Lighting Design Lab

Basic Lighting Design Principles

Presented by
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An Exciting Time for Lighting…

How to make the most of the possibilities…

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Lighting Design

- **What is Lighting Design?**
- **The Lighting Design Process**
- **Specific Considerations**
- **Layout Guides**
- **Project Examples**

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What is Lighting Design?

Creating a plan

• to supply light when and where it is needed
• in an appropriate amount and quality
• to meet the visual needs of the occupant and
• clarify the form of the space
• *using effective, energy efficient and sustainable practices*

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The Lighting Design Process

Defining the Project

Opening Assessment

Setting Goals

Determining the Scope

Establishing Strategies

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The Lighting Design Process

Defining the Project...

- »Lighting for a new space?

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The Lighting Design Process

Defining the Project...

- »Lighting for a new space?
- »Need to correct existing lighting problems?

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The Lighting Design Process

Defining the Project...

- »Lighting for a new space?
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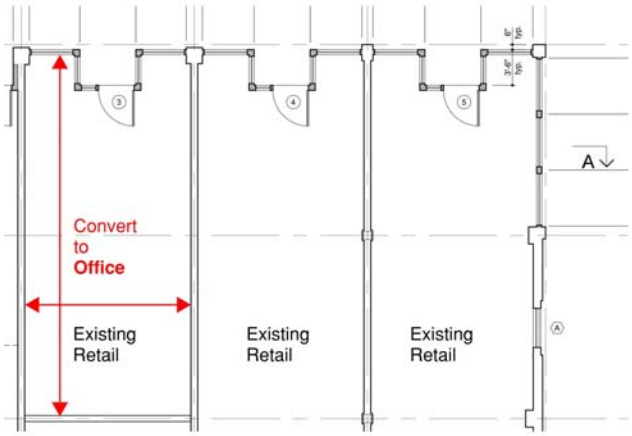
The Lighting Design Process

Defining the Project...

- »Lighting for a new space?
- »Need to correct existing lighting problems?
- »Change in the use of the space?



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The Lighting Design Process

Defining the Project...

- »Lighting for a new space?
- »Need to correct existing lighting problems?
- »Change in the use of the space?
- »Desire to save energy and stretch the budget?

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The Lighting Design Process

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The Lighting Design Process

- Opening Assessment
  - Meet with owner, occupants, architect, etc.
  - Identify legal constraints
  - Identify uses of space
  - Identify physical challenges, opportunities

and determine their needs, priorities

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The Lighting Design Process

- Opening Assessment
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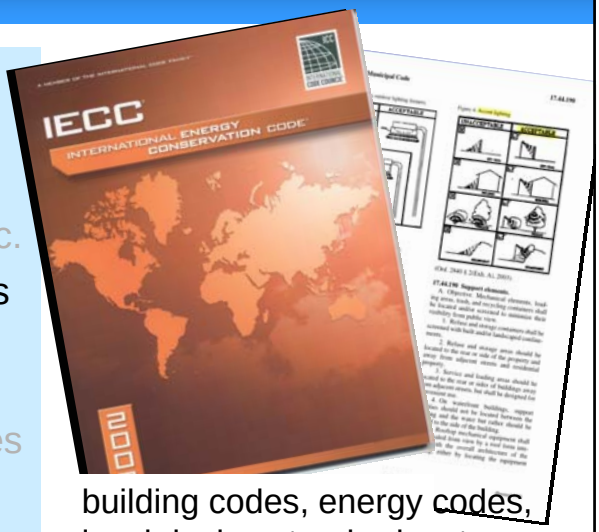

building codes, energy codes, local design standards, etc.

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The Lighting Design Process

- Opening Assessment
  - Meet with owner, occupants, architect, etc.
  - Identify legal constraints
  - Identify uses of space
  - Identify physical challenges, opportunities

tasks, activities, age of users, and special visual & illumination needs.

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The Lighting Design Process

- Opening Assessment
  - Meet with owner, occupants, architect, etc.
  - Identify legal constraints
  - Identify uses of space
  - Identify physical challenges, opportunities

ceiling height, wall reflectances, obstructions, etc.

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The Lighting Design Process

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The Lighting Design Process

»Lighting Goals

- » Lighting quality/quantity targets
- » Energy efficiency level of achievement
- » Working within the Budget
- » Integration with architecture and other building systems
- » Integration of daylight

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The Lighting Design Process

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Establishing Strategies

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Determining the Scope

»Retrofit

- Use existing luminaires
- Replace old lamps and ballasts with new, energy efficient versions

Advantages:

- An inexpensive path to greater energy efficiency and better lighting quality
- No new wiring or ceiling work

Disadvantages:

- No option to re-locate luminaires for better light distribution
- Still the same old luminaire, except for lamps, ballasts, and possibly reflector tray
- Limited options for upgrading controls, or adding occupancy sensors, daylight sensors
- May result in undesirable increase in illumination levels, and might not comply with energy code

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Determining the Scope

»Redesign

- Remove old luminaires, controls and re-design the lighting system using new luminaires and controls to suit the needs of the project.

Advantages:

- Ability to match lighting to needs with appropriate current technology
- Ability to locate luminaires appropriately for best performance
- Good prospects for upgrading controls, control zones, adding daylight harvesting & occupancy sensors, dimmers, etc.

Disadvantages:

- More expensive than retrofit – w/ longer payback period
- Requires permits, new wiring, ceiling repairs
- Likely to require energy code compliance
- May be limited to existing power supply and circuits, depending on circumstances

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Determining the Scope

»New Design

- Create a lighting system plan for a "new", previously unlit space

Advantages:

- Opportunity to integrate lighting with architecture, engineering and other building systems beginning in the initial stages of planning
- Good time to consider integration of electric light and daylight.
- Best situation for optimal lighting system design and implementation

Disadvantages:

- Limited only by architectural & budget constraints, and the difficulty in planning for technology advancements that may be available in near future.

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The Lighting Design Process

Defining the Project

Opening Assessment

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Determining the Scope

Establishing Strategies

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Establishing Strategies

This is the time to consider…

- **Distribution approach** (General Illumination, or...)
- **Integration w/ daylight** (If applicable)
- **Control strategy**
- **Code compliance path**
- **Source types**
- **Luminaire types**

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Establishing Strategies

Distribution approach

Some spaces are appropriately lit with no more than a general wash of light for circulation and visibility.

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Establishing Strategies

In other instances a **task / ambient / accent** approach provides a livelier visual atmosphere with ample light where needed for tasking, general illumination for circulation and accent highlights for sparkle and drama.

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Establishing Strategies

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Establishing Strategies

Integration with Daylight

Is daylight available?

Daylight can

- provide information about time and place
- enhance the visual quality
- save energy
- promote sales
- increase productivity and well-being

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Establishing Strategies

Control Strategy

- Switching or dimming?
- Automatic or manual?
- Programmable?

Area?
Whole building?
Whole Campus?

or

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Establishing Strategies

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- » **Luminaire types**

What are the energy code options?
Prescriptive?
Lighting power allowance?
Space by space? Space as a whole?

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Lighting Levels and Energy Use

Some important terms and metrics regarding lighting and energy…

LPW *efficacy, in **lumens per watt***

LPD *lighting power density, **watts per sq. ft.***

LPA *lighting power allowance, **watts per sq. ft.***

fc *footcandle, Illuminance, in **lumens per sq. ft.***

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Establishing Strategies

This is the time to consider…

- **Distribution approach** (General Illumination, or...)
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- **Control strategy**
- **Code compliance path**
- **Source types**
- **Luminaire types**

- Determined by suitability to lighting objectives & needs
- Choice of source is an integral part of the luminaire selection process

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Establishing Strategies

This is the time to consider…

- » **Distribution approach** (General Illumination, or...)
- » **Integration w/ daylight** (If applicable)
- » **Control strategy**
- » **Code compliance path**
- » **Source types**
- » **Luminaire types**

- The proper selection and placement of luminaires is of primary importance to the success of the plan

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The Lighting Design Process
Luminaires

»Luminaire

A **complete lighting unit**, consisting of

- a ***source*** (lamp or lamps),
- a ***power supply*** (incl. ballast(s), transformers, etc., if req'd), and
- light ***distribution control components*** (reflectors, baffles, lenses, diffusers, etc.), as appropriate, together with
- a ***housing***, to hold, connect, and provide protection for the other components.

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The Lighting Design Process
Luminaire Selection

» Selecting Luminaires

- » Right luminaire type – meets the needs of the situation
- » Delivers required efficiency, efficacy & effectiveness
- » Ease of use – adjusting and maintenance
- » Quality and longevity
- » Appearance – visual appeal and style

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The Lighting Design Process
Luminaire Selection

» Luminaire Type Consideration Factors:

- » function
- » fixed, adjustable, portable…
- » source
- » open or enclosed
- » distribution
- » mounting
- » distribution control apparatus
- » Integrated controls

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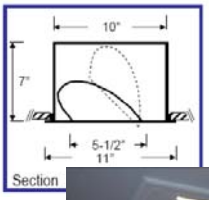
Luminaire Types
by function

Task

Accent

General Illumination



Wall Washing

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Luminaire Types
fixed, adjustable, portable...

Fixed

Adjustable

Portable

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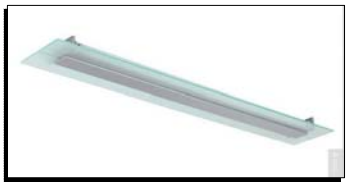
Luminaire Types
by source

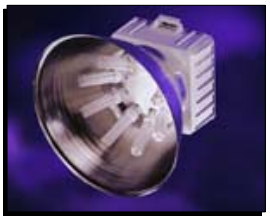
Incandescent

High Intensity Discharge

LED



Linear Fluorescent



Compact Fluorescent

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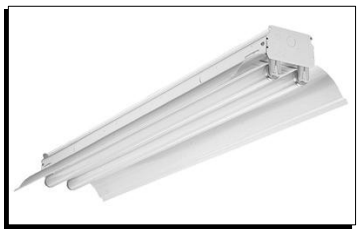
Luminaire Types
open or enclosed



Open

Enclosed

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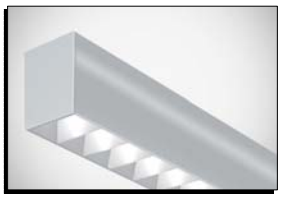
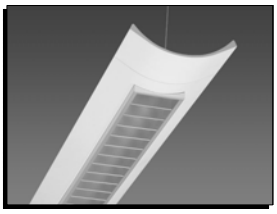
Luminaire Types
by distribution

Indirect



Direct



Direct/Indirect

Diffuse

Spot

Flood

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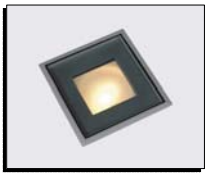
Luminaire Types
by mounting

wall

ceiling



floor

post

track

suspended

surface

recessed

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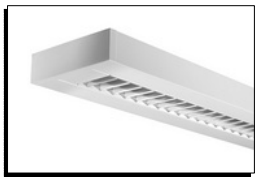
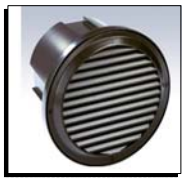
Luminaire Types
by distribution control apparatus

reflectors

lenses





louvers

barn doors

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Luminaire Types
integrated controls

Vertically Integrated Design

Personal Control Features:

Direct/ Indirect Pendant Luminaire

Task light: 2T8-PS Dimmable EB (64W)/ 100%-5%

Ambient light: 1T8-PS EB (31W)/ ON/OFF only

Photocell Sensor built in

Occupancy Sensor built in

Courtesy: Ledalite,
B.C. Hydro

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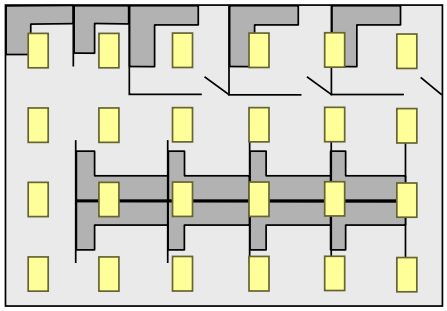
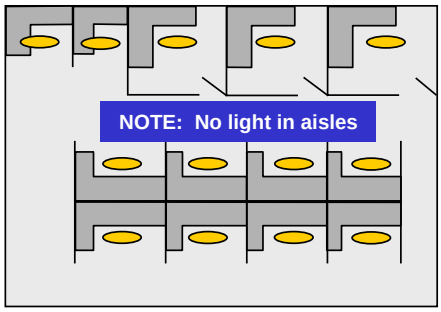
Luminaire Types
integrated controls

Comparison to a Standard Troffer Layout



- 2x4 Parabolics
- **24 Luminaires**
- 72 lamps
- **~2300 watts**

- Direct Indirect
- **13 Luminaires**
- 39 lamps
- **~1250 watts**



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Luminaire Selection
Luminaire Efficiency, Efficacy & Effectiveness

Luminaire Efficiency:

How much light is being delivered by the luminaire
compared to
how much light is produced by the lamps in the luminaire,

expressed as a percentage

example: **luminaire efficiency = 79%**

and, should you wish to take it to the next step…

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Luminaire Selection
Luminaire Efficiency, Efficacy & Effectiveness

Luminaire Efficacy:

Efficacy of the luminaire as a whole, expressed in lumens per watt (LPW)

example: Lamp/ballast efficacy = 80 LPW
Luminaire efficiency = 90%
Luminaire Efficacy = 90% x 80 = 72 LPW

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Luminaire Selection
Luminaire Efficiency, Efficacy & Effectiveness

Luminaire Effectiveness:

A matter of whether or not the luminaire is right for the task, delivering the light where it is needed and in the manner required, independently of luminaire efficiency and efficacy.

In other words -
"make every watt count."

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The Lighting Design Process
Controls – Why use them?

- **Energy Savings**
- **Maintenance Savings**
- **Productivity Gains**
- **Employee Satisfaction**
- **Energy Code Compliance / LEED**

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The Lighting Design Process
Determining Controls

» Controls Basics

- **Typical Strategies**
  - User Controlled Lighting
  - Scheduling
  - Daylight Harvesting
  - Task Tuning
  - Adaptive Compensation
  - Lumen Maintenance
  - Occupancy Sensing

Lents Boys and Girls Club
Portland, OR
RMB Architects

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The Lighting Design Process
Determining Controls

» Controls Basics

- **Equipment**
  - Switches / Timers
  - Dimmers
  - Occupancy / Vacancy Sensors
  - Photo-Cells
  - Whole Building Systems

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The Lighting Design Process
The Lighting & Controls Layout Plan

»Space by Space Decisions

- »**Specific requirements based on physical features and space use**
- »**Matching the luminaire to the space and function**
- »**Spacing and placement of luminaires**
  - ***Help from manufacturer's specifications***
  - ***Calculation studies and recommended illumination levels***
  - ***Mock-ups***
  - ***Keeping track of Lighting Power Density***
  - ***Placement & lighting angles: accent, wall-washing, grazing***

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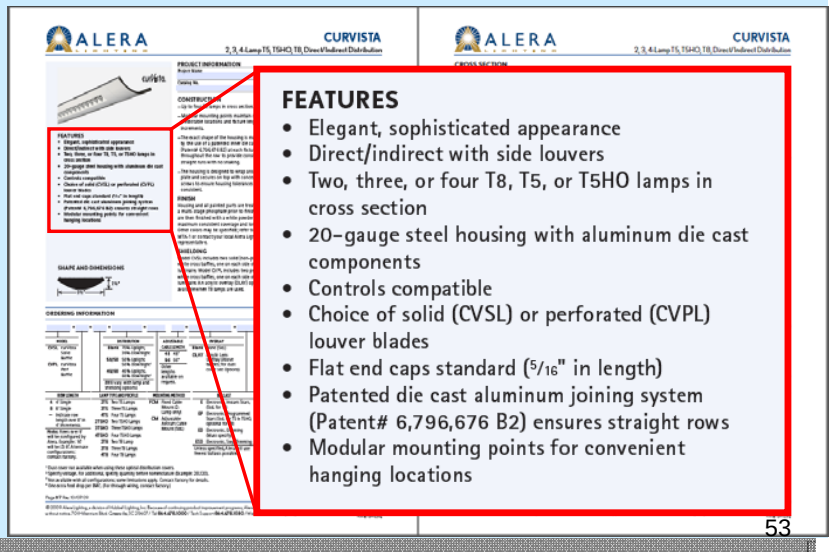
The Lighting Design Process
Space by Space Decisions

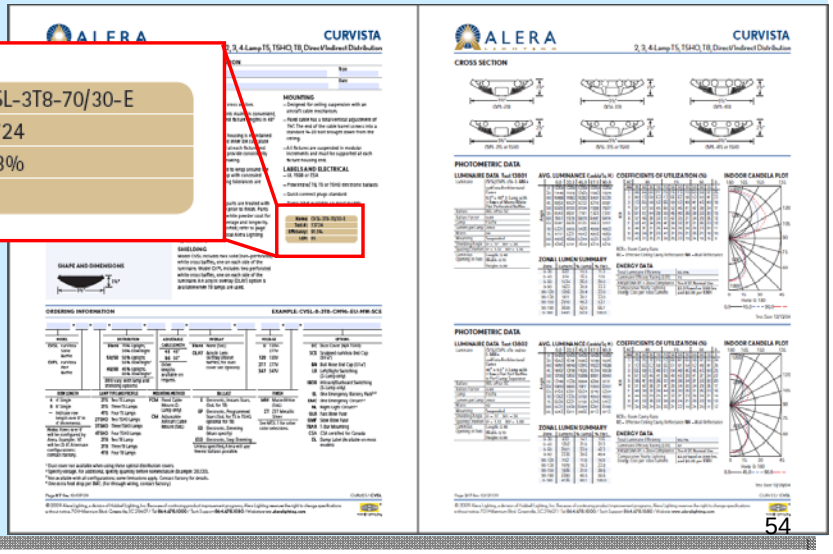
Matching the luminaire to the space and function



The Lighting Design Process
Space by Space Decisions

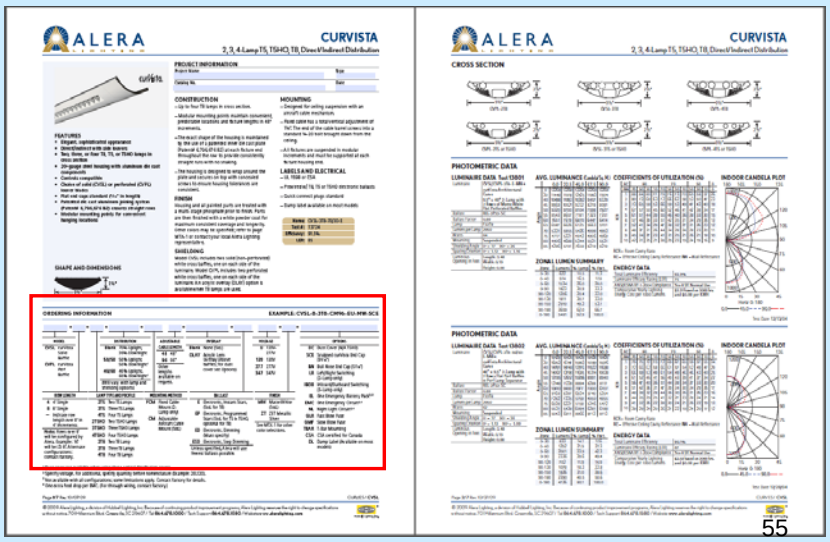
Matching the luminaire to the space and function

Name:	CVSL-3T8-70/30-E
Test #:	13724
Efficiency:	91.3%
LER:	85



The Lighting Design Process
Space by Space Decisions

Matching the luminaire to the space and function



The Lighting Design Process
Space by Space Decisions

ORDERING INFORMATION — **EXAMPLE:** CVSL-8-3T8-CM96-EU-MW-SCE

MODEL
- CVSL curVista Solid Baffle
- CVPL curVista Perf Baffle

ROW LENGTH
- 4 4' Single
- 8 8' Single
- – Indicate row length over 8' in 4' increments

Note: Rows over 8' will be configured by Alera. Example: 16' will be (2) 8'. Alternate configurations: contact factory.

DISTRIBUTION
- Blank 70% Uplight, 30% Downlight
- 50/50 50% Uplight, 50% Downlight[1]
- 40/60 40% Uplight, 60% Downlight[1]

(Will vary with lamp and shielding options)

LAMP TYPE AND PROFILE
- 2T5 Two T5 Lamps
- 3T5 Three T5 Lamps
- 4T5 Four T5 Lamps
- 2T5HO Two T5HO Lamps
- 3T5HO Three T5HO Lamps
- 4T5HO Four T5HO Lamps
- 2T8 Two T8 Lamp
- 3T8 Three T8 Lamps
- 4T8 Four T8 Lamps

ADJUSTABLE CABLE LENGTH
- 48 48"
- 96 96"

Other lengths available on request.

MOUNTING METHOD
- FCM Fixed Cable Mount (2-Lamp only)
- CM Adjustable Aircraft Cable Mount (Std.)

OVERLAY
- Blank None (Std.)
- OLAY Acrylic Lens Overlay (Above baffles; for dust cover see Options)

BALLAST
- E Electronic, Instant Start, (Std. for T8)
- EP Electronic, Programmed Start (Std. for T5 & T5HO, optional for T8)
- ED Electronic, Dimming (Must specify)
- ESD Electronic, Step Dimming

Unless specified, Alera will use fewest ballasts possible.

VOLTAGE
- U 120V-277V
- 120 120V
- 277 277V
- 347 347V

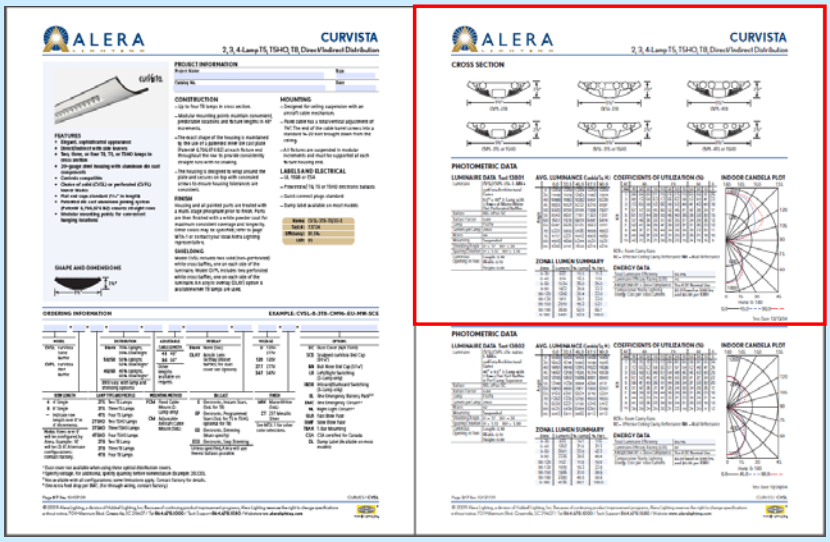
FINISH
- MW Matte White (Std.)
- ZT ZET Metallic Silver

See MTX-1 for other color selections.

OPTIONS
- DC Dust Cover (N/A T5HO)
- SCE Sculpted curVista End Cap (5⁹/₁₆")
- BN Bull Nose End Cap (5⁹/₁₆")
- LR Left/Right Switching (2-Lamp only)
- IBOB Inboard/Outboard Switching (3-Lamp only)
- EL One Emergency Battery Pack[2,3]
- EMC One Emergency Circuit[3,4]
- NL Night Light Circuit[3,4]
- GLR Fast Blow Fuse
- GMF Slow Blow Fuse
- TBAR T-Bar Mounting
- CSA CSA certified for Canada
- DL Damp Label (Available on most models)

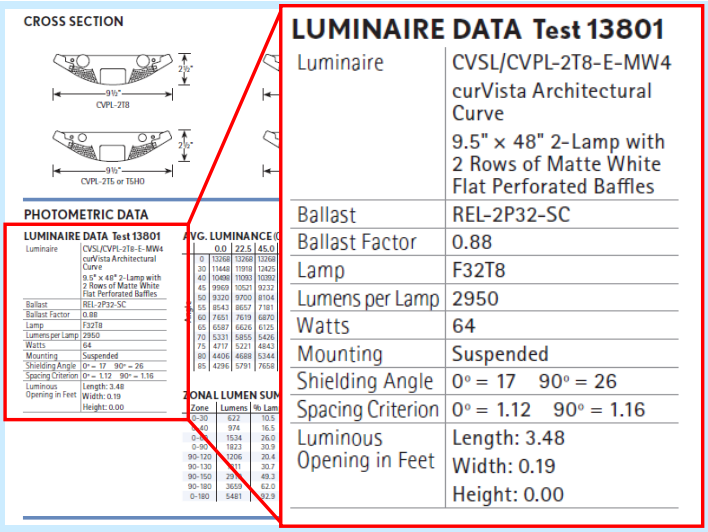
The Lighting Design Process
Space by Space Decisions

Matching the luminaire to the space and function



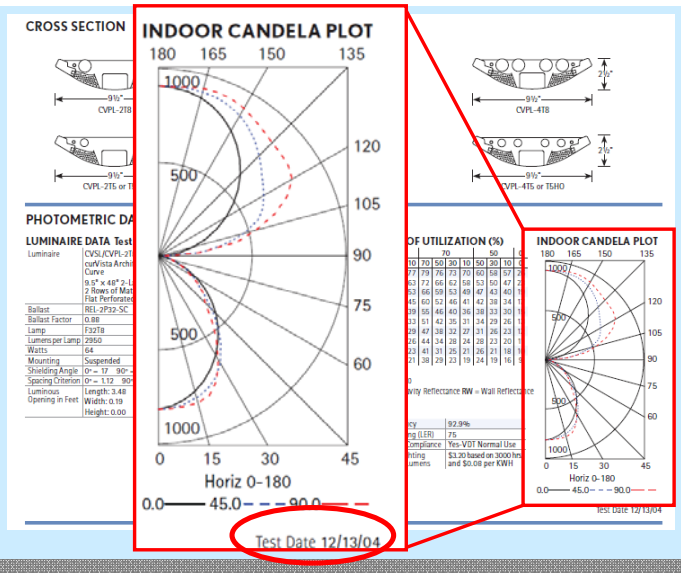
The Lighting Design Process
Space by Space Decisions

Matching the luminaire to the space and function

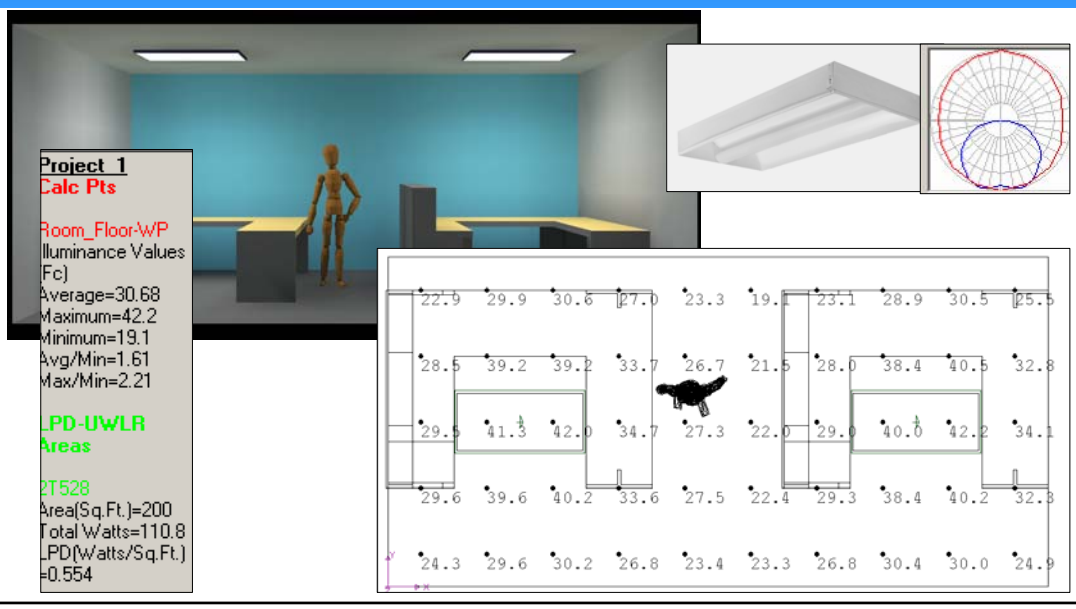


The Lighting Design Process
Space by Space Decisions

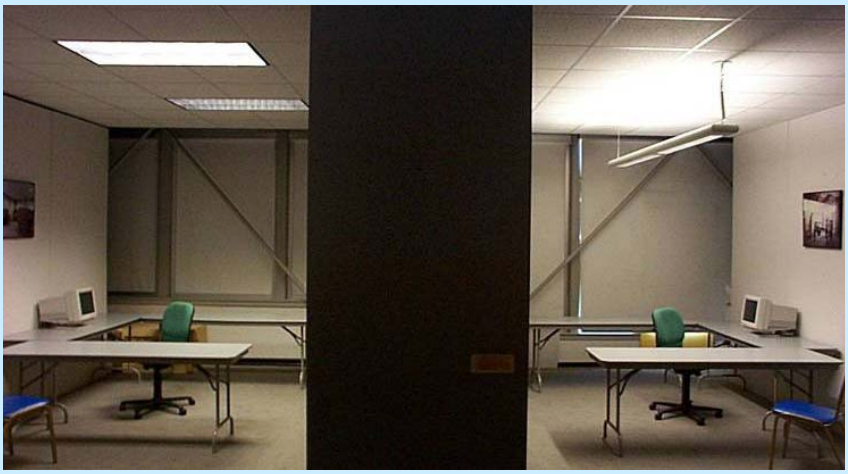
Matching the luminaire to the space and function



The Lighting Design Process
Space by Space Decisions



The Lighting Design Process
Space by Space Decisions



Matching the luminaire to the space and function

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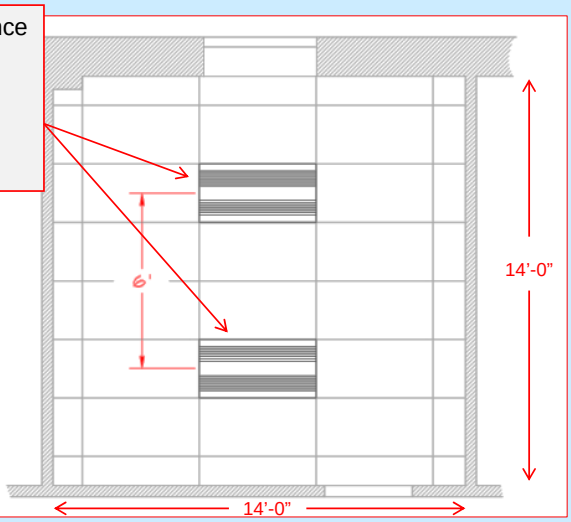
The Lighting Design Process
Space by Space Decisions

Lamps: (2) F32T8 High Performance
Lumens per Lamp: 3100
Ballast Factor: 0.88*
Lamp Lumen Depreciation: 0.95
Total Fixture Efficiency: 84%
Watts: 54.5

Watts: 2 x 54.5 = **109 w**
Area: 14' x 14' = **196 sq. ft.**
Lighting Power Density:
109 / 196 = **0.56 w/sq. ft.**

Keeping track of Lighting Power Density



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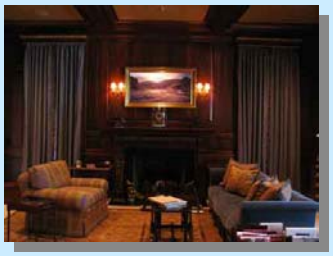
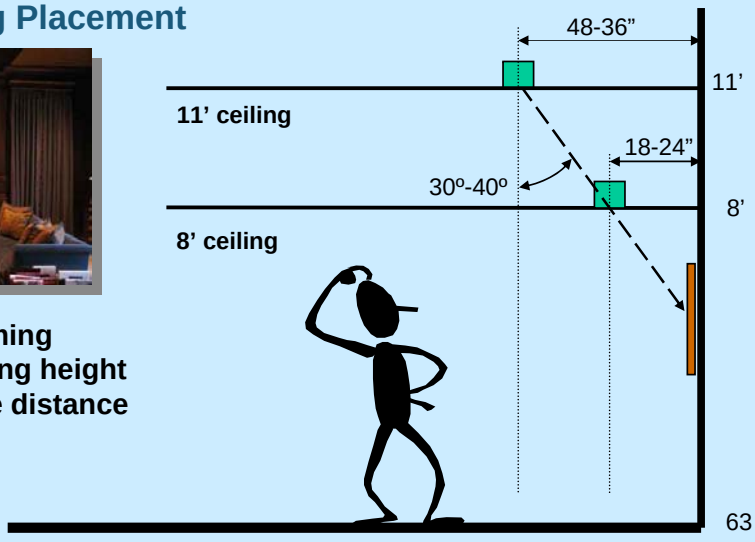
The Lighting Design Process
Space by Space Decisions

Accent Lighting Placement

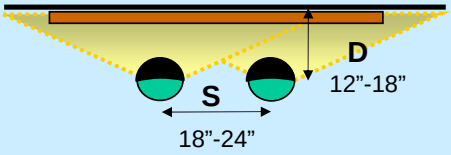


For a given aiming angle, the ceiling height determines the distance from the wall.

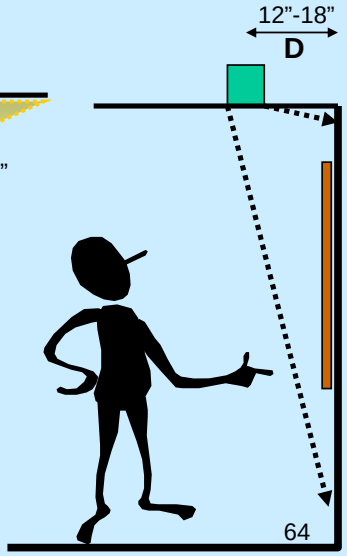


The Lighting Design Process
Space by Space Decisions

Wall Washing



Plan view

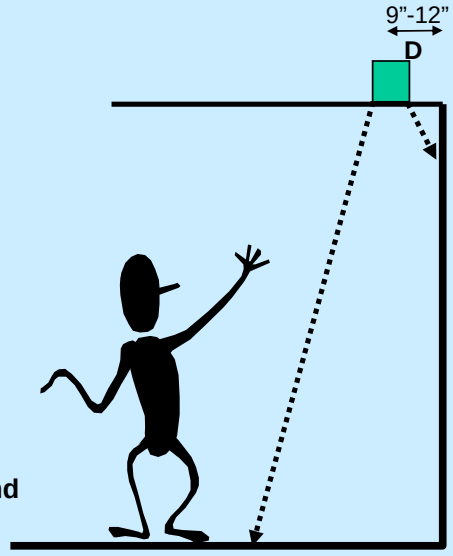


Gets light high on wall, minimizes scallops, flattens texture. Used in groups. Generally, the spacing (S) should equal the distance (D) from the wall.

The Lighting Design Process
Space by Space Decisions

Grazing

Extreme angle from a position close to wall surface highlights and models surface textures



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Elements of a Lighting Plan:

- Reflected Ceiling Plan
- Luminaire & Controls Schedule
- Specification Sheets
- Lighting Detail Drawings

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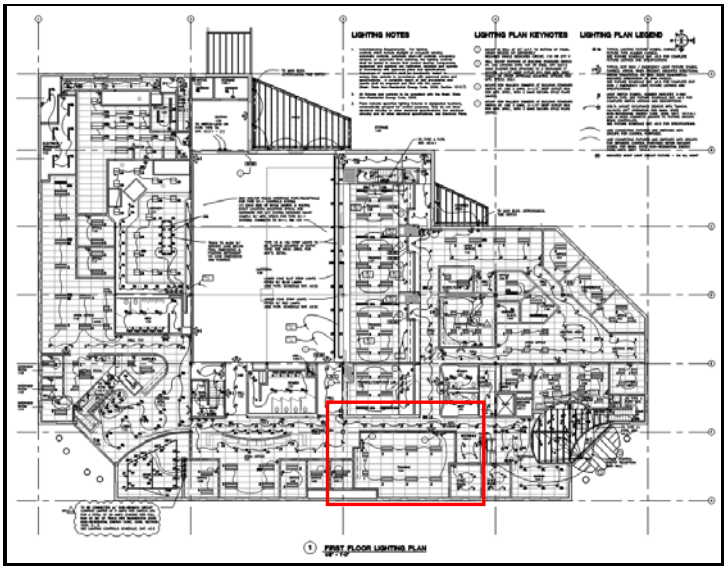
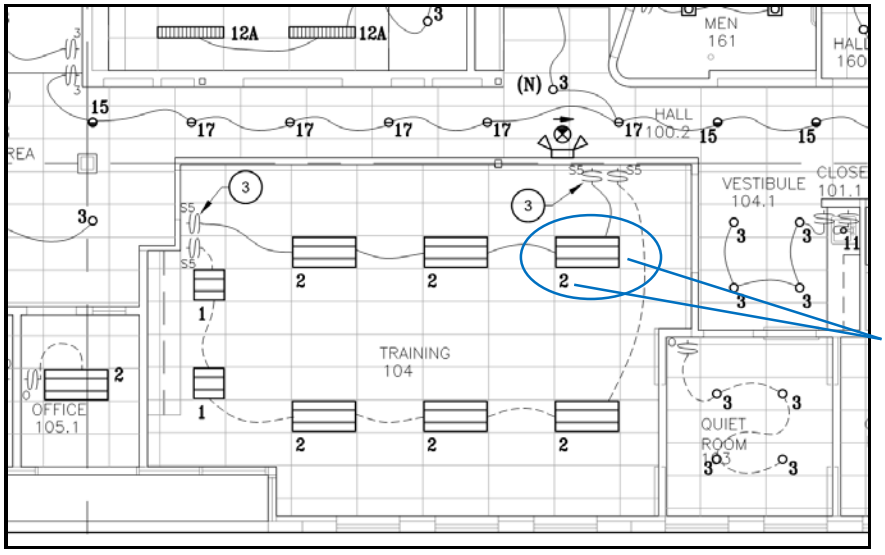
Reflected Ceiling Plan

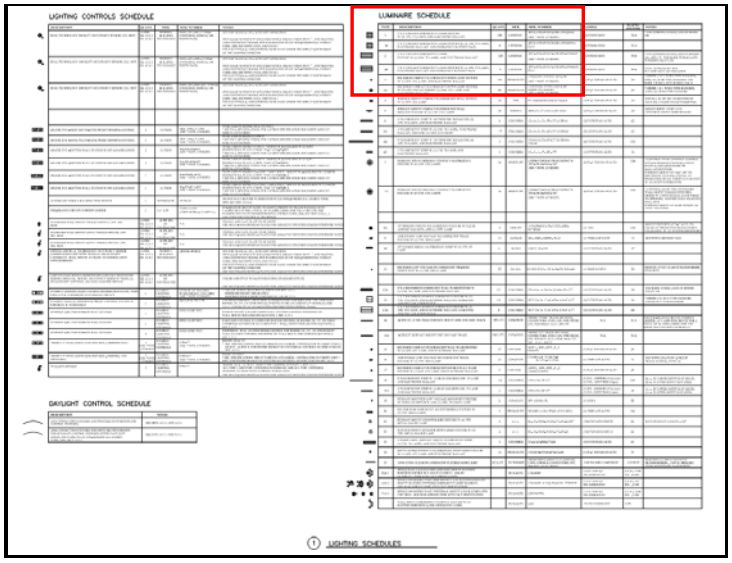


Reflected Ceiling Plan



Luminaire symbol and type number (typical)

Luminaire & Controls Schedule



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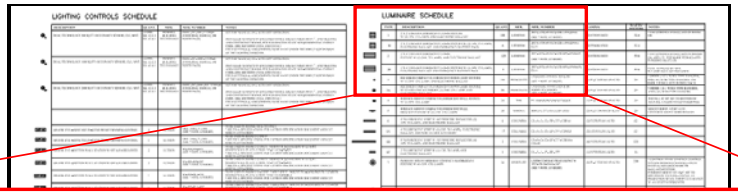
Luminaire & Controls Schedule

Luminaire symbol and type number (typical)



LUMINAIRE SCHEDULE

TYPE	DESCRIPTION	QUANT.	MFR.	MFR. NUMBER
1	2' X 2' LINEAR FLUORESCENT LAY-IN FIXTURE W/ (2) 14W. T5 LAMPS, AND ELECTRONIC BALLAST	188	LITHONIA	2RT5-14T5-MVOLT-GEB115PS-LP841 (SEE * NOTE AT RIGHT)
1E	2' X 2' LINEAR FLUORESCENT LAY-IN FIXTURE W/ (2) 14W. T5 LAMPS, ELECTRONIC BALLAST AND EMERGENCY BATTERY PACK	6	LITHONIA	2RT5-14T5-MVOLT-GEB115PS-LP841-EL14
2	2 'X 4' LINEAR FLUORESCENT LAY-IN FIXTURE W/ (2) 28W. T5 LAMPS, AND ELECTRONIC BALLAST	129	LITHONIA	2RT5-28T5-MVOLT-GEB10PS-LPM841P (SEE * NOTE AT RIGHT)
2E	2 'X 4' LINEAR FLUORESCENT LAY-IN FIXTURE W/ (2) 28W. T5 LAMPS, ELECTRONIC BALLAST AND EMERGENCY BATTERY PACK	5	LITHONIA	2RT5-28T5-MVOLT-GEB10PS-LPM841P-EL14
3	RECESSED COMPACT FLUORESCENT DOWN LIGHT FIXTURE W/ (1) 26W. CFL LAMP, AND ELECTRONIC BALLAST	195	PRESCOLITE	CFQ626EB - STF602 - B24 & B6 (SEE * NOTE AT RIGHT)
3A	RECESSED COMPACT FLUORESCENT DOWN LIGHT FIXTURE W/ GLASS LENS ACCESSORY, (1) 26W. CFL LAMP, AND ELECTRONIC BALLAST	50	PRESCOLITE	CFQ626EB - STF602 - B24 & B6 SQ6005 ACCESSORY (SEE * NOTE AT RIGHT)

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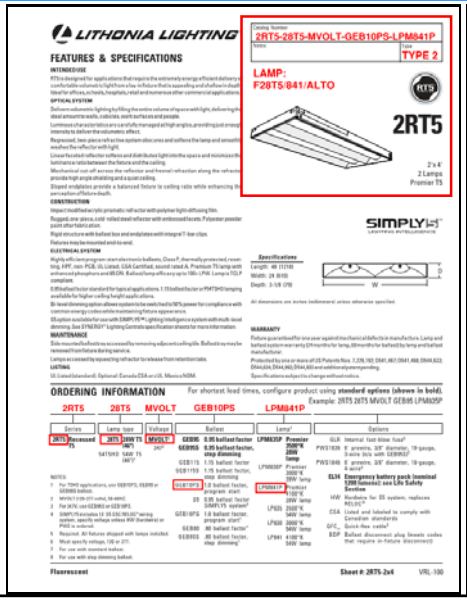
Specification Sheets


LITHONIA LIGHTING

Catalog Number: 2RT5-28T5-MVOLT-GEB10PS-LPM841P
Notes
Type: TYPE 2

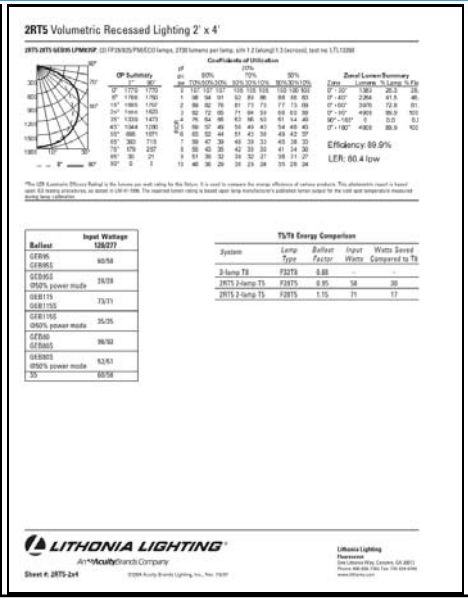
LAMP:
F28T5/841/ALTO

2RT5
2'x4'
2 Lamps
Premier T5

SIMPLY

FEATURES & SPECIFICATIONS

ORDERING INFORMATION


2RT5 Volumetric Recessed Lighting 2' x 4'

Efficiency: 89.9%
LER: 80.4 lpw

LITHONIA LIGHTING

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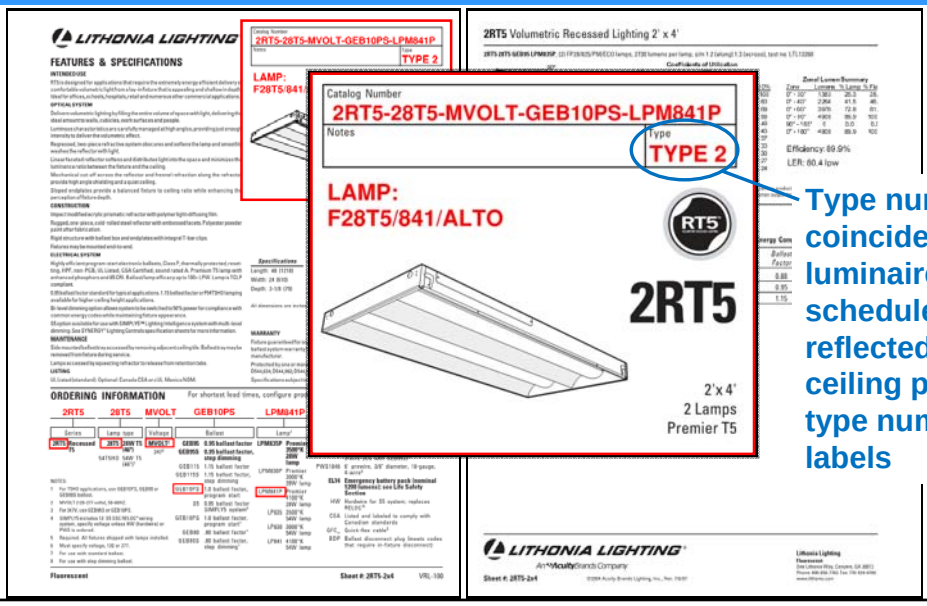
Specification Sheets



Type number coincides w/ luminaire schedule and reflected ceiling plan type number labels

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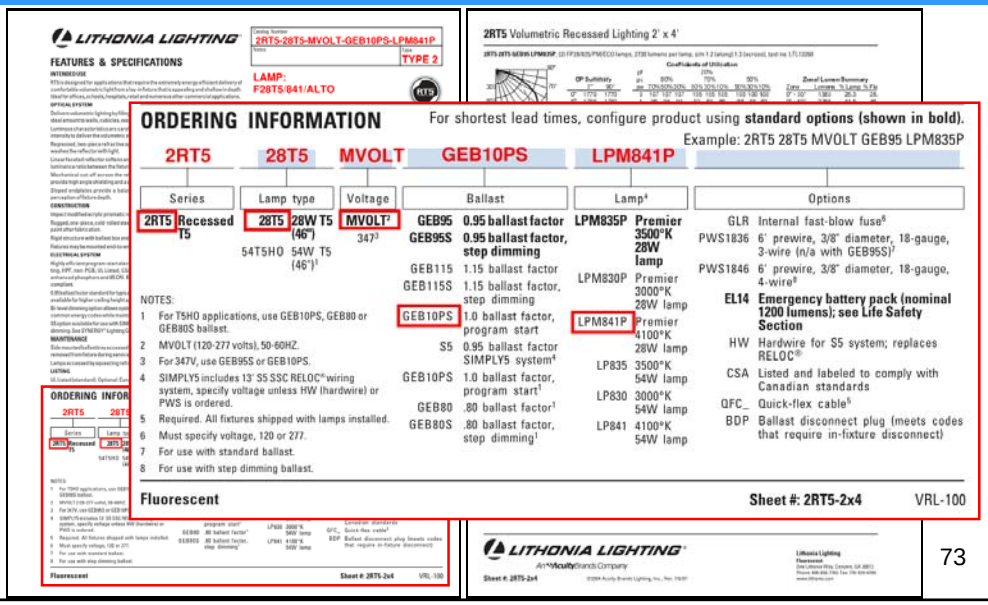
Specification Sheets



LITHONIA LIGHTING

FEATURES & SPECIFICATIONS

2RT5-28T5-MVOLT-GEB10PS-LPM841P

TYPE 2

LAMP: F28T5/841/ALTO

2RT5 Volumetric Recessed Lighting 2' x 4'

ORDERING INFORMATION

For shortest lead times, configure product using **standard options (shown in bold).**

Example: 2RT5 28T5 MVOLT GEB95 LPM835P

2RT5	28T5	MVOLT	GEB10PS	LPM841P	
Series	Lamp type	Voltage	Ballast	Lamp[4]	Options
2RT5 Recessed T5	**28T5 28W T5 (46")**	**MVOLT[2]**	**GEB95 0.95 ballast factor**	**LPM835P Premier 3500°K 28W lamp**	GLR Internal fast-blow fuse[8]
	54T5HO 54W T5 (46")[3]	347[3]	**GEB95S 0.95 ballast factor, step dimming**	LPM830P Premier 3000°K 28W lamp	PWS1836 6' prewire, 3/8" diameter, 18-gauge, 3-wire (n/a with GEB95S)[7]
			GEB115 1.15 ballast factor	LPM841P Premier 4100°K 28W lamp	PWS1846 6' prewire, 3/8" diameter, 18-gauge, 4-wire[8]
			GEB115S 1.15 ballast factor, step dimming	LP835 3500°K 54W lamp	**EL14 Emergency battery pack (nominal 1200 lumens); see Life Safety Section**
			GEB10PS 1.0 ballast factor, program start	LP830 3000°K 54W lamp	HW Hardwire for S5 system; replaces RELOC®
			S5 0.95 ballast factor SIMPLY5 system[4]	LP841 4100°K 54W lamp	CSA Listed and labeled to comply with Canadian standards
			GEB10PS 1.0 ballast factor, program start[1]		QFC_ Quick-flex cable[5]
			GEB80 .80 ballast factor[1]		BDP Ballast disconnect plug (meets codes that require in-fixture disconnect)
			GEB80S .80 ballast factor, step dimming[1]		

NOTES:

1. For T5HO applications, use GEB10PS, GEB80 or GEB80S ballast.
2. MVOLT (120-277 volts), 50-60HZ.
3. For 347V, use GEB95S or GEB10PS.
4. SIMPLY5 includes 13' S5 SSC RELOC® wiring system, specify voltage unless HW (hardwire) or PWS is ordered.
5. Required. All fixtures shipped with lamps installed.
6. Must specify voltage, 120 or 277.
7. For use with standard ballast.
8. For use with step dimming ballast.

Fluorescent

Sheet #: 2RT5-2x4 VRL-100

LITHONIA LIGHTING

An Acuity Brands Company

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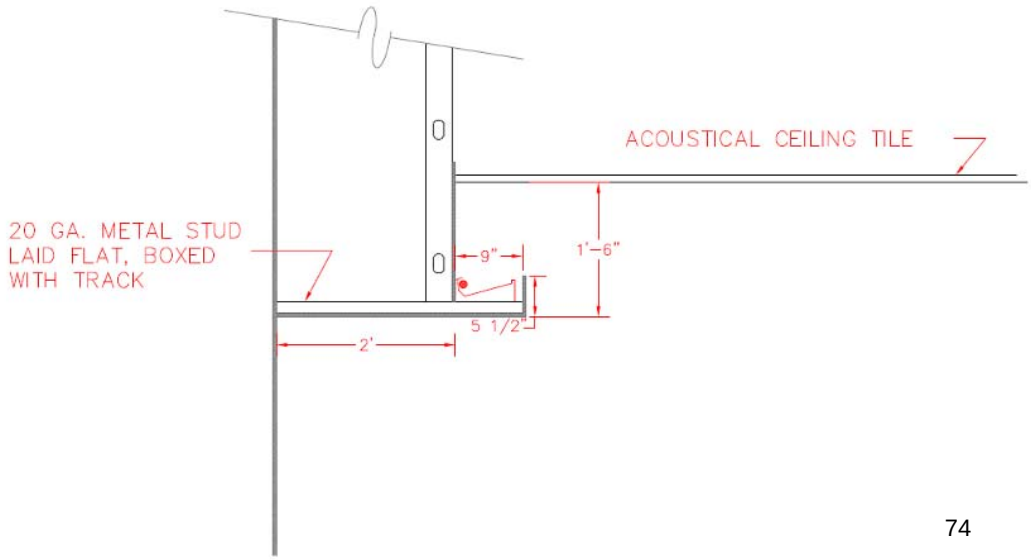
Lighting Detail Drawings



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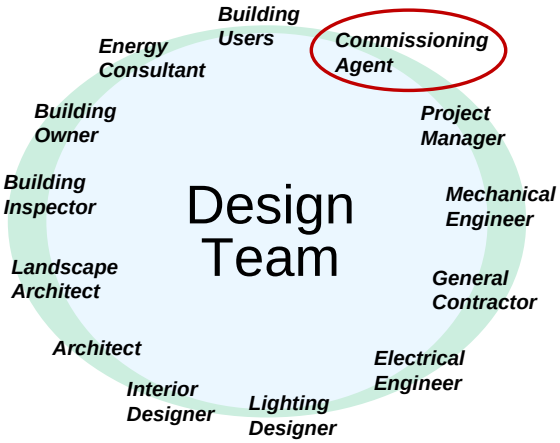
The Lighting Design Process
Design Development & Documentation

»Commissioning

"A systematic quality assurance process to ensure that all elements of the lighting and control system perform interactively and continuously according to the documented design intent and owner's operational needs."

ALGonline
Advanced Lighting Guidelines



Commissioning is critical to success, but… …it's complex

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Specific Lighting Design Considerations: Impact of Surface Reflectance

Small changes…

Can make a big difference

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Specific Lighting Design Considerations: "Glare"

- **Direct glare**
  - Discomfort
  - Disability
- **Reflected glare**
  - Veiling reflections
  - Specular surfaces
- **High contrast**
  - Daylight
  - High reflectance diffuse surfaces

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Specific Lighting Design Considerations: "Contrast"

- Can be used to draw the viewers' attention to the brightest area
- HOW MUCH IS ENOUGH?
- Contrast ratio - the difference between the light on the subject and the light in the surrounding area:
  - ***2:1*** difference can just be perceived (flat)
  - ***3:1*** distinct focal area
  - ***5:1*** minimum for accent
  - ***10:1*** strong focal accent
  - ***15:1*** (or higher) feature element

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Specific Lighting Design Considerations

- Lighting Quantity
  - Integration w/ arch, designer on surfaces, reflectance's, color…
  - Light where needed, when needed, and matched to task
  - Recommended illumination levels

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IES Recommended Illumination Levels

Applications and Tasks[a]	Notes	Recommended Maintained Illuminance Targets (lux)[b,c,d] Horizontal (E_h) Targets — Visual Ages of Observers (years) where at least half are <25	25-65	>65	Gauge	Vertical (E_v) Targets — Visual Ages of Observers (years) where at least half are <25	25-65	>65	Gauge
		Category				Category			
OFFICES	See READING AND WRITING, establish tasks and normalize to illuminance of most important task or most common task; use controls to provide illuminance variability if tasks so demand.								
PARKING	See 26 | LIGHTING FOR EXTERIORS								
PEDESTRIAN WAYS	See 26 | LIGHTING FOR EXTERIORS								
READING AND WRITING									
• Computer	See READING AND WRITING/VDT Screen and Keyboard								
• Electronic Readers									
• Electronic Ink Devices	E_h and E_v @height of device	P	150	300	600 Avg	N	75	150	300 Avg
• LCD or LED Devices	E_h and E_v @height of device	N	75	150	300 Avg	K	25	50	100 Avg
• Facsimile									
• Analog	E_h @2' 6" AFF; E_v @4' AFF[j]	R	250	500	1000 Avg	M	50	100	200 Avg
• Digital	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600 Avg	L	37.5	75	150 Avg
• Handwritten Work	Based on fair-to-good penmanship/hand print on white or canary paper								
• Pencil									
• Graphite/HB	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600 Avg	L	37.5	75	150 Avg
• Red	E_h @2' 6" AFF; E_v @4' AFF[j]	R	250	500	1000 Avg	M	50	100	200 Avg
• Ballpoint/Rollerpoint/Felt-tip									
• Black	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600 Avg	L	37.5	75	150 Avg
• Red, Green, Blue	E_h @2' 6" AFF; E_v @4' AFF[j]	Q	200	400	800 Avg	L	37.5	75	150 Avg

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IES Recommended Illumination Levels

Applications and Tasks[a]	Notes		Recommended Maintained Horizontal (E_h) Targets — Visual Ages of Observers (years) where at least half are <25	25-65	>65	
• Facsimile						
• Analog	E_h @2' 6" AFF; E_v @4' AFF[j]	R	250	500	1000	Avg
• Digital	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600	Avg
• Handwritten Work	Based on fair-to-good penmanship/hand print on white or canary paper					
• Pencil						
· Graphite/HB	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600	Avg
· Red	E_h @2' 6" AFF; E_v @4' AFF[j]	R	250	500	1000	Avg
• Ballpoint/Rollerpoint/Felt-tip						
· Black	E_h @2' 6" AFF; E_v @4' AFF[j]	P	150	300	600	Avg
· Red, Green, Blue	E_h @2' 6" AFF; E_v @4' AFF[j]	Q	200	400	800	Avg

Values given in Lux (what would they be in foot candles?)

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Simplifying the Process

» Lighting Layout Guides
(available at *www.lightingdesignlab.com*)

» **Warehouse T5HO Fluorescent**

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Simplifying the Process

» Lighting Layout Guides
(available at *www.lightingdesignlab.com*)

» **Warehouse**
T5HO
Fluorescent

ROOM CHARACTERISTICS

Length: 72'
Width: 150'
Height: 28' Open Ceiling
Reflectivity:
Ceiling = 80%
Walls = 30%
Floor = 20%
Product = 30%

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Simplifying the Process

» Lighting Layout Guides
(available at *www.lightingdesignlab.com*)

» **Warehouse**
T5HO
Fluorescent

PRODUCT SPECIFICATIONS

Dimensions: 9.75" x 48" (4 ft.)
Louvers: Blade type
Lamps: (2) F54T5 HO
Lumens per Lamp: 4400
Ballast Factor: 1.0*
Lamp Lumen Depreciation: 0.95
Total Fixture Efficiency: ~83%
Watts: 120

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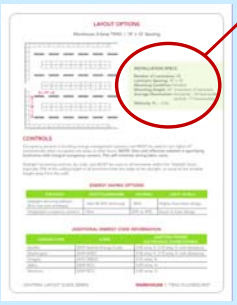
Simplifying the Process

» Lighting Layout Guides

(available at *www.lightingdesignlab.com*)

» **Warehouse**
T5HO
Fluorescent



INSTALLATION SPECS

Number of Luminaires: 48
Luminaire Spacing: 18' x 12'
Mounting Condition: Pendant
Mounting Height: 24" to bottom of luminaire
Average Illumination: horizontal ~14 footcandles
vertical ~11 footcandles
Watts/sq. ft.: ~0.50

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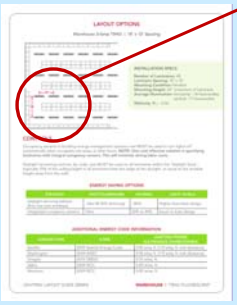
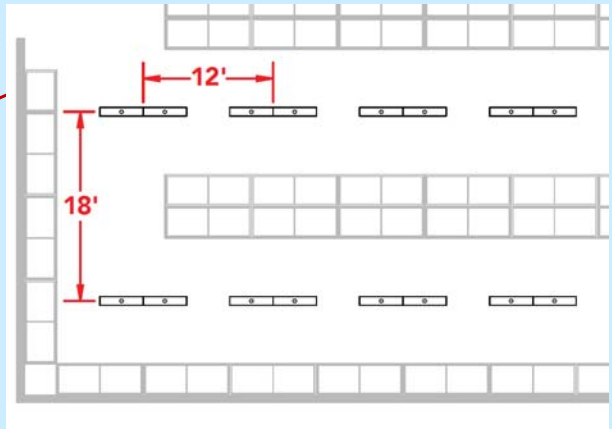
Simplifying the Process

» Lighting Layout Guides

(available at *www.lightingdesignlab.com*)

» **Warehouse**
T5HO
Fluorescent





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Simplifying the Process

» Lighting Layout Guides
(available at *www.lightingdesignlab.com*)
» **Warehouse**
T5HO
Fluorescent

ENERGY SAVING OPTIONS

STRATEGY	WATTS/LUMINAIRE	SAVINGS	LIGHT LEVELS
Daylight dimming ballasts (first row near windows)	~24w (@ 20% dimming)	~80%	Higher than base design
Integrated occupancy sensors	120w	20% to 40%	Equal to base design

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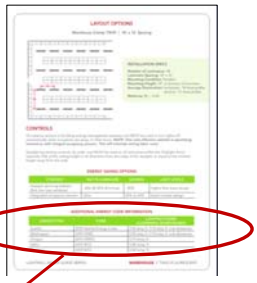
Simplifying the Process

» Lighting Layout Guides
(available at *www.lightingdesignlab.com*)
» **Warehouse**
T5HO
Fluorescent



ADDITIONAL ENERGY CODE INFORMATION

JURISDICTION	CODE	LIGHTING POWER ALLOWANCE (WAREHOUSES)
Seattle	2009 Seattle Energy Code	0.50 w/sq. ft. (1.15 w/sq. ft. rack allowance)
Washington	2009 WSEC	0.50 w/sq. ft. (1.15 w/sq. ft. rack allowance)
Oregon	2010 OEESC	0.73 w/sq. ft.
Idaho	2009 IECC	0.80 w/sq. ft.
Montana	2009 IECC	0.80 w/sq. ft.

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Simplifying the Process

» Additional Lighting Layout Guides

(available NOW at *www.lightingdesignlab.com*)

- **Warehouse**
  - **T8 Fluorescent**
- **Open Office**
  - **2-Lamp Acrylic Lensed**
  - **2-Lamp High Performance Lensed**
  - **2-Lamp Pendant Direct/Indirect**
  - **2-Lamp High Performance Retrofit Kit**
- ***(more to come soon…)***

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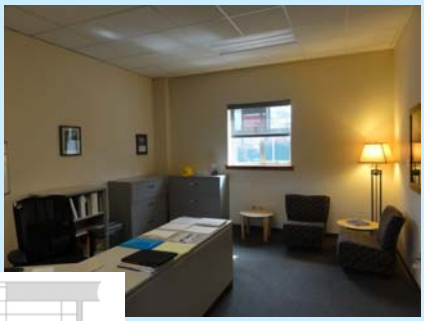
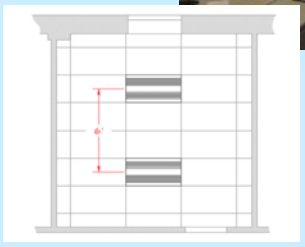
Examples - Interior Lighting

» Private Office





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Examples - Interior Lighting

» Conference Room

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Applications

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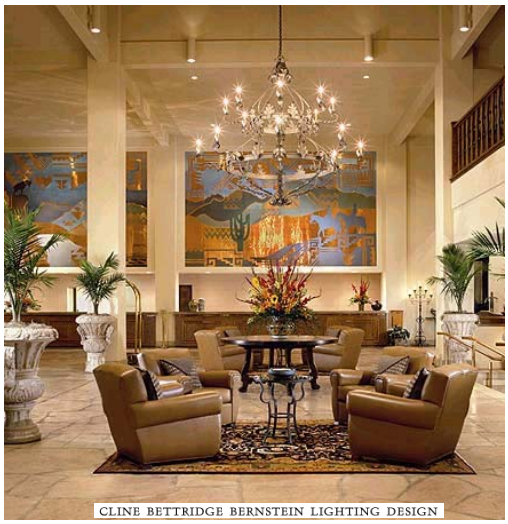
Applications



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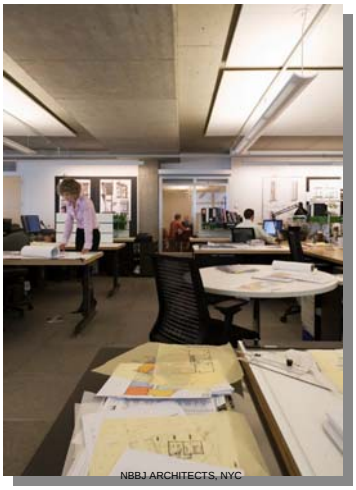
Applications



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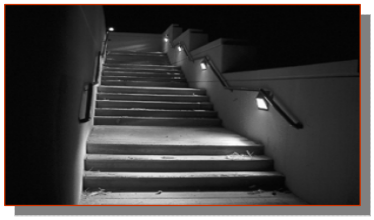
Applications



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Luminaire & Controls Selection and Layout Resources

- »Lighting Design Lab www.lightingdesignlab.com
- »Advanced Lighting Guidelines www.algonline.org
- »Lightsearch www. lightsearch.com
- »FacilitiesNet www. facilitiesnet.com

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Additional Resources:

- IES www.ies.org
- US Green Buildings Council www.usgbc.org
- Lighting Controls Association www.aboutlightingcontrols.org
- Lighting Research Institute www.lrc.rpi.edu
- Northwest Energy Education Institute www.nweei.org
- Northwest Energy Efficiency Alliance www.northwestalliance.org
- ASHRAE www.ashrae.org

Contact Us

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  - www.lightingdesignlab.com
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  - 2915 4th Avenue S.
  - Seattle, WA 98134