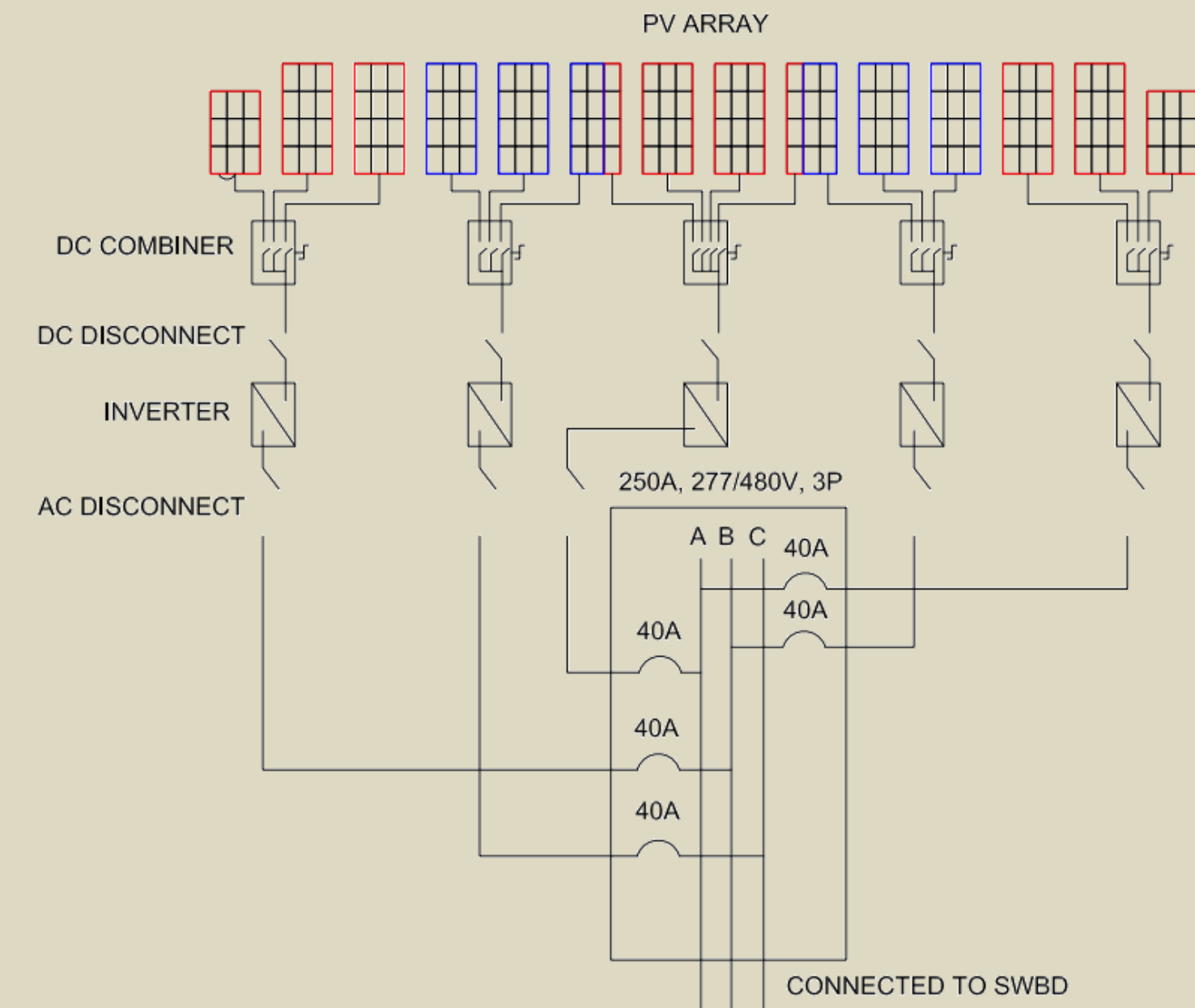
## NREL System Advisory Model

### SAM Model Assumptions

<b>Annual Panel Performance Depreciation</b>	1% compounded yearly
<b>Avg. Cost of Commercial Electricity (NY)</b>	\$0.1637 / kWh
<b>Analysis Period</b>	20 years

### Performance Results

<b>First Year Annual Energy</b>	57,627 kWh
<b>Capacity Factor</b>	15.4%
<b>System Performance Factor</b>	0.86
<b>Net Savings with System</b>	\$9,433.21
<b>Payback</b>	<b>4.27 years</b>



- Introduction
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# Conclusion





- Introduction
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- Conclusions

***I would like to thank...***

***The Audience***

***The Penn State AE Department***

***Professors:***

***Dr. Kevin Houser***

***Dr. Richard Mistrick***

***Dr. Jefferey Brownson***

***Leslie Beahm***

***Cline Bettridge Bernstein Lighting Design***

***RAMSA Architects***

***Ismael Leyva Architects***

- Introduction
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# Questions?

