

# BUILDING CODE TRAINING

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Commercial Lighting – Controls

Presenter: Joey Starr

# ABOUT SOUTHFACE



*Building a Regenerative Economy, Responsible Resource Use  
& Social Equity Through a Healthy Built Environment for All*

# ENERGY CODE RESOURCES

Online educational resources are available by visiting:

[www.southfaceonlinetraining.org](http://www.southfaceonlinetraining.org)

Technical assistance or training requests can be submitted to Georgia Energy Code Hotline at: [energycodes@southface.org](mailto:energycodes@southface.org) or 404-604-3598

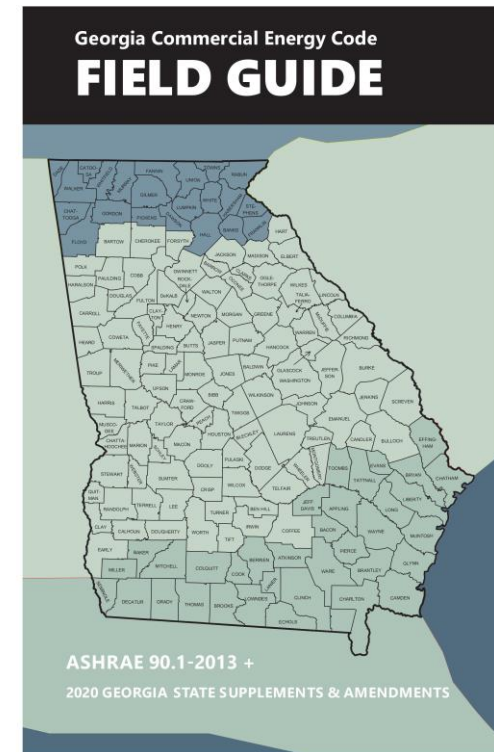
## Additional Resources

Georgia Energy Code: If you would like additional information on Georgia's current energy code, please visit the Georgia Department of Community Affairs website at: [www.dca.ga.gov/development/ConstructionCodes/programs/EnergyCodeTrainingWorkshops.asp](http://www.dca.ga.gov/development/ConstructionCodes/programs/EnergyCodeTrainingWorkshops.asp)

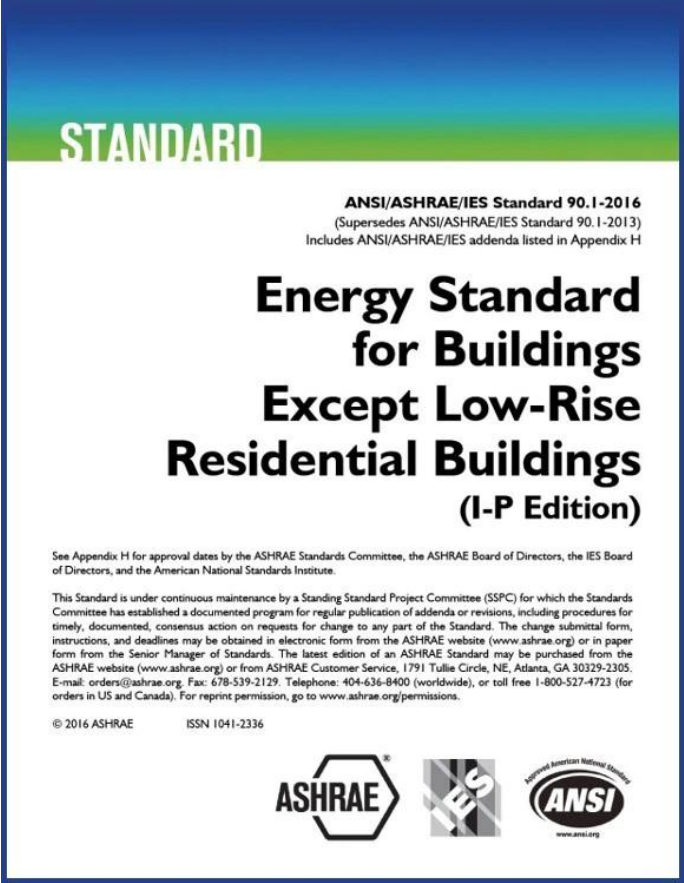
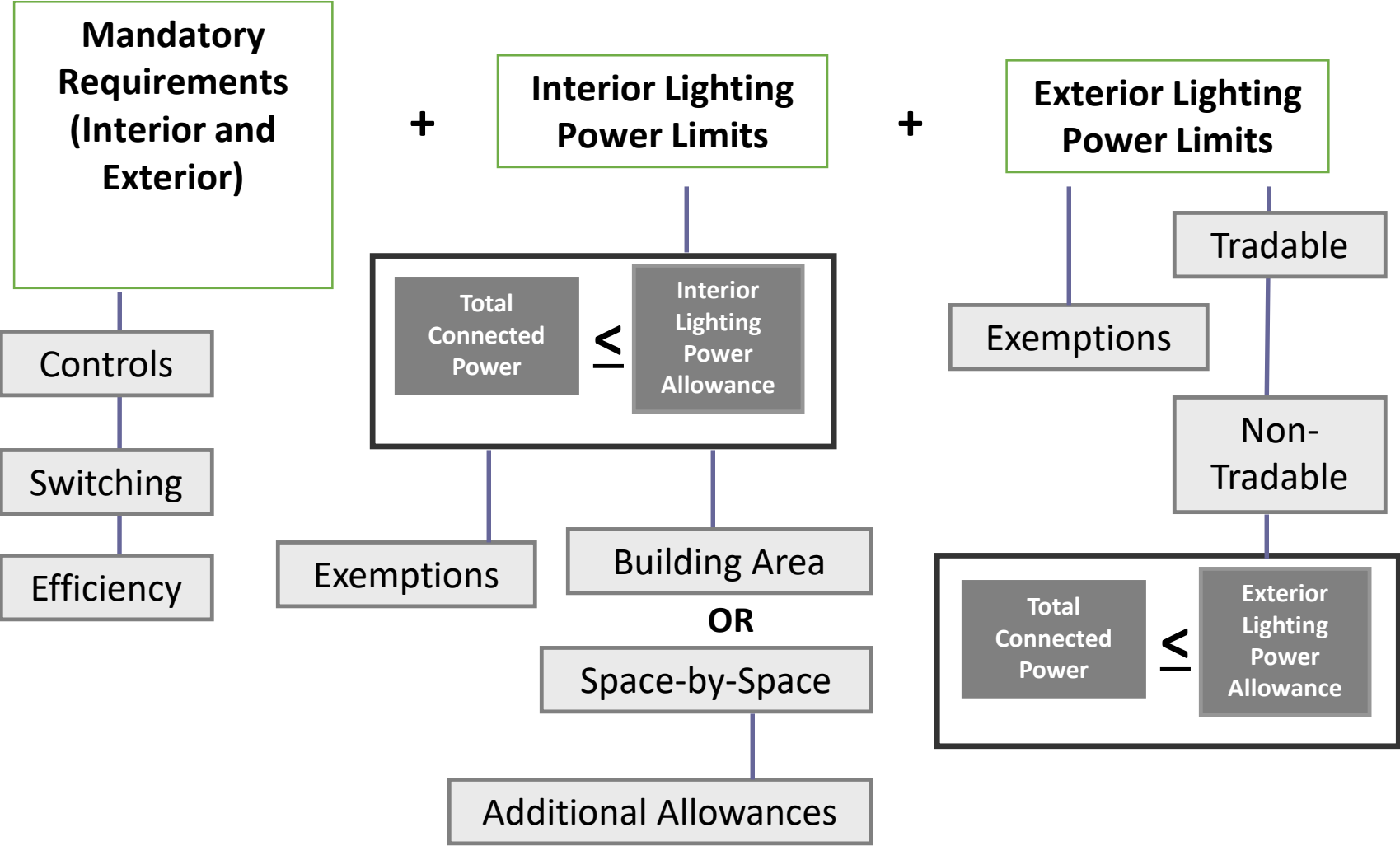
DOE Field Study: If you would like additional information on other DOE Field Studies and participating states, please visit the Building Energy Codes website here: <https://www.energycodes.gov/compliance/energy-code-field-studies>

Georgia Field Study: If you would like further information regarding the Georgia Energy Code Field Study, please visit our project webpage found at: [www.seealliance.org](http://www.seealliance.org)

Tools Available: Commercial Field Guide, Pre-drywall Inspection video, webinars  
<https://www.southface.org/resources/georgia-energy-code-resources/>



# COMPLIANCE OPTIONS





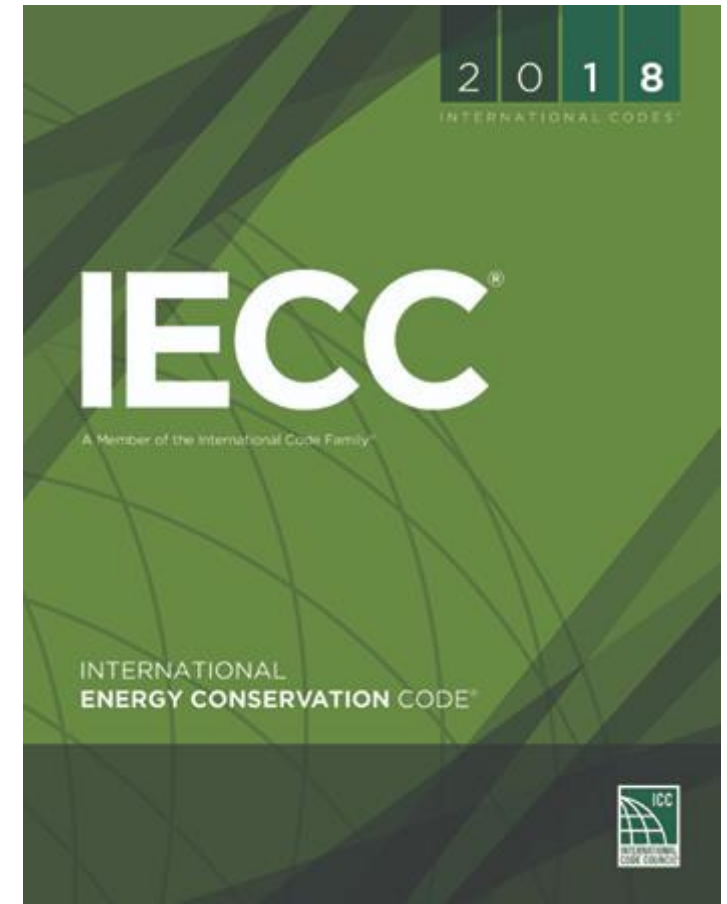
# COMPLIANCE OPTIONS

Prescriptive path must comply with these:

- C402 Envelope
- C403 Mechanical
- C404 SWH
- C405 Lighting

Plus one optional path from C406

- C406.3 Reduced Lighting Power
- C406.4 Enhanced Lighting Controls



# HIGH-EFFICACY LAMPS

- Neither ASHRAE nor the IECC require LEDs
- Future codes, your local jurisdiction, and your customers might have more stringent requirements
- Compact fluorescent lamps, LED lamps, T8 or smaller diameter linear fluorescent lamps, or other lamps with an efficacy based on lamp wattage

Lamp Wattage	Efficacy
> 40 watts	60 lumens/watt
15-40 watts	50 lumens/watt
< 15 watts	40 lumens/watt

# LIGHTING POWER DENSITY

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## **ASHRAE 90.1 2013 > 2016 Changes**

- LPDs were revised based on improved efficacy of LED lighting
- Space-by-space LPDs were reduced by an average of 26%
- Building area LPDs were reduced by 12% on average
- Exterior LPDs were reduced by 30%

## 406.3 REDUCED LIGHTING POWER (OPTIONAL)

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- Whole building LPD determined using 90% of values in Table C405.4.2(1) x floor area for the building types OR
- Using 90% by the space-by-space method in Section C405.4.2
- Determine total LPD of building using reduced whole building interior lighting power in Table 406.3 x floor area for the building types



## 406.4 ENHANCED LIGHTING CONTROLS (OPTIONAL)

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Enhanced digital lighting controls per C406.4, controls located and operated in accordance with C405.2.2:

- Luminaires capable of continuous dimming
- Luminaires capable of being addressed individually OR a controlled group of < 4 luminaires
- < 8 luminaires controlled together in a daylight zone
- Fixtures controlled through digital control system that includes the following function:
  - Control reconfiguration based on digital addressability
  - Load shedding
  - Individual user control of overhead general illumination in open offices
  - Occupancy sensors capable of being reconfigured through the digital control system
- Construction documents including submittal of Sequence of Operations including specs outlining each function of the fixture requirements above
- Functional testing of controls comply with C408

# BUILDING AREA METHOD

- Determine gross lighted area for each building type area using:
  - Exterior faces of exterior walls
  - Centerline of interior walls
- Calculate the area power allowance by multiplying the gross lighted area by the applicable building type allowance from applicable table
- Sum all the allowances (if more than one building type area)

# BUILDING AREA METHOD

## Advantages

- Fewer calculations

Building Area Type	LPD (w/ft <sup>2</sup> )
Automotive facility	0.80
Convention center	1.01
Courthouse	1.01
Bar lounge/leisure	1.01
Cafeteria/fast food	0.90
Dining: family	0.95
Dormitory	0.57

## Disadvantages

- Limited building area type selection - use reasonably equivalent type
- Insensitive to specific space functions and room configurations
- Generally more restrictive than space-by-space method

# SPACE-BY-SPACE METHOD

- Determine the gross lighted area of each space type
- Include balconies and mezzanines
- Use centerline of walls between spaces
- Calculate the space power allowance by multiplying the space type area by the applicable allowance
- Sum all the allowances

# SPACE-BY-SPACE METHOD

## Advantages

- More flexible than building area method
- More accurately accounts for actual room lighting power needs
- Provides additional allowances for:
  - Difficult room configurations
  - Decorative and retail needs
  - Use of advanced controls not already required in the standard

## Disadvantages

- More calculations needed (individual spaces)

Common Space Types	LPD (w/ft²)
Locker room	0.75
Lounge/breakroom	
In a healthcare facility	0.92
Otherwise	0.73
Retail	
In Dressing Room	0.71
In a Mall Concourse	1.10

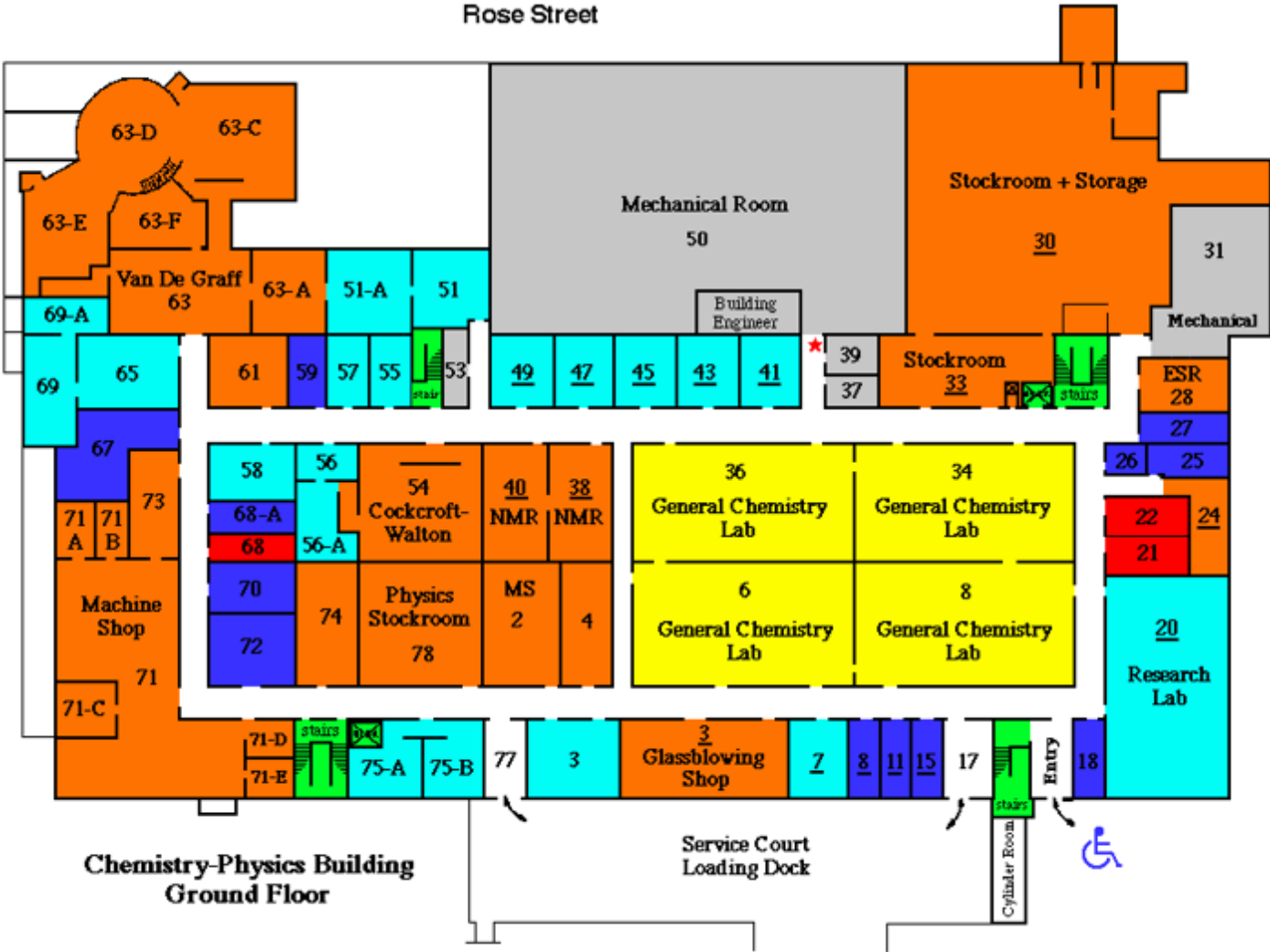
# SPACE-BY-SPACE METHOD

- If a physical space has multiple functions such that more than one space type
  - Break the space into smaller subspaces
  - Use the centerline of interior walls and dividing line between subspaces to determine subspace areas
  - Calculate the allowance separately for each subspace
- Exception - Subspaces with areas less than 20% of the original space and less than 1000 ft<sup>2</sup> do not need to be broken out separately



# SPACE-BY-SPACE METHOD

School Example	LPD (w/ft <sup>2</sup> )
Audience Seating Area - Gym	0.65
Classroom	1.34
Computer Room	1.71
Lab - Classroom	1.43
Mechanical Room	0.42
Restroom	0.98
Storage Room => 50 ft <sup>2</sup>	1.10



**TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method  
and Minimum Control Requirements Using Either Method (Continued)**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type: (1) All REQs shall be implemented. (2) At least one ADD1 (when present) shall be implemented. (3) At least one ADD2 (when present) shall be implemented.											
Common Space Types <sup>1</sup>	LPD, W/ft <sup>2</sup>	RCR Threshold	Local Control (See Section 9.4.1.1[a])	Restricted to Manual ON (See Section 9.4.1.1[b])	Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	Bilevel Lighting Control (See Section 9.4.1.1[d])	Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e] <sup>6</sup> )	Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f] <sup>6</sup> )	Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	Automatic Full OFF (See Section 9.4.1.1[h])	Scheduled Shutoff (See Section 9.4.1.1[i])
<b>Electrical/Mechanical Room<sup>7</sup></b>	0.42	6	REQ	—	—	—	REQ	REQ	—	—	—
<b>Emergency Vehicle Garage</b>	0.56	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
<b>Food Preparation Area</b>	1.21	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Guest Room</b>	0.91	6	See Section 9.4.1.3b.								
<b>Laboratory</b>											
... in or as a classroom	1.43	6	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
... all other laboratories	1.81	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Laundry/Washing Area</b>	0.60	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
<b>Loading Dock, Interior</b>	0.47	6	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
<b>Lobby</b>											
... in a facility for the visually impaired (and not used primarily by the staff) <sup>3</sup>	1.80	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... for an elevator	0.64	6	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a hotel	1.06	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a motion picture theater	0.59	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a performing arts theater	2.00	6	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... all other lobbies	0.90	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
<b>Locker Room</b>	0.75	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
<b>Lounge/Breakroom</b>											
... in a healthcare facility	0.92	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
... all other lounges/breakrooms	0.73	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

1. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft and is not based on the RCR.

3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.

4. For accent lighting, see Section 9.6.2(b).

5. Sometimes referred to as a "Picking Area."

6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.

7. An additional 0.53 w/ft<sup>2</sup> shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft<sup>2</sup>. The additional 0.53 w/ft<sup>2</sup> allowance shall not be used for any other purpose.

energycode.pnl.gov/COMcheckWeb/index.html

COMcheck-Web™

New Project

Project title

2015 IECC

jstarr@southface.org

Log In

Register

Forgotten Password?

Reports

Code/Location

Code: 2015 IECC

State: Alabama

City: Abbeville

If your location is not included here, choose a nearby location with similar weather conditions.

Project Type

New Construction

Addition

Alterations

Compliance Options

Efficiency: Unspecified

Project Details (optional)

This information will appear on the compliance report.

Edit Project Details...

Notes:

Building Envelope Area

Building Area Method

Area Category (Space)

Add Area Category

1	Double-click to s
2	Warehouse: Medium

Create Area Category

☐ Automotive

Vehicular Maintenance Area

☐ Bank

Banking Activity Area

☐ Common Space Types

Atrium

☐ Convention Center

Audience/Seating Area

☐ Courthouse/Police Station/Penitentiary

Courtroom

☐ Dormitory

Living Quarters

☐ Facility for Visually Impaired

Chapel

☐ Fire Stations

Sleeping Quarters

☐ Gymnasium/Fitness Center

Exercise Area

☐ Healthcare Facility

Corridor/Transition <8 ft wide

☐ Hotel

Hotel Lobby

☐ Library

Reading Area

☐ Manufacturing

Corridor/Transition <8 ft wide

☐ Motion Picture Theater

Audience/Seating Area

☐ Museum

General Exhibition

☐ Parking Garage

Garage Area

☐ Performing Arts Theater

Audience/Seating Area

☐ Post Office

Sorting Area

☐ Religious Buildings

Audience/Seating Area

☐ Retail

Dressing/Fitting Room

☐ Sports Arena - Play Area

Audience/Seating Area

☐ Transportation

Baggage/Carousel Area

☐ Warehouse

Fine Material Storage

Create Area Category

Cancel

CHECK COMPLIANCE

To display compliance results, click the Check Compliance button.

10:56 AM

12/20/2019

## A. LOCAL CONTROL

Requires one or more manual control in the space that controls all the lighting in that space.

- Each control device will control a maximum of:
  - 2,500 ft<sup>2</sup> in spaces < 10,000 ft<sup>2</sup>
  - 10,000 ft<sup>2</sup> in spaces > 10,000 ft<sup>2</sup>
- Readily accessible to occupants
- Located where the controlled lights are visible
- Must identify the area served by the lights and indicate their use

### **Exceptions:**

Remote location for safety & security (requires pilot indicator and lighting clearly labeled)



## B. RESTRICTED TO MANUAL ON

### Occupancy

- Turn lights ON automatically upon detecting the presence of people
- Occupancy sensors are better for areas with no daylight like bathrooms or where safety is a concern



### Vacancy

- Must be turned on manually
- Vacancy sensors save more energy
- No “false positives”

# EXEMPTIONS

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Full auto-on controls allowed in

- Public corridors
- Stairways
- Restrooms
- Primary building entrance areas and lobbies
- Areas where manual-on operation would endanger safety or security of room or occupants



## C. RESTRICTED TO PARTIAL AUTOMATIC ON

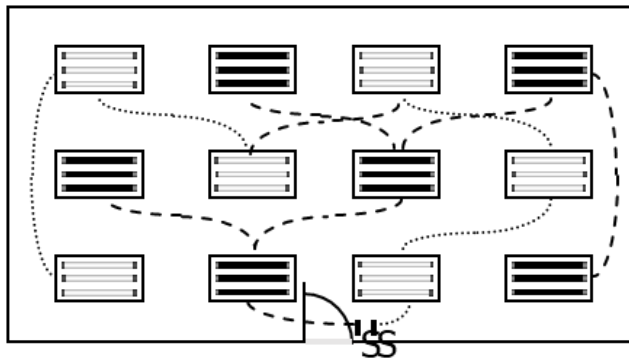
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Maximum of 50% of the lighting power for general lighting is allowed to be automatically turned on and none of the remaining shall be auto ON

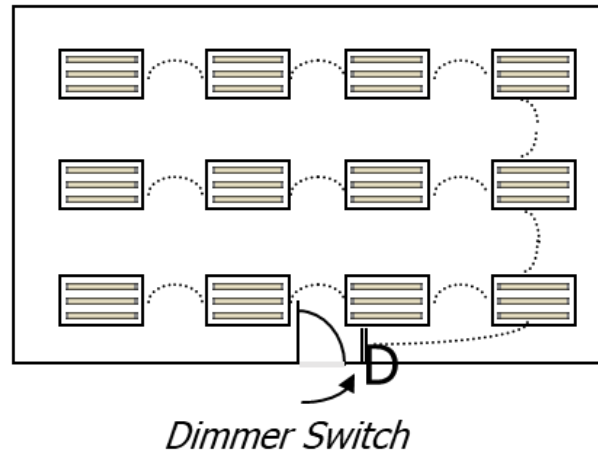
## D. BILEVEL LIGHTING CONTROLS

- Light Reduction Controls must allow the occupant to reduce connected lighting load
  - To have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off
  - In a reasonably uniform illumination pattern
- Light-reduction control are not required in daylight zones with daylight responsive controls complying with C405.2.3

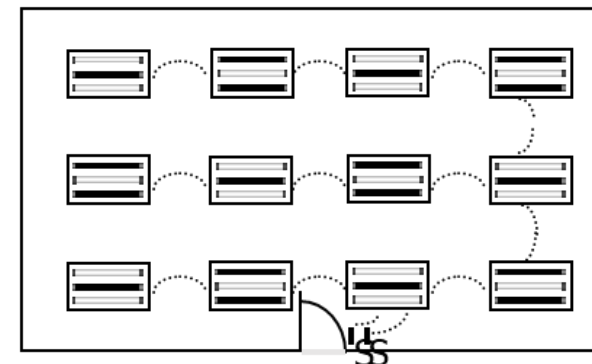
Alternating Luminaires



Dimming



Alternating Lamps



## D. BILEVEL LIGHTING CONTROLS (CONT.)

- Controlling all lamps or luminaires
- Dual switching of alternate rows of luminaires, alternate luminaires or lamps
- Switching middle lamp luminaires independently from the outer lamps
- Switching each luminaire or each lamp



## E./F. AUTO DAYLIGHT CONTROLS

- Photocontrols required for general lighting in any space top-lit by  $> 150 \text{ W}$
- Photocontrols shall:
  - Have readily accessible calibration adjustments
  - Reduce electric lighting based on available daylight using continuous or 4-step staged dimming
  - Combine controls for overlapping top and sidelit areas and lighting shall be controlled by toplighting
- Exceptions for toplighting with tall adjacent shading, skylight  $VT < 0.4$ , spaces in CZ 8  $< 200 \text{ W}$



## G. AUTO PARTIAL OFF

- Automatically turn lights off within 20 minutes after occupants have left space
- Either manual-on or controlled to automatically turn on lighting to not more than 50% power
- Incorporate a manual control to allow occupants to turn off lights

# I. SCHEDULED SHUTOFF

Must include an override switching device with the following:

- Minimum 7-day clock
- Capable of being set for 7 different day types/week
- Incorporate holiday "shutoff" feature to turn all controlled lighting loads for  $\geq 24$  hours and resume to normally scheduled operations
- Program backup capabilities to prevent loss of program and time setting for  $\geq 10$  hours if power is interrupted





# EXTERIOR LIGHTING CONTROLS

- Automatic off control when daylight is available
- Curfew hours for façade and landscape lighting (midnight – 6am or close to open)
- Other exterior lighting (**including advertising**) must automatically reduce power by a minimum of 30% either:
  - Midnight – 6am (or 1 hour after business close until open)
  - Motion sensor control (any period of inactivity greater than 15 min)



# EXTERIOR CONTROLS EXCEPTIONS

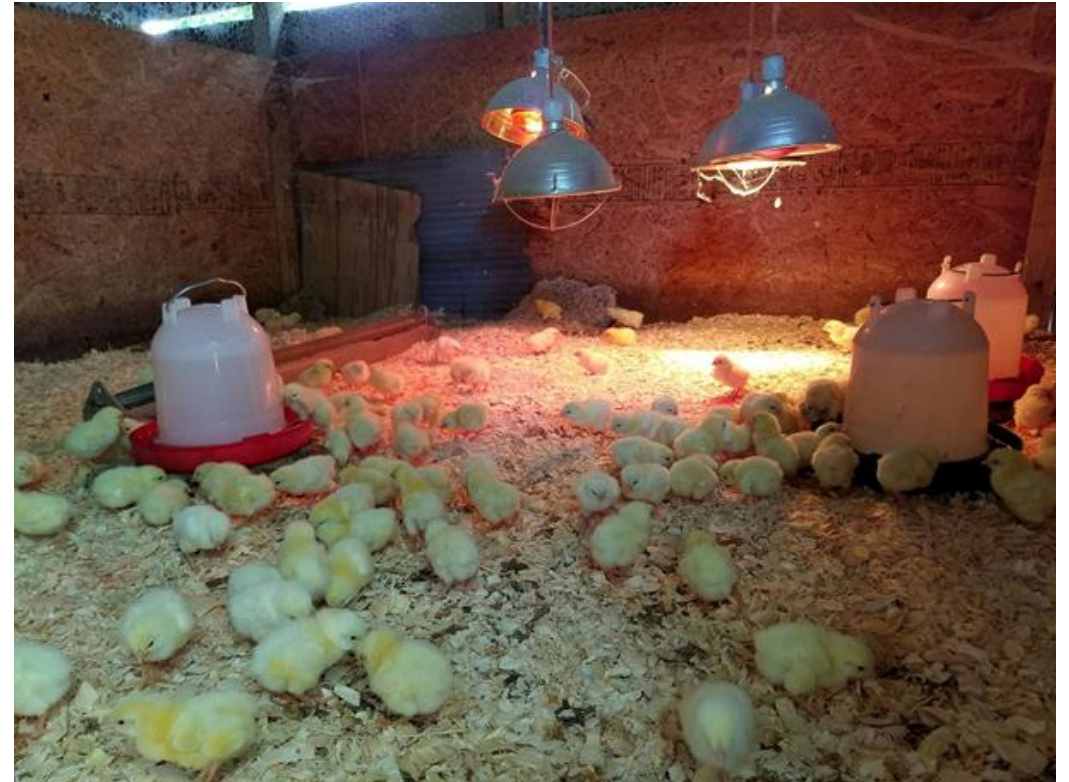
- Lighting for covered vehicle entrances or exits where required for safety, security or eye adaptation
- Lighting integral to signage



# CONTROL OF SPECIAL APPLICATIONS

Special applications separately controlled from general lighting

- Display or accent lighting
- Case lighting
- Nonvisual lighting
- Demonstration lighting



*Photo Courtesy of Sweet Grass Pastures*

# FUNCTIONAL TESTING

## ASHRAE 90.1

- Functional testing (calibrated/adjusted/programmed) of lighting control devices and systems required within 90 days of occupancy
- Must be performed by individuals NOT involved in design, manufacture, or installation



## IECC

Prior to passing final inspection, registered design professional to provide evidence that lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working order per construction documents and manufacturer's installation instructions



# LIGHTING CONTROL DESIGN

- Keep sensors simple and verify that they are set up properly
- Foster good human behavior to save energy
- *An educated* occupant is the best sensor



# LIGHTING CONTROL DESIGN

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- Occupants must have ready access
- Recommission equipment if necessary, even (especially) on new buildings





# THANK YOU!

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404-604-3598