



Daylight Responsive Lighting Control

Shedding Light on Daylight Harvesting

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HUBBELL
Building Automation

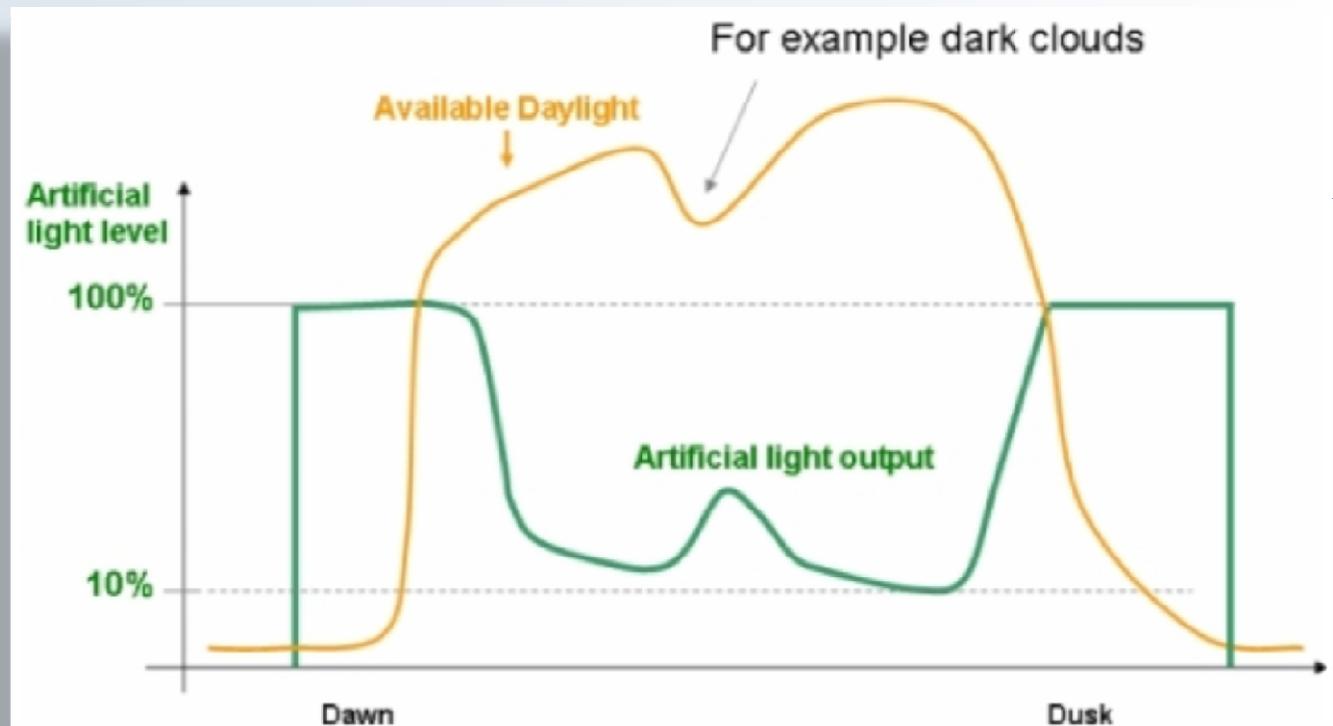
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Lighting

A photograph of a modern, brightly lit hallway. The hallway features a polished, reflective floor that captures the light from large windows on the right side. A metal railing runs along the windows. The overall atmosphere is clean, bright, and airy, with strong shadows cast across the floor from the window panes. The text 'Daylight Harvesting' is overlaid in white on a dark blue semi-transparent background on the right side of the image.

Daylight Harvesting

What Is Daylight Harvesting?

Control of electric lighting based on the amount of available daylight



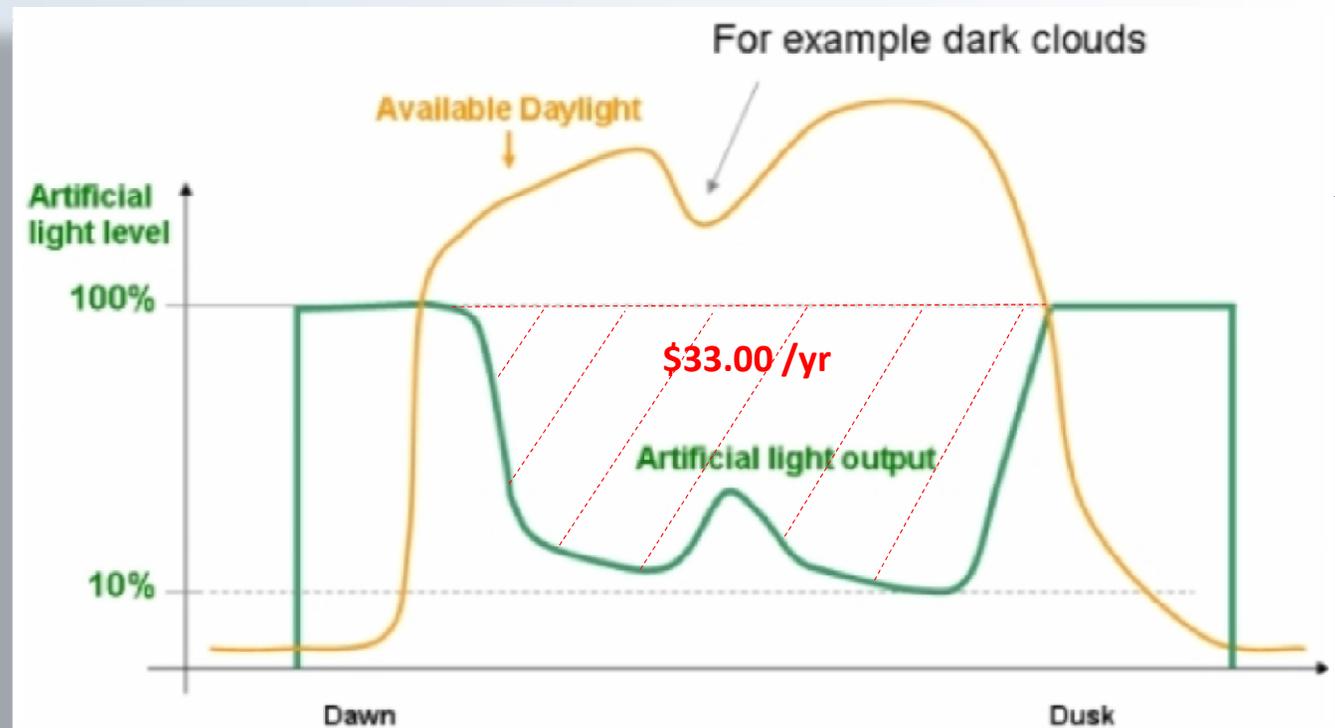
Why Install Daylight Responsive Lighting Controls?

- Required by code
- Save energy, be “Green”
- Save money?

What Is the Potential Savings?

164 watts = 4 LED 2 X 4 Lay In

85% savings for 3000 hours per year



In a perfect daylight harvesting world?

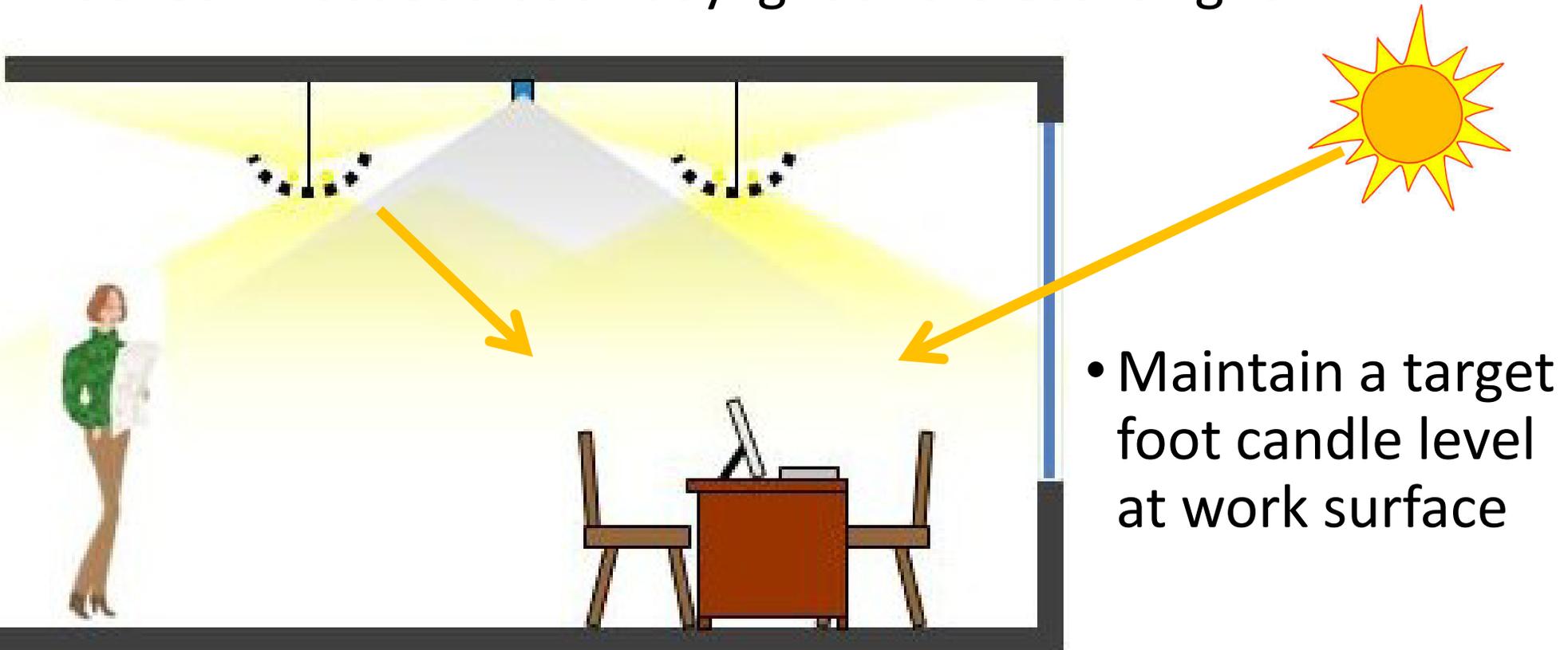
- Lots of window area
- The sun would always shine
- Site conditions would never change
- The sun would never move

Technologies and Applications

Closed Loop – Open Loop – Single Zone – Multi Zone

Closed Loop Lighting Control

- Sensor must see both daylight and electric light



Closed Loop Lighting Control



Fixture mounted,
downward looking,
daylight sensor

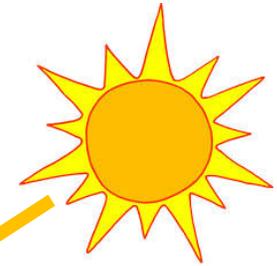
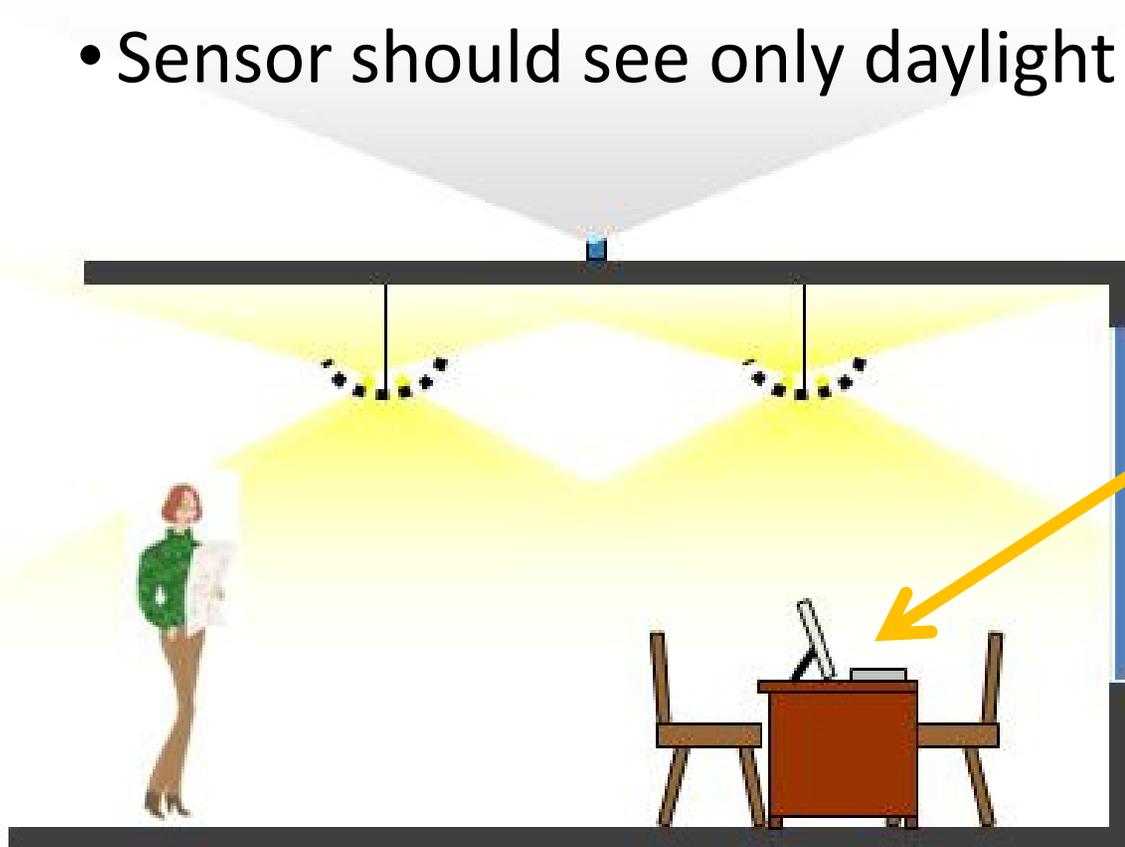


Closed Loop Control

- Sensor must “see” mix of daylight and electric light
- Best suited to single zone control
- Works well with fixture integrated sensor
- Enables granular applications
- Can provide lumen maintenance

Open Loop Lighting Control

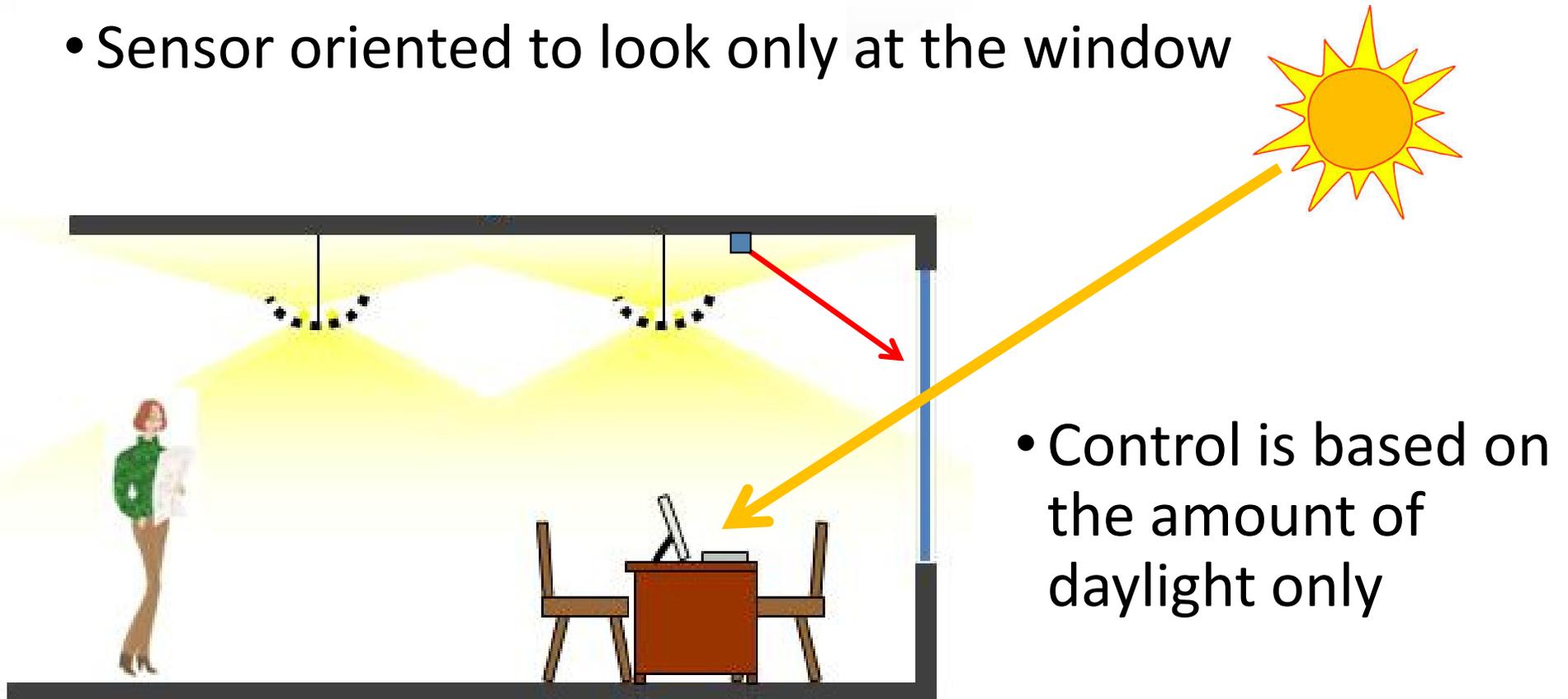
- Sensor should see only daylight



- Exterior photocell can be problematic for interior lighting control

Open Loop Lighting Control

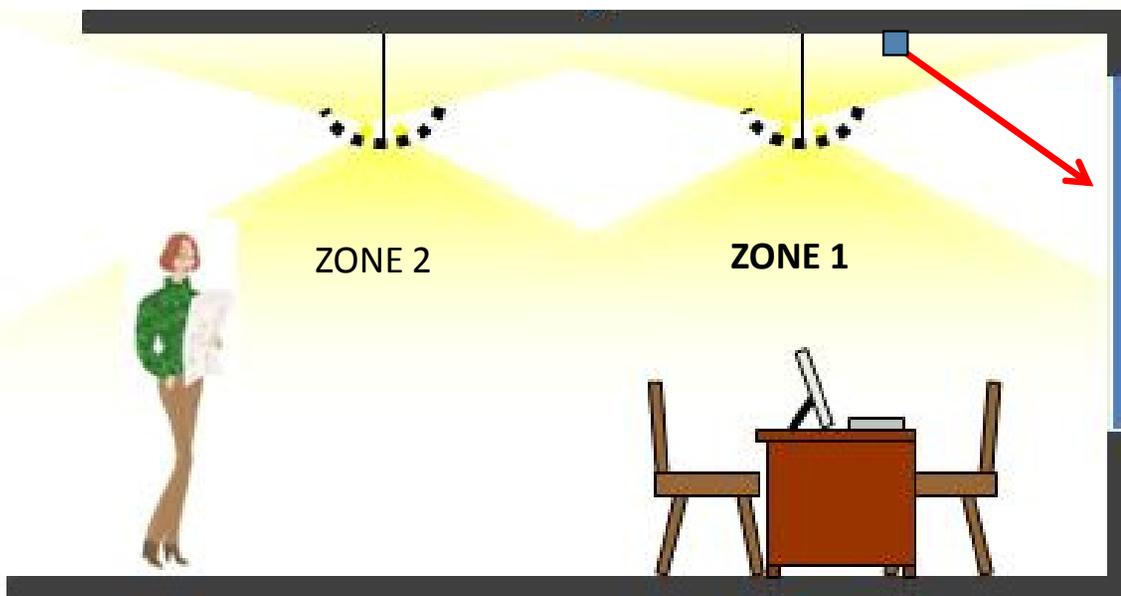
- Sensor oriented to look only at the window



- Control is based on the amount of daylight only

Open Loop Lighting Control

- Single or multi-zone



Full Range Dimming

Zone 1 Daylight Levels

Design Level: 35

At Sensor: 215

Get Level

At Task: 52

Zone 1 Dimmer Rates

Ramp Up Rate (sec): 15

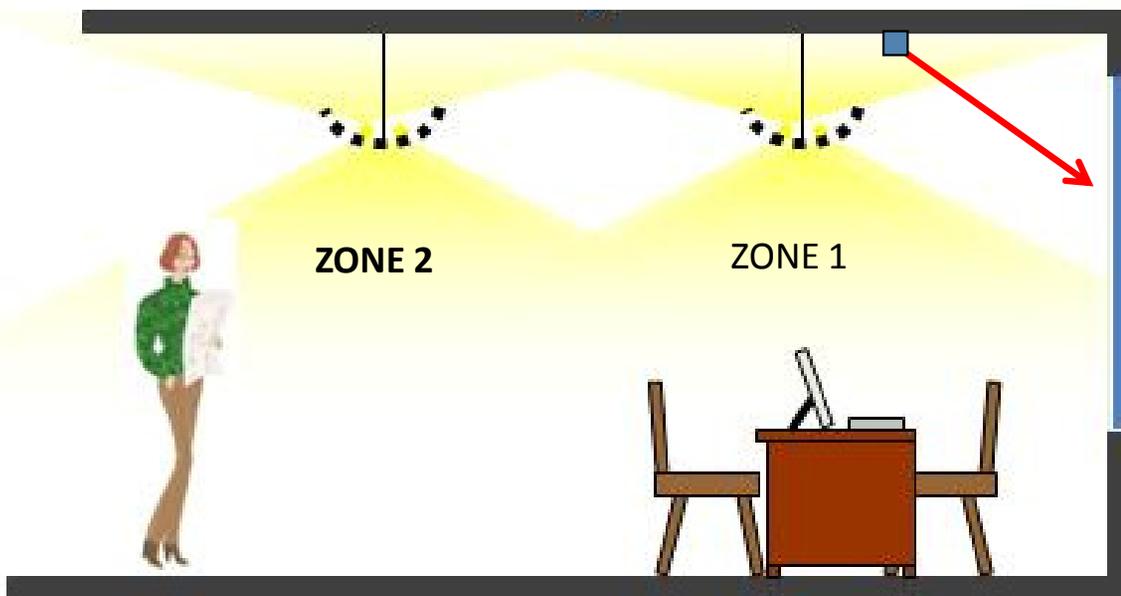
Ramp Down Rate (min): 5

Zone 1 Group Settings

01	02	03	04
05	06	07	08
09	10	11	12
13	14	15	16

Open Loop Lighting Control

- Single or multi-zone



Full Range Dimming

Zone 2 Daylight Levels

Design Level: 35

At Sensor: 215

Get Level

At Task: 29

Zone 2 Dimmer Rates

Ramp Up Rate (sec): 15

Ramp Down Rate (min): 5

Zone 2 Group Settings

01	02	03	04
05	06	07	08
09	10	11	12
13	14	15	16

Open Loop Control

- Sensor must “see” only daylight
- Sensor should be in the space it is controlling
- Works in single or multi-zone applications
- Capable of controlling large zones
- Not suited well for fixture mounting

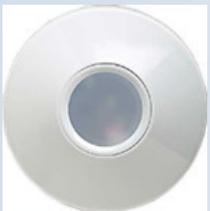
Daylight Responsive Lighting Control Components

Stand Alone Devices and Systems

Daylight Responsive Lighting Controls

Control Options

- Stand-alone or System
- Analog or Digital
- Low voltage or Line Voltage
- Class 1 or Class 2 control
- Dimming, step dimming, ON/OFF

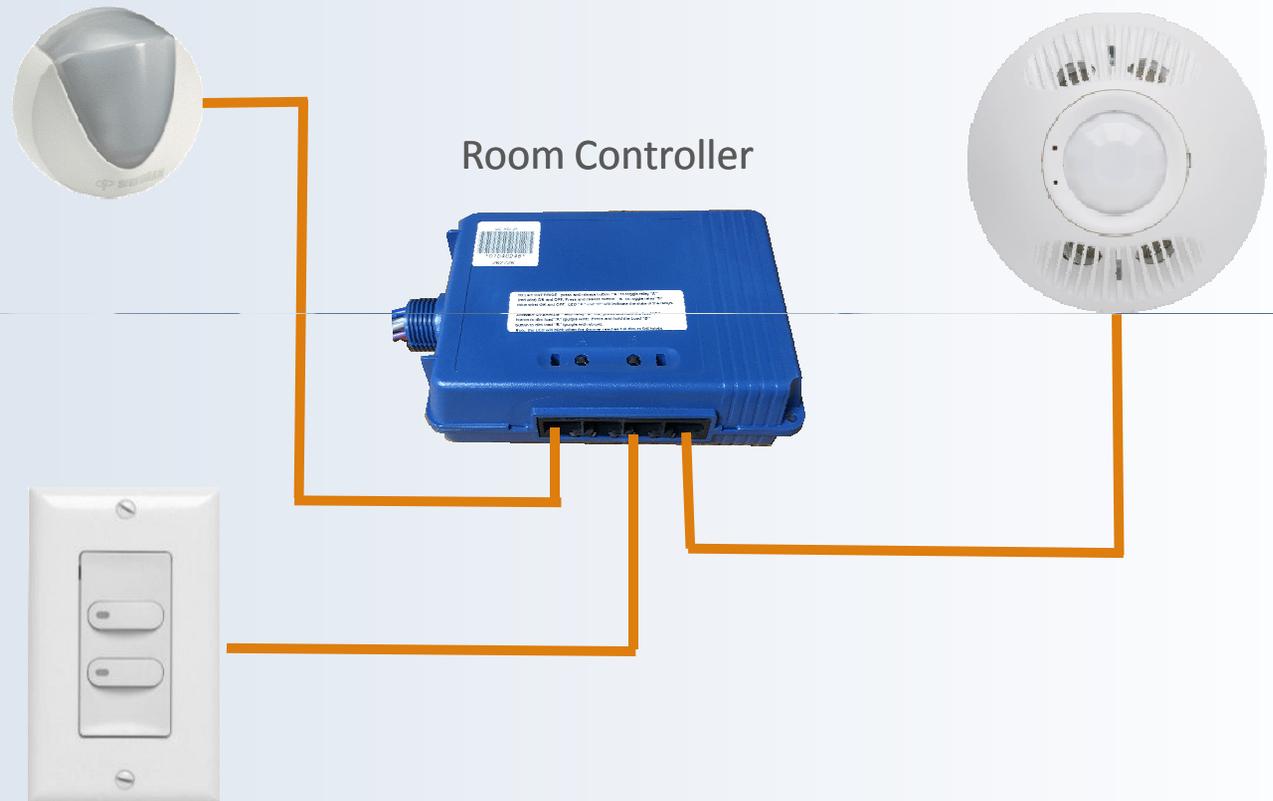


Most common today is 0 – 10 volt, current-sink, dimming control

Incremental Control Strategy Driven by Energy Codes

- Multi-level control or dimming
- Automatic shutoff
 - Motion Sensor
 - Scheduling
- Manual on operation
- Daylight harvesting

Coordinated Sequence of Operation



Code Requirements

Daylight Harvesting

Daylighting Controls & Energy Codes

ASHRAE 90.1 2010

Daylight Zone Adjacent to Sidelighting

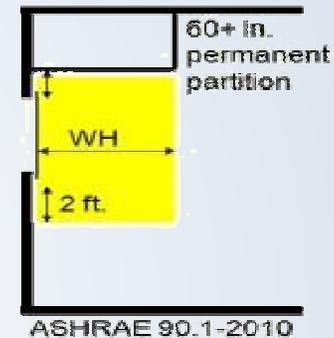
Daylight Zone = Depth x Width

Depth = The LESSER value of:

Distance from floor to top of window OR Distance on the floor perpendicular to the glazing, to nearest 60+ inch high permanent partition.

Width = The LESSER value of:

Width of window + 2 ft. on each side OR width of window + distance to a 60+ inch high vertical obstruction.



- General lighting in daylight zones must be separately circuited and controlled from other general lighting in the space.*
- The control method must be **automatic and multilevel (or continuous dimming)**, providing one step between 50% and 70% of the design lighting power, and another between OFF and 35%.

*EXCEPTION: Enclosed area containing daylight zones is less than 250 sq. ft.

<http://lightingcontrolsassociation.org/energy-standards-take-on-daylight-harvesting/>

Daylighting Controls & Energy Codes

ASHRAE 90.1 2010 (cont.)

Daylight Zone Below Toplighted Spaced

Daylight Zone = Length x Width (with no double counting of lapping areas)

Length = Length of Skylight + The LOWEST value of:

70% of the ceiling height OR distance to any primary sidelighted area or daylight area under rooftop monitors OR distance to the front face of any vertical obstruction where any part of the obstruction is further away than $0.7 \times$ (ceiling height – obstruction height).

- General lighting in daylight zones must be separately circuited and controlled from other general lighting in the space.*
- The general lighting must be separately controlled using either a **stepped switching or continuous dimming** controller, with some exceptions.

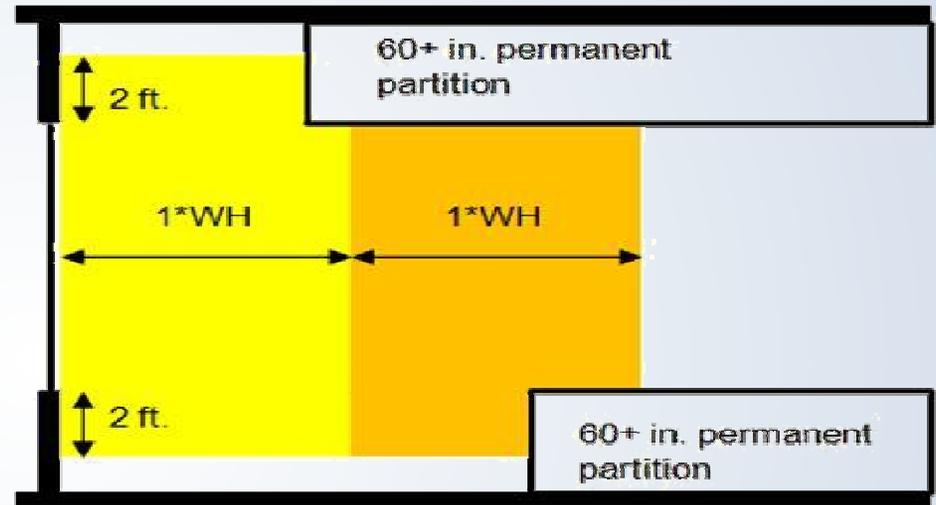
*EXCEPTION: Total daylight area under skylights plus the total daylight area under rooftop monitors is less than 900 sq. ft.

<http://lightingcontrolsassociation.org/energy-standards-take-on-daylight-harvesting/>

Daylighting Controls & Energy Codes

ASHRAE 90.1 2010 (cont.)

Secondary Daylight Zones



- These zones extend deeper into the space, controlled separately from primary daylight zones and other general space lighting.
- Not mandatory but encouraged through the use of power credits, i.e. more available power.

Daylighting Controls & Energy Codes

ASHRAE 90.1 2010 (cont.)

Daylight Zone in Parking Garage

Daylight Zone = within 20 ft of any perimeter wall structure that has a net opening to wall ratio of at least 40% and no exterior obstructions within 20 ft.

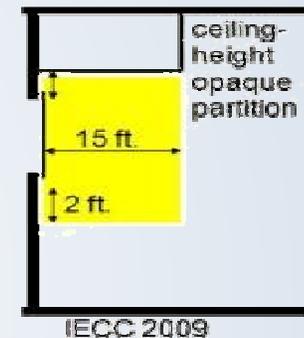
- General lighting in daylight zones must be separately circuited and controlled from other general lighting in the space.
- Daylight zone lighting must be separately controlled using either a **stepped switching or continuous dimming** controller, with some exceptions.

Daylighting Controls & Energy Codes

IECC 2009

Daylight Zone Adjacent to Sidelighting

- General lighting in daylight zones must be separately circuited and controlled from other general lighting in the space.*
 - Contiguous daylight zones adjacent to windows can be controlled together as long as the zone is not adjacent to windows facing more than two different cardinal directions
 - Areas under skylights more than 15 feet away from windows must be controlled separately
- Method of control is not specified, so the designer has a choice between **Switching or Dimming**.



*EXCEPTION: Areas with two or fewer fixtures

<http://lightingcontrolsassociation.org/energy-standards-take-on-daylight-harvesting/>

Daylighting Controls & Energy Codes

IECC 2012

- The 2012 IECC follows the 2009 IECC in requiring general lighting in defined daylight zones to be separately controlled from other general lighting
- The maximum size of control zones to 2,500 sq.ft.
- Allowable options for automatic daylight harvesting control include continuous dimming with a 100% to <35% light output range or multilevel controls offering 100%, a step between 50% and 70%, and another step between OFF and 35%.



Daylight Responsive Lighting Control

Shedding Light on Daylight Harvesting

Thank You



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