

Advanced Lighting Practices for New Buildings and Retrofits

(and some not so advanced but still great ideas)

January 27, 2009

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Primary Lighting System Opportunities

▶ Exterior

- Façade and security areas
- Parking and street applications

▶ High Bay Interior

▶ General Interior – application guidance for all space types

- Inefficient technology replacement
- Overlit spaces
- Controls
- Daylighting

Project Basics For Effective Lighting

Application

- Match light level and task needs – maximum efficiency not always best
- Match controls to space function
- ▶ “Quality” and user acceptance
 - Lighting quality should be maintained to promote productivity and work environment
 - Users need to be able to accept changes
 - change prompts attention - good and bad!**
- ▶ Cost-effectiveness
 - Simple tool for initial screening
 - More involved tools for specific application methods

Exterior Applications: Façade and Security

▶ Current issues

- Incandescent – even low watt lamps add up
- Excessive façade lighting
- More light does not always mean better security!

▶ Appropriate Technologies

- High Pressure Sodium (HPS) – efficient/poor color
- Metal Halide (MH) good color and efficiency (pulse start!)
- LED – the current hot technology
 - Good exterior application – likes the cold
 - Long life – but does not last forever (~25K – 100K)

▶ Control, Control, Control

- Always incorporate photocell or astronomical time switch



Exterior Applications: Parking/Street

▶ Current issues

- Older MH or HPS technology – even Mercury Vapor!
- Overlit spaces
- Security

▶ Appropriate Technologies/Applications

- HPS, MH,
- LED – good application for exterior!
- Existing poles in retrofits – LED may be tough!
- Uniformity, color, dimmability

▶ Control

- Always incorporate photocell or astronomical time switch
- Consider late-hour switching or dimming



Interior Applications: High Bay

▶ Current issues

- Older MV, MH, FL, Incandescent
- Overlit
- No daylighting control with skylights

▶ Appropriate Technologies

- HPS – storage and non-critical activity
- MH (pulse start) – sports/recreation, accurate color needs
- LED – Good potential application but still emerging
- FL – common retrofit – dimmable, often lower cost

▶ Control

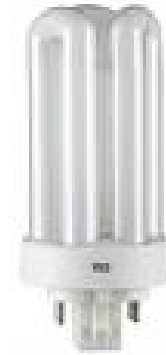
- incorporate daylighting control
- Consider occupancy in some storage and low use areas



General Interior Applications: Older Technology

▶ Current issues

- Incandescent lamps
- Older T12 (and T8) lamps
- Non-electronic ballasts



▶ Appropriate Technologies

- Compact Fluorescent (CFL) pin and screw-based
 - Good Incandescent retrofit
 - May not be best for specialty spotlighting tasks
- Linear Fluorescent – T8, T5 and electronic ballast
- MH (pulse start) good higher ceiling application
- What about LEDs?
 - Good small task application
 - Not quite ready for general overhead lighting



General Interior Applications: Manual Switching

▶ Current issues

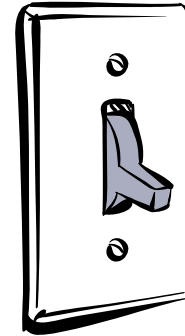
- Manual switches
- Lack of area control

▶ Appropriate Technologies

- Occupancy based control types
 - “Occupancy” sensor (auto-on, auto-off)
 - “Vacancy” sensor (manual-on, auto-off)
- Sensor type
 - Passive Infrared (field-of-view sensing)
 - Ultrasonic (“sees” around objects)

▶ Application Issues

- Ultrasonic too “hot”
- Manual-on practicality



General Interior Applications: Overlit Spaces

▶ Current issues

- Standard (old) practice
- Hard to retrofit and not dead yet!

▶ Application Technologies

- Replace older T12 (and T8) systems and adjust levels
 - May not be able to effectively retrofit just lamps/ballasts - may need complete fixture replacement
- Replace standard with low factor ballasts
 - Consider cost-effectiveness. May be better to replace system

▶ User Acceptance Planning

- Highlight “new lighting” that “meets lighting guidelines”
- Plan retrofits in off hours where possible



General Interior Applications: Daylight Control

▶ Current issues

- Skylights/Sidelighting with no control
- Prime daylight spaces with no skylights

▶ Appropriate Technologies

- Step and continuous dimming controls
 - Need to match with dimmable lighting (Fluorescent)
- On-Off control (least effective)
 - Still need to consider effect of on-off (warm-up of MH/ HPS)
- Linear Fluorescent – T8, T5 and electronic ballast
- Consider integration of occupancy control for storage and non-critical spaces



Basic Project Cost Analysis

- ▶ Simple/General assessment of cost-effectiveness

$$Y_{\text{Payback}} = \frac{\text{Cost of upgrade}}{T_A * E_{\text{Rate}} * (W/1000)}$$

Where:

Y_{Payback} = length of time (in years) it takes for energy savings to pay for new lighting system

T_A = length of time affected luminaires are operated (in annual hours)

E_{Rate} = cost of electricity (\$/kWh)

W = Total project wattage difference between existing and proposed technology

- ▶ Will need more advanced methods to incorporate specific control savings

Specific Technology Notes and References

- ▶ Technology notes cover Lamps, Ballasts, Controls
 - Address general characteristics
 - Identify generic application issues:
 - Lamp color characteristics
 - Ballast factor for light level tuning
 - LED characteristics – where they work best
 - Provides information to assist with for other applications not specifically covered in the Appendix

- ▶ References
 - Point to additional application information
 - Identify design guideline information (i.e. light levels)

- ▶ Questions?
- ▶ Suggestions?