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BENYA LIGHTING DESIGN



The Technology of Sustainable Lighting Design

Why This Matters

- Energy Code Compliance
- LEED
 - Requires 14% better than energy code performance
 - To get Platinum or Gold, requires much better than energy code performance
- Energy Incentives and Rebates
 - Require better than energy code performance
- Federal Project Requirements
 - Requires 30% better than energy code performance

Meeting Room Example

300 sf space – code 1.3 w/sf

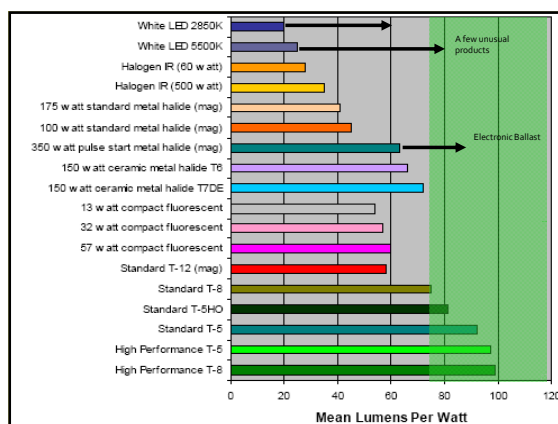
INCANDESCENT	COMPACT FLUORESCENT
<ul style="list-style-type: none"> A-lamp downlights 10 @ 100 w = 1000 watts 3.33 w/sf 	<ul style="list-style-type: none"> Compact fluorescent downlights 10 @ 32 w (35 w) = 350 watts 1.16 w/sf 

Light Sources

Not quite the end of the incandescent lamp

Qualities of a Light Source

- Efficacy *efficiency in lumens per watt*
- Color *color temperature and color rendering*
- Lamp Life *average hours of life*
- Temperature Sensitivity *applicability issues*
- Starting and Warm Up *ranges from instant to several seconds*
- Restarting *ranges from immediate to ten minutes*
- Dimming *some do, some don't, some have issues*
- Cost *ranges from 10¢ to \$5.00 per million lumen hours*



Tungsten Lighting

- Efficacy *poor, most less than 30 lumens per watt*
- Color *excellent color rendering at 2700-3100K*
- Lamp Life *short (500 hours) to medium (6000 hours)*
- Temperature Sensitivity *none*
- Starting and Warm Up *instant*
- Restarting *instant*
- Dimming *dims well with color temperature shift*
- Cost *50¢ to \$1.00 per million lumen hours*

Lamps

The first major consideration

Standard Incandescent Lamps

- Appealing
- Warm, attractive color (2600-2900K)
- Dimmable
- Wide variety of shapes, wattages
- Not energy efficient



Low Voltage Incandescent Lamps

- Most operate at 6, 12 or 24 volts
- Usually low wattage but not inherently energy efficient; most lamps 5 to 50 watts
- Greatest advantage: small size



Halogen Lamps

- Appealing
- Crisp warm, attractive color (2800-3100K)
- Dimmable
- Wide variety
- Longer life, slightly more energy efficient than incandescent; IR versions even better



Low Voltage Halogen

- Compact, bright lamps
- A bit more energy efficient; IR versions even better
- Excellent focal, accent and display light sources
- Color Temp: 2900-3100K
- Long life



Fluorescent Lamps

- Efficacy *good to superior, up to over 100 lumens per watt*
- Color *good to excellent; choose color temp and CRI 80-90*
- Lamp Life *very long with some versions now 42,000 hours*
- Temperature Sensitivity *significant, varies with product*
- Starting and Warm Up *instant or rapid, some warm up*
- Restarting *instant*
- Dimming *expensive, but dims well with color quality shift*
- Cost *10¢ (non dimming) to \$1.00 (dimming) per million lumen hours*

Linear Fluorescent Lamps

- T-8 High Performance ("super") Lamps
 - 90-102 mean lumens per watt
 - Most lamps >80 CRI
 - Up to 42,000 hour lamp life
 - 4' standard; 2', 3', 5', and 8' lamps available at lower efficacy
- T-5 Standard Lamps
 - 90-101 mean lumens per watt.
 - >80 CRI
 - 20,000 hours + life.
 - 4' standard; 2', 3', 5', and circle lamps available at lower efficacy
- T-5 HO Lamps
 - 80-85 mean lumens per watt
 - >80 CRI
 - 20,000 hours life.
 - 4' standard; 2', 3' 5' and circle lamps available at lower efficacy





Compact Fluorescent Lamps

Pin based lamps


- Average life 10,000 hours
- External ballast part of fixture
- Dimming possible with electronic dimming ballast

Screw/GU-24 lamps

- Average life 7,500 hours
- Internal ballast may overheat in enclosed fixture
- Dimming with specially rated products ONLY







Pin-based Compact Fluorescent

- Twin tube
- Quad (double twin) tube
- Hex (triple twin) tube and quad twin tube
- Flat quad tube
- Long Twin tube
- Minimum watts: 5
- Maximum watts: 80



Screw Based Compact Fluorescent

- Spiral lamps
- Variations on single/double/triple/four twin tube lamps

Bare Products		Covered Products			Reflector Products
Mini-Spiral or Twist	Tube or Universal	Incandescent/ A-line	Globe G25, G30, G40	Candelabra, Post or Bullet Shape	Indoor and Outdoor R20, R30, R40, PAR38
					

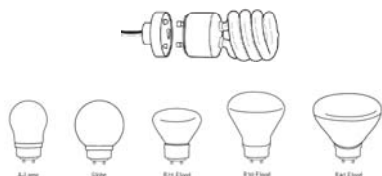
Special Screw Based Lamps

- Induction Lamps
 - Very long life >15,000 hrs
 - Medium Efficacy
 - Low maintenance
- Cold Cathode Lamps
 - Ultra long life >25,000 hrs
 - Low wattage
 - Low maintenance



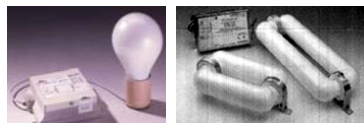

GU-24 Based Lamps

- For compact fluorescent lamps with integral ballasts
- Ensures replacement with a compact fluorescent
- Allows owner to pick lamp



Power Induction Lamps

- High wattage (65-150)
- High efficacy (75 mean lumens per watt)
- HID alternative
- Very long lamp life (50,000 hours+)
- Low maintenance



LED's

- Efficacy** *Highly variable; no standards; up to 100 lumens per watt; beware poor products*
- Color** *poor to very good, varies considerably*
- Lamp Life** *under proper conditions, >50,000 hours*
- Temperature Sensitivity** *must not get hot*
- Starting and Warm Up** *instant*
- Restarting** *instant*
- Dimming** *dims well with proper but expensive gear*
- Cost** *Most expensive; \$5.00 to \$20.00 per million lumen hours*

Option 1: LED "lamps"

- Temperature concerns
- Current products 30-50 lumens per watt
- Dimming but not like incandescent
- Typically 7-20 watts equal to 30-90 watts tungsten



Option 2: LED "Fixtures"

- White, colored or color changing
- Temperature concerns
- Current products 15-60 lumens per watt
- Dimming but not like incandescent
- Reasonable amount of light output



Option 3: LED "Systems"



High Intensity Discharge (HID) Lamps

- Mercury Vapor Lamps
 - Obsolete and now banned
 - Poor color, poor lumen maintenance
- High Pressure Sodium
 - High efficacy but poor color
 - Useful as street and security lighting due to low cost and minimum temperature sensitivity
- Low Pressure Sodium
 - No color; should only be used when needed
- Metal Halide
 - Quartz metal halide: high efficacy, mediocre color
 - Ceramic metal halide: high efficacy, superior color

Ceramic Metal Halide

- Efficacy *good to superior, up to over 80 lumens per watt*
- Color *good to excellent; choose color temp and CRI 80-90+*
- Lamp Life *Long, 12,000-25,000 hours*
- Temperature Sensitivity *None significant*
- Starting and Warm Up *Slow start and warm up*
- Restarting *must wait 3-5 minutes to restrike*
- Dimming *not recommended, can be used for energy management purposes*
- Cost *50¢ to \$1.00 per million lumen hours*

Ceramic Metal Halide

- High CRI >80
- Choice of 3000K or 4100K
- Lamps from 20 watts to 400 watts
- Choice of lamp type and shape



Other Lamp Types

- Neon *custom made discharge tubing, long life and moderately efficient, dimmable and flashable, requires special high voltage wiring*
- Cold Cathode *similar to neon but bigger, more lumens*
- Fiber Optics *not really a lamp type, can be used to transmit light from an illuminator to a display*

Ballasts

Critical Part of the Equation

Fluorescent Ballasts

Non-dimming ballasts

- Standard instant start
- High efficiency instant start
- Standard program start
- High efficiency program start

Fixed ballast factors

- Reduced light and power (0.7-0.8)
- Normal light and power (T8 ~ .88, T5/T5HO .95-1.0)
- High light and power (1.15-1.2)




Fluorescent Ballasts

Step dimming ballasts

- All rapid start
- 2 steps (0-50-100)
- 3 steps (0-30-70-100)
- 7 steps dissolve (3-100%)

Analog dimming ballasts

- 0-10 volt external circuit for photocells and complex systems
- 2 wire wallbox dimmer circuit
- 3 wire legacy fluorescent dimming circuit for dimming systems




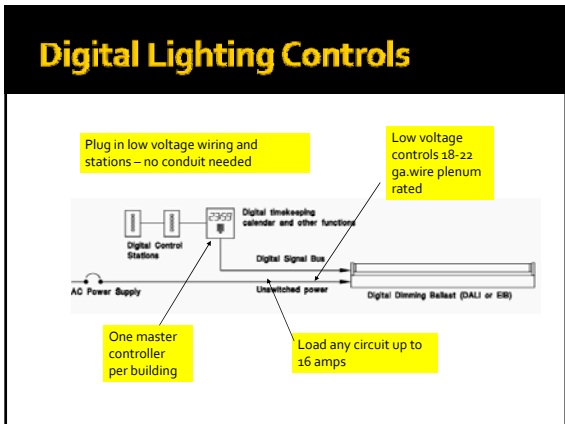
HID Ballasts

- Electronic ballasts for all HID lighting through 150 watts, indoor and some outdoor applications
- Electronic ballasts for indoor HID lighting 250-400 watt
- Magnetic ballasts for all other HID



LED Drivers

- Dimming and non-dimming
- Designed to power "standardized" LED's

Digital Lighting Ballasts

Fluorescent dimming

- Standard DALI dimming ballasts (T8, T5, CF)
- Proprietary advanced dimming ballasts
- High performance dimming ballasts
- Combination analog legacy/digital ballasts
- Legacy fluorescent dimming ballast interface

Other Lamps

- Digital incandescent dimmer packs
- Digital dimming LED drivers
- Digital non-dimming interfaces for HID and other non dim sources


Luminaires

Samples from 2008 and 2009 Lighting Shows



Classic Styles

Decorative
The Glass Artichoke



Incandescent
Compact fluorescent
Metal halide

Rings




Large Venue

Fluorescent Surface and Pendant




Troffers and Panels



Downlights

Specification Grade

LED (1200 lumens)
Compact fluorescent (4200 lumens)
Ceramic Metal Halide (15000 lumens)



Decorative



This program can be DOWNLOADED at www.benyalighting.com

End