2021 WSEC-C Lighting Controls Review

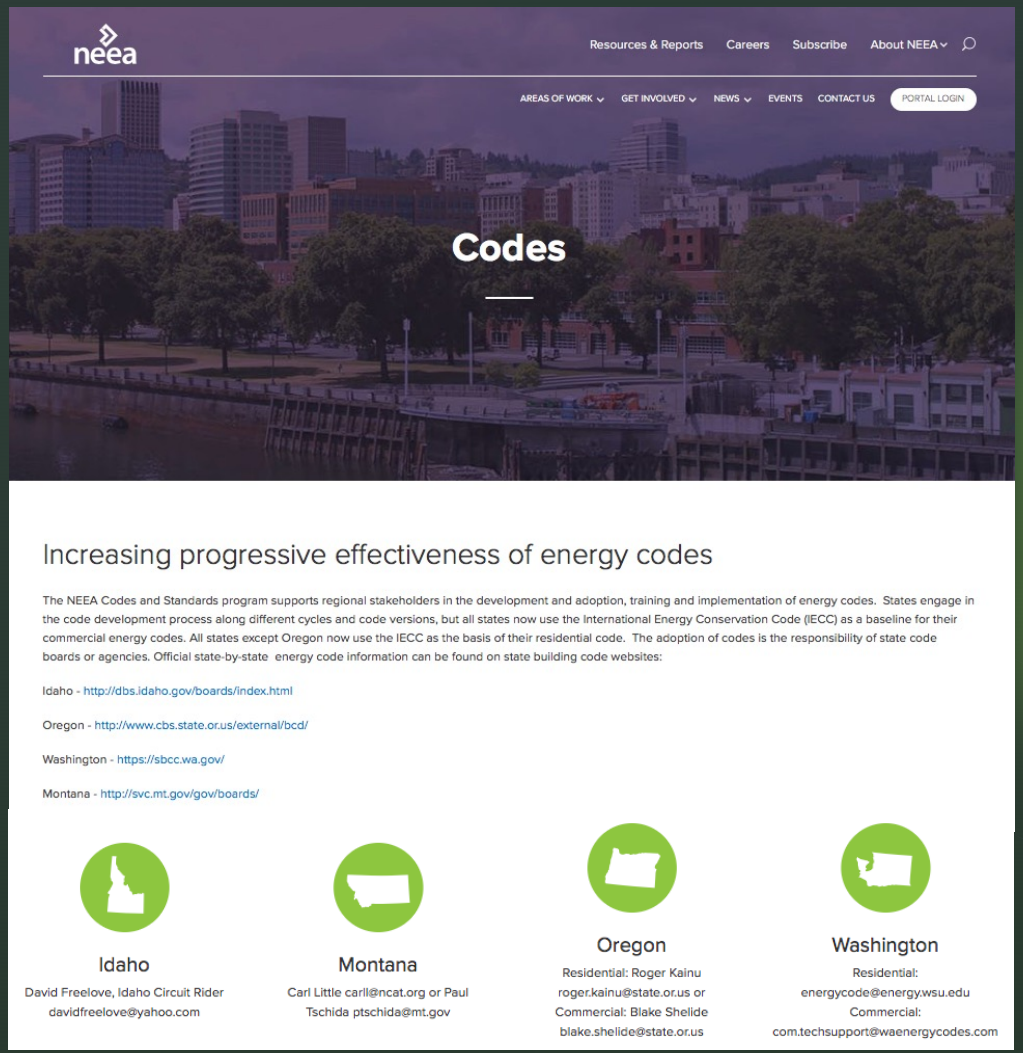
WSEC Commercial Technical Support Team:
Duane Lewellen – Lewellen Associates, LLC
Lisa Rosenow – Evergreen Technology Consulting (ETC)
(360) 539-5300|com.techsupport@waenergycodes.com

WSEC Commercial Technical Support

- On-call technical support thru 3 avenues
  - Telephone hot line – **360-539-5300**
  - Online form – **https://www.waenergycodes.com**
  - Email inquiries – **com.techsupport@waenergycodes.com**
- Classroom and webinar training
- We administer the technical support and compliance documentation webtool

Duane Lewellen,
Lewellen Associates

Lisa Rosenow, ETC



WSEC technical support services are made possible thanks to the generous support of the Northwest Energy Efficiency Alliance

www.neea.org

Today's Presentation

- This presentation represents ETC's ***unofficial*** interpretation of WA State Energy Code intent.
- Our technical support team is not an affiliate, nor do we speak for the Washington State Building Code Council (SBCC).
- The WSEC commercial technical support we provide is advisory only and non-binding.

WSEC Commercial Technical Support Team:
Duane Lewellen – Lewellen Associates, LLC
Lisa Rosenow – Evergreen Technology Consulting (ETC)
(360) 539-5300|com.techsupport@waenergycodes.com

Topics we'll discuss today ~

1. Lighting power allowance (LPA) calculation fundamentals
2. Interior lighting controls compliance paths – General & LLLC
3. Summary of interior lighting controls requirements
4. Advanced interior lighting controls – LLLC, NLC & high-end trim
5. Summary of exterior lighting controls requirements
6. Lighting system alterations and change of space use or occupancy
7. Functional testing of lighting controls (commissioning)


Lighting Power

Interior Lighting Power Allowances (LPA)

History of LPAs

- LED technology has been a key driver for reductions in lighting power allowances over successive energy code cycles.
- General LPAs are balanced with additional allowance LPAs, following industry trends in the use of specific application lighting.
- Greater emphasis on more granular occupancy-based lighting controls.

Interior Lighting Power Allowance Methods

Building Area Method

- Simplified list of building use types
- Each building area must comply independent of other building areas (no wattage trading allowed between areas)
- No additional lighting power allowances
- Typically provides less generous overall allowance

Table C405.4.2(1)
Interior Lighting Power Allowances—Building Area Method

Building Area Type	LPD(w/ft^2)
Automotive facility	0.64
Convention center	0.64
Court house	0.79
Dining: Bar lounge/leisure	0.79
Dining: Cafeteria/fast food	0.72
Dining: Family	0.71
Dormitory	0.46
Exercise center	0.67
Fire station	0.54
Gymnasium	0.75
Health care clinic	0.70
Hospital	0.84
Hotel/motel	0.56
Library	0.83
Manufacturing facility	0.82
Motion picture theater	0.44
Multiple family	0.41
Museum	0.55
Office	0.64
Parking garage	0.14
Penitentiary	0.65
Performing arts theater	0.84
Police station	0.66
Post office	0.65
Religious building	0.67
Retail	0.84
School/university	0.70
Sports arena	0.62
Town hall	0.69
Transportation	0.50
Warehouse	0.40
Workshop	0.91

Table C405.4.2(1)

Interior Lighting Power Allowance Methods

Space-by-Space Method

- Building may be divided into multiple space types
- 101 space types available
- Total LPA may be distributed across the entire project area
- Additional lighting allowances available
- More effort to calculate, however often provides a more generous overall allowance

Table C405.4.2(2)
Interior Lighting Power Allowances—Space-by-Space Method

Common Space-by-Space Types[a,j]	LPD (w/ft^2)
Atrium - Less than 20 feet in height	0.39
Atrium - 20 to 40 feet in height	0.48
Atrium - Above 40 feet in height	0.60
Audience/seating area - Permanent[i]	
In an auditorium	0.61
In a gymnasium	0.23
In a motion picture theater	0.27
In a penitentiary	0.67
In a performing arts theater	1.16
In a religious building	0.72
In a sports arena	0.33
Otherwise	0.23
Banking activity area[i]	0.61
Breakroom (see lounge/breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	0.89
Otherwise[h]	0.71
Computer room, data center	0.94
Conference/meeting/multipurpose	0.97
Confinement cell	0.70
Copy/print room	0.31
Corridor	
In a facility for the visually impaired (and not used primarily by the staff)[b]	0.71
In a hospital	0.71
In a manufacturing facility	0.41
Otherwise[c,i]	0.41
Courtroom[c]	1.20

Table C405.4.2(2)

Interior Lighting Power Density

Compliance is determined by comparing the total LPA, based on either the Building Area Method or the Space-by-Space Method, to the lighting power density of the proposed design.

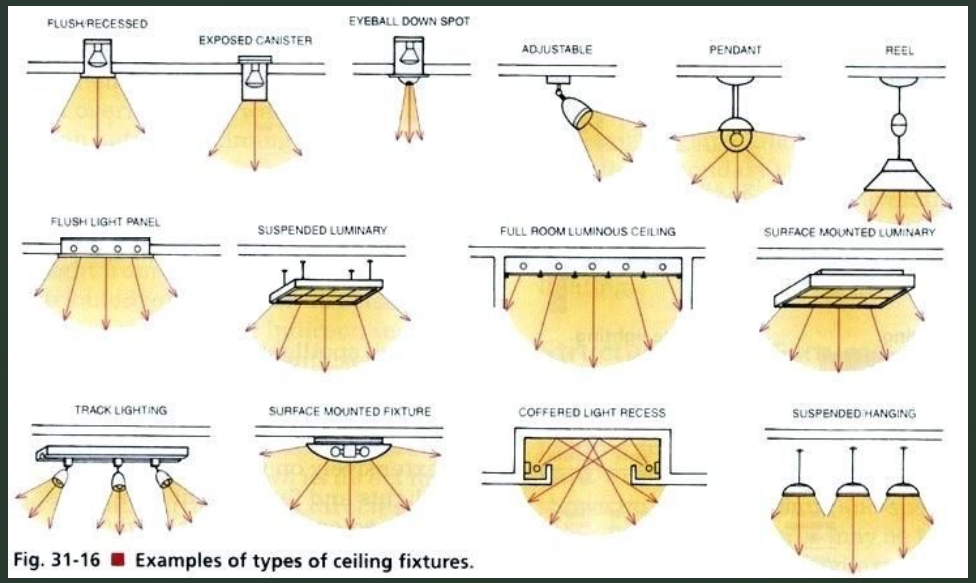


Fig. 31-16 ■ Examples of types of ceiling fixtures.

Interior Additional Allowance LPAs

Section C405.4.2.2.2
Table C405.4.2(2) Footnotes

Interior Additional Allowance LPAs

Space-by-Space Method Additional Allowances

1. Lighting in sales areas to highlight retail merchandise
   - Additional base site allowance = 500 watts
   - Retail 1 & 2 = 0.45 w/sf; Retail 3 = 1.05 w/sf; Retail 4 = 1.87 w/sf
2. Lighting to highlight art & exhibits – 0.2 watt/sf
3. Directional lighting for classroom white/chalkboard – 4.5 watts/lf
4. Ornamental lighting for decorative purposes – 0.15 w/sf

Use it or lose it allowances – Additional allowances can only be applied to installed fixtures, cannot carry over unused wattage allowance to other spaces.

Section C405.4.2.2.2
Table C405.4.2(2) Footnotes

Interior Lighting Power

Interior Lighting Allowances

Space-by-Space Type or Building Area allowances
Additional interior lighting allowances (SBS Only)
\+ (Base site allowance - Retail Only)

Total allowed interior lighting wattage

Additional allowance interior lighting shall be controlled independently from *general lighting per Section C405.2.6.*

Section C405.5.3
Table C405.5.3(1), (2) & (3)

Interior lighting power additional energy efficiency measures

Reduced lighting power options

- Total connected interior lighting power within the project area is 10% or 20% lower compared to the WSEC lighting power allowance (LPA).
- Applies to projects complying via the Building Area Method or Space-by-space Method.

Lamp efficacy in Group R-1 & R-2

- Lamps within permanently installed lighting fixtures shall have a minimum efficacy of 90 lumens per watt. Applies to ≥ 95% of fixtures.
- Applies to dwelling units and sleeping units within Group R-1 and Group R-2 occupancies.

Section C406.2.3.1
Section C406.2.3.2
Section C406.2.3.3

Exterior Lighting Power Allowance LPAs

Exterior Surface Allowances

- Lighting zone for the building establishes the base site allowance and all the exterior lighting power allowances
- Two categories of exterior lighting allowances
  1. General exterior surface allowances (parking, building grounds, areas under exterior canopies, etc)
  2. Allowances for specific exterior elements and locations (entrance lighting, loading areas, ATMs, building façade lighting)

Section C405.5.3
Table C405.5.3(1), (2) & (3)

Exterior Lighting Power Allowance LPAs

Table C405.5.3(2)
Lighting Power Allowances for Building Exteriors

	Lighting Zones			
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Base Site Allowance	160 W	280 W	400 W	560 W
Uncovered Parking Areas				
Parking areas and drives	0.015 W/ft^2	0.026 W/ft^2	0.037 W/ft^2	0.052 W/ft^2
Building Grounds				
Walkways and ramps less than 10 feet wide	0.04 W/ft^2	0.07 W/ft^2	0.10 W/ft^2	0.14 W/ft^2
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.04 W/ft^2	0.07 W/ft^2	0.10 W/ft^2	0.14 W/ft^2
Dining areas	0.156 W/ft^2	0.273 W/ft^2	0.390 W/ft^2	0.546 W/ft^2
Stairways	Exempt	Exempt	Exempt	Exempt
Pedestrian tunnels	0.063 W/ft^2	0.110 W/ft^2	0.157 W/ft^2	0.220 W/ft^2
Landscaping	0.014 W/ft^2	0.025 W/ft^2	0.036 W/ft^2	0.050 W/ft^2
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	5.6 W/linear foot of opening	9.8 W/linear foot of opening	14.0 W/linear foot of opening	19.6 W/linear foot of opening
Entry canopies	0.072 W/ft^2	0.126 W/ft^2	0.180 W/ft^2	0.252 W/ft^2
Loading docks	0.104 W/ft^2	0.182 W/ft^2	0.260 W/ft^2	0.364 W/ft^2

Table C405.5.3(1)
Exterior Lighting Zones

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

Section C405.5.3
Table C405.5.3(1), (2) & (3)

Exterior Lighting Power

Exterior Surface Lighting Allowance

Base site allowance

Exterior surface allowances

\+ Specific exterior element allowances

Total allowed exterior lighting wattage

Specific exterior element lighting shall be controlled independently from general exterior surface lighting

Section C405.5.3
Table C405.5.3(1), (2) & (3)

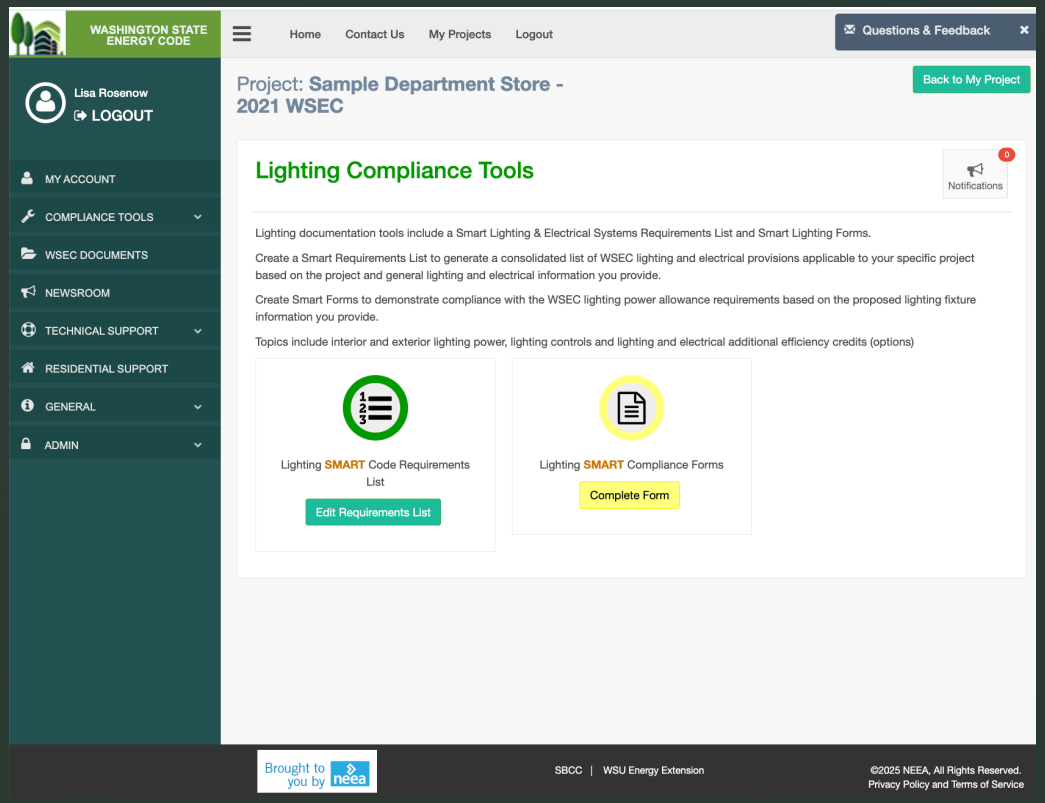
WSEC Commercial Compliance Documentation Webtool

INTERIOR LIGHTING FEATURES

- Supports building area method & space-by-space method calculations
- Supports additional lighting power allowance calculations
- Applies interior lighting additional efficiency credit multiplier to LPA calculations to verify compliance with this efficiency measure
- Includes various interior lighting controls prompts

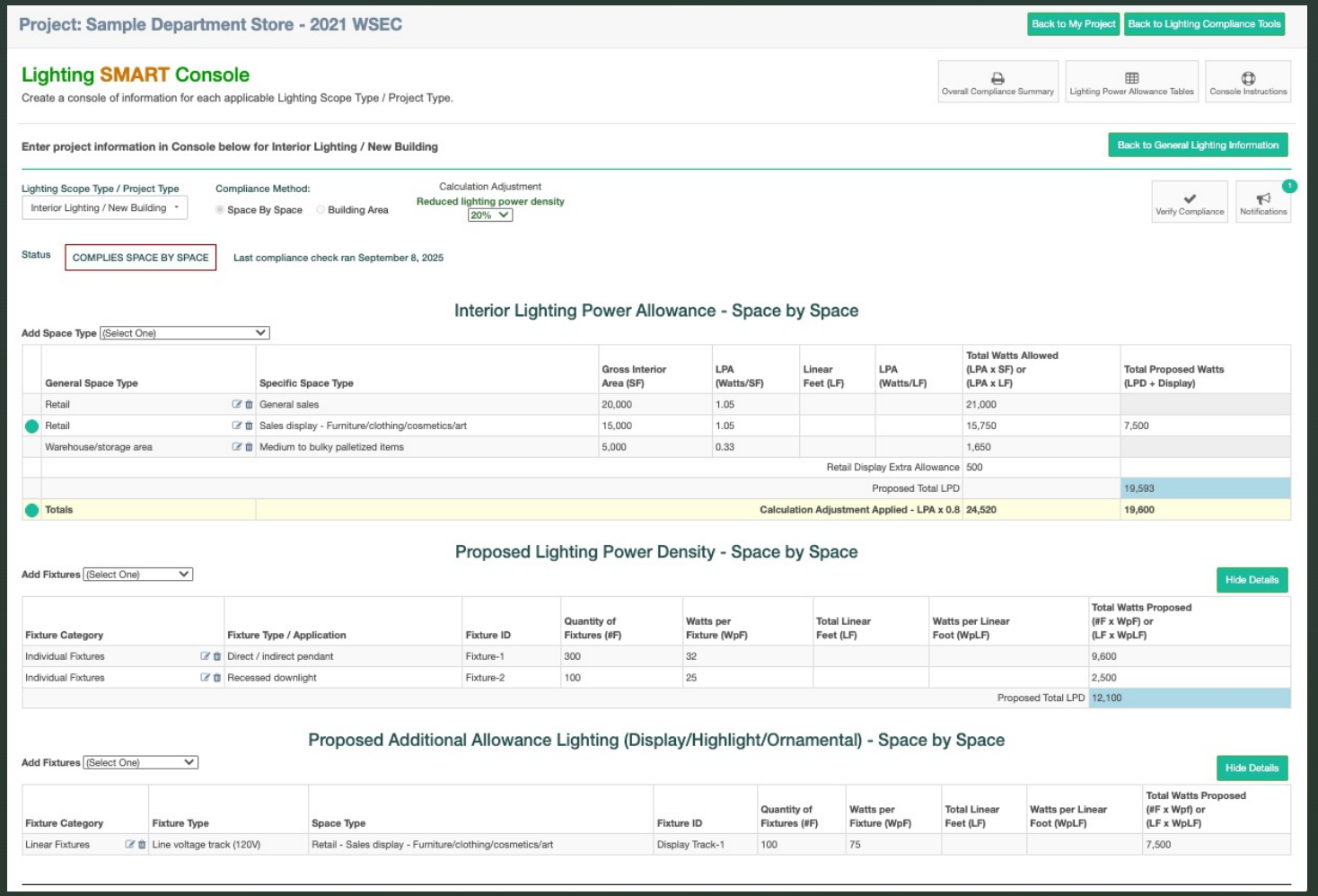
EXTERIOR LIGHTING FEATURES

- Supports exterior lighting and specific lighting power allowance calculations, including lighting zone base site allowance
- Includes various exterior lighting controls prompts



WSEC Commercial Compliance Documentation Webtool

Interior Lighting Compliance Console



Project: Sample Department Store - 2021 WSEC

Back to My Project | Back to Lighting Compliance Tools

Lighting SMART Console

Create a console of information for each applicable Lighting Scope Type / Project Type.

Overall Compliance Summary | Lighting Power Allowance Tables | Console Instructions

Enter project information in Console below for Interior Lighting / New Building

Back to General Lighting Information

Lighting Scope Type / Project Type: Interior Lighting / New Building

Compliance Method: Space By Space | Building Area

Calculation Adjustment: Reduced lighting power density 20%

Verify Compliance | Notifications

Status: COMPLIES SPACE BY SPACE — Last compliance check ran September 8, 2025

Interior Lighting Power Allowance - Space by Space

Add Space Type (Select One)

General Space Type	Specific Space Type	Gross Interior Area (SF)	LPA (Watts/SF)	Linear Feet (LF)	LPA (Watts/LF)	Total Watts Allowed (LPA x SF) or (LPA x LF)	Total Proposed Watts (LPD + Display)
Retail	General sales	20,000	1.05			21,000	
Retail	Sales display - Furniture/clothing/cosmetics/art	15,000	1.05			15,750	7,500
Warehouse/storage area	Medium to bulky palletized items	5,000	0.33			1,650	
					Retail Display Extra Allowance	500	
					Proposed Total LPD		19,593
Totals					**Calculation Adjustment Applied - LPA x 0.8**	**24,520**	**19,600**

Proposed Lighting Power Density - Space by Space

Add Fixtures (Select One)

Hide Details

Fixture Category	Fixture Type / Application	Fixture ID	Quantity of Fixtures (#F)	Watts per Fixture (WpF)	Total Linear Feet (LF)	Watts per Linear Foot (WpLF)	Total Watts Proposed (#F x WpF) or (LF x WpLF)
Individual Fixtures	Direct / indirect pendant	Fixture-1	300	32			9,600
Individual Fixtures	Recessed downlight	Fixture-2	100	25			2,500
						Proposed Total LPD	12,100

Proposed Additional Allowance Lighting (Display/Highlight/Ornamental) - Space by Space

Add Fixtures (Select One)

Hide Details

Fixture Category	Fixture Type	Space Type	Fixture ID	Quantity of Fixtures (#F)	Watts per Fixture (WpF)	Total Linear Feet (LF)	Watts per Linear Foot (WpLF)	Total Watts Proposed (#F x Wpf) or (LF x WpLF)
Linear Fixtures	Line voltage track (120V)	Retail - Sales display - Furniture/clothing/cosmetics/art	Display Track-1	100	75			7,500

LIGHTING COMPLIANCE SUMMARY

2021 WSEC Compliance Forms for Commercial Buildings including Group R2, R3 & R4 over 3 stories and all R1

Project & Applicant Information	**Project Title**	Sample Department Store - 2021 WSEC	For Building Department Use:	**Date: Sep 08, 2025**
	Project Address	1234 Main Street Shorleline, WA 98133		
	Applicant Name			
	Applicant Phone			
	Applicant Email			

For questions about this report, contact WSEC Commercial Technical Support at 360-539-5300 or via email at com.techsupport@waenergycodes.com

General Occupancy	All Commercial		**General Building Use Type**		Retail, General Sales	**Building Cond. Floor Area**	40,000
General Project Types	New Building	**New Building or Addition Lighting Scope**	Interior Lighting Exterior Lighting	**Alteration Lighting Scope**		**Project Cond. Floor Area**	40,000
						Floors Above Grade	1
						Compliance Method	General Prescriptive
Lighting Project Description							

Lighting Compliance Scope and Method	**Project Type**	**Interior / Exterior** (Interior includes both interior & parking)	**Luminaire Replacement Scope**	**Compliance Method**	**LPA Calculation Adjustment**	**Compliance Verification**
	New Building	Interior Lighting		Space by space	Reduced lighting power density option - 20%	**COMPLIES**
	New Building	Exterior Lighting			Not applicable to exterior	**COMPLIES**
Additional Energy Efficiency (AEC) Measures Included	Reduced lighting power density - 10% lower than LPA		**Load Management (LDM) Measures Included**		No lighting or electrical load management measures included in project	

Lighting Power Calculation	**NEW BUILDING - INTERIOR LIGHTING**	**Compliance Verification**	**COMPLIES**
Compliance Method	**Space by space**	**LPA Calculation Adjustment**	**LPA x 0.8**

Interior Lighting Power Allowance - Space by Space

General Space Type	**Specific Space Type**	**Gross Interior Area (SF)**	**LPA (Watts/SF)**	**Total Watts Allowed (SF x LPA x 0.8)**	**Total Proposed Watts (LPD + Display LPD)**	**Compliance Status**
Retail	General sales	20,000	1.05	21,000		
Retail	Sales display - Furniture/clothing/cosmetics/art	15,000	1.05	15,750	7,500	
Warehouse/storage area	Medium to bulky palletized items	5,000	0.33	1,650		
			Retail Display Extra Allowance	500		
			Proposed Total LPD		**12,100**	
	Totals	**Calculation Adjustment Applied - LPA x 0.8**		**24,520**	**19,600**	**COMPLIES**

Proposed Lighting Power Density

Fixture Type	**Fixture ID**	**Quantity of Fixtures (#F)**	**Watts or Wattage Limit per Fixture (WpF)**	**Total Linear Feet (LF)**	**Watts per Linear Foot (WpLF)**	**Total Watts Proposed (#F x WpF) or (LF x WpLF)**
Individual Fixtures						
Direct / indirect pendant	Fixture-1	300	32			9,600
Recessed downlight	Fixture-2	100	25			2,500
					Proposed Total LPD	**12,100**

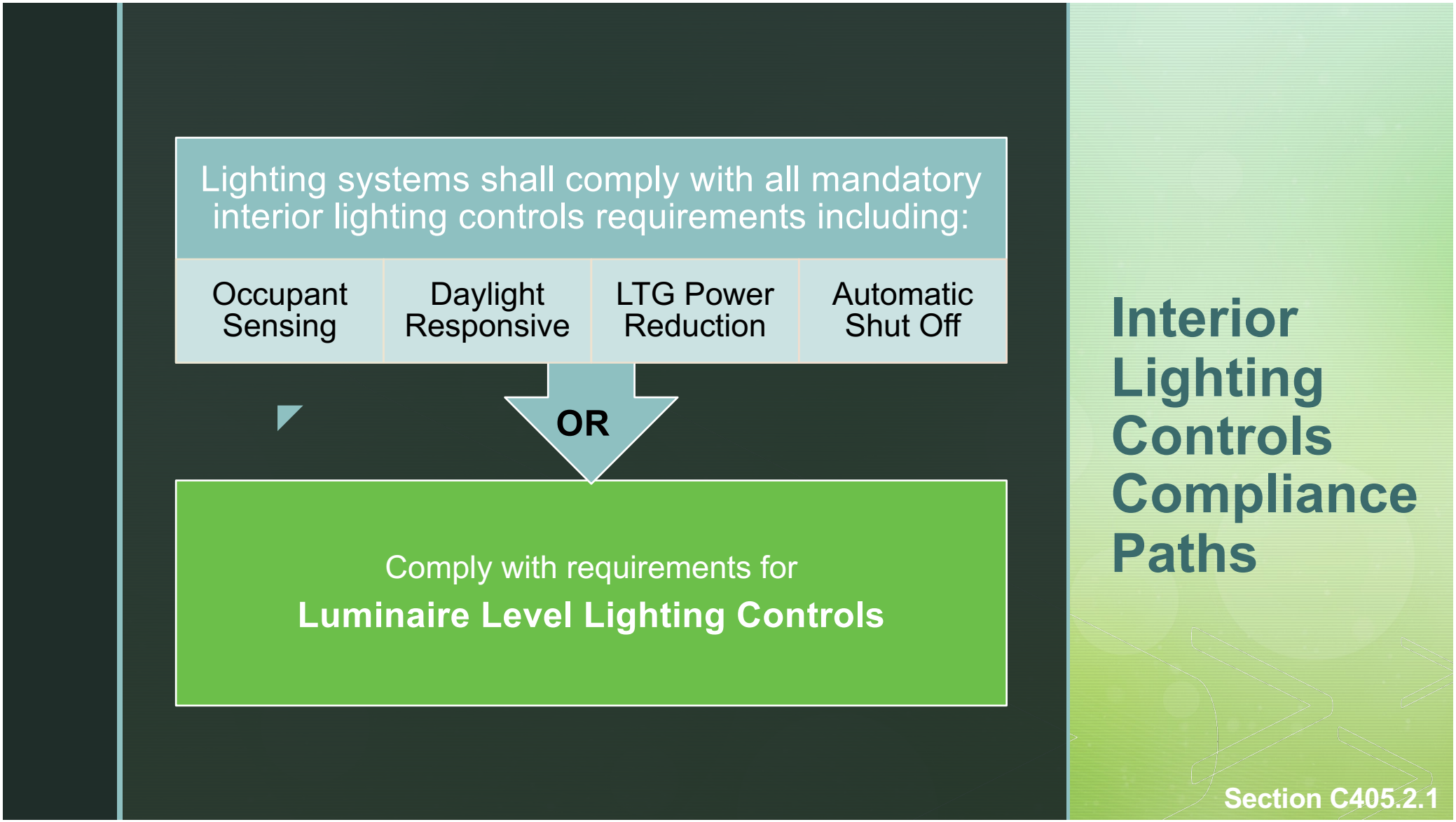
Proposed Additional Allowance Lighting (Display/Highlight/Ornamental)

Fixture Type	**Fixture ID**	**General and Specific Space Type**	**Quantity of Fixtures (#F)**	**Watts or Wattage Limit per Fixture (WpF)**	**Total Linear Feet (LF)**	**Watts per Linear Foot (WpLF)**	**Total Watts Proposed (#F x WpF) or (LF x WpLF)**
Linear Fixtures							
Line voltage track (120V)	Display Track-1	Retail - Sales display - Furniture/clothing/cosmetics/art	100	75			7,500

Proposed Fixtures Details	**NEW BUILDING - INTERIOR LIGHTING**			
Fixture Type/Application	**Fixture ID**	**Location in Documents**	**Lamp Type**	**New or Existing-to-Remain**
Individual Fixtures				
Direct / indirect pendant	Fixture-1	Plan L-1	LED	New
	Fixture Description:			Are these fixtures located within a daylight zone?: No
	Do these fixtures require specific application lighting controls?: None required			
Recessed downlight	Fixture-2	Plan L-1	LED	New
	Fixture Description:			Are these fixtures located within a daylight zone?: No
	Do these fixtures require specific application lighting controls?: General display/accent lighting, occupancy or time switch			

Generates output report for permit submittals

Interior Lighting Controls



Interior Lighting Controls Compliance Paths

Section C405.2.1

Occupant Sensing & Manual Controls

- Occupant sensing control function requirements ***vary by Space Type***
- Lighting fixtures in spaces not required to have occupant sensing controls shall comply with some other automatic lighting power reduction or automatic shut-off control requirement.
- Daylight sensing and specific application lighting control requirements may also apply.
- **MANUAL CONTROLS** - All fixtures are required to also be provided with a means of manual control, unless located within spaces where manual operation would endanger occupant safety or security.

Section C405.2.1
Section C405.2.1.1
Table C405.2.1
Section C405.2.3

Occupant Sensor Controls

General occupant sensing control requirements apply to the following space types:

- Classrooms, lecture & training rooms
- Conference, meeting & multipurpose rooms
- Open office areas
- Enclosed offices & open office areas ≤ 300 sf
- Copy/print rooms
- Lounge & breakrooms
- Locker rooms
- Restrooms & storage rooms
- Other misc small spaces ≤ 300 sf

Section C405.2.1
Table C405.2.1

Occupant Sensing Controls

Exceptions apply to:

- Corridors in manufacturing facilities
- General lighting & task lighting in shop & laboratory classrooms
- Luminaires that require specific application lighting controls per Section C405.2.6, unless this section specifically requires occupant sensing controls for the application

Section C405.2.1
Section C405.2.6

Occupant Sensing Control Functions

General occupant sensing & vacancy control requirements

- Provide manual-on control or configure control to automatically turn lighting on to ≤ 50% power when the control zone becomes occupied.
- Automatically turn off lights within 20 minutes of occupants leaving the space.
- Also include manual control, unless space is specifically exempted for occupant safety or security reasons.

Section C405.2.1.1

Occupant Sensing Control Functions

General lighting **in open plan office areas**

- Largest control zone for general lighting is ***≤ 600 sf***
- Automatically turn general lighting on to full power when control zone becomes occupied.
- General lighting in unoccupied control zones within the same open plan office area are permitted to automatically turn on to ***20% power*** OR remain off.
- When a general lighting zone is unoccupied for 20 minutes, automatically turn off or uniformly reduce lighting power to unoccupied setpoint ≤ 20% power.
- Automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office area.

Section C405.2.1.3

Occupant Sensing Control Functions

Warehouse storage areas & library stacks

- Each aisleway shall be controlled independently
- Automatically turn general lighting on to full power or design target lighting power when aisleway becomes occupied.
- When an aisleway is unoccupied for 20 minutes, automatically turn off or uniformly reduce lighting power to unoccupied setpoint ≤ ***50% power***.
- Automatically turn off lighting in all other areas of the warehouse or library within 20 minutes after all occupants have left the area OR comply with the time switch control requirements when building is vacant.

Section C405.2.1.2
Section C405.2.2

Occupant Sensing Control Functions

Enclosed fire rated stairways

- Automatically turn lighting on to full power when occupants enter stairway.
- When stairway is unoccupied for 20 minutes, reduce lighting power to unoccupied setpoint ≤ ***50% power***.
- Lighting levels in stairways shall comply with Section 1008 of the IBC while in vacancy mode.

Section C405.2.1.4

Occupant Sensing Control Functions

General corridors

- When corridor is unoccupied for 20 minutes, reduce lighting power to unoccupied setpoint ≤ ***50% power***.
- **Exception** - Corridors with less than 2 foot-candles of illumination on the floor at the darkest location of the corridor when all lights are on.

Section C405.2.1.5

Occupant Sensing Control Functions

Parking garages & covered vehicle entrances

- Lighting shall be controlled via general occupant sensor requirements (C405.2.1.1) or time switch controls (C405.2.2.1).
- Largest control zone is ***≤ 3,600 sf***
- Reduce lighting power by ***at least 30% w***hen lighting zone is unoccupied for 20 minutes***.***
- Lighting provided at covered vehicle entrances for eye adaptation, and luminaires within 20 feet of perimeter wall openings, shall be separately controlled to reduce lighting power to ≤ ***50% power*** from sunset to sunrise.

Section C405.2.10

Light Reduction & Time Switch Controls

As a starting point, luminaires that are ***not required*** to be controlled by occupant sensing controls shall comply with the following ~

- **C405.2.4 Light reductions controls for general lighting**
- **C405.2.2 Time switch controls**

Exemptions applicable to both provisions:

- Luminaires required to comply with specific application control requirements per **Section C405.2.6** (unless light reduction or time switch controls are required for the specific application).
- Where automatic light reduction or shut-off would endanger occupant safety or security.

Section C405.2.2
Section C405.2.4
Section C405.2.6

Light Reduction Control Functions for General Lighting

Manual control compliance options

1. Step lighting power reduction functionality to uniformly reduce overall lighting power within the lighting zone to ≤ 50% power.
   - Reduce lighting power of each luminaires by 30-70%, OR
   - Reduce total lighting power of rows of luminaires by 30-70%
2. Continuous dimming functionality from 100% to ≤ 20% power.

Additional exempt spaces & applications:

- Luminaires that are controlled by ***daylight responsive controls.***
- Spaces with low lighting wattage - 0.45 watts/sf OR small spaces served by just one < 60 watt luminaire.
- Additional exempt spaces - Corridors, lobbies, elec/mech rooms

Section C405.2.4

Time Switch Control Functions

Minimum functionality

- 7-day programmability with automatic holiday shut off
- Manual on override switch for ≤ 2 hours for area ≤ 5,000 sf
- Override may exceed 2 hours for areas up to 20,000 sf for the following spaces - Mall concourses, auditoriums, sales areas, manufacturing facilities, natatoriums, skating rinks and sports arenas

Additional exempt spaces & applications:

- Shop & laboratory classrooms
- Spaces where patient care is directly provided
- Lighting intended for continuous operation

Section C405.2.2

Daylight Responsive Controls

Daylight Responsive Controls

Daylight responsive controls are required for *general lighting* luminaires located within spaces with access to natural daylight

- Applies to daylit zones with the following lighting wattage:
  - Primary sidelit daylight zone > 75 watts
  - Combined primary & secondary daylight zones > 150 watts
  - Toplit daylight zone > 75 watts
- Refer to Sections C405.2.5.2 through C405.2.5.4 for daylight zone diagrams and definitions
- ***Provide daylight responsive controls in addition to occupancy sensing, light reduction and time switch controls, where required.***

Section C405.2.5

Daylight Responsive Controls

Exempt spaces

- Sidelit daylight zones on the 1st floor above grade in Group A-2 & Group M occupancies with the following qualifiers:
  - Fenestration adjoins a sidewalk or other outdoor pedestrian area
  - Exempt luminaires are controlled separately from general lighting
- Spaces where patient care is directly provided

Section C405.2.5

Daylight Responsive Control Functions

Controls function criteria

- Lighting in primary sidelit daylight zones is controlled independently of lighting in secondary sidelit daylight zones.
- Lights in toplit daylight zones is controlled independently of lighting in sidelit daylight zones.
- Lights in sidelit daylight zones facing different cardinal orientations are controlled independently of each other.
- Means of calibration is within the space served with ready access.
- Lighting power adjustment includes continuous dimming from full power to 15% power and full off.
- Largest control zone per daylight responsive control device is ***≤ 2,500 sf***

Section C405.2.5.1

Daylight Responsive Control Functions

Criteria for occupant sensing & daylight responsive combined controls

- When occupant sensing controls have reduced lighting power to the unoccupied setpoint, daylight responsive controls shall continue to reduce the lighting power level in response to available daylight.

Section C405.2.5.1

Specific Applications

Specific application lighting shall be controlled ***independently from*** general area lighting

- Additional lighting controls applications include:
  - Lighting for visual purposes other than general area lighting
  - Lighting for non-visual applications
  - Vacancy controls in sleeping units
  - Means of egress illumination
- Specific application lighting control requirements ***do not supersede*** mandatory lighting control requirements.

Section C405.2.6

Specific Applications

Item 1 – Lighting for visual purposes other than general area lighting

- Applications include:
  - Display & accent lighting, including display case lighting
  - Supplemental task lighting
  - Lighting for sale or demonstration
  - Exhibit display lighting in galleries, museums and monuments
- Provide occupancy sensors or time switch controls to turn lighting off.
- Light reduction controls ***are not*** required.
- Provide manual control in the same manner as all other lighting.

Section C405.2.6

Specific Applications

Item 2 – Vacancy controls in sleeping units

- Provide controls that automatically switch off all permanently installed luminaires and switched receptacles within 20 minutes after occupants have left the unit.
- Applies to all occupancies where there are sleeping units.

Section C405.2.6

Specific Applications

Item 3 – Lighting for non-visual applications

- Applications include:
  - Life support for nonhuman life forms (i.e. grow lights for plants)
  - Lighting used for food warming
- Dedicated control that is independent of controls for other lighting in the space.
- Largest control zone is ***≤ 4,000 sf*** or area served by a single luminaire, whichever is larger.

Section C405.2.6

Specific Applications

Item 5 – Means of egress illumination

- Applies to exit access and means of egress lighting as required by Section 1008 of the IBC.
- Includes luminaires that function as both normal and emergency means of egress illumination.
- Provide vacancy shut-off when areas are unoccupied when triggered by emergency relay & occupancy sensors, or a signal from another building control system

Section C405.2.6

Advanced Interior Lighting Controls

When are advanced interior lighting controls required?

- ***Mandatory*** for contiguous open office areas > 5,000 sf
- Projects complying via the LLLC compliance path
- Projects complying with the enhanced digital lighting controls additional energy efficiency measure.

Section C405.2.8
Section C405.2.1
Section C406.2.4.2

Advanced Interior Lighting Controls

Advanced control systems encompass all of the mandatory lighting control requirements in an optimized manner to enhance overall lighting system performance

- Advanced control methods include:
  - Networked lighting control (NLC)
  - Luminaire level lighting controls (LLLC)
- Both methods require all luminaires in the system to be configured with continuous full range dimming and high-end trim (or task tuning) for lighting power management.

Section C405.2.8.1
Section C405.2.8.2
Section C405.2.8.3

Advanced Interior Lighting Controls

Networked Lighting Controls (NLC)

- A smart lighting control strategy that uses a digital network to connect and control multiple luminaires, sensors and controllers for centralized lighting system management.
- Each luminaire shall be individually addressed
- The following may be addressed as a single fixture:
  - Multiple luminaires on ≤ 12-feet of linear track
  - Multiple luminaires ganged together to create the appearance of a single fixture up to 12-feet in length
- System shall collect and submit data to the control system to allow for demand response load shedding.

Section C405.2.8.2

Advanced Interior Lighting Controls

DEFINITION – Luminaire level lighting controls (LLLC)

- A lighting system consisting of one or more luminaires where each luminaire has embedded lighting control logic, occupancy and ambient light sensors, and local override switching capability, eliminating the need for separate devices.
- Each luminaire controller has wireless networking capabilities to detect and share information with other luminaires to automatically adapt lighting levels to the occupancy and daylight conditions.

Image courtesy of Energy Trust of Oregon

Section C202
Section C405.2.8.1

LLLC - Fewer Components

Without LLLC:

Dimming Driver

Wired Installation

Occupancy and Daylight Sensors

With LLLC:

Image courtesy of Cree, Inc.

LED luminaire with WSEC-required occupant sensing and daylight responsive functions built-in

Section C405.2.8.1

Lighting Control Example

Code-required control zones

Granular control zone potential

Dynamic LLLC Control

Multiple Benefits

- Simplified installation
- Flexible lighting control
- Improves occupant comfort
- Provides better lighting quality
- Delivers energy savings
- Lowers maintenance costs
- Supports integration with other building lighting systems

betterbricks/ *https://betterbricks.com/resources/luminaire-level-lighting-controls*

Enhanced lighting control additional energy efficiency measures

Enhanced digital lighting controls measure

- Lighting systems in at least 50% of the project floor area are provided with NLC or LLLC lighting controls with high end trim.

Group R-2 lighting controls measure

- In each dwelling or sleeping unit in a Group R-2 occupancy, provide a master control switch by the main entrance that turns off all lights and switched receptacles in the unit.
- Measure includes additional requirements for switched receptacles.

Section C406.2.4.1
Section C406.2.4.2

Exterior Lighting Controls

Exterior Lighting Control Functions

Daylight and occupancy-based control requirements

- Exterior lighting control function categories include:
  - Building façade & landscape lighting
  - Outdoor parking area lighting
  - All other exterior lighting surfaces
- All exterior lighting shall automatically turn off lighting when daylight is present and light level is sufficient to satisfy the lighting needs.
- Exterior time switch control function requirements apply.

Exempt exterior lighting:

- Covered vehicle entrances/exits for eye adaptation, safety or security
- Lighting controlled from within dwelling units

Section C405.2.9

Exterior Lighting Control Functions

Lighting setback for building façade & landscape lighting

- Automatically turn off lighting for ≥ 6 hours per night, or from 1 hour after business closing to 1 hour before business opening, whichever is less.
- Exception for areas where automatic shutoff would endanger safety or security.

Section C405.2.9.2

Exterior Lighting Control Functions

Lighting setback for outdoor parking areas

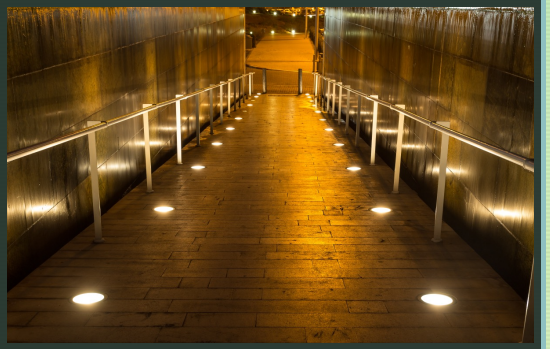
- For all outdoor parking luminaires, controls shall turn off lighting when daylight is present and light level is sufficient to satisfy the lighting needs.
- For luminaires with rated wattage > 40 watts and mounting height is ≤ 24 feet above the ground, lighting controls shall automatically reduce lighting power by ≤ 50% power when no activity is detected for 15 minutes.
- Largest control zone is ***≤ 1,500 watts*** of lighting power

Section C405.2.9.3, Item 1

Exterior Lighting Control Functions

Lighting setback for all other exterior surfaces

- Automatically reduce lighting power within the exterior surface scope area by ≤ 50% power.
- Accomplish by selectively switching off or dimming luminaires by one of the following schedules:
  1. Not later than midnight until 6:00am
  2. 1 hour after business closing to 1 hour before business opening
  3. When no activity is detected for 15 minutes
- *"All other lighting surfaces"* includes entry canopies, outdoor dining, loading docks, outdoor sales, walkways, ramps & stairways, etc



Section C405.2.9.3, Item 2

Lighting Alterations in Existing Buildings

Building Alterations

Alterations that trigger lighting power & controls upgrades

- Installation of new interior and/or exterior lighting systems
- Change of interior space configuration
- Building addition or initial tenant improvement (first build out)
- Change of use - Space is changed from one space use type to another space use type based on the lighting power allowance tables in Section C405, either per Building Area or Space-by-Space method.
- Change of occupancy
  - Group F,S or U to an occupancy other than Group F, S or U
  - Space converted to Group R from another use or occupancy OR Group R dwelling unit converted to commercial occupancy
- Change in space conditioning from low energy/semi-heated to fully conditioned space.

Luminaire Alterations

Interior lighting (including parking garages)

- If the lighting alteration adds or replaces **< 20%** of the ***number of fixtures*** in the space or building area ~
  - **No change in space use** – Total lighting power in the space prior to the alteration shall be maintained or reduced (cannot be increased).
  - **Change in space use or occupancy** – Total proposed lighting power (new + existing-to-remain) shall comply with the LPA requirements of the current code.
- Lighting power allowance test applies to each **SPACE TYPE or BUILDING AREA** individually.

Section C503.7.2

Luminaire Alterations

Interior lighting (including parking garages)

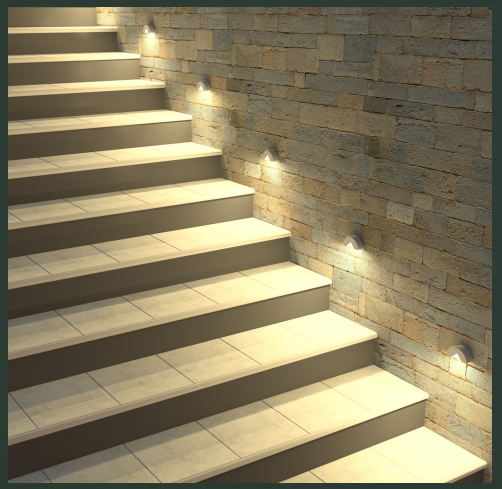
- If the lighting alteration adds or replaces **≥ 20%** of the ***number of fixtures*** in the space or building area ~
  - Total proposed lighting power (new + existing-to-remain) shall comply with the LPA requirements of the current code.
  - May comply via Building Area Method or Space-by-Space Method
- Lighting power allowance test applies to each **SPACE TYPE or BUILDING AREA** individually.

Section C503.7.2

Luminaire Alterations

Exterior lighting

- If the lighting alteration adds or replaces **< 20%** of the ***installed wattage*** of exterior luminaries for an exterior surface type ~
  - Total lighting power of the project exterior surface(s) prior to the alteration shall be maintained or reduced (cannot be increased).
- Lighting power allowance test applies to each **EXTERIOR SURFACE TYPE** individually.



Section C503.7.2

Luminaire Alterations

Exterior lighting

- If the lighting alteration adds or replaces **≥ 20%** of the ***installed wattage*** of exterior luminaries for an exterior surface type ~
  - Total proposed lighting power (new + existing-to-remain) shall comply with the LPA requirements of the current code.
  - *ETC Unofficial Interpretation – Base Site Allowance cannot be applied to the exterior lighting alteration LPA unless the calculation includes all exterior lighting wattage for the entire building site.*
- Lighting power allowance test applies to each **EXTERIOR SURFACE TYPE** individually.

Section C503.7.2

Rewiring and Recircuiting

ALL applicable lighting control requirements apply as follows ~

Where new wiring is installed to serve added or relocated fixtures:

- Occupant sensing (C405.2.1)
- Manual controls (C405.2.3)
- Light-reduction controls (C405.2.4)
- Daylight responsive controls (C405.2.5)

New lighting panel is installed with new raceway and conductors from the panel to the fixtures:

- Same requirements as for new wiring
- Additional lighting controls (C405.2.6)
- Advanced lighting controls (C405.2.8)
- Commissioning (C408.4)

Section C503.7.3
Section C503.7.4

Newly Created Rooms

Where new walls or ceiling-height partitions are added to an existing space to create a new enclosed space, but the lighting fixtures are not changed other than being relocated.

- Occupant sensing (C405.2.1)
- Manual controls (C405.2.3)
- Light-reduction controls (C405.2.4)
- Daylight responsive controls (C405.2.5)
- Daylight responsive controls (C405.2.5)
- Additional lighting controls (C405.2.6)
- Commissioning (C408.4)

Section C503.7.5

Lighting Commissioning (Cx)

Applicable Cx Codes & Resources

- 2021 WSEC-C – Section C408
- ASHRAE Standard 202-2024 Commissioning Process Requirements for New Buildings and Systems
- ASHRAE Guideline 0 – The Commissioning Process
- IES DG-29-11 – The Commissioning Process Applied to Lighting and Control Systems
- Lighting Design Lab – Commissioning Lighting Control Systems
- BCxA - Building Commissioning Association

When is Cx of lighting controls required?

Cx is required when **BOTH** of the following are true:

- The total installed lighting power is greater than 20 kW (20,000 watts).
- The lighting power controlled by occupant sensing or automatic daylight responsive controls is greater than 10 kW (10,000 watts).

NOTE – These Cx thresholds also apply to initial tenant improvements, building additions and lighting alterations.

Cx Example – Big Box Retail Store

- Connected lighting power in the retail space is 35 kW (35,000 watts)
- Connected lighting power in the back of house and administrative areas is 3 kW (3,000 watts)
- Retail space lighting controlled by programmable timeclock with override
- Occupant sensing controls in the back of house and administrative areas
- No daylight responsive controls

Is Cx of lighting controls required?

ANSWER – NO

The connected lighting power controlled by occupant sensing and daylight responsive controls is less than 10 kW (10,000 watts).

Cx Example – Elementary School

- Total connected lighting power is 35 kW (35,000 watts)
- Total connected lighting power controlled by occupant sensing or daylight responsive controls is 33 kW (33,000 watts)

Is Cx of lighting controls required?

ANSWER – YES
The total lighting power is > 20 kW and the connected lighting power controlled by occupant sensing and daylight responsive controls is greater than 10 kW.

Common Lighting Control Cx Issues

- Occupancy sensor time delay not programmed and exceeds the maximum time limit of 20 minutes per Section C405.2.1.1.
- Automatic daylight responsive controls not programmed per the design intent.
- Time switch controls not programmed to the correct date and time.
- Daylight responsive controls are not configured to dim from full output to 15% power per Section C405.2.5.1.
- Lighting controls in sleeping units (hotel/motel rooms) not configured to turn off all permanently installed luminaires within 20 minutes after occupants have left the unit per Section C405.2.6.
- Advanced controls (LLLC or NLC) are not configured with the required functionality per Section C405.2.8.

Lighting Design Lab

- Multiple webinars that cover details about lighting controls design
- 2021 WSEC and 2021 SEC lighting requirements
- https://www.lightingdesignlab.com/

2021 WSEC-C Lighting Controls Review

WSEC Commercial Technical Support Team:
Duane Lewellen – Lewellen Associates, LLC
Lisa Rosenow – Evergreen Technology Consulting (ETC)
(360) 539-5300|com.techsupport@waenergycodes.com