Commissioning Photo Sensor Based Lighting Controls for Daylight Harvesting

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Daylight Harvesting Controls

• Control electric lighting
  – Switching
  – Dimming

• Based on
  – Time / day
  – Photo sensing

• To minimize electric lighting use without dropping below design light levels
Daylighting Commissioning

• IES Handbook Definition
  "... a systematic process that ensures that all elements of the daylighting system perform interactively and continuously according to documented design intent and the needs of the building owner."

• Kosta Definition
  "Here it is. Make it work."
Daylighting Commissioning

• Adjust Photo Sensing Control Parameters...
  – Photo sensor parameters
  – Controller (algorithm) parameters

• ... To Match the Space (calibration)...
  – Geometry and reflectance of interior surfaces
  – Daylight distributions
  – Electric light distributions

• ... and Occupants (adjustment)
  – Activities
Photo Sensing Parameters

• Photo sensor parameters
  – Location
  – View direction
  – Field of view (some products)

• Controller parameters (depending on product)
  – On-Off / Up-Down set points
  – Dead Bands
  – Time delays
  – ...
Traditional Control Strategies

- **Single Photo Sensor**
  - Closed Loop
    - Photo sensor signal *IS affected* by the electric lighting being controlled
  - Open Loop
    - Photo sensor signal *is NOT affected* by the electric lighting being controlled
Issues with Current Strategies

• Open Loop Systems
  – Outdoor and indoor daylight levels change at different rates
Skylight Application

Open Loop vs. Closed Loop FC, Signal Ratio

Time

6:28 AM 8:24 AM 10:19 AM 12:14 PM 2:09 PM 4:04 PM 6:00 PM 7:55 PM

Open Loop FC

Closed Loop FC, Signal Ratio
Issues with Current Systems

• Open Loop Systems
  – Outdoor and indoor daylight levels may change at different rates

• Open & Closed Loop Systems
  – Changes in geometry and/or reflectance of interior (and possibly exterior) surfaces may affect calibration
Geometry & Reflectance of Surfaces

December

January

February
Closed Loop Photosensor

Electric light (EL) readings at photo sensor at night as seasonal displays change

12/25/08: EL = 4.75
12/26/08: EL = 4.77
12/29/08: EL = 4.94

01/01/09: EL = 5.77
01/04/09: EL = 6.34
01/05/09: EL = 6.97 (+47%)!
Single Sensor Closed Loop Issues

• Cannot differentiate between
  – Changes in indoor daylight levels, and
  – Activities in the room affecting sensor signal

• Time delays may work
  – Pretty well on on/off & stepped switching
    • long delay
  – Not so well on dimming during daylight changes
Emerging Technologies

• Automatic, Continuous Calibration
• Occupancy Sensor Integration
• Multi Photo Sensor Dimming
• Customized Photo Sensor Angular Sensitivity
The Future of (Lighting) Controls Commissioning

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Digital Lighting Controls

• Digitally addressable components
  – Ballasts, sensors, switches, dimmers, ...
• Simplified physical setup
  – Wired in series and/or wireless
• Digital wired and/or wireless communication
• Unlimited Controls Capabilities
  – Customized Control Strategies & Algorithms
  – Multiple Inputs
    • Sensors, Communications, Manual Controls
  – Multiple Outputs
    • Automated Lighting, Window/Skylight & HVAC Controls
    • Automated Status & Diagnostic Messages
Traditional & Emerging Strategies

• Traditional Control Strategies
  – Limited number of inputs
  – Fixed algorithms embedded in controllers
  – Hardware control for key control parameters

• Emerging Control Strategies
  – Unlimited number of inputs
  – Customized algorithms through software
  – Software control for all control parameters
  – Dynamic strategies & reconfigurability
Traditional Commissioning Tasks

• Device Placement
  – Lighting Systems
  – Occupancy & Photo Sensors
• Wired Connections
• Wireless Connections
• Established Communications
• Physical Testing & Verification
Emerging Commissioning Tasks

• Software-based Setup
• Customized Control Strategies
• Customized Control Algorithms
• Software-based Monitoring & Diagnostics
• Remote, Web-based Commissioning
• Long-term Commissioning Services
• Reconfiguration of Strategies & Algorithms
Floor Plan Imported or Drawn
Export to Web-based Environment
Individually Addressable Luminaires
Luminaires Organized in Groups
Groups Controlled through Algorithms
Monitoring & Controls Software
Building Power Usage
Green Glance
Thank you for your interest!

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