Lighting & Controls

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WEST MICHIGAN LIGHTING INC.

Presentation by: Rob Cilic - OSRAM SYLVANIA
The Hallmarks of “Good” Lighting

- Aesthetically Pleasing
- Energy Efficient
- Adequate Task Light Level
- Visually Comfortable
- Easy to Maintain
- Enhance Learning and Teaching Environment
- Minimal environmental impact

Today’s Lighting Technology can do this!

Technologies

- Lighting Controls
The installation of properly applied controls to a lighting system will reduce energy consumption by one third.

Purpose of Controls

- Enhance Building Environment
- Visual Comfort
- Lighting Quality
- Adaptability
- Conserve Energy
- Conserve Money
- Conserve Equipment
Direct Benefit of Controls

- Straight energy savings
- Maintenance savings
- System life extension
- Reduction in demand charges
- Cost savings on “Time of Use” energy rates

Indirect Benefits of Controls

- Impact on building HVAC system
  - for every 4-5 Watts of Light, 1 Watt heat

- Lower maintenance cost due to longer effective lamp life.
Major Strategies for Lighting Controls

• Time based
• Occupancy based
• Light level based

(Can be mixed and matched for effectiveness)

Time Based or Scheduled Controls

• Provides light to an area when scheduled for use
• Does not control amount of light
• Not suitable for areas with highly variable occupancy.
Energy Management Systems
• Can control lighting and other systems
• Trend is toward fully integrated timing systems
• Lighting, HVAC, Security and Accounting

Time Based or Scheduled Controls

Occupancy Based Controls

Occupancy Sensors
• Regulate lighting system operation based on actual use (self adapting)
• Do not require scheduling
• Off delay time must be set with consideration to source used and application.

Occupancy Sensor Types
• Infrared - Direct Line of Sight
• Ultrasonic - Indirect, Spatial limits
• Dual Technology – Prevents False Tripping
• Ceiling and Wall Mounted
• Line and Low Voltage
Lighting Level Based Controls

- Vary light output of system to match desired target illuminance
- Provide only the quantity of light required
- Can compensate for lamp/fixture depreciation
- Two methods of control
  - Selective switching (banks of lights or stepped dimming)
  - Continuous dimming

Photocells/Sensors

- Photocells on/off
- Photosensor variable to amount of ambient light
- Generally used with dimming or “staged” lighting systems
- Can be used to compensate for both natural light levels and lamp lumen depreciation.
Energy Savings from Lighting Controls

• Typically 35%-45% in Commercial and School Buildings
  – California Energy Commission

• 58 Office Study – 43% Energy Savings from Occupancy Sensors increases to 61% when combined with manual dimming capability
  – Lighting Research Center

Building Energy Savings through Control Strategies

<table>
<thead>
<tr>
<th>Option</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
<th>Option 5</th>
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<tbody>
<tr>
<td>Scheduling Control</td>
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<tr>
<td>Load Shedding &amp; Daylight Dimming</td>
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<td>Optimized High Performance Luminaires and Layout</td>
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<td>Workspace Occupancy Sensing</td>
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<td>Personal Dimming</td>
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<tr>
<td>Total Energy Cost Savings Realized</td>
<td>5%</td>
<td>10%</td>
<td>40%</td>
<td>60%</td>
<td>70%</td>
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</table>
Technologies

• Lamps
• Ballasts

Technologies

• Incandescent/Halogen
IR Halogen

New Kid on the Block!

IR Halogen Technology

- More visible light generated for each watt consumed
- Lower energy costs and less heat generated
- Multi-layered thin film Infrared coating on outer surface of halogen capsule
- Infrared energy (heat) is recycled within the IR capsule

Technologies

- Fluorescent Systems
The Lamps

*Linear Fluorescent*  *Compact Fluorescent*

The Fluorescent System
Lamp technology has moved forward

1.5" T12 → 1.0" T8 → 0.625" T5

**Fluorescent Systems**

Fluorescent Ballast Types

- Magnetic
  - Standard
  - Energy-saving
- Electronic
Electronic Ballasts

Advantages
- Multiple lamp operation
- Very energy efficient
- Lower operating cost
- Relatively lightweight (potted/unpotted)
- Quieter and cooler operation
- Special functions/features available
  - Lamp End of Life Sensing
  - Programmed Starting
  - Dimming
  - Status Reporting
  - Universal input voltage

Disadvantages
- Slightly higher per unit cost – lower per system cost

Magnetic Ballasts

Advantages
- Lower per unit cost

Disadvantages
- Higher operating cost compared to Electronic
- Relatively heavy compared to electronic
- 1 or 2 lamp operation only
- Series lamp operation
- Recycling Issues (PCBs in older units)

Fluorescent Systems

Preheat Fluorescent Ballasts
- Time delay to lamp start - flicker
- Cathodes are heated prior to lamp start (0.5-1.0s)
- Lamp start in 1.0 - 2.0 seconds
- 2 step process: Coil heat then OCV 0.7-2 kV applied
- External starter required

Rapid Start Fluorescent Ballasts
- Cathodes are heated constantly by applying coil voltage
- Series operated
- Ground plane required for starting
- Operation down to 50°F

Instant Start Fluorescent Ballasts
- Most energy efficient system- no cathode heating
- Discharge arc initiated by applying high OCV to jump start lamp
- Parallel operation
- Operation down to 0°F
- NEMA recommendation – shunted sockets for retrofit
Fluorescent Systems

**Programmed Rapid Start Fluorescent Ballasts**
- Coil heat applied w/reduced or no open circuit voltage (OCV)
- OCV is then applied (After coils reach optimum temperature)
- Typically 50,000 to 100,000 start cycles
- Up to 250% longer life than current systems (IS/RS)
- Coil heat turned off or reduced after lamp starts

- Lower energy consumption than rapid start
- Longest lamp life in all applications
  - Including high switching cycles – Occupancy Sensors
- <10% THD
- Multiple ballast factor options 0.71 – 1.20

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**Fluorescent Ballast Starting Modes**

<table>
<thead>
<tr>
<th></th>
<th>GOOD Instant Start</th>
<th>GOOD Rapid Start</th>
<th>BEST Programmed Start</th>
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<tbody>
<tr>
<td>Cathode Voltage</td>
<td>0V</td>
<td>4V</td>
<td>6V 3V</td>
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<tr>
<td>Starting Voltage</td>
<td>600V</td>
<td>250V</td>
<td>heating delay 600V</td>
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<table>
<thead>
<tr>
<th></th>
<th>up to 15k</th>
<th>up to 15k</th>
<th>50k +</th>
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<tr>
<td>Start Cycles</td>
<td>0 deg F</td>
<td>50 deg F</td>
<td>0 deg F</td>
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<tr>
<td>Start Temp</td>
<td>59W</td>
<td>63W</td>
<td>60W</td>
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<tr>
<td>Input Power</td>
<td>Parallel</td>
<td>Series</td>
<td>Series (Parallel)</td>
</tr>
<tr>
<td>(2L)</td>
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<tr>
<td>Wiring</td>
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**Fluorescent Systems**

**T5 vs. T8**

**T8 Applications**
- Retrofitting T12 fixtures
- New direct fixtures
- New high lumen lamps +10% light
- New high ballast factor lamps + 20% light

**T5 / T5HO Applications**
- New indirect fixtures
- Multi-lamp high bay fixtures
- Not really a retrofit

**Fluorescent Applications**

**T5HO**
T5HO – Indirect

T5 – Direct/Indirect
CFL Systems

- Applications: downlights, wall washers, wall sconces, table lamps, floor lamps, pendants, low and high-bay industrial/sports lighting

Compact Fluorescent Lamps

- Up to 75% more efficient than incandescent
- 6 - 13 times the life of incandescent (10,000 hrs)
- Reduce maintenance and re-lamp labor costs
- Good for the environment
Compact Fluorescent
Light Output Equivalency

15 - watts
20 - watts
23 - watts

Divide Incandescent wattage by 4

60 - watts
75 - watts
90 - watts
**Triple Tube Compact Fluorescent Sources**

- Improved high temperature performance
- Maintains >90% light output from 40-140°F
- Universal burning position
- Wide Range of Colour Temperatures
- 10,000 hours Life
- Flicker free, good LPW
- Increased flexibility in fixture design and application
Fluorescent Systems

Luminous Flux/Temperature Curve
Amalgam Compact Fluorescent vs. Standard

Technologies

- Electrodeless Fluorescent Systems
Electrodeless Fluorescent Systems

• Long Life – up to 100,000 Hours
• Instant On, Instant Restrike
• High Color Rendering White Light
Technologies

• HID Systems

Why Use HID Lighting?

• Crisp white light source
• High light output in compact sources
• Requires fewer lamps
  • Lower installation & maintenance costs
  • Less cluttered, more attractive design
• Uses less energy (very efficient)
  – Compact HID lamps are 3 to 6 times more efficient than incandescent (100W 1HID=5 incandescent)
  – Full size Metal Halide and standard HPS lamps are ~2 times more efficient than Mercury Vapor lamps
Ceramic Metal Halide

Pulse start lamp/ballast combinations

- 320w, 350w, 400w, 450w
- Variety of lumen packages to fit the need
- As high as 20% energy savings
- Better lamp lumen maintenance
- Longer lamp life
- Faster starting
- Holds color better.
HID Systems

HID Applications

*DIY Stores, Gymnasiums, Superstores, Outdoor*

- Quality
- Color Rendering
- Color Temperature
- Open Fixtures (indoor only)
- Ease of Maintenance
- Increased Illumination Levels

Outdoor lighting
Satellite Night Image
Western end of Lake Ontario
The Worst

The Usual
The Usual

Most Desirable
Directional
Outdoor
Low-Mounted

Cut-off
Area
Lighting
Luminaire
Controlled Area Lighting Luminaire

Sports Lighting - Good Cut-off
High – low HID switching Ballasts

• During idle times
  – Reduces energy by 50%
  – Reduces light output to 30% of high.

• Process
  – Dual Capacitor
  – Dimming

Applications:
- Parking Garages
- Gymnasiums
- Loading docks
- Shipping areas
- Storage rack areas
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