

Electrical Systems: Lighting

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Objective of Course

- Review of current Wisconsin lighting codes
- Overview of LED products on market today
- Questions and comments are encouraged



Wisconsin Lighting Code

- IECC/SPS 363
 - International Energy Conservation Code 2015 with amendments
 - Safety & Professional Services 363
- Applies to upgrades over 50% of building
- Good idea to follow it, avoid costly change orders based on code



Lighting Controls

- Occupancy sensors are mandatory
- Exceptions:
 - For safety or security reasons
 - Stairways or egress pathways
 - Lighting Power Density (LPD) < 0.6 watts
- A good lighting design for a classroom consumes less than 0.3 watts/square foot
- Your choice if you want to install occ sensors



Time-switch Controls

- Must have controls in any space >250 ft to turn the lights off
- Exceptions:
 - LPD < 0.6 watts/sq foot
 - Science labs
 - Shops
 - Wherever a shutoff would endanger safety



Light Reduction

- For manual switches, must have dimming option to $>50\%$
- Exceptions:
 - LPD < 0.6 watts
 - One luminaire in room
 - Corridors
 - Mechanical rooms



Daylight Controls

- Lighting in daylight zones must be controlled separately from other areas
- Exceptions:
 - LPD < 0.6 watts/square foot



Specific Applications

- Dedicated independent controls
 - Displays
 - Accent
 - Display cases
 - Task Lighting
 - Nonvisual applications –food warming or plant growth

Exterior Controls

- Auto shut off in daylight
- Sign and façade lighting must shut off one hour after operations and turn on not more than one hour before operations
- Lighting must dim at least 30% from midnight to 6AM
- Best way (least expensive) to do this is with photocell or time clock

Lighting Power Densities

- Must not exceed the watts/square foot below
 - Exemptions include locations like theaters, emergency, task lighting for maintenance, etc.

Space	Watts/foot ²
Cafeteria	1.4
Weight room	1.0
Gymnasium	1.1
Library	1.3
Office	1.0
Shop/lab	1.4
Entire Building	1.2

Commentary

- If your LPD is below 0.6 watts/foot, you are exempt from most control requirements
- Parking lots are an exception, (lot or garage)
- If you use quality LED's and designers, you should meet all interior and exterior code requirements with ease

Where is Lighting Going?

- Efficiency continues to improve
- T8 LED tubes as high as 200 lumens/watt
 - Jiaxing Super Lighting, ETI Solid State Lighting, Kobi
 - Probably overdriving LEDs
 - How does warranty work? (you will have failures)
- Philips (Signify), Sylvania (LEDvance), GE Current, Keystone
 - 140–170 LPD
 - Warranty service is good

Where is Lighting Going?

- IOT – Internet of Things
- All about connectivity
 - Controls, Occ sensors, Security, etc
- The ROI is not there unless you have specific uses for connectivity like controlling HVAC



Color Tuning Lights

- Do you need it?
 - Does the sky change color during the day?
 - You want kids and staff alert all day...no afternoon siesta
- Exception: Special Needs Classrooms
 - Some teachers swear by it
 - Helps manage students behavior and or emotions
 - This can be funded with special needs dollars

Direct Wire T8s

- NEVER direct wire T8 LED's
 - Low cost, but...
 - Line voltage to lamp holder – can be hazard
 - No surge protection
- Flicker
 - Trigger for migraine headaches
 - Evidence of trigger for autistic and epileptic seizures

Low Cost Lighting Upgrade

- Fluorescent to T8LED
- Use a driver with dimming capabilities
- Separate front of room from student area
 - Able to dim for greater visual acuity on smart board
- Adjust classroom lighting to minimize glare for laptops and tablets
- Glare is a big problem with poor lighting design

Kits or Flat Panels

- Gives the space a whole new look
- Easy to install controls
- Easily add sensors if desired
- About twice the cost of lamps & drivers

New Fixtures

- Redesign the lighting
- Go from 12 to 9 fixtures
- Connect with cat5; this will future proof your system
- New technology is a simple add on
 - Time of flight technology, smoke or gas detection

Lighting Power Densities

- If lighting designed properly
 - Tube upgrade – .34 watts/sq ft
 - Flat Panels – .34 watts/sq ft
 - BLTR Kit – .28 watts/sq ft
 - Redesign – .21 watts/sq ft

Lighting Redesign Energy Cost

- Cost to operate a classroom
 - $0.21 \text{ watts/ft} \times 900 \text{ sq.ft} = 189 \text{ watts/room}$
 - $189 \times 8 \text{ hours} = 1,512 \text{ watts}$
 - $1,512/1000 \times \$0.11/\text{kWh} = 16.6\text{¢/day}$



Final Thoughts

- Use dimmer switches to adjust illuminance based on task; computer vs paper
- Keep system easy to operate and maintain
- Stay away from proprietary systems
- Stick with name brand
- Use 5000k or 6500k; the science is there to improve alertness and performance



High Kelvin Lighting & Student Performance

- Rich blue will become a standard
- Keeps students and teachers more focused
- Suppresses melatonin; increases alertness
- 5000k, 6500k is even better
- MUST have a professional design higher kelvin or it will be too bright

EPL Expertise

- Over 22 million square feet of lighting upgraded – Schools, Military, Prisons, etc.
- Updated ASHRAE/IES retrofit standards for 2016 and 2019
- Driving lighting design through research
 - Harvard Medical School
 - UW School of Medicine & Public Health



Questions / Comments

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