Lighting Controls and Daylighting

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Topics

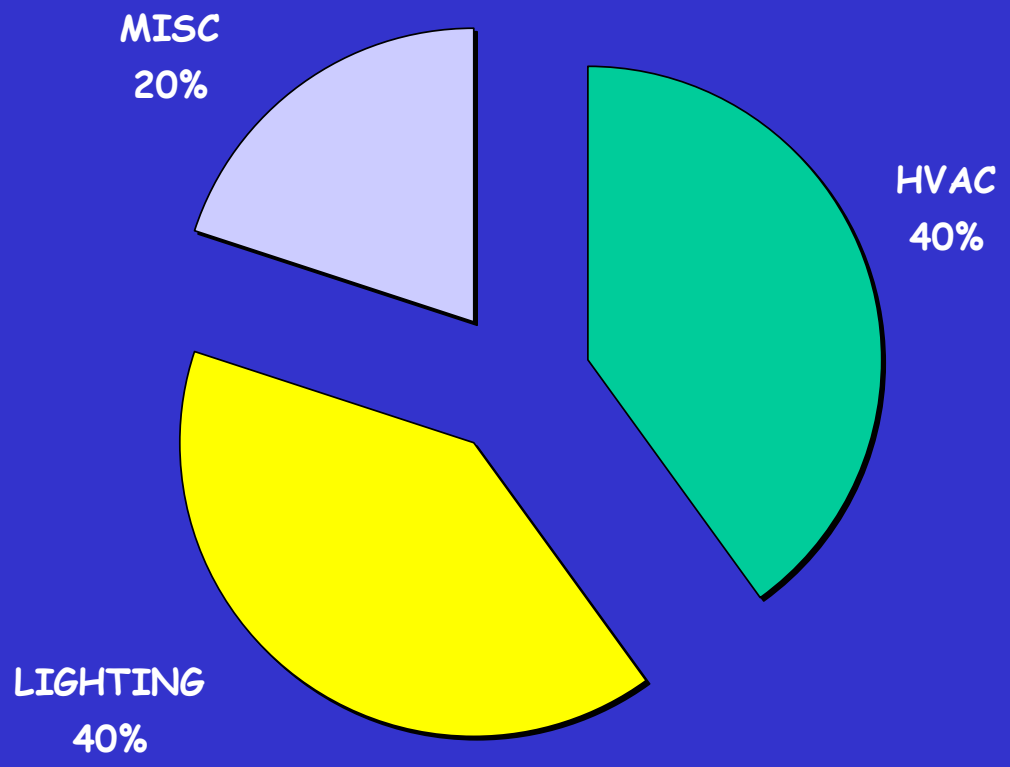
- Energy Efficiency Opportunities
- Types of Lighting Controls
- Design Considerations
- Sample Calculation

Energy Efficiency Opportunities

Automatic Lighting Controls!

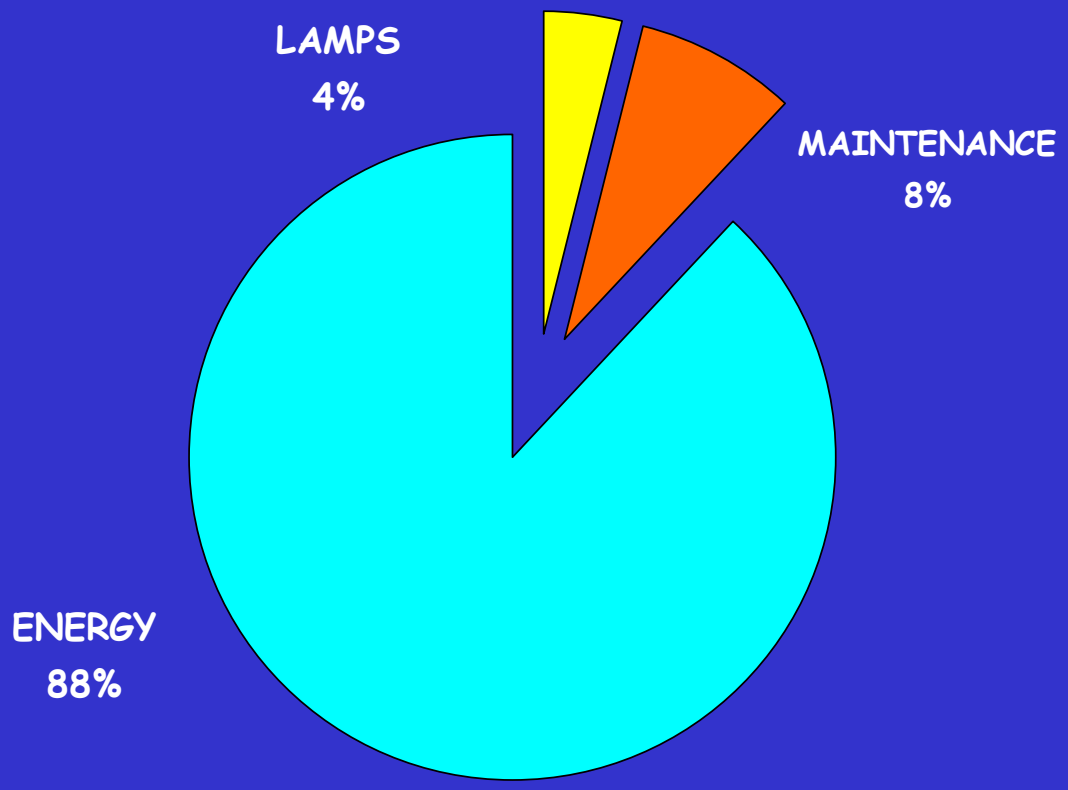
Energy Efficiency Opportunities

Typical Building Electrical Costs



Energy Efficiency Opportunities

What is the True Cost of Lighting?



Energy Efficiency Opportunities

Turning Lighting Off Saves Money!

- Lighting energy is saved
- Air conditioning energy is saved
- Lamps are replaced less frequently

Energy Efficiency Opportunities

Other Benefits

- Increase occupant productivity and satisfaction
- Improved security
- Help the environment
- Improve the bottom line
- Increase asset value

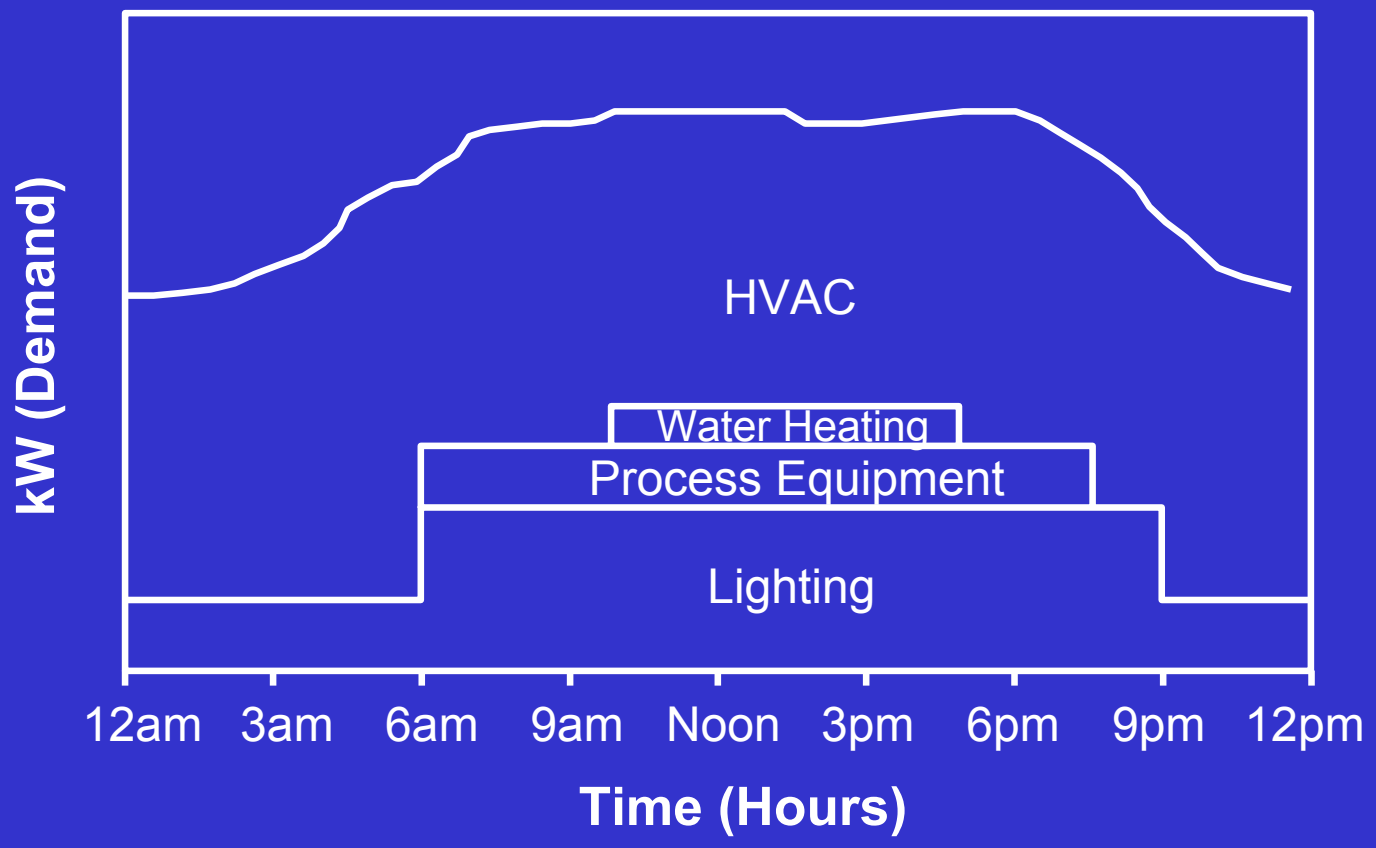
Energy Efficiency Opportunities

Energy Savings = Increased Asset Value

		Per Sq. Ft.
Automatic Lighting Controls Cost		$0.35
Annual Savings		$0.18
Payback		2.0 years
Annual ROI		56%
Net Operating Income Increase	$0.18	
Asset Value Increase		$1.80
(10% Capitalization Rate)		
Increase Per 100,000 Square Feet		180,000

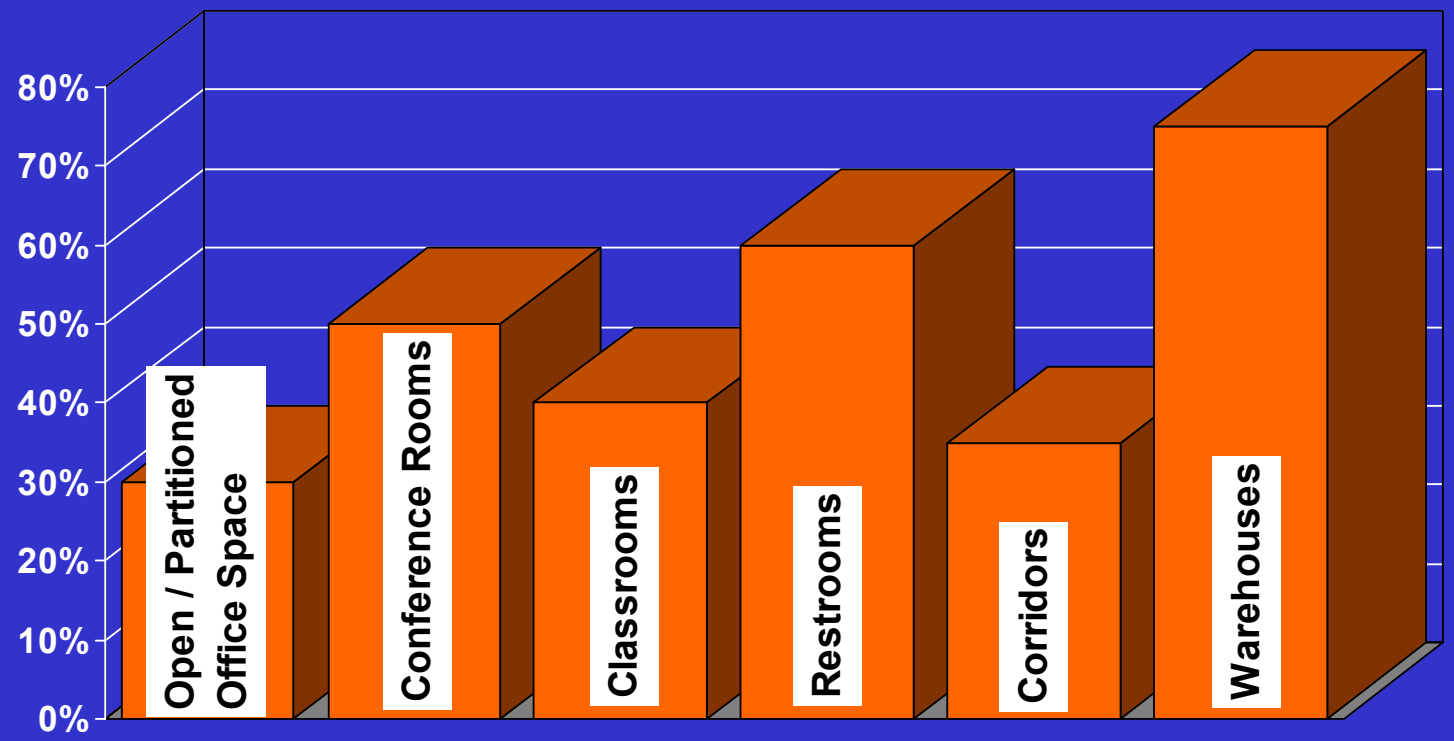
Energy Efficiency Opportunities

Typical Daily Electric Load Profile



Energy Efficiency Opportunities

EPA Monitored Occupancy Sensor Savings



Source: EPA Greenlights Metered Test in 171 Sites - 1997

Energy Efficiency Opportunities

Occupancy Sensor Savings

Daily Lighting Period	Hours of Lighting	Hours Wasted
8am – 12 noon	4	1
12 noon – 2pm	2	1
2pm – 6pm	4	1
6 pm – Midnight	3*	2.8
Daily Hours	13	5.8
Percent of Total Daily Hours	100%	45%

*Assumes cleaning crew turns out lights as they complete each floor

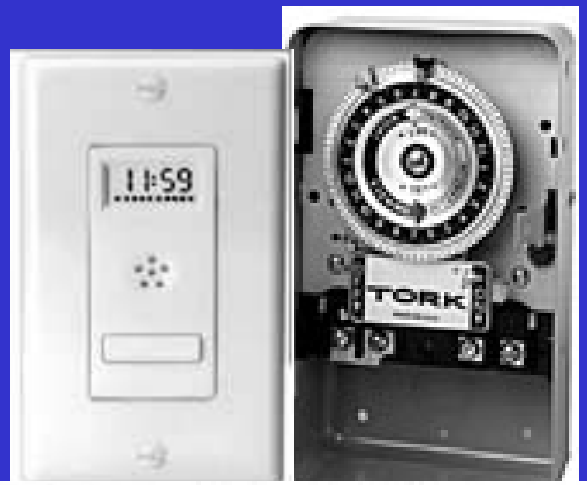
Types of Lighting Controls

- Scheduling/Dimming
  - Time Clocks
  - Centralized Systems
- Occupancy Sensing
- Daylighting
- Other

Types of Lighting Controls

Scheduling/Dimming – Time Clocks

- An internal clock turns lights on or off at preset times
- For use when occupancy never varies
- Available in either wall-box or enclosure-mounted; mechanical and digital models



Types of Lighting Controls

Scheduling/Dimming - Centralized Systems

- Automatically turn on, turn off or dim lights throughout a building
- Can coordinate with occupancy sensing and/or daylighting controls
- Should include:
  - Warning method with occupant override … or
  - Connection to occupancy sensors

Types of Lighting Controls

Occupancy Sensing

- Automatically turns lights on and off when detecting presence or absence of people
- Available in wall-box, wall- and ceiling-mounted versions
- Can coordinate with scheduling and/or daylighting controls

Types of Lighting Controls

Daylighting

- Sensor Types
  - Indoor
  - Outdoor
  - Atrium
  - Skylight
- 0-10V controllable dimming ballasts versus separate controller
- Can combine with scheduling and/or occupancy sensing controls

Types of Lighting Controls

Other

- Wireless communication systems
- Power-line carrier communication systems
- Internet accessible by paging systems
- DALI Systems (Digital Addressable Lighting Interface)

Design Considerations

Best Way To Save Lighting Electricity

- To automate control of the lighting to take advantage of:
  - Identifiable occupant schedules
  - simply by dimming or turning the lighting out when unoccupied for more than 5 to 10 minutes
  - extra daylight entering the space
- Two critical considerations:
  - Occupant acceptance and productivity
  - Return on investment

Design Considerations

Lighting Controls Mandates/Proponents

- International Energy Conservation Code - IECC (www.energycodes.gov)
- ASHRAE 90.1 (www.ashrae.org)
- Leadership in Energy and Environmental Design - LEED (www.usgbc.org/leed/leed_main.asp)

Design Considerations

IECC / ASHRAE 90.1 Mandates

- Applies to:
  - New construction
  - Additions to existing buildings
  - Alterations to existing buildings (50% or more)
- Latest versions require automated lighting controls for buildings over 5,000 ft^2
- All States must address by 2004

Design Considerations

LEED Program

- U.S. Green Building Council
- The rating system is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings for all segments of the building industry
- Rating points are provided for automatic lighting controls and daylighting

Design Considerations

Savings on Various Options

• Scheduling/Dimming	18 – 30%
• Occupancy Sensors	30 – 80%
• Daylighting	16 – 30%

Design Considerations

Scheduling/Dimming

- Assess acceptance by the occupant
- Identify waste during 8am – 5pm
- Determine unoccupied hours
- Address occupant override capability
- Match technology selection to building maintenance staff expertise
- Consider link to HVAC

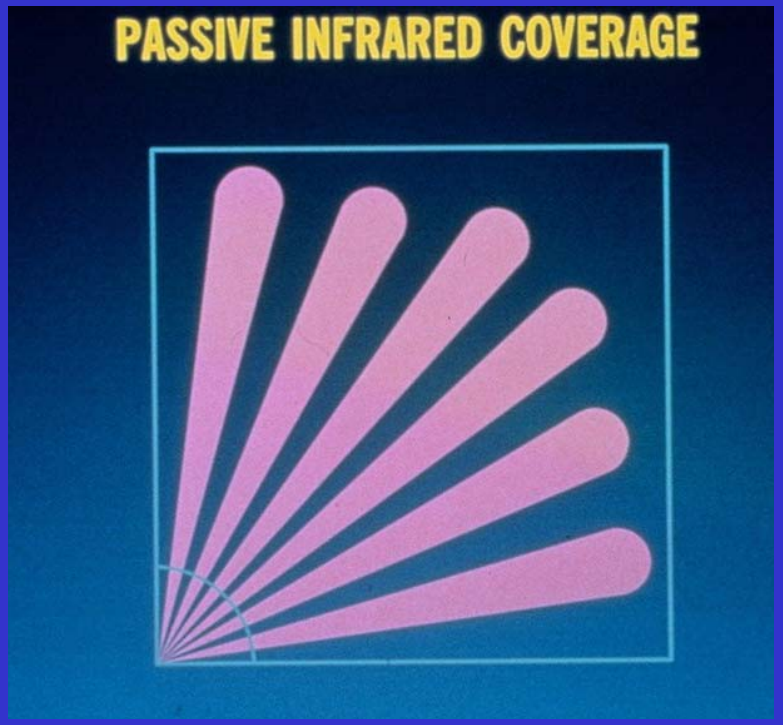
Design Considerations

Occupancy Sensing – Technologies

- Passive Infrared
- Ultrasonic
- Microphonics
- Dual-Technology

Design Considerations

Occupancy Sensing – Passive Infrared

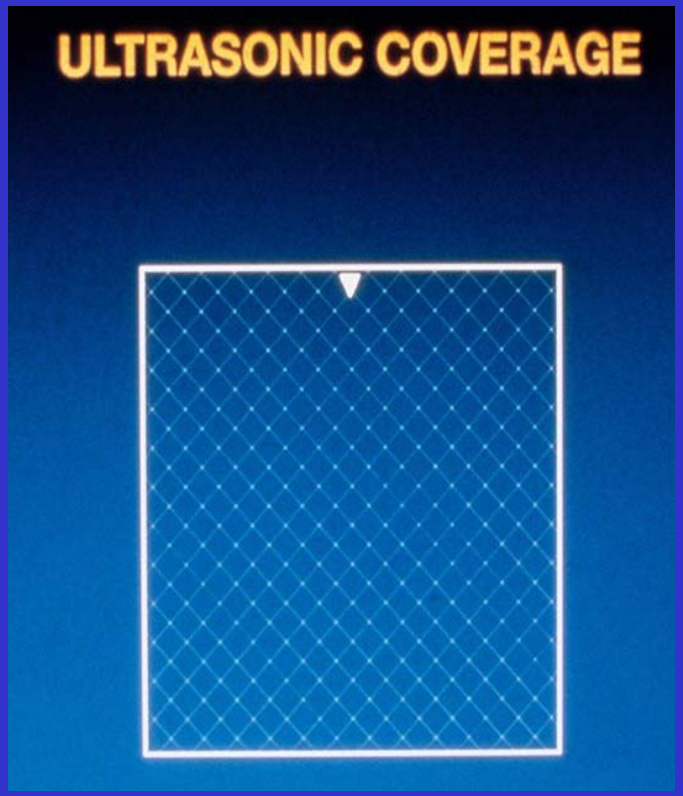


- Triggered by the movement of a heat-emitting body through the field of view (passive technology)
- Best suited for small, enclosed spaces and areas with high airflow
- Potential coverage gaps

Design Considerations

Occupancy Sensing – Ultrasonic

- Emits an inaudible sound wave (active technology)
- Occupancy determined by changes in the reflected sound
- Provides coverage without gaps



Design Considerations

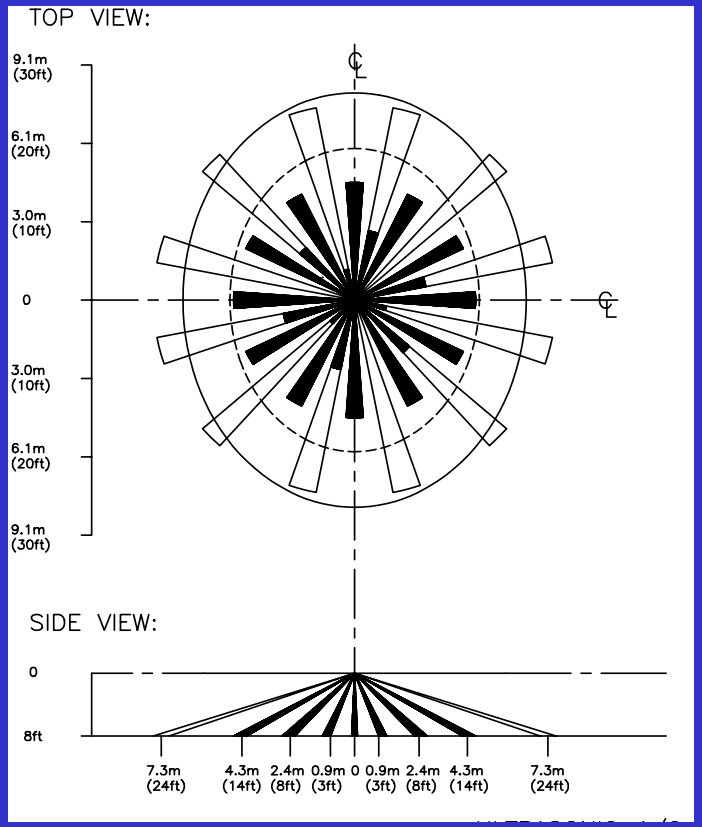
Occupancy Sensing – Microphonics

- Listens for a range of audible sound waves (passive technology)
- Provides coverage without gaps
- Best combined with passive-infrared technology
- Provides coverage without gaps

Design Considerations

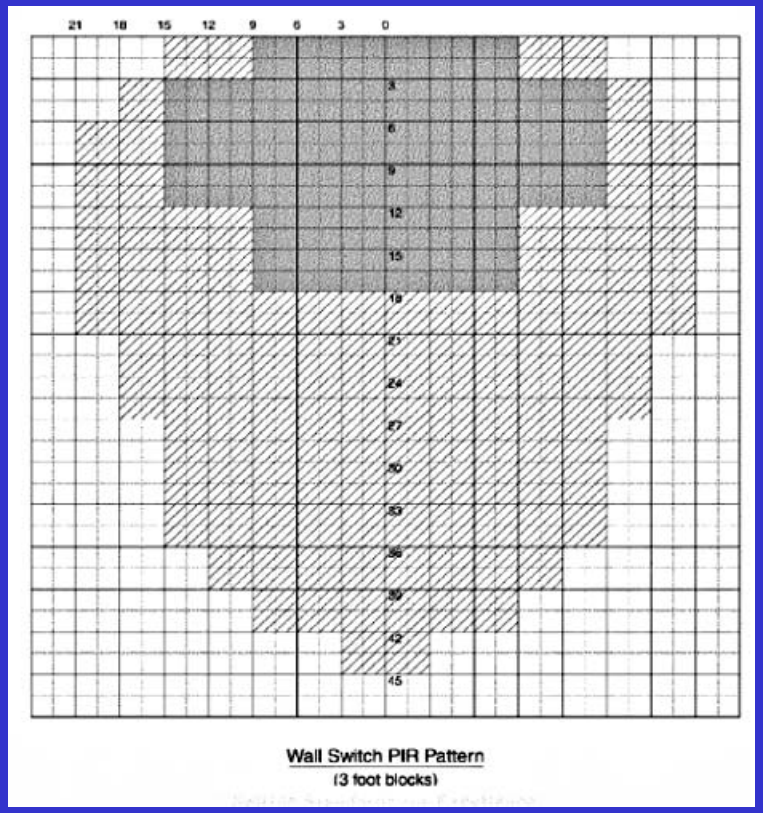
Occupancy Sensing – Dual Technology

- Combines passive-infrared with either ultrasonic or microphonic technologies
- Passive-infrared initially triggers sensor and other technology activates for minor motion coverage
- Provides coverage without gaps



Design Considerations

Occupancy Sensing – Coverage Verification
NEMA WD-7 Guidlines



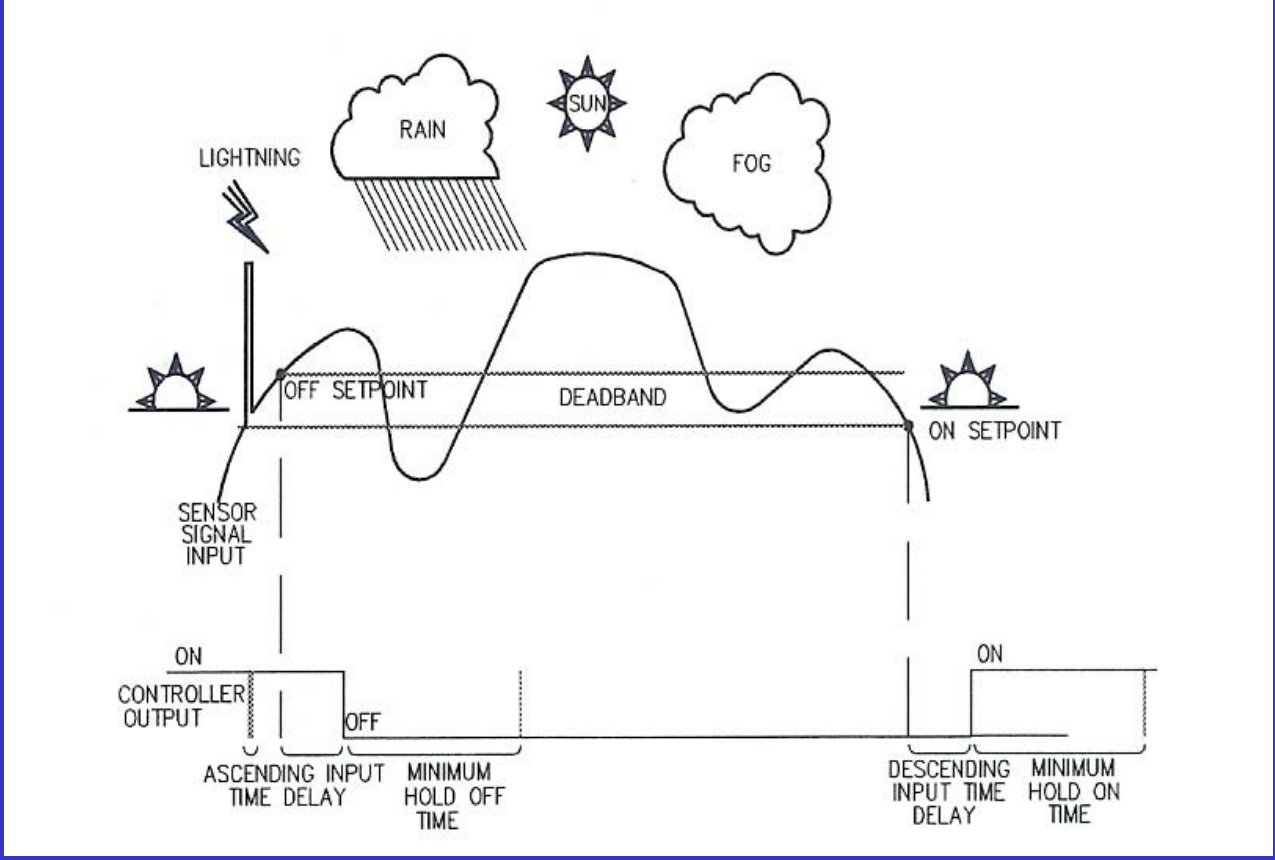
Design Considerations

Occupancy Sensing

- Performance more important than technology
- Match technologies selection to application
- Ability to detect minor motion
- Assess ease of installation and maintenance
- Correct and reliable control adjustments/settings
- Consider sensors with automatic settings

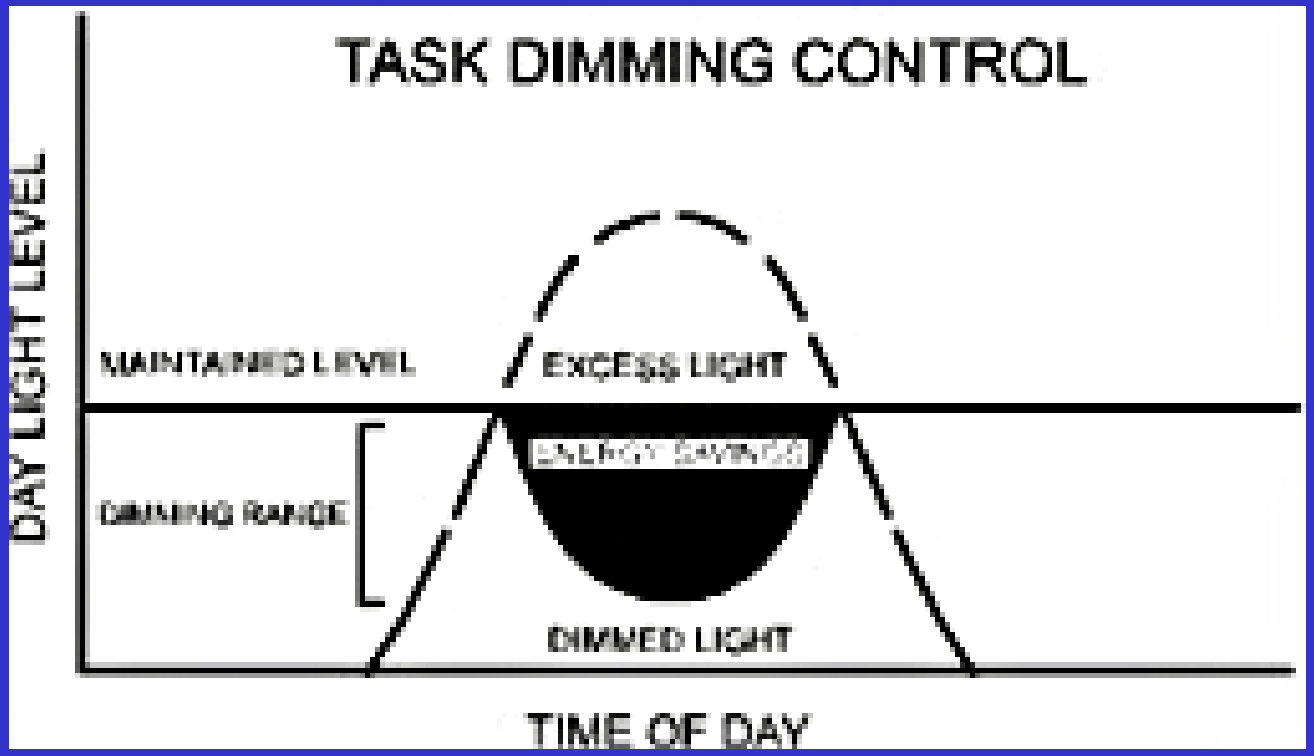
Design Considerations

Daylighting



Design Considerations

Daylighting



Design Considerations

Daylighting

- Availability of natural light
- Prevent outside glare and heat
- Link to automatic shut-off
- Provide occupant overrides availability of natural light
- Prevent outside glare and heat
- Link to automatic shut-off
- Provide occupant overrides

Sample Calculation

Combining Sensors and Electronic Ballasts/T-8

15x10 Office w/ Two Fixtures		Sensors Only	Lamps/Ballast Only	Combined
Before	Original Watts	288	288	288
	Annual Lighting Hours	3,500	3,500	3,500
	Annual KWH	1,008	1,008	1,008
	Expense @ $0.08	$81	$81	$81
After	Watts	288	196	196
	Annual KWH	554	686	377
	Savings Percent	45%	32%	63%
	Annual $ Saved	$36	$26	$51
	Installed Cost	$55	$140	$195
	Payback	1.5 years	5.3 years	3.8 years
	ROI	70.1%	20.0%	29.0%

Sample Calculation

Annual Savings

	Small Office	Conf Room	Restroom
Typical Room Size	15’ X 10’	15’ X 24’	15’ X 20’
Lighting Loads (Watts)*	196	588	392
Annual Lighting Hours	3,500	3,500	5,600
Annual KWH	686	2,058	2,195
Annual Cost @ $.10 KWH	$55.00	$165.00	$176.00
Percent Savings	45%	55%	60%
Annual Savings	$25.00	$91.00	$105.00
Savings Per Square Foot	$0.16	$0.25	$0.35

*Assumes Electronic Ballasts and T-8 Lamps have been installed.

Sample Calculation

Payback and Return on Investment

	Small Office	Conf Room	Restroom
Installed Cost	$55.00	$206.00	$177.00
Annual Savings	$25.00	$91.00	$105.00
Cost Per Square Foot	$0.37	$0.57	$0.59
Savings Per Square Foot	$0.16	$0.25	$0.35
Payback	2.2 years	2.3 years	1.5 years
5 Year Net Savings	$68.00	$247.00	$346.00
Return on Investment	49.7%	48.3%	63.9%

*Assumes Electronic Ballasts and T-8 Lamps have been installed.

Summary

- ✓ Energy Efficiency Opportunities
- ✓ Types of Lighting Controls
- ✓ Design Considerations
- ✓ Sample Calculation

Questions?

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