

IECC Commercial Lighting for Code Compliance with 2018 Updates





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Funding for Energy Code Training









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2018 UPDATES Added to Slides in RED TEXT

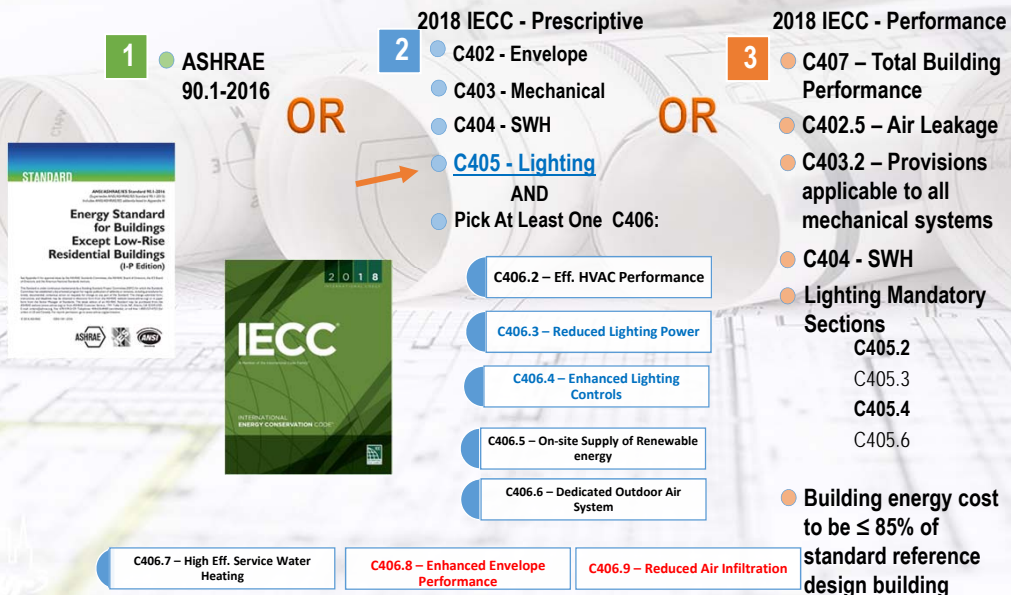
- House Bill 218 passed both the House and Senate – awaits the Governor's Signature
- Adopts the 2018 IECC Commercial Provisions
- 2015 IECC Residential Provisions remain with several new modifications
- Other 2018 I-Codes adopted
- Effective Date: July 1, 2019



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Commercial Compliance Options



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When do the Lighting and Power Requirements Apply?

- ✓ Original Installed Lighting System in a New Building, Addition, or Tenant Build-out
- ✓ Existing Lighting System that is Altered
- ✓ Change in Occupancy that Increases Energy
- ✓ Change in Occupancy that requires less LPD as shown in the LPD tables

Exceptions:



- Historic buildings
 - State or National listing
 - Eligible to be listed
- Alterations where less than 10% of the luminaires in a space are replaced and installed interior power lighting is not increased
- Lighting within dwelling units
 - Where $\geq 75\%$ of permanently installed fixtures (except low-voltage) are fitted for and include high-efficacy lamps
- Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, and refrigerated warehouse freezers comply with C403.2.15 or C403.2.16

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What's Covered Under Electrical Power and Lighting Systems Requirements?

- Mandatory Interior Lighting requirements
 - Required Controls
 - Wattage/Efficiency Limits
- Interior Lighting Power Allowances (watts/ft²)
 - LPD – Lighting Power Density
- Exterior Lighting Controls
 - Required Controls
 - Lamp Efficiency
- Exterior Lighting Power Allowances (watts/ft²)
- Electric Metering
- Electrical Transformers and Motors
- Vertical and Horizontal Transportation Systems and Equipment



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What's Covered Under Electrical Power and Lighting Systems Requirements?



Exception:

- Dwelling units within commercial building are not required to comply IF they comply with the residential Section R404.1

A minimum of 75 percent of the lamps in permanently installed lighting fixtures are high-efficacy lamps or 75% of permanently installed lighting fixtures contain only high efficacy lamps

Exception:

- ✓ Low-voltage lighting

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High-Efficacy Lamps - Definition

- ✓ Compact fluorescent lamps, **LED lamps**, T-8 or smaller diameter linear fluorescent lamps, or **other** lamps with a minimum efficacy based on lamp wattage


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

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Interior Lighting Power Allowance Section C405.3.2

Two methods to determine allowance:

- ✓ **Building Area Method**
 - Floor area for each building area type x value for the area
 - “area” defined as all contiguous spaces that accommodate or are associated with a single building area type as per the table
 - When used for an entire building, each building area type to be treated as a separate area
- ✓ **Space-by-Space Method**
 - Floor area of each space x value for the area
 - Then sum the allowances for all the spaces
 - Tradeoffs among spaces are allowed



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Building Area Method

2015 LPDs — 2018 LPDs

Table C405.4.2(1) (partial table)

Building Area Type	LPD (w/ft ²)
Automotive facility	0.8 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	0.9 0.79
Dining: family	0.95 0.78
Dormitory	0.57 0.61
Exercise center	0.84 0.65
Fire station	0.67 0.53
Gymnasium	0.94 0.68

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Space-By-Space Method **2015 LPDs** **2018 LPDs**
Table C405.3.2(2)

Common Space Types	LPD (w/ft ²)	
Locker room	0.75	0.48
Lounge/breakroom		
In a healthcare facility	0.92	0.78
Otherwise	0.73	0.62
Office		
Enclosed	1.11	0.93
Open plan	0.98	0.81
Parking area, interior	0.19	0.14
Pharmacy area	1.68	1.34

(partial table)

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Additional Interior Lighting Power **2015** **2018**
Section C405.3.2.2.1



Additional Interior Lighting Power Allowance =
500 ~~1000~~ watts +
 (Retail Area 1 x ~~0.6~~ **0.45** W/ft²) +
 (Retail Area 2 x ~~0.6~~ **0.45** W/ft²) +
 (Retail Area 3 x ~~1.4~~ **1.05** W/ft²) +
 (Retail Area 4 x ~~2.5~~ **1.87** W/ft²),

Where:

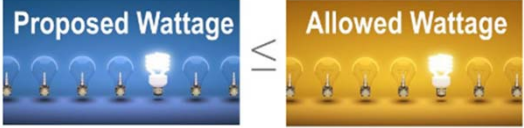
- ✓ **Retail Area 1** = the floor area for all products not listed in Retail Area 2, 3 or 4.
- ✓ **Retail Area 2** = the floor area used for the sale of vehicles, sporting goods and small electronics.
- ✓ **Retail Area 3** = the floor area used for the sale of furniture, clothing, cosmetics and artwork.
- ✓ **Retail Area 4** = the floor area used for the sale of jewelry, crystal, and china.

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Proposed Connected Lighting Calculation - Section C405.3.1

Proposed lighting wattage must be calculated in accordance with **Equation 4-10**

- **TCLP = [LVL + BLL + LED + TRK + OTHER]**
(Fixture wattage, not just bulb/luminaire)
- TCLP = total connected lighting power (watts)
- LVL = labeled wattage of luminaires connected directly to building power
- BLL = wattage of the ballast or transformer
- LED = wattage of LEDs with either integral or remote drivers
- TRK = wattage of lighting tracks, cable conductors, rail conductors, and plug-in busways specified wattage of the luminaires but not less than 8W per linear foot OR the wattage limit of other permanent current-limiting devices on the system OR wattage limit of the transformer
- OTHER = the wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other approved sources



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Lighting Controls Section C405.2 - Mandatory

Lighting systems required to be provided with controls as specified for:

- Occupant sensor controls – C405.2.1
- Time-switch controls – C405.2.2
- Daylight-responsive controls – C405.2.3
- Specific application controls – C405.2.
- **Manual Controls – C405.2.5**
- Exterior lighting controls – C405.2.6

Exemptions:

- Security or emergency areas that must be continuously lighted
- Interior exit stairways, interior exit ramps and exit passageways
- Emergency egress lighting normally off



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Occupant Sensor Controls

Sections C405.2.1, C405.2.1.1

Occupancy sensors are required in:

- ✓ Classrooms/lecture/training rooms
- ✓ Conference/meeting/multipurpose rooms
- ✓ Lounges/breakrooms
- ✓ Enclosed Offices
- ✓ Open plan Office areas
- ✓ Private offices
- ✓ Restrooms
- ✓ Storage rooms
- ✓ Janitorial closets
- ✓ Locker rooms
- ✓ Other spaces < 300 ft² enclosed by floor-to-ceiling height partitions
- ✓ Warehouses storage areas

Occupancy sensor function (other than for warehouses):

- ✓ Automatically turn lights off within ~~30~~ 20 minutes of after occupants have left space
- ✓ Either manual-on or controlled to automatically turn lighting on to not more than 50% power
- ✓ Incorporate a manual control to allow occupants to turn off the lights



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Occupant Sensor Controls - C405.2.1.1 Exemptions

Exemptions:

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



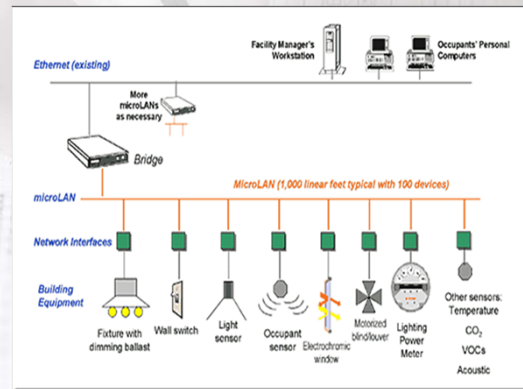
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Occupant Sensor Controls

Section C405.2.1.3 – Open Plan Office Areas

- Spaces less than 300 ft² to comply with C405.2.1.1
- All other spaces to comply with:
 - General lighting controlled separately in zones with floor areas not greater than 600 ft²
 - Automatically turn off general lighting in all control zones within 20 minutes after occupants have left
 - General lighting power in each control zone reduced by not less than 80% of full zone general lighting power, in reasonable uniform illumination pattern within 20 minutes of all occupants leaving
 - Control functions that switch control zone lights completely off when zone is vacant meet this requirement
- Any daylight responsive control to active general lighting or control zone general lighting only when occupancy for the same area is detected



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Time-switch Controls

Section C405.2.2

Each area of the building that is NOT provided with occupant sensor control must have a time-switch control to turn lights off automatically.

Exceptions where a manual control can provide the light reduction and **time-switch** control is not required:

- Spaces where patient care is directly provided
- Spaces where an automatic shutoff would endanger occupant safety or security
- Lighting intended for continuous operation
- Shop and laboratory classrooms



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Light-reduction Controls Section C405.2.2.2

Light Reduction Controls must allow the occupant to reduce connected lighting load

- ✓ By **not less than** 50%
- ✓ In a reasonably uniform illumination pattern



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Light-reduction Controls Section C405.2.2.2 - Exemption

Light Reduction Control **Not** required in *daylight* zones
with *daylight* responsive controls complying with C405.2.3

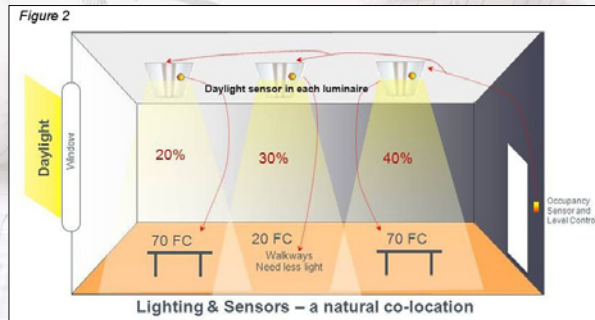


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Daylight-responsive Controls Section C405.2.3

- Definition: A device or system that provides automatic control of electric light levels based on the amount of daylight in a space
- Required to control lighting in spaces with ≤ 150 watts of general lighting:
 - ~~Sidelight~~ **Sidelit** daylight zones
 - ~~Toplight~~ **Toplit** daylight zones
- **Exceptions:**
 - Health care facilities where patient care is directly provided
 - Dwelling units and sleeping units
 - Lighting required for specific application control per C405.2.4
 - **Sidelit** daylight zones on 1st floor above grade in Group A-2 and Group M occupancies

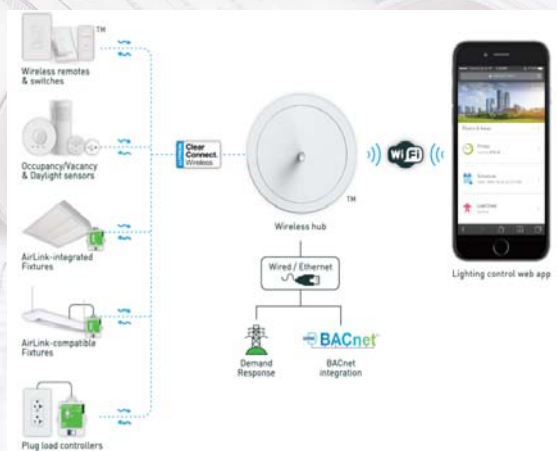


A-2: Restaurant, banquet hall, casino, bar, club
M: Mercantile

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Daylight-responsive Control Functions - Section C405.2.3.1

- **Toplit** zones shall be controlled independently of lights in **sidelit** zones
- Controls shall be configured so that they can be calibrated from within the space by authorized personnel
- Calibration mechanisms shall be **in a location with ready access**
- In offices, classrooms, laboratories, and library reading rooms, controls shall dim lights continuously from full light output to $\leq 15\%$

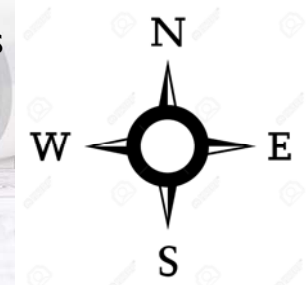


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Daylight-responsive Controls - Section C405.2.3 – Cont'd.

- **Configured to completely** shut off all controlled lights
- **Sidelit** zones facing different cardinal orientations (within 45 degrees of due north, east, south, west) controlled independently of each other



Exception:

- < 150 watts in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation

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Sidelit Zone - Section C405.2.3.2 - Diagram next slide

Definition: floor area adjacent to vertical fenestration **which that** complies with all of the following:

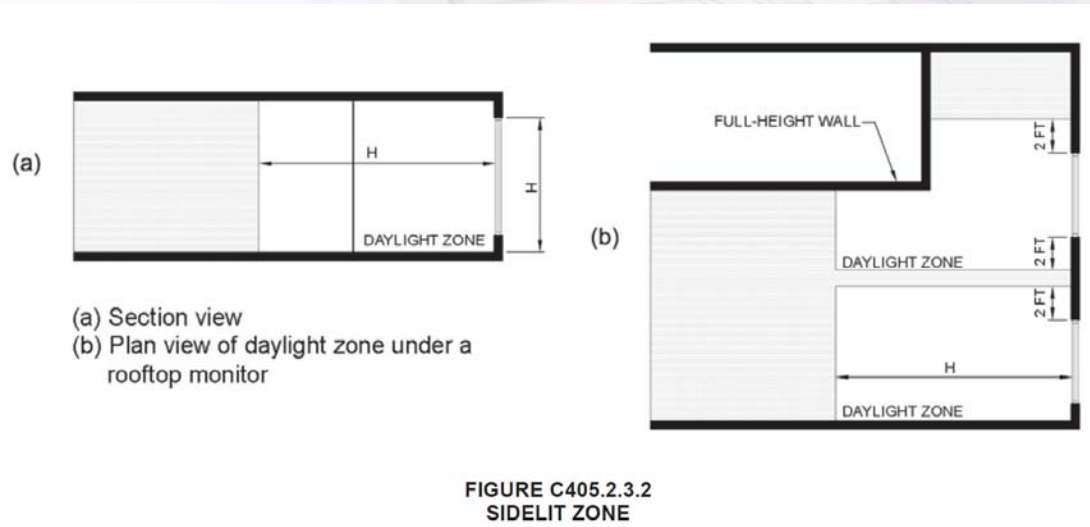
- Fenestration located in a wall:
 - **Sidelit** zone shall extend laterally to the nearest full-height wall OR
 - < 1.0 x height from the floor to the top of the fenestration, and longitudinally from the edge of the fenestration to the nearest full-height wall, or up to 2 ft., whichever is less
- Area of fenestration $\geq 24 \text{ ft}^2$
- Distance from fenestration to any building or geological information **that** would block access to daylight is > than the height from bottom of fenestration to top of building or geologic information
- The visible transmittance of fenestration ≥ 0.20



 DBP Partners Ltd M Stone Control Panels T&N Turn Aluminum dual wall Triple Glazing Argon Low E DBP-MH-00007-00011	
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./h-F)	Solar Heat Gain Coefficient
0.16	0.13
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./h-F)
0.20	≤.03
<small>Manufacturers declare that these ratings conform to applicable NFRC procedures for determining whole window performance. NFRC ratings are determined by a test of an environmental chamber and a double-slit test. NFRC does not guarantee any product and does not warrant the validity of any product for any specific use. General manufacturer's literature for other product performance. © 2018</small>	

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Sidelit Zone – C405.2.3.2



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Toplit Daylight Zone - Section C405.2.3.3 - Diagrams next 3 slides

Definition: the floor area underneath a roof fenestration assembly **that** complies with all of the following:

- Zone shall extend laterally and longitudinally beyond the edge of the roof fenestration assembly to the nearest obstruction that is (taller) $> 0.7 \times$ the ceiling height, $> 0.7 \times$ the ceiling height, whichever is less
- Where located in rooftop monitor, toplit zone to extend laterally to nearest obstruction taller than $0.7 \times$ the ceiling height, or up to 1.0 times the height from floor to bottom of fenestration, whichever is less, and longitudinally from the edge of the fenestration to the nearest obstruction taller than $0.7 \times$ ceiling height, or up to 0.25 times the height from the floor to bottom of fenestration, whichever is less
- No building or geological formation blocks different sunlight from hitting the roof fenestration assembly at the peak solar angle on the summer solstice
- Where located in existing buildings, visible transmittance of the roof fenestration assembly times the area of the rough opening of the roof fenestration assembly divided by area of daylight zone ≥ 0.008

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Toplit Zone - C405.2.3.3

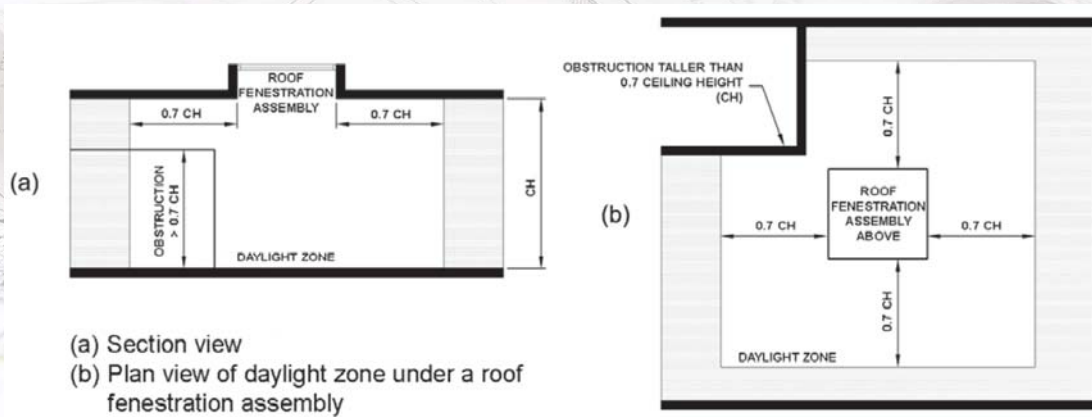


FIGURE C405.2.3.3(1)
TOPLIT ZONE

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Top lit Zone, Rooftop Monitor – C405.2.3.3

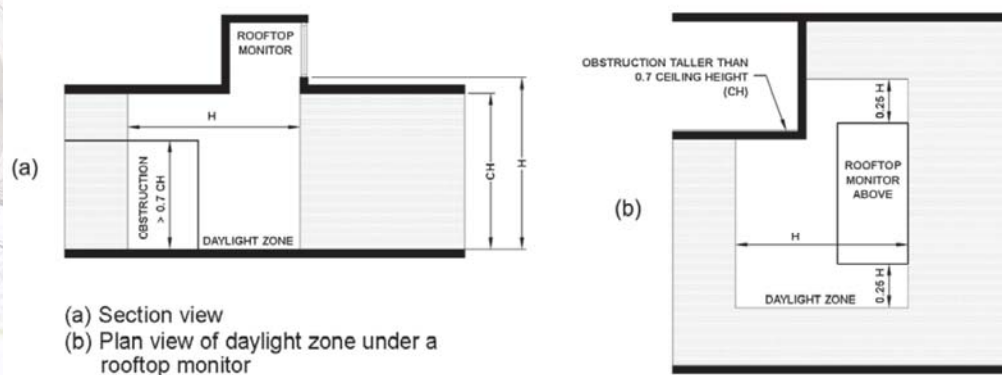


FIGURE C405.2.3.3(2)
DAYLIGHT ZONE UNDER A ROOFTOP MONITOR

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Top lit Zone, Rooftop Monitor – C405.2.3.3

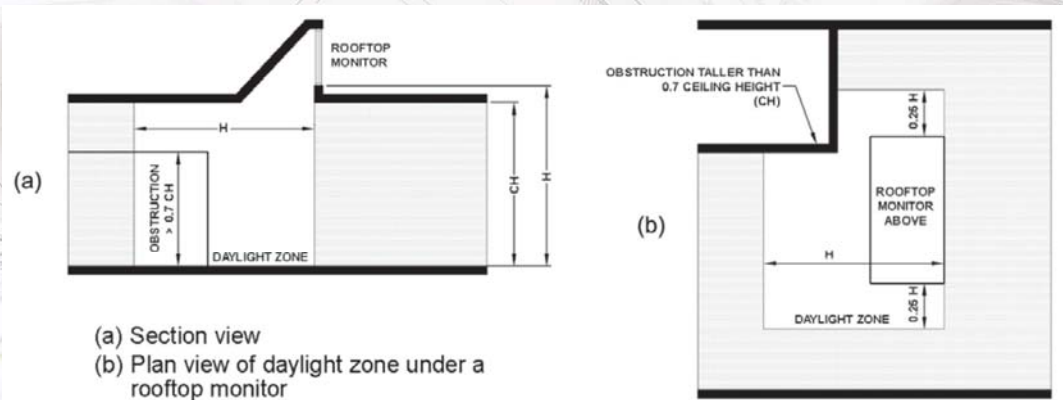


FIGURE C405.2.3.3(3)
DAYLIGHT ZONE UNDER A SLOPED ROOFTOP MONITOR

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Specific Application Controls - Section C405.2.4

- ✓ These types to be controlled by **occupant sensor or time-switch control, and a manual control provided to control separately from general lighting**
 - Display and accent lighting
 - Display case lighting
 - Supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting
 - Equipment for sale or educational demonstrations
- ✓ Hotel and motel sleeping units
 - Master control device capable of automatically switching off all installed luminaires and switched receptacles within 20 minutes of occupants leaving the room
 - **Exceptions:** lighting and switch receptacles controlled by captive key systems **and spaces where patient care is provided**
- ✓ Permanently installed luminaires within dwelling units to have controls complying with C405.2.1.1 or C405.2.2.2
- ✓ Nonvisual applications, plant growth and food warming shall be controlled via time-switch control



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Manual Controls - Section C405.2.5

✓ In a location where

- occupants have ready access
- controlled lights are visible (or identify the area served by the lights and indicate status)



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Exterior Lighting Power Limits Section C405.5.1



What areas are covered under exterior lighting allowances?

✓ Tradable surfaces

Common exterior lighted needs that can be traded for other needs

- For example, wattage allowed for parking lot lighting can be “traded” and used for canopy lighting

✓ Nontradable surfaces

Less common exterior lighted needs that cannot be traded for other needs

- These applications have more specific security or task illuminance needs

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Exterior Lighting Zones

Table C405.5.2(1)

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

Power allowances are listed by lighting zone

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Exterior Lighting Zones

Table C405.5.2(2)

Allowances include a base allowance plus tradeable allowance

	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance	500 350 W	600 400 W	750 500 W	1300 900 W
Tradable Surfaces				
Uncovered Parking Areas				
Parking areas and drives	0.04 0.03 W/ft ²	0.06 0.04 W/ft ²	0.10 0.06 W/ft ²	0.13 0.08 W/ft ²
Building Grounds				
Walkways and ramps less than 10 feet wide	0.7 0.5 W/linear foot	0.7 0.5 W/linear foot	0.8 0.6 W/linear foot	1.0 0.7 W/linear foot
Walkways and ramps 10 feet wide or greater				
Plaza areas				
Special Feature Areas	0.14 0.10 W/ft ²	0.14 0.10 W/ft ²	0.16 0.11 W/ft ²	0.2 0.14 W/ft ²

Partial Table

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Exterior Lighting Zones cont'd.

	Zone 1	Zone 2	Zone 3	Zone 4
Building facades	No allowance	0.075 W/ft ² of gross above-grade wall area	0.113 W/ft ² of gross above-grade wall area	0.15 W/ft ² of gross above-grade wall area
Automated teller machines (ATM) and night depositories	270 135 W per location plus 90 45 W per additional ATM per location			
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.75 0.5 W/ft ² of area			
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 0.35 W/ft ² of area			
Drive-up window and doors	400 200 W per drive-through			
Parking near 24-hour retail entrances	800 400 W per main entry			



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Electrical Energy Consumption Mandatory Requirement Section C405.6

Separate metering required for each dwelling unit



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Electrical Transformers Section C405.6 - Mandatory

- Electric transformers must meet minimum efficiency requirements of Table C405.7 when tested and rated in accordance with test procedure DOE 10 CFR 431
- Efficiency to be verified through certification under an approved certification program or when program does not exist, ratings shall be supported by data furnished by transformer manufacturer



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Electrical motors Section C405.7 - Mandatory

- Electric motors must meet minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with test procedure DOE 10 CFR 431
- Efficiency to be verified through certification under an approved certification program or when program does not exist, ratings shall be supported by data furnished by motor manufacturer



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Vertical and Horizontal Transportation System and Equipment

Section C405.8.1 – Elevator Cabs

- The sum of lumens divided by the sum of the watts ≥ 35 lumens/W (not including signal and displays)
- Ventilation fans without their own air-conditioning system shall not consume ≤ 0.33 watts/cfm at the max. rated speed of the fan
- Controls shall be provided that will de-energize ventilation fans and lighting systems when the elevator is stopped, unoccupied and with its doors closed for > 15 minutes



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Vertical and Horizontal Transportation System and Equipment

Section C405.8.2 – Escalators and Moving Walks

- Must comply with ASME A17.1/CSA B44
- Automatic controls configured to reduce speed to minimum permitted speed in accordance with ASME A17.1/CSA B44 or applicable local code when not conveying passengers

Exception: variable voltage drive systems that reduce operating voltage in response to light loading conditions is an alternative to reduced speed function

- Regenerative drive
 - Escalators designed for one-way down operation only or for reversible operation
 - Must have a variable frequency regenerative drive that supplies electrical energy to the building electrical system when escalator is loaded with passengers with a combined weight > 750 pounds

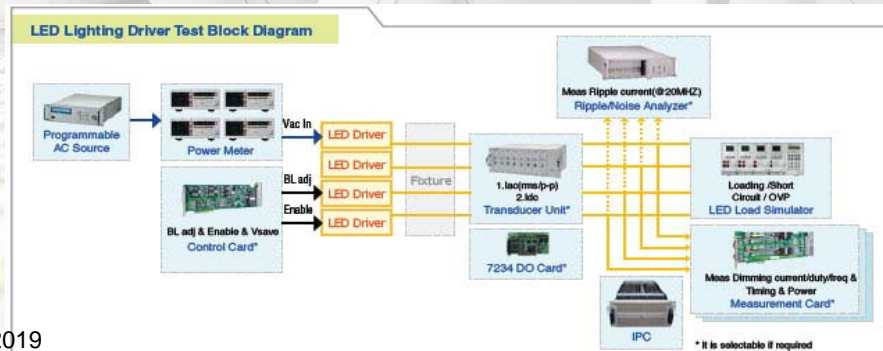


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Lighting System Functional Testing - Section C408.3.1 (Commissioning)

- ✓ 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



March 14, 2019

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QUESTIONS OR COMMENTS?

Thank you for your participation!

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