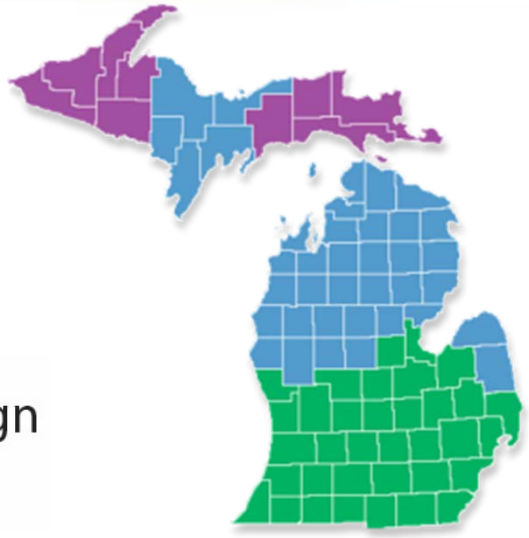
CP-17-00111

2017 Michigan Energy Code Changes Overview-Commercial

Michigan Energy Code Training and Implementation Program

2.0 Hour Commercial Program Course Number ***Pending***



MICHIGAN STATE UNIVERSITY

School of Planning, Design and Construction

Presenters

Michigan Commercial Energy Code Training and Implementation Program:

Tim Mrozowski, A.I.A. LEED® AP

Instructor # 1455

Marcus Metoyer

Instructor # 1540

William Bezdek, P.E.

Instructor # 1616

Course Number:

Pending

2 Hour Technical:

Categories

Pending

Michigan Energy Code – Commercial (1 of 15)

- Michigan updated its Commercial Energy Code and it is effective September 20, 2017
- The Code is now referred to as the “Michigan Energy Code”

Overall Training Project Objectives

To train *building officials, inspectors, architects, engineers, contractors, subcontractors, suppliers, and owners* in the revised Michigan energy code for the purpose of:

1. Increasing understanding
2. ReduciImproving compliance
3. ng administrative time
4. Improving customer relationships

Presentation Overview

MICHIGAN STATE UNIVERSITY

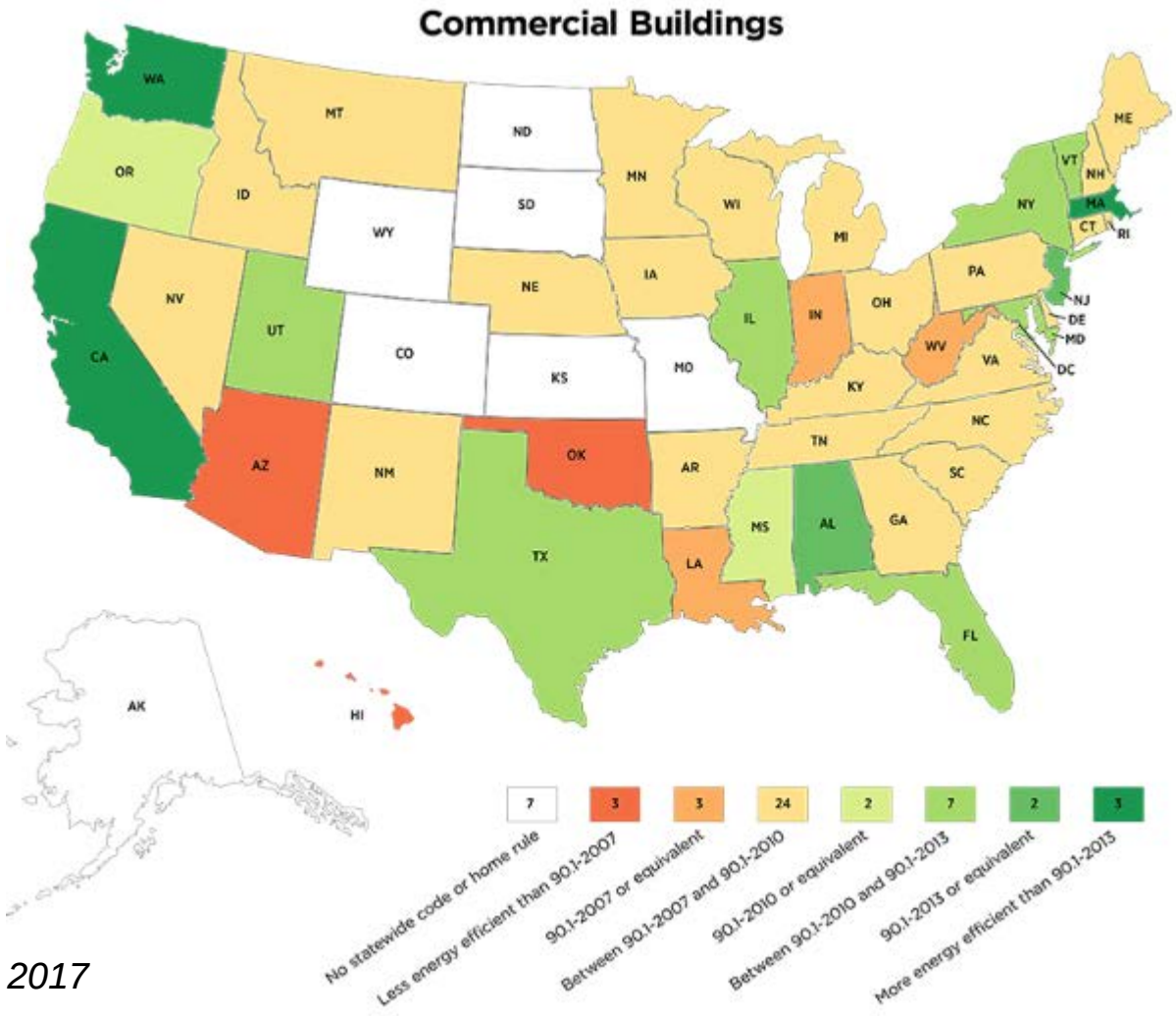
- Background on new code
- Michigan code status
- When does it apply?
- Significant changes
- Other compliance paths
    - COMCheck
    - Above Code Programs
    - Energy Cost Budget Method
    - Whole Building Simulations-Appendix G and LEED V4 Requirements

Disclaimer

This presentation presents an educational overview of the significant changes in the Michigan Energy Code for Commercial Buildings effective September 20, 2017.

While it is believed to be accurate it is not intended to substitute for actual code language. Code language is addressed only generally and is not verbatim, language is paraphrased and not all code sections are addressed in this presentation. Designers, contractors, code officials etc, should always use the actual code in projects.

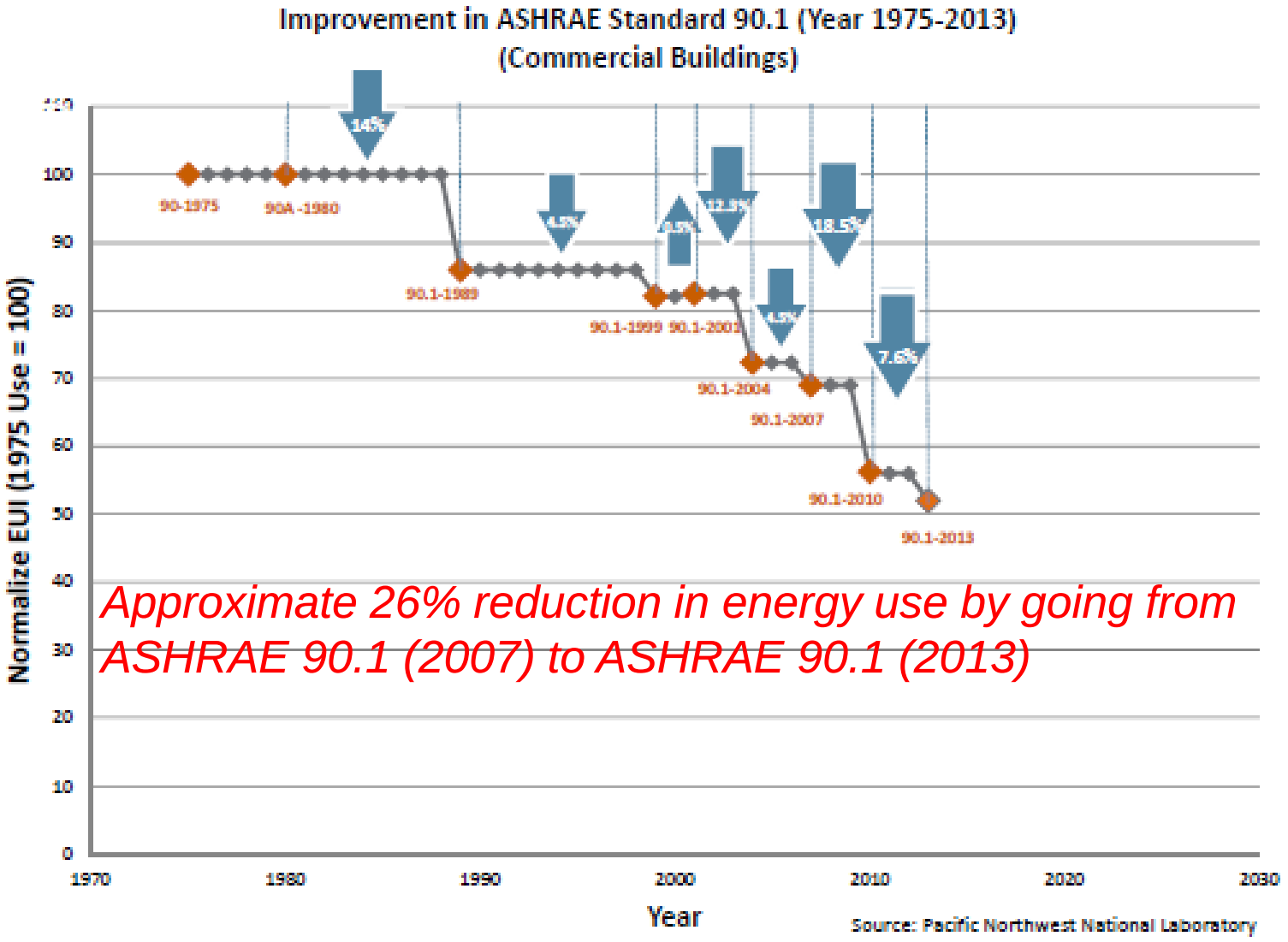
National Commercial Energy Code Status



As July 31, 2017

Viewed September 5, 2017 https://www.energycodes.gov/status-state-energy-code-adoption

Impact of Energy Codes



Approximate 26% reduction in energy use by going from ASHRAE 90.1 (2007) to ASHRAE 90.1 (2013)

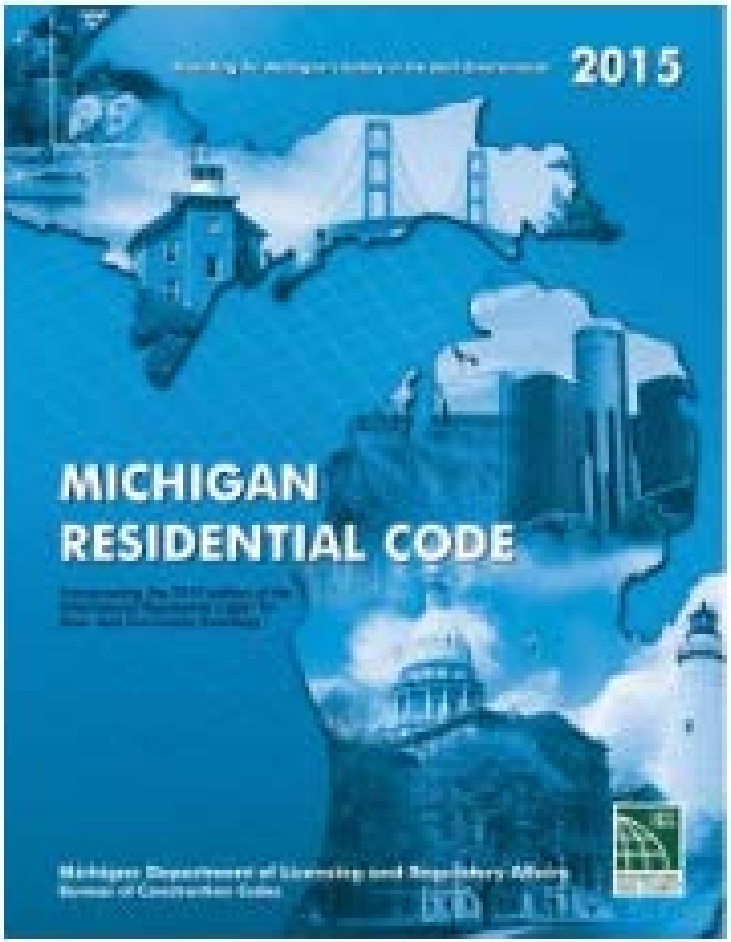
Michigan Residential Energy Code

- Michigan adopted IECC (2015) with Michigan Amendments
- Entitled “Michigan Energy Code”
- Effective Feb 2016

Applies to one and two family dwellings and townhouses

Will be applied to buildings classified as R2, R3, R4 not more than three stories above grade

Note: R1 (Hotels, Motels, Boarding Houses, Congregate Housing more than 10 people) are under Michigan Commercial energy code



Mixed Construction Types - Residential

One story steel + 3-4 stories wood residential over first floor retail with fire separation

Governed under the Michigan commercial energy code

Michigan Energy Code - Commercial (2 of 15)

Three documents are needed in addition to various reference standards

- The modifying Act Language from the Department of Licensing and Regulatory Affairs dated August 1, 2016
- The International Energy Conservation Code 2015 (IECC 2015)
- The ASHRAE 90.1 (2013) (ASHRAE 90.1 (2013) (referred to as the “Standard”)

Michigan Energy Code – Commercial (3 of 15)

Michigan Commercial Energy Code = the Act + portions of IECC 2015 + ASHRAE 90.1 (2013)

DEPARTMENT OF ~~ENERGY, LABOR, AND ECONOMIC GROWTH~~ LICENSING AND REGULATORY AFFAIRS

DIRECTOR'S OFFICE

CONSTRUCTION CODE

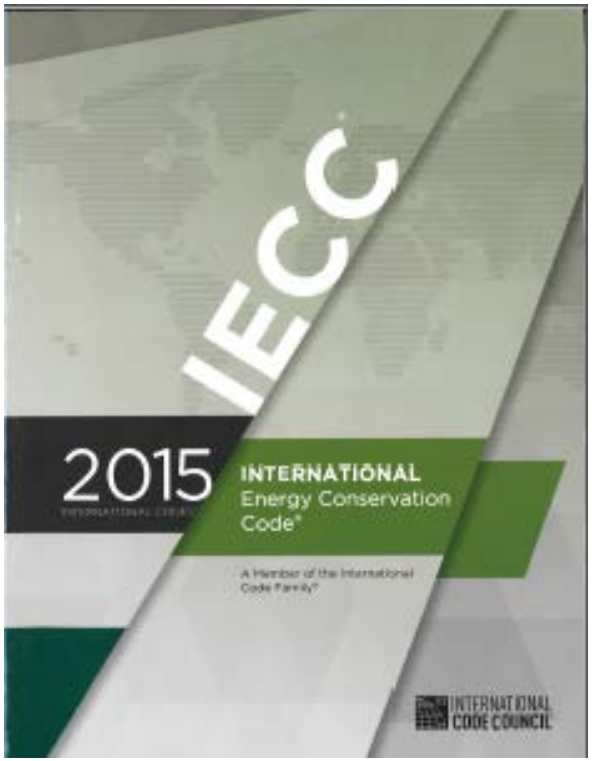
Filed with the Secretary of State
These rules take effect 120 days after filed with the Secretary of State

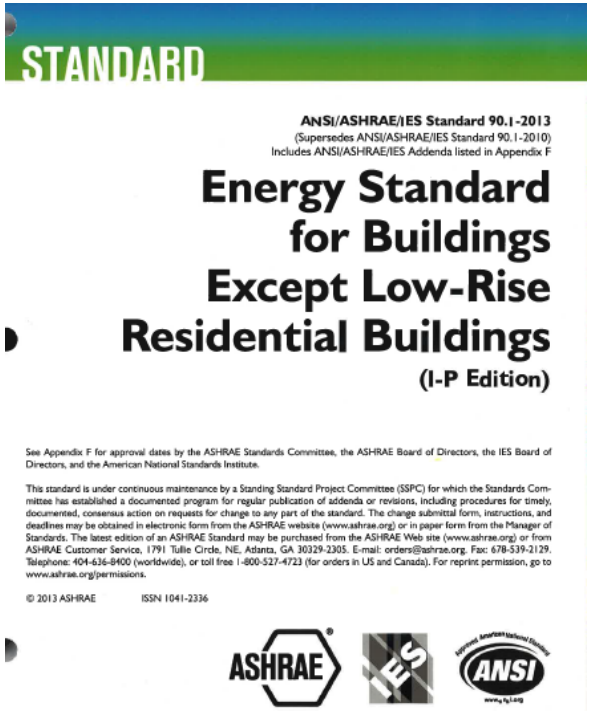
(By authority conferred on the director of the department of ~~energy, labor, and economic growth~~licensing and regulatory affairs by section 4 of 1972 PA 230, MCL 125.1504, and Executive Reorganization Order Nos. 2003-1, ~~and~~ 2008-~~4~~20, and 2011-4, MCL 445.2011, ~~and~~ MCL 445.2025, and MCL 445.2030)

R 408.31087, R 408.31087a, R 408.31088, and R 408.31090 of the Michigan Administrative Code are amended and R 408.31089 is rescinded and R 408.31087b, R 408.31088a, R 408.31091, R 408.31092, R 408.31092a, R 408.31093, R 408.31094, R 408.31095, R 408.31096, R 408.31097, R 408.31098, R 408.31098a, and R 408.31098b are added to the code as follows:

PART 10a
MICHIGAN ~~UNIFORM~~ ENERGY CODE

R 408.31087. ~~Adoption~~ Applicable code.
Rule 1087. Rules governing the energy efficiency for the design and construction of buildings and structures, not including residential buildings, shall be those contained in the international energy conservation code, 2009~~2015~~ edition, ~~section 501.1,~~ except for sections C107.2 to C107.5, C108.2 to C108.4, C301.2, C301.3, C302, C401.2.1 to C408.3.2, C502.2 to C502.2.6.2, C503.2 to C503.6 and the ASHRAE energy standard for buildings except low-rise residential buildings, ANSI/ASHRAE/IESNA standard 90.1-~~2007~~2013 (hereafter the standard), including appendices A, B, C, ~~and~~ D, and G, except for sections 8.4.2, 8.4.3 to 8.4.3.2 . With the amendments noted, ~~Section 501.1,~~ of the international energy conservation code and the standard are adopted in these rules by reference. The Michigan ~~uniform~~ energy code is available for inspection ~~or purchase~~ at the ~~Okemos~~ Lansing office of the
Michigan Department of ~~Energy, Labor and Economic Growth~~Licensing and Regulatory Affairs, Bureau of Construction Codes, ~~2501 Woodlake Circle, Okemos, Michigan 48864~~611 W. Ottawa Street, Lansing, Michigan 48933. The code may be purchased from the International Code Council, through the bureau's website at www.michigan.gov/bcc, at a cost as of the time of adoption of these rules of ~~$38.00~~$44.00 ~~or may be purchased from the International Code Council, 500 New Jersey~~





Michigan Energy Code – Commercial (4 of 15)

Act defines adoptions, ammendments and deletions

DEPARTMENT OF ~~ENERGY, LABOR, AND ECONOMIC GROWTH~~ LICENSING AND REGULATORY AFFAIRS

DIRECTOR'S OFFICE

CONSTRUCTION CODE

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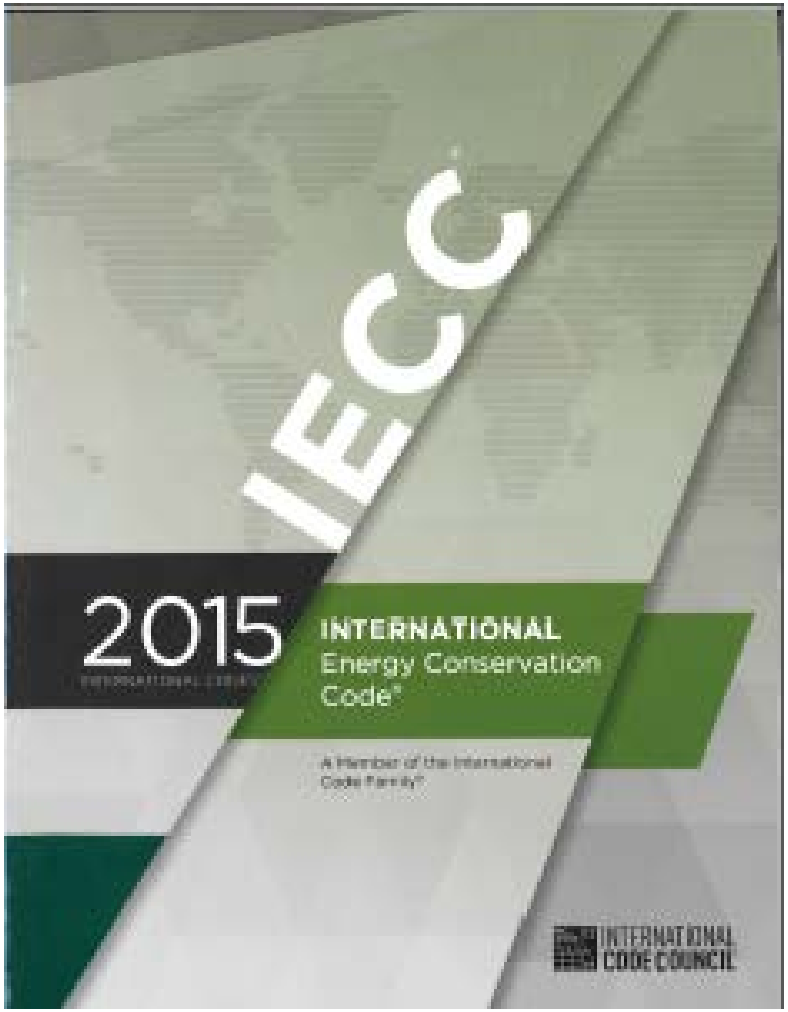
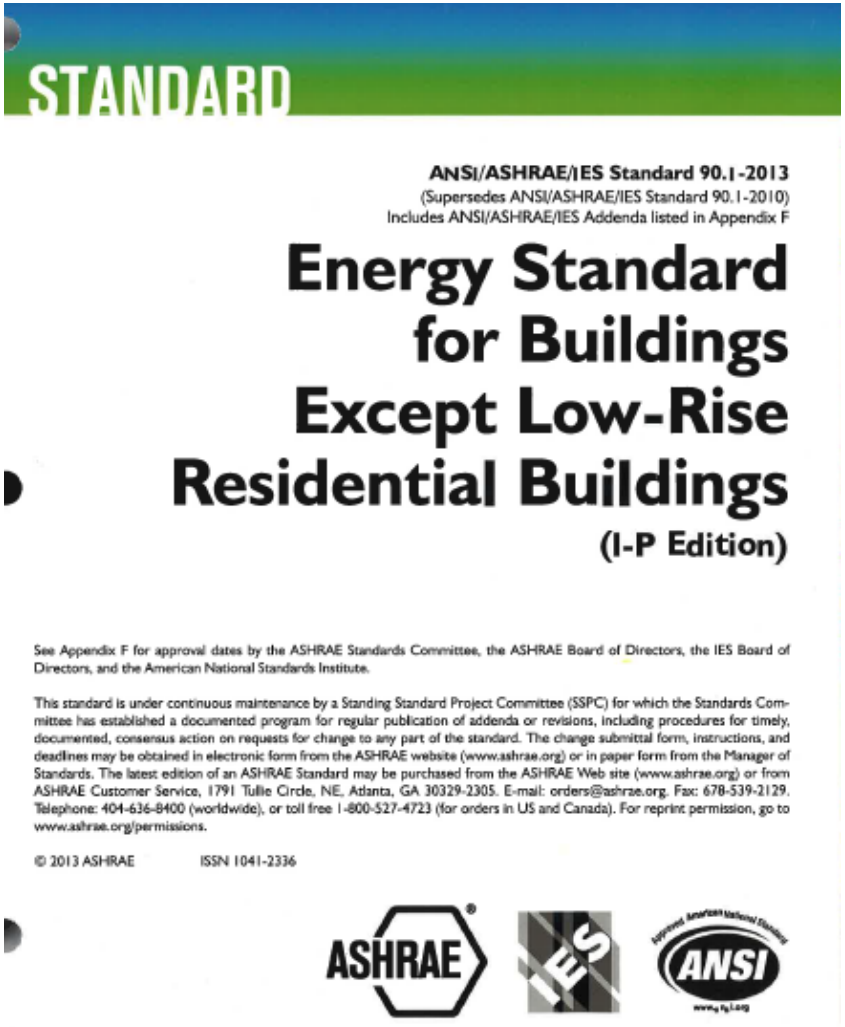
Michigan Energy Code – Commercial (5 of 15)

Scoping requirements in referenced sections of IECC 2015



Michigan Energy Code – Commercial (6 of 15)

Technical provisions In ASHRAE 90.1 (2013)



STANDARD

ANSI/ASHRAE/IES Standard 90.1-2013
(Supersedes ANSI/ASHRAE/IES Standard 90.1-2010)
Includes ANSI/ASHRAE/IES Addenda listed in Appendix F

Energy Standard for Buildings Except Low-Rise Residential Buildings

(I-P Edition)

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IES Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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ASHRAE IES ANSI

Michigan Energy Code – Commercial (7 of 15)

The Act either directly or indirectly lays out:

- The portions of IECC 2015 and ASHRAE 90.1 which are used or not used and any deletions and changes

  - Direct= explicit statement that something is included or not included
  - Indirect = when you must navigate to a section and view any amendments or deletions to learn if something is included or excluded.

Act Language

The international energy conservation code, ~~2009~~**2015** edition, ~~section 501.1,~~ **except for sections C107.2 to C107.5, C108.2 to C108.4, C301.2, C301.3, C302, C401.2.1 to C408.3.2, C502.2 to C502.2.6.2, C503.2 to C503.6**

and the ASHRAE energy standard for buildings except low-rise residential buildings, ANSI/ASHRAE/IESNA standard 90.1-~~2007~~**2013** (hereafter the standard), including appendices A, B, C, ~~and~~ D**, and G, except for sections 8.4.2, 8.4.3 to 8.4.3.2** . With the amendments noted, ~~Section 501.1, of~~ the international energy conservation code and the standard are adopted in these rules by reference.

Michigan Energy Code – Commercial (8 of 15)

Navigating the changes

Map and mark in your books the applicable sections, deletions, amendments and changes referenced in the Act language to sections in:

IECC 2015
ASHRAE 90.1 (2013)

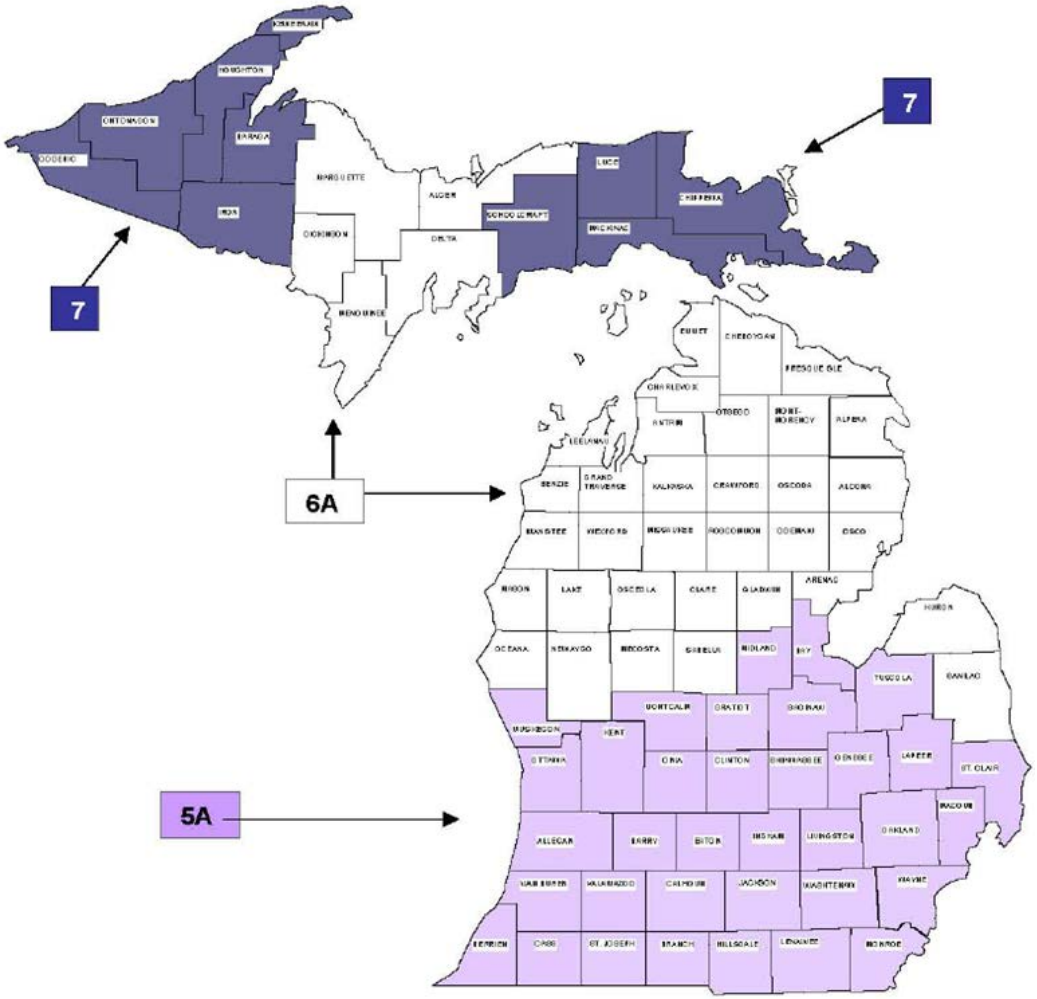
Michigan Energy Code – Commercial (9 of 15)

IECC 2015 Layout

Commercial Provisions-prefaced by “C”
Residential Provisions prefaced by “R” (Not applicable to the commercial energy code)

Michigan Climate Zones

Map remains the same



Michigan Uniform Energy Code

Michigan Energy Code – Commercial (10 of 15)

CHAPTER 3 (CE) GENERAL REQUIREMENTS

C303.1.3 Fenestration Product Rating-*(amended by Mich. Act to allow for computer simulations to be used to determine product U factors and indicates conditions when default U factor, SHGC and VT should be used.*

Fenestration product rating. U-factors or fenestration products (windows, doors, and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking a labeled U-factor shall be assigned a default U-factor from Table C303.1.3(1) or C303.1.3(2).

Exception:

1. Computer simulations by independent NFRC certified laboratories or approval under the Stille-Derossett-Hale Single State Construction Code Act, 1972 PA 230, MCL 125.1501 to 125.1531, is considered in compliance with this section.

2. Where required, garage door U-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105. U-factors shall be determined by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking a labeled U-factor shall be assigned a default U-factor from Table C303.1.3(1) or C303.1.3(2). The solar heat gain coefficient (SHGC) and visible transmittance (VT) of glazed fenestration products (windows, glazed doors, and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled SHGC or VT shall be assigned a default SHGC or VT from table C303.1.3(3).

Michigan Energy Code – Commercial (11 of 15)

CHAPTER 5 (CE) EXISTING BUILDINGS

SECTION 5.1.3 (MAY BE TYPO- SHOULD READ 503.1 *(Important amendment by Mich. Act addressing alterations that need not comply with ASHRAE 90.1 (2013) it identifies the following conditions.*

Exceptions:

1. *Installation of storm windows or glazing panels over existing glazing, provided the storm window or glazing panel contains a low-emissivity coating. However, a low-emissivity coating is not required where the existing glazing already has a low-emissivity coating. Installation may be either on the inside or outside of the existing glazing.*
2. *Replacement of glazing in existing sash and frame, provided the U-factor and SHGC will be equal to or lower than before the glass replacement.*

Michigan Energy Code – Commercial (12 of 15)

CHAPTER 5 (CE) EXISTING BUILDINGS

Exceptions (Continued)

3. *Alterations to roof or ceiling, wall, or floor cavities that are insulated to full depth with insulation having a minimum nominal value of R-3.0/in.*
4. *Alterations to walls and floors, where the existing structure is without framing cavities and no new framing cavities are created.*

See next slide for exceptions 5-7

8. *Replacement of existing fenestration, provided that the area of the replacement fenestration does not exceed 25% of the total fenestration area of an existing building and that the U-factor and SHGC, will be equal to or lower than before the fenestration replacement.*

Michigan Energy Code – Commercial (13 of 15)

CHAPTER 5 (CE) EXISTING BUILDINGS

Exceptions (Continued)

5. *Roof recovering.*
6. *Removal and replacement of a roof membrane where there is existing roof insulation integral to or below the roof deck.*
7. *Removal and replacement of a roof membrane where the insulation is installed entirely above the roof deck, a minimum of R-20 insulation shall be permitted where the placement of additional insulation greater than R-20 insulation would require either of the following:*
   a. *Raising the height of parapets, weep systems, or through wall flashings where roof abuts adjoining walls or parapets.*
   b. *Raising the height of mechanical or electrical equipment, mechanical curbs, roof hatches, skylight curbs, service equipment, piping, conduit, duct work, roof platforms, ladders, stairs, guard rails, expansion joints, roof davits, or door thresholds.*

Don’s Roof


Don’s roof- replacement likely exempt if existing R 20 otherwise would need to comply

Michigan Energy Code – Commercial (14 of 15)

C503.2-Change space conditioning *(not adopted by Mich. Act)*

C502.2-502.2.6.2 *(not adopted by Mich. Act)*

C503.2-Change space conditioning *(not adopted by Mich. Act)*

C503.3-Building Envelope *(not adopted by Mich. Act)*

C503.4 Heating and cooling systems *(not adopted by Mich. Act)*

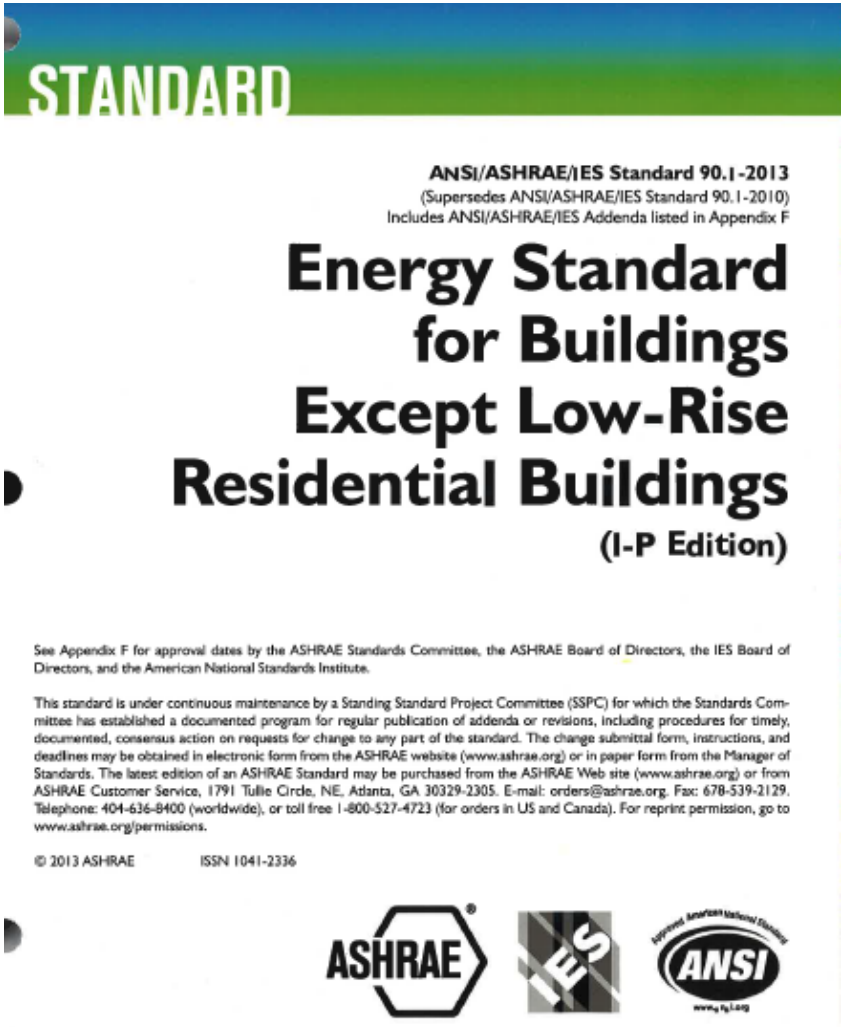
C503.5-Service hot water systems *(not adopted by Mich. Act)*

C503.6 Lighting Systems *(not adopted by Mich. Act)*

**These sections were not adopted because ASHRAE 90.1 (2013) was adopted to cover the technical provisions*

Michigan Energy Code – Commercial (15 of 15)

Technical provisions In ASHRAE 90.1 (2013)



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ASHRAE IES ANSI

ASHRAE 90.1 (2013) MICHIGAN AMENDMENTS

ASHRAE 90.1 (2013) MICHIGAN AMENDMENTS (MARK YOU BOOKS) *Three Items are amended by Michigan*

Key word is “Standard” in the Michigan Act.

- *Section 5.4.3.4 Vestibules (Mich. Act amends exceptions for when a vestibule is not required*
- *Section 6.7.2.4 System Commissioning (Mich. Act amends system commissioning for HVAC controls for projects over 10,000 SF rather than the SF 50,000 indicated in ASHRAE 90.1 (2013).*
- *Section 9.1.2 Lighting Alterations (Mich. Act amends the exception for when lighting needs to comply with the code during alterations to 50% of connected load rather than the 10% indicated in ASHRAE 90.1 (2013).*

ASHRAE 90.1 (2013) for use in Michigan

Bird's Eye View of changes from ASHRAE 90.1 (2013) from ASHRAE 90.1 (2007)

ASHRAE 90.1 (2013) Significant Changes (1 of 2)

What makes it hard to compare:

No summary document was found to date that lays out the detailed changes from ASHRAE 90.1 (2007) to ASHRAE 90.1 (2013)

There are no sidebar markings in ASHRAE 90.1 (2013) to indicate changes from 2010 or 2007.

Appendix F does list changes from ASHRAE 90.1 (2010), but ASHRAE 90.1 (2010) was not adopted by Michigan

ASHRAE 90.1 (2013) Structure

Layout of ASHRAE 90.1 (2013) is the same as ASHRAE 90.1 (2007)

Section 1 - Purpose
Section 2 - Scope
Section 3 - Definitions, Abbreviations, and Acronyms
Section 4 - Administration and Enforcement
Section 5 - Building Envelope
Section 6 - Heating, Ventilating, and Air Conditioning
Section 7 - Service Water Heating
Section 8 - Power
Section 9 - Lighting
Section 10 - Other Equipment
Section 11 - Energy Cost Budget Method
Section 12 - Normative References

A. Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations
B. Building Envelope Climate Criteria
C. Methodology for Building Envelope Trade-Off Option in Subsection 5.6
D. Climatic Data
E. Informative References –not adopted by Michigan
F. Addenda Description Information not adopted by Michigan
G. Performance Rating Method

ASHRAE 90.1 Chapter 3 Definitions

*"It depends upon **what the meaning** of the word 'is' is."*

- *There are significant changes to the definitions in ASHRAE 90.1 (2013) from ASHRAE 90.1 (2007)*
- *Page count for definitions in this section went from 10 in ASHRAE 90.1 (2007) to 18 in ASHRAE 90.1 2013)*
- *Approximately 100 new or modified definitions*
- *Some are highly technical and reflect new code provisions such as daylighting, sensible heat and cooling panels, computer rooms and various controls.*

ASHRAE 90.1 (2013) Significant Changes – Section 4 (1 of 2)

Section 4 – addresses Scope for:

- Normative Appendices
- Compliance Paths
- Compliance Documentation
- Construction details
- Supplemental Information
- Manuals
- Labeling of Material and Equipment
- Inspections

ASHRAE 90.1 (2013) Significant Changes – Section 4 (2 of 2)

Section 4

- *Inspection requirements under section 4.2.2 are changed to include the requirement to inspect "continuous air barriers after installation but before concealment."*

- *Also note that Section 4.1.1.3 Alterations is also impacted by Michigan's adoption and amending of IECC 2015 Section 5.3.1 (referred to as 5.1.3)*

There are no other significant changes to Section 4

ASHRAE 90.1 (2013) Significant Changes (2 of 2)

Typical Technical Chapter Layout-

Technical Sections 5,6,7,8,9, and 10

General (Section - .1)
Compliance Methods (Section - .2)
Simplified Building (Section - .3)
Mandatory Provisions (Section - .4)
Prescriptive Path (Section - .5)
Alternate Compliance Path (Section - .6)
Submittals (Section -.7)
Product Information and Installation (Section - .8)
Tables

Role and Structure

Compliance Paths

- Mandatory Provisions (must meet these)

Choose one of the following:

- Prescriptive Approach
- Tradeoff (COM*check*)
- Simplified (for some HVAC systems)
- Whole Building Simulation (Cost Budget Method)
- ASHRAE Appendix G for LEED projects
- “Above Code Programs”(Energy Star Version 3 or ICC 700-2012 Silver Rating)

Demonstrate Compliance

Prescriptive

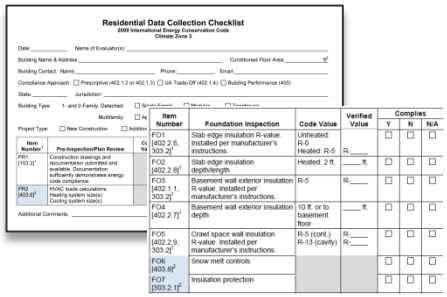
Trade-off

Performance

"Prescriptive Packages Approach"

"Trade-off Approach"

"Performance Approach"



Residential Data Collection Checklist

2009 International Energy Conservation Code

Climate Zone 3

Item Number	Foundation Inspection	Code Value	Verified Value	Complies Y	N	N/A
FO1 [402.2.8, 303.2]	Slab edge insulation R-value. Installed per manufacturer's instructions.	Unheated: R-0 Heated: R-5	R-____	☐	☐	☐
FO2 [402.2.8]	Slab edge insulation depth/length.	Heated: 2 ft.	____ ft.	☐	☐	☐
FO3 [402.1.1, 303.2]	Basement wall exterior insulation R-value. Installed per manufacturer's instructions.	R-5	R-____	☐	☐	☐
FO4 [402.2.7]	Basement wall exterior insulation depth	10 ft. or to basement floor	____ ft.	☐	☐	☐
FO5 [402.2.9, 303.2]	Crawl space wall insulation R-value. Installed per manufacturer's instructions.	R-5 (cont.) R-13 (cavity)	R-____ R-____	☐	☐	☐
FO6 [403.8]	Snow melt controls			☐	☐	☐
FO7 [303.2.1]	Insulation protection			☐	☐	☐

COMcheck™

DOE-2

Residential Requirements of the 2009 IECC. U.S. DOE Building Energy Codes Program. (2010)

Role and Structure

Compliance “Exceptions”

The code provides detailed requirements and then provide “exceptions” and certain conditions

- For small buildings
- For low energy use buildings
- When meeting other optional provisions

ASHRAE 90.1 (2013) Significant Changes – Section 5 (1 of 12)

Section 5- Building Envelope

ASHRAE 90.1 (2013) 17 pages +31% ASHRAE 90.2 (2007) is 13 pages

General (Section 5.1)-several changes

- *5.1.2 Space Conditioning Categories*
  - *5.1.2.2 specifies minimum skylight requirements also apply to unconditioned spaces*
- *5.1.3 Envelope Alterations-Michigan has amended this section to reflect the roof recovering language for roofs with R-20 and when it would necessitate raising non-energy related elements such as curbs and flashings.*
- *5.1.4 Climate*
  - *5.1.4.2 International Locations- slight language changes but does not apply in Michigan*

Compliance Methods (Section 5.2) – no significant changes

Simplified Building (Section 5.3) Not Used

Section 5 – 5.1.2 Space-Conditioning Categories

Separate envelope component requirements apply to three types of conditioned spaces

- Nonresidential
- Residential
- Semiheated

Residential spaces are used for dwelling

Semiheated spaces are heated, but not to comfort levels, and not cooled

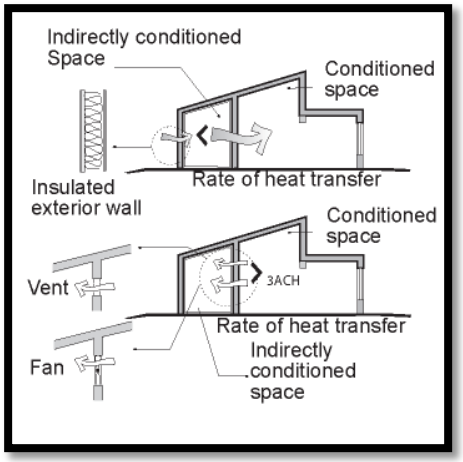


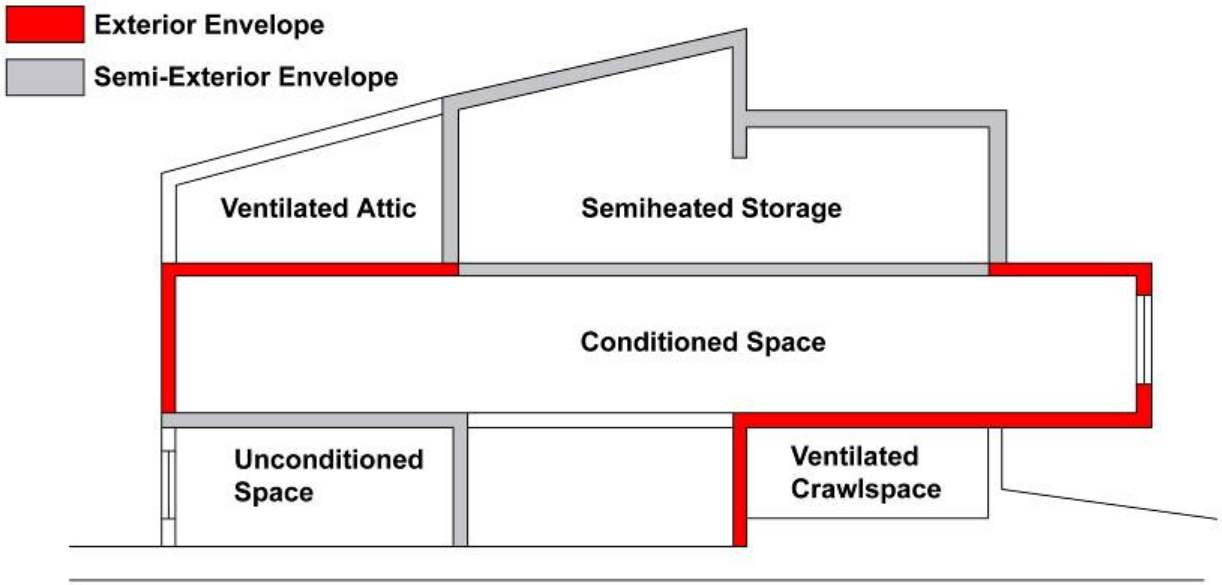
Figure 5-A

Examples of Indirectly Conditioned Spaces

(User's Manual – 90.1.-2013)

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 Building Envelope



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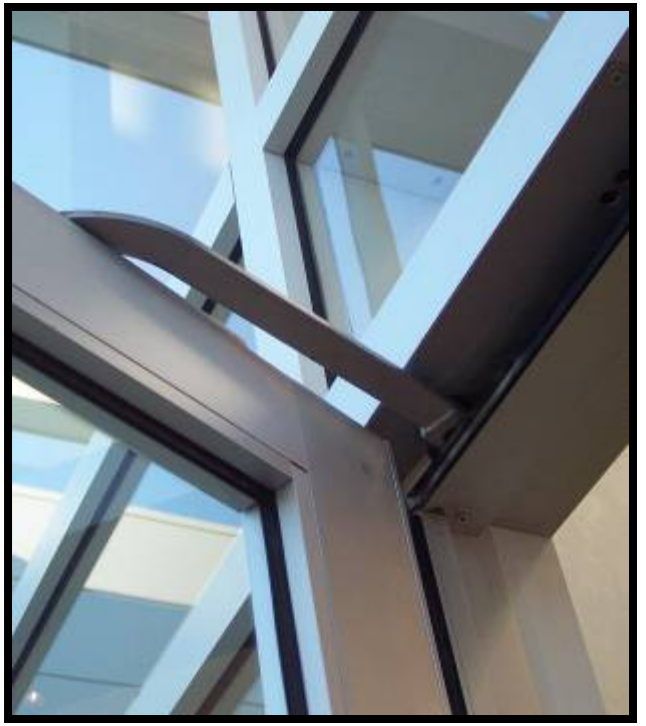
Mandatory Provisions

- Insulation *(Section 5.8.1)*
  - Labeling *(Section 5.8.1.1)*
  - Substantial Contact *(Section 5.8.1.5)*
  - Recessed Equipment *(Section 5.8.1.6)*
  - Insulation Protection *(Section 5.8.1.7)*
  - Insulation Above Suspended Ceilings *(Section 5.8.1.8)*
- *Fenestration and Doors (Section 5.8.2)*
- *Air Leakage (Section 5.4.3)*



U.S. Department of Energy (2010)

Section 5 – 5.4 Mandatory Provisions

- ✓ Fenestration and Doors *(Section 5.4.2 that refers to 5.8.2)*
- ✓ Air Leakage *(Section 5.4.3)*

Photo courtesy of Ken Baker, K energy

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ASHRAE 90.1 (2013) Significant Changes – Section 5 (2 of 12)

Section 5- Building Envelope

Mandatory Provisions (Section 5.4) –many changes

5.4.3 Air Leakage

- *5.4.3.1 Continuous Air Barrier-significant change. Adds new requirement for continuous air barrier, air barrier design and acceptable materials*
- *5.5.3.2 Fenestration and Doors- Adds air leakage requirements and reference standards various fenestration products such as glazing, doors and skylights*

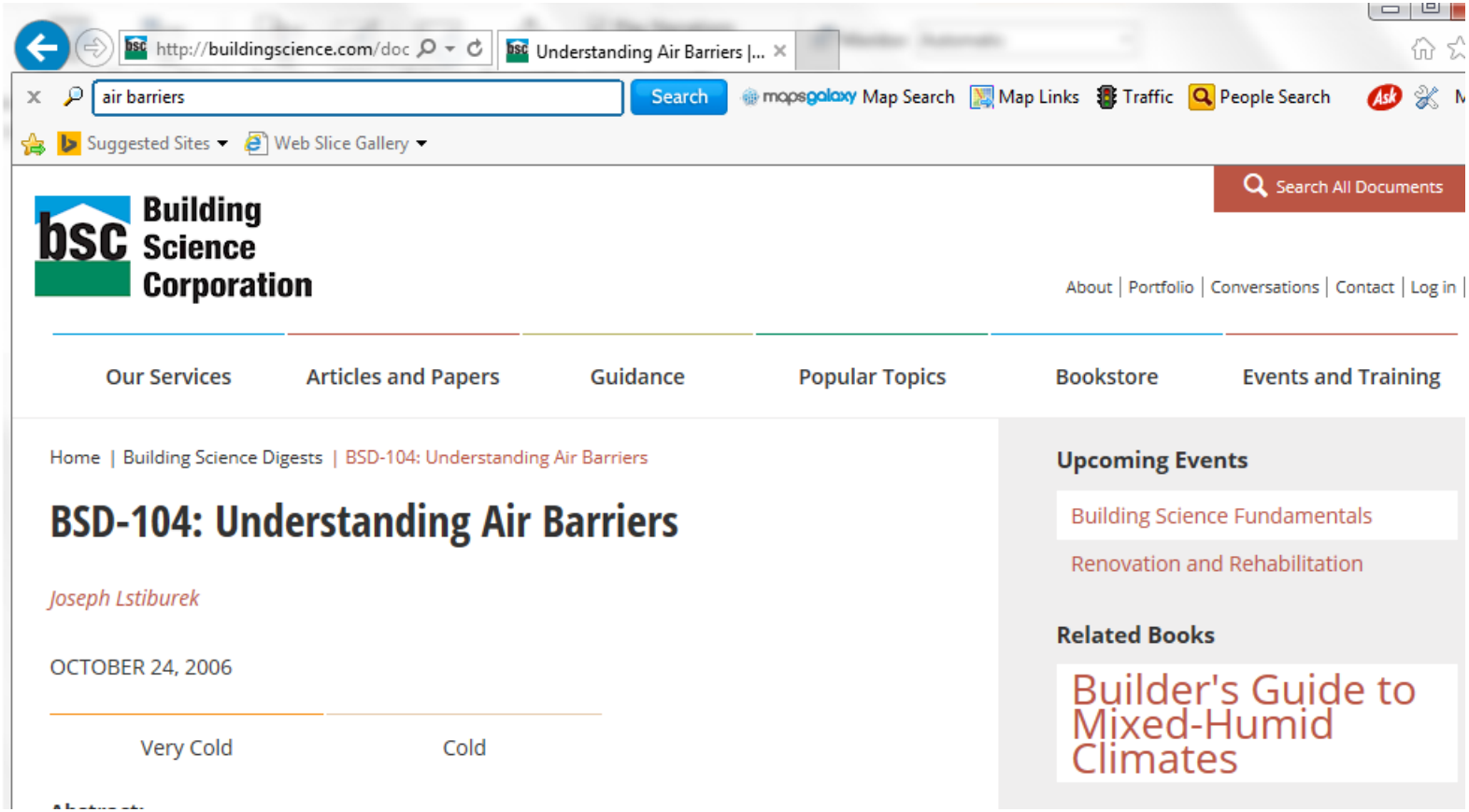
Section 5 – 5.4.3 Air Leakage

- Continuous air barrier
- Fenestration and doors
- Loading dock weather seals
- Vestibules

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Thermal Envelope- Changes

Air Barriers – good information sources Building Science Corp



http://buildingscience.com/documents/digests/bsd-104-understanding-air-barriers *visited Jan 21, 2016*

Section 5 – 5.4.3.1 - *Continuous Air Barrier*

- Continuous air barrier required except in:
  - Semiheated spaces in climate zones 1-6
  - Single wythe concrete masonry buildings in climate zone 2B
- Plans
  - Air barrier components identified or noted in construction documents
  - Joints, intersections, and penetrations of air barrier components (incl. lighting fixtures) detailed
- To extend over all surfaces of building envelope
  - At lowest floor, exterior walls, and ceiling or roof
- Designed to resist positive and negative pressures
  - Wind, stack effect, and mechanical ventilation

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.4.3.1.2 Air Barrier Installation

The following areas are to be wrapped, sealed, caulked, gasketed, or taped

- Joints around fenestration and door frames
  Junctions between walls
  - –And foundations
  - –At building corners
  - –And roofs or ceilings
- Penetrations for roofs, walls, and floors
- Building assemblies used as ducts or plenums
- Joints, seams, connections between planes, and other changes in air barrier materials

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.4.3.1.3 Air Barrier Materials

Material	Thickness (minimum)
Plywood	3/8 in.
Oriented strand board	3/8 in.
Extruded polystyrene insulation board	½ in.
Foil-faced urethane insulation board	½ in.
Exterior gypsum sheathing or interior gypsum board	½ in.
Cement board	½ in.
Built up roofing membrane	
Modified bituminous roof membrane	
Fully adhered single-ply roof membrane	
A Portland cement/sand parge, stucco, or gypsum plaster	½ in.
Cast-in-place and precast concrete	
Sheet metal	
Closed cell 2 lb/ft^3 nominal density spray polyurethane foam	1 in.

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Section 5 – 5.4.3.2 Air Leakage – Fenestration

Product	cfm/ft^2	Procedure	psf
Glazed swinging entrance doors and revolving doors	1.0	AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283	1.57
Curtainwall and storefront glazing	0.06	NFRC 400 or ASTM E283	1.57
Unit skylights with condensation weepage openings	0.3	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400	1.57
Unit skylights with condensation weepage openings	0.5	AAMA/WDMA/CSA 101/I.S.2/A440	6.24
Nonswinging doors for vehicular access and material transportation (min. opening of 32 in/s)	1.3	ANSI/DASMA 105, NFRC 400, or ASTM E283	1.57
Nonswinging opaque doors, glazed sectional garage doors, and upward acting nonswinging glazed doors	0.4	ANSI/DASMA 105, NFRC 400, or ASTM E283	1.57
All other products	0.2	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400	1.57
All other products	0.3	AAMA/WDMA/CSA 101/I.S/A440	6.24

Exceptions

- *Field-fabricated fenestration and doors*
- *Metal coiling doors in semiheated spaces In climate zones 1-6*
- *Products in buildings that comply with a whole building air leakage rate of 0.4 cfm/ft^2 under pressure differential of 0.3 in. H_2O, 1.57 psf per ASTM E779*

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Section 5 – 5.4.3.3 Loading Dock Weatherseals

In climate zones 4-8

- Cargo doors and loading dock doors equipped with weatherseals
  - To restrict infiltration when vehicles are parked in the loading dock/doorway

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ASHRAE 90.1 (2013) Significant Changes – Section 5 (3 of 12)

Section 5- Building Envelope

Mandatory Provisions (Section 5.4)

5.3.4. Vestibules - requires vestibules for building entrances, sets maximum size for vestibules at 50sf or 2% of gross conditioned floor area for level served. Michigan has amended the exceptions in this section.

5.4.3.1 addresses vestibules for large spaces greater than 40,000 sf when equipped with automatic doors and requires they have a minimum 16 ft between doors.

Section 5 Air Leakage – Vestibules Exceptions

Exceptions:

- 1. Doors not intended to be used by the public, such as doors to storage, mechanical, electrical, or equipment rooms.
- 2. Doors opening directly from a sleeping unit or dwelling unit.
- 3. Doors that open directly from a space less than 3,000 feet^2 (298 m^2) in area.
- 4. Revolving doors.
- 5. Doors used primarily to facilitate shipping, receiving, or material handling.
- 6. Doors with no exterior entrance hardware.
- 7. Doors leading solely to outdoor

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ASHRAE 90.1 (2013) Significant Changes – Section 5 (4 of 12)

Section 5- Building Envelope

Prescriptive Building Envelope Option (Section 5.5)

5.5.1- requires compliance with the envelope requirements for residential or non-residential and refers to Building Envelope Requirements for Climate Zones Table 5.5-1 to 5-5-8.

There are substantial changes to these envelope tables. Almost all values for Zones 5, 6 and 7 are changed and call for lower U factors and higher R values.

Building Envelope Requirements (Table 5.5-5)

Climate Zone 5

- Nonresidential Examples See Tables for Zones 5,6,7
  - Roofs: insulation entirely above deck = **R-30** (R-20.0 c.i.)
  - Roofs: Attic and other = **R-49** (R-38.0)
  - Above-Grade Walls: mass = **R-11.4 c.i.** (R-11.4 c.i.)
  - Above-Grade Walls: steel-framed = **R-13+R-10 c.i.** (R-13.0 + R-7.5 c.i.)
  - Above-Grade Walls: wood-framed = **R-13+ R-7.5 c.i. or R-19 + R-5 c.i.** (R-13.0 + R-3.8 c.i)
  - Below-Grade Walls: below-grade wall = **R- 7.5 c.i.** (R-7.5 c.i.)
  - Floors: mass = **R-14.6 c.i.** (R-10.4 c.i.)
  - Floors: steel joist = **R-30** (R-30.0)
  - Slab-On-Grade Floors: heated = R-20 for 48: (R-15 for 24 in.)
  - Doors: nonswinging = **U-0.500** (U-0.500)

Presenter's note: ( ) = 2007 ASHRAE 90.1 values

ASHRAE 90.1 (2013) Significant Changes – Section 5 (5 of 12)

Section 5- Building Envelope

Prescriptive Building Envelope Option (Section 5.5)

5.5.3.1 Roof Insulation

- *5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance-section changed but does not apply in Michigan it only applies in Climate Zones 1-3.*

5.5.3.2 Above Grade Walls- exception requirements for mass walls are added

Section 5 – 5.5 Prescriptive Envelope Option

Each envelope component must separately meet requirements

Opaque Areas (5.5.3)
Fenestration (5.5.4)

- WWR ≤ 40% of gross wall area
- Skylight-roof ratio ≤ **3%** of roof area

Prescriptive requirements for each component specified by climate zone and space conditioning category (Tables 5.5-1 through 5.5-8)

- Insulation levels for roofs, walls, floors and doors
- Fenestration criteria for windows, glazed doors and skylights

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.5.1 - Opaque

*TABLE 5.5-5 Building Envelope Requirements For Climate Zone 5 (A, B, C)**

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
Roofs						
Insulation Entirely above Deck	U-0.032	R-30 c.i.	U-0.032	R-30 c.i.	U-0.063	R-15 c.i.
Metal Building	U-0.037	R-19+R-11 Ls or R-25+R-8 Ls	U-0.037	R-19+R-11 Ls or R-25+R-8 Ls	U-0.082	R-19
Attic and Other	U-0.021	R-49	U-0.021	R-49	U-0.034	R-30
Heated	F-0.688	R-20 for 48 in.	F-0.688	R-20 for 48 in.	F-0.900	R-10 for 24 in.
Opaque Doors						
Swinging	U-0.500		U-0.500		U-0.700	
Nonswinging	U-0.500		U-0.500		U-1.450	

Reference Table 5.5-5 on page 31 in 90.1-2013

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.5.3.1 Roof Insulation *(cont'd)*

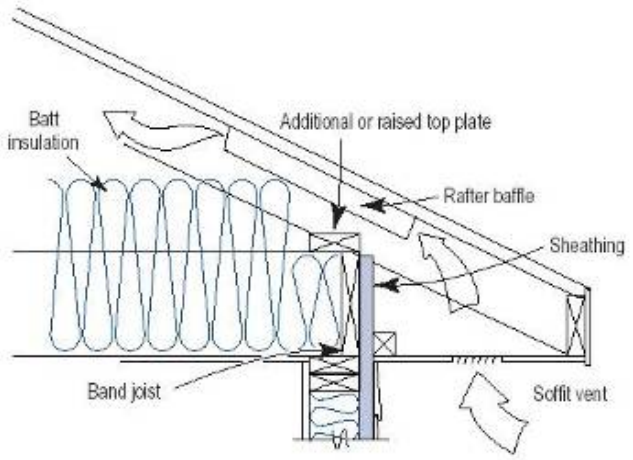
Three types of roofs are defined

- ✓ Roofs with insulation entirely above deck
  - R-value is for continuous insulation
  - Interruptions for mechanical equipment ≤ 1% of surface of the total roof area
- ✓ Metal building roofs
  - First value is for insulation
    - draped over purlins and then compressed when metal spanning members attached or
    - hung between purlins provided there's a min. of 1" thermal break between purlins and metal spanning members
  - Second value is for double-layer installations with insulation installed parallel to the purlins
- ✓ Attics and other roofs
  - R-value is for insulation installed both inside and outside the roof or entirely inside the roof cavity

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.8.1 Insulation Installation

- ✓ Per manufacturer's instructions
- ✓ Achieve rated R-value
- ✓ No open-blown or poured loose-fill insulation when ceiling slope is > 3/12
- ✓ If eave vents installed
  - Provide baffling of air vents to deflect incoming air above the surface of the insulation
  - Metal buildings **Exception**
    - if roof and wall insulation is compressed between roof or wall skin and the structure



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Section 5 High Albedo Roof - *Example*

Not required for Michigan but ay still be needed as part of a LEED project

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Section 5 Above-Grade Wall Insulation

Four types of walls are defined (cont'd)

- Metal building wall R-value
  - for insulation compressed between metal wall panels and the steel structure
- Steel-framed wall R-value
  - for uncompressed insulation installed in the cavity between steel studs; also acceptable to be continuous insulation uninterrupted by studs
- Wood-framed and other R-value
  - for uncompressed insulation installed in the cavity between wood studs; also acceptable to be continuous insulation uninterrupted by studs

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Section 5 – 5.5.3.3 Below-Grade Wall Insulation

Meet or exceed values in appropriate table for climate zone

R-value is for continuous insulation

Exception

- If framing is used, compliance is based on maximum assembly C-factor

Photo courtesy of Dow Building Solutions

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Section 5 – 5.5.3.5 - SOG Floor Insulation

Meet or exceed values in appropriate table for climate zone *(includes R-value and depth or width of insulation)*

Be installed around the perimeter to the distance specified

- **Inside foundation wall** – extend downward from top of slab a minimum distance specified or to the top of the footing, whichever is less
- **Outside foundation wall** – extend from top of the slab or downward to at least the bottom of the slab and then horizontally to a minimum distance specified

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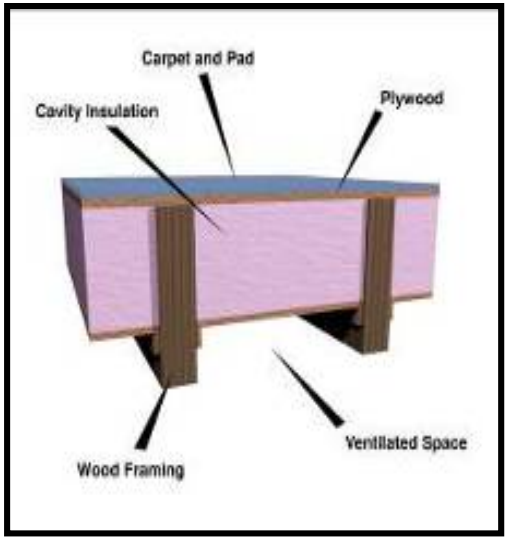
Floor Insulation *(Section 5.5.3.4)*

- Meet or exceed values in appropriate table for climate zone
- 3 classes of floors over unconditioned space are defined:
  - Mass floors
    - R-value is for continuous insulation
    - If framing is used, compliance is based on maximum assembly U-factor
  - Steel-joist floors
    - R-value is for uncompressed insulation or spray-on insulation, but is also acceptable for continuous insulation
  - Wood-framed and others
    - R-value is for uncompressed insulation, but is also acceptable for continuous insulation



U.S. Department of Energy (2010)

ASHRAE 90.1 (2013) Significant Changes – Section 5 (6 of 12)

Section 5- Building Envelope

Prescriptive Building Envelope Option (Section 5.5)

5.5.4 Fenestration

- *5.5.4.1 General-stipulates that U factors, SHGC and VT/SHGC be demonstrated for the whole product.*

- *Requires wall and roof areas of fenestration to be calculated separately for each space conditioning category*

Fenestration Area

- Total vertical fenestration area to be < 40% of gross wall area *(Section 5.5.4.2.1)*
  - Including both fixed and operable vertical fenestration
- Total skylight area to be < 3% of gross roof area *(Section 5.5.4.2.2)*
  - Including glass skylights, plastic skylights with a curb, and all skylights without a curb

U.S. Department of Energy (2010)

Section 5 – 5.5.4.3 and *5.8.2.3* Fenestration U-Factor

U-factor not greater than specified in Tables 5.5-1 through 5.5-8

- For *climate zone 5*
  - **U-0.32** for non-metal framing (U=0.35 in 2007)
  - **U-0.42** for fixed metal framing (U=0.45 in 2007)
  - **U-0.50** for operable metal framing (U=0.55 in 2007)
  - **U-0.77** for entrance door metal framing (U=0.7 swinging and 0.5 non-swinging in 2007)
  - **U-0.50** for Skylights (Varies with application in 2007)

Labeled and certified by manufacturer

Exceptions

- A8.1 acceptable for skylights, A8.2 acceptable for other vertical fenestration, and A7 acceptable for opaque doors
- ANSI/DASMA 105 acceptable for garage doors

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Fenestration and Doors

U-factors *(Section 5.8.2.4)*

- NFRC 100 or
- Assemblies listed in Appendix A

SHGC *(Section 5.8.2.5)*

- NFRC 200 or
- Assemblies listed in Appendix A

Visible Light Transmittance *(Section 5.8.2.6)*

- NFRC 200 when building envelope trade-off option is used

U.S. Department of Energy (2010)

Using the Evaluation Checklists
Fenestration

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)	Solar Heat Gain Coefficient
0.30	**0.30**

ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	Air Leakage (U.S./I-P)
0.51	**0.2**

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. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.
www.nfrc.org

FR8 [5.8.2.1][2]	Fenestration products rated in accordance with NFRC.

ASHRAE 90.1 (2013) Significant Changes – Section 5 (7 of 12)

Section 5- Building Envelope

Prescriptive Building Envelope Option (Section 5.5)

5.5.4.2 Fenestration Areas

5.5.4.2.2-Maximum Skylight Fenestration Area sets (0-3%) maximum skylight areas from Tables 5.5-1 to 5.5-8 and provides an exception for 6% of gross roof area for certain daylight areas

5.5.4.2.3-Minimum Skylight Fenestration Area -establishes minimum skylight for certain functional spaces greater than 2,500 sf and meeting various roof/ceiling conditions. This section also provides exceptions.

ASHRAE 90.1 (2013) Significant Changes – Section 5 (8 of 12)

Section 5- Building Envelope

Prescriptive Building Envelope Option (Section 5.5)

5.5.4.4 Fenestration Solar Heat Gain Coefficient (SHGC)- sets the SHGC requirements as meeting Tables 5.5-1 to 5.5-8 and identifies exceptions

5.5.4.5 Fenestration Orientation- puts limitations on how much fenestration can be located on the West or East facades through calculations based on total wall area and West and East wall areas.

5.5.4.6 Visible Light Transmission-new section sets VT/SHGC per Tables 5.5-1 to 5.5-8 when using automatic daylight controls in accordance with 9.4.1.1(e)

Section 5 – 5.5.4.5 - Fenestration Orientation

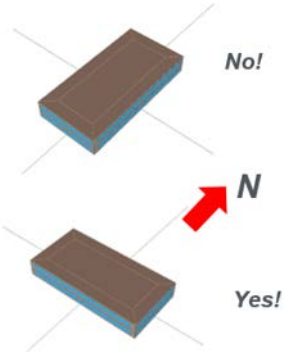
Two options to comply:

$$a)\ A_w \leq \frac{A_t}{4} \text{ and } A_e \leq \frac{A_t}{4}$$

$$b)\ A_w \times SHGC_w \leq \frac{A_t \times SHGC_c}{4} \text{ and } A_e \times SHGC_e \leq \frac{A_t \times SHGC_c}{4}$$

Where,

A_w and $SHGC_w$ = west-oriented vertical fenestration area and SHGC
A_e and $SHGC_e$ = east-oriented vertical fenestration area and SHGC
A_t = total vertical fenestration area
$SHGC_c$ = SHGC criteria in Tables 5.5-1 through 5.5-8



Exceptions

- *Complies with Exception 3 of Section 5.5.4.4.1*
- *Buildings shaded by other buildings within 20 ft to the south which is at least ½ as tall as the proposed building*
- *Buildings with shade on 75% of the west and east*
- *Alterations and additions that don't increase vertical fenestration area*
- *Buildings where west- and east-oriented vertical fenestration area < 20% of gross wall area for each of those facades and SHGC on those facades < 90% of $SHGC_c$*
- *In climate zone 8*

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Section 5 – 5.5.4 Fenestration

Criteria apply to fenestration, including windows, glass doors, glass block, plastic panels, and skylights

- specified by fenestration type, space conditioning category and by climate zone

Compliance with values in Tables 5.5-1 through 5.5-8

- U-factor not greater than specified
- SHGC not greater than specified
- *Meet or exceed minimum VT/SHGC*
- Use NFRC ratings or default values in Appendix A
- Area weighting allowed within same class of construction and space conditioning category

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Section 5 – 5.5.4.2.3 Minimum Skylight Area

Minimum skylight area must be provided in enclosed spaces that are

- ≥ *2,500* ft^2
- In spaces with ceiling height > 15 ft and
- Space types

- Office
- Lobby
- Atrium
- Concourse
- Corridor
- Storage *(incl. nonrefrigerated warehouse)*
- Gymnasium*/fitness/exercise*
- *Area, playing area*
- *Gymnasium seating*
- Convention *exhibit/event space*
- Courtroom
- Automotive space
- *Fire state engine room*
- Manufacturing
- *Corridor/transition and bay areas*
- Retail
- *Library reading and stack areas*
- Distribution/sorting area
- Transportation
- *Baggage and seating areas*
- Workshop

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 *Visible Transmittance/SHGC Ratio*

When automatic daylighting controls are required per 9.4.1.1 (e) or (f)

- *fenestration to have a ratio of VT/SHGC not less than listed in Tables 5.5-1 through 5.5-8 (>1.1 for all climate zones)*

***Exceptions**:*

- *Can have a light-to-solar-gain ratio (LSG) of not less than 1.25*
  - *center-of-glass SHGC and VT determined per NFRC 300 and NFRC 301 by independent lab or included in a database published by a government agency and certified by a manufacturer*
- *Fenestration not covered in scope of NFRC 200*
- *Enclosed spaces*
  - *where daylight area under rooftop monitors is > 50% of enclosed floor area*
  - *with skylights complying with 5.5.4.2.3*
  - *where sidelighting effective aperture is ≥ 0.15*
- *Dynamic glazing*
  - *VT/SHGC ratio and LSG determined using maximum VT and maximum SHGC*
  - *Considered separately from other fenestration; cannot include dynamic glazing with other fenestration for area-weighted averaging*

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.5.4.4 Fenestration SHGC

Vertical fenestration (5.5.4.4.1)

- SHGC values < Table value for appropriate total vertical fenestration area

Exceptions

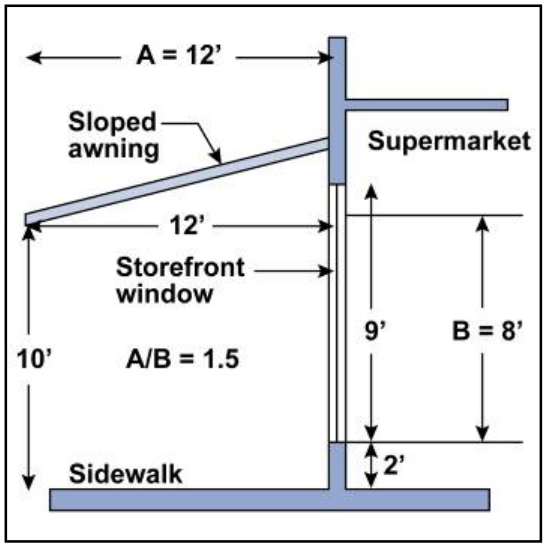
- For vertical fenestration only, the SHGC in the proposed building can be reduced by using the multipliers in Table 5.5.4.4.1 for fenestration shaded by permanent projections that will last as long as the building itself
- For vertical fenestration shaded by partially opaque permanent projections that will last as long as the building itself, can reduce the PF by multiplying by values in Section 5.5.4.4.1
- Street-level exception only applies when using the prescriptive compliance option
- Dynamic glazing cannot be area-weighted with other fenestration and minimum SHGC of dynamic glazing shall be used to show compliance for dynamic glazing
- North-oriented vertical fenestration allowed to have SHGC lower than that specified Tables 5.5-1 through 5.5-8 by 0.05

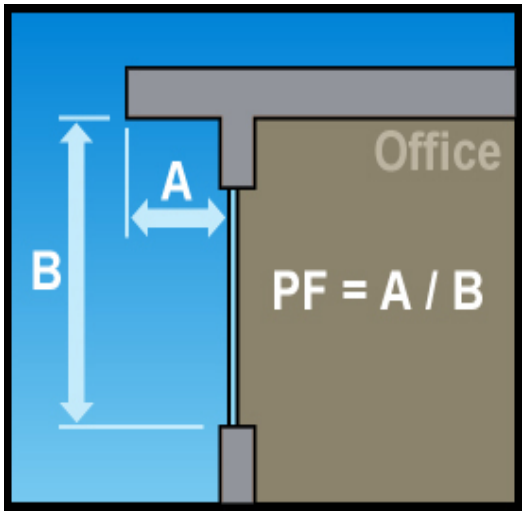
Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Information – Overhangs

Standard credits permanent overhangs by adjustment to SHGC

Size of overhang is determined by projection factor





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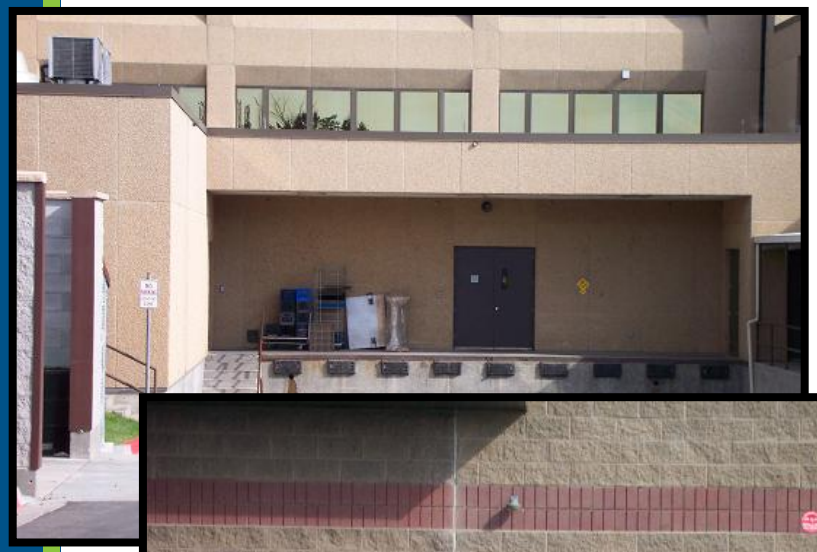
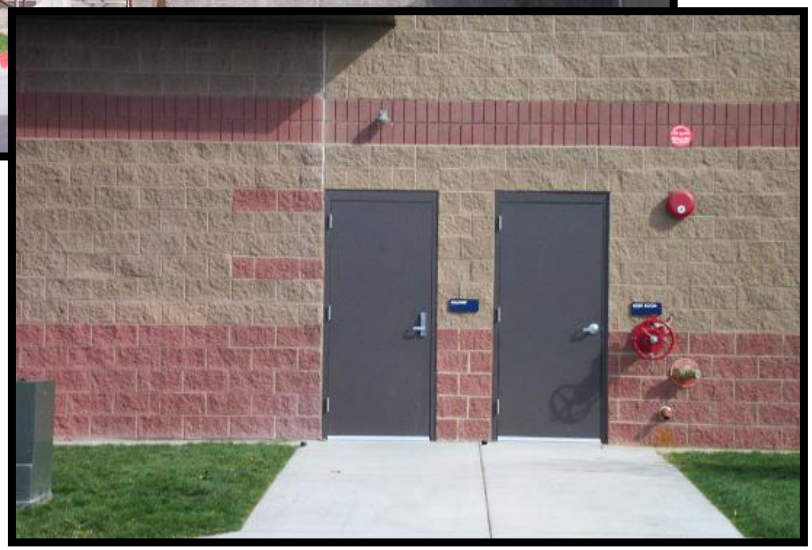
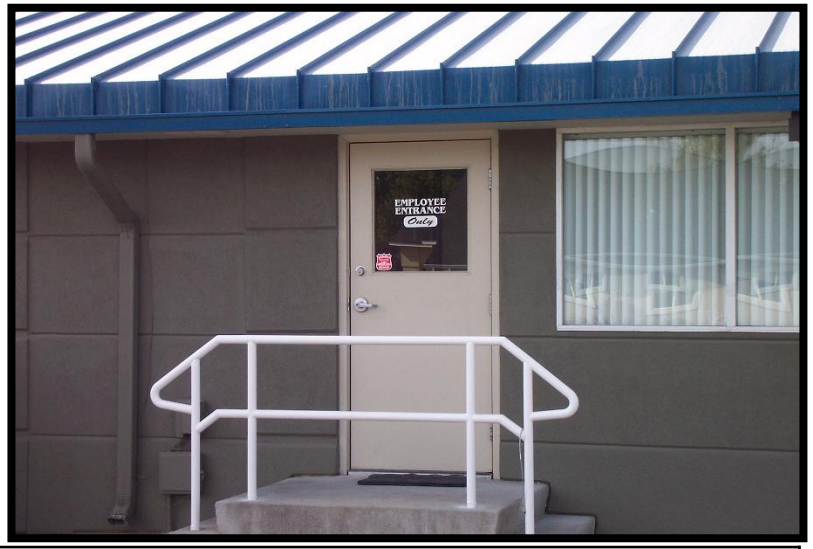
Using the Evaluation Checklists:
Thermal Envelope Requirements





Opaque Door Requirements

- **Permanently installed nameplate on all manufactured doors showing U-factor and Air Leakage Rate**
- **Opaque Doors must meet U-factor requirements of Tables 5.5- through 5.5-8**



FI5 [5.8.2.3, 5.5.3.6] [2]	U-factor and air leakage of opaque doors associated with the building thermal envelope meets requirements.

Visible Light Transmittance

- A measure of the amount of visible light that passes through fenestration
- Affected by:
  - composition of the glass
  - coatings
  - internal shading devices
- Relationship between VLT and SHGC
  - Day-lighting without excessive solar gain– VLT at least 1.2 x SHGC

U.S. Department of Energy (2010)

Fenestration SHGC

- Vertical fenestration *(Section 5.5.4.4.1)*
  - SHGC values < Table value for appropriate total vertical fenestration area
- Skylights *(Section 5.5.4.4.2)*
  - SHGC values < Table value for appropriate total skylight area
- No SHGC requirements for semi-heated spaces
- No criteria for Visible Light Transmittance in Prescriptive Building Envelope Option, but there are minimum criteria in the Trade-Off Option (Details in Appendix C)
- Exceptions

U.S. Department of Energy (2010)

Section 5 – 5.6.1
Building Envelope Trade-Off Option "Rules"

Building must comply with Sections 5.1, 5.4, 5.7, and 5.8

Complies with trade-off option if envelope performance factor (EPF) of proposed design is less than or equal to that of budget building defined by rules in Appendix C

- *All building envelope components shown on drawings or installed in existing buildings to be included in proposed building design*
- *Fenestration and opaque envelope types and area used in simulation model to be consistent with design documents*
- *Don't need to separately describe any envelope assembly covering < 5% of total area of that assembly*
  - *as long as it's similar to an assembly being modeled*
  - *if not separately described, add the area of that assembly to an assembly with same orientation and thermal properties*

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Section 5 – 5.6.1.2
Trade-Offs Limited to Building Permit

- If building permit will apply to less than the whole building
  - Parameters relating to unmodified existing conditions or future building components to be identical for both proposed EPF and base EPF
- Future components meet prescriptive requirements of Section 5.5

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.7 Submittals

- General – AHJ can require compliance documentation and supplemental information per 4.2.2
- Space Conditioning Categories – if building has semiheated or unconditioned spaces and compliance is sought using semiheated criteria, spaces to be clearly indicated on floor plans
- Visible Transmittance – include test results for skylight glazing or diffusers (per 5.8.2.5)
- **Daylight Areas** – documentation to identify daylight areas on floor plans, including
  - Primary sidelighted areas
  - Secondary sidelighted areas
  - Daylight area under skylights
  - Daylight areas under roof monitor

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Section 5 – 5.8
Product Information and Installation Requirements

- ✓ Labeling of Building Envelope Insulation *(Section 5.8.1.1)*
- ✓ Compliance with Manufacturers' Requirements *(Section 5.8.1.2)*
- ✓ Loose-Fill Insulation Limitation *(Section 5.8.1.3)*
- ✓ Baffles *(Section 5.8.1.4)*
- ✓ Substantial Contact *(Section 5.8.1.5)*
- ✓ Recessed Equipment *(Section 5.8.1.6)*
- ✓ Insulation Protection *(Section 5.8.1.7)*
- ✓ Location of Roof Insulation *(Section 5.8.1.8)*
- ✓ Extent of Insulation *(Section 5.8.1.9)*
- ✓ Joints in Rigid Insulation *(Section 5.8.1.10)*

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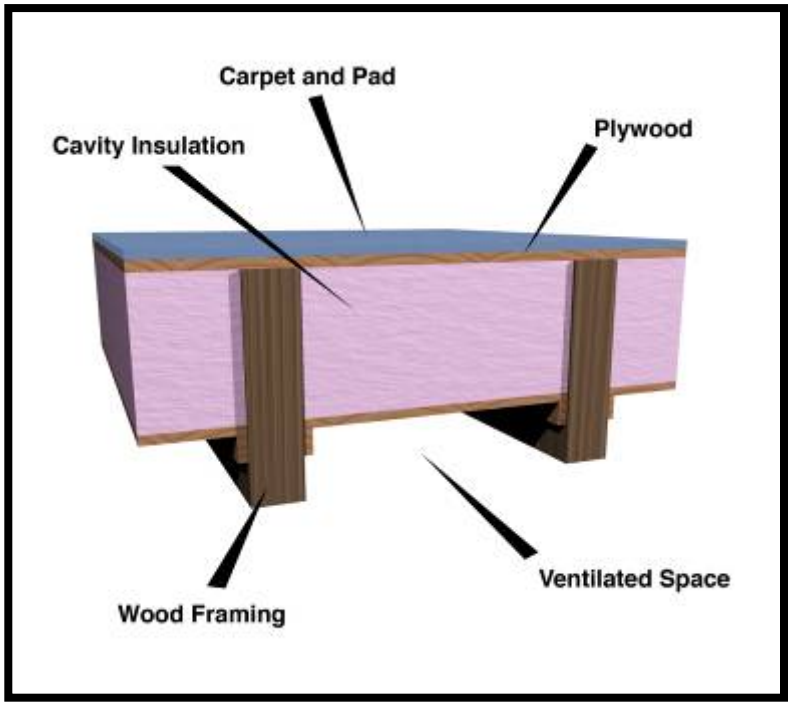
Insulation - Substantial Contact *(Section 5.8.1.5)*

- Install insulation in a permanent manner in substantial contact with inside surface
- Flexible batt insulation in floor cavities
  - Supported in a permanent manner by supports no more than 24 in. on center (o.c.)



U.S. Department of Energy (2010)

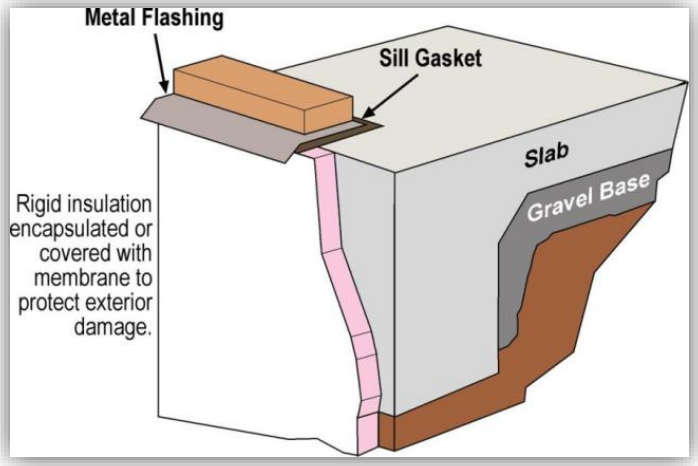
Recessed Equipment *(Section 5.8.1.6)*

- Do not recess equipment to affect insulation thickness
  - Lighting fixtures
  - HVAC equipment (includes wall heaters, ducts, and plenums)
  - Other
- Except when
  - Total combined area affected (include necessary clearances) is
    < 1% of opaque area of the assembly, **OR**
  - Entire roof, wall, or floor is covered with insulation to the full depth required, **OR**
  - Effects of reduced insulation are included in area-weighted calculations

Section 5 – 5.8.1.7 -Insulation Protection

Insulation Protection

- Cover exterior insulation with protective material
  - Sunlight
  - Moisture
  - Landscaping operations
  - Equipment maintenance
  - Wind
- Access to attics and mechanical rooms without damaging or compressing insulation
- Insulation materials in ground contact to have a water absorption rate ≤ 0.3% *(ASTM C272)*



Example

Source: slide modified from www.energycodes.gov ANSI/ASHRAE Standard 90.1 2013 ENVELOPE - VISITED SEPT. 5, 2017

Section 5 – 5.8.1.8 - Suspended Ceilings

Roof Insulation

- Not installed on a suspended ceiling with removable ceiling panels
- Non-compliant

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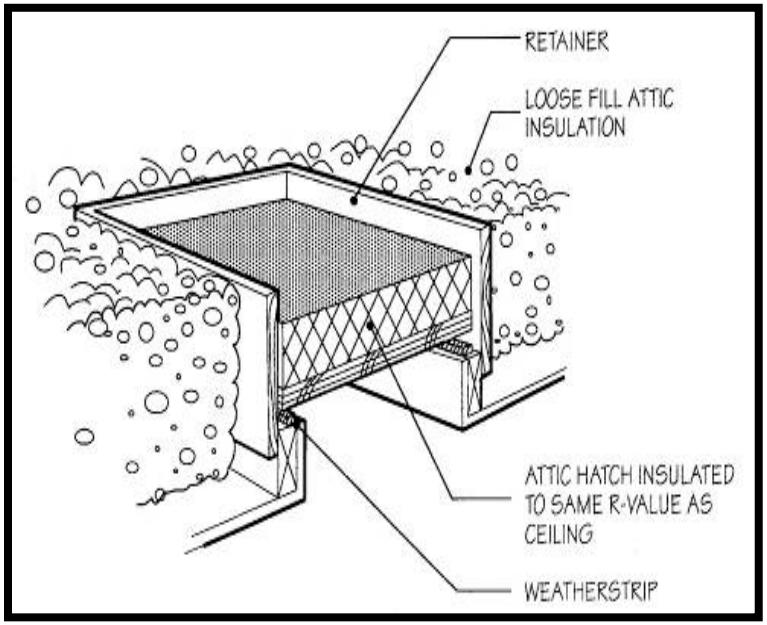
Insulation Protection

Insulation Protection:

- Cover exterior insulation with protective material (*Section 5.8.1.7)*
  - Sunlight
  - Moisture
  - Landscaping operations
  - Equipment maintenance
  - Wind



U.S. Department of Energy (2010)

- Access to attics and mechanical rooms without damaging or compressing insulation *(Section 5.8.1.7.1)*
- Insulation materials in ground contact to have a water absorption rate ≤ 0.3% (ASTM C272) *(Section 5.8.1.7.3)*

Suspended Ceilings

Roof Insulation:

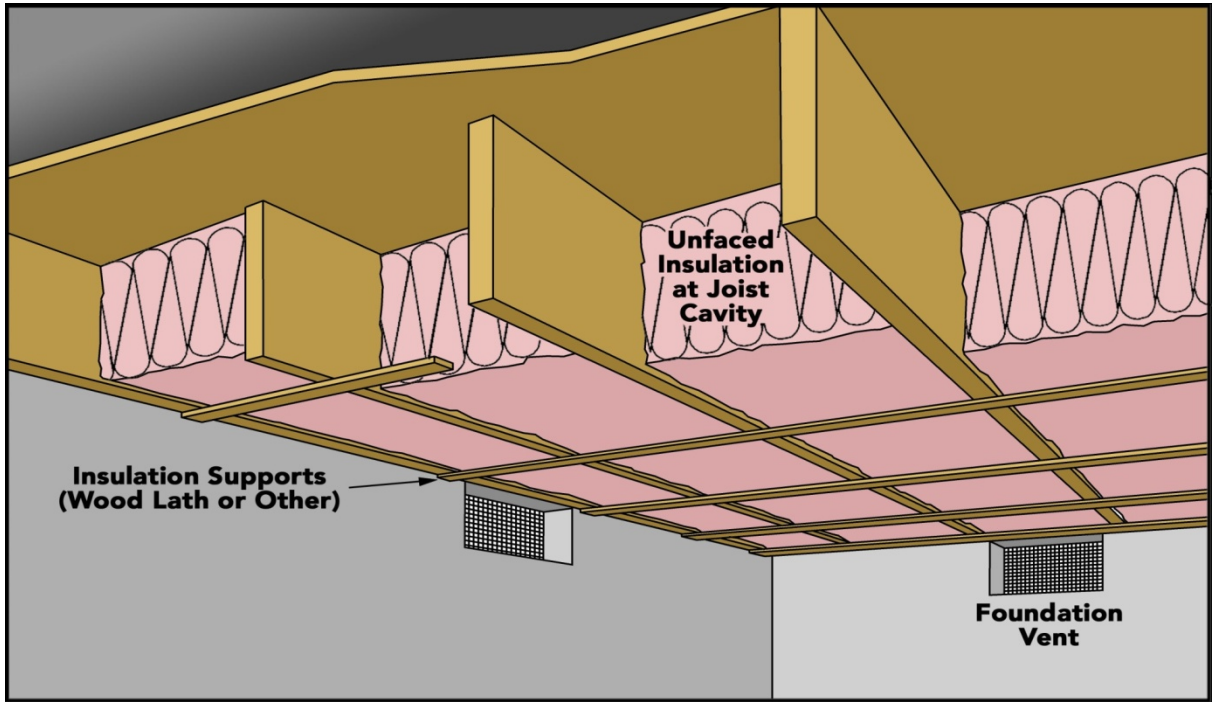
- Not installed on a suspended ceiling with removable ceiling panels *(Section 5.8.1.8)*

U.S. Department of Energy (2010)

Using the Evaluation Checklists:
Insulation Compression

IN7 [5.8.1.6] [2]	Recessed equipment installed in building envelope assemblies does not compress the adjacent insulation.

Using the Evaluation Checklists
Foundation Vents & Insulation



IN9 [5.8.1.7.1] [2]	Foundation vents do not interfere with insulation.

Using the Evaluation Checklists:
Roof Insulation

IN15 [5.8.1.8] [3]	Roof Insulation not installed on suspended ceiling with removable panels.

ASHRAE 90.1 (2013) Significant Changes – Section 5 (9 of 12)

Section 5- Building Envelope

Building Envelope Trade-Off Option (Section 5.6)

5.6.1.1 Modifies language addressing modeling of the envelop of a proposed design and the base building in the simulation model

5.6.1.2 Trade-Offs Limited to Building Permit- addresses how future building components shall be addressed in the simulation model.

ASHRAE 90.1 (2013) Significant Changes – Section 5 (10 of 12)

Section 5- Building Envelope

Submittals (Section 5.7)

5.7.3 Visible Light Transmittance. Establishes that test results for skylight glazing be included in the contract documents submitted for a building permit.

5.7.4 Submittal Documentation of Daylight Areas- new section requires daylight areas to be shown on the floor plan

ASHRAE 90.1 (2013) Significant Changes – Section 5 (11 of 12)

Section 5- Building Envelope

Product Information and Installation Requirements (Section 5.8)

5.8.1.10 Joints in Rigid Insulation- requires joints to be staggered when two or more layers of rigid insulation are used.

ASHRAE 90.1 (2013) Significant Changes – Section 5 (12 of 12)

Section 5- Building Envelope

5.8.2 Fenestration and Door Products

- *5.8.2.2 Fenestration and Door Products- all manufactured and site built fenestration products shall be labeled or a certificate from the product manufacturer and establishes an exception for doors with less than 25% glass.*
- *5.8.2.5 Visible Transmittance-establishes an exception and alternate procedure when not within scope of NFRC 200.*

ASHRAE 90.1 Chapter 6 – HVAC (1 of 9)

Significant Changes Chapter 6

Numerous detailed changes to many sections

ASHRAE 90.1 Chapter 6 – HVAC (2 of 9)

Significant Changes-Simplified approach for smaller buildings changed requirements for:

- *Single zone VAV controls*
- *Piping insulations*
- *Demand control ventilation*
- *Door switch requirements*

Section 6 – 6.3 Simplified Approach Option

The simplified approach is an optional path for compliance when the following are met:

- Buildings with 1 or 2 stories
- Buildings with gross floor area < 25,000 ft^2
- System serving single HVAC zone
- Unitary packaged or split air conditioners (air-cooled or evaporatively cooled)

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ASHRAE 90.1 Chapter 6 – HVAC (3 of 9)

Significant Changes-Mandatory Provisions 6.4

New requirements for:

- *Computer rooms*
- *Commercial refrigerators and freezers*
- *Commercial refrigeration*
- *Parking garages*
- *Sensible heating systems*
- *New equipment types*
- *Controls requirements*

ASHRAE 90.1 Chapter 6 – HVAC (4 of 9)

Significant Changes-Mandatory Provisions 6.4

New requirements for

Minimum Equipment efficiencies 6.4.1.1

- *Load Calculations 6.4.2.1*
- *Pump Head –new section 6.4.2.2*
- *Set back controls-modification 6.4.3.2*
- *Optimum Start Controls 6.4.3.3.3*
- *Humidification and dehumidification modifications 6.4.3.6*
- *Heating in Vestibules-new section 6.4.3.9*
- *Direct Digital Control (DDC) – new section 6.4.3.10*

ASHRAE 90.1 Chapter 6 – HVAC (5 of 9)

Significant Changes-Mandatory Provisions 6.4
New requirements for

- *Demand Control Ventilation -6.4.3.8*

- *Shutoff Damper Controls*
- *Damper Leakage 6.4.3.4.3*

- *Enclosed parking garage ventilation-new section 6.4.3.4.5*

ASHRAE 90.1 Chapter 6 – HVAC (6 of 9)

Significant Changes-Mandatory Provisions 6.4
New requirements for

- *Ventilation controls for high occupancy spaces 6.4.3.8*
- *Heating in Vestibules-new section automatic shutoff controls 6.4.3.9*
- *Direct Digital Control (DDC)-new section 6.4.3.10*
- *Piping Insulation-changes 6.4.4.1.3*

ASHRAE 90.1 Chapter 6 – HVAC (7 of 9)

Significant Changes-Mandatory Provisions 6.4
New requirements for

- *Sensible Heating Panels –new section 6.4.4.1.4*
- *Radiant Floor Heating Insulation –new section 6.4.4.1.5*
- *Duct Sealing- 6.4.4.2*
- *Walk-in coolers and freezers-new section 6.4.5*
- *6.4.6 Refrigerated Display Cases-new section 6.4.6*

ASHRAE 90.1 Chapter 6 – HVAC (8 of 9)

Numerous Changes-Prescriptive Requirements 6.5

- *Economizers 6.5.1*
- *Simultaneous heating and cooling 6.5.2*
- *Fan controls 6.5.3*
- *Hydronic systems 6.5.4*
- *Heat Recovery 6.5.6*
- *Exhaust Systems 6.5.7*
- *Door Switches-new section 6.5.10*
- *Condensers serving refrigeration systems 6.5.11*

ASHRAE 90.1 Chapter 6 – HVAC (9 of 9)

Changes-

Alternate Compliance Path-computer rooms 6.6

ASHRAE 90.1 Chapter 7 Service Water Heating

Significant Changes Include:

Performance Requirements for equipment Table 7.8

Piping Insulation thickness-7.4 Virtually all piping insulation thickness have changed

New requirements for buildings with high heat capacity service water systems 7.5.3

ASHRAE 90.1 (2013) Significant Changes – Section 8 (1 of 4)

Section 8 - Power

General (Section 8.1) - minor changes reflecting clarifications of how this standard applies to additions and alterations

Compliance Paths (Section 8.2) - no significant change

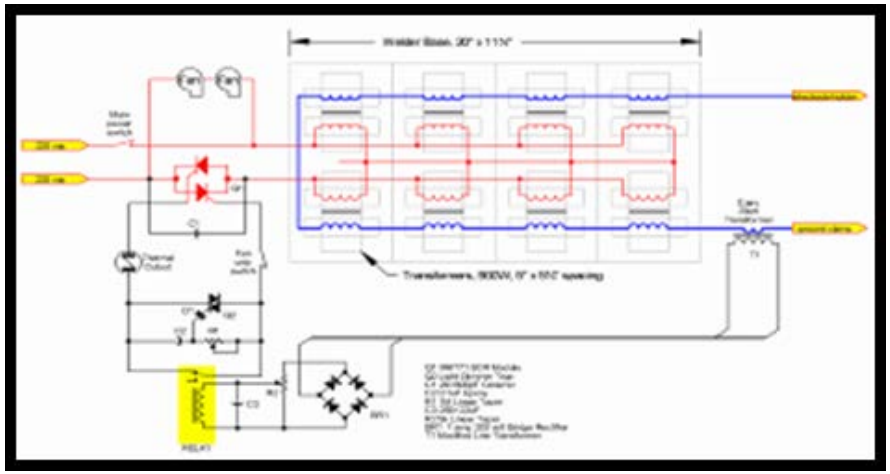
Simplified/Small Building Option (Section 8.3) - not used

ASHRAE 90.1 (2013) Significant Changes – Section 8 (2 of 4)

Section 8- Power

Mandatory Provisions (Section 8.4)

- *8.4.1 Voltage drop- minor change to exceptions for "feeder conductors and branch circuits for circuits dedicated to emergency services*



U.S. Department of Energy (2010)

ASHRAE 90.1 (2013) Significant Changes – Section 8 (3 of 4)

Section 8- Power

Mandatory Provisions (Section 8.4)

- *8.4.1 Voltage drop- minor change to exceptions for "feeder conductors and branch circuits for circuits dedicated to emergency services*

- *Michigan Deleted the following sections*

- *8.4.2 Automatic receptacle control*
- *8.4.3 Electrical Energy Monitoring*
- *8.4.3.1 Monitoring*
- *8.4.3.2 Recording and Record Keeping*

ASHRAE 90.1 (2013) Significant Changes – Section 8 (4 of 4)

Section 8- Power

Mandatory Provisions (Section 8.4)

- *8.4.4 Low Voltage Dry-Type Distribution Transformers (new section added)*

Prescriptive Path (Section 8.5)- not used

Alternate Compliance Path (Section 8.6) – not used

Submittals (Section 8.7) -no significant change

Product Information and Installation Requirements (Section 8.8) – not used

Table 8.4.4-added and shows efficiency levels for Low Voltage Dry Type Distribution Transformers

Power Submittals *(Section 8.7)*

Owner gets information about the building's electrical system

- Record drawings of actual installation within 30 days *(Section 8.7.1)*
  - Single-line diagram of electrical distribution system
  - Floor plans showing location and areas served for all distribution
- Manuals *(Section 8.7.2)*:
  - Submittal data stating equipment rating
  - O&M manuals for equipment
  - Qualified service agency
  - Complete narrative of system as it's normally intended to operate

U.S. Department of Energy (2010)

U.S. Department of Energy (2010)

Lighting *(Section 9)*

- General Application *(Section 9.1)*
  - Scope
  - Lighting Alterations
  - Installed Interior Lighting Power
  - Luminaire Wattage
- Compliance Path(s) *(Section 9.2)*
- Mandatory Provisions *(Section 9.4)*
  - Lighting control
  - Tandem wiring
  - Exit signs
  - Exterior building grounds lighting
  - Exterior building lighting power
- Building Area Method Compliance Path (*Section 9.5)*
- Alternative Compliance Path: Space-by-Space Method *(Section 9.6)*

U.S. Department of Energy (2010)

Section 9 - Lighting

- ✓ General Application *(Section 9.1)*
  - Scope
  - Lighting Alterations
  - Installed Lighting Power
  - *Interior and Exterior* Luminaire Wattage
- ✓ Compliance *(Section 9.2)*
- ✓ Mandatory Provisions *(Section 9.4)*
  - Lighting control
  - Exterior building lighting power
  - Functional testing
- ✓ Building Area Method Compliance Path *(Section 9.5)*
- ✓ Alternative Compliance Path: Space-by-Space Method *(Section 9.6)*

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Section 9 - Lighting General Scope

- Interior spaces of buildings
- Exterior building features
- Exterior grounds lighting powered through building

Exceptions

- Emergency lighting
- Lighting required by life safety statute
- Lighting within dwelling units of buildings
- Decorative gas lighting

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ASHRAE 90.1 (2013) Significant Changes – Section 9 (1 of 2)

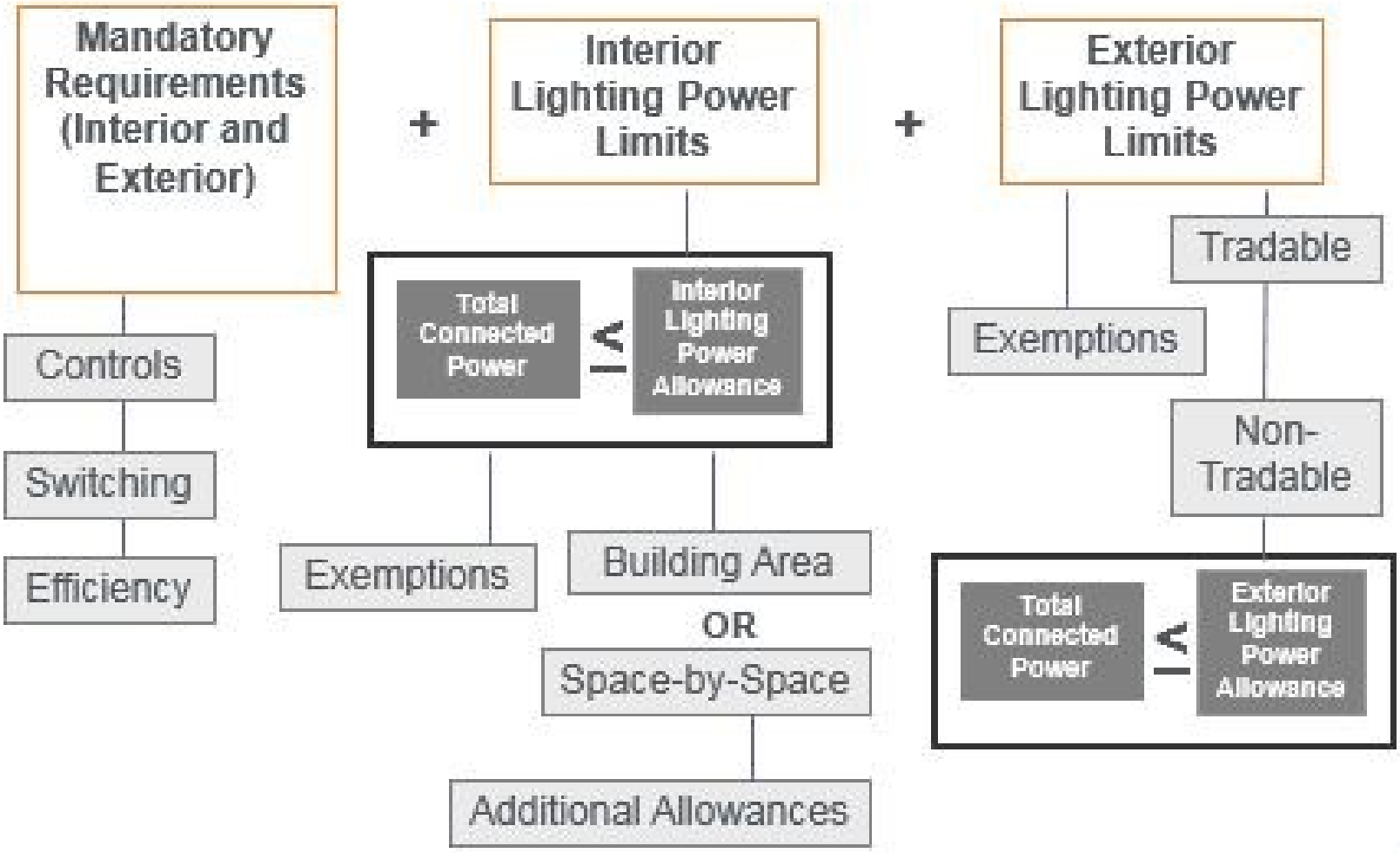
Section 9 – Lighting

ASHRAE 90.1 (2013) 17 pages + 240% from ASHRAE 90.1 (2007) 7 pages

General (Section 9.1)

- *9.1.2 Lighting Alterations-added alteration language. Michigan amends the exception threshold to 50% of connected lighting load for when requirements do not apply.*

Basic Lighting Requirements



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ASHRAE 90.1 (2013) Significant Changes – Section 9 (2 of 2)

Section 9 – Lighting

Compliance (Section 9.2) –

9.2.2.3 Interior Lighting Power-this section requires using the Building Area Method or Space by Space Method.

Exceptions for certain lighting from being included in the calculation under this section are modified from the ASHRAE 90.1 (2007)

Two new exceptions for mirror lighting and certain parking garages transition lighting are added.

Section 9 – 9.1.3
Installed Lighting Power Calculation Requirements

These requirements apply to both interior and exterior

Installed Lighting Power shall include all power used by the luminaires, including lamps, ballasts, transformers, and controls

- **Exception**: where two independent lighting systems exist in the same space or area and are controlled to prevent simultaneous operation, only the system with the highest total wattage must be included

Luminaire Wattage for various systems shall be determined in accordance with details in Section 9.1.4

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Exceptions-Interior Lighting Power Calculation Exemptions

Lighting that does not have to be included in the installed lighting power calculation:

- Theatrical, stage, film, and video production
- Medical and dental procedures
- Exhibit displays for museums, monuments, and galleries
- Integral to equipment or instrumentation installed by manufacturer
- Integral to both open and glass-enclosed refrigerator and freezer cases
- Retail display windows, provided the display is enclosed by ceiling-height partitions
- Food warming and food preparation equipment
- Interior spaces specifically designated as registered interior historic landmarks
- Integral part of advertising or directional signage

- *Exit signs*
- *Sale or lighting educational demonstration systems*
- *Lighting for television broadcasting in sporting activity areas*
- *Casino gaming areas*
- *Furniture-mounted supplemental task lighting controlled by automatic shutoff and complying with 9.4.1.4(d)*
- *For use in areas specifically designed for life support of nonhuman life forms*
- *Mirror lighting in dressing rooms and accent lighting in religious pulpit and choir areas*
- *Parking garage transition lighting*

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Section 9 Building Area Method

Can be used for entire building or separate building type occupancies

Advantages

- ✓ Fewer calculations

Limitations

- ✓ Limited building area type selection - use reasonably equivalent type
- ✓ Insensitive to specific space functions and room configurations
- ✓ Generally more restrictive that space-by-space method

Calculation Process

1) Determine gross lighted area for each building type area using:
   - Exterior faces of exterior walls
   - Centerline of interior walls
2) Calculate the area power allowance by multiplying the gross lighted area by the applicable building type allowance from Table 9.5.1
3) Sum all the allowances (if more than one building type area)

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Section 9 – Table 9.5.1 Building Types

Part of Table 9.5.1 shown below.

Complete table in the Standard has 32 different building types

Building Type	Lighting Power Density (W/ft^2)
Automotive Facility	*0.80*
Convention Center	*1.01*
Court House	*1.01*
Dining: Bar Lounge/Leisure	*1.01*
Dining: Cafeteria/Fast Food	*1.01*
Dining: Family	*1.01*
Dormitory	*0.57*
Exercise Center	*0.84*

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Section 9 – 9.6.1-Space-by-Space Method

Applies to any building configuration by calculating allowances for individual spaces

Advantages

- ✓ More flexible than building area method
- ✓ More accurately accounts for actual room lighting power needs
- ✓ Provides additional allowances for:
  - Difficult room configurations
  - Decorative and retail needs
  - Use of advanced controls not already required in the standard

Limitations

- ✓ More calculations needed (individual spaces)

Calculation Process

1) Determine the gross lighted area of each space type
   - include balconies and mezzanines
   - Use centerline of walls between spaces
2) Calculate the space power allowance by multiplying the space type area by the applicable allowance from Table 9.6.1
3) Sum all the allowances

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Section 9 – Table 9.6.1 Space-by-Space Allowances

Small part of Table 9.6.1 shown below
Approximately 100 different space types included in the Standard

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

Informative Note: This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft²	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Atrium											
... that is <20 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... that is ≥20 ft and ≤40 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... that is >40 ft in height	0.40 + 0.02/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Audience Seating Area											
... in an auditorium	0.63	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a convention center	0.82	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2

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Room Geometry Adjustment – *9.6.4*

Room Cavity Ratio Adjustment for relief in unusual space configurations

- Used only when applying the space by space method
- Calculate the *Room Cavity Ratio* (RCR) for the empty room:

$$RCR = \frac{2.5 \times \text{Room Cavity Height} \times \text{room perimeter}}{\text{room area}}$$

(Room Cavity Height = Luminaire mounting height – Workplane height)

- If RCR is greater than the RCR threshold for that space type from Table 9.6.1, a 20% increase is allowed
- For corridor/transition spaces, a 20% adjustment is allowed when less than 8 feet wide, regardless of the RCR

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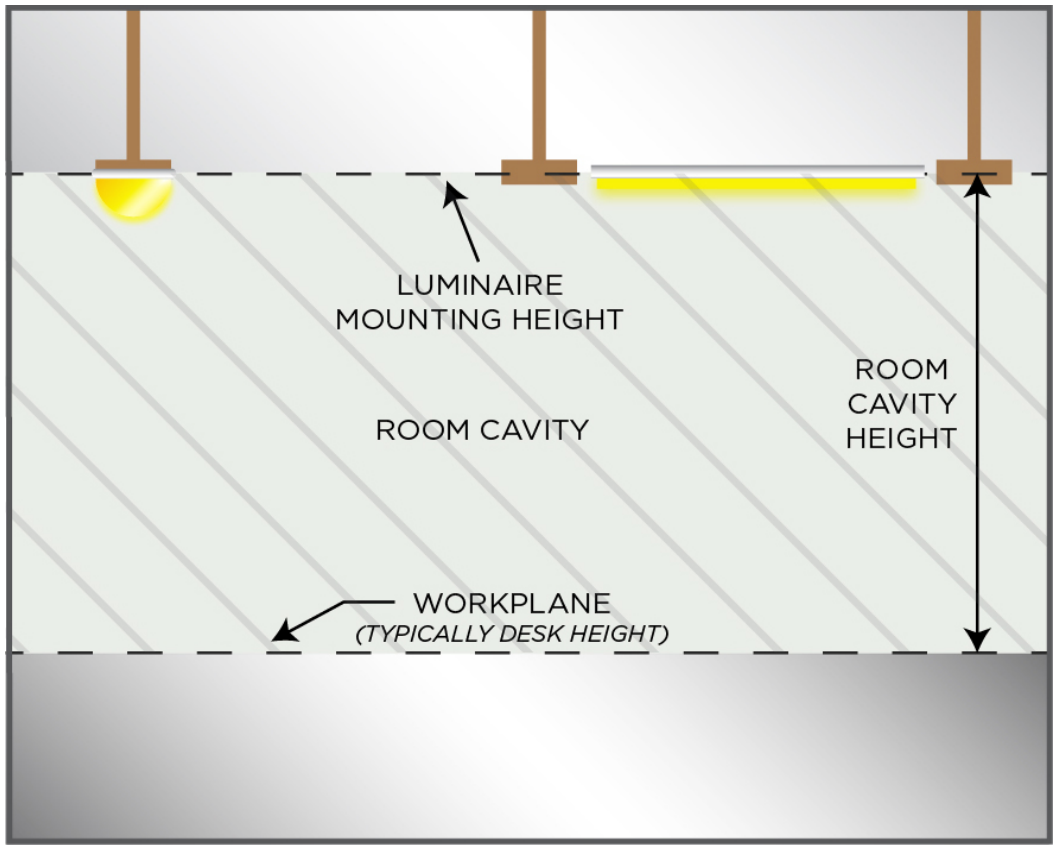
Room Geometry Adjustment (1 of 2)



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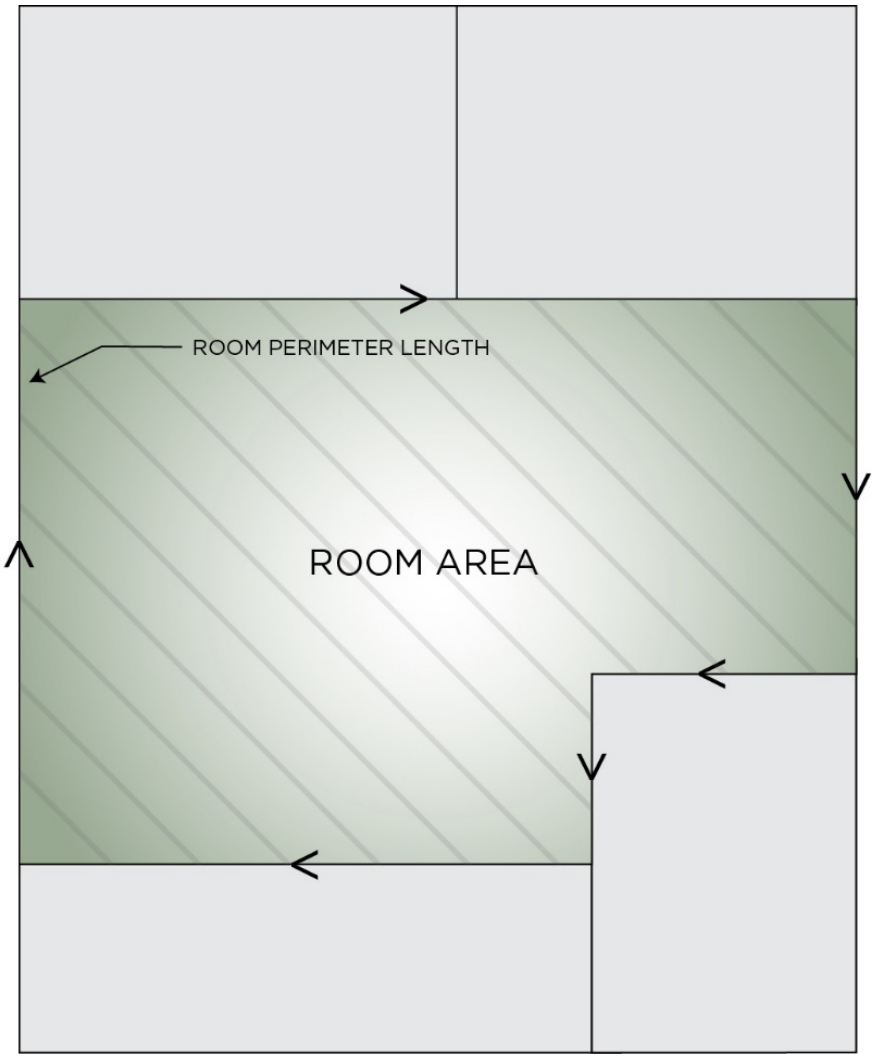
Room Geometry Adjustment (2 of 2)



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Section 9 – 9.6.2 – 9.6.3
Additional Interior Lighting Power

Decorative and Retail display highlighting

An increase in the lighting power allowance is allowed for specific decorative and retail applications when using the space-by-space method.

Must be automatically controlled, separately from the general lighting, to be turned off during non-business hours.

The additional allowances can only be used for the additional lighting equipment – and not general lighting

- ✓ Decorative luminaires in addition to the general lighting = 1.0 W/ft^2
- ✓ Retail display lighting = varies by retail type

Advanced Controls

An increase in the allowance is also allowed for the use of specified advanced controls that are installed in addition to those already required

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Section 9 – *9.6.3* Advanced Controls Incentive

If all mandatory control requirements are met for a space AND advanced controls are installed in that space, THEN additional limited lighting power is allowed:

- Additional power can be used anywhere in the building
- Additional Interior Lighting Power Allowance is calculated as

  Lighting Power Under Control x Control Factor

Additional Control Method (in Addition to Mandatory Requirements).	Space Type: Open Office	Private Office	Conference Room, Meeting Room, Classroom (Lecture/ Training)	Retail Sales Area	Lobby, Atrium, Dining Area, Corridors/ Stairways, Gym/ Pool, Mall Concourse, Parking Garage
Manual, continuous dimming control or Programmable multi-level dimming control	0.05	0.05	0.10	0.10	0
Programmable multi-level dimming control using programmable time scheduling	0.05	0.05	0.10	0.10	0.10

(Partial) Table 9.6.3 Control Factors Used in Calculating Additional Interior Lighting Power Allowance

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ASHRAE 90.1 (2013) Significant Changes – Section 9 (1 of 11)

Section 9 – Lighting

Simplified Building (Section 9.3) –not used

Mandatory Provisions (Section 9.4)

- *9.4.1 Lighting Controls*
- *9.4.1.1 Interior Lighting Controls-this new section requires a number of lighting controls as indicated in Table 9.6.1.*

–see next slide for continuation

ASHRAE 90.1 (2013) Significant Changes – Section 9 (2 of 11)

Section 9 – Lighting

9.4.1.1 Interior Lighting Controls (continued)

Nine different lighting controls measures are defined.

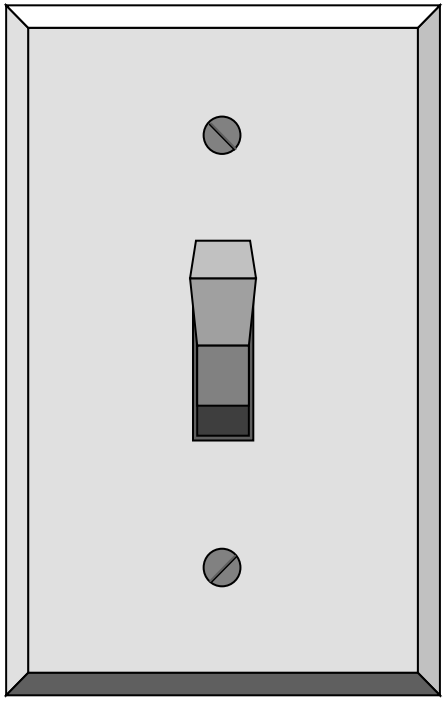
Table 9.6 is used to determined which lighting controls are required for various space types.

All measures marked as REQ are required.

Measures marked as ADD 1 or ADD 2 each require a selection of at least one measure so marked.

Using the Evaluation Checklists

- Lighting controls required for each area enclosed by ceiling height partitions
- Switch locations
  - In view of lights
  - “On” or “off” indication from remote location



EL8 [9.4.1.2] [2]	Independent lighting control installed per approved lighting plans and all manual control readily accessible and visible to occupants.

Section 9.4.1.1 Interior Lighting Controls

For each space type, apply the lighting control functions listed.

- *If using the Space-by-Space method for LPD requirements, use same space type for control requirements. For space types not listed, use a reasonable equivalent*
- *"REQ" = mandatory*
- *"ADD1" = at least one of these must be implemented*
- *"ADD2" = at least one of these must be implemented*

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

Informative Note: This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft²	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section [e][5])	f Automatic Daylight Responsive Controls for Toplighting (See Section [f][5])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Atrium											
... that is <20 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... that is ≥20 ft and ≤40 ft in height	0.03/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... that is >40 ft in height	0.40 + 0.02/ft total height	NA	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Audience Seating Area											
... in an auditorium	0.63	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a convention center	0.82	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2

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Section 9.4.1.1 Control Functions

- Local control
- Restricted to manual ON
- Restricted to partial automatic ON
- Bilevel lighting control
- Automatic daylight responsive controls for sidelighting
- Automatic daylight responsive controls for toplighting
- Automatic partial OFF (full OFF complies)
- Automatic full OFF
- Scheduled shutoff

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Section 9 – 9.4.1.1 *(a)* Local Control

At least one control that controls all the lighting in the space

- In spaces ≤ 10,000 ft^2, each control serves 2,500 ft^2 maximum and in spaces > 10,000 ft^2, serves 10,000 ft^2 maximum

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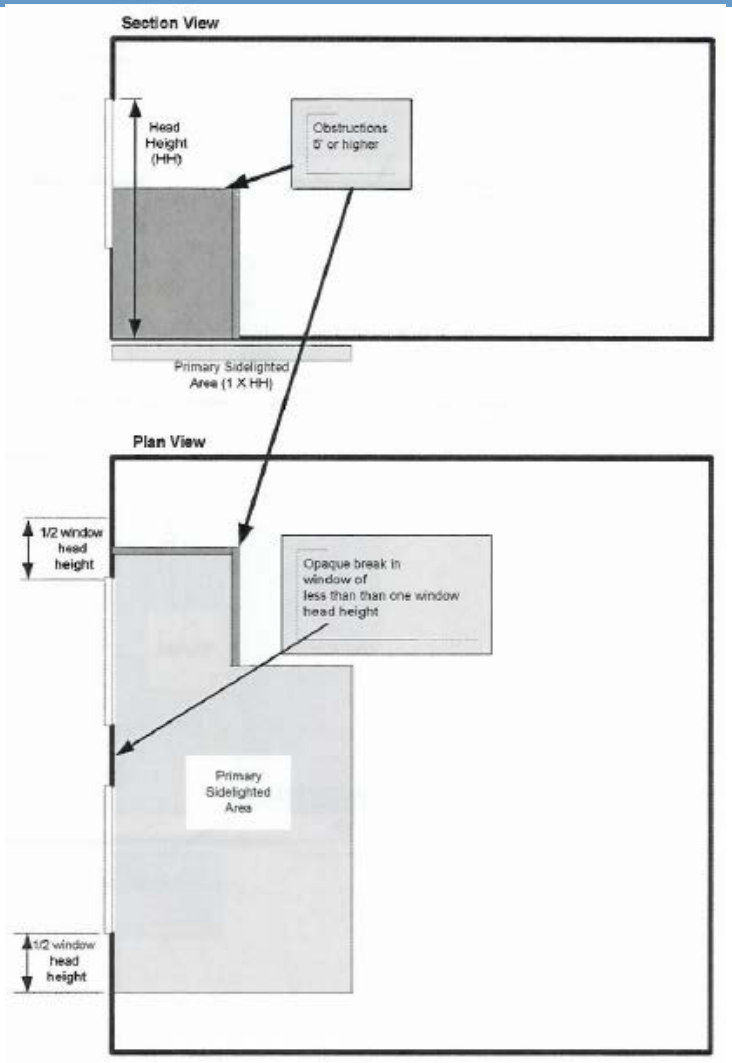
Section 9 – 9.4.1.4
Daylight Zone Definition – Primary Sidelighted Area



© 2013, ASHRAE, ANSI/ASHRAE/IES Standard 90.1-2013, Figure 3.2-3

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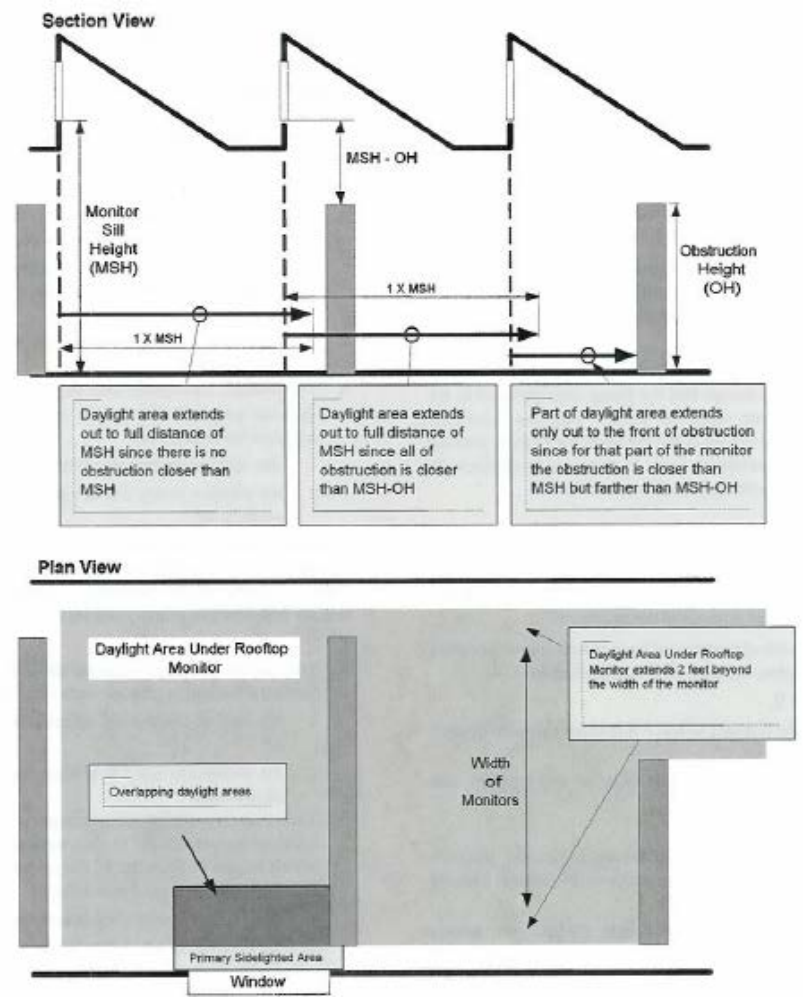
Section 9 – 9.4.1.4
Daylight Zone Definition – Under Rooftop Monitors



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ASHRAE 90.1 (2013) Significant Changes – Section 9 (3 of 11)

Section 9 – Lighting

9.4.1.2 Parking Garage Lighting Controls-new section requires:

- *automatic lighting shutoff*
- *automatically reducing power by 30% for periods of inactivity in a lighting zones of 20 minutes.*
- *Lighting zones shall be a maximum of 3600 sf.*

Section 9 – 9.4.1.*2* -Parking Garage Lighting Control

Section 9 – Lighting

- Automatic lighting shutoff per 9.4.1.1(i)
- Must reduce lighting power by minimum of 30% when no activity is detected for ***20*** minutes within a lighting zone ≤ 3,600 ft^2
- Automatically reduce power in response to daylight for luminaires within 20 ft of any perimeter wall that has
  - a net opening to wall ratio of ≥ 40% and
  - no exterior obstructions within 20 ft

Exception

- Daylight transition zones and ramps without parking are exempt from 30% reduction and daylight control

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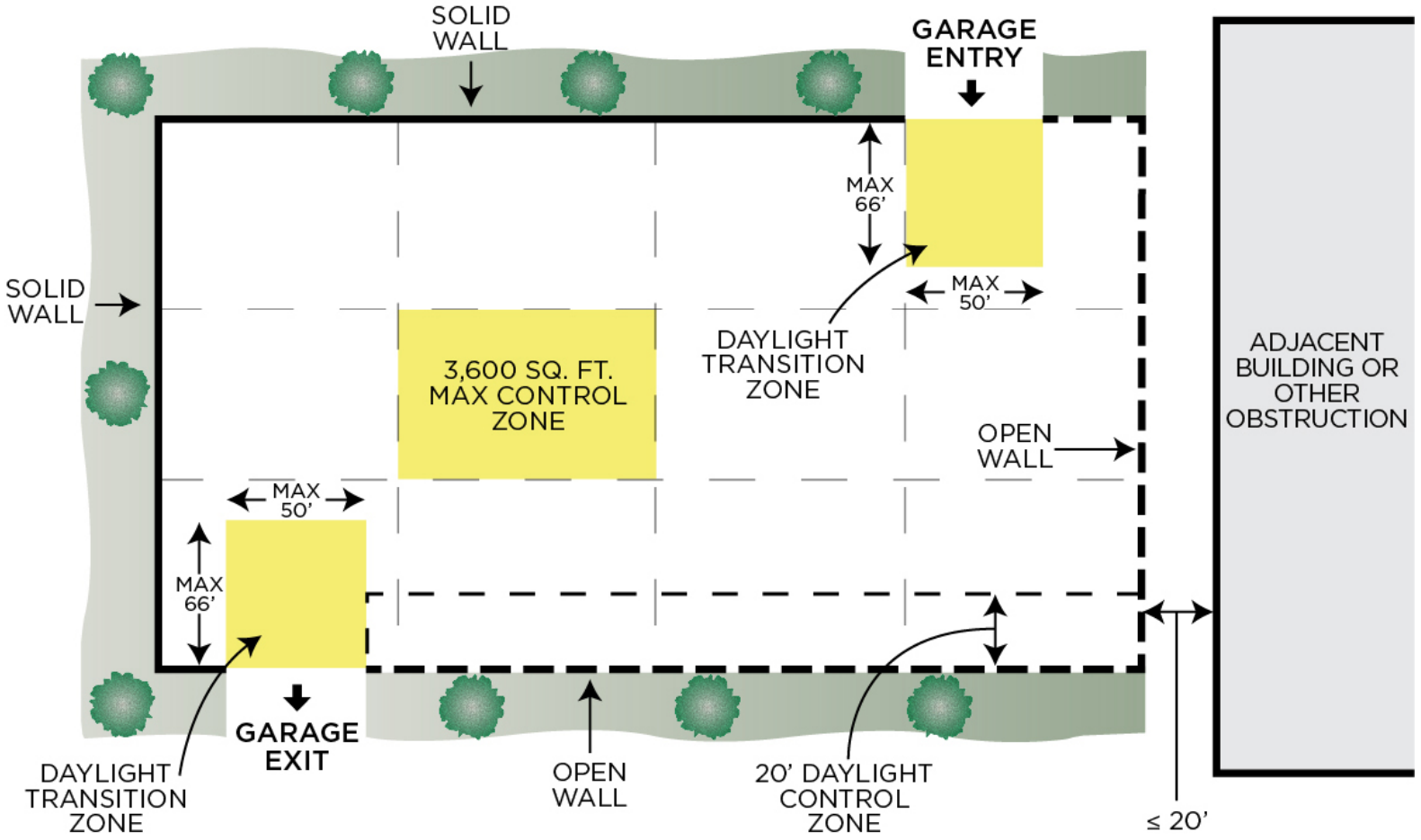
Section 9 – 9.4.1.2 Parking Garage Lighting Control



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ASHRAE 90.1 (2013) Significant Changes – Section 9 (4 of 11)

Section 9 – Lighting

9.4.1.3 Special Applications-sets requirements for certain display lighting, non visual lighting for plant growth or food warming and lighting equipment for sale to be separately controlled.

Establishes that lighting and switched receptacles in guestrooms and suites in hotels, motels and boarding houses shall be automatically controlled.

Bathrooms shall have separate control device that shuts off lighting after 20 minutes.

Section 9 – 9.4.1.*3* - Control of Special Applications

Special applications separately controlled from general lighting

- Display or accent lighting
- Case lighting
- Nonvisual lighting
- Demonstration lighting

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Section 9 – 9.4.1.*3* Control of Special Applications

- Guestroom lighting *and switched receptacles to be turned off within 20 minutes of occupants leaving the space*
  - **Exception**: where captive key systems used
- Bathrooms controlled to automatically turn off lighting within *30* minutes of occupants leaving space
  - **Exception**: night lighting not > 5W
- Supplemental task lighting controlled by
  - Controller integral to the luminaires OR
  - Wall-mounted controller-readily accessible and located so occupant can see controlled lighting

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ASHRAE 90.1 (2013) Significant Changes – Section 9 (5 of 11)

Section 9 – Lighting

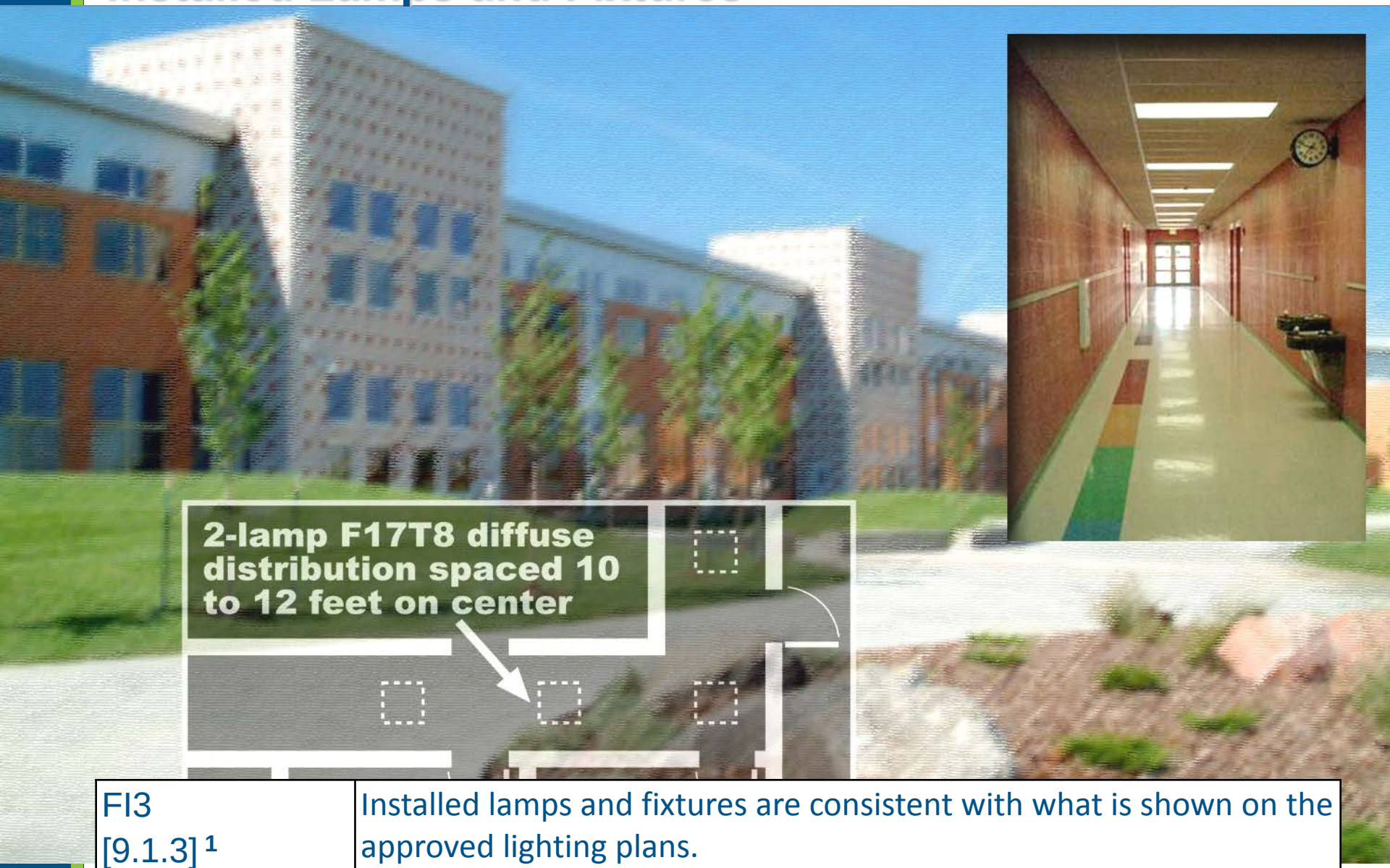
9.4.1.4 Exterior Lighting Control-sets requirements for exterior lighting.

It establishes early and late hours of operation and for periods with no activity.

It also establishes that switches retain their programmed settings during periods of lost power.

Using the Evaluation Checklists

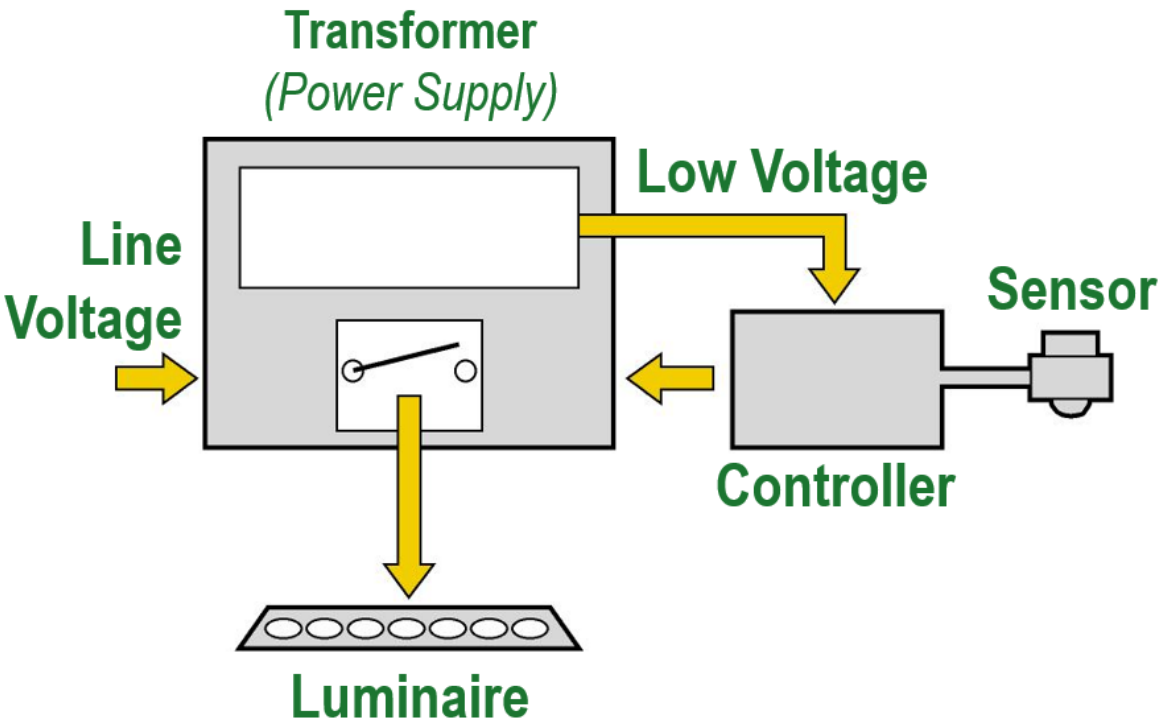
Installed Lamps and Fixtures



FI3 [9.1.3] [1]	Installed lamps and fixtures are consistent with what is shown on the approved lighting plans.

Using the Evaluation Checklists

Exterior Ground Lighting Controls



EL3 [9.4.4] [1]	Exterior ground lighting over 100 W provides >60 lm/W unless on motion sensor or fixture is exempt from scope of code or from external LPD.

Section 9 – *9.4.1.4* Mandatory Exterior Lighting Control

- Lighting must turn off when there is sufficient daylight
- Building façade and landscape lighting must be shut off between
  - midnight or business closing (whichever is later) and
  - 6am or business opening (whichever comes first) OR
  - times established by AHJ
- Power for other lighting *and lighting for signage* to be automatically reduced by at least 30%
  - From midnight or within 1 hour of end of business operations (whichever is later) and until 6am or business opening (whichever is earlier) OR
  - During any period when no activity has been detected fo a time no longer than 15 minutes

Exceptions

- Covered vehicle entrances
- Exits from buildings or parking structures

  (where required for safety, security, or eye adaptation)
- *Lighting integral to signage and installed by manufacturer*

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ASHRAE 90.1 (2013) Significant Changes – Section 9 (6 of 11)

Section 9 – Lighting

9.4.2 Exterior Building Lighting Power-this section is modified to add determination of exterior lighting "Zones" from Table 9.4.2.

Exterior lighting power for various tradeable and non-tradeable surfaces is determined from Table 9.4.2-2 Individual Lighting Power Allowances for Building Exteriors.

The section also identifies numerous exceptions for lighting which is exempt from the densities in Table 9.4.2-2

Section *9.4.2* Exterior Lighting Power

Exterior Building Lighting Power must meet prescribed power limits.

- The total exterior lighting power allowance is the sum of the base site allowance plus individual lighting power densities (LPD) for the applicable “lighting power zone”
- Trade-offs are allowed only among “Tradable Surfaces” applications
- Some exemptions apply

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Section 9.4.5 - Exterior Lighting Power Zones

ZONE 1
Developed areas of parks, forest, and rural areas.

ZONE 2
Residential and mixed use, neighborhood business, light industrial with limited night use.

ZONE 3
All other.

ZONE 4
High activity commercial in major metro as designated by AHJ.

In 2010, Zone 0 was introduced to represent undeveloped areas within national parks, forest land, and rural areas as defined by AHJ.

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Section 9 Tradable Exterior LPDs (1 of 2)

Exterior applications are divided into 2 categories:

Tradable: *allowed wattage may be traded among these applications*

Non-Tradable: *allowed wattage cannot be traded between surfaces or with other exterior lighting*

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Section 9 Tradable Exterior LPDs (2 of 2)

TABLE 9.4.3B Individual Lighting Power Allowances for Building Exteriors

	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (base allowance may be used in tradable or non-tradable surfaces)					
	No Base Site in Zone 0	500 W	600 W	750 W	1300 W
Tradable Surfaces (LPDs for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs, and outdoor sales areas may b traded.)					
Uncovered parking areas					
Parking areas and drives	No allowance	0.04 W/ft2	0.06 W/ft2	0.10 W/ft2	0.13 W/ft2
Building grounds					
Walkways less than 10 ft wide	No allowance	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
Walkways 10 ft wide or greater Plaza areas Special feature areas	No allowance	0.14 W/ft2	0.14 W/ft2	0.16 W/ft2	0.2 W/ft2
Stairways	No allowance	0.75 W/ft2	1.0 W/ft2	1.0 W/ft2	1.0 W/ft2
Pedestrian tunnels	No allowance	0.15 W/ft2	0.15 W/ft2	0.2 W/ft2	0.3 W/ft2
Landscaping	No allowance	0.04 W/ft2	0.05 W/ft2	0.05 W/ft2	0.05 W/ft2
Building entrances and exits					

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Section 9 – 9.4.3
Exterior Lighting Power Exemptions

The following are exempt when equipped with separate controls:

- lighting that is integral to signage *and installed by its manufacturer*;
- lighting for athletic playing areas;
- lighting for industrial production, material handling, transportation sites, and associated storage areas;
- theme elements in theme/amusement parks;
- lighting used to highlight features of public monuments and registered historic landmark structures or buildings;
- lighting for water features;
- specialized signal, directional, and marker lighting associated with transportation;
- lighting that is integral to equipment or instrumentation and is installed by its manufacturer;
- lighting for theatrical purposes, including performance, stage, film, and video production;
- temporary lighting;
- lighting for hazardous locations;
- Lighting for swimming pools;
- searchlights.

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ASHRAE 90.1 (2013) Significant Changes – Section 9 (7 of 11)

Section 9 – Lighting

9.4.3 Functional Testing-new section requires control systems be tested and calibrated with control hardware and software.

Requirements for testing Occupant Sensors, Automatic Time Switches and Daylight Controls

Testing to be conducted by someone other than the design professional or constructor for the project

Documentation required certifying the results.

ASHRAE 90.1 (2013) Significant Changes – Section 9 (8 of 11)

Section 9 – Lighting

Building Area Compliance Path (Section 9.5) –no significant changes

Alternative Compliance Path- Space by Space Method (Section 9.6)

9.6.3 Additional Interior Lighting Power Using Non-mandatory controls-this section establishes that when non-mandatory controls are added, additional lighting power is allowed.

Table 9.6.3 is used to determine the increase.

ASHRAE 90.1 (2013) Significant Changes – Section 9 (9 of 11)

Section 9 – Lighting

Building Area Compliance Path (Section 9.5) –no significant changes

Alternative Compliance Path- Space by Space Method (Section 9.6)

9.6.4 Room Geometry Adjustment-this new section allows for increase in lighting power density as a function of the "Room Cavity Ratio" which is calculated by multiplying the Room Cavity Height by the Room Perimeter and dividing by the Room Area.

ASHRAE 90.1 (2013) Significant Changes – Section 9 (10 of 11)

Section 9 – Lighting

Submittals (Section 9.7)

9.7 Submittals

- *Sections 9.7.1 General, 9.7.2 Completion Requirements, 9.7.2.1 Drawings, 9.7.2.2 Manuals and 9.7.2.3 Daylight Documentation together establish the requirements and time frames for submitting documents. Record drawings and manuals must be provided to the owner within 90 days.*

ASHRAE 90.1 (2013) Significant Changes – Section 9 (11 of 11)

Section 9 – Lighting

Product Information and Installation Requirements (Section 9.8) (Not used)

Tables 9.6.1 Lighting Power Density Using Space by Space Method is substantially changed to include:

- *Lower LPD*
- *The lighting control measures*
- *RCR (Room Cavity Ratio)*

Table 9.5.1 Lighting Power Densities Using the Building Area Method has lower LPD's for various building types.

Using the Evaluation Checklists

Additional Interior Lighting Power

- Space-by-space increases
  - Specific lighting function
  - Only if specific lighting is installed
  - Only for specified luminaries
  - Shall not be used for any other purpose or space

EL4 [9.6.2] [1]	Additional interior lighting power allowed for special functions per the approved lighting plans and is automatically controlled and separated from general lighting.

ASHRAE 90.1 (2013) Significant Changes – Section 10 (1 of 6)

Section 10 - Other Equipment

General (Section 10.1) - no significant changes

Compliance Paths (Section 10.2) - no significant changes

Simplified Building (Section 10.3) - not used

ASHRAE 90.1 (2013) Significant Changes – Section 10 (2 of 6)

Section 10 - Other Equipment

Mandatory Provisions (Section 10.4) –changes and addition of subsections

10.4.1 Electric Motors- changed language for motor efficiencies and reference to Tables 10.8-1 to 10.8-6

10.4.2 Service Water Booster Pump -requirements added

ASHRAE 90.1 (2013) Significant Changes – Section 10 (3 of 6)

Section 10 - Other Equipment

Mandatory Provisions (Section 10.4) –changes and addition of subsections

10.4.3 Elevators-subsection added laying out requirements for elevators

- *10.4.3.1 Lighting - new requirement added*
- *10.4.3.2 Ventilation Power Limitations –new requirement added*
- *10.4.3.3 Standby Mode- new requirement*

ASHRAE 90.1 (2013) Significant Changes – Section 10 (4 of 6)

Section 10 - Other Equipment

Mandatory Provisions (Section 10.4) –changes and addition of subsections

10.4.4 Escalators and Moving Walks-subsection added requirement for automatic slowing when not conveying passengers- new requirement added

ASHRAE 90.1 (2013) Significant Changes – Section 10 (5 of 6)

Section 10 - Other Equipment

Mandatory Provisions (Section 10.4) –changes and addition of subsections

10.4.5 Whole Building Energy Monitoring –new requirement added

- *10.4.5.1 Monitoring-new requirement added*
- *10.4.5.2 Recording and Reporting-new requirement added*
- *Exceptions to 10.4.5.1 and 10.4.5.2 were added*

ASHRAE 90.1 (2013) Significant Changes – Section 10 (6 of 6)

Section 10 - Other Equipment

Prescriptive Compliance Path (Section 10.5) – not used
Alternative Compliance Path (Section 10.6) – not used
Submittals (Section 10.7) – not used
Product Information and Installation Requirements (Section 10.8) – no information

Tables 10.8-1 to Tables 10.8.6 for various motor type efficiencies added or modified

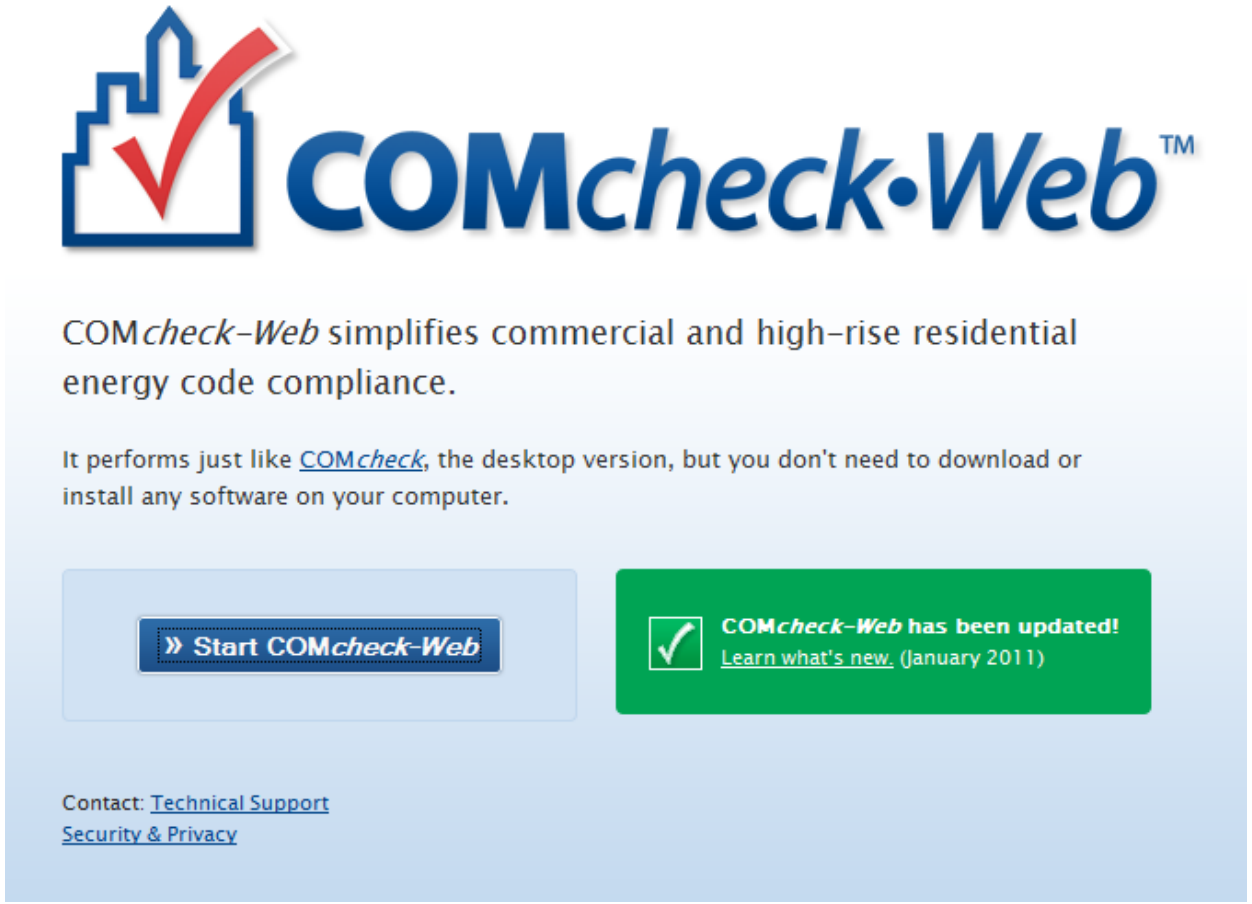
ASHRAE 90.1 Other Compliance Paths

Other Compliance Paths

- *COMCheck – Used for Envelope Tradeoffs*
- *Above Code Programs*
- *Energy Cost Budget Method*
- *Whole Building Simulations-Appendix G for LEED V4*

COMcheck Online Tool

COMCheck can be used for envelop tradeoffs –available at www.energycodes.gov



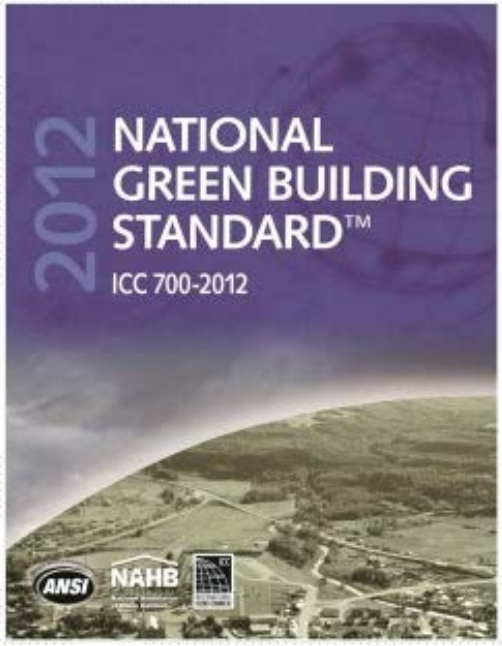
Michigan Energy Code-Commercial

SECTION C102

C102.1.1 *(amended by Mich. Act to identify example above code programs such as ICC 700 (2012) Silver and Energy Star Version 3 as complying,*

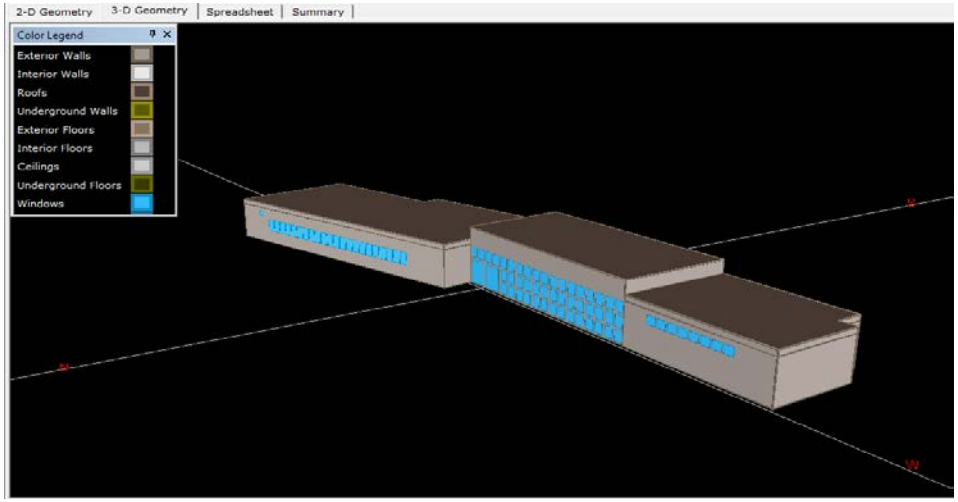
***Still requires mandatory provisions of Chapter 4 of IECC 2015 to be met*

(Note: while Michigan code states Energy Star v3.0, the newer v3.1 may be more appropriate as Energy Star may not recognize v3.0 in states that have adopted IECC 2012 or 2015)



Performance Paths in Standard 90.1

- Standard 90.1 includes two performance paths
  - Both based on energy simulation
  - Requires approved software
  - Both compare a proposed building design to a baseline building meeting the prescriptive requirements
  - Chapter 11 -Energy Cost Budget Method
  - Appendix G – Used for LEED projects



Energy Codes-Resources (1 of 2)

www.energycodes.gov

Energy Codes – Resources (2 of 2)

Link to the Building Energy Codes Program site on the Energy Codes website

https://www.energycodes.gov/training-courses/ansiashraeies-standard-901-2013

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Q + A

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