



# Lighting Design for the Built Environment I

Design Project 01: Light Structures Models in AGi32

Retail Lighting Design

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### Executive Summary

Most of the time, people go shopping when they are in a good mood, feeling excited, happy, and energetic. It is vital for retail shop owners to maintain a conducive state for their customers, allowing them to shop with an excellent mindset. Therefore, many retail owners invest millions into research to understand the types of clients they are dealing with and provide necessary services to keep their customers in a good mood. Retail owners work closely with lighting designers, architects, and researchers to design premises that enhance the shopping experience.

This lighting design project aims to compare spaciousness and closure concepts by following John Flynn's psychological principles. The project achieved uniform peripheral lighting for spaciousness and non-uniform low luminances for closure, meeting the criteria for psychological reinforcement. Despite missing some illuminance targets, particularly in ambient vertical and horizontal illuminance, the display illuminance criteria were met successfully. The design also achieved the desired uniformity and color rendering, the energy sustainability targets were fully met in both scenarios. The collaborative effort ensures a well-designed retail space that supports customers' positive experiences and meets the technical requirements of modern lighting design.

#### Design Consideration:

- Psychological reinforcement
- Illuminance and uniformity
- Energy/Sustainability
- Color rendering
- Biological needs of the sales personnel
- Visual task at the counter
- Code/standards (LEED and WELL)
- Visual comfort/Glare

### Solution

#### Spaciousness:

The first scene is designed to immerse customers in a high-quality, spacious, and mood-enhancing environment. This scene is characterized by high-intensity, shadow-free lighting, allowing customers to adequately evaluate the merchandise. LED luminaires were chosen for their high color fidelity, long-lasting performance, and energy efficiency, ensuring a cost-effective and sustainable lighting solution.

#### Closure:

The second scene is characterized by a low-intensity environment, focusing on creating a cozy and intimate atmosphere. This approach uses non-uniform lighting with no peripheral lighting, aligning with Flynn's principles of closure.

#### Lighting Concepts and Luminaires:

The concepts of spaciousness and closure create a versatile space adaptable to different retail scenarios. Flynn's psychological principles, including uniformity, non-uniformity, high and low luminances, and peripheral lighting, guided the selection and placement of luminaires.

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Track lights were strategically placed to highlight merchandise, while 2`x2` panel LED luminaires provided general illumination. Cove lighting was used to enhance the perception of spaciousness by grazing the walls with light.

## Results

Table A-1 is derived from the ANSI\_IES\_RP-2-20 standard for retail lighting

Table A-1. Recommended Illuminance Criteria for Interior Retail Spaces

Recommended Maintained Illuminance Targets <sup>(a, b)</sup>														
TS = Task Surface: Recommended illuminances are at height of task surface above finished floor (AFF)														
Veiling Reflection Risk Light Level for Task or Area?			Horizontal (E <sub>h</sub> )				Vertical (E <sub>v</sub> )							
			Target E <sub>h</sub> @ Height AFF		Uniformity Ratio		Target E <sub>v</sub> @ Height AFF		Uniformity Ratio					
APPLICATION TASK/AREA	Task or Area	High Med Low	C	A	Max Avg Min	Ratio	Ratio Basis	C	A	Max Avg Min	Ratio	Ratio Basis		
			T	Lux @ m	(Fc @ Ft)	Min	Ratio	Ratio Basis	T	Lux @ m	(Fc @ Ft)	Min	Ratio	Ratio Basis
<b>Sales Transactions</b>														
Sales transaction areas min.	T		P	300 @ 0.91	(30 @ 3.0)	Min	2.4:1.2:1	Max:Avg:Min	M	100 @ 1.52	(10 @ 5.0)	Avg	3:1.5:1	Max:Avg:Min
Sales transaction areas max.	T		Q	400 @ 0.91	(40 @ 3.0)	Max								
<b>Fashion and Specialty Store</b>														
General retail min.	A		O	200 @ 0.91	(20 @ 3.0)	Min			R	500 @ 1.83	(50 @ 6.0)	Avg		
General retail max.	A		Q	400 @ 0.91	(40 @ 3.0)	Max			T	1,000 @ 1.83	(100 @ 6.0)	Avg		
Feature displays min. <sup>1</sup>	T		T	1,000 @ 0.91	(100 @ 3.0)	Min								
Feature displays max. <sup>1</sup>	T		V	2,000 @ 0.91	(200 @ 3.0)	Max								
Circulation min.	T		N	150 @ 0.00	(15 @ 0.0)	Min			K	50 @ 1.52	(5 @ 5.0)	Avg	2.4:1.2:1	Max:Avg:Min
Circulation max.	T		O	200 @ 0.00	(20 @ 0.0)	Max								

The results of the lighting design project demonstrated that the proposed solution effectively met some of the vital design criteria as illustrated in the table below:

Design Consideration	Design Criteria	Calculated results	Criteria		
Psychological reinforcement	Work of John Flynn (Spaciousness and Closure) Spaciousness: Uniform, peripheral (wall) lighting, higher luminances Closure: Nonuniform, No peripheral lighting, low luminances	The uniformity, peripheral and higher luminances were achieved for spaciousness as illustrated below. The closure was characterized by non-uniformity, no peripheral	✓		
Illuminance (Visual performance, visual clarity)	Ambient	Vertical-15 fc	Closure	21.4 fc	✗
		Spacious	34.4 fc	✗	
	Horizontal 40 fc	Closure	21.37 fc	✓	
		Spacious	53.1 fc	✗	
	Display	200 fc max and 100 fc min	Closure	Max:36.1 fc & Min:4.7 fc	✗
			Spacious	36.7 fc & 7 fc min	✗
Uniformity	Vertical	Circulation: 2.4:1.2:2.1 Max:Avg:Min	Closure	7.7:5.2:1	✗
			Spacious	2.4:1.7:1	✓
	Horizontal	--	Closure	-	-
			Spacious	-	-
Color rendering	Ra ≥ 80	Ra > 80	✓		
Biological needs of the sales personnel	250 lux Melanopic EDI during the day	-	-		
Energy/Sustainability (Standard 90.1)	0.78 W/ft <sup>2</sup> and since it is a retail store, the energy wattage is 5.96 W/ft <sup>2</sup> as calculated in the appendix	Closure	0.755 W/ft <sup>2</sup>	✓	
		Spacious	1.350 W/ft <sup>2</sup>	✓	

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Sales transaction area (Visual Task)	Horizontal	Max-40 fc	Closure	13.6 fc	✓
			Spacious	63.3 fc	✗
		Min-30 fc	Closure	12.7 fc	✗
			Spacious	54.9 fc	✗
		Max:Avg:Min 2.4:1.2:1	Closure	1.1:1.1:1	✓
			Spacious	1.3:1.2:1	✓
Visual comfort/Glare	Glare control in retail spaces involves strategic placement and design of lighting to minimize direct glare and reflections				✓

The lighting design project aimed to implement the concepts of spaciousness and closure by following John Flynn's psychological principles. For psychological reinforcement, the design achieved uniform, peripheral, and higher luminances for spaciousness, while closure was characterized by non-uniformity and low luminances, meeting both criteria successfully.

In terms of illuminance and visual clarity, ambient vertical illuminance was slightly below the target, with closure at 21.4 foot-candles (fc) and spaciousness at 31.32 fc, both missing the 15fc target. Ambient horizontal illuminance also fell short, with closure at 21.37 fc and spaciousness at 46.62 fc, not meeting the 40fc target. However, display illuminance criteria were not met, with closure achieving a maximum of 36.1 fc and a minimum of 4.7 fc, and spaciousness achieving 34.7 fc with a minimum of 7 fc.

For uniformity, vertical circulation uniformity was slightly off-target in the closure scenario at 7.7:5.2:1, but met the criteria for spaciousness at 2.5:1.7:1. The color rendering index exceeded the requirement of  $Ra \geq 80$ , achieving  $Ra > 80$ .

Biological needs of sales personnel, specified as 250 lux Melanopic EDI during the day, were not provided. Energy sustainability for closure was within the limit at 0.755 W/ft<sup>2</sup>, but spaciousness exceeded the target with 1.35 W/ft<sup>2</sup>. However, for retail lighting, the standard 90.1 states that if additional lighting is required for displaying some artwork or merchandise, the space-by space method can be implemented. In this regard, the wattage in the spaciousness illustrating space complied with the standard 90.1. The statement is as follows:

*“Exception to 9.5.2.2: Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.”*

The detail calculations is illustrated in the appendix.

In the sales transaction area, the horizontal illuminance for closure and spaciousness exceeded the maximum target of 40 fc, achieving 13.6 fc and 70.9 fc respectively. However, the minimum illuminance target of 30 fc was not met in the closure scenario, with only 12.6 fc, but was met in spaciousness with 54.7 fc. Vertical circulation uniformity was below target in the closure scenario but met in spaciousness at 1.1:1:1.

Visual comfort and glare control results were not provided in detail but were part of the strategic design considerations to minimize direct glare and reflections in retail spaces.

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## **Description of the Space**

### **Geometry and Assumptions:**

The retail store is designed with dimensions of 16' x 14' x 12'. The ceiling height was reduced by 1 ft to incorporate a hypothetical ceiling for the cove lighting. The detailed layout is illustrated in the AutoCAD drawing. A wall thickness of 50 inches was provided to represent the architectural drawings, which are greyed out, reducing the overall length and width of the room by 1 ft each. However, this wall thickness was not implemented in AGi32.

### **Assumptions about Furniture and Room Surfaces:**

The furniture dimensions were based on the room structure, with default colors for the coffee table and sofa. All shelves and walls were painted with upright and kickplate sections in a dark color (reflectance: 0.02). The room surfaces have reflectances of 80% for the ceiling, 50% for the walls, and 20% for the floor. The walls and ceiling are painted white, except for the section behind the sales desk, which features artistic design. The floor is covered with tiles.

### **Purpose of the Room:**

The chosen space type is a retail store, necessitating a comparison between spaciousness and closure lighting for various performances. The lighting in this retail space, where items like shoes, clothes, and bags are sold, plays a crucial role in creating the right atmosphere and enhancing the customer's perception of the products. Each lighting setting serves a unique purpose:

Ambient lighting is used for circulation within the retail premises, providing uniformity throughout the space.

Accent or display lighting is crucial in highlighting and revealing the texture of the products. It is used in window displays to attract potential customers and on the shop floor to highlight merchandise on racks, influencing purchasing decisions.

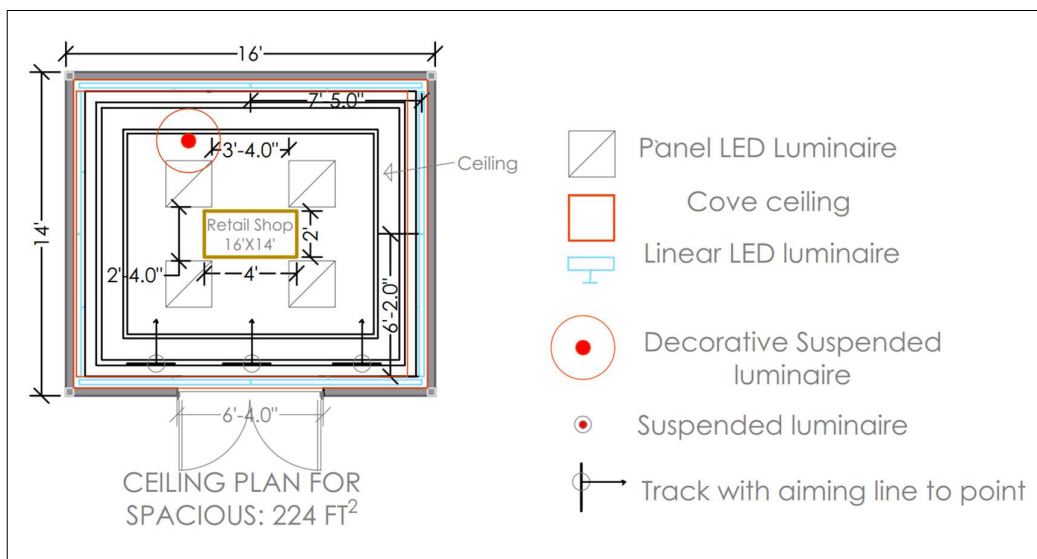
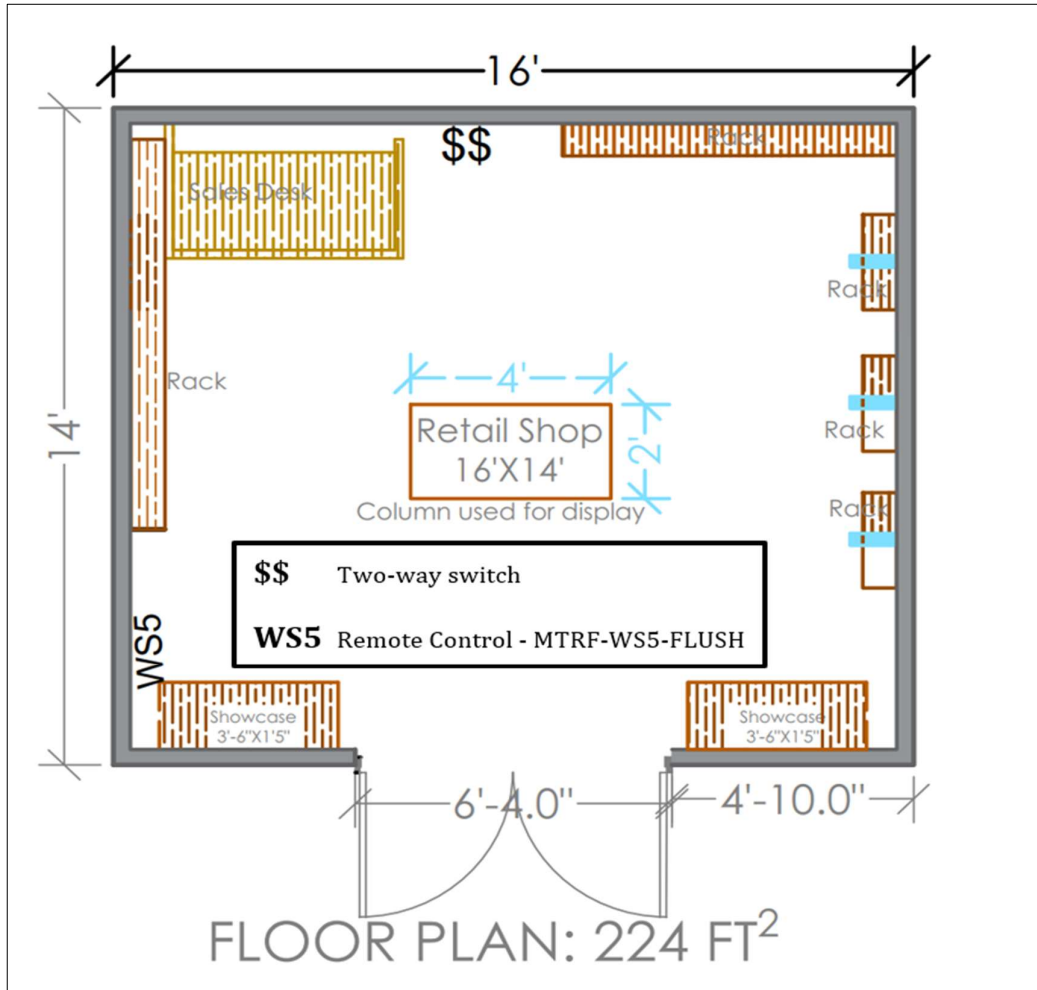
The design communicates the marketing strategy used by retail industries to attract customers and compel them to buy merchandise, thus increasing sales. High-quality, colorful, emotional, and energy-boosting light is used in window displays and shop premises to provide visually appealing products.

**Prioritized List of Lighting Design consideration and Criteria**

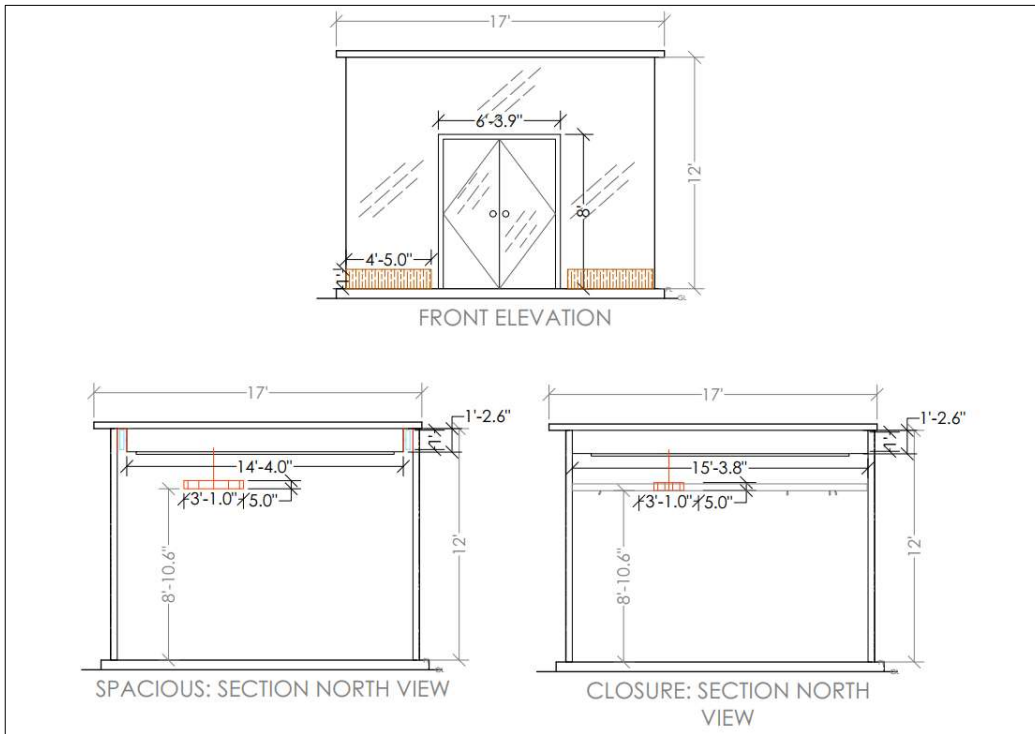
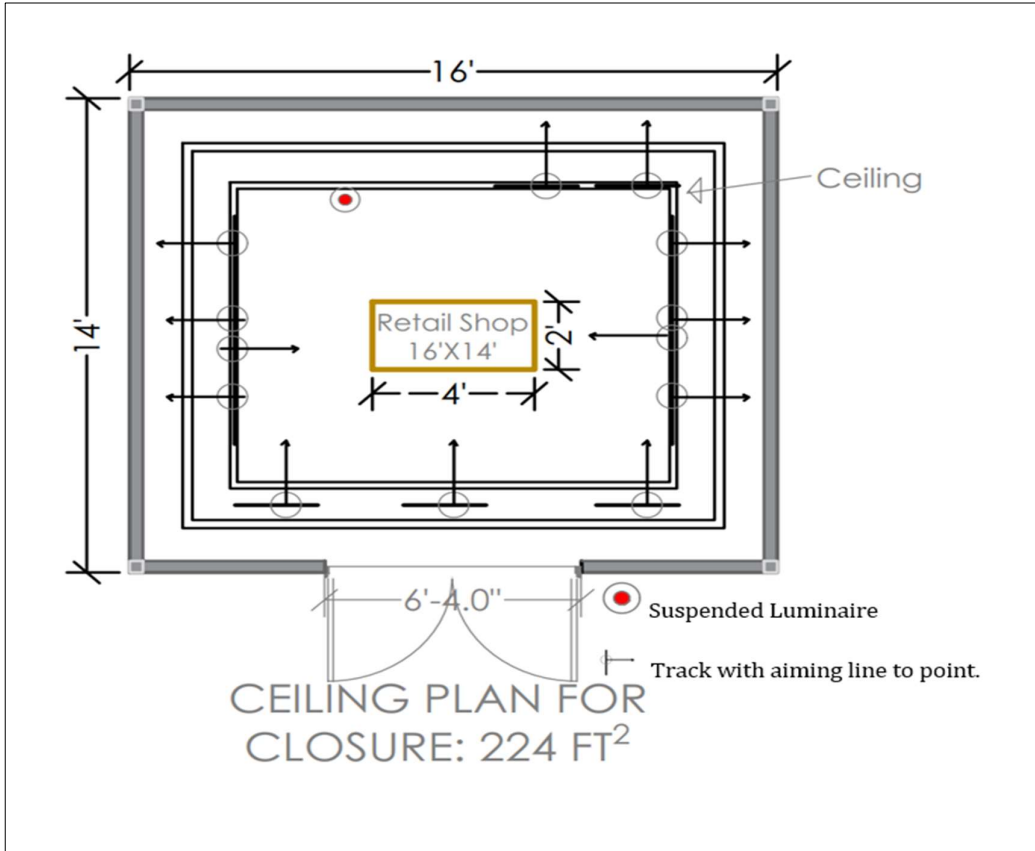
Design Consideration	Design Criteria	
<b>Psychological reinforcement</b>	<b>Work of John Flynn (Spaciousness and Closure)</b> <b>Spaciousness: Uniform, peripheral (wall) lighting, higher luminances</b> <b>Closure: Nonuniform, No peripheral lighting, low luminances</b>	
Illuminance (Visual performance, visual clarity)	Ambient	Vertical-15 fc
		Horizontal 40 fc
	Display	200 fc max and 100 fc min
Uniformity	Vertical	Circulation: 2.4:1.2:2.1 Max:Avg:Min
	Horizontal	--
Color rendering	Ra ≥ 80	
Biological needs of the sales personnel	250 lux Melanopic EDI during the day	
Energy/Sustainability (Standard 90.1)	0.78 W/ft <sup>2</sup> and since it is a retail store, the energy wattage is 5.96% as calculated in the appendix	
Sales transaction area (Visual Task)	Horizontal	Max-40 fc
		Min-30 fc
		Max:Avg:Min 2.4:1.2:1
Visual comfort/Glare	Glare control in retail spaces involves strategic placement and design of lighting to minimize direct glare and reflections	

## Specification of the Design

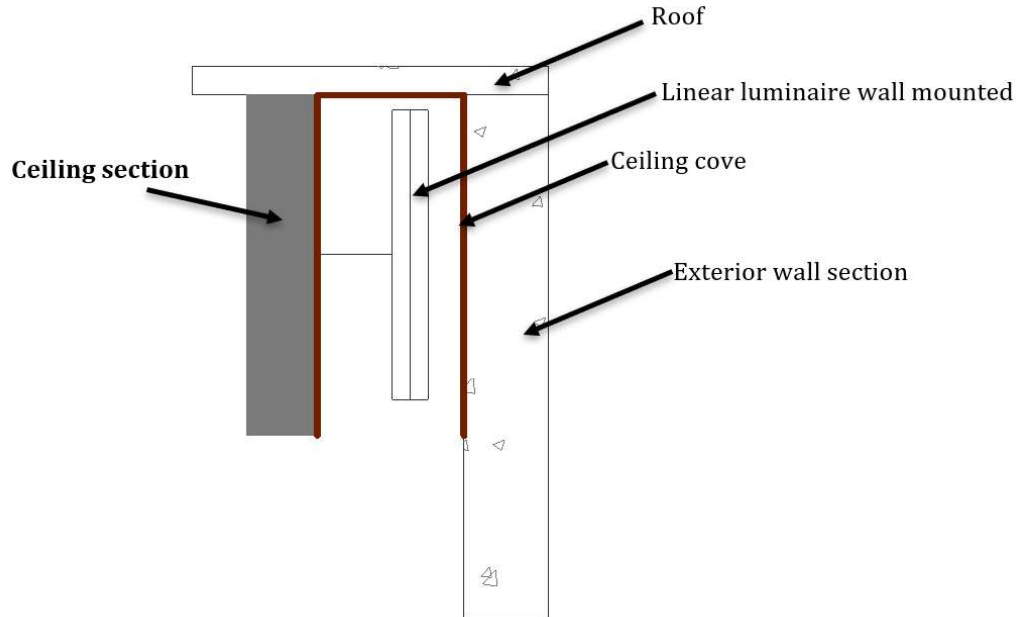
### AutoCAD Drawings



Lighting Design for the Built Environment I



## Lighting Design for the Built Environment I



## Luminaire Schedule

Fixture Type	Description	Fixture (Manufacturers and Models)	Light Source	Total Delivered Lumens	Fixt. Load (W)	Driver	Location / Use
RDP	Round dot pendant					Integral or Remote	
P	Pendant (usually a discreet unit)	T	Track				
RFL	Recessed Flush	W	Wall mounted				
P	circular LED direct Pendant	Prulite 0-30-LED35-SO-FWA-D1	CCT: 3500K, 90+ CRI	13790 lm x 1 piece	76 W	Remote	Decorative lighting
W	Cove Lighting, Linear wallgraze, variable length. 7.5" long along the length of the room and 6.2' along the wide.	Interlux, 20 Linear Perimeter Regressed and Wallgraze WG-20LPR-RBT-S-48_P3-935-X-OD-W	CCT: 3500K, 90+ CRI	3792 lm x 8 pieces	80 W	L1 DALI, remote	perimeter lighting
T	Track Light, 3.3" diameter Adjustable housing with 0-90° tilt and 360° rotation, with 20 deg beam angle	3G lighting 3G-SDL33RA-15-S80-35K-20D Housing: Extruded aluminum, Lens: Proprietary anodized, aluminum reflectors	CCT: 3500K, CRI: 80+	Lument output: 1500 lm x 16 pieces with 3 in spacious space and 13 in closure	180.7 W	1% dimming standard with several integral driver options, remote	accent lighting
RFL	Panel LED, Recessed panel luminaire, 2'x2'	Exislighting IES FILE: SKFLED-22-3000-80-35-F Housing: Die formed cold rolled sheet steel (20 gauge). Lens: Frosted acrylic lens	CCT: 4000K, 90 CRI	2878 lm x 4 pieces	131.2 W	0-10V - 1% Standard Lutron Bi-level dimming	General Lighting
RDP	Pendant Light, Decorative Pendant, 5" wide and 37" diameter	Prulite RDP-6-LED35-HO-NU-UNV-ND	LED4 4000K, 90 CRI	1325 lm x 1 piece	20.2 W	SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	general lighting and sales desk

## Controls Narrative






The lighting scenes and schedules were thoughtfully designed, although it was impossible to implement this in AGi32 software to create animations. The control system designed allows for adjusting the concepts of spaciousness and closure within the same store. For example, the shopping experience can be enhanced by providing spaciousness from 8 am to 4 pm with bright light, then from 4 pm to 10 pm, dimming the lights or switching off some luminaires, such as the panel luminaires, leaving only the track lights and the counter light.

Two separate designs were made in the current project. The general lighting in the sales area is automatically controlled using the DALI control system according to the standard 90.1, which states that “the sales area should be automatically controlled to reduce the lighting by a minimum of 75% during non-business hours; turn off the other lighting system except the general lighting during non-business hours; and dim the lighting if sufficient daylight is available.” Although no windows were incorporated in the design, the southern façade is entirely made of glass to allow sufficient daylight penetration. Sales personnel can use a manual switch to control their lighting scenes and turn off the lights after closing at 10 p.m.

## Cut Sheets

The luminaire types are labelled on each page of the luminaire specification using red color.

Summary of the luminaires used in the project and their specification sheets

		Quantity
This was used in the sales transaction area as decorative and task lighting luminaire in space illustrating spaciousness		1 piece
Used for peripheral lighting in space illustrating spaciousness		8 pieces
Use for highlighting the merchandise in both spaces		13 pieces in the closure expressing store and 3 in spaciousness
Use for general lighting in space illustrating spaciousness		4 pieces
Use in the space illustrating closure at the sales transaction area for both task and decorative lighting		1 piece

# Lighting Design for the Built Environment I

LED O | Pendant & Surface



**PRUDENTIAL LTG.**  
 PRULITE.COM 213.746.0360



4" aperture for all sizes,  
5" body width

Type:

Job:



**This is O.**

It's essentially the P4000's (way more fun) twin. We've reinterpreted the popular original into a playful ring of light. It's a donut-shaped O — as in the shape your mouth makes when you see it.

**O-30-LED35-SO-FWA-D1**  
 3397 Delivered Lumens  
 76 Watts  
 45 lm/w  
 3500 CCT

**LUMEN OUTPUT: Direct (D1)**

	LO	MO	SO	HO
<b>O-20:</b> lm/w	1050	1500	2100	2600
	24	34	47	70
<b>O-30:</b> lm/w	1650	2140	3400	3850
	37	48	76	103
<b>O-40:</b> lm/w	2200	2800	4600	5100
	49	62	105	139



Lumen output for Osram drivers and may vary +/- 5%  
 Consult factory for Strip, Lutron & Eldo drivers  
 4000K used for lm/ft estimates above  
 3500K -2% lfl, 3000K -4%, 2700K -6%  
 \*10% LFL for 90 CRI (4k, 3500K and 3k)  
 See LED Details PDF for more info

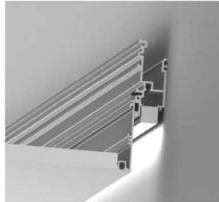
SERIES	LED COLOR	OUTPUT	SHIELDING	COLOR FINISH	DISTRIBUTION	CIRCUITING	VOLTAGE	MOUNTING	CEILING SYSTEMS	DRIVERS	OPTIONS
			<b>FWA</b>								
O-20 2" Dia.	LED27 2700K (90CRI)	LO Low	FWA Flat White Acrylic Lens	TMW Textured Matte White	D1 Direct Solid Top NOTE: Only 1 row of LEDs	SC Single Circuit	UNV (120- 277)	SUR Surface Mount (1" Standoff from ceiling)	X1 T-Bar 9/16" or 3/8" Exposed (Standard)	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard)	EMHE CAT20 Emergency Battery (Remote only; 500 delivered lumens; CAT1e 20 compliant)
O-30 3" Dia.	LED3 3000K	MO Medium						CA48", 96" or 144" Aircraft Cable (Adjustable)	X3 Hard Ceiling	LDE1 Lutron Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming)	
O-40 4" Dia.	LED35 3500K	SO Standard		YGW Gloss White (Standard)	D9 Semi- Direct (No Surface)	DC Dual Circuit (Two feeds required, D9 only)	347 (Emer- gency battery requires a Step Down trans- former)	3RPM48", 96" or 144" Round Cast Aluminum Canopy (Min from fixture to ceiling 2: 10", 3: 16", 4: 20")	X6 Slot Grid or Interlude	ECO 1% 0-10v, EldoLED (Logarithmic dimming std)	EML Emer- gency Battery (3-4: 400 delivered lumens)
	LED4 4000K	HO High		Y Prie- mium Color	NOTE: -17% Up/ight, 83% Down. To specify more or less Up/ight, see Output			35PM48", 96" or 144" Square Cast Aluminum Canopy (Min from fixture to ceiling 2: 10", 3: 16", 4: 20")		ECDA 1% DALI EldoLED (Logarithmic dimming std)	IBC Insulated Braided Cord
	LED3- 90 90CRI	PROG Program- mable Light Output (Specify desired lm or w/fixture)		CC Custom Color	NOTE: Rec- ommended distance to hang from top of fixture to avoid hotspots: 2: 18", 3: 24", 4: 30"			MPCA48", 96" or 144" Monopoint Mounting (18" min from fixture to ceiling)		SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std)	SENSORS: FM-105 Wattstopper H164 Hidden Frequency Occupancy Sensor
	LED35- 90 90CRI	NOTES: Specify separate output Down / Up if desired eg. LO/ HO (Low Down, High Up) Con- sult factory for uplight lumen output						SSC Top-Swivel Stem Mount (Specify length)		SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	
	LED4- 90 90CRI	2: NA LO or MO Uplight unless Downlight is same output level									

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# 20 Linear Perimeter Regressed and Wallgraze



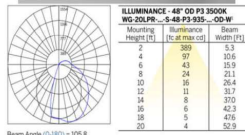
inter•lux



Recessed Plaster Trim (RPT)

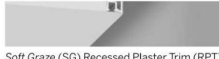
### Ordering Information

Model	Fixation	Pattern	Length	Power <sup>2</sup>	CRI/ CCT <sup>3</sup>	Driver <sup>5</sup>	Lens	Finish <sup>6</sup>	Options
WG-20LPR	RPT	S	A	P0	927	E1	OD (std)	W (std)	EM
WG-20LPRSG	RBT	PI <sup>1</sup>	A x B	P1	930	L1	SD	B	WL
	RRT	PO <sup>1</sup>	A x B x C	P2	935	POE	MPL	S	
	RGT9	PZ <sup>1</sup>	A x B x A x B	P3	940		LL16	F	
	RGT15				TW <sup>4</sup>		LL45B <sup>6</sup> LL45W <sup>6</sup> LL45S <sup>6</sup>		
				L M H	WD RGBW	DO10 DPH L3DAE	L3DOE EL96 DMX		

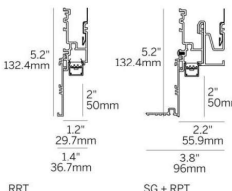
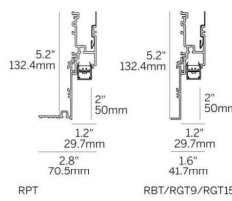


Beam Angle (0-180) = 105.8

Beam Angle (90-270) = 134.2



Soft Graze (SG) Recessed Plaster Trim (RPT)



- See pattern specsheet.
- Wattage shown does not include power supplies/drivers.
- See photometric data sheet for delivered lumens.
- TW offered up to P3 (10W/ft) power level.
- See power supply page for details.
- Louvers available in 4.75" increments, straight runs only.
- See Tiger Drylac color chart: inter-lux.com/tiger.
- Wet Location option available for OD / SD / MPL lenses and recessed / surface ceiling applications only.

### Luminaire

- Recessed perimeter mount fixture with regressed light for continuous mounting to any desired length, as well as standard grid multiples
- Soft Graze (SG) version with 1" extension.
- Extruded aluminum housing, easily installed internal LED fixture insert. Remote driver. Field replaceable LED boards.
- 4' class 2 plenum rated feed cable standard.
- 90+ CRI, 3 Steps MacAdam.
- L/O (1 M2L Projected 85°C) 72,000 hours.
- RGBW 50,000 hours. WD 36,000 hours.
- ETL and ETL-C for dry and damp locations.
- Standard Satin Opal Diffuser for even illumination and no LED appearance. Multiple lens options for high efficiency, low brightness or luminous effect.
- Lengths and angles factory cut to exact field dimensions. Standard and custom corners.
- Powdercoat painted.

### Fixation

- RPT = Recessed plaster trim
- RBT = Recessed bezel trim
- RRT = Recessed return trim
- RGT9 = Recessed grid trim 9/16"
- RGT15 = Recessed grid trim 15/16"

### Pattern

- S = Straight run
- PI = Standard patterns 2, 3 or 4 sided with 90° inside corners on the same plane<sup>1</sup>
- PO = Standard patterns 2, 3 or 4 sided with 90° outside corners on the same plane<sup>1</sup>
- PZ = Non-standard patterns and/or corners other than 90°; consult factory<sup>1</sup>

### Length

- A, B, C = specify inches to the nearest 0.25" (i.e. 72.25") For patterns specify each length (i.e. 2 sided: A x B = 72.25" x 48"; 3 sided: A x B x C; 4 sided: A x B x A x B)
- For 2 and 4 foot fixtures to fit ceiling grids specify 24" and 48" lengths

### Power<sup>2</sup>

- P0 = 1.5 W/ft
- P1 = 3 W/ft
- P2 = 6 W/ft
- P3 = 10 W/ft
- L = 2.7 W/ft WD low power (24V)
- M = 5.5 W/ft WD medium power (24V) [RGBW 7.6 W/ft]
- H = 8W/ft WD high power (24V)

### Lenses/Accessories

- Opal Diffuser (OD)
- Satin Diffuser (SD)
- Micro-prismatic Lens (MPL)
- Narrow Lens (NL16)
- Louvers (LL45)

### CRI / CCT (90+ CRI minimum)<sup>3</sup>

- 927 = 2700K
- 930 = 3000K
- 935 = 3500K
- 940 = 4000K
- TW = Tunable White 2200K - 4000K<sup>4</sup>
- WD = Warm Dim 1800K-3000K
- RGBW = 3000K White

### Driver (remote)<sup>5</sup>

- E1 = eldoLED 0.1% dimming, 0-10V (120-277V)
- L1 = Lutron 1% dimming, EcoSystem (120-277V)
- POE = Power over Ethernet
- BT = Wireless CAS - Casambi (Must specify BT with E1 or DALI)
- DALI = eldoLED DALI DT8 0.1% (120-277V)
- TQ = T-series for Lutron Quantum 0.1% (120-277V) [TW only]
- DO10 = Osram, 10%, 0-10V dimming, 120-277V [WD only]
- DPH = Phase Dimming, 1% dimming, 120V only [WD only]
- L3DAE = Lutron Hi-lume 1% EcoSystem, 120-277V [WD only]
- L3DOE = Lutron Hi-lume Premier 0.1% EcoSystem, 120-277V (remote) [WD only]
- DMX = Osram - eldoLED 24V, DMX dimming [WD + RGBW Only]

### Lens

- OD = Satin opal diffuser (standard)
- SD = Satin clear diffuser
- MPL = Micro-prismatic lens
- NL16 = Linear narrow lens, 16"
- LL45B = Linear louvre black<sup>6</sup>
- LL45W = Linear louvre white<sup>6</sup>
- LL45S = Linear louvre satin<sup>6</sup>

### Finish<sup>6</sup>

- W = White, 15% gloss, RAL 9010 / Tiger Drylac 009/10120 (standard)
- B = Black, 15% gloss, RAL 9005 / Tiger Drylac 049/90053
- S = Silver, 15% gloss, RAL 9006 / Tiger Drylac 049/90500
- F = Custom finished trim, specify RAL

### Options

- EM = Emergency LED driver (remote only)
- WL = Wet Location Under Canopy / Cover<sup>8</sup>

410 381 1497 inter-lux.com answers@inter-lux.com Patent: 10190738 (930-20261-REV.F) 1

whitegoods



# Lighting Design for the Built Environment I

T

## 3G LIGHTING

### 3G-SDL33RA

3.3" ADJUSTABLE DOWNLIGHT  
CYLINDER 7" AND 11" HEIGHT

3.3" diameter high performance cylinders  
Companion to 3G-DL33R series downlight family  
Extruded aluminum housing with powder coated finish  
Twist and lock construction and no visible hardware  
Recessed LED source for enhanced glare control  
Adjustable housing with 0-90° tilt and 360° rotation  
Lumen range up to 2200lm (80+, 90+, and 97+ CRI options)  
1% dimming standard with several integral driver options



<b>PROJECT:</b>		<b>TYPE:</b>	
<b>CATALOG#:</b>		<b>DATE:</b>	<b>QTY:</b>

CAT. NO	FIXTURE HEIGHT	LUMEN OUTPUT	CRI	COLOR TEMP	BEAM ANGLE
3G-SDL33RA	7H - 7" HEIGHT *	10 - 1000 LUMENS	S80 - 80+ CRI <sup>1</sup>	27K - 2700K	20D - 20°
	11H - 11" HEIGHT	15 - 1500 LUMENS	H90 - 90+ CRI	30K - 3000K	40D - 40°
		22 - 2200 LUMENS	H97 - 97+ CRI <sup>1</sup>	35K - 3500K	60D - 60°
				40K - 4000K	90D - 90°

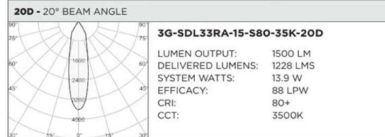
\*7H available up to 1500lm with integral driver (DIM & LE options). Select remote driver option for higher lumen outputs

VOLTAGE	DRIVER	HOUSING FINISH	INSERT FINISH
UNV - 120/277V	DIM - 0-10V (100-1%)	WH - WHITE	WI - WHITE
120 - 120V	LE - PHASE DIM <sup>3</sup> (TRIAC/ELV, 100-1%)	BK - BLACK	BI - BLACK
347 - 347V <sup>2</sup>	DO1 - 0-10V (100-0.1%) <sup>4</sup>	SV - SILVER	SI - SILVER
	DALI - DALI (100-1%) <sup>4</sup>		
	DHL2 - LUTRON HI-LUME (1% ECOSYSTEM)		
	DMX - DMX (100-0%)		
	RDIM - REMOTE 0-10V (100-1%)		
	RLE - REMOTE PHASE (TRIAC/ELV, 100-1%)		

\*Not available with 7H model  
Remote drivers supplied with enclosure

OPTIONS
LS - LINEAR SPREAD LENS
SB - SANDBLASTED LENS
SF - SOFTENING LENS (SUPPLIED STANDARD)
CFW - WHITE CONDUIT FEED CANOPY
CFB - BLACK CONDUIT FEED CANOPY
CFS - SILVER CONDUIT FEED CANOPY
FXC - SEAMLESS CANOPY OPTION
EMR - EMERGENCY BATTERY (RENOTE) <sup>5</sup>

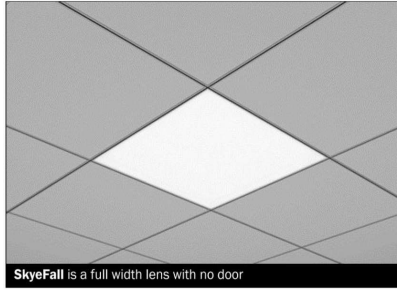
Maximum 1 optical accessory  
Not available with 90D reflector option



1 S80 not available in 27K. H97 available in 30K and 35K as standard  
 2 347 available in "DIM" 0-10V and "RDIM" 0-10V only (100-1%). Not available with 7H model  
 3 Phase dimming options available in 120V only  
 4 DALI-2 (Type 6) provided as standard. Consult factory for DALI Type B option  
 5 Emergency battery installed remotely by others. Not accessible through the inside of the fixture

SkyeFall | Recessed Mount

RFL



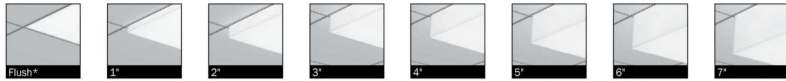
SkyeFall is a full width lens with no door

Project \_\_\_\_\_  
 Type SKFLED-22-4000-80-35-F  
 Notes \_\_\_\_\_

PERFORMANCE AT 3500K

	NOMINAL LUMEN OUTPUT	INPUT WATTS	EFFICACY
<b>Flush</b>	<b>3000 lm</b>	<b>32.8 W</b>	<b>90 lm/W</b>
1" SkyeFall	3000 lm	32.9 W	91 lm/W
2" SkyeFall	3000 lm	32.8 W	91 lm/W
3" SkyeFall	3000 lm	32.8 W	92 lm/W
4" SkyeFall	3000 lm	32.9 W	94 lm/W
5" SkyeFall	3000 lm	33 W	87 lm/W
6" SkyeFall	3000 lm	33 W	88 lm/W

\* Based on a 2' x 2' luminaire using one driver



\* Flush lens at same height as adjacent tile. See page 2 for details.



Ordering Guide

SKFLED	22	TOTAL NOM. LUMENS		CRI	COLOR TEMP. (choose one)	
SKFLED Recessed LED	22 2'x2'	1300	1300 lm - Min	80	27	2700 K
		3800	3800 lm - Max at 90 CRI	90	30	3000 K
		4200	4200 lm - Max at 80 CRI		35	3500 K
					40	4000 K
					B30	3000 K - BIOS*
					B35	3500 K - BIOS*
					B40	4000 K - BIOS*

Outputs between listed min and max are available. Consult factory for outputs outside of the listed range. Consult factory for max output with BIOS.

\* Not available with BIOS.

Consult Axiome technical sheet for more information on color technology. Consult BIOS guide for more information on BIOS technology.

SHIELDING	FINISH	VOLTAGE	DRIVER	CIRCUITS
FL Flush	W white	120 120 V	DP dimming (0-10V) 1% LT Lutron	1 1 circuit
15F 1" SkyeFall		277 277 V	BI bi-level dimming	+E(Ø) emergency section*
25F 2" SkyeFall		347 347 V	O(Ø) other**	+NL(Ø) night light section*
35F 3" SkyeFall		UNV universal	DPB(STC) dimming (0-10V) 1% with BIOS*	+GTD(Ø) generator transfer device*
45F 4" SkyeFall		DC low voltage*	DPB(DYN) Bio-dimming** 100%-81% with BIOS*	
55F 5" SkyeFall			TW(Ø) tunable white drivers*	
65F 6" SkyeFall			POE(Ø) POE drivers*	
75F 7" SkyeFall				

\* Flush mounted to different ceiling tiles and system see page 2 for details. All lens options use frosted lens.

\* Only available with POE drivers.

\*\* See page 3 to specify system.

\*\* Please consult factory; see page 3.

\* Specify quantity.

MOUNTING	BATTERY (OPTIONAL)	OTHER (OPTIONAL)	CONTROLS - REMOTE (OPTIONAL)	CUSTOM (OPTIONAL)
TB9 t-bar 9/16"	B(Ø) battery pack	FW flex whip (6' std)*	DS(Ø) daylight sensor	C custom
TB15 t-bar 15/16"		CP Chicago plenum	OS(Ø) occupancy sensor	
ST screw slot t-bar			DOS(Ø) daylight & occupancy sensor	
TG9 tegular 9/16"			ENR(Ø) enlightened remote*	
TG15 tegular 15/16"			WC(Ø) wireless control dimming	
DF drywall flange				

\* Other lengths available; please consult factory.

\*\* Please consult factory. Specify quantity. Remote only. See integrated controls guide for more details. Consult factory for Tunable White. Not available with DPB (DYN) driver for BIOS with Dynamic Spectrum.

Product design and development is an ongoing process at Axis Lighting. We reserve the right to change specifications. Contact Axis for the latest product information.

1 / 10  
 April 17, 2024

File Name:SkyeFall-LED.SPEC

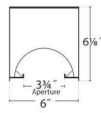
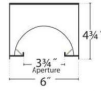
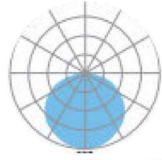
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# Lighting Design for the Built Environment I



## Stream™ Dot Round | Pendant

### Radiant light in cylinder pendant.

The sleek, minimalist Round Stream Dot Pendant offers a slightly softer look, complementing other design elements within the space. Thick (frosted or clear) or thin Top Glows offer a range of uplight options including seven brightly colored acrylics.

RDP-LED35-SO/SO-DDC	Delivered Lumens
1325	Watts
20.2	lm/w
67	CCT
3500	

UP TO 64 LPW [CLICK HERE](#)

	LO	MO	SO	HO
DOWN	325	500	650	850
	5.2	7.7	10.1	14
UP-DDC				
Im	350	515	675	—
W	5.2	7.7	10.1	—

NOTE: White cord for all except black fixtures (black cord).



Lumen output may vary +/- 5%  
 TGI-CLER, TG2P -5% Up  
 TGI-Colors, TG2F -10% Up  
 3500K used for lumen chart  
 4000K +2% If, 3000K -2%, 2700K -4%

SE-RIES	SIZE	LED COLOR	OUTPUT UP/DOWN	UP-LIGHT	TGT1: TOP GLOW COLOR	FIXTURE COLOR	CIRCUITING	VOLT-AGE	MOUNT-ING	ELECTRI-CAL COVER	CANOPY COLOR	CEILING SYSTEMS	REMOTE DRIVER BOX	DRIVERS	OP-TIONS
RDP							SC								
Round Dot Pendant	4 1/4" 6" 9 5/8"	LED27 2700K 90 CRI LED3 3000K 90 CRI LED35 3500K 90 CRI LED4 4000K 90 CRI	LO Low (Matches 4" recessed SO) MO Medium SO Standard HO High (NA Indirect)	NU No Uplight (Uplight NA only) DDC* Diffused TG1* Thin 3/4" Top Glow FROSTED MAND Mandarín TG2F* Thick 3/4" Top Glow Frosted TG2P* Thick 3/4" Top Glow Polished SUP Surface Mount Uplight (LO only) *NA SUR	SKIP COLUMN IF TGI IS NOT SPECIFIED CLER Clear (Standard) SNSH Sunshine YSW Seashell White (Premium color) MAND Mandarín STRW Strawberry Y Premium Color CC Custom Color LGNA Laguna KIWI Kiwi	TMW Textured Matte White (Standard) YGW Gloss White YSW Seashell White (Premium color) Y Premium Color CC Custom Color	SC Single Circuit	UNV (120-277) 347 (Consult factory for Eldo, Lutron)	SSC Top-Swivel Stem Mount (Specify lengths longer than 8'; minimum 6')	EBCP1G Single Gang (Electrical Box Cover/Plat. Mud Ring) EBCP2G Dual Gang (Electrical Box Cover/Plat. Mud Ring)	TMW Textured Matte White (Standard) YGW Gloss White YSW Seashell White (Premium color) Y Premium Color CC Custom Color	X1 T-Bar 'On Tee' Pendant XTP T-Bar 'Off Tee' Pendant X3 Hard Ceiling Pendant EXCP Exposed Conduit Ceiling	SKIP COLUMN IF REMOTE BOX IS NOT NEEDED X1 P T-Bar 1 1/2" or 1 3/4" (NA Surface mount) X3 P/5 Hard Ceiling Plenum Access Required S Mounted Separately (See page 6) SUR1 Remote Box Surface Mount for Open Ceilings (See page 6)	ND Non-Dimming DMO1 0-10v, 1% Dimming (Standard) LDE1 Lutron Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	EML Emergency Battery (EML not available in certain configurations) NOTE: RTK kit required ADC Acrylic Dust Cover (Uplight standard, Downlight optional, ships installed)

Prudential Ltg. reserves the right to change design specifications or materials without notice. Please visit prulite.com for most current data.  
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## Appendix

### Assumptions and Procedures

#### Programming

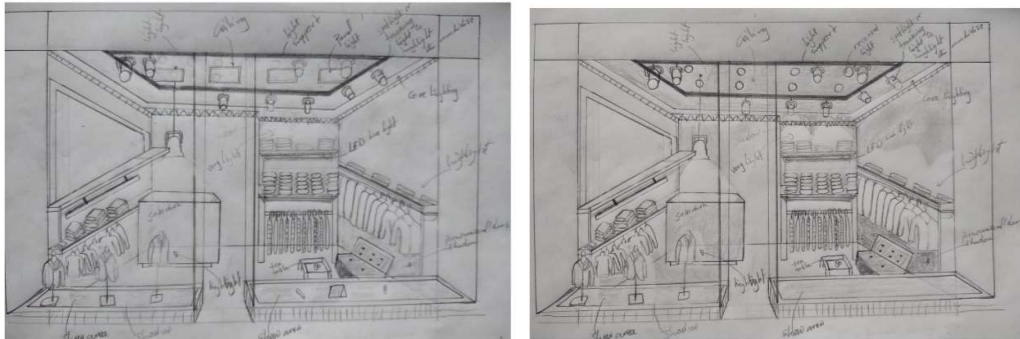
Setting the objectives with considerations for psychological reinforcement, illuminance, uniformity, energy sustainability, color rendering, biological needs, visual tasks, and compliance with codes and standards. In this step, goals were set to determine how the space should feel.

#### Schematic Design

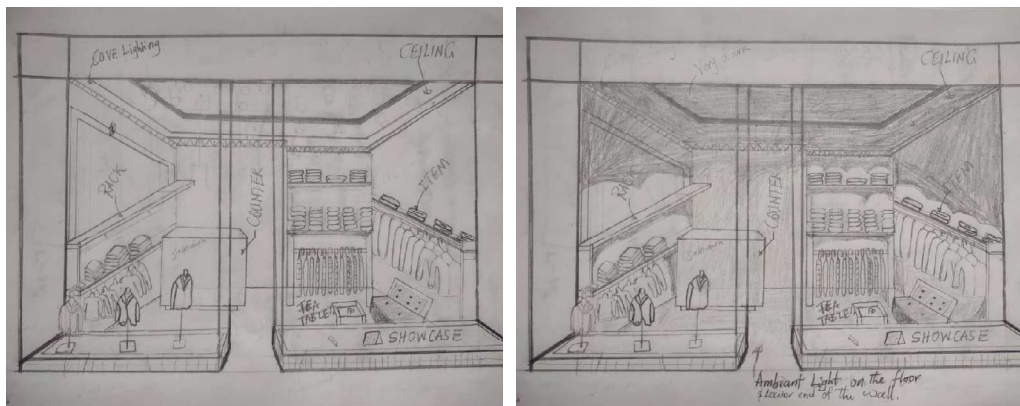
Addressing questions about light sources, directions, distribution, placements, and room materials. This step was initially implemented using hand sketches of the desired scenes. It is crucial to consider the transformative aspect of light: how will the lighting support and reveal the true texture of the merchandise in the store? Brightness and dimness areas were determined to understand how the lighting distribution would be implemented.

In the first iteration of my programming and schematic design, I included luminaires and describing the types of luminaires I need. However, after getting feedback from the professor, I sketched the second diagram below. In addition, the closure scenario was not well illustrated using shadows, but in the second iteration, the shadows were more pronounced.

#### First iteration



#### Second iteration



Spacious


Closure

## Design Development

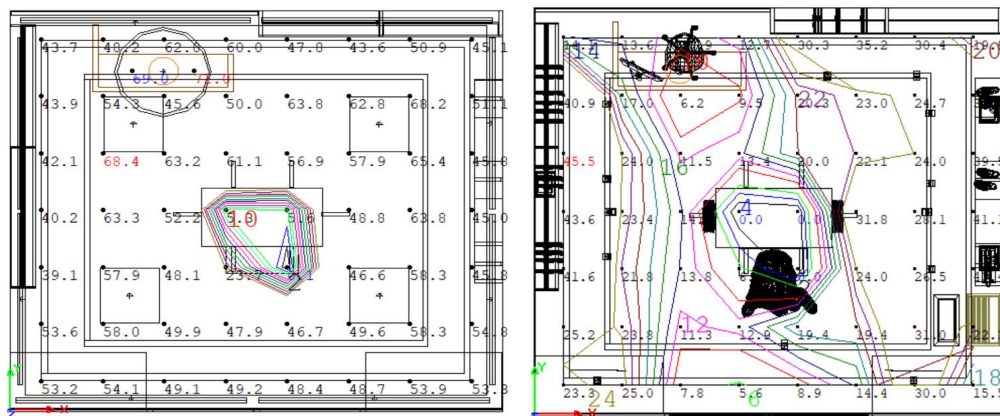
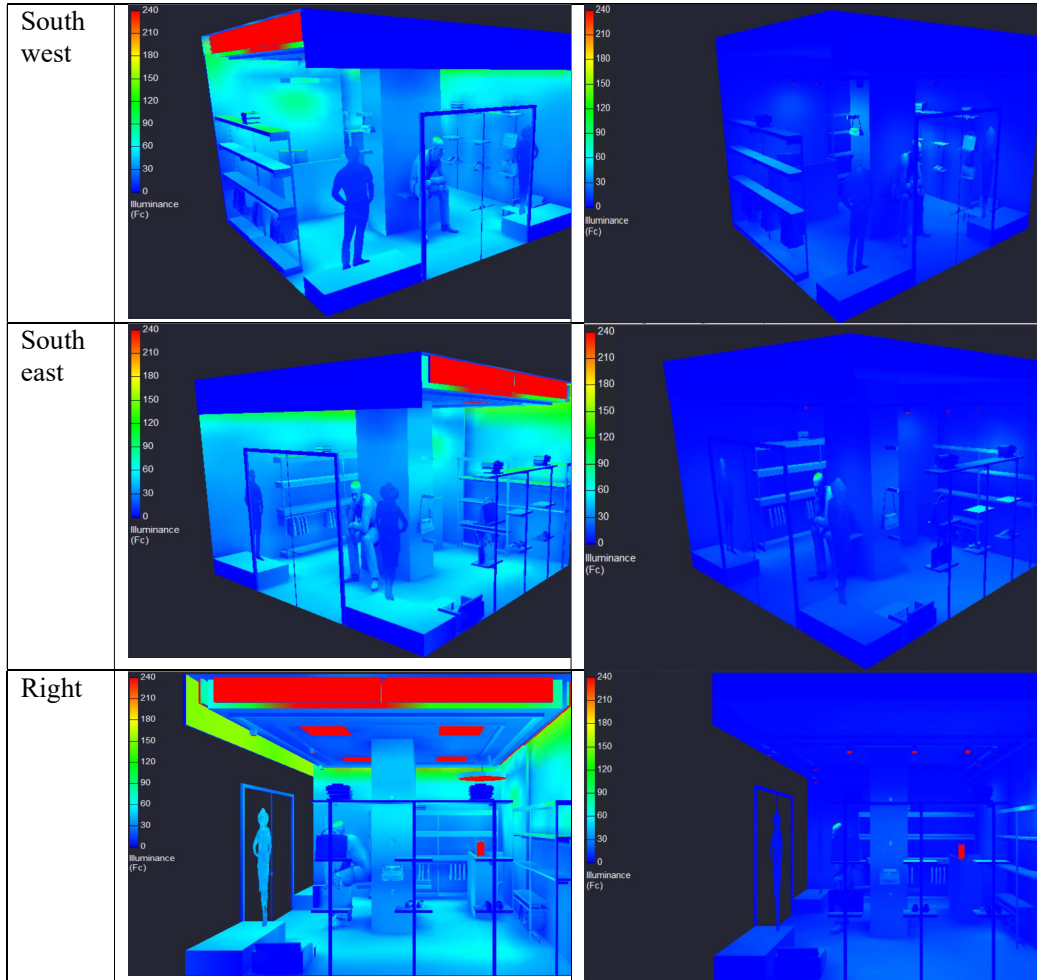
The lighting design process involved detailed computer modeling, equipment selection, calculations, and implementing programming and schematic design goals. This precision ensured that once the lighting direction and distribution were determined, the ideal luminaire could be chosen to execute the schematic design and programming decisions. For the retail store, track lights were used to highlight merchandise and display windows effectively. The concept of spaciousness is characterized by uniformity, peripheral lighting, and high intensity. Perimeter lighting, as suggested by John Flynn, was essential to wash out the wall and bring uniformity to the space. General lighting was provided using 2'x2' LED panels for their efficiency and aesthetic appeal. Pendant luminaires were strategically placed for decoration in both closure and spacious spaces.

## Simulations

Running AGi32 simulations to optimize lighting solutions, ensuring they meet psychological and functional criteria. We can appreciate the simulated spaces below.

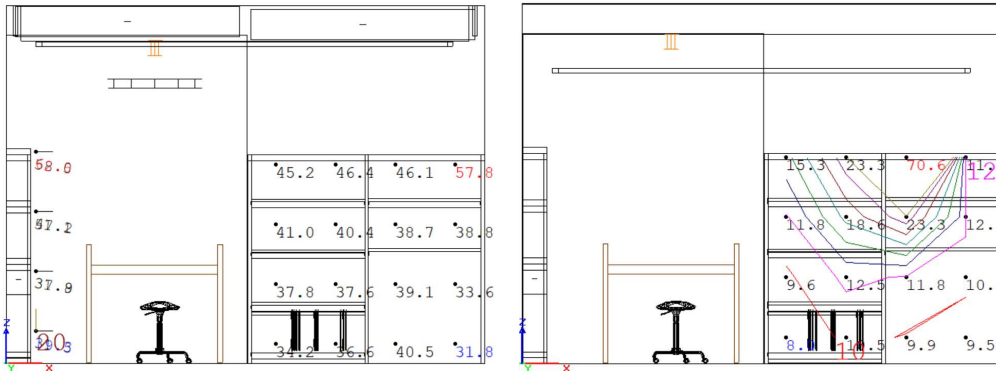
View	Spaciousness	Closure
		
Front		

# Lighting Design for the Built Environment I



Horizontal illuminance for spacious and closure spaces

## Lighting Design for the Built Environment I



Vertical illuminance of the North shelves for spacious and closure spaces

### Energy Consumed, LPD for the rooms and some surfaces calculated values.

LPDArea_2		Spaciousness				
Area = 224.00 Sq.ft						
Total Watts = 302.3						
LPD = 1.350 Watts/Sq.ft						
Calculation Summary						
Label	Units	Avg	Max	Min	Avg/Min	Max/Min
East Shelves	Fc	40.58	52.2	32.3	1.26	1.62
East side middle column	Fc	23.10	36.1	0.1	231.00	361.00
Manequin	Fc	21.46	36.7	7.0	3.07	5.24
North Shelves	Fc	42.46	60.4	33.6	1.26	1.80
sales transaction Top 1	Fc	63.30	71.7	54.9	1.15	1.31
West Shelves	Fc	41.95	63.5	20.0	2.10	3.18
West side middle column	Fc	36.73	49.1	29.0	1.27	1.69
Workplane Workplane	Fc	53.05	77.2	0.3	176.83	257.33
Luminaire Schedule						
Symbol	Qty	Label	Luminaire Lumens	Luminaire Watts	Total Watts	
⊙	1	O-30-TU-SO-D1	3398	75	75	
⊙	4	SKFLED-22-2400-80-35-F	2400	27.36	109.44	
⊙	3	3G-SDL33RA-TW-08-H90-35K-20D	730	12.62	37.86	
⊙	4	75 linear perimeter 10W	3792	10	40	
⊙	4	20 Linear Perimeter Regressed and Wallgraze 10W	3792	10	40	

Room		Closure				
Area = 224.00 Sq.ft						
Total Watts = 169.06						
LPD = 0.755 Watts/Sq.ft						
Luminaire Schedule						
Symbol	Qty	Label	LLF	Luminaire Lumens	Luminaire Watts	
⊕	1	Desk light 5W	0.800	849	5	
⊕	13	Tracklight	0.800	730	12.62	
Calculation Summary						
Label	Units	Avg	Max	Min		
East Shelves	Fc	21.96	56.0	10.0		
East side middle column	Fc	15.73	29.4	3.2		
Manequin	Fc	5.99	15.4	2.6		
North Shelves	Fc	16.84	70.6	8.0		
Transacion Top 1	Fc	13.15	13.6	12.7		
West Shelves	Fc	17.18	37.6	5.6		
West side middle column	Fc	4.20	7.3	0.0		
workplane Workplane	Fc	21.37	45.5	0.0		

## ANSI/ASHRAE/IES Standard 90.1 (version 2019)

Computing lighting power allowance with space-by-space method for retail store

<b>9.6.1 Space-by-Space Method of Calculating Interior Lighting Power Allowance</b>			
Space	Gross Lighted Area (ft <sup>2</sup> )	LPD (Watts/ft <sup>2</sup> )	Pwr Budget (Watts)
Sales Area	224	1.05	235
<b>Subtotal =</b>			<b>235</b>
<b>9.6.2 Additional Interior Lighting Power</b>			
<b>b. Lighting equipment installed in sales areas</b>			
= 1000 W + (224) (0.45)		Subtotal =	1,101
Power Budget (Watts) =			<b>1,336</b>
Unit Power Density (Watts/ft <sup>2</sup> ) =			<b>5.96</b>

### Limitations of the Design

The design has several limitations. The selected luminaires are not energy efficient for a small room. Specifically, the luminaire used for decoration has a very high-power consumption of around 76 W. Additionally, for a room size of 16' x 14', the number of luminaires used is relatively higher than normal. Based on feedback from the professor, I decided to reduce the number of luminaires in both spaces.

### Future Considerations

Before starting any future projects, I aim to improve my organizational and design steps, as I wasted unnecessary time in the simulation phase due to inappropriate luminaire selection. Time management is another issue I need to address for future lighting design procedures. The initial decisions made before starting the project should be adhered to more strictly. Although it is possible to change some aspects of the design during the simulation phase, not all conditions should be altered. This led to a significant amount of time spent on simulations, although it did help me learn new features of the AGi32 software.

## Lighting Design for the Built Environment I

### Project Timeline

ARE 461: Lighting Design for the Built Environment I							Abbr
Time Sheet for Star Leicht							PR=Programming
DP #01: Light Structures in AGI32							SD=Skematic Design
Rate Schedule: 1 = Consultation Rate \$125 per hour							DD=Design Development
							CD=Contract Document
Date	Start	End	Hours	Rate	Fee	Phase	Tasks
15-May-24	9:30 AM	11:00 AM	1.50	1	\$187.50	PR	Started with programming and choosing the space
16-May-24	4:00 PM	7:00 PM	3.00	1	\$375.00	LR	Got started with AGI32 software learning the interface and getting the basics
17-May-24	5:00 PM	8:00 PM				SD	Scheching the space chose
20-May-24	3:00 PM	5:00 PM	2.00	1	\$250.00	DD	Started CAD drwing of the plan in the autocad software
21-May-24	2:30 PM	3:30 PM	1.00	1	\$125.00	DD	Started implementing the layout in the AGI32
23-May-24	6:30 AM	7:30 AM	1.00	1	\$125.00	DD	Browsing the lighting companies to download the IES files for my desire luminaires
24-May-24	6:30 AM	7:30 AM	1.00	1	\$125.00	DD	Testing the downloaded luminaires and doing the first simulation iteration
25-May-24	6:30 AM	7:30 AM	1.00	1	\$125.00	DD	Testing the downloaded luminaires and doing the second simulation iteration
30-May-24	4:30 PM	6:30 PM	2.00	1	\$250.00	DD	Finalizing the simulation and preparing for the oral presentation
2-Jun-24	5:30 PM	7:30 PM	2.00	1	\$250.00		Preparing the slide for the presentation
4-Jun-24	8:30 AM	9:50 AM	1.33	1	\$166.67		Oral Presentation
4-Jun-24	10:00 AM	10:20 AM	0.33	1	\$41.67		Getting feedback from the professor
5-Jun-24	3:30 PM	4:30 PM	1.00	1	\$125.00		Implementing the feedback
8-Jun-24	4:30 PM	7:30 PM	3.00	1	\$375.00	CD	Preparing for the report
10-Jun-24	10:30 AM	2:30 PM	4.00	1	\$500.00	CD	Checking the final report for submission
<b>Total =</b>			<b>24.17</b>		<b>\$3,021</b>		
<b>Task Subtotals</b>							
Programming (PR) =			1.50		\$188		
Schematic Design (SD) =			0.00		\$0		
Design Development (DD) =			8.00		\$1,000		
Contract Documents (CD) =			7.00		\$875		

### References

1972\_Flynn\_PsychologyOfLightSeries

ANSI\_ASHRAE\_IES 90.1-2022

ANSI\_IES RP-2-20.

IES10eHandbook\_12.3Psycho

Steffy, G., & Aiami, H. A. (n.d.). *Subjective Lighting: Power of Perception*.

Study\_LimbicLighting