

Top 40 Requirements You Should Know: 2018 IECC

Part 1 (Commercial Envelope & Commercial Lighting)

4.23.2020



SEDAC

SMART ENERGY DESIGN ASSISTANCE CENTER

Providing effective energy strategies for buildings and communities

SEDAC is a Preferred Education Provider with the International Code Council (ICC). Credits earned on completion of this program will be reported to ICC for ICC members. Certificates of Completion will be issued to all participants.



This workshop is approved for 1.5 LU/HSW CES credits from the American Institute of Architects (AIA). Credits earned on completion will be reported for AIA members.





Learning Objectives

1. Learn about the changes in the updated Illinois Energy Conservation Code (2015 IECC to 2018 IECC).
2. Identify the 20 most important Illinois Energy Conservation Code compliance issues in the commercial envelope and commercial lighting provisions
3. Understand how to comply with the current Illinois Energy Conservation Code for commercial building design and construction

Who We Are

The Smart Energy Design Assistance Center (SEDAC) is an applied research program at University of Illinois.

Our mission: Reduce the energy footprint of Illinois and beyond.



SEDAC is the Illinois Energy Conservation Code Training Provider



This training program is sponsored by **Illinois State Energy Office**

Energy Code Training Program

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



Illinois Energy Conservation Code

Energy Code Training

Illinois Energy Conservation Code

Workshops

Webinars

Online Training

Resources

Frequently Asked Questions

Contact us

Illinois Energy Conservation Code

Effective date of 2018 IECC for State of Illinois: July 1, 2019

The updated Illinois Energy Conservation Code based on the 2018 IECC with Illinois Amendments became effective on **July 1, 2019**. For permit applications started on or after July 1, 2019, this code applies.

In accordance with the [Energy Efficient Building Act](#), the [Capital Development Board](#) (CDB) is required to review and adopt the most current version of the International Energy Conservation Code (IECC) within one year of its publication date. The Code will then become effective in Illinois within 6 months following its adoption by the CDB. The CDB, in conjunction with the [Illinois Environmental Protection Agency](#) and the [Illinois Energy Conservation Advisory Council](#), initiates the cycle for the Illinois Energy Conservation Code to be updated every three years.

The 2018 Illinois Energy Conservation Code can be accessed here:

- [2018 IECC](#)
- [Illinois amendments](#)

Effective date of 2018 IECC for City of Chicago: June 1, 2019

For permit applications started on or after June 1, 2019, the Chicago Energy Conservation Code (Title 14N of the Municipal Code), based on the 2018 edition of the International Energy Conservation Code applies. Solar requirements for roof coverings are still applicable and can be found in Section 1515 of the Chicago Building Code (Title 14B). For more details on the Chicago Energy Conservation Code and required Energy Conservation Compliance Statement, please visit the Department of Buildings, City of Chicago [website](#).



Illinois Energy Conservation Code



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Illinois Energy Conservation Code

The Illinois Energy Conservation Code requires design and construction professionals to follow the latest published edition of the International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings" including amendments adopted by the Capital Development Board.

State Funded Facilities must comply with ASHRAE 90.1 per 20 ILCS 3105/10.09-5. See Subpart B of the [Illinois Energy Conservation Code](#) for more information. The 2013 edition of ASHRAE 90.1 went into effect on 1/1/16.

Privately Funded Commercial Facilities must comply with IECC per 20 ILCS 3125. See Subpart C of the [Illinois Energy Conservation Code](#) for more information. The 2015 edition of the IECC went into effect on 1/1/16.

Residential Buildings must comply with IECC per 20 ILCS 3125. See Subpart D of the [Illinois Energy Conservation Code](#) for more information. The 2015 edition of the IECC went into effect on 1/1/16.

July 2019
State Funded Facilities no longer need to comply with the ASHRAE 90.1

CDB ▸ [Business with CDB](#) ▸ [Illinois Codes](#) ▸ [Illinois Energy Conservation Code](#)

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Additional information including training opportunities, interpretations and frequently asked questions can be found on the [Illinois Environmental Protection Agency's web site](#).

Upcoming Training Opportunities for the 2018 Illinois Energy Conservation Code are being provided by the Smart Energy Design Assistance Center. For more information, please use the following link, <https://smartenergy.illinois.edu/upcoming-energycode-events>.

Updates to the Illinois Energy Conservation Code

ILLINOIS CODES

[Building Codes & Regulations](#)

[Illinois Accessibility Code](#)

[Illinois Administrative Code](#)

[Illinois Energy Conservation Code](#)

[State Building Code Information](#)

Chicago Building Dept. Energy Code Compliance Statement



2019 Commercial Compliance Statement ENERGY CONSERVATION CODE

This form must be completed by an Illinois-licensed architect or engineer and submitted with every application to construct or alter a building, other than a residential building four stories or less above grade. A Residential Compliance Statement must be filed for a residential building up to four stories. If a mixed-occupancy building contains both a non-residential occupancy and a residential occupancy up to four stories, both forms must be filed. No form is required for temporary structure, cellular communication, electrical-only, and easy permit applications.

1. Project Information	
Address:	Permit App. No.:
2. Professional Certification of Compliance with Chicago Energy Conservation Code and Solar Reflectance Requirements	
To the best of my knowledge, belief, and professional judgment, all work shown in the plans submitted with this permit application is:	
<input type="checkbox"/> In compliance with the commercial requirements of the Chicago Energy Conservation Code (Title 14N) as detailed in section 3. <input type="checkbox"/> Exempt from the commercial requirements of the Chicago Energy Conservation Code as (select one):	
<input type="checkbox"/> the reconstruction, or renewal of any part of an existing building for its maintenance or to correct damage (repairs). (NO alterations or additions)	<input type="checkbox"/> the alteration, relocation, or change of occupancy of a historic building, and the report required by CS01.6 is attached to this compliance statement.
Roof coverings to be installed under this application comply with the solar reflectance requirements of the Chicago Building Code (Sec. 1515). Additionally, the plans and documents submitted with this application comply with the specific requirements the Chicago Energy Conservation Code (as applicable) and the general requirements of Chapter 14A-4 of the Chicago Construction Codes.	
I have notified the permit applicant of all post-construction testing or commissioning requirements of the Chicago Energy Conservation Code which are applicable to the project based upon the scope of work identified in the permit application and compliance method identified below.	
Name:	IL License No.:
Signature:	Seal:

3. Compliance Method	
<input type="checkbox"/> A. COMcheck (RECOMMENDED) <small>visit www.energycodes.gov/comcheck for more info</small> A COMcheck compliance certificate demonstrating the project's compliance with IECC-2018 or ASHRAE 90.1-2016 is attached to this compliance statement. Accurate information about the project was entered into COMcheck.	
<input type="checkbox"/> B. IECC Prescriptive Path A report or narrative substantiating how the project complies with the prescriptive requirements of the Energy Conservation Code, including C402, C403, C404, and C405 is attached to this compliance statement. The project meets C406 by providing (select one):	
<input type="checkbox"/> more efficient HVAC performance <input type="checkbox"/> on-site supply of renewable energy <input type="checkbox"/> enhanced envelope performance	<input type="checkbox"/> reduced lighting power density system <input type="checkbox"/> dedicated outdoor air system for HVAC <input type="checkbox"/> reduced air infiltration <input type="checkbox"/> enhanced lighting controls <input type="checkbox"/> high-efficiency service water heating <input type="checkbox"/> exception: prev. occupied tenant space
<input type="checkbox"/> C. IECC Total Building Performance Method The project complies with C407 and a compliance report meeting the requirements of C407.4.1 is attached to this compliance statement. An explanation of any error or warning messages appearing in the simulation tool output is also attached.	
<input type="checkbox"/> D. ASHRAE 90.1 Prescriptive Path The project complies with sections 5, 6, 7, 8, 9 and 10 of ASHRAE 90.1-2016, as detailed below, and complete compliance forms from the 2016 edition of the 90.1 User's Manual or equivalent documentation is attached to this compliance statement. (select one in each column)	
<input type="checkbox"/> 5.5 prescriptive building envelope <input type="checkbox"/> 5.6 building envelope trade-off	<input type="checkbox"/> 6.3 simplified HVAC <input type="checkbox"/> 6.5 HVAC prescriptive path <input type="checkbox"/> 6.6 HVAC alternative compliance path <input type="checkbox"/> 9.5 lighting - building area method <input type="checkbox"/> 9.6 lighting - space-by-space method
<input type="checkbox"/> E. ASHRAE 90.1 Energy Cost Budget The project complies with section 11 of ASHRAE 90.1-2016, and documentation complying with section 11.7 is attached to this compliance statement.	
<input type="checkbox"/> F. ASHRAE 90.1 Performance Rating Method The project complies with normative appendix G of ASHRAE 90.1-2016, and a simulated performance report, complying with section G1.3, is attached to this compliance statement.	

Access to 2018 IECC, Illinois Amendments & Chicago Energy Conservation Code

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

<https://www2.illinois.gov/cdb/business/codes/IllinoisAccessibilityCode/Documents/2018%20Illinois%20Specific%20Amendments%20with%20Modifications%20Shown.pdf>

<https://www.chicago.gov/content/dam/city/depts/bldgs/general/Energycode/Title%2014N%20ordinance.pdf>

The screenshot shows the ICC website interface for the 2018 International Energy Conservation Code. It includes a search bar, a navigation menu on the left with categories like 'EFFECTIVE USE OF THE INTERNATIONAL ENERGY CONSERVATION CODE', 'IECC—COMMERCIAL PROVISIONS', and 'IECC—RESIDENTIAL PROVISIONS'. The main content area displays the title '2018 International Energy Conservation Code' with a 'Legend' section explaining navigation options and a 'My Notes and Bookmarks' section. An 'Associated Titles' section lists previous editions of the code.

ARTICLE XIII. CHICAGO ENERGY CONSERVATION CODE

SECTION 1. The Municipal Code of Chicago is hereby amended by inserting a new Title 14N, as follows:

TITLE 14N ENERGY CONSERVATION CODE

PART I – COMMERCIAL PROVISIONS

CHAPTER 14N-C1 SCOPE AND PURPOSE

14N-C1-C001 Adoption of the commercial provisions of the International Energy Conservation Code by reference.

The commercial provisions of the *International Energy Conservation Code*, 2018 edition, second printing, and all errata thereto identified by the publisher (hereinafter referred to as "IECC-CE"), except Appendix CA, are adopted by reference and shall be considered part of the requirements of this title except as modified by the specific provisions of this title.

If a conflict exists between a provision modified by this title and a provision adopted without modification, the modified provision shall control.

14N-C1-C002 Citations.

Provisions of IECC-CE which are incorporated into this title by reference may be cited as follows:

14N-C[IECC-CE chapter number]-[IECC-CE section number]

14N-C1-C003 Global modifications.

The following modifications shall apply to each provision of IECC-CE incorporated into this title:

- Replace each occurrence of "International Codes" with "Chicago Construction Codes."
- Replace each occurrence of "International Building Code" with "Chicago Building Code."
- Replace each occurrence of "ASME A17.1" or "ASME A17.1/CSA B44" with "the Chicago Conveyance Device Code."
- Replace each occurrence of "NFPA 70" with "the Chicago Electrical Code."

CHAPTER 1 [CE] SCOPE AND ADMINISTRATION

SECTION C101 SCOPE AND GENERAL REQUIREMENTS

C101.1 Title. This code shall be known as the *International Energy Conservation Code of [NAME OF JURISDICTION]* and shall be cited as such. *Illinois Energy Conservation Code* or "this Code" and shall mean:

With respect to the State facilities covered by 71 Ill. Adm. Code 600.Subpart B:

This Part, all additional requirements incorporated within Subpart B (including the 2018 International Energy Conservation Code, including all published errata but excluding published supplements that encompass ASHRAE 90.1-2016), and any statutorily authorized adaptations to the incorporated standards adopted by CDB are effective July 1, 2019.

With respect to the privately funded commercial facilities covered by 71 Ill. Adm. Code 600.Subpart C:

This Part, all additional requirements incorporated within Subpart C (including the 2018 International Energy Conservation Code, including all published errata and excluding published supplements that

C101.1.3 Adaptation. The Board may appropriate to adapt the International Energy Conservation Code apply to the particular economy, population distribution, geography and climate of the State a construction within the State, consistent with public policy objectives of the EEB Act.

C101.5 Compliance. Residential buildings shall meet the provisions of IECC—Residential Provisions Commercial buildings shall meet the provisions IECC—Commercial Provisions the *Illinois Energy Conservation Code* covered by 71 Ill. Adm. Code 600.Subpart C. The local authority having jurisdiction (AHJ) shall establish its own procedure for enforcement of the Illinois Energy Conservation Code. Minimum compliance shall be demonstrated submission of:

- Compliance forms published in the ASHRAE 90.1 User's Manual; or
- Compliance Certificates generated by the U.S. Department of Energy's COMcheck™ Code compliance tool; or
- Other comparable compliance materials that meet or exceed, as determined by the AHJ, compliance forms published in the ASHRAE 90.1 User's Manual or the U.S. Department of Energy's COMcheck™ Code compliance tool;
- The seal of the architect/engineer as required Section 14 of the Illinois Architectural Practice Act [225 ILCS 305], Section 12 of the Struct

SEDAC TOP 10 Series Webinars

Top 10 Requirements You Should Know: 2018 IECC

- Residential: September 12 (Archived)
- Commercial Envelope: October 16 (Archived)
- Commercial Lighting: December 18 (Archived)
- Commercial HVAC: January 29 (Archived)

- COMcheck™ & REScheck™ Walk-through: May 6

Registration: <https://smartenergy.illinois.edu/energy-code-training/webinars>

Top 40 Requirements (Part 1): 2018 IECC Commercial Envelope

1. Building Exemptions from IL Energy Code [600.310]
2. Roof Assembly [C402.2.1]
3. Above & Below Grade Walls [C402.2.2, C402.2.5]
4. Fenestration – Assembly U-factors [C402.4]
5. Floor/Slab Insulation [C402.2.3, C402.2.4]
6. Air Leakage – Thermal Envelope [C402.5]
7. Air Barrier Compliance [C402.5.1.2]
8. Component Performance Alternative [C402.1.5]
9. Air Barrier Materials [C402.5.1.2.1]
10. Air Leakage of Fenestration [C402.5.2]



www.wbdg.org/resources

Top 40 Requirements (Part 1): 2018 IECC Commercial Lighting

11. Occupant Sensor Controls [C405.2.1]
12. Time-switch Controls [C405.2.2]
13. Daylight-responsive Controls [C405.2.3]
14. Specific Application Controls [C405.2.4]
15. Exterior Lighting Controls [C405.2.6]
16. Lighting Power Allowances [C405.3, C405.4]
17. Functional Testing of Lighting Controls [C408.3]
18. Reduced Lighting Power [C406.3]
19. Enhanced Digital Lighting Control [C406.4]
20. Luminaire Level Lighting Controls [C405.2]



#1. 600.310 Building Exemptions from IL Energy Code

Exempt From Locally Adopted Building Code



Don't Contain Conditioned Space



Buildings Without Comfort Conditioning

- Presumed no comfort conditioning if electric service <100 amps
- Code official may determine service required for other purposes and exempt the building if 100+ amps.



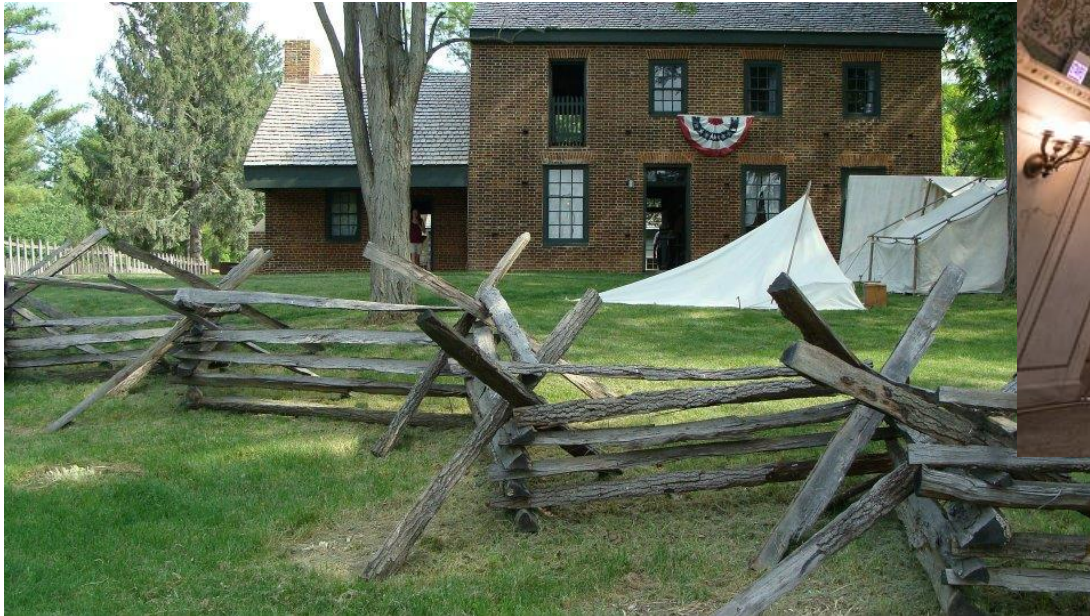
Listed Historic Buildings

- Listed on National Register
- Listed on IL Register
- Designated by authorized personnel as historically significant



Buildings Specified in IECC

C501.6 Historic Buildings. Provisions of this code...shall not be mandatory for historic buildings provided a report has been submitted...demonstrating that compliance with the provision would threaten, degrade, or destroy the historic form, fabric, or function of the building.



#2. C402.2.1 Roof Assembly – Insulation Requirements

Insulation Can't Sit on Suspended Ceilings

- Insulation counts



Continuous Must be Minimum of 2 Layers

New 2018 IECC: Continuous insulation needs to have 2 layers with joints staggered



Skylight Curbs Minimum of R-5 or NFRC 100

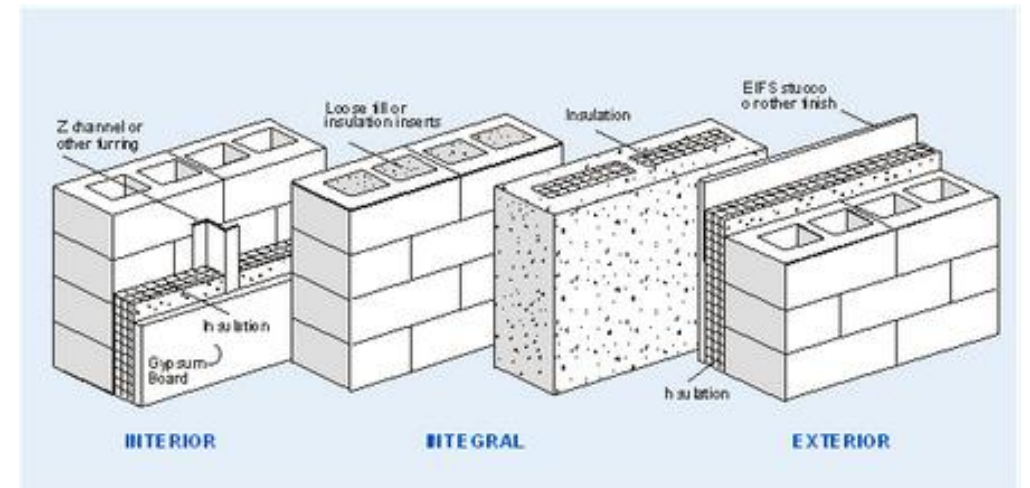
R-5 minimum curb insulation is new requirement if not NFRC 100-labeled skylight assembly.



#3. C402.2.2, Above-Grade & C402.2.5 Below Grade Wall Insulation

Wall Insulation – Chicago Title 14N Modification

- Chicago Title 14N Deletes Section 402.2.2 in its entirety, leaving only the requirements in Table C402.1.3 for above-grade wall assemblies.
- Essentially simplifies down to walls have to meet Table C402.1.3 R-value requirements if following the R-value compliance method.



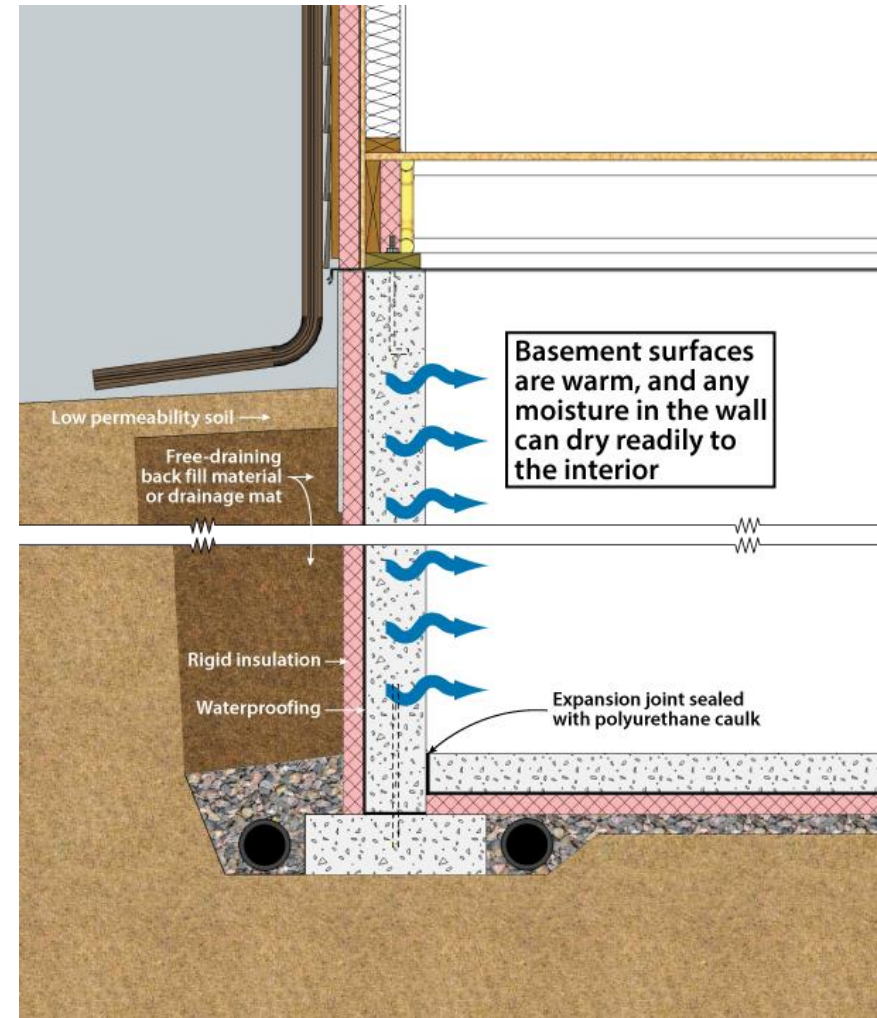
Insulation Interior or Exterior



Below Grade Walls, Beware Water Vapor


New 2018 IECC: C402.2.5 Below grade walls: C-factor and R-value must follow Tables C402.1.4 or C402.1.3 values, and insulation used to meet values must extend ≥ 10 ft below grade or to the level of lowest conditioned floor, whichever is less.

Best practice is to insulate exterior to allow for interior drying.



#4. C402.4 Fenestration

Fenestration labeling

 National Fenestration Rating Council CERTIFIED	Restorations Windows Vinyl Extruded, UltraCore Frame, Triple Glazed, Krypton90, Low-E Product Type: Vertical Slider
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) 0.18	Solar Heat Gain Coefficient 0.22
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance 0.42	Air Leakage (U.S./I-P) 0.1
Condensation Resistance 70	
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>	
Actual test sample .03 air leakage.	

Pre-built window assemblies are easy – window label tacked to glazing
What about site-built (curtain wall) assemblies?
NFRC has a site-built program and component modeling program to create label certificates for fenestration assemblies.

To meet code compliance, labels have to be available to AHJ for verification.

Fenestration Certificate of Compliance

Single document for all windows at the site

Generated by Component Modeling Approach Software Tool -

<http://cmast.nfrc.org/>

Final site-built products verified by [NFRC-Approved Calculation Entity](#)

The screenshot displays the 'Product' software interface with the following sections:

- Product Information:** Server ID: P-TUB-15327, Client ID: [empty], Product Name: 300 ES, Manufacturer: Tubelite, Inc., Description: [empty], Notes: [empty].
- Performance Metrics:**

Property	NFRC Size	Actual Size
U factor:	78.74 x 78.74 in. 0.313	78.74 x 78.74 in. 0.313
SHGC:	0.192	0.192
VT:	0.408	0.408
- Configuration:** Frame Assembly: FA-TUB-20845: TUB-300ES CW-Validation, Product Type: GWCW - Glazed Wall System Curtain Wall, Width: 78.74 in., Height: 78.74 in., Status: Design.
- Component Selection for Individual Product:** Framing: F-TUB-13215: TUB-300ES CW-Jams-VAL; Insulated Glazing Unit: Center Of Glazing: GA-PPG-7858: SB70XL PPG Sole; Spacer Edge Seal Assembly: SA-NFR-3572: Generic Spacer; Dividers: [empty].
- Visibility:** My Company Only [dropdown], Additional Persons & Companies [button].
- Buttons:** History, Calculate, EnergyPlus Report, Doe2 Report, OK, Cancel.

#5. C402.2.3 Floors and C402.2.4 Slab-on- Grade Insulation

Floor insulation problems



Must ensure insulation maintains permanent contact with subfloor. Avoid fibrous insulation on rim joists!



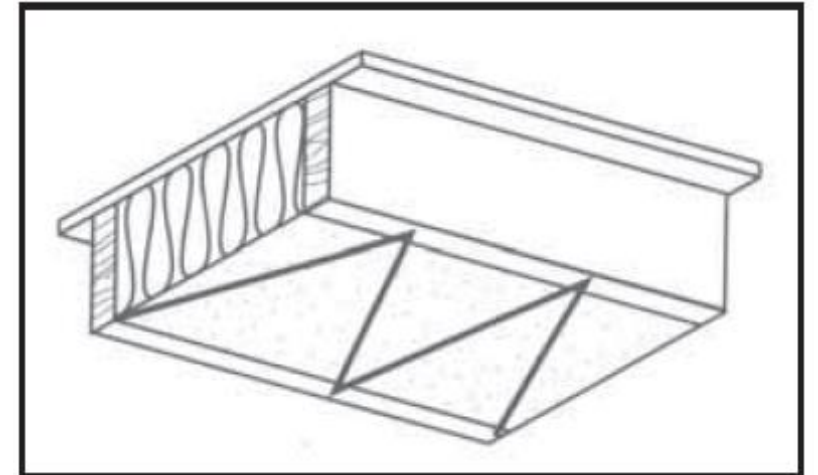
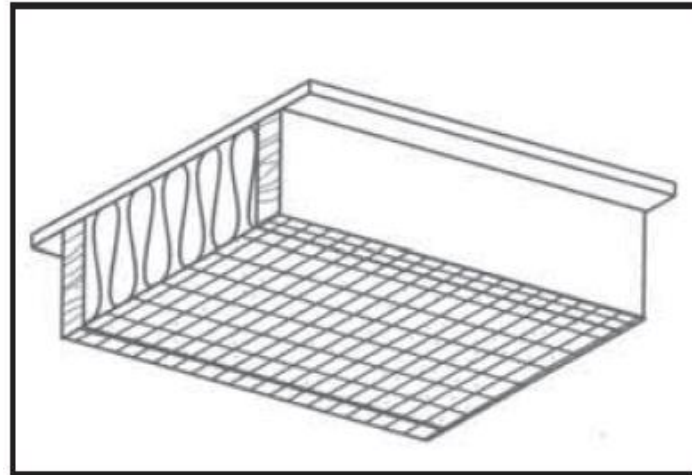
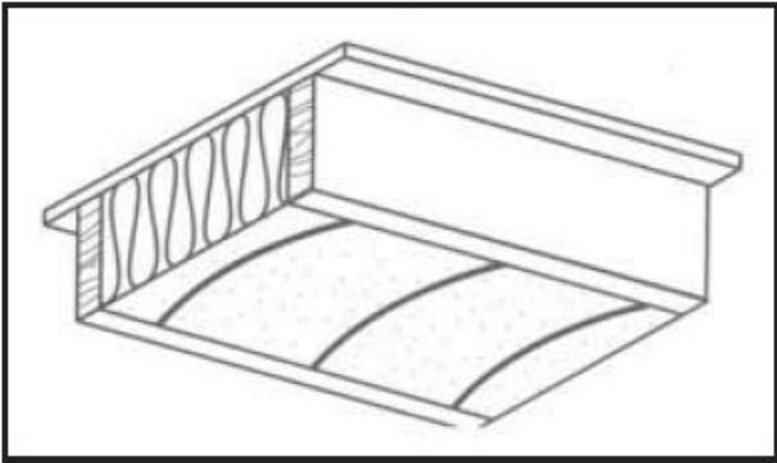
Different methods of attaching insulation

Left method is partially compressed

Note all three are in contact with the subfloor per code

Requires full depth insulation

R-10 for mass floors, R-30 for joist cavity floors



Examples of attachment



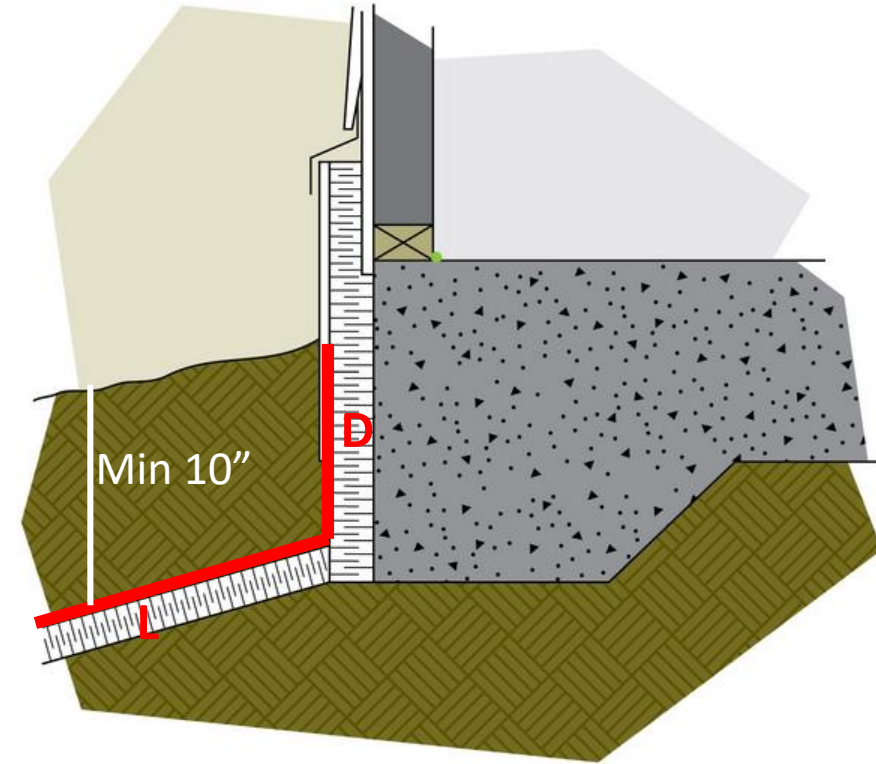
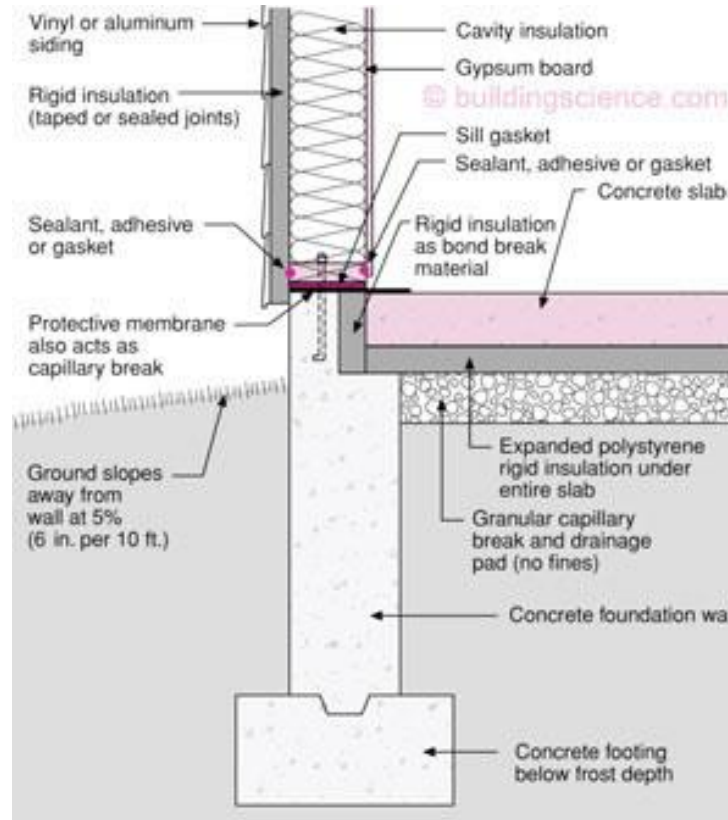
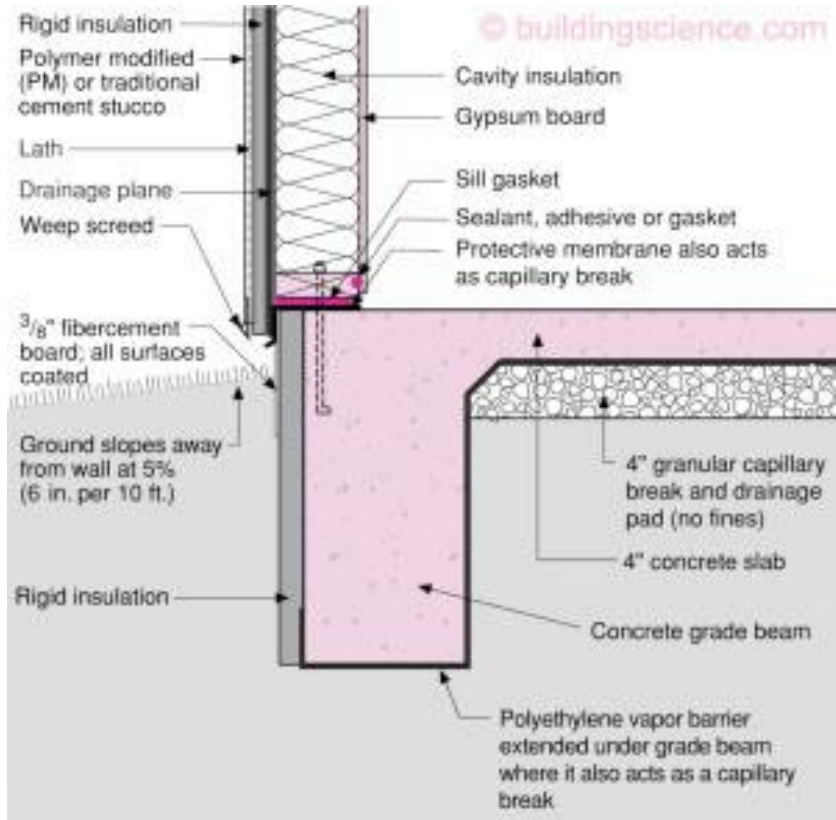
Continuous insulation

R-5 required under entire heated slab

Perimeter requirement increased from R-10 24" below grade to R-15 36" below grade, or to bottom of heated slab.



Slab insulation options



Images courtesy of Building Science Corporation

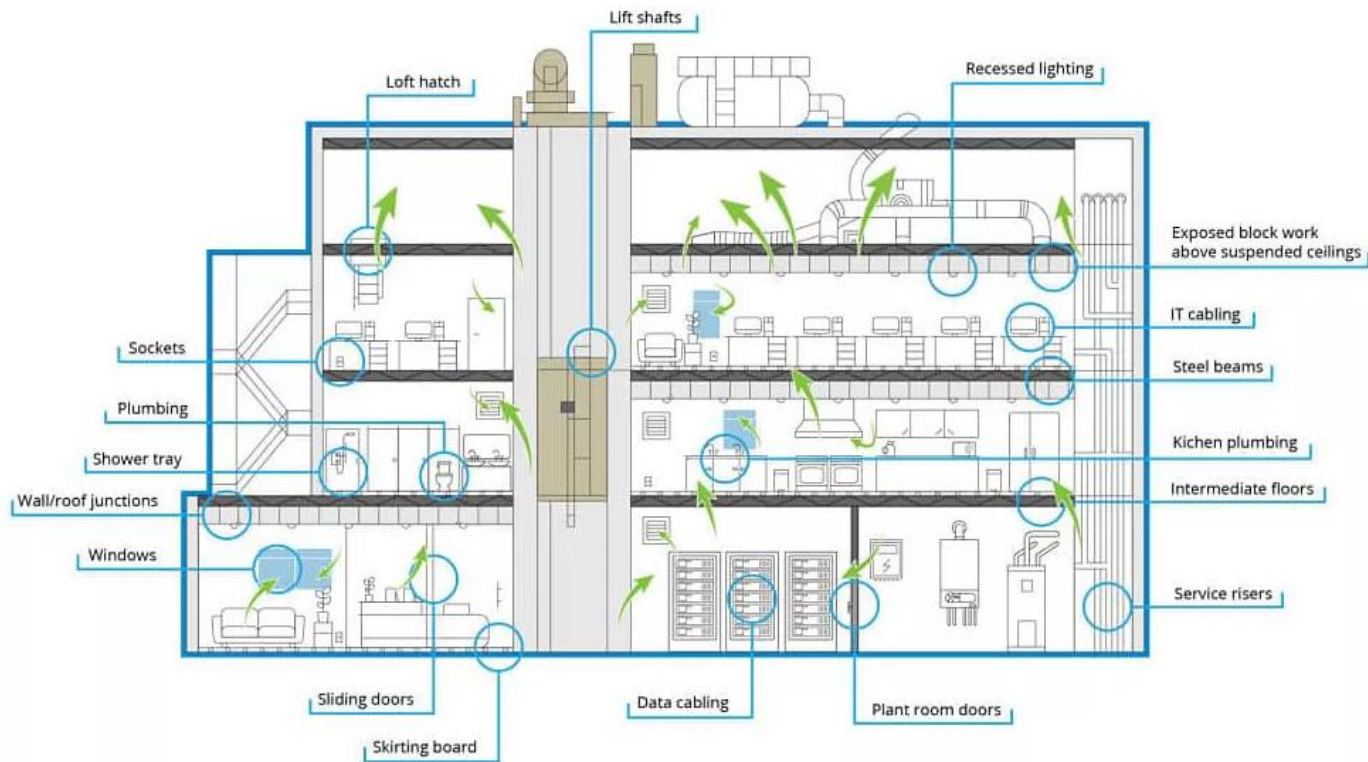
Image courtesy of Natural Resources Canada

Depth+Length must equal depth listed in R-value and U-factor Tables (24", 36" for heated slab).

#6. C402.5 Air Leakage – Thermal Envelope

C402.5 Air Leakage – Thermal Envelope

The thermal envelope of buildings shall comply with Sections C402.5.1-C402.5.8, or...shall be pressure tested in accordance with ASTM E779 at a pressure differential of 0.3" w.g. (75 Pa) or an equivalent method...when the tested air leakage rate...is ≤ 0.40 cfm/sf



C402.5 Air Leakage – Thermal Envelope

- Though rarely done, smaller commercial buildings can be pressure tested with multiple blower doors
- Larger buildings can be pressure tested using HVAC systems
- Must seal all intentional openings (vents, fans not used for pressurization test, gravity dampers, etc...)
- On-site built fenestration particularly susceptible to air leakage testing oversight or failure (curtain walls)



**#7. C402.5.1.1 Air
Barrier Construction
and C402.5.2 Air Barrier
Compliance Options**

C402.5.1.1 Air Barrier Construction

A continuous air barrier for the opaque building envelope shall comply with Section C402.1.5.2.1 (Materials) or C402.5.1.2.2 (Assemblies).

C402.5.1.1 Air Barrier Construction to be

1. Continuous for all assemblies
2. Joints to be sealed so that seals can't be dislodged/broken
3. Penetrations are to be sealed, as are associated joints
4. Recessed lighting or other envelope penetrations to have provisions to maintain the air barrier continuity.

Fluid applied air barriers



Self-Adhered Membranes



Sealed and Taped Boards or Building Wrap



C402.5.1.2 Air Barrier Compliance Options

- Pay particular attention to complex/hidden details and building joints
 - Walls surrounding exterior overhangs with perforated roof often left open.
 - Odd angles for rooflines and wall joints, difficult to reach joints.
 - Penetrations made by other contractors after envelope completion.
 - Drywall stopping just above dropped ceilings, leaving open cavities connected to outdoors.



**#8. C402.1.5
Component
Performance
Alternative**

C402.1.5 Assembly U-Factor Undesirable Results

UA trade-off provides some flexibility to energy code, but important to consider impacts of some trade-offs

Example: Removing continuous insulation from metal stud wall and compensating with cavity insulation. Met code, but condensation

C402.1.4.1 Thermal resistance of cold-formed steel walls.

U-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1

$$U = 1/[R_s + (ER)]$$

(Equation 4-1)

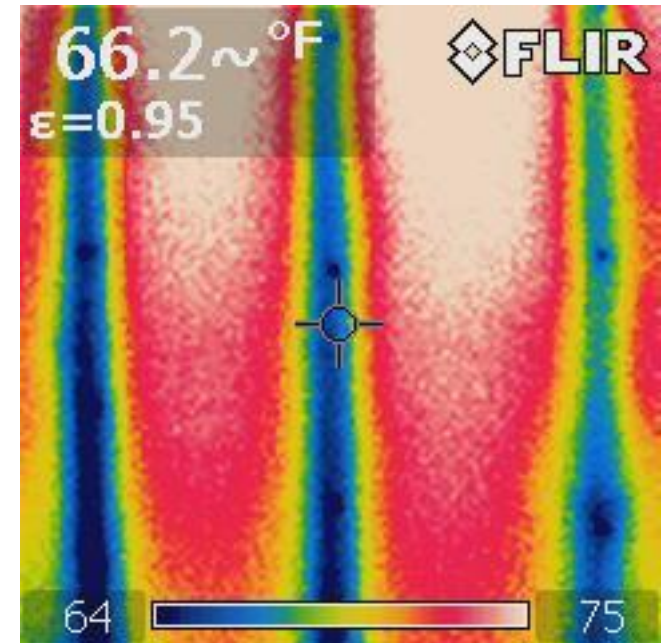
where:

R_s = The cumulative R-value of the wall components along the path of heat transfer, excluding the *cavity insulation* and steel studs.

ER = The effective R-value of the *cavity insulation* with steel studs as specified in Table C402.1.4.1.

TABLE C402.1.4.1
EFFECTIVE R-VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY R-VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE R-VALUE (ER) (Cavity R-Value $\times F_c$)
3 1/2	16	13	0.46	5.98
		15	0.43	6.45
3 1/2	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50



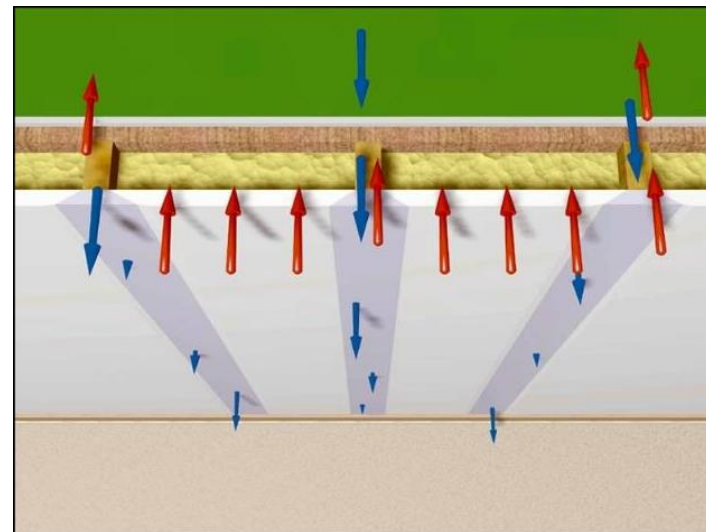
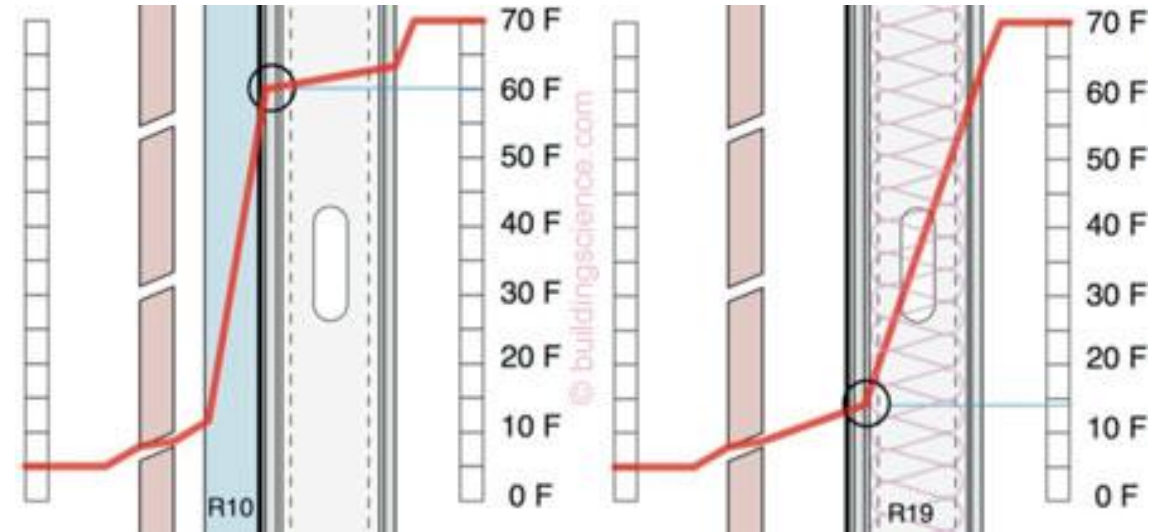
C402.1.5 Assembly U-Factor Undesirable Results

Dew point calculations can help avoid condensation risk in building assemblies.

Maintaining a thermal break helps mitigate condensation risk.

Increased surface temperature will help prevent occupant radiant cooling to surfaces, improving occupant comfort.

<https://wufi.de/en/service/free-wufi-versions/>



#9. C402.5.1.2.1 Materials (Air Barriers)

C402.5.1.2.1 Inadequate material installation

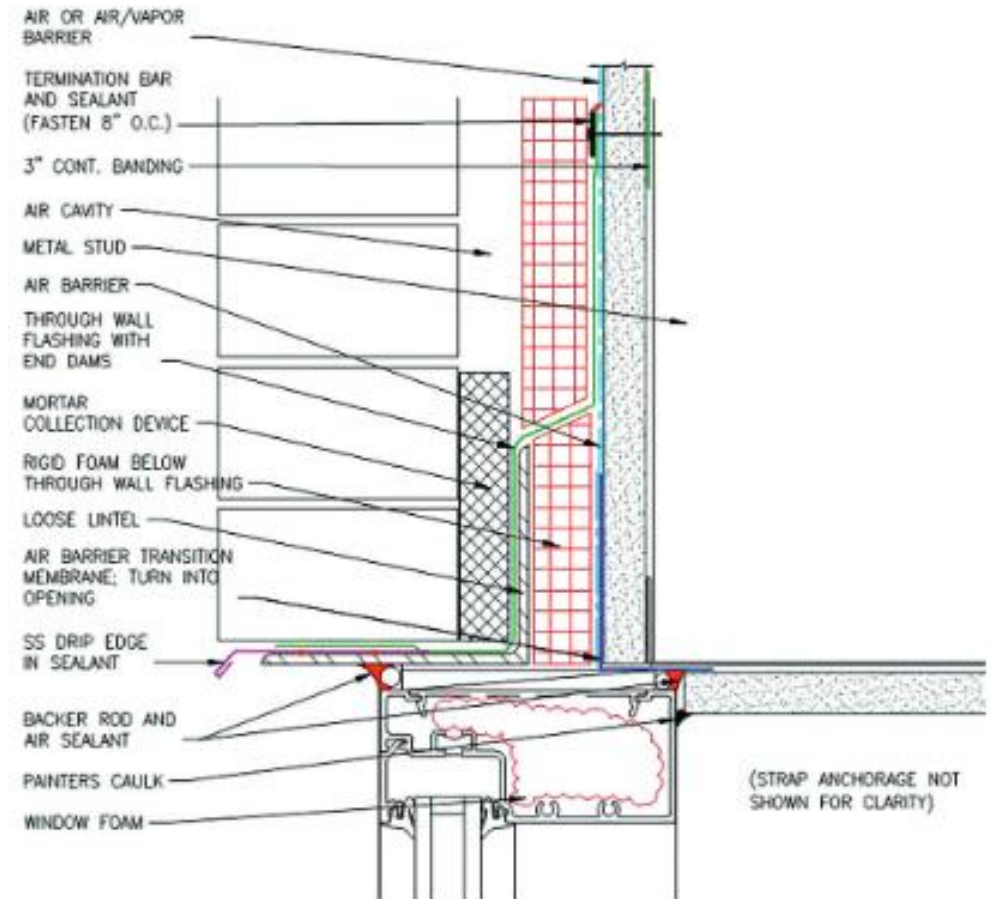
Materials with air permeability not greater than 0.004cfm/sf under a pressure differential of 0.3”w.g. when tested in accordance with ASTM E2178 shall comply...”

- C402.5.1.2.1 lists acceptable air barrier materials.
- UngROUTED CMUs, felt paper, fibrous insulation, thin coatings of spray insulation (<1.5” closed cell or <4.5” open cell), and brick are **not** air barriers.
- Corrugated roof deck often not properly sealed. Gap between deck and wall often filled with fibrous insulation/fire-stop instead of air seal material.



C402.5.1.2.1 Compliance

- Usually compliance verified through plan review
- Materials and interfaces between materials must be detailed in plans for continuous air barrier.
 - Materials specified must be verified to be compliant with air permeability requirements.
 - Interfaces must be detailed with appropriate sealants



#10 C402.5.2 Missing Fenestration Labeling

C402.5.2 Air Leakage of Fenestration

The air leakage of fenestration assemblies shall meet the provisions of Table 402.5.2. Testing shall be in accordance with the applicable reference test standard in Table C402.5.2 by an accredited, independent testing laboratory and labeled by the manufacturer.

- Labels are often missing from products, primarily due to site-built fenestration on commercial buildings.
- Whole building pressure testing in accordance with Section C402.5 does not require air leakage labeling.
- Whole building testing also addresses probability that an assembly with a proper NFRC certification is improperly installed, and thus leaks.



 National Fenestration Rating Council® CERTIFIED	World's Best Window Co. Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) 0.35	Solar Heat Gain Coefficient 0.32
ADDITIONAL PERFORMANCE RATINGS	
	Air Leakage (U.S./I-P) 0.2
	—
<small>m to applicable NFRC procedures for determining whole ed for a fixed set of environmental conditions and a l any product and does not warrant the suitability of any er's literature for other product performance information. vw.nfrc.org</small>	

Top 40 Requirements: 2018 IECC Commercial Lighting

11. Occupant Sensor Controls [C405.2.1]
12. Time-switch Controls [C405.2.2]
13. Daylight-responsive Controls [C405.2.3]
14. Specific Application Controls [C405.2.4]
15. Exterior Lighting Controls [C405.2.6]
16. Lighting Power Allowances [C405.3, C405.4]
17. Functional Testing of Lighting Controls [C408.3]
18. Reduced Lighting Power [C406.3]
19. Enhanced Digital Lighting Control [C406.4]
20. Luminaire Level Lighting Controls [C405.2]



#11. C405.2.1 Occupant Sensor Control

Automatic Shut-off is Required in Nearly Every Space

Occupant sensing, time-switch, or both



C405.2.1 Occupant Sensor Controls are Required at

1. Classrooms/lecture/training rooms
2. Conference/meeting/multi-purpose rooms
3. Copy/print rooms
4. Lounges/breakrooms
5. Enclosed offices
- 6. Open plan office areas**
7. Restrooms
8. Storage rooms
9. Locker rooms
10. Other spaces 300 sf or less enclose by floor-to-ceiling height partitions
11. Warehouse storage areas



C405.2.1.2 Occupant Sensor Control Function in *Warehouse*

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



Image from <http://luxreview.com>

C405.2.1.3 Occupant Sensor Control Function in *Open Plan Office* (≥ 300 sf)

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



Image from <https://www.focalpointlights.com>

C405.2.1.1 Occupant Sensor Control Function in *Other Areas*

1. Auto-off within **20 minutes** of occupants leaving.
2. Manual on or can be auto-on if not more than 50% power.

Exception: Full auto-on permitted in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

Image from <https://lightingcontrolsassociation.org>

3. Shall incorporate manual control to allow occupants to turn lights off.



#12. C405.2.2 Time-switch Controls

C405.2.2 Time-switch Controls are Required at

- Areas not provided with occupant sensor controls
- Exception:
 - Areas with manual control (C405.2.2.2) where
 1. Patient care is directly provided
 2. Automatic shutoff would endanger occupant safety or security
 3. Lighting intended for continuous operation
 4. Shop and laboratory classrooms



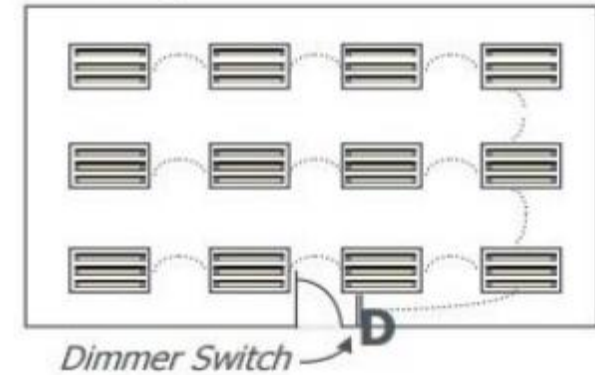
C405.2.2.1 Time-switch Control Functions

- Each space with time-switch controls shall be provided with a manual control for light reduction in accordance with C405.2.2.2.
- Time-switch controls shall comply with following:
 1. Minimum 7-day clock
 2. Capable of 7 different day types
 3. Holiday shut-off (skip schedule for 24 hrs)
 4. Program backup of at least 10 hours
 5. Include override switch (manual, max. 2hrs & individual override switch shall not cover larger than 5,000 sf)

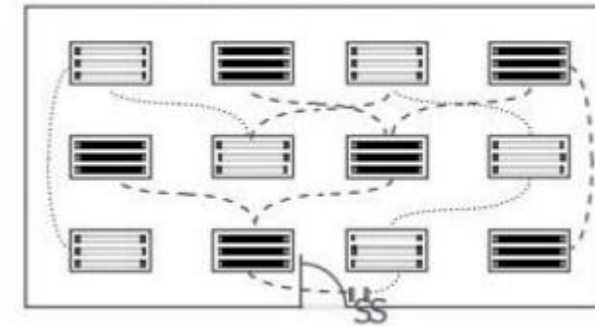
C405.2.2.2 Light-reduction Controls

1. Manual controls to allow occupants to reduce lighting by at least 50% in reasonably uniform pattern
 1. Control all lamps/luminaires
 2. Switching alternate rows or luminaires
 3. Switching outer lamps
 4. Switching each lamp/luminaire
2. Exceptions for:
 1. Spaces with 1 luminaire rated less than 100 watts
 2. Spaces <0.6 watts/SF
 3. Corridors, lobbies, electrical / mechanical rooms
 4. Daylight zones with daylight responsive controls

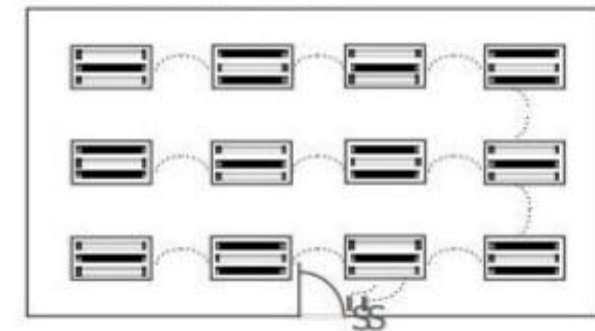
Dimming



Alternating Luminaires



Alternating Lamps



#13. C405.2.3 Daylight-responsive Controls

Exception

Connected lighting power < Adjusted lighting power budget

Adjusted lighting power budget = Normal lighting power budget *
(1.0- [0.4* weighted average of SF in daylit zone])

If below this threshold, no daylight controls required



C405.2.3 Daylight Controls

Example Office 1:

200,000 sf total area

100,000 sf daylit zones

LPD: 0.79 W/sf

LPA: 158,000 W

LPA adj

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

= 158,000 W x 0.8

= 126,400 W (20% less)

Example Office 2:

200,000 sf total area

50,000 sf daylit zones

LPD: 0.79 W/sf

LPA: 158,000 W

LPA adj

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

= 158,000 W x 0.9

= 142,200 W (10% less)

C405.2.3 Daylight Controls

Required in the following spaces:

1. > 150 W of general lighting in sidelit zone
2. > 150 W of general lighting in toplit zone

Exceptions:

Health care facilities where patient care is directly provided

Lighting required for specific application control per C405.2.4

Sidelit zones on 1st floor above grade in Group A-2 (assembly uses for food/drink) and Group M (mercantile) occupancies

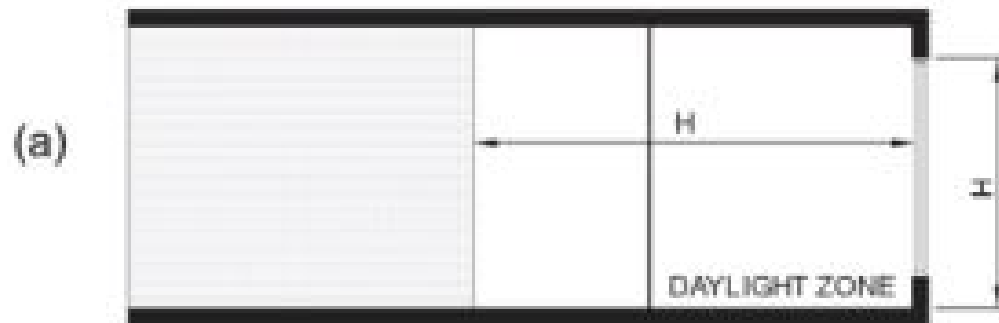


C405.2.3.1 Daylight Control Functions

1. Toplit and sidelit separately controlled (up to 150W overlap acceptable)
2. Must be able to be calibrated within the space
3. Calibration mechanism must be readily accessible
4. Must dim continuous down to at least 15% in offices, classrooms, laboratories, and library reading rooms
5. Must be configured to turn lights completely off when adequate daylight present
6. Sidelit zones of different cardinal directions controlled independently
Exception: < 150 W in each space can be controlled together.

C405.2.3.2 Sidelit Zones

- Floor area adjacent to vertical fenestration
- Area of fenestration ≥ 24 sf
- Visible Transmittance > 0.20



(a) Section view

(b) Plan view of daylight zone under a rooftop monitor

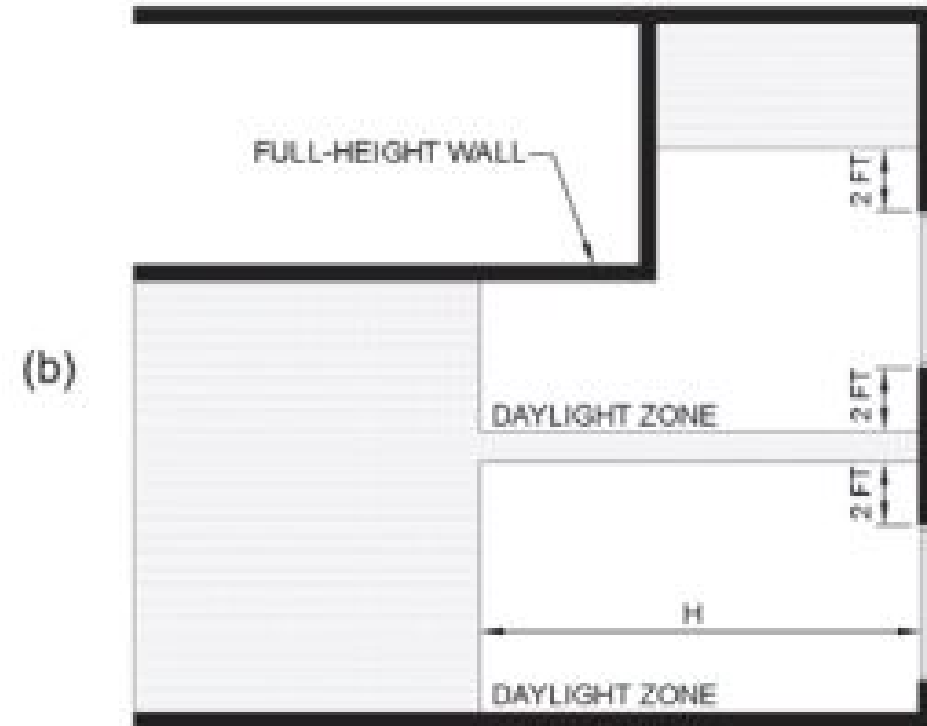
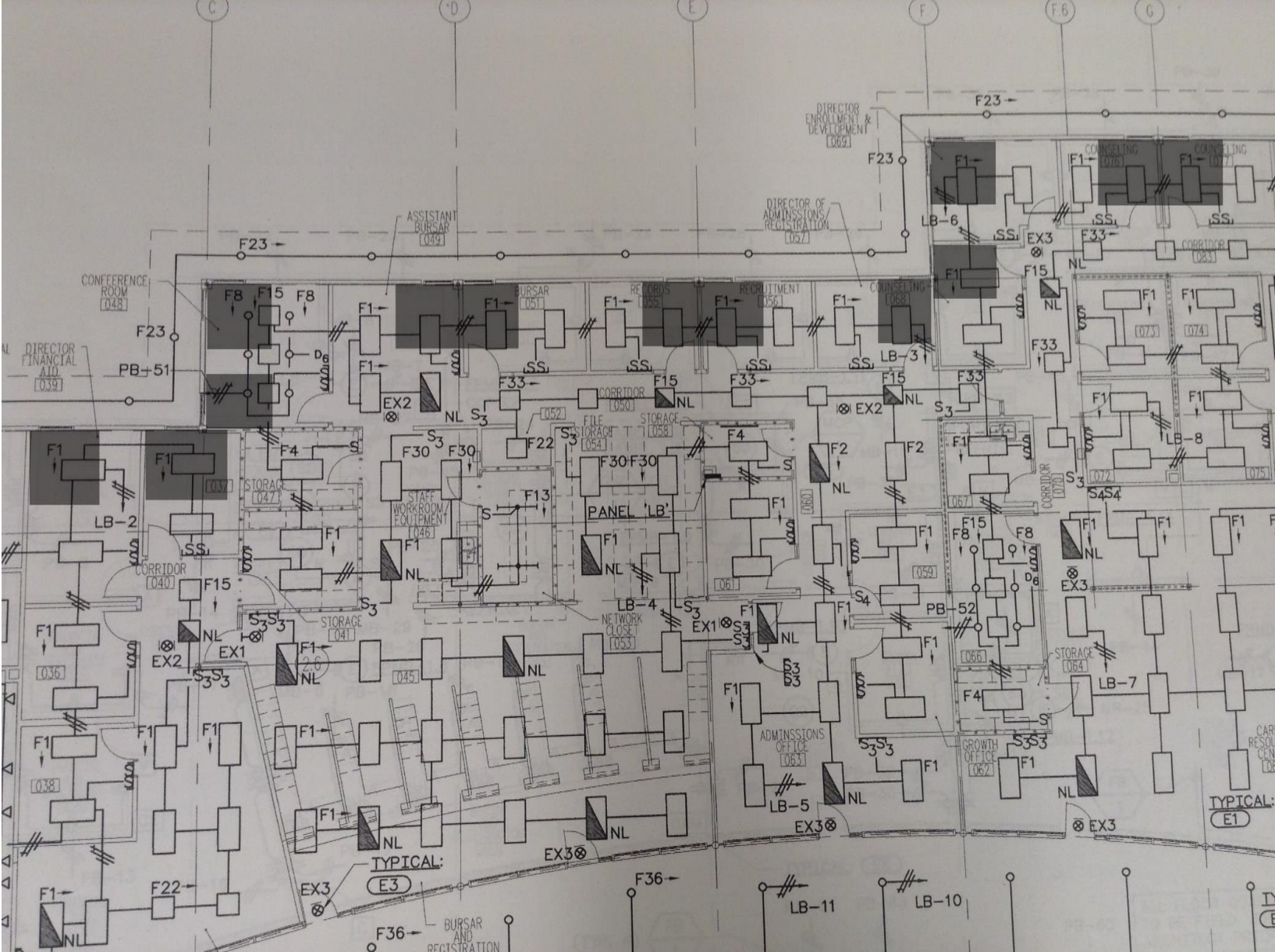


FIGURE C405.2.3.2
SIDELIT ZONE

C405.2.3.2 Sidelit Zones



C405.2.3.3 Toplit Zones

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

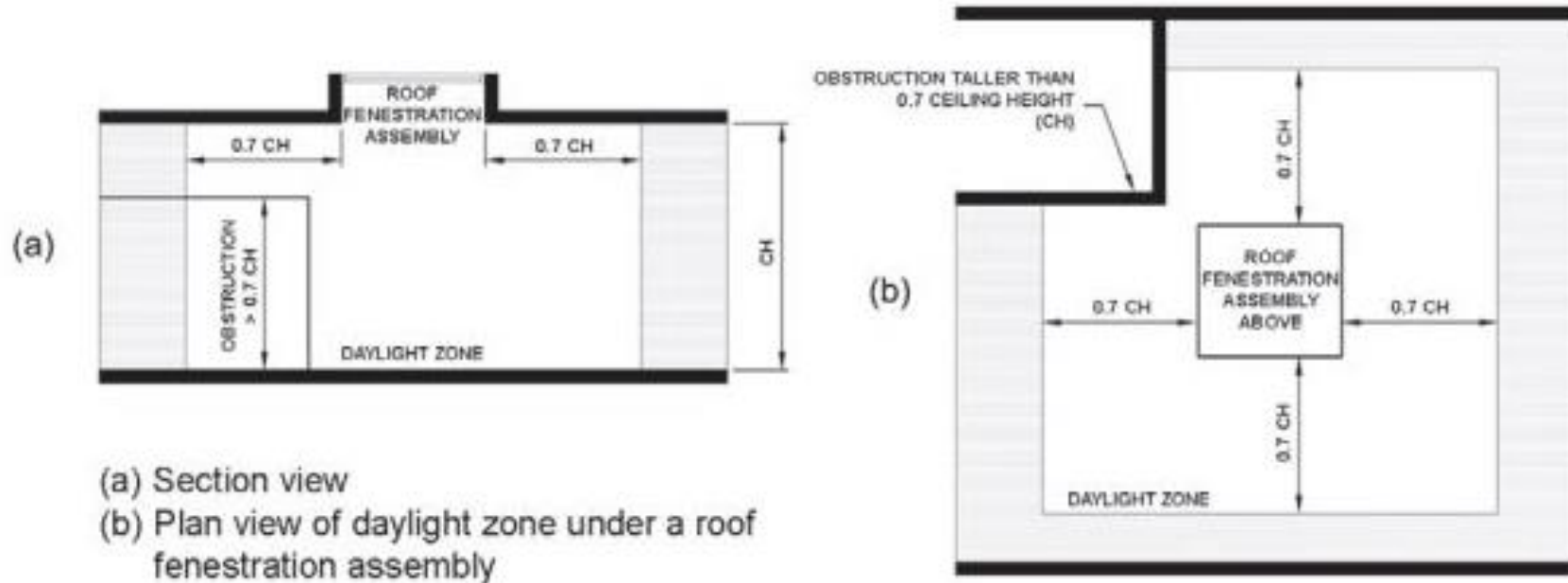


FIGURE C405.2.3.3(1)
TOPLIT ZONE

#14. C405.2.4 Specific Application Controls

C405.2.4 Specific Application Controls

(Occupancy sensor or Time-switch) + Manual control required in:

- Display and Accent area
- Lighting in display cases
- Supplemental task lighting
- Lighting equipment for sale or demonstration



Sleeping Units

Automatically switch off all permanently installed luminaires & switched receptacles within 20 min. after no occupancy

Exception: Keycard controlled switches & receptacles
Patient care space

C405.2.4 Specific Application Controls

- Dwelling Units:

Occupant sensor control (C405.2.1) or light-reduction controls (C405.2.2.2)

- Lighting for Nonvisual Application (Plant, Food Warming)

Time-switch control (C405.2.2.1) independent of other lighting within the space



Image courtesy of DOE



Image courtesy of Quora

#15. C405.2.6 Exterior Lighting Controls

C405.2.6 Exterior Lighting Controls

Façade & Landscape Lighting

C405.2.6 Exterior Lighting Control

- Exterior Lighting
- C405.2.6.1
- C405.2.6.3
- C405.2.6.4

- Decorative Lighting**
- C405.2.6.1
- C405.2.6.2
- C405.2.6.4

- C405.2.6.1: Daylight Shutoff
- C405.2.6.2: Decorative Lighting Shutoff
- C405.2.6.3: Lighting Setback
- C405.2.6.4: Time-switch Function

C405.2.6 Exterior Lighting Controls

- Daylight Shutoff

- Decorative Lighting Shutoff

Building façade and landscape lighting shall automatically shutoff ≤ 1 hr after business closing to ≤ 1 hr before opening

- Lighting Setback

Total wattage reduced by $\geq 30\%$ by switching or dimming during one of the following:

From not later than midnight to not earlier than 6 am

From ≤ 1 hour after business closing to ≤ 1 hour before opening

During any time where activity has not been detected for ≥ 15 min

- Time-switch Control

Same as interior time-switch



#16. C405.3 & C405.4 Lighting Power Allowances

C405.3.1 Total Connected Interior Lighting Power

- Maximum fixture wattage label
- Ballast input wattage
- Transformer input wattage
- Track lighting

2018 IECC: **8W/ft** (2015 IECC was 30 W/ft)

AHRAE 90.1-2016: 30 W/ft

NEC: 150W/2ft

C405.3.2 Interior Lighting Power Allowance

- Building Area Method
- Space by Space Method w/ additional allowances for special use lighting

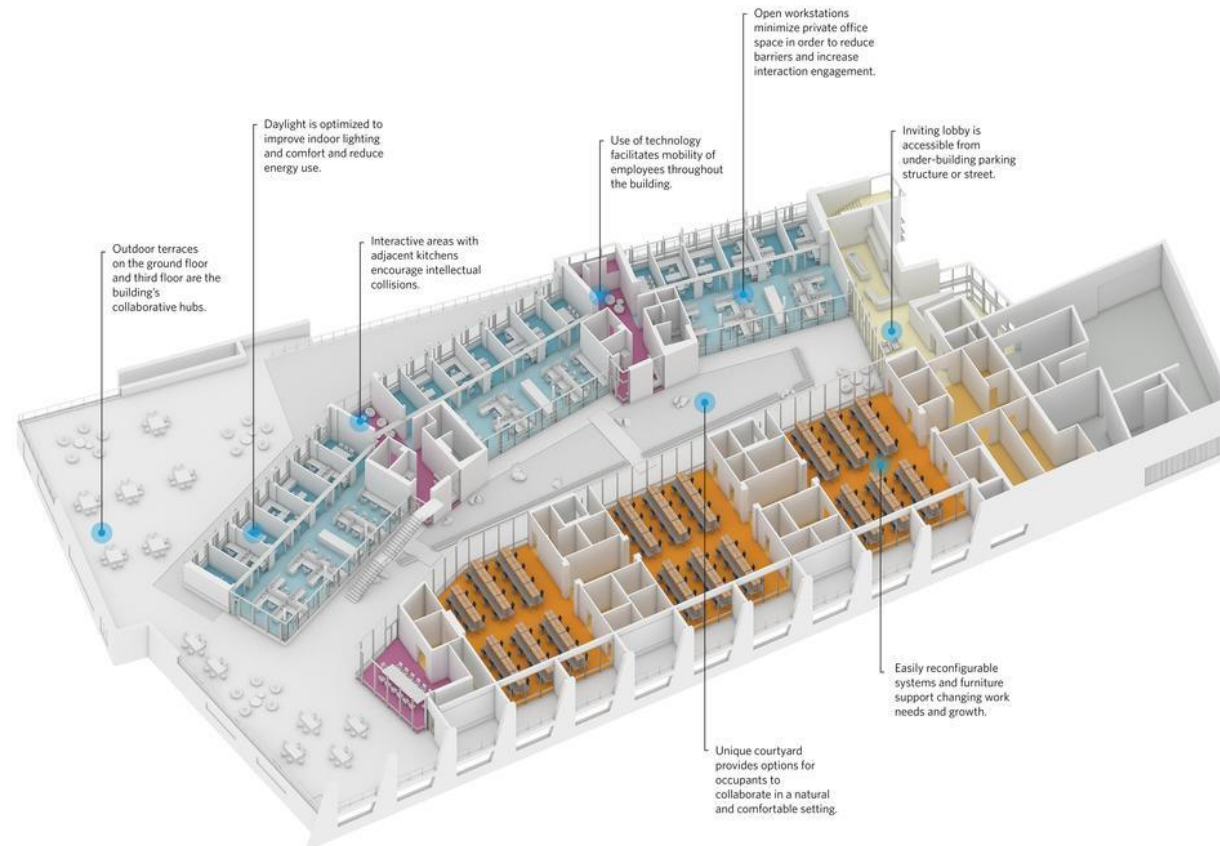


Image courtesy of AIA

Table C405.3.2 (1) Interior LP Allowances: Bldg Area Method

Bldg Area Type	2015 IECC (W/SF)	2018 IECC (W/SF)	% Improvement
Convention Center	1.01	0.76	25%
Courthouse	1.01	0.90	11%
Dining: Bar lounge/leisure	1.01	0.90	11%
Dining: cafeteria/fast food	0.90	0.79	12%
Office	0.82	0.79	4%
Library	1.19	0.78	34%
Dormitory	0.57	0.61	-7%
Performing Arts Center	1.39	1.18	15%

C405.3.2.1 Building Area Method

Example Library: 100,000 sf

- 2015 allowance: 119,000 W
- 2018 allowance: 78,000 W
- A Savings of 41,000 W
- Equivalent to 12 tons of cooling



Image courtesy of East Peoria

Bldg Area Type	2015 IECC (W/SF)	2018 IECC (W/SF)	% Improvement
Library	1.19	0.78	34%

C405.4.2 Exterior Lighting Power Allowance

Table C405.4.2(1) partial

Exterior Allowance	Zone 1	Zone 2	Zone 3	Zone 4
Base allowance	350	400	500	900 W
Parking/drives	0.03	0.04	0.06	0.08 W / sf
Walkways <10' wide	0.5	0.5	0.6	0.7 W / lf
Walkways, other	0.1	0.1	0.11	0.14 W / sf
Landscaping	0.03	0.04	0.04	0.04 W / sf
Entry canopies	0.2	0.25	0.4	0.4 W / sf



C405.4.2 Exterior Lighting Power Allowance

Table C405.4.2(2) & (3) partial

Type (Zone 3)	2015 IECC (W/sf)	2018 IECC (W/sf)	% Improvement
Parking Area	0.10	0.04	60%
Stairways	1.00	0.70	30%
Entry Canopies	0.40	0.40	0%
Loading Dock	0.50	0.35	30%
Sales Canopies	0.80	0.60	25%
Non-tradable			
Entry parking 24/7	800 W	400 W	50%
Drive-up	400 W	200 W	50%

#17. C408.3

Functional Testing of Lighting Controls

C408.3.1 Functional Testing

Must be complete before final inspection

Registered design professional to provide evidence of testing

1. Occupant sensor controls
2. Time-switch controls
3. Daylight responsive controls

Documentation Requirements: Construction documents shall specify that Drawings (location & catalogue # of each equipment), Manuals & Report are provided to the owner within 90 days of the receipt of Certificate of Occupancy

C408.3.1.1 Occupant Sensor Controls

1. Certify sensors located and aimed per manufacturer recommendations
2. Testing of each space geometry sensor combination including 10%+ of each combination
3. Verify status indicators, time delay, dimming or off level, correct auto-on or manual-on functionality, no false tripping due to HVAC operation



C408.3.1.2 Time-switch Controls

1. Weekday, weekend, holiday schedules
2. Documentation of programming including schedules, set-up and preference programs
3. Verify date and time, installation and operation of battery, override time limit, control switches operation when occupied, lighting turns off when unoccupied, proper manual override switch operation



C408.3.1.3 Daylight Responsive Controls

1. Verify control devices properly located, calibrated & setpoints and thresholds set
2. Loads adjust in response to daylight
3. Calibration equipment readily accessible only to authorized personnel



#18. C406.3 Reduced Lighting Power

C406.3 Reduced Lighting Power

To follow prescriptive compliance path, you need to comply with at least one of the Additional Energy Efficiency Options

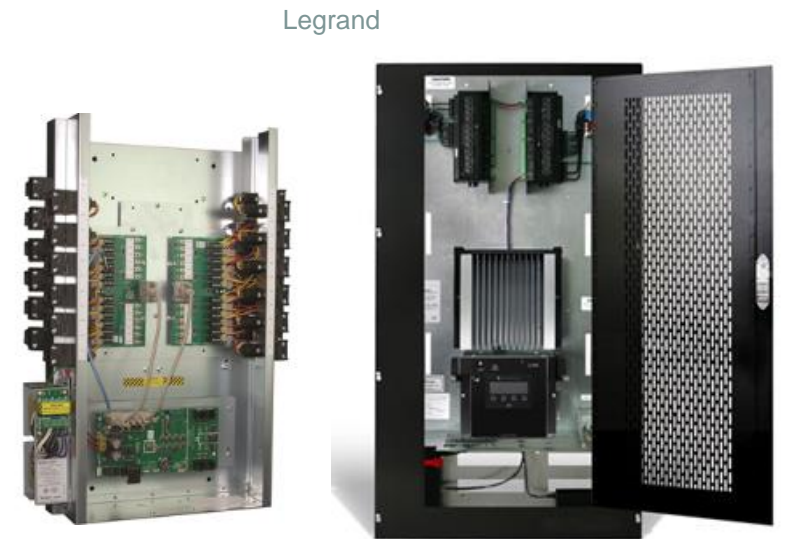
Total connected power shall be **< 90%** of total lighting power allowance per C405.3.2



#19. C406.4 Enhanced Digital Lighting Controls

C406.4 Enhanced Digital Lighting Controls

1. Luminaires configured for continuous dimming
2. Luminaires addressed individually or ≤ 4 luminaires
3. ≤ 8 luminaires be controlled together in a daylight zone
4. Controlled through a digital control system
5. CD to include a Sequence of Operation
6. Functional testing to comply with C408



**#20. C405.2
Luminaire Level
Lighting Controls**

Luminaire Level Lighting Control (LLLC)

C405.2 Lighting Control (Choose one)

Lighting Controls

C405.2.1
C405.2.2
C405.2.3
C405.2.4
C405.2.5
C405.2.6

LLLC

C405.2.1
C405.2.4
C405.2.5

C405.2.1:
Occupancy Control
C405.2.2:
Time-switch Control
C405.2.3:
Daylight Control
C405.2.4:
Specific App Control
C405.2.5:
Manual Control
C405.2.6:
Exterior Lighting Control

A lighting system consisting of one or more luminaires with embedded lighting control logic, occupancy and ambient light sensors, wireless networking capabilities and local override



Luminaire Level Lighting Control (LLLC)

C405.2 Lighting Control (Choose one)

Lighting Controls

C405.2.1

C405.2.2

C405.2.3

C405.2.4

C405.2.5

C405.2.6

LLLC

C405.2.1

C405.2.4

C405.2.5

LLLC shall independently capable of:

Monitoring occupancy to brighten or dim lighting

Monitoring electric & daylight to brighten or dim electric lights

Configuration & reconfiguration of performance parameters (dim setpoints, timeouts, wireless zoning...)



Questions?

energycode@sedac.org

800-214-7954