

Blue LEDs

onic

LEDinside

Inhabitat

# LED Lighting



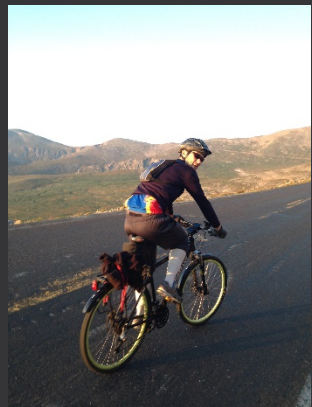
**ARCHITECTURAL ENGINEERING DESIGN GROUP, INC.**  
1900 Wazee Street | Suite 350 | Denver, Colorado 80202 | 303.296.3034 voice | [www.aedesign-inc.com](http://www.aedesign-inc.com)





## About AE Design

- Started in 2004 by Jon Brooks and Jeff Mullikin
- Fundamental belief in Sustainable Design
- Specialize in Lighting Design and Electrical Engineering
- About process as well as results
- 17 team members
- Offices located in Denver and Chicago



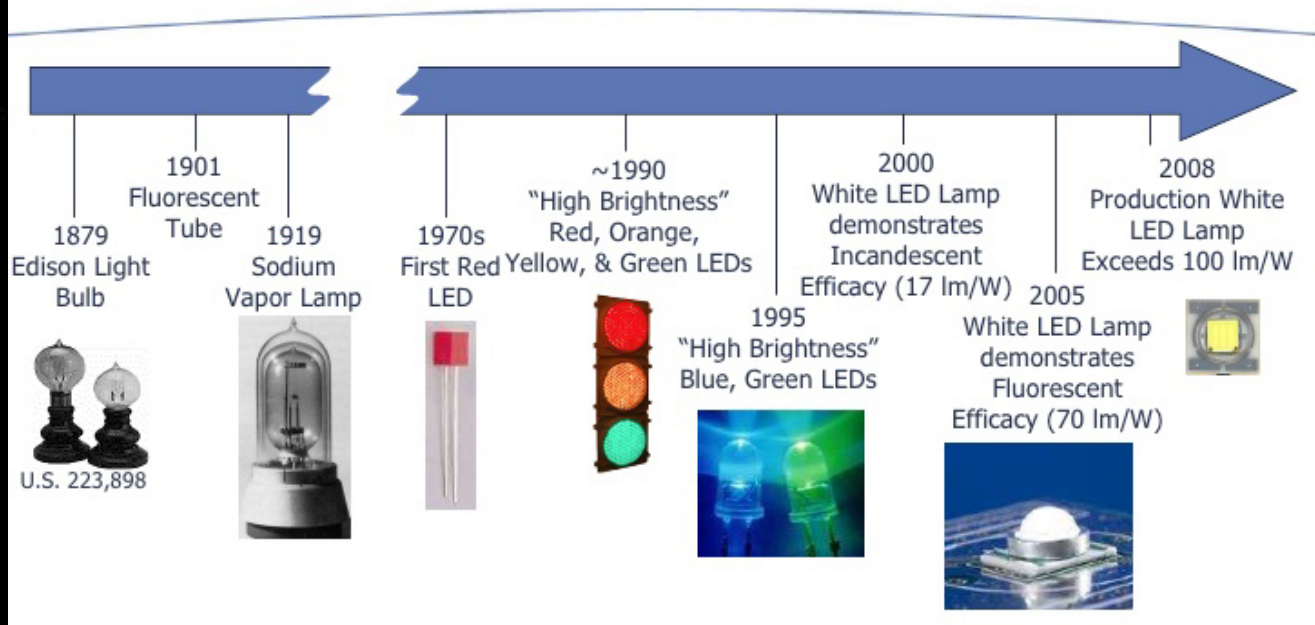


## Objectives of Today's Discussion:

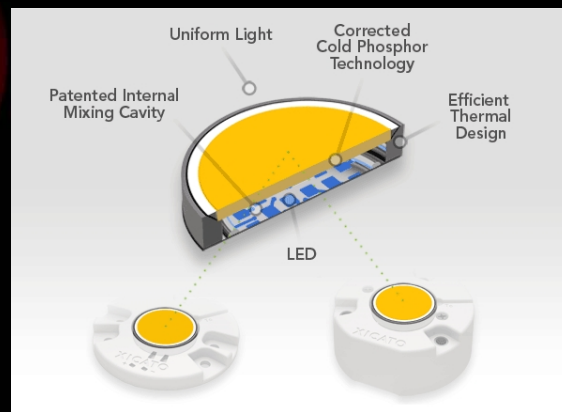
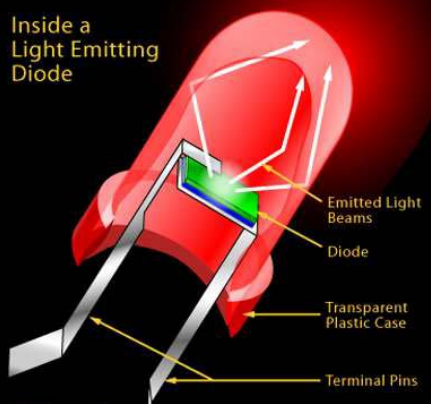
- Understanding the history and evolution of lighting
- Some crucial technical aspects of light
- Why LEDs?
- How do I know when to use LEDs?
- Challenges and drawbacks
- Lighting Applications
- What we do
- What is in store for our future?

Jeff Mullikin, PE, LEED AP BD+C – Principal  
Anna-Lisa Conners, LC – Designer

## ...A Brief History of Lighting



Inside a Light Emitting Diode



## Driving Technological Advances:

- Better efficiencies
- Creative Innovation/Competition
- Price competitive
- Unexplored Applications
- RGB LEDs
- Phosphor LED



## 1 Light Output or Lumens

How much light is the source putting out? Compare these values when you are choosing between replacement sources.

When replacing lamps, this is an approximate chart for going from older incandescent lamps to LEDs while keeping the same lumens, or brightness

### Old Fashioned Incandescent

100W	_____	1600 lumens
75W	_____	1100 lumens
60W	_____	800 lumens
40W	_____	450 lumens

## 2 Watts


How much power does the lamp use? The lower the number, the lower the usage, the lower the energy bill.

Note: *Higher wattage does not mean more lumens, or brightness, when comparing different sources.*

## 3 Lumens per Watt

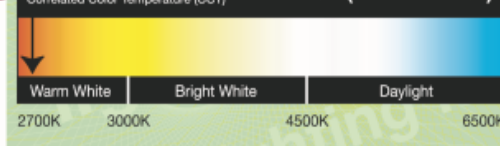
How energy efficient is the source? A typical incandescent lamp is 20 lumens/watt, while some LEDs are now over 100 lumens/watt.

LED
Cree CR Series



**lighting facts**<sup>®</sup>  
A Program of the U.S. DOE

<b>1 Light Output (Lumens)</b>	<b>625</b>
<b>2 Watts</b>	<b>9.5</b>
<b>3 Lumens per Watt (Efficacy)</b>	<b>65</b>
<b>4 Color Accuracy</b> <small>Color Rendering Index (CRI)</small>	<b>92</b>
<b>5 Light Color</b> <small>Correlated Color Temperature (CCT)</small>	<b>2700 (Warm White)</b>



2700K    3000K    4500K    6500K

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit [www.lightingfacts.com](http://www.lightingfacts.com) for the **Label Reference Guide**.

Registration Number: KBNH-2W0IU2 (10/8/2013)  
Model Number: CR6-625L-27K-12-xxxx  
Type: Luminaire - Downlight

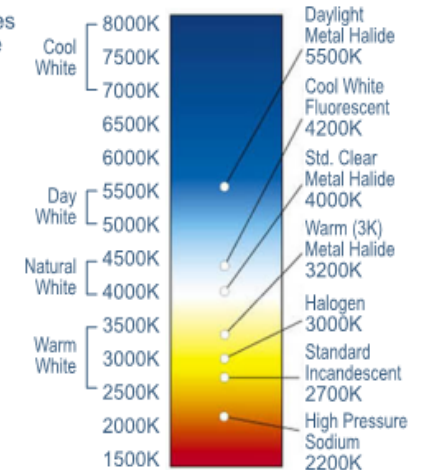
## 4 CRI or Color Rendering Index

How "true" does the object look? Can you tell what color the object is? Is each object in a scene the color it should be? CRI describes how accurately the source is able to illuminate an object's color.



## 5 Color Temperature

Describes what color the light source is. Does the source look warm (yellow,) cool (blue,) or neutral?



- So where do I use these?
- Which one is the best?

## LIGHT SOURCE COMPARISON CHART

LIGHT SOURCE	LIFE* (YEARS)	COLOR TEMPERATURE (K)	COLOR RENDERING INDEX (0-100)	DIMMING
INCANDESCENT	0.2-1.5	2700 (WARM - RESIDENTIAL/HOSPITALITY)	100 (EXCELLENT)	STANDARD INC DIMMER
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HIGH PRESSURE SODIUM	3.5-9.0	1900-2200 (ORANGE - PARKING/LOW SECURITY)	20-22 (POOR)	NO
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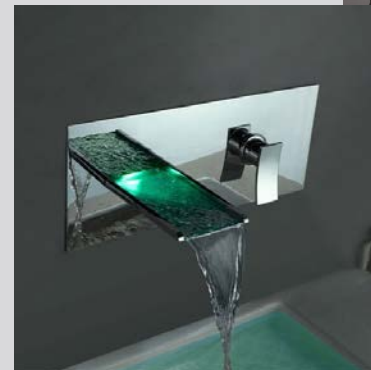
*\*LIFE BASED ON 12 HOUR/DAY ON TIME  
AVERAGE VALUES, NOT INCLUSIVE OF ALL MANUFACTURERS AND LAMP TYPES*



CCT-Color Temperature

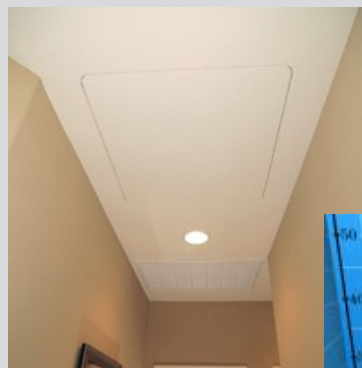
CRI-Color Rendering Index

- Higher Efficiency
- Higher Color Variation
- Smaller "Bulb" Size
- Quick On/Off Time
- Customizable Dimming
- Longer Lifetime
- Shock Resistance
- Better Focus
- Great Outdoors



# LED Cons

- High Initial Price
- Remote Driver
- Blue Light
- Egress Lighting
- LED Replacement







## Steps for Choosing a Replacement Light Source or Fixture

- 1 Make sure the lamp base, ballasts/transformers, controls, dimmers and voltages are compatible.
- 2 Check to make sure the light output, CRI and color are adequate for your application.
- 3 Make sure you are actually saving energy by verifying the wattage on the replacement bulb.

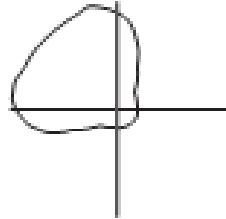


**McGRAW-EDISON**



**GLEON**  
GALLEON LED

**SLL**  
(90° Spill Light Eliminator Left)



**BEGA-US**



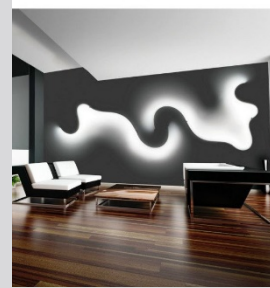
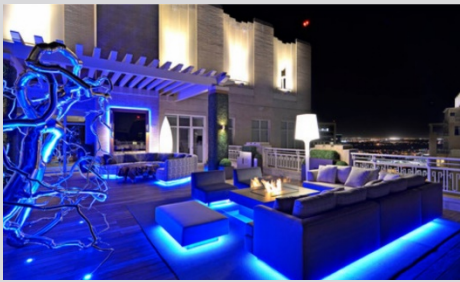
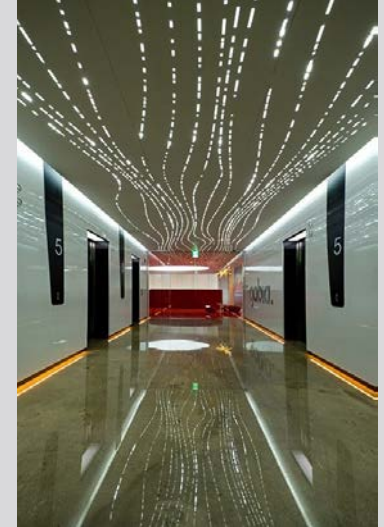
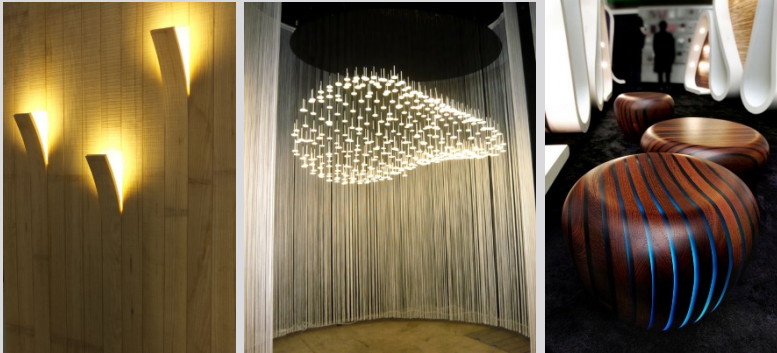
**louis  
poulsen**



## Parking Lots and Area Illumination:

- Better lamp efficacy and better light distribution from a directional source creates higher fixture efficiencies
- Reduce fixture quantity and therefore cost
- Utility Rebates
- Replamping and maintenance costs
- Unique fixture shapes

# LED Applications





# Lighting to set an Environment



Mysterious



Warm & Cozy



Vintage / Eclectic



Bright



# Case Study – Mushrif Central Park

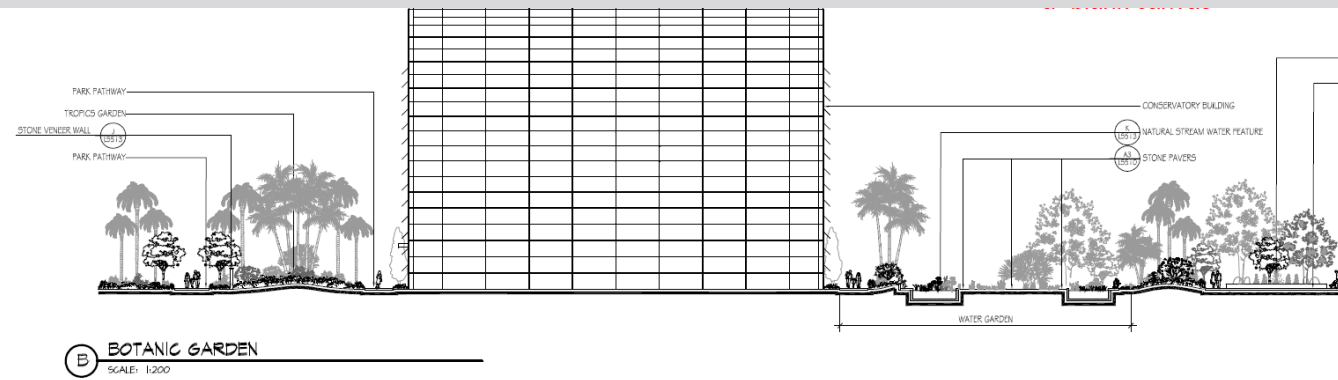
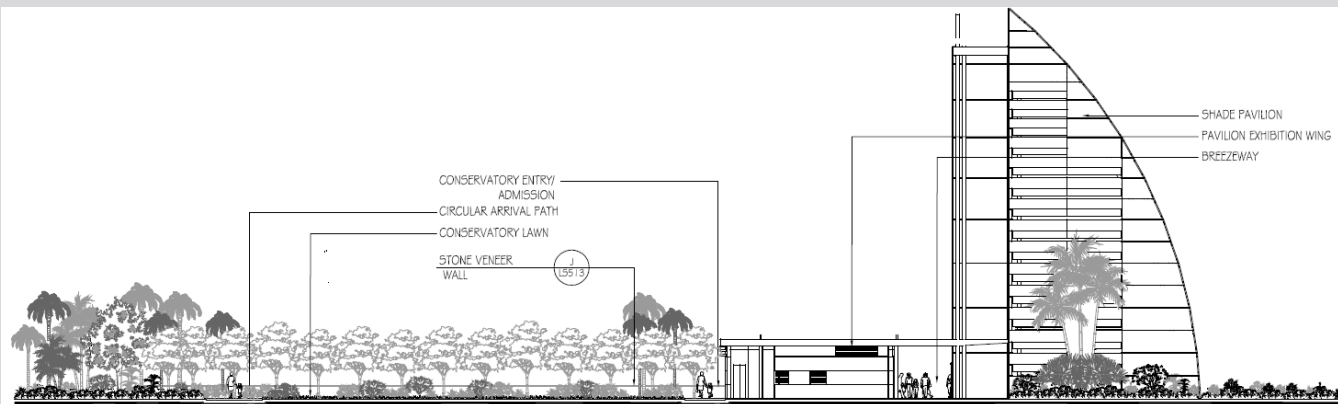


Mushrif Central Park  
Shade House

# Case Study – Mushrif Central Park



Mushrif Central Park will be a People's Park. Connecting communities in a safe and secure environment and creating opportunities to explore, enrich and educate through a vibrant range of facilities.



## The Architect Sets the Scene

The Architect wanted to create a Beacon would be visible at night.

The main function at night will be a viewing platform that is visible from any other point in the park.

The white tube design was intentionally a “blank canvas.”

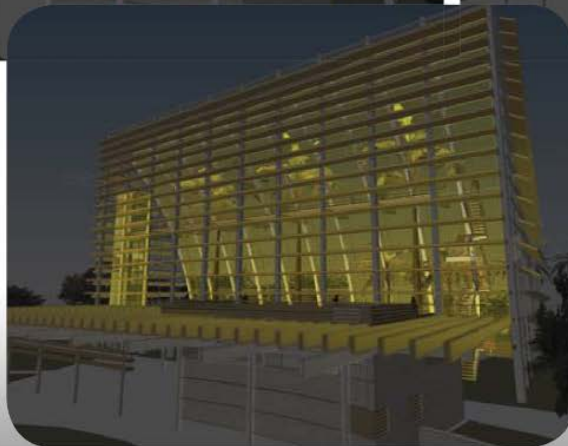
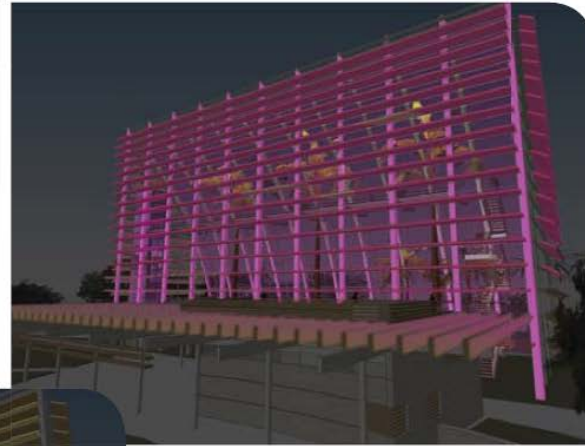
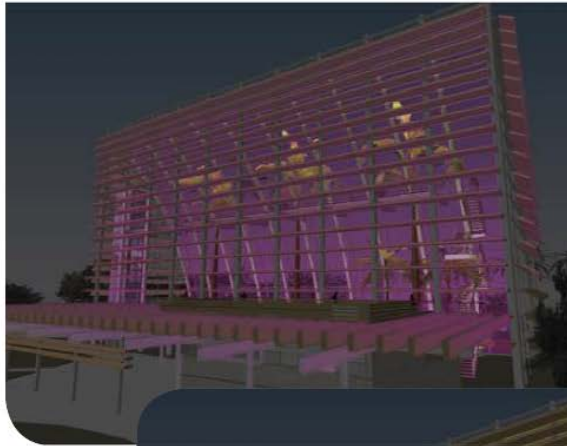




## Lighting Designer Communicates Ideas

We compile concept imagery that displays the overall lighting effects.

## MUSHRIF CENTRAL PARK



TOP LEFT: INTERNAL GLOW WITH COLOR  
TOP RIGHT: EXTERNAL WASH WITH COLOR  
BOTTOM LEFT: INTERNAL GLOW "WARM" COLOR

Conservatory



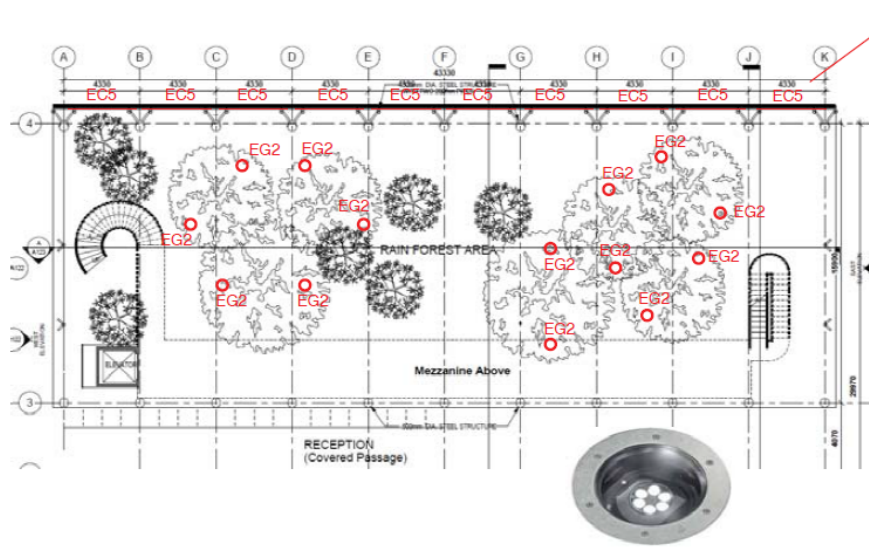
AE DESIGN GROUP  
1900 WAZEE ST, STE 350  
DENVER, CO 80202

1 OF 1

## Lighting Designer Communicates Ideas

We present (2) options – Illumination from the front and from the back.





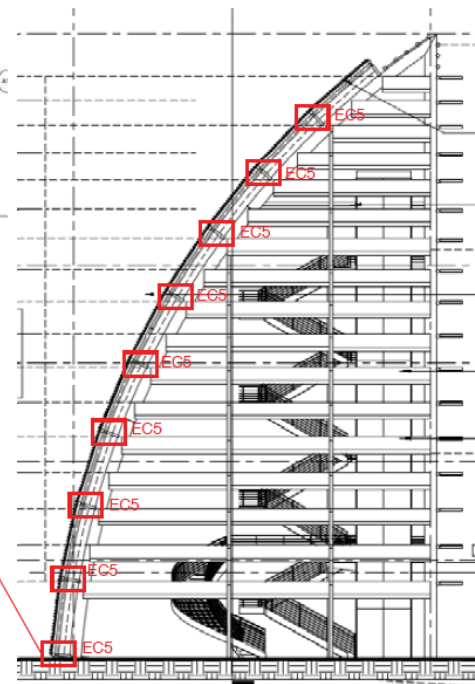
Between each numbered grid line there is to be (4) 4' linear LED grazers mounted on metal structure. Drivers should be hidden behind beams, and runs of strip should be connected together.



**EG2**  
In-grade uplights to illuminate trees within Conservatory.

Every run should have linear grazers mounted as shown above, runs with linear grazers are boxed in

**EC5**



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MUSHRIF CENTRAL PARK  
LIGHTING FIXTURE LAYOUT & DESIGN INTENT  
CONSERVATORY

CO  
10

## Figuring Out the Details

We figure out the placement of fixtures.



# Fixture Selection – Mushrif Central Park

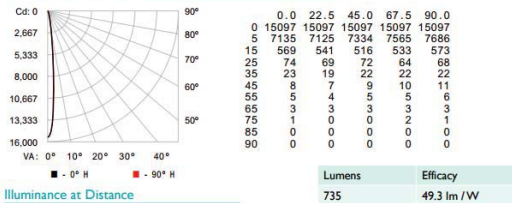


## Typical Items During Fixture Selection

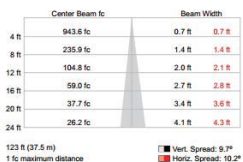
- Lumen Output
- Beam Spread (Typically Multiple Options)
- Static White – CCT
- Colored Light – Available Channels of Color
- CRI (Color Rendering Index)
- Wattage (Efficacy)
- Voltage
- Dimming Ability
- Integral Power Supply or Remote
- Warranty

### Photometrics

eW Graze MX Powercore  
2700 K, 1 ft, 9° x 9° beam angle  
Polar Candela Distribution

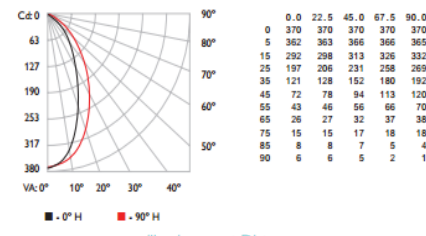


### Illuminance at Distance

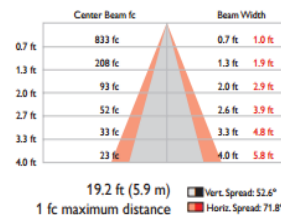


### 4000 K

### Polar Candela Distribution



### Illuminance at Distance



Lumens	518
Efficacy	43.5 lm / W

For lux multiply fc by 10.7

# Fixture Selection – Mushrif Central Park



Static White



Static White



Colored Light

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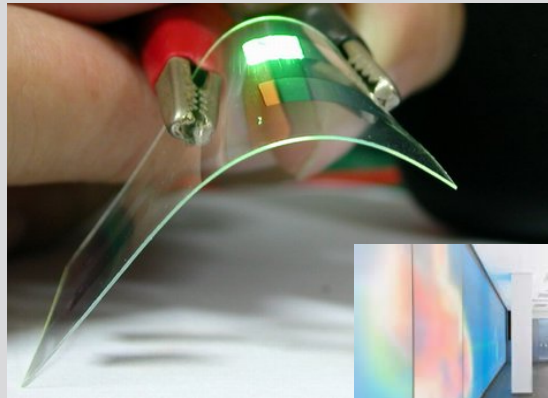


## Final Photos

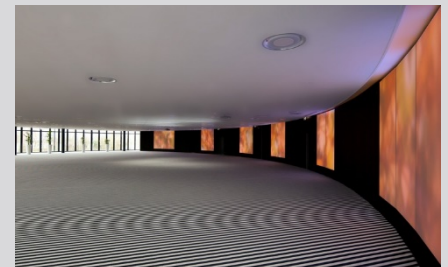
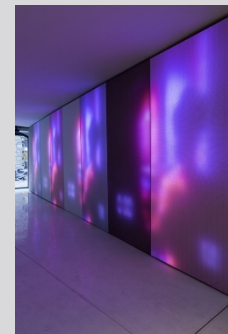
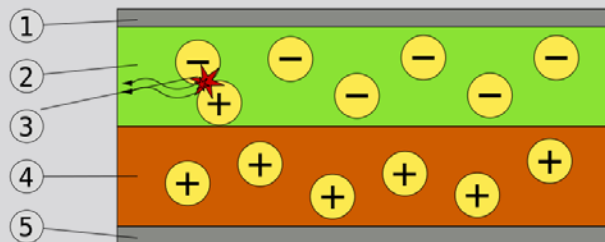
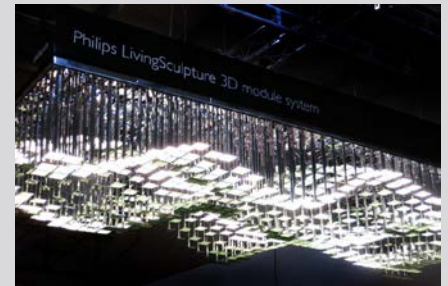
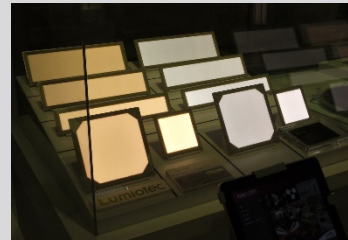




# OLEDs



- Lightweight and flexible
- Improved brightness
- Better power efficiency and thickness
- Short Lifespan
- Poor color balance
- Easily damaged with water
- Poor readability outdoors
- High power consumption with white light



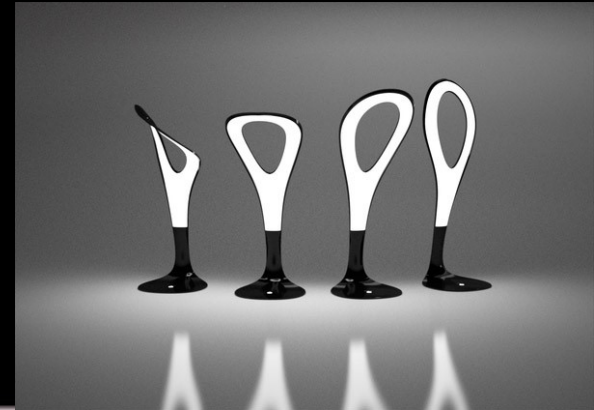
## Industry Drivers:

- Energy Codes
- Building Automation
- Energy Consumption Awareness
- How do I know when to use LEDs?
- Challenges and drawbacks
- What is in store for our future?



Questions?  
info@aesign-inc.com

Thank you!



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