

WISCONSIN DSPS HAS ADOPTED THE 2015 SUITE OF CODES EFFECTIVE MAY 1, 2018



ALL PROJECTS WITH BUILDING PERMIT DATES AFTER MAY 1, 2018 MUST COMPLY WITH THE 2015 IECC SUITE OF CODES

Each Code has Wisconsin Amendments "Wisconsinism's"

Each Code references appropriate NFPA Standards

Application

C401.2/SPS363.0401(4)

- Commercial Building Codes to comply with either
 - A. ASHRAE 90.1 – 2013

OR

- B. IECC via Sections C402 – C405

The result using IECC building energy cost will be equal to less than the standard reference design building

PRESENTATION TODAY ON THE 2015 IECC COMMERCIAL ENERGY CODE

SECTION C405 – ELECTRICAL POWER & LIGHTING SYSTEMS

Energy Codes and standards set minimum efficiency required for new and renovated buildings. Energy Codes are a subset of building Codes, which establish base line requirements and govern building construction.



WHATS COVERED

ALL NEW AND RENOVATED COMMERCIAL BUILDINGS IN THE FOLLOWING IBC OCCUPANCY GROUPS:

- GROUP A – Assembly
- GROUP B – Business
- GROUP E – Educational
- GROUP F and high hazard GROUP H
- GROUP I – Institutional
- GROUP M – Mercantile
- GROUP R – Residential over two units
- GROUP S – Storage
- GROUP U – Utility and Miscellaneous

IECC Code applies to the following:

- Original installed lighting systems in a new building, additions, alterations or tenant build-outs
- For alterations to buildings if over 50% of the lighting is replaced
- Speculative buildings Code applies to the building shell and core lighting installed for common areas such as corridors, toilets, stairwells and lobbies
- Shell buildings constructed prior to knowing the building use. Code will apply to build-outs as the spaces are leased.
- Garages and parking areas, covered parking is treated as internal lighting spaces, uncovered or rooftop parking areas are treated as exterior lighting spaces
- Review IBC Occupancy Group U for agricultural building public spaces. Animal containment, milking parlors, free-stall barns may not be covered

WHATS NOT COVERED

- Dwelling units within commercial buildings are not required to comply IF they comply with the residential Section R404.1
- Dwellings covered under the Uniform Dwelling Code (UDC) for one and two family dwellings
- Agricultural buildings not intended for public use.

IECC SECTION C405
ELECTRICAL POWER & LIGHTING SYSTEMS

C405.1 General (mandatory)
This section covers lighting systems

Controls

- General lighting
- Within side light (window) areas
- Within top light (skylight) areas
- Exterior building lighting
- Exterior site lighting
- Exceptions

Maximum lighting power allowance (LPD) for interior spaces
Maximum lighting power allowance (LPD) for exterior spaces

Commentary: The biggest change in the 2015 IECC are in lighting controls. This presentation summarizes these requirements. Interior lighting shutoff controls were for building over 5,000 sq. ft., the 2015 IECC requires all size buildings require interior lighting must be turned off when not being used. The basic choice is occupancy – or time-based (time clock) control.

OUTLINE OF CODE REQUIREMENTS

- C405.2 – Lighting Controls (Mandatory)
 - ~~C405.2.1 Occupancy sensor controls~~ **WI AMENDMENT REMOVES**
 - ~~C405.2.2.2 Occupancy sensor control function~~
 - ~~C405.2.2.2 Occupancy sensor control function in warehouses~~
 - C405.2.2 Time-switch controls
 - C405.2.2.1 Time-switch control function
 - Exceptions
 - C405.2.2.2 Light-reduction controls
 - Exceptions
 - C405.2.2.3 Manual controls
 - C405.2.3 Daylight-responsive controls **WI AMENDMENT ROOMS >250 SQ. FT.**
 - C405.2.3.1 Daylight-responsive control function
 - Exception
 - C405.2.3.2 Sidelight (windows) daylight zone
 - C405.2.3.3 Toplight (skylight) daylight control
 - C405.2.4 Specific (display, accent, task & sale) application controls
 - C405.2.5 Exterior lighting controls
 - Exceptions



OUTLINE OF CODE REQUIREMENTS

- C405.3 Exit signs (mandatory)
- C405.4 Interior lighting power requirements (Prescriptive)
 - C405.4.1 Total connected interior lighting power (LPD)
 - Exceptions
 - C405.4.2 Interior lighting power (LPD)
 - C405.4.2.1 Building Area Method
 - Table C405.4.2(1) Interior Lighting power allowances: Building Area Method
 - C405.4.2.2 Space-by Space Method
 - Table C405.4.2(2) Interior Lighting power allowances: Space by Space Method
 - C405.4.2.2.1 Additional (Retail areas 1-4) interior lighting power allowed
 - Exception
- C405.5 Exterior lighting (Mandatory)
 - Exception
 - C405.5.1 Exterior building lighting power (LPD)
 - Exceptions
- C405.6 Electrical energy consumption (Dwellings in R-2 buildings) (Mandatory)
- C405.7 Electrical Transformers efficiency (Mandatory)

WI AMENDMENT REMOVES
LIGHTING CONTROLS

C-105.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounge.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
9. Janitorial closets.
10. Locker rooms.
11. Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses.

NOTE: Wisconsin amendment SPS-363.0405(3) has eliminated this requirement. This makes these occupant sensor controls **OPTIONAL** in listed areas.
Commentary: You may want to use occupant sensors for automatic shutoff control as they are now required in all commercial buildings. Either occupant sensors or an automatic time clock device must be installed. Gone is 2009 exception for buildings under 5,000 square feet.

LIGHTING CONTROLS CONT.
WI AMENDMENT REMOVES

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces *other than warehouses* specified in Section C405.2.1 shall comply with the following. Here in Wisconsin they are optional in the listed spaces but if used they must comply:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space.
2. Be manual or controlled to automatically turn the lighting on to **not more than 50 percent power.**
Exception: Full (100%) automatic on controls shall be permitted to control *lighting in public corridors, stairways, restrooms, primary building entrance area and lobbies*, and areas where manual or (at 50% power) operation would endanger the safety or security of the room or building occupants.
3. Shall incorporate a *Manual control* to allow occupants to turn lights off.
Note: If automatic on/off controls are used then one must either have a independent emergency power system OR the normal power system which is capable of 0-100% operation shall have UL-924 ballasts or similar for emergency system backup.

Commentary: **IF USED** The 2015 IECC will only allow the traditional 100% auto-on/auto-off occupant sensor for the areas listed above in the exception. If you are using occupant sensors for lighting controlled for the means of egress 100% would be allowed. All other rooms or areas using occupant sensors must automatically turn lighting on to no more than 50% but full off after 30 minutes of vacancy.

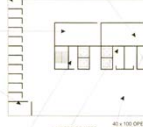
LIGHTING CONTROLS EXAMPLES

LABORATORY

LABORATORY 204 TO MEETING ROOMS NEED AT LEAST TWO MANUAL CONTROLS

A FIRST CONTROL REQUIRED FOR THE ENCLOSED SPACE

B ADDITIONAL CONTROL FOR THE LIGHT REDUCTION REQUIREMENT (MANUAL OR OCCUPANT SENSING DEVICE)



CONFERENCE ROOM

CONFERENCE ROOM NEEDS AT LEAST TWO MANUAL CONTROLS

A ONE CONTROL FOR THE ENCLOSED SPACE

B ADDITIONAL CONTROL FOR THE LIGHT REDUCTION REQUIREMENT (MANUAL OR OCCUPANT SENSING DEVICE)

STORAGE ROOM

STORAGE ROOM NEEDS ONE MANUAL CONTROL

SINCE NO SIGNIFICANT LEVELS TRAFFIC OCCUR, CONTROLS ARE REQUIRED SEE IFC CODE TABLE 7.2.1 EXCEPTION 3

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LIGHTING CONTROLS EXAMPLES

NOTE: Illustrations shown have auto-off 100%, auto-on at 50% if activated via sensors

<p>Suggests the Following Requirements:</p> <ul style="list-style-type: none"> • Full Auto-Off on Occupancy Sensor (IBC 2.1.1) • Manual Control (Local Switch) (IBC 2.7.6) • Lighting Reduction (IBC 2.7.2) 		<p>Suggests the Following Requirements:</p> <ul style="list-style-type: none"> • Full Auto-Off on Occupancy Sensor (IBC 2.1.1) • Manual Control (Local Switch) (IBC 2.7.6) • Lighting Reduction (IBC 2.7.2) 	
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<p>Office with no windows or skylight. More than one luminaire. Three required controls:</p> <ul style="list-style-type: none"> • Manual control for full-on • Occupant sensor for auto-off after 30 min. • Light reduction control – uniform pattern 	<p>Office with no windows or skylight. More than one luminaire. Three required controls:</p> <ul style="list-style-type: none"> • Manual control for full-on • Occupant sensor for auto-off after 30 min. • Light reduction control – using dimmer
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Old auto-on/auto-off sensors have limited use under the 2015 IECC

LIGHTING CONTROLS EXAMPLES

Suggests the Following Requirements:

- Full Auto-Off on Occupancy Sensor (IBC 2.1.1)
- Manual Control (Local Switch) (IBC 2.7.6)
- Lighting Reduction (IBC 2.7.2)
- Skylight Daylight Zone (IBC 2.3.2)
- Enhanced Digital Lighting Controls if connected to network (IBC 6)

Open office example does have windows. Four controls required:

- Full off via occupant sensor
- Manual control override
- Light reduction control via 50%-on occupancy sensor
- Sidelight (windows) control by daylight sensor

LIGHTING CONTROLS CONT.


C405.2.1.2 Occupant sensor control function in warehouses

In warehouses, the lighting in aiseways and open areas shall be controlled with occupant sensors that automatically reduce lighting power by not less than 50% when the areas are unoccupied. The occupant sensors shall control lighting in **each aisleway independently** and shall not control lighting beyond the aisleway being control by the sensor.

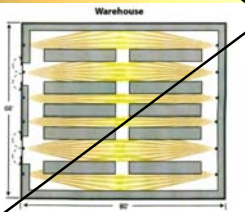
Commentary: Warehouse lighting controls have been extensively revised. 2015 IECC now requires occupancy controls for *EACH* warehouse aisleway. Long aiseways may require two or more occupancy sensors for coverage. They must be directional for control of each aisleway independently. Aisleway lighting must not trigger any other lighting beyond the aisleway. The occupant sensor(s) will trigger full-on in response to the presence of people in the space. After the space is vacated the sensor shall reduce lighting levels to a minimum of 50%. The sensor must also have a full-off function after a 30 minute vacancy period detected.

WI AMENDMENT REMOVES REQUIREMENT

LIGHTING CONTROLS EXAMPLES
WI AMENDMENT REMOVES REQUIREMENTS

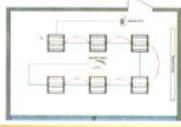



Warehouse



Warehouse or library aisles:
Each aisle is controlled independently
Control must only control lighting in effected aisle and shall not control lighting beyond the aisleway being controlled by the sensor or in open areas
Control required:
Automatic full off via sensor or time clock
Automatic partial off via sensor when vacated
Daylight or skylight responsive control
Commentary: It may be difficult to control aisle lighting depending on length of aisle
Occupant sensor on each fixture here may be a better choice.

LIGHTING CONTROLS EXAMPLES






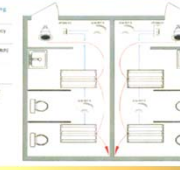
Classrooms with windows.

Four controls required:

- Full off via occupant sensor
- Manual control override
- Light reduction control via 50%-on occupancy sensor or right side shows dimmers
- Sidelight (windows) control by daylight sensor

LIGHTING CONTROLS EXAMPLES





Private rest room.
Two controls required:

- Old style occupant sensor full-on/full-off
- Manual override control
- Light reduction exception:
 - Single luminaire 100-watts or less
 - Spaces using 0.6 watts/ sq. ft.

Public rest room.
Three controls required:

- Occupant sensor full-off
- Manual override control
- Light reduction:
 - Via occupant sensor –on 50%
 - Exception
 - Spaces using 0.6 watts/ sq. ft.

LIGHTING CONTROLS EXAMPLES

Stairwell – NOT IN EGRESS PATH.
Two controls required:
Manual on 100%
Automatic off via occupant sensor
NOTE: If this stairwell is included in the path of egress automatic full-off is not recommended.

Corridors – NOT IN EGRESS PATH.
Two controls required:
Manual on 100%
Automatic off via occupant sensor
NOTE: If this corridor is included in the path of egress automatic full-off is not recommended.

LIGHTING REDUCTION CONTROLS

C405.2.2.2 Light-reduction controls. Spaces required to have light-reduction controls shall have a *manual control* that allows the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50%. Lighting reduction shall be achieved by one of the following or another *approved* method:

1. Controlling all lamps or luminaires.
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps.
3. Switching the middle lamp of luminaires independently of the outer lamps.
4. Switching each luminaire or each lamp.
5. Dimming to a 50% level

Commentary: All rooms and spaces with ceiling to floor partitions with more than one luminaire require light reduction control. The old technology using fluorescent luminaires with master/slave or dual ballasts will also work. Check with your supplier to see if you can get dual driver LED luminaires and switch each one independently.

Exception:

1. Light reduction controls are not required in daylight zones with daylight controls.
2. Rooms or spaces using occupant sensors.
3. Rooms or spaces with one luminaire rated 100W or less.
4. Warehouse light reduction control is automatically controlled using occupancy sensors.

LIGHTING REDUCTION CONTROLS

Alternating Lamps

Alternating Luminaires

Dimming

Dimmer Switch

MANUAL CONTROLS

C405.2.2.3 Manual Controls. *Manual controls* for lights shall comply with the following:

1. Shall be readily accessible to occupants.
2. Shall be located where the controlled lights are visible, or shall identify the area served by the lights and indicate their status.

Commentary: This section provides the requirement for *location of manual controls* for lighting. The areas requiring a manual control are occupancy sensors, time clock override, light reduction if manual control and daylight response control. The typical wall switch location as occupants enter a room or space is the required location. If more than one door or location to enter the room or space only one of these locations can be the designated control location. Also that chosen location must be located to see the controlled lights and be readily accessible. This section in no way designates the location of the other lighting controls such as occupancy or vacancy sensors, day-light control sensor or time clock device. It only deals with the manual override for these controls. Be careful when using time clocks as they are normally located in the electrical equipment room next to the panel. The manual override switch is incorporated into the time clock device which should identify the area served and the status of the load served. When using this section, it is important to remember that that manual controls must be "readily Accessible" so some additional wiring from the time clock device override switch may be required in the room or area served.

MANUAL CONTROLS



Occupancy or vacancy sensors will have the required manual override switch.



Combination occupancy sensor and dimmer will also have the manual override switch.



Simple on/off sensor with override switch.



Single pole switch can also be used for manual control in certain applications.

TIME CLOCK CONTROLS

C405.2.2 Time-switch controls

Each area of the building that is not provided with *occupant sensors controls* complying with Section C405.2.1.1 shall be provided with *time switch controls* complying with Section C405.2.2.1.

Exception: Where a manual control provides light reduction in accordance with Section C405.2.2.2, automatic controls shall not be required for the following:

1. *Sleeping units*
2. Spaces where patient care is directly provided
3. Spaces where an automatic shutoff would endanger occupant safety or security
4. Lighting intended for continuous operation
5. Shop and laboratory classrooms

Commentary: This rule requires automatic shutoff controls for ALL commercial occupancies. The 2009 IECC only required automatic shutoff controls for buildings over 5000 sq. ft. The basic rule here is that all rooms except the ones listed above require either an occupancy sensor control or a time clock for automatic shutoff control of the entire building. Building with a lot of small rooms occupancy sensors make sense, but the big box stores or buildings with large areas a time clock makes more sense.

TIME SWITCH CONTROL FUNCTIONS

C405.2.2.1 Time-switch control function. Each space provided with *time-switch controls* shall also be provided with a *manual control* for light reduction in accordance with Section C405.2.2.2. *time-switch controls* shall include an override switching device that complies with the following:

1. Have a minimum 7-day clock
2. Be capable of being set for seven different day types per week.
3. Incorporate an automatic holiday "shutoff" feature, which turns off all controlled lighting loads for at least 24 hours and then resumes normally scheduled operations.
4. Have program backup capabilities, which prevent the loss of program and time settings for at least 10 hours, if power is interrupted.
5. Include an override switch that complies with the following:
 - 5.1 The override switch shall be a manual control.
 - 5.2 The override switch when initiated, shall permit the controlled lighting to remain on for no more than 2 hours.
 - 5.3 Any individual override switch shall control the lighting for an area not larger than 5,000 square feet.

TIME SWITCH CONTROL FUNCTIONS

Exceptions:

1. Within malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas:
 - 1.1 The time limit shall be permitted to be greater than 2 hours, provided that the override switch is a captive key device.
 - 1.2 The area controlled by the override switch is permitted to be greater than 5,000 square feet, but shall not be greater than 20,000 square feet.

Commentary: Choose a good quality astronomical time clock which should have the required features. 7-day clock, capable of 7 different day types (Sun. thru Sat.) have the holiday shutoff programming ability, have a battery backup for 10 hours and include a manual override function for each circuit.

The exception is for longer than 2 hours manual override (this is for the cleaning people in areas like a mall) and control spaces greater than 5,000 square feet is for malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities like factories and sports arenas. You would not want the time clock to turn all lighting off during maintenance or cleaning functions.

TIME SWITCH MANUFACTURERS



DAYLIGHT-RESPONSIVE CONTROLS

C405.2.3.1 Day-responsive control function. Where required, (NOTE WISC. SPS.0405(a) ROOMS GREATER THAN 250 SQ FT. ONLY) daylight-responsive controls shall be provided within each space for control of lighting in that space shall comply with all of the following:

1. Lights in toplight (skylight) *daylight zones* in accordance with Section C405.2.3.3 shall be controlled independently of lights in sidelight (windows) *daylight zones* in accordance with Section C405.2.3.2.
2. *Daylight responsive controls* within each space shall be configured so that they can be calibrated from within that space by authorized personnel.
3. Calibration mechanisms shall be readily accessible.
4. Where located in offices, classrooms, laboratories and library reading room, *daylight responsive controls* shall dim light continuously from full light output to 15 percent of full light output or lower.
5. *Daylight responsive controls* shall be capable of a complete shutoff of all controlled lights.
6. Lights in sidelight (window) *daylight zones* in accordance with Section C405.2.3.2 facing different cardinal orientations [within 45 degrees of due north east, south, west] shall be controlled independently of each other.

Exception: Up to 150 watts of lighting in each space is permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation.

DAYLIGHT-RESPONSIVE CONTROLS

Commentary: This section describes how daylight responsive automatic controls required by the Code must function. The goal of this section is to establish minimum standards for the required daylight controls. This is best explained by an example where a room with windows facing east and West. The east side of the room will be brightest in the morning and the West side of the room will be the brightest in the afternoon. It makes sense to control each side of the room with an independent sensor. That exception allows up to 150 watts of lighting in each space to be controlled together with lighting in a daylight zone facing a different cardinal orientation. The intent of this exception is to allow for lights in a corner room with than 300 watts of lighting in daylight zones to be controlled by a single sensor.

We will explore the two different types of daylight areas with the following Code sections. The Code refers to windows as *sidelights* and skylights as *toplights*.

Primary exceptions include:

- Health and patient care spaces
- Dwelling and sleeping units
- Specific application lighting (task or display lighting to name a few)
- WISC. SPS 363.0405(a) enclosed interior rooms over 250 sq ft & a density more than 0.6 W/ft2
- WISC. SPS 363.0405(1)(b)1 Zones where the effective aperture of glazing is equal or less than 0.1 for vertical glazing and 0.01 for horizontal glazing
- WISC. SPS 0405(1)(b)2 Zones where existing adjacent structures or natural objects obstruct daylight to make use of daylighting not feasible

DAYLIGHT-RESPONSIVE CONTROLS

C405.2.3.2 Sidelight daylight zone. The sidelight *daylight zone* is the floor area adjacent to vertical fenestration which complies with all of the following:

Fenestration is the arrangement, proportioning, and design of windows or doors in a building

1. Where the *fenestration* is located in a wall, the daylight zone shall extend laterally to the nearest full-height wall, or up to 1.0 times the 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 feet, whichever is less.
2. Where the *fenestration* is located in a rooftop monitor, the *daylight zone* shall extend laterally to the nearest obstruction that is taller than 0.7 times the ceiling height, or up to 1.0 times the height from the floor to the bottom of the fenestration, whichever is less. And longitudinally from the edge of the fenestration nearest obstruction that is taller than 0.7 times the ceiling height, or up to 0.25 times the height from the floor to the bottom of the *fenestration*, whichever is less.
3. The area of the *fenestration* is not less than 24 square feet.
4. The distance from the *fenestration* to any building or geological formation which would block access to day light is greater than the height from the bottom of the *fenestration* to the top of the building or geologic formation.
5. Where located in existing buildings, The *visible transmittance* of the *fenestration* is not less than 0.20.

DAYLIGHT-RESPONSIVE CONTROLS

FIGURES ARE WORTH A THOUSAND WORDS

Fenestration is the arrangement, proportioning, and design of windows or doors in a building

Lighting in daylight areas ***IF 150-WATTS OR MORE*** must be automatically controlled to dim lighting within the daylight zone from full light output to 15% or lower.

The daylight zone is a distance from the window into the room equal to the distance from the floor to the top of the window and 2' on both sides

DAYLIGHT-RESPONSIVE CONTROLS

Simple example of daylight control, single window or corner office with two windows.

If working with a large corner space either use:

- Two sensors, one pointed toward each façade.
- A single sensor close to the corner, pointed at either façade

Daylight zone shall extend laterally to the nearest obstruction that is (taller) $>0.7 \times$ the ceiling height, or up to $1.0 \times$ the height from the floor to the bottom of the skylight whichever is less.

DAYLIGHT-RESPONSIVE CONTROLS

Skylight controls

The exception for 150 watts of lighting in the daylight area also applies to skylights.

Daylight zone shall extend laterally to the nearest obstruction that is (taller) $>0.7 \times$ the ceiling height, or up to $1.0 \times$ the height from the floor to the bottom of the skylight whichever is less. Simple example: 10' ceiling the daylight zone will be 7' in all directions from the skylight footprint not including any obstructions taller than 7'.

Slide 31

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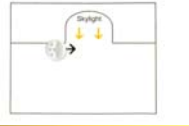
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DAYLIGHT-RESPONSIVE CONTROLS

Skylight control placement

Skylights

- Mount the sensor as close as possible to the skylight with the field of view oriented toward the floor under the skylight covering.
- Do not position the sensor inside skylight.



Sensor placement is critical for proper daylight control and if done correctly the occupants will not even notice the dimming levels as the daylight changes throughout the day.

SPECIFIC APPLICATION CONTROLS

C405.2.4 Specific application controls. Specific application controls shall be provided for the following:

1. Display and accent lighting – dedicated independent control.
2. Lighting for display cases - dedicated independent control.
3. Hotel and motel sleeping units.
4. Task lighting including permanently installed under-shelf or under-cabinet lighting. Shall have an integral control or a readily accessible wall-mounted control.
5. Lighting for nonvisual applications, food warming plant growth independent control.
6. Lighting that is for sale or demonstration – independent controls required.

Commentary: The Code does give some relief for those specific areas. Retail Sales, display cases, office areas with under-cabinet lighting, education areas for demonstrations and all the special lighting for plant growth food warmers in food sales areas and signs. Keep in mind that all these controls must be independent and dedicated to the loads served. The Code does not clearly define all the areas you may encounter consult with the designer or AHJ. The Code does not address any portable lights that are plugged in after occupancy. This area of the Code should be reviewed for compliance for your specific applications. Some permanently installed like under-cabinet or under shelf lights may need to be connected to occupant sensors or time clocks and be zoned separately from the general lighting.

EXTERIOR LIGHTING CONTROLS

C405.2.5 Exterior lighting controls. Lighting for exterior applications other than emergency lighting that is intended to be automatically off during building operation, lighting specifically required to meet health and life safety requirements or decorative gas lighting systems shall:

1. Be provided with a control that automatically turns off the lighting as a function of available daylight.
2. Where lighting the building facade or landscape, the lighting shall have controls that automatically shut off the lighting as a function of dawn/dusk and a set opening and closing time.
3. Where not covered in Item 2, the lighting shall have controls configured to automatically reduce the connected lighting power by not less than 30 percent from not later than midnight to 6 a.m., from one hour after business closing to one hour before business opening or during any period when activity has not been detected for a time of longer than 15 minutes.

Commentary: Photocell/time clock combination is the most effective plan for exterior lighting. However from midnight to 6 a.m. or one hour after closing to one hour before business opening will require controls to reduce connected lighting power by 30%. There is an exception for covered vehicle entrances or exits from buildings or parking structures where required for safety, security or eye adaptation.

INTERIOR LIGHTING POWER ALLOWANCES

C405.4 Interior lighting power requirements (Prescriptive). A building complies with this section where its total connected lighting power calculated under Section C405.4.1 is not greater than the interior lighting power calculated under Section C405.4.1.

Commentary: Under this section of the Code the installed interior lighting power (wattage) must be calculated using the appropriate tables C405.4.2(1) for total building method or Table C405.4.2(2) for the space-by-space method. This is where we are limited to the amount of lighting wattage we are permitted in building occupancies. Each Code cycle these lighting power allowances (wattage) go down as energy efficient lighting fixtures are introduced. Example under the 2009 IECC we were allowed 1.0 watts/sq.ft. for an office building. The 2015 IECC Code that value using the total building area method is reduced to .82 watts/sq.ft. The designer has two options for calculating the interior lighting power allowances the total building area method or using the space-by-space method which allows more watts/sq.ft. but a lot more calculations is required. This Code seems to force us into using LED lighting which results in less wattage for the same light output. There are 13 exceptions allowing us to exclude those wattages in our calculations.

INTERIOR LIGHTING POWER ALLOWANCES

Exceptions:

1. The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.
 - 1.1. professional sports arena playing field lighting.
 - 1.2. Lighting in sleeping units, provided that the lighting complies with Section R404.1.
 - 1.3. Emergency lighting automatically off during normal building operation
 - 1.4. Lighting in spaces specifically designated for use by occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
 - 1.5. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
 - 1.6. Casino gaming areas.
 - 1.7. Mirror lighting in dressing rooms.
2. Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device:
 - 2.1. Task lighting for medical and dental purposes.
 - 2.2. Display lighting for exhibits in galleries, museums and monuments.

INTERIOR LIGHTING POWER ALLOWANCES

Exceptions:

3. Lighting for theatrical purposes, including performance, stage, film production and video production
4. Lighting for photographic processes.
5. Lighting integral to equipment or instrumentation and installed by the manufacturer
6. Task lighting for plant growth or maintenance.
7. Advertising signage or directional signage
8. In restaurant buildings and areas, lighting for food warming or integral to food preparation equipment.
9. Lighting equipment that is for sale.
10. Lighting demonstration equipment in education facilities.
11. Lighting approved because of safety or emergency considerations, inclusive of exit lights.
12. Lighting integral to both open and glass-enclosed refrigerator and freezer cases .
13. Display area is enclosed by ceiling-height partitions.
14. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
15. Exit signs.

INTERIOR LIGHTING POWER ALLOWANCES

BUILDING AREA TYPE	SPCS (W/FT)
Administrative facility	0.80
Chemical storage	1.00
Craft/shop	1.00
Dining, bar, lounge/refresh	1.00
Dining, restaurant/food	0.80
Electrical control room	0.50
Executive	0.57
Executive center	0.84
Fine arts	0.87
Food service	0.84
Gymnasium	0.94
Health care office	0.80
Hospital	1.00
Hotel/Motel	0.87
Library	1.00
Manufacturing facility	1.17
Medical patient storage	0.76
Manufacturing	0.91
Museum	1.00
Office	0.82
Parking garage	0.31
Pharmaceutical	0.81
Postsecondary	1.00
Professional office	0.87
Public storage	0.87
Post office	0.87
Religious building	1.00
Retail	1.00
School/college	0.87
Special storage	0.81
Trains hall	0.80
Transportation	0.76
Warehouse	1.00
Workshop	1.00

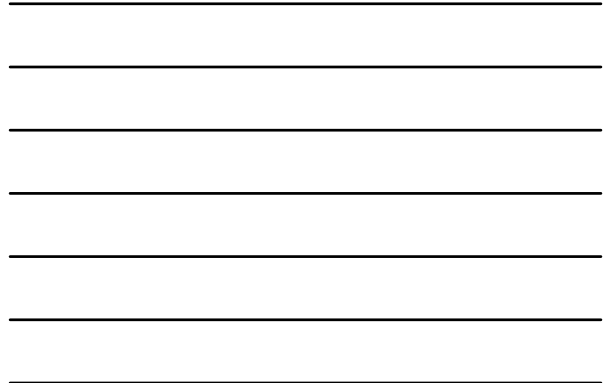
Commentary: Use this method for ease of use if your considerably under the lighting power allowance. Most applications using LED fixtures and luminaires you will comply with Code requirements.

Pick the building type that is 80% or more that type. Many buildings have office areas and another type of area like warehouse or manufacturing. You cannot combine the area method and the space-by-space method for the same project. The Code also gives us some additional power allowances for retail sales areas. Example:

Its best to calculate the maximum power allowance before laying out the fixtures.

A 5000 sq.ft. office building = $5000 \times 0.82 = 4100$ watts allowed in this building.

A 2x4 LED troffer equal to a 3-lamp F32T8 fluorescent fixture has an input wattage of 36 watts. If all fixtures are these 4100 allowed wattage divided by 36 watts/fixture = 113 fixtures allowed for this building. If I was using 3-lamp T8 only 41 allowed.



INTERIOR LIGHTING POWER ALLOWANCES

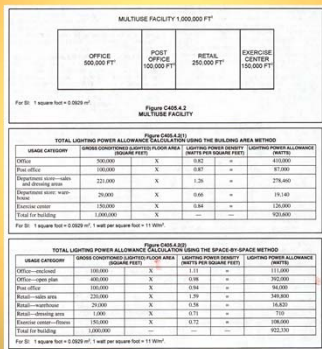
Slightly higher lighting power allowances using space-by-space method

BUILDING TYPE	SPCS (W/FT)
Administrative facility	0.80
Chemical storage	1.00
Craft/shop	1.00
Dining, bar, lounge/refresh	1.00
Dining, restaurant/food	0.80
Electrical control room	0.50
Executive	0.57
Executive center	0.84
Fine arts	0.87
Food service	0.84
Gymnasium	0.94
Health care office	0.80
Hospital	1.00
Hotel/Motel	0.87
Library	1.00
Manufacturing facility	1.17
Medical patient storage	0.76
Manufacturing	0.91
Museum	1.00
Office	0.82
Parking garage	0.31
Pharmaceutical	0.81
Postsecondary	1.00
Professional office	0.87
Public storage	0.87
Post office	0.87
Religious building	1.00
Retail	1.00
School/college	0.87
Special storage	0.81
Trains hall	0.80
Transportation	0.76
Warehouse	1.00
Workshop	1.00



INTERIOR LIGHTING POWER ALLOWANCES

Multiuse facility example using space-by-space method



INTERIOR LIGHTING POWER ALLOWANCES

Code does give us some additional allowance for retail spaces

Additional Retail Lighting Power Allowance Table C405.5.2(2) – Footnotes



Additional Interior Lighting Power Allowance =
 50.0 watts +
 (Retail Area 1 x 0.6 W/ft²) +
 (Retail Area 2 x 0.6 W/ft²) +
 (Retail Area 3 x 1.4 W/ft²) +
 (Retail Area 4 x 2.5 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.

EXTERIOR LIGHTING POWER ALLOWANCES

C405.5 Exterior lighting (Mandatory). Where the power for exterior lighting is supplied through the energy service to the building, all exterior lighting shall comply with Section C405.5.1.

C405.5.1 Exterior building lighting power. The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table C405.5(2) for the applicable lighting zone. Trade-offs are allowed only among exterior lighting applications listed in Table C405.5(2), in the Tradable Surfaces section. The lighting zone for the building exterior is determined from Table C405.5(1) unless otherwise specified by the local jurisdiction.

Commentary: All exterior lighting requires a combination of specific controls, which vary depending on dust-to-dawn operation.

All exterior lighting (with the exception of emergency lighting) that is intended to be auto-OFF during building operation, is specifically required to meet health/safety requirements or decorative gas lighting systems must include controls that comply with the following:

- Auto-OFF as a function of available daylight.
- For façade or landscape lighting, must auto-OFF as a function of sunrise/sunset clock and a set opening and closing time schedule.
- For non-façade/landscape lighting, must be configured to automatically reduce lighting by a least 30% from midnight to 6am, from one hour after closing to one hour before business opening, or during any period when activity has not been detected for at least 15 minutes.

EXTERIOR LIGHTING POWER ALLOWANCES

Exceptions for exterior lighting power

Exception: Lighting used for the following exterior applications is exempt where equipped with a control device independent of the control of the nonexempt lighting:

1. Specialized signal, directional and marker lighting associated with transportation
2. Advertising signage or directional signage.
3. Integral to equipment or instrumentation and is installed by its manufacturer.
4. Theatrical purposes, including performance, stage, film production and video production.
5. Athletic playing areas.
6. Temporary lighting.
7. Industrial production, material handling, transportation sites and associated storage areas.
8. Theme elements in theme/amusement parks.
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

EXTERIOR LIGHTING POWER ALLOWANCES

TABLE (A) (I) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS LIGHTING ZONES					
Load Use, Allocation, Description, or Remarks (in words or symbols or combinations thereof)	Zone 1		Zone 2		Zone 4
	300 W	600 W	750 W	1500 W	
Parking areas and drives <i>Maximum area 1500 sq. ft.</i>	Uncovered Parking Areas	0.24 W/ft ²	0.30 W/ft ²	0.37 W/ft ²	0.43 W/ft ²
	Building Entrances	0.70 W/linear foot	0.70 W/linear foot	0.80 W/linear foot	0.90 W/linear foot
	Exterior signs, signs for people, signs above covered parking areas	0.14 W/ft ²	0.14 W/ft ²	0.16 W/ft ²	0.2 W/ft ²
Retail, Office, Professional, and Public Buildings <i>Maximum area 10,000 sq. ft.</i>	Entrances	0.75 W/ft ²	0.8 W/ft ²	0.9 W/ft ²	0.9 W/ft ²
	Exterior signs	0.12 W/ft ²	0.12 W/ft ²	0.12 W/ft ²	0.12 W/ft ²
	Building Entrances and Exits	0.15 W/linear foot	0.15 W/linear foot	0.15 W/linear foot	0.15 W/linear foot
	Maintenance	0.10 W/linear foot of door width	0.10 W/linear foot of door width	0.10 W/linear foot of door width	0.10 W/linear foot of door width
	Office doors	0.10 W/linear foot of door width	0.10 W/linear foot of door width	0.10 W/linear foot of door width	0.10 W/linear foot of door width
Site Construction	Site signs	0.25 W/ft ²	0.25 W/ft ²	0.3 W/ft ²	0.3 W/ft ²
	Free-standing and attached	0.4 W/ft ²	0.4 W/ft ²	0.4 W/ft ²	0.4 W/ft ²
	Outdoor Signs	0.25 W/ft ²	0.25 W/ft ²	0.3 W/ft ²	0.3 W/ft ²
	Signs that include vehicle signs but not parking signs	0.25 W/ft ²	0.25 W/ft ²	0.3 W/ft ²	0.3 W/ft ²
	Signs not including vehicle signs but not parking signs	No allowance	10 W/linear foot	10 W/linear foot	10 W/linear foot
Nonresidential Buildings <i>Lighting power density (LPD) values for lighting applications are based on the average unit area (AUA) for each lighting application and include the lighting application and associated area.</i>	Building interiors	No allowance	0.015 W/ft ² of gross floor area and all other areas	0.115 W/ft ² of gross floor area and all other areas	0.115 W/ft ² of gross floor area and all other areas
	Auxiliary office space, including the following applications: conference rooms, storage, waiting areas, corridors, elevators, restrooms, and other areas	0.20 W/ft ² per location plus 10 W per additional AUA per location	0.20 W/ft ² per location plus 10 W per additional AUA per location	0.20 W/ft ² per location plus 10 W per additional AUA per location	0.20 W/ft ² per location plus 10 W per additional AUA per location
	Other areas, including the following applications: waiting areas, corridors, elevators, restrooms, and other areas	0.20 W/ft ² of covered and uncovered area	0.20 W/ft ² of covered and uncovered area	0.20 W/ft ² of covered and uncovered area	0.20 W/ft ² of covered and uncovered area
Specialty Applications <i>Lighting power density (LPD) values for lighting applications are based on the average unit area (AUA) for each lighting application and include the lighting application and associated area.</i>	Signage	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
	Signage	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
	Signage	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
Specialty Applications <i>Lighting power density (LPD) values for lighting applications are based on the average unit area (AUA) for each lighting application and include the lighting application and associated area.</i>	Signage	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
	Signage	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area

TABLE (A) (II) EXTERIOR LIGHTING ZONES	
LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, farms, lakes, and rural areas
2	Areas predominantly consisting of residential, commercial, 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.

COMPLIANCE

1. COMPLIANCE
 1. System testing
 2. Documentation
 3. Submit documents to the local inspection agency (AIJ)
 4. Submit compliance statement
2. DESIGN
 1. Plans required showing luminaire layout and controls
 2. Compliance details using ComCheck or approved spreadsheet
 3. Buildings up to 50,000 cubic feet Master electrician can sign, inclusive of his DSPS customer ID as associated with Master Electrician's License & have the code compliance calculations and associated code compliance documents available on-site **IF HE IS THE INSTALLER ON THE PROJECT**
 1. Buildings greater than 50,000 cubic feet must be signed and sealed by:
 1. Registered Designer of Engineered systems
 2. Project registered Architect

COMPLIANCE USING COMCHECK

Interior lighting compliance certificate

COMPLIANCE USING COMCHECK

Exterior lighting compliance certificate

COMPLIANCE USING EXCEL FORM

COMPLIANCE USING EXCEL FORM

Either one of these compliance statements must be on-site along with lighting plan showing lighting, egress lighting and controls.

COMPLIANCE STATEMENT



Supervising professional must submit this Compliance Statement if building is 50,000 cubic feet or greater



Questions
