



*Providing effective energy strategies for buildings and communities*

# Updates on New Illinois Energy Code (2018 IECC & ASHRAE 90.1-2016): Lighting & Electrical

1.25.2019



# Who we are

We assist buildings and communities in achieving energy efficiency, saving money, and becoming more sustainable.

We are an applied research program at University of Illinois, working in collaboration with 360 Energy Group.

**Our goal: Reduce the energy footprint of Illinois.**



# SEDAC is the Illinois Energy Conservation Code Training Provider

This training program  
is sponsored by  
Illinois EPA  
Office of Energy



# Energy Code Assistance

---

- Technical support
  - 800.214.7954
  - [energycode@sedac.org](mailto:energycode@sedac.org)
- Online resources at [sedac.org/energy-code](http://sedac.org/energy-code)
- Workshops
- Webinars
- Online on-demand training modules





## Energy Code Training

Illinois Energy Conservation Code

Workshops

Webinars

Online training

Resources

Frequently Asked Questions

Contact us

## Energy Code Training

### SEDAC is the Illinois Energy Conservation Code training provider

The Smart Energy Design Assistance Center (SEDAC), in partnership with the Illinois EPA Office of Energy, provides training to increase awareness of the Illinois Energy Conservation Code and to improve the energy efficiency of new construction and renovation in Illinois. Community code officials, construction professionals and trades, and design professionals such as architects and engineers are invited to participate. SEDAC offers [workshops](#), [webinars](#), [online training](#), [resources](#), and [technical support](#).



Funding provided in whole or in part by the Illinois EPA Office of Energy.

Smart Energy Design Assistance Center  
University of Illinois  
1 St Mary's Road | Champaign, IL 61820  
800.214.7954 | [info@sedac.org](mailto:info@sedac.org)

Department of  
LANDSCAPE ARCHITECTURE



CONTACT NEWSLETTER



# Access to 2018 IECC

<https://codes.iccsafe.org/public/document/iecc2018>

Search product titles  Experience the ICC premiumACCESS™ Demo ICC Home cdpACCESS Store premiumACCESS™ publicACCESS™

ICC INTERNATIONAL CODE COUNCIL Browse Category Year Help | Sign In

Home / I-Codes

## 2018 International Energy Conservation Code

Enable Premium Features

This title is available for premiumACCESS. Click to [purchase](#) a premium subscription to this content.

TABLE OF CONTENTS

### Table Of Contents

- LEGEND
- COPYRIGHT
- PREFACE
- EFFECTIVE USE OF THE INTERNATIONAL ENERGY CONSERVATION CODE
- IECC—COMMERCIAL PROVISIONS
- CHAPTER 1 [CE] SCOPE AND ADMINISTRATION



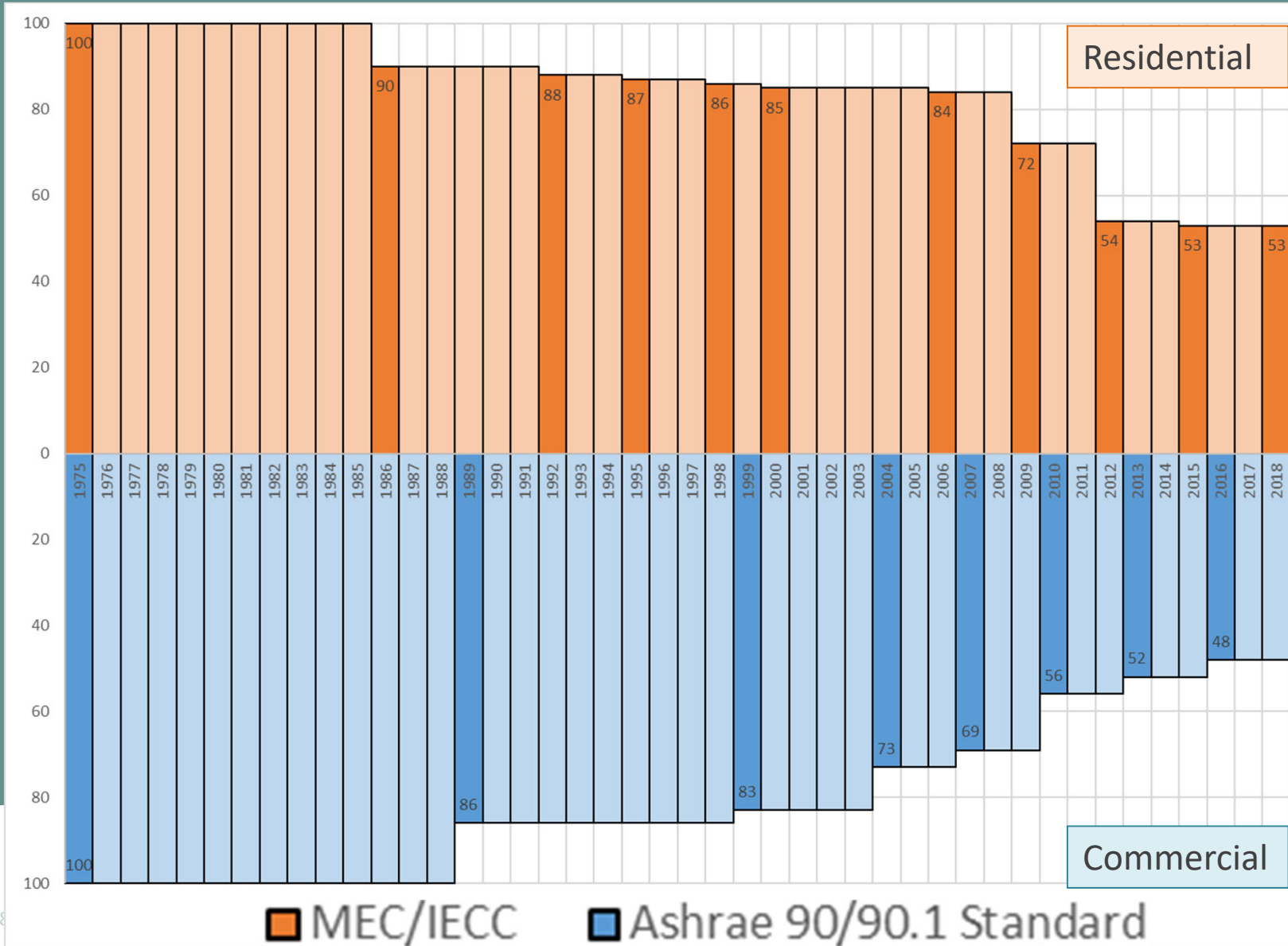
# Access to 90.1-2016

<https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards>

The screenshot displays the ASHRAE website interface. At the top left is the ASHRAE logo with the tagline "Shaping Tomorrow's Built Environment Today". A "Buy Now" button is located at the top right. Below the header is a navigation bar with icons for View, Search, Redact, and E-Sign, along with page navigation controls showing "1 of 388". The main content area features a large graphic with a blue-to-green gradient background and the word "STANDARD" in white. Below this, the text reads: "ANSI/ASHRAE/IES Standard 90.1-2016 (Supersedes ANSI/ASHRAE/IES Standard 90.1-2013) Includes ANSI/ASHRAE/IES addenda listed in Appendix H". The title "Energy Standard for Buildings Except Low-Rise Residential Buildings (I-P Edition)" is prominently displayed in large, bold, black font. At the bottom of the page, there is a small paragraph of text regarding approval dates and a paragraph about the continuous maintenance program by the Standing Standard Project Committee (SSPC).



# History of Model Codes Improvement



# 2018 IECC: Commercial or Residential?

## Residential:

- A detached one-family or two family dwelling
- Any building 3 stories or less above grade that contains multiple dwelling units, where occupants reside on a primarily permanent basis (4 stories or less in Chicago)
- Examples:
  - Townhouse
  - Row house
  - Apartment house
  - Convent
  - Monastery
  - Rectory
  - Fraternity or sorority house
  - Dormitory
  - Rooming house

**ASHRAE 90.1-2016.** low-rise residential buildings

Single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes) and modular houses



# 2018 IECC: Commercial or Residential?

---

- 5 story mixed use building with 2 stories of retail stores and 3 stories of apartments in Chicago
- 3 story mixed use building with 1 story of retail stores and 2 stories of apartments in Bloomington
- 5 story single family home
- 3 story hotel



# 2018 IECC C405 Lighting

- Major Highlights

- Reduced Lighting Power Allowances
- New Choice of Luminaire-Level Lighting Controls (LLLC)
- Broadened Mandatory Control Requirements
- Interior Automatic Lighting Shutoff
- Manual Override Switches
- Daylight-Responsive Interior Lighting Controls
- Special Applications
- Exterior Lighting Control
- Clarifications



# 2018 IECC Other **Commercial** Lighting related requirements

- Major Highlights

Additional Energy Efficiency Options:

- C406.3 Reduced Lighting Power: < 90%
- C406.4 Enhanced Digital Lighting Controls:
  - Luminaires configured for continuous dimming
  - Luminaires addressed individually or  $\leq 4$  luminaires
  - $\leq 8$  luminaires be controlled together in a daylight zone
  - Controlled through a digital control system
  - CD to include a Sequence of Operation
  - Functional testing to comply with C408



# 2018 IECC Other **Commercial** Lighting related requirements

- Major Highlights

- C408.3 Functional Testing of Lighting Controls

- Prior to passing final inspection, registered design professional shall provide evidence that lighting controls have been tested to ensure that control hardware & software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents & manufacturer's instruction.
    - Documentation Requirements: Construction documents shall specify that Drawings (location & catalogue # of each equipment), Manuals & Report are provided to the owner within 90 days of the receipt of Certificate of Occupancy



# 2018 IECC Other **Commercial** Lighting related requirements

---

- Major Highlights
  - Appendix CA Solar-Ready Zone



# 2018 IECC R404 Electrical & Lighting

- **R404.1 Lighting Equipment (Mandatory)**
  - Not less than **90%** of the permanently installed lighting fixtures shall contain only high-efficacy lamps\*
- **R404.1.1 Lighting Equipment (Mandatory)**
  - Fuel gas lighting systems shall not have continuous burning pilot lights.
- **\* High-Efficacy Lamps:**
  - 60 lm/W for lamps > 40W
  - 50 lm/W for lamps 15 – 40W
  - 40 lm/W for lamps ≤ 15W

**IL Amendments:**

**Fixtures ≥ 55 lm/W**

**Lamps ≥ 65 lm/W**

≥ 4 story above grade  
multifamily building

**ASHRAE 90.1-2016. 9.4.4. Dwelling units.** Not less than 75% shall use fixtures with ≥ 45 lm/W or lamps with ≥ 55 lm/W

Exception: lighting controlled with dimmers or automatic control



# 2018 IECC Other Residential Lighting related requirements

- R402.4.5 Recessed Lighting
  - Recessed luminaires installed in the thermal envelope shall be sealed. IC-rated.
  - Labeled as having an air leakage rate  $\leq 2.0$  cfm.
  - Sealed with a gasket or caulked between the housing & interior wall or ceiling covering



# 2018 IECC C405 Lighting

---

- **Mandatory Provisions**
  - C405.1 General
  - C405.2 Lighting Controls
  - C405.4 Exterior Lighting Power Requirements



**IECC 2018**  
**Section 405**  
**Lighting Systems**



# C405.1 General

## Dwelling Units within Multi-family Buildings

- R404.1

## All Other Dwelling Units

- R404.1
- or C405.2.4 & C405.3

## Sleeping Units

- C405.2.4 & R404.1
- or C405.2.4 & C405.3

R404.1:  
High-efficacy  
Lights

C405.2.4:  
Specific App  
Control

C405.3:  
Interior LP  
Requirements



# C405.2 Lighting Controls

## C405.2 Lighting Control (Choose one)

### Lighting Controls

C405.2.1

C405.2.2

C405.2.3

C405.2.4

C405.2.5

C405.2.6

### LLLC

C405.2.1

C405.2.4

C405.2.5

C405.2.1:  
Occupancy Control

C405.2.2:  
Time-switch Control

C405.2.3:  
Daylight Control

C405.2.4:  
Specific App Control

C405.2.5:  
Manual Control

C405.2.6:  
Exterior Lighting Control



Image courtesy of Cree



# C405.2 Lighting Controls

## C405.2 Lighting Control (Choose one)

### Lighting Controls

C405.2.1

C405.2.2

C405.2.3

C405.2.4

C405.2.5

C405.2.6

### LLLC

C405.2.1

C405.2.4

C405.2.5

LLLC shall independently capable of:

- Monitoring occupancy to brighten or dim lighting
- Monitoring electric & daylight to brighten or dim electric lights
- Configuration & reconfiguration of performance parameters (dim setpoints, timeouts, wireless zoning...)



# C405.2.1

## Occupant Sensor Controls



# C405.2.1 Occupant Sensor Controls

- **Required at**
  - Classrooms/lecture/training rooms
  - Conference/meeting/multipurpose rooms
  - Copy/print rooms
  - Lounges/breakrooms
  - Enclosed offices
  - Open plan office areas
  - Restrooms
  - Storage rooms
  - Locker rooms
  - Other spaces 300 sf or less that are enclosed by floor-to-ceiling height partitions
  - Warehouse storage areas



## C405.2.1.2 Occupant Sensor Cntrl Function in *Warehouse*

- Must reduce lighting power by at least 50% when unoccupied.
- Controls must cover aisles and open areas. Control for each aisleway shall be independent and shall not control beyond the aisleway.



Image from <http://luxreview.com>



## C405.2.1.2 Occupant Sensor Cntrl Function in *Open Plan Offices* ( $\geq 300$ sf)

- Zones limited to 600 sf
- Turn off general lights in all zones within 20 minutes of occupants leaving
- Must reduce lighting power by at least 80% in a reasonably uniform pattern within 20 minutes after no occupancy
- Daylight responsive controls may activate fixtures only if occupants present



## C405.2.1.2 Occupant Sensor Cntrl Function in *Other Areas*

- Auto-off within **20 minutes** of occupants leaving
- Manual on or can be auto-on if not more than **50%** power
  - Exception: Full auto-on permitted in *public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.*
- Shall incorporate manual control to allow occupants to turn lights off



Image from <https://lightingcontrolsassociation.org>



# C405.2.2

## Time-switch Controls



## C405.2.2 Time-switch Controls

- **Required at**
  - Areas without occupancy sensor controls
- **Exception:**
  - Areas with a manual control (C405.2.2.2) where
    - Patient care is directly provided
    - Automatic shutoff would endanger occupant safety or security
    - Lighting is intended for continuous operation
    - In shop and laboratory classrooms



# C405.2.2.1 Time-switch Cntrl Functions

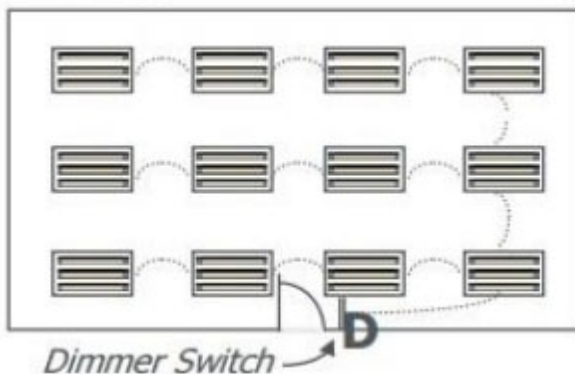
- Each space with time-switch controls shall be provided with a manual control for light reduction in accordance with C405.2.2.2.
- Time-switch controls shall comply with following:
  - Have a min. 7-day clock & capable of 7 daily schedule
  - Holiday shutoff (skip schedule for 24 hrs)
  - Program backup for at least 10 hrs if power is disrupted
  - Have override switch:
    - Shall be manual
    - Override for max. of 2 hrs
    - Individual override switch may not cover more than 5,000 sf



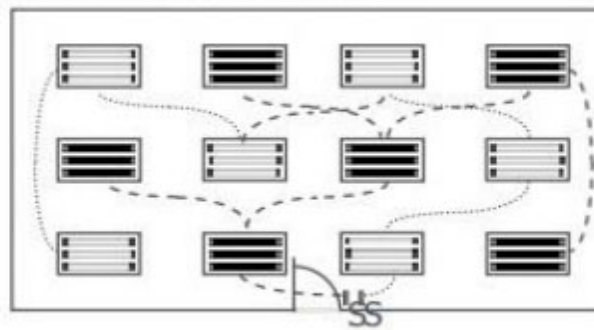
# C405.2.2.2 Light-reduction Controls

- **Manual Controls**
  - Allows occupants to reduce lighting by at least 50% in reasonably uniform pattern:
    - Control all lamps or luminaires
    - Dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps
    - Switching of middle lamp luminaires independent of the outer lamps
    - Switching each luminaire or each lamp

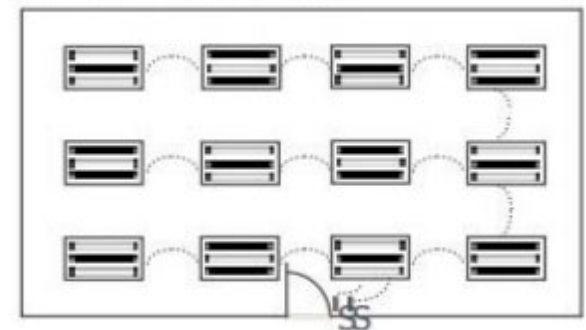
Dimming



Alternating Luminaires



Alternating Lamps



# **C405.2.3**

## **Daylight-responsive Controls**



# C405.2.3 Daylight Controls

- **Required in the following spaces:**
  - > 150 W of general lighting within sidelit zones
  - > 150 W of general lighting within toplit zones
- **Exceptions:**
  - Health care facilities where patient care is directly provided
  - Lighting required for specific application control per C405.2.4
  - Sidelit zones on 1st floor above grade in Group A-2 (assembly uses for food/drink) and Group M (mercantile) occupancies
  - New bldg with  $TCLP \leq LPA$  adj



## C405.2.3 Daylight Controls

- **TCLP (Total Connected Lighting Power)**  
**= LVL + BLL + LED + TRK + Other**

Where:

LVL = Rated W of luminaires (max. W installed) for line voltage lamps

BLL = Rated input W of ballast or transformers for luminaires incorporating ballasts or transformer

LED = Rated W of LEDs with drivers

TRK = one of the following for track systems:

W of luminaires but not less than 8 W per linear ft

W limit of other permanent current-limiting devices

W limit of the transformer

Other = W of all other not covered previously



## C405.2.3 Daylight Controls

- **LPA adj (Adjusted Interior Lighting Power Allowance)**  
**= LPA norm x (1.0 – 0.4 x UDZFA / TBFA)**

Where:

LPA norm = Normal Interior Lighting Power Allowance (C405.3.2)

UDZFA = Uncontrolled Daylight Zone Floor Area

TBFA = Total Building Floor Area included in the LPA calc



# C405.2.3 Daylight Controls

- LPA adj Exception
  - 40% less than the normal power allowance for daylit areas

## Example Office 1:

200,000 sf total area

100,000 sf daylit zones

LPD: 0.79 W/sf

LPA: 158,000 W

LPA adj

= 158,000 W x (1.0 –  
0.4x100,000/200,000)

= 158,000 W x 0.8

= 126,400 W (20% less)

## Example Office 2:

200,000 sf total area

50,000 sf daylit zones

LPD: 0.79 W/sf

LPA: 158,000 W

LPA adj

= 158,000 W x (1.0 –  
0.4x50,000/200,000)

= 158,000 W x 0.9

= 142,200 W (10% less)



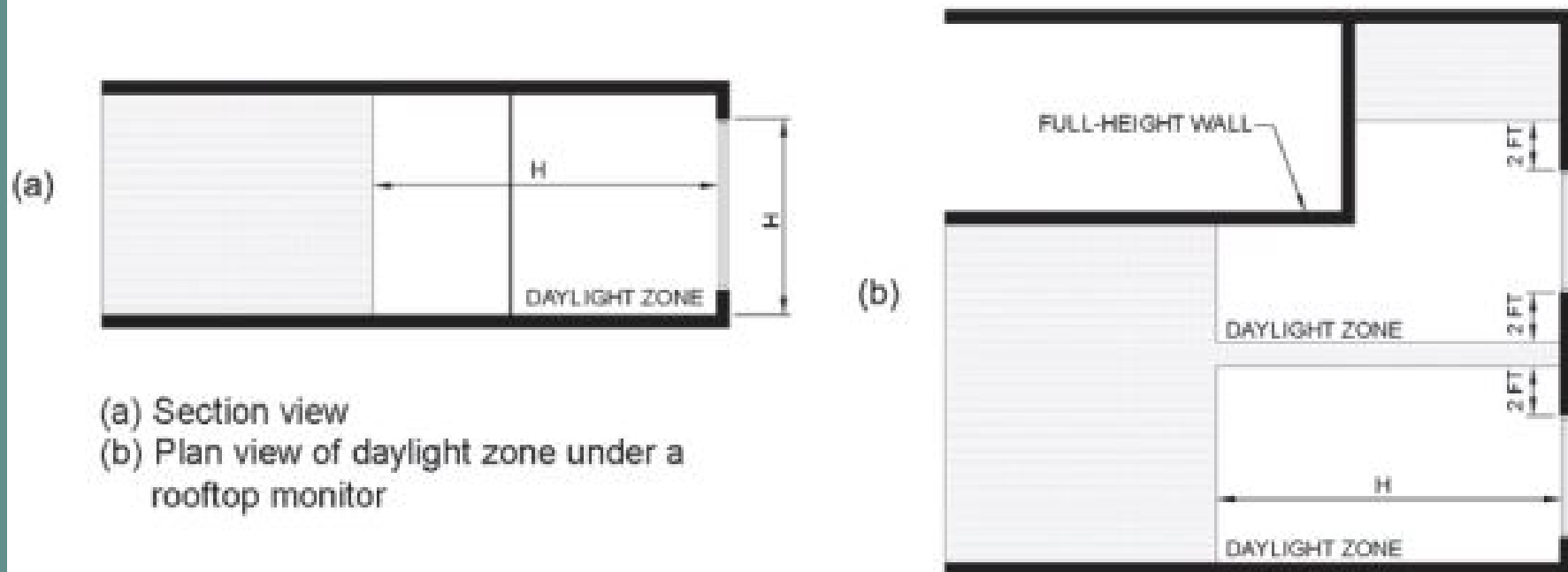
## C405.2.3.1 Daylight Control Functions

- Toplit zones to be controlled independently of sidelit zones
- Be configured to be calibrated from within the space
- Calibration mechanism to be in a location with ready access
- Dim continuously from full to  $\leq 15\%$  in offices, classrooms, labs & library reading rooms
- Configured to completely shut off all lights
- Sidelit zones facing different cardinal orientations to be controlled independently
  - Exception:  $< 150$  W in each space can be controlled together



## C405.2.3.2 Sidelit Zones

- Floor area adjacent to vertical fenestration
- Area of fenestration  $\geq 24$  sf
- Visible Transmittance  $\geq 0.20$

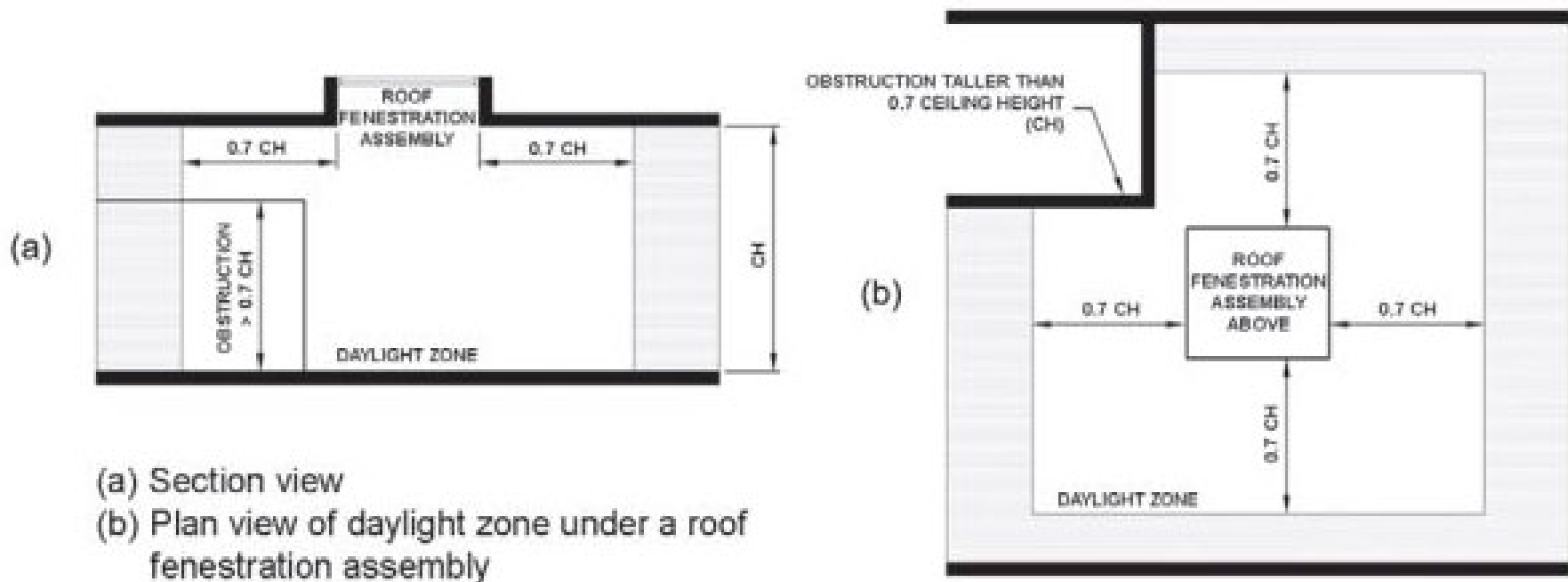


**FIGURE C405.2.3.2**  
**SIDELIT ZONE**



## C405.2.3.3 Toplit Zones

- Floor area underneath a roof fenestration
- No buildings block direct sunlight hitting the fenestration at the peak solar angle
- $(VT \times \text{area of roof opening}) / \text{toplit zone area} \geq 0.008$



**FIGURE C405.2.3.3(1)**  
**TOPLIT ZONE**

# **C405.2.4**

## **Specific Application Controls**



## C405.2.4 Specific App Controls

- **(Occupancy sensor or Time-switch) + Manual control required in:**
  - Display and Accent area
  - Lighting in display cases
  - Supplemental task lighting
  - Lighting equipment for sale or demonstration
- **Sleeping Units**
  - Automatically switch off all permanently installed luminaires & switched receptacles within 20 min. after no occupancy  
Exception: Keycard controlled switches & receptacles  
Patient care space



Image courtesy of Wattstopper



# C405.2.4 Specific App Controls

- **Dwelling Units:**
  - Occupant sensor control (C405.2.1) or light-reduction controls (C405.2.2.2)
- **Lighting for Nonvisual Application (Plant, Food Warming)**
  - Time-switch control (C405.2.2.1) independent of other lighting within the space



Image courtesy of DOE



Image courtesy of Quora



# C405.2.5

## Manual Controls



# C405.2.5 Manual Controls

- Occupants must have ready access
- Located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status



Image courtesy of <https://nwlighingnetwork.com>



# **C405.2.6**

## **Exterior Lighting Controls**



# C405.2.6 Exterior Lighting Controls

## C405.2.6 Exterior Lighting Control

### Façade & Landscape Lighting

#### Exterior Lighting

C405.2.6.1

C405.2.6.3

C405.2.6.4

#### Decorative Lighting

C405.2.6.1

C405.2.6.2

C405.2.6.4

C405.2.6.1:  
Daylight Shutoff

C405.2.6.2:  
Decorative Lighting Shutoff

C405.2.6.3:  
Lighting Setback

C405.2.6.4:  
Time-switch Function



# C405.2.6 Exterior Lighting Controls

- **Daylight Shutoff**
- **Decorative Lighting Shutoff**
  - Building façade and landscape lighting shall automatically shutoff  $\leq 1$  hr after business closing to  $\leq 1$  hr before opening
- **Lighting Setback**
  - Total wattage reduced by  $\geq 30\%$  by switching or dimming during one of the following:
    - From not later than midnight to not earlier than 6 am
    - From  $\leq 1$  hour after business closing to  $\leq 1$  hour before opening
    - During any time where activity has not been detected for  $\geq 15$  min
- **Time-switch Control**
  - Same as interior time-switch



# C405.3

## Interior Lighting



# C405.3 Interior Lighting

- **Methods for determining power allowance (choose one)**
  - Building area method
  - Space by space method w/ additional allowances for special use lighting
  
- **2014 NEC 220.12 Exception Requirements**
  - Power monitoring system for total general lighting load of building
  - Power monitoring system alarms if load exceeds values in energy code
  - Demand factors specified in 220.42 not applied to general lighting load



# C405.3 Interior Lighting

- **The following are excluded from interior load calculation**
  - TV broadcast lighting
  - Emergency lighting that is off during normal operation
  - Exit signs
  - Lighting for occupants with special needs such as visual impairment
  - Casino gaming areas
  - Mirror lighting in dressing rooms
  - Task lighting for medical or dental purposes
  - Display lighting for galleries, museums, and monuments
  - Lighting for theatrical purposes
  - Lighting for photographic processes
  - Lighting integral to equipment installed by manufacturer
  - Task lighting for plant growth
  - Food Warming
  - Lighting equipment for sale
  - Advertising or directional signage



# C405.3 Interior Lighting

- **Building Area Method**
  - Floor area for each building type listed in Table C405.3.2(1) times the value in that table for that area
  - Area: All contiguous spaces that accommodate or are associated with a single building area type
  - Where used, each building area type shall be treated as a separate area



# C405.3 Interior Lighting

| Type of Occupancy           | 2015 IECC Table C405.3.2(1)<br>(W/SF) | 2018 IECC Table<br>C405.3.2(1) (W/SF) |
|-----------------------------|---------------------------------------|---------------------------------------|
| Automotive facility         | 0.80                                  | 0.71                                  |
| Convention Center           | 1.01                                  | 0.76                                  |
| Courthouse                  | 1.01                                  | 0.90                                  |
| Dining: Bar lounge/leisure  | 1.01                                  | 0.90                                  |
| Dining: cafeteria/fast food | 0.90                                  | 0.79                                  |
| Dining: family              | 0.95                                  | 0.78                                  |
| Dormitory                   | 0.57                                  | <b>0.61</b>                           |
| Performing Arts Center      | 1.39                                  | <b>1.18</b>                           |



# C405.3 Interior Lighting

| Type of Occupancy | 2015 IECC (W/SF) | 2018 IECC (W/SF) |
|-------------------|------------------|------------------|
| Library           | 1.19             | 0.78             |

- **Example Library: 200,000 SF**
  - What would be the 2015 limit?
  - What would be the 2018 limit?
  - What is the difference?
  - (238,000-156,000)
- How many amps would the 2018 lighting consume using 277V lighting? (82,000W)



# C405.3 Interior Lighting

| Type of Occupancy | 2015 IECC (W/SF) | 2018 IECC (W/SF) |
|-------------------|------------------|------------------|
| Library           | 1.19             | 0.78             |

- **Example Library: 200,000 SF**
  - Given the difference of 82,000W, how many tons of air conditioning is this?
  - (3.412 BTUh/W & 12,000 BTUh/ton)
  - $82,000 * 3.412 / 12,000$



# C405.3 Interior Lighting

- **Space-by-Space Method**
  - Floor area for each space type listed in Table C405.3.2(2) times the value in that table for that space
  - Tradeoffs between spaces are allowed
  - Additional allowance provided for specific lighting functions if using automatically controlled separate from the general lighting and only for the purpose specified. Additional allowances can not be traded



# C405.3 Interior Lighting

| Type of Occupancy                         | 2018 IECC Table<br>C405.3.2(2) (W/SF) | 2015 IECC Table<br>C405.3.2(2) (W/SF) |
|---|---------------------------------------|---------------------------------------|
| Healthcare facility-exam room             | <b>1.68</b>                           | 1.66                                  |
| Healthcare facility-imaging room          | 1.06                                  | 1.51                                  |
| Healthcare facility-medical supply room   | 0.54                                  | 0.74                                  |
| Healthcare facility-nursery               | <b>1.00</b>                           | 0.88                                  |
| Healthcare facility-nurse's station       | <b>0.81</b>                           | 0.71                                  |
| Healthcare facility-operating room        | 2.17                                  | 2.48                                  |
| Healthcare facility-patient room          | 0.62                                  | 0.62                                  |
| Healthcare facility-physical therapy room | 0.84                                  | 0.91                                  |



# C405.3 Interior Lighting

| Additional Allowance for sales area                             | 2018 IECC Table C405.3.2(2) (W/SF) |
|---|------------------------------------|
| Base Allowance  | 1000 watts                         |
| Vehicles, sporting goods, small electronics                     | 0.45                               |
| Furniture, clothing, cosmetics, artwork                         | 1.05                               |
| Jewelry, crystal, china   | 1.87                               |
| Other   | 0.45                               |
| Allowances based on square foot of sales area for each category |                                    |



# C405.3 Determining Connected Load

- Maximum fixture wattage label
- Ballast input wattage
- Transformer input wattage
- Track lighting
  - IECC: 8W/ft (previously 30 W/ft)
  - AHRAE 90.1: 30 W/ft
  - NEC: 150W/2ft



# C405.4

## Exterior Lighting



# C405.4 Exterior Lighting

- **The following are excluded from exterior load calculation**
  - Lighting approved because of safety considerations
  - Emergency lighting that is off during normal operation
  - Exit signs
  - Specialized signal, directional, and marker associated with transportation
  - Advertising and directional signage
  - Integral to equipment and installed by manufacturer
  - Theatrical purpose lighting
  - Athletic playing areas
  - Temporary lighting
  - Industrial production, material handling, transportation sites, and associated storage areas
  - Theme elements in theme/amusement parks
  - Used to highlight features of art, monuments, and national flag
  - Lighting for water features and swimming pools
  - Lighting controlled within dwelling units complying with R404.1



# C405.4 Exterior Lighting

- **Exterior Power Allowance**
  - Sum of the base plus the individual areas that are to be illuminated as specified in Table C405.4.2(2) using the zones found in Table C405.4.2(1)

| Zone | 2018 IECC Table C405.4.2(1) Description   |
|------|---|
| 1    | National & State Parks, forest land, rural areas  |
| 2    | Predominantly residential zoning, neighborhood business district, light industrial with limited night-time use, residential mixed use areas |
| 3    | All Other areas   |
| 4    | High activity commercial in major metropolitan areas designated by the local land use planning authority                                    |



# C405.4 Exterior Lighting

| Exterior Allowance | Zone 1 | Zone 2 | Zone 3 | Zone 4    |
|--------------------|--------|--------|--------|-----------|
| Base Allowance     | 350    | 400    | 500    | 900 W     |
| Parking/drives     | 0.03   | 0.04   | 0.06   | 0.08 W/SF |
| Walkways <10' wide | 0.5    | 0.5    | 0.6    | 0.7 W/LF  |
| Walkways, other    | 0.1    | 0.1    | 0.11   | 0.14 W/SF |
| Landscaping        | 0.03   | 0.04   | 0.04   | 0.04 W/SF |
| Entry canopies     | 0.2    | 0.25   | 0.4    | 0.4 W/SF  |
| Loading docks      | 0.35   | 0.35   | 0.35   | 0.35 W/SF |
| Open sales lots    | 0.2    | 0.2    | 0.35   | 0.5 W/SF  |



# C405.4 Exterior Lighting

| Exterior Allowance | Zone 1 | Zone 2 | Zone 3 | Zone 4    |
|--------------------|--------|--------|--------|-----------|
| Base Allowance     | 350    | 400    | 500    | 900 W     |
| Parking/drives     | 0.03   | 0.04   | 0.06   | 0.08 W/SF |
| Walkways <10' wide | 0.5    | 0.5    | 0.6    | 0.7 W/LF  |
| Walkways, other    | 0.1    | 0.1    | 0.11   | 0.14 W/SF |
| Landscaping        | 0.03   | 0.04   | 0.04   | 0.04 W/SF |
| Entry canopies     | 0.2    | 0.25   | 0.4    | 0.4 W/SF  |
| Loading docks      | 0.35   | 0.35   | 0.35   | 0.35 W/SF |
| Open sales lots    | 0.2    | 0.2    | 0.35   | 0.5 W/SF  |



# C405.4 Exterior Lighting

| Exterior Allowance                     | Zone 1                                    | Zone 2 | Zone 3 | Zone 4    |
|--|---|--------|--------|-----------|
| Building Façade                        | 0   | 0.075  | 0.113  | 0.15 W/SF |
| ATM and night depository               | 135W per site plus 45W per additional ATM |        |        |           |
| Inspection station at guarded facility | 0.5 W/SF of area                          |        |        |           |
| Drive-up window                        | 200W per drive through                    |        |        |           |
| Parking near 24-hr retail entrance     | 400W per main entry                       |        |        |           |



# C405.4 Exterior Lighting

| Exterior Allowance       | Zone 3                                    |
|--------------------------|---|
| ATM and night depository | 135W per site plus 45W per additional ATM |
| Drive-up window          | 200W per drive through                    |



# C405.5-9 Equipment



# C405.5 Dwelling Metering

- **Each dwelling unit located in a Group R-2 building shall have a separate electrical meter**
  - Group R-2: Residential occupancies containing sleeping units of more than two dwelling units where the occupants are primarily permanent in nature including:
    - Apartments
    - Congregate living facilities with more than 16 occupants
      - Boarding houses (nontransient), Convents, Dormitories, Fraternities and sororities, monasteries
    - Hotels (nontransient)
    - Live/work units
    - Motels (nontransient)
    - Vacation timeshare properties



# C405.6 Transformers

- **Requirements**
  - Low-voltage dry-type transformers shall meet the minimum efficiency requirements of Table C405.6 (DOE 2016)
  - Efficiency shall be verified through a certification program or shall be supported by data from the transformer manufacturer
    - Exemptions:
      - Exempt by EPACT
      - Drive or Rectifier transformers
      - Auto-transformers
      - UPS transformers
      - Impedance or Regulating transformers
      - Sealed and non-ventilating transformers
      - Welding transformers
      - Grounding or Testing transformers



# C405.6 Transformers

- **Example**

- 500 kva Low-voltage dry-type transformer
- TP-1 (2007) Efficiency: 98.7% (1.3% loss)
- DOE 2016 Efficiency: 99.14% (0.86% loss)
  
- What was the previous maximum loss?
- 6,500W
- What is the new maximum loss?
- 4,300W
- How many kWh would be saved over a 30 year life?
- 578,160kWh
- What would the loss be if the efficiency was 99.24%? (0.76% loss)
- 3,800W



# C405.7 Electric Motors

- **Requirements**
  - Electric motors shall meet the minimum efficiency requirements of Tables C405.7(1) through C 405.7(4) (NEMA Premium)
  - Efficiency shall be verified through a certification program or shall be supported by data from the motor manufacturer
    - Exemptions:
      - Air-over electric motors
      - Component sets of an electric motor
      - Liquid-cooled electric motors
      - Submersible electric motors
      - Inverter-only electric motors



# C405.8 Transportation

---

- **Elevator Requirements**
  - Luminaires in elevator cab, not including signals and displays total efficiency must be at least 35 lm/W
  - Ventilation fans in elevators that do not have their own air conditioning shall not consume more than 0.33 watts/cfm at maximum rated speed
  - Controls shall de-energize lighting and ventilation fans when the elevator is stopped, unoccupied, and with its doors closed for over 15 minutes



# C405.8 Transportation

- **Escalator and moving walks Requirements**
  - Shall comply with ASME A17.1/CSA B44 and have automatic controls configured to reduce speed to the minimum permitted speed in accordance with above or applicable local code when not conveying passengers
    - Exception: Variable Voltage Drive that reduces voltage rather than speed
  - Escalators designed for one-way down operation or reversible operation shall have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when the escalator is loaded with passengers whose combined weight exceeds 750 pounds



# C405.9 Voltage Drop

- Total voltage drop across the combination of feeders and branch circuits shall not exceed 5%
- Matches fine print notes in 210.19(A) and 215.2(A) in the NEC

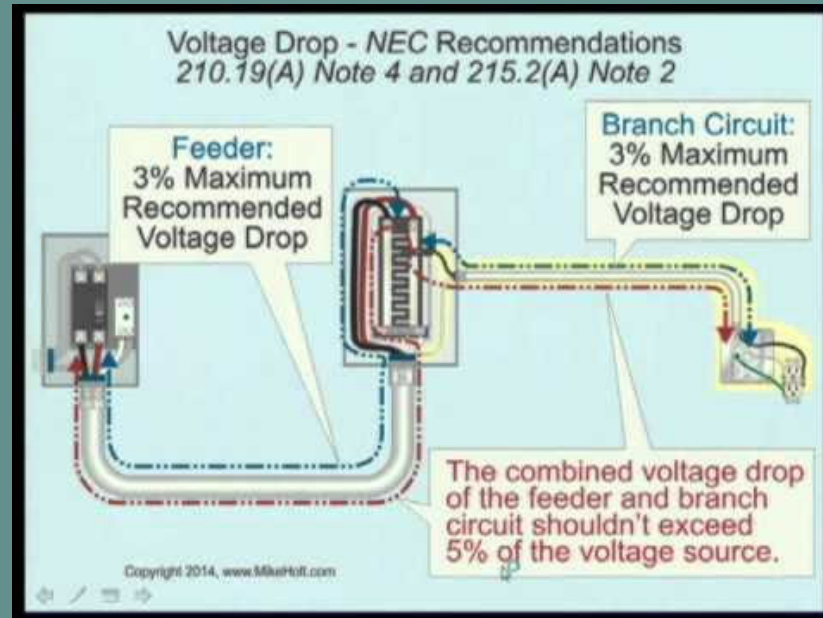


Image courtesy of Mike Holt Enterprises



# ASHRAE 90.1 - 2016



# ASHRAE 90.1

---

- New climate zone map (6 counties in Illinois – Calhoun, Clark, Coles, Cumberland, Greene, Jersey: from 5A to 4A)
- New performance-based compliance path (Appendix G)
- Not commonly used due to some additional requirements
  - 8.4.2 Automatic Receptacle Control
  - 8.4.3 Electrical Energy Monitoring
- Generally used if client requests it or for semi-heated spaces as IECC does not have this category (only conditioned or low-energy building)



## 8.4.2 Automatic Receptacle Control

- At least 50% of all 125V 15, and 20 amp receptacles and at least 25% of branch circuit feeders for modular furniture
  - Private offices, conference rooms, printing/copy rooms, break rooms, classrooms, and individual workstations
- Controlled by:
  - Scheduled control (zones of 1 floor or 5,000 SF, whichever is less)
  - Occupancy sensor
  - Automated control system
- Must be permanently marked to differentiate controlled and non-controlled and distributed uniformly



## 8.4.2 Automatic Receptacle Control



Image courtesy of Leviton



## 8.4.3 Electrical Energy Monitoring

- Each of the following must be monitored separately:
  - Total electrical energy
  - HVAC systems
  - Interior lighting
  - Exterior lighting
  - Receptacle circuits
- Individual tenant spaces separately monitored and made available to each tenant
- Recorded every 15 minutes for at least 36 months



## 9.4.1.2 Parking Garage Lighting Control

- Automatic scheduled shutoff
- Lighting power of each luminaire shall be automatically reduced by min. of 30% when no activity within a lighting zone ( $\leq 3,600$  sf) for 20 minutes.
- (new!) Lighting for **covered vehicle entrances & exits** from bldgs and parking structures shall be **separately controlled** by automatic control to reduces lighting by at least 50% from sunset to sunrise
- (new!) Power to luminaires within 20ft of any perimeter wall that has opening-to-wall ratio  $\geq 40\%$  and no exterior obstruction within 20ft, shall be automatically reduced by at least 50% in response to **daylight**



# Appendix G Lighting Baseline

- Interior lighting power in the baseline shall be determined using the values in Table G3.7.

**Table G3.7 Performance Rating Method Lighting Power Density Allowances and Occupancy Sensor Reductions Using the Space-by-Space Method**

| Common Space Types <sup>a</sup> | Lighting Power Density, W/ft <sup>2</sup> | Occupancy Sensor Reduction <sup>b</sup> |
|---------------------------------|---|---|
| <b>Audience Seating Area</b>    |   |   |
| Auditorium                      | 0.90                                      | 10%                                     |
| Convention center               | 0.70                                      | 10%                                     |
| Exercise center                 | 0.30                                      | 10%                                     |
| Gymnasium                       | 0.40                                      | 10%                                     |
| Motion picture theater          | 1.20                                      | 10%                                     |
| Penitentiary                    | 0.70                                      | 10%                                     |
| Performing arts theater         | 2.60                                      | 10%                                     |
| Religious facility              | 1.70                                      | 10%                                     |
| In a sports arena               | 0.40                                      | 10%                                     |

- Automatic shutoff controls for buildings >5,000 sf
- Occupancy sensors in employee lunch/break rooms, conference/meeting rooms, classrooms



# Appendix G Lighting Baseline

- Exterior lighting in areas identified as “tradable surfaces” in Table G3.6 shall be modeled with the baseline lighting power in Table G3.6. Other exterior lighting shall be modeled the same as in the proposed design

**Table G3.6 Lighting Power Densities for Building Exteriors**

|   |   |                                |
|---|---|--------------------------------|
| <b>Tradable Surfaces</b><br>(Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.) | <b>Uncovered Parking Areas</b>                      |                                |
|   | Parking lots and drives                             | 0.15 W/ft <sup>2</sup>         |
|   | <b>Building Grounds</b>                             |                                |
|   | Walkways less than 10 ft wide                       | 1.0 W/linear foot              |
|   | Walkways 10 ft wide or greater                      | 0.2 W/ft <sup>2</sup>          |
|   | Plaza areas   |                                |
|   | Special feature areas                               |                                |
|   | Stairways   | 1.0 W/ft <sup>2</sup>          |
|   | <b>Building Entrances and Exits</b>                 |                                |
|   | Main entries  | 30 W/linear foot of door width |
|   | Other doors   | 20 W/linear foot of door width |
|   | <b>Canopies and Overhangs</b>                       |                                |
|   | Canopies (free standing and attached and overhangs) | 1.25 W/ft <sup>2</sup>         |
|   | <b>Outdoor Sales</b>                                |                                |
|   | Open areas (including vehicle sales lots)           |                                |



**Questions?**

**[energycode@sedac.org](mailto:energycode@sedac.org)**

**800-214-7954**

