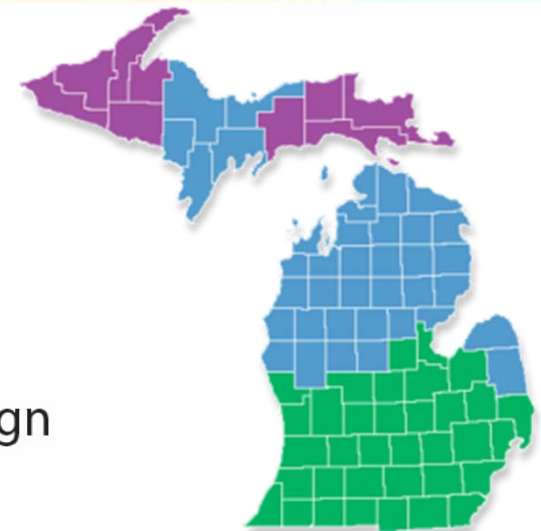


2017 Michigan Energy Code Changes Electrical Provisions-Commercial

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 11)

- 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. Improving compliance
3. Reducing administrative time
4. Improving customer relationships

Presentation Overview

- Background on new code
- Michigan code status
- When does it apply?
- Changes-Electrical Provisions

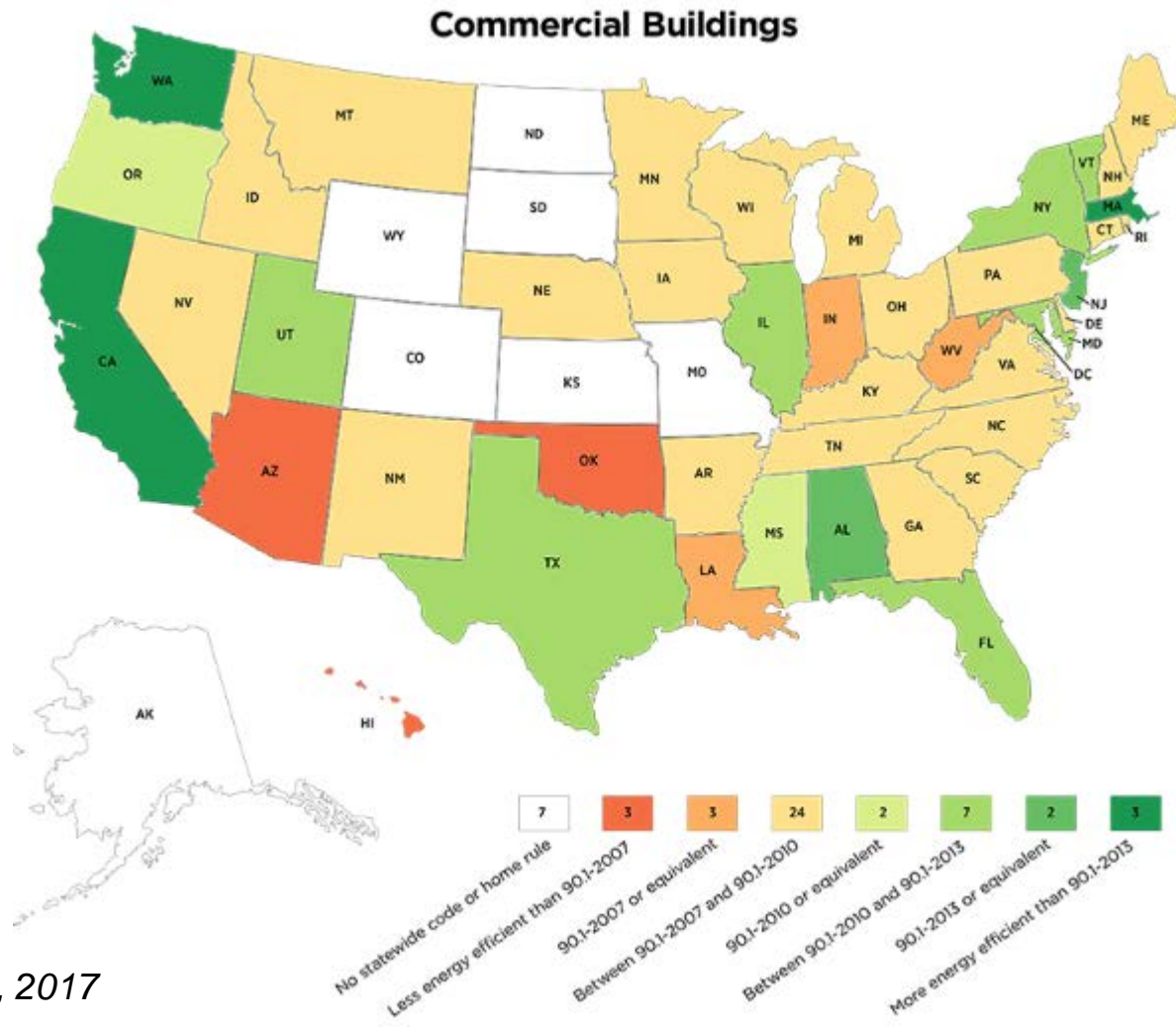


Disclaimer

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

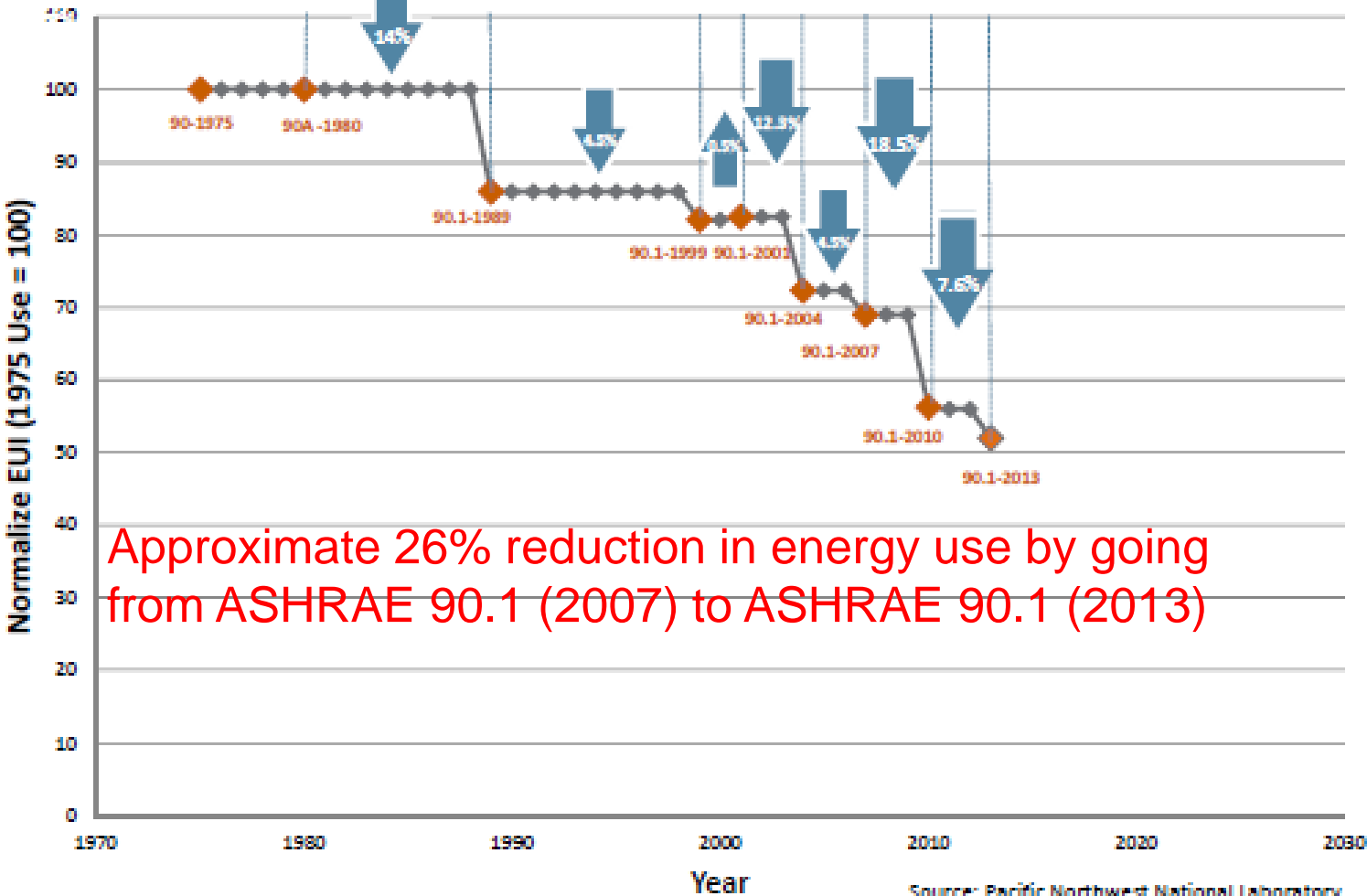


As July 31, 2017

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

Impact of Energy Codes

Improvement in ASHRAE Standard 90.1 (Year 1975-2013)
(Commercial Buildings)



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

Source: Pacific Northwest National Laboratory

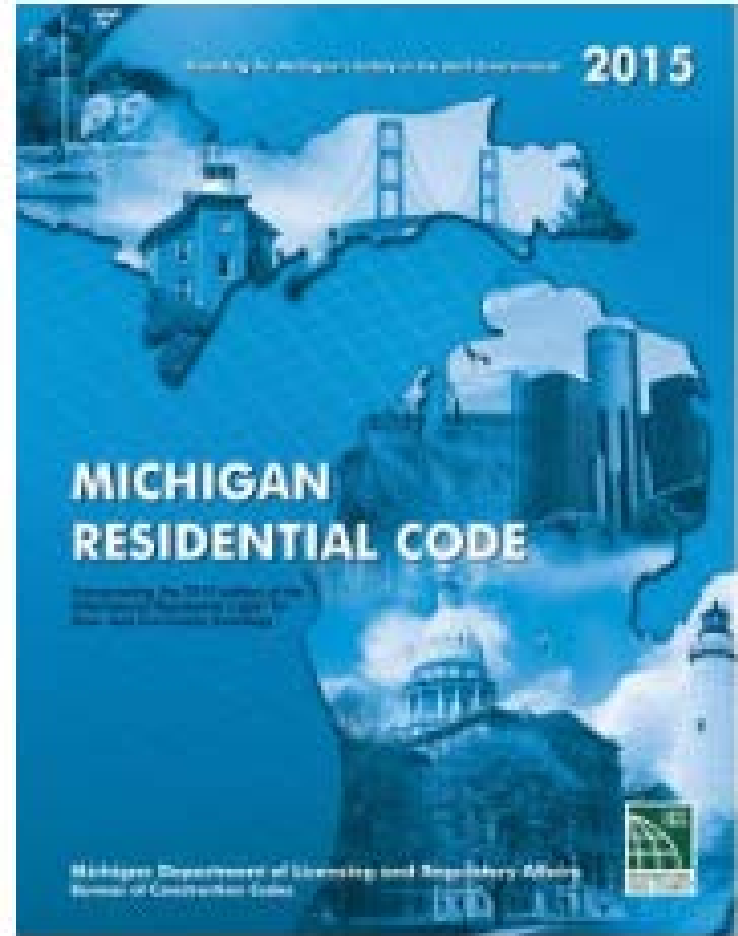
Michigan Residential Energy Code

- 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 11)

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 11)

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

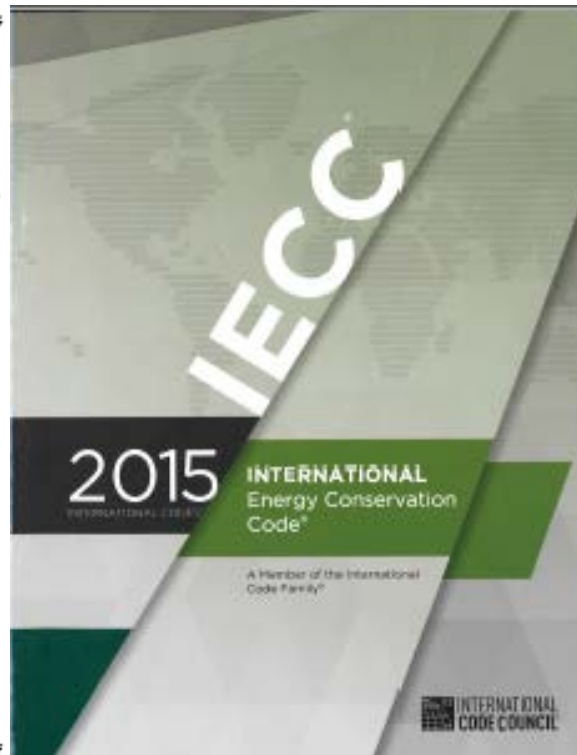
(By authority conferred on the director of the department of ~~energy, labor, and economic growth licensing~~ and regulatory affairs by section 4 of 1972 PA 230, MCL 125.1504, and Executive Reorganization Order Nos. 2003-1, and 2008-430, and 2011-4, MCL 445.2011, and MCL 445.2025, and MCL 445.2030)

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. 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 90.1-2009/2013 (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 ~~Construction~~ office of the Michigan Department of ~~Energy, Labor and Economic Growth Licensing and Regulatory Affairs~~, Bureau of Construction Codes, 2501 Woodlake Circle, Okemos, Michigan 48864-6111 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



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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ISSN 1041-2336



Michigan Energy Code – Commercial (4 of 11)

Act defines adoptions, amendments and deletions

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 2008-426, 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

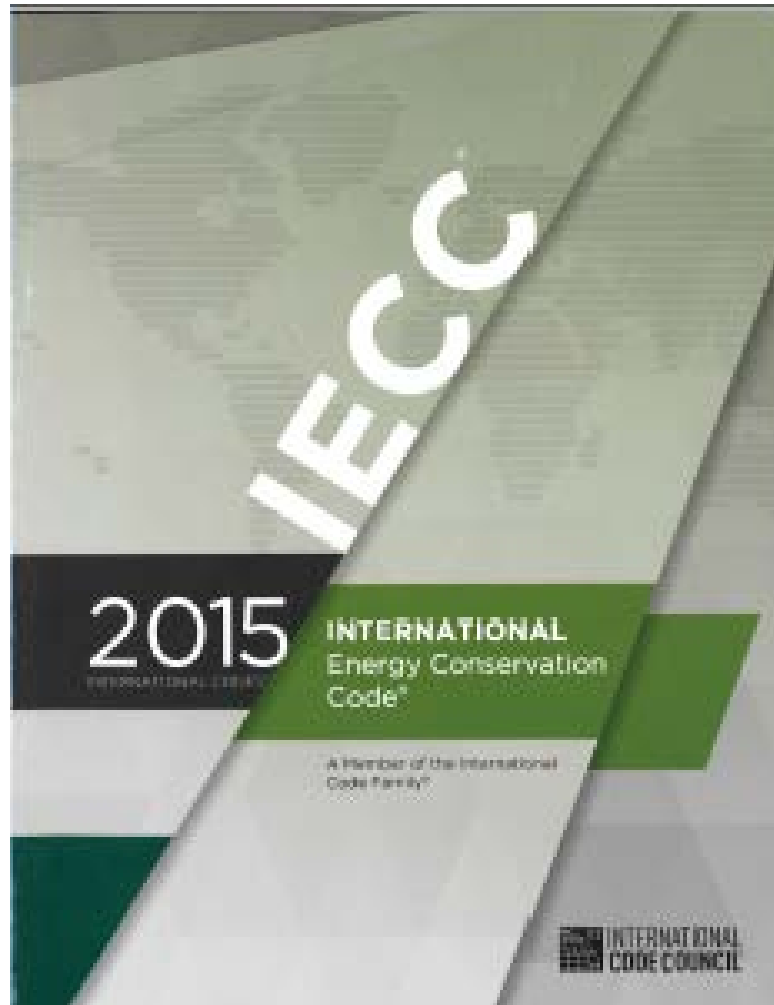
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Michigan Department of Energy, Labor and Economic Growth Licensing and Regulatory Affairs, Bureau of Construction Codes, 2504 Woodlake Circle, ~~Grand Rapids~~, Michigan 49546/611 W. Ottawa Street, Lansing, Michigan 48933. The code may be purchased 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

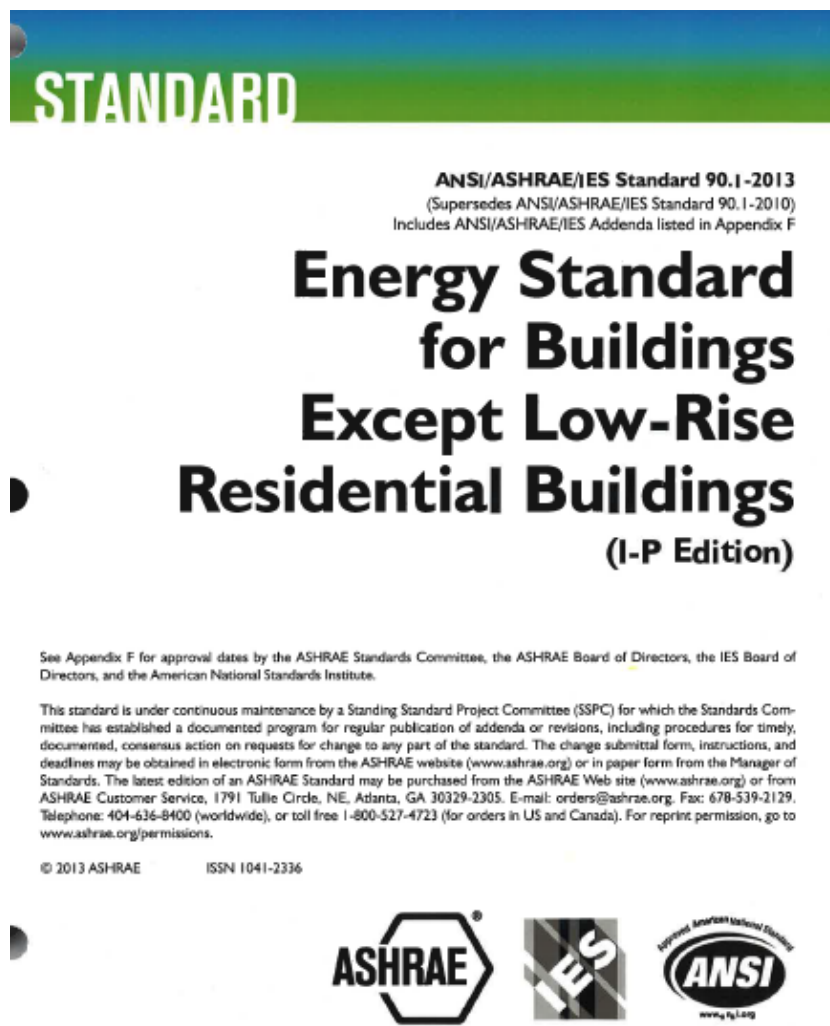
Michigan Energy Code – Commercial (5 of 11)

Scoping requirements in referenced sections of IECC 2015



Michigan Energy Code – Commercial (6 of 11)

Technical provisions In ASHRAE 90.1 (2013)



Michigan Energy Code – Commercial (7 of 11)

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 11)

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 11)

IECC 2015 Layout:

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

Michigan Energy Code – Commercial (10 of 11)

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)*

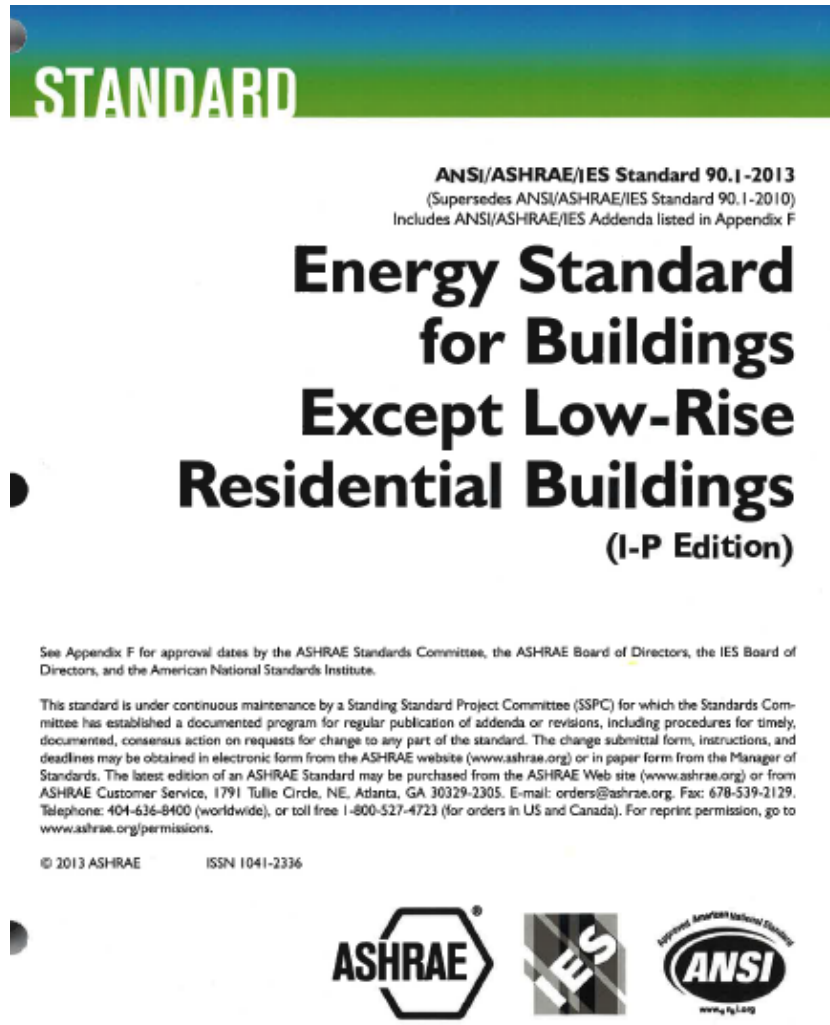
C503.5-Service hot water systems *(not adopted by Mich. Act)*

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 (11 of 11)

Technical provisions In ASHRAE 90.1 (2013)



ASHRAE 90.1 (2013) MICHIGAN AMENDMENTS

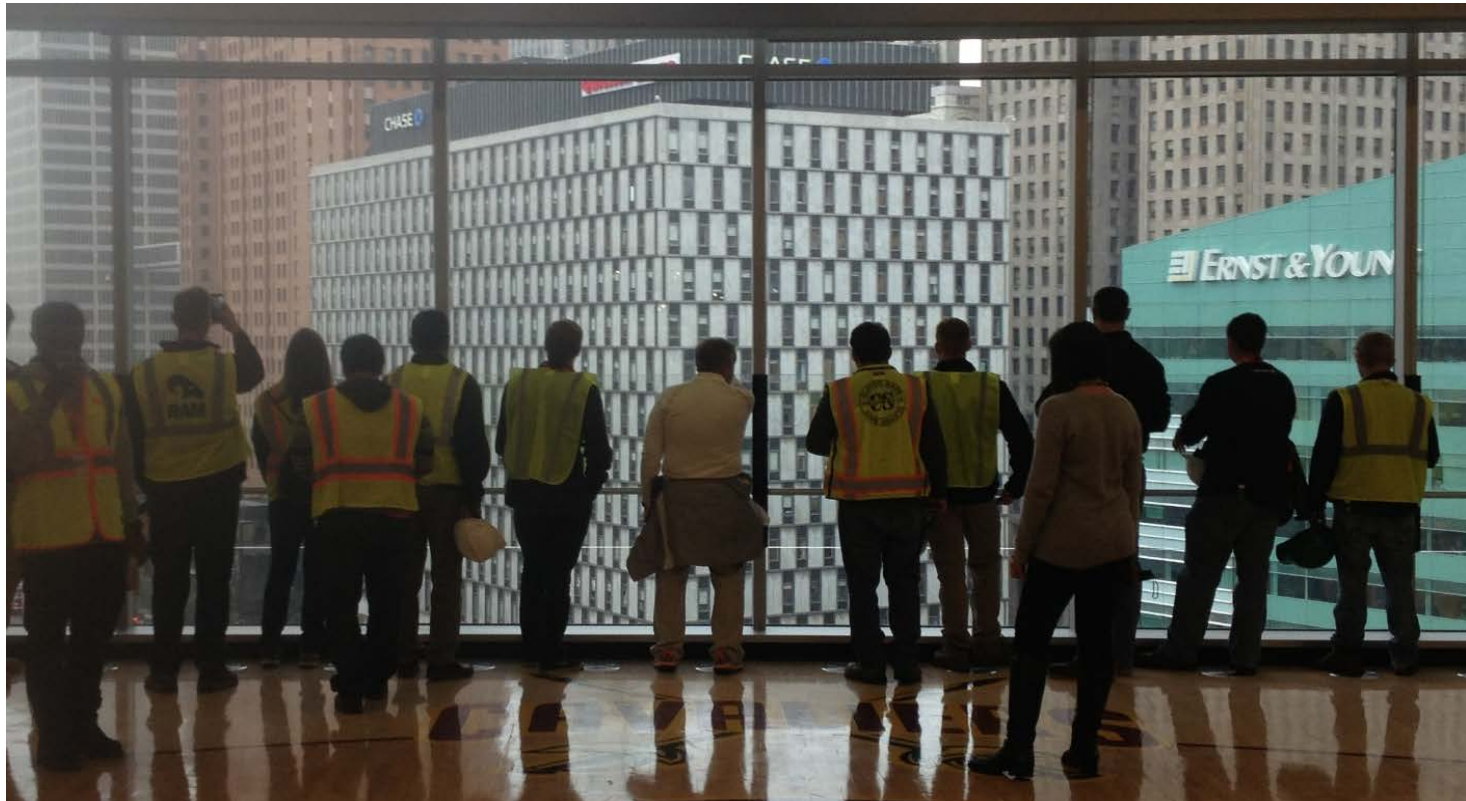
ASHRAE 90.1 (2013) MICHIGAN AMENDMENTS
(MARK YOUR BOOKS) *Three Items are amended by Michigan*

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 (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 (COMcheck)
- 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
Edition Zero 2

Date: _____ Name of Evaluator(s): _____

Building Name & Address: _____ Conditioned Floor Area: _____ sq ft

Building Contact Name: _____ Phone: _____ Email: _____

Compliance Approach: Prescriptive (IECC 1.2 or 402.1.3) Use Trade-Off (402.1.4) Building Performance (402)

State: _____ Jurisdiction: _____

Building Type: 1- and 3-Family, Detached 3- Family, Attached Single-Family, Attached Multifamily

| Item Number | Description | Item Number | Foundation Inspection | Code Value | Verified Value | | | Complies |
|-------------|--|-------------|--|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | | | | | Y | N | N/A | |
| 402.1.1 | Pre-Inspection/Review | FO1 | Slab edge insulation R-value installed per manufacturer's instructions | Unheated R-5 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.2 | Construction of exterior wall assembly. Documentation includes: Documentation of insulation. | FO2 | Slab edge insulation depth/length | Heated: 2 R | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.3 | Basement wall exterior insulation. | FO3 | Basement wall exterior insulation R-value installed per manufacturer's instructions. | R-5 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.4 | HVAC duct insulation. Heating system energy coding system name. | FO4 | Basement wall exterior insulation depth | 10 R, or to basement floor | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.5 | Crawl space wall insulation. | FO5 | Crawl space wall insulation R-value installed per manufacturer's instructions. | R-5 (cove) R-1.3 (cavity) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.6 | Snow melt controls | FO6 | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 402.1.7 | Insulation protection | FO7 | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Additional Comments: _____



Role and Structure

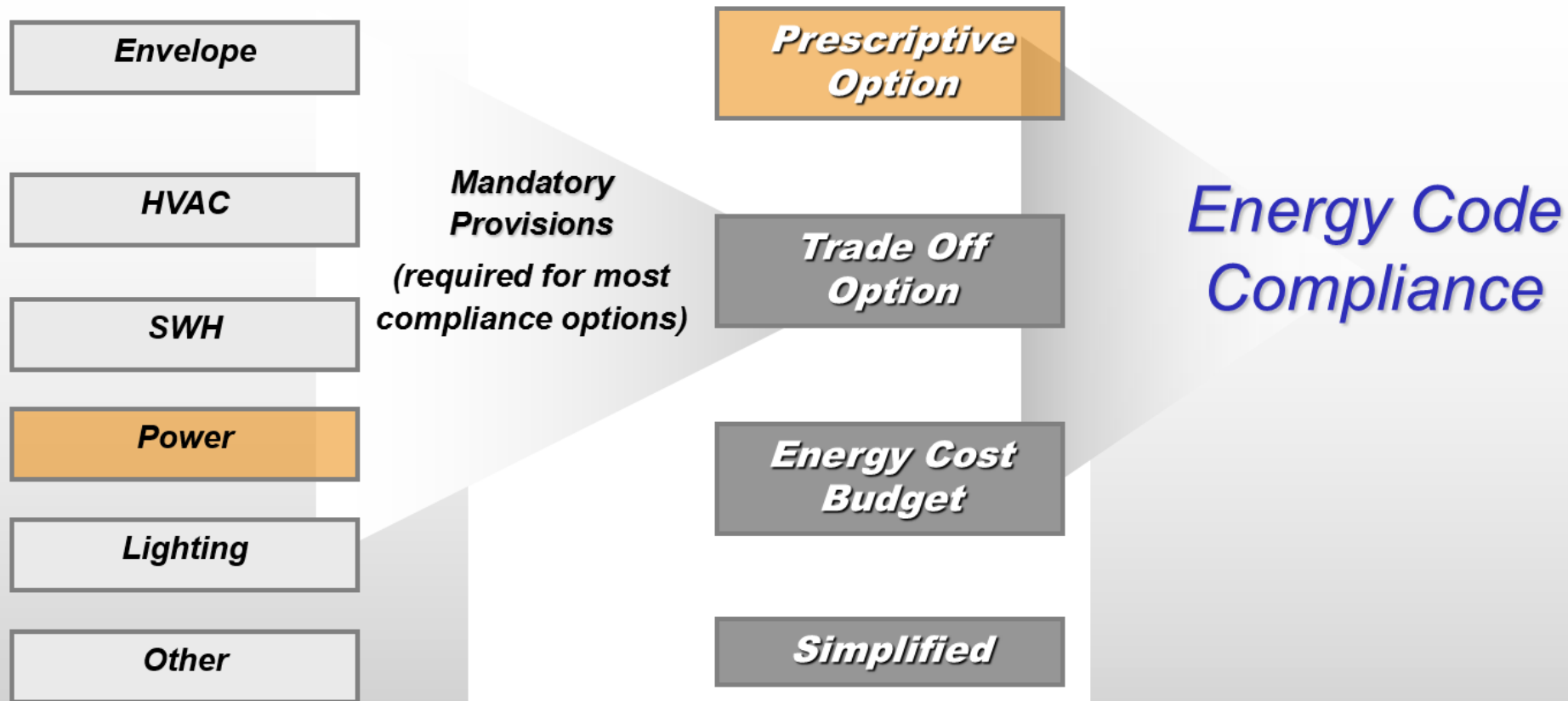
Compliance “Exceptions”

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

Building System

Compliance Options



Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting
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Section 8

Power – Scope

- ✓ New Buildings
- ✓ Additions
- ✓ Alterations
- ✓ Mandatory Provisions
 - ✓ Voltage drop
 - ✓ Automatic receptacle control
 - ✓ Electrical Energy Monitoring
 - ✓ Low-Voltage Dry Type Distribution Transformers
- ✓ Submittals

Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting

June 2014 – PNNL-SA-102812

Section 8 – 8.1.2 – 8.1.4

New Buildings, Additions, and Alterations to Existing Buildings

- Equipment installed in **new** buildings or **additions** to existing buildings must comply
- **Alterations** to equipment or systems must comply with requirements applicable to those specific portions of the building and systems being altered
 - New equipment installed as a direct replacement of existing equipment must comply with requirements for that equipment
 - **Exception** - Compliance not required for relocation or reuse of existing equipment at the same site

Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting

June 2014 – PNNL-SA-102812

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

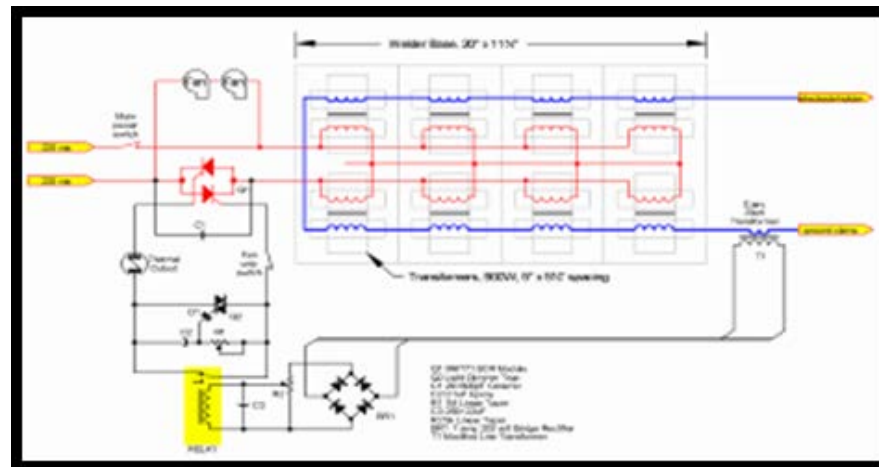
Simplified/Small Building Option (Section 8.3) - not used

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



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



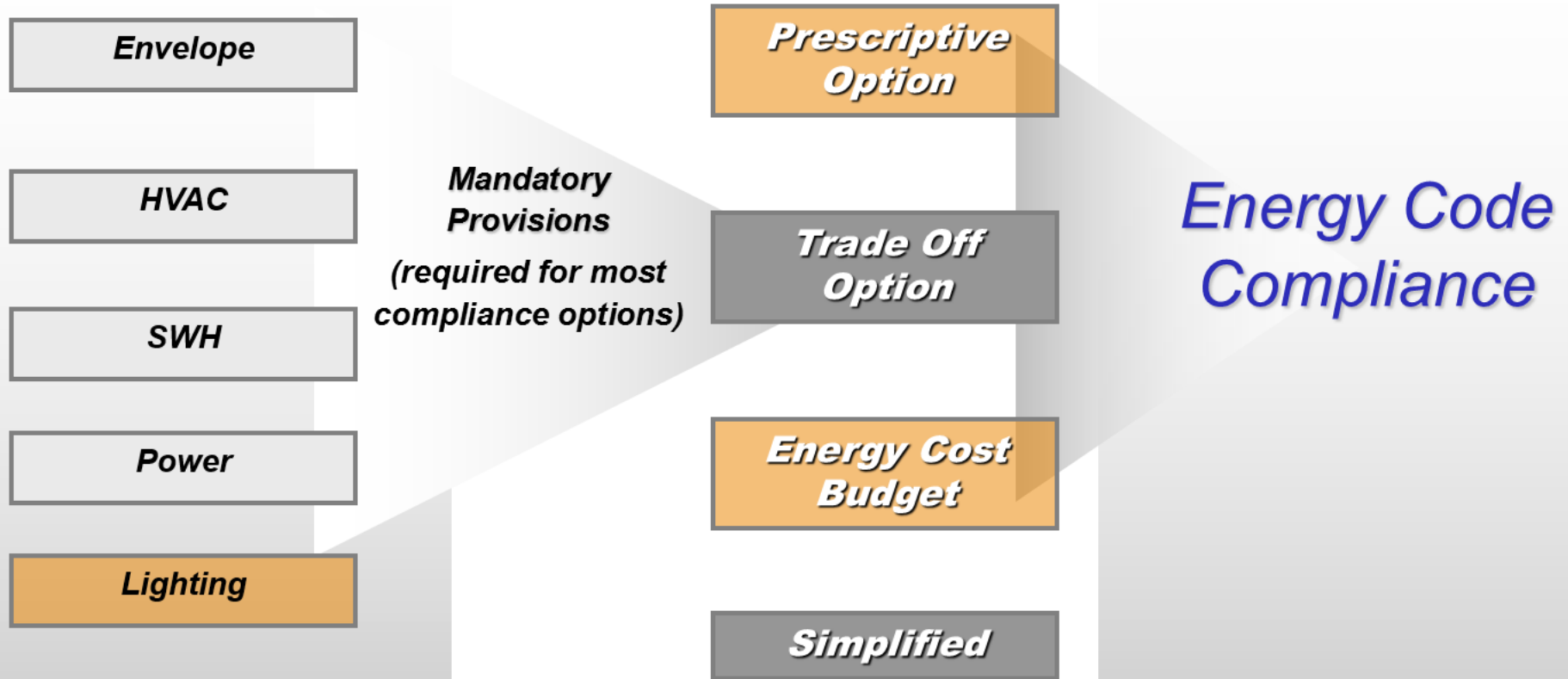
U.S. Department of Energy (2010)



U.S. Department of Energy (2010)

Building System

Compliance Options



ASHRAE 90.1 (2013) Significant Changes – Section 9 (1 of 13)

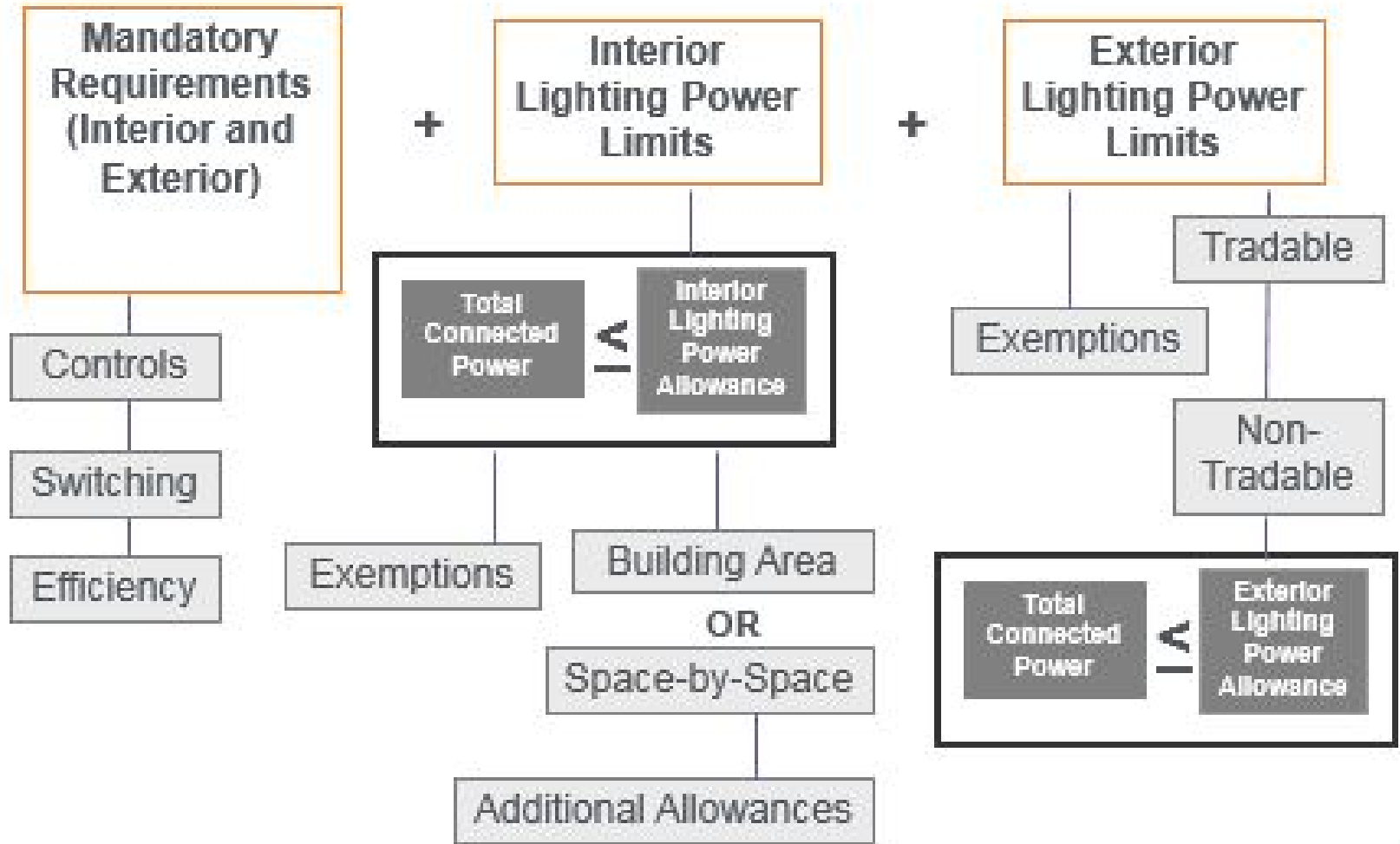
Section 9 – Lighting

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



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



*Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting
June 2014 – PNNL-SA-102812*

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)



*Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting
June 2014 – PNNL-SA-102812*

Section 9

Lighting General – Alterations

- Applies to these retrofits:
 - where luminaires are added, replaced, or removed
 - Replacement of lamp plus ballast in luminaires
- Requires BOTH interior and exterior alterations to comply with Lighting Power Density (LPD) limits and basic after hours automatic shutoff requirements

Exception

Spaces where alterations involve < 10% of connected lighting load and the LPD for the space is not increased

Michigan amended to 50%



Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting

June 2014 – PNNL-SA-102812

Section 9

Interior Lighting Power

Installed interior lighting power must be \leq lighting power allowance

Installed interior lighting power calculation method

- Calculation requirements
- Lots of exemptions (next page)

Power allowance calculation methods

- Building area compliance path
- Alternative Compliance Path: Space-by-space method

Trade-offs of interior lighting power allowance aren't allowed when both methods are used in different portions of the building

Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting

June 2014 – PNNL-SA-102812

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 – INTERIOR and EXTERIOR

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

Slide Modified From ANSI/ASHRAE/IES Standard 90.1-2013 Power and Lighting

June 2014 – PNNL-SA-102812

Section 9 – 9.1.4 Luminaire Wattage Calculation Requirements

These requirements apply to both interior and exterior

- Line voltage luminaires without ballasts or transformers = max. labeled wattage of the luminaire
- Luminaires with ballasts or transformers = wattage of the maximum lamp/auxiliary combination OR max. labeled wattage of the luminaire. For luminaires with factory adjustable ballast factors (not user changeable), apply the ballast factor to be used in the space)
- Line voltage track = actual wattage with a min. 30 W per foot OR wattage limit of system's circuit breaker OR wattage limit of other permanent-current-limiting device(s) on the system
- Low voltage track = transformer wattage
- All others as specified on equipment

Section 9

Installed 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 of Calculating Interior Lighting Power Allowance

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 than 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 of Calculating Interior Lighting Power Allowance

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 – 9.6.1

Space-by-Space Method of Calculating Subspaces

- If a physical space has multiple functions such that more than one space type from Table 9.6.1 applies
 - Break the space into smaller subspaces
 - Use the centerline of interior walls and dividing line between subspaces to determine subspace areas
 - Calculate the allowance separately for each subspace

Exception

- Subspaces with areas less than 20% of the original space and less than 1000 ft² do not need to be broken out separately

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

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.

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.

| | | | | | | | | |
|---|---|--|--|---|--|--|--|---|
| Local Control (See Section 9.4.1.1[a]) | Restricted to Manual ON (See Section 9.4.1.1[b]) | Restricted to Partial Automatic ON (See Section 9.4.1.1[c]) | Bilevel Lighting Control (See Section 9.4.1.1[d]) | Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e]) | Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f]) | Automatic Partial OFF (See Section 9.4.1.1[g]) [Full Off complies] | Automatic Full OFF (See Section 9.4.1.1[h]) | Scheduled Shutoff (See Section 9.4.1.1[i]) |
|---|---|--|--|---|--|--|--|---|

| Common Space Types ¹ | LPD, W/ft ² | RCR Threshold | a | b | c | d | e | f | g | h | 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 |

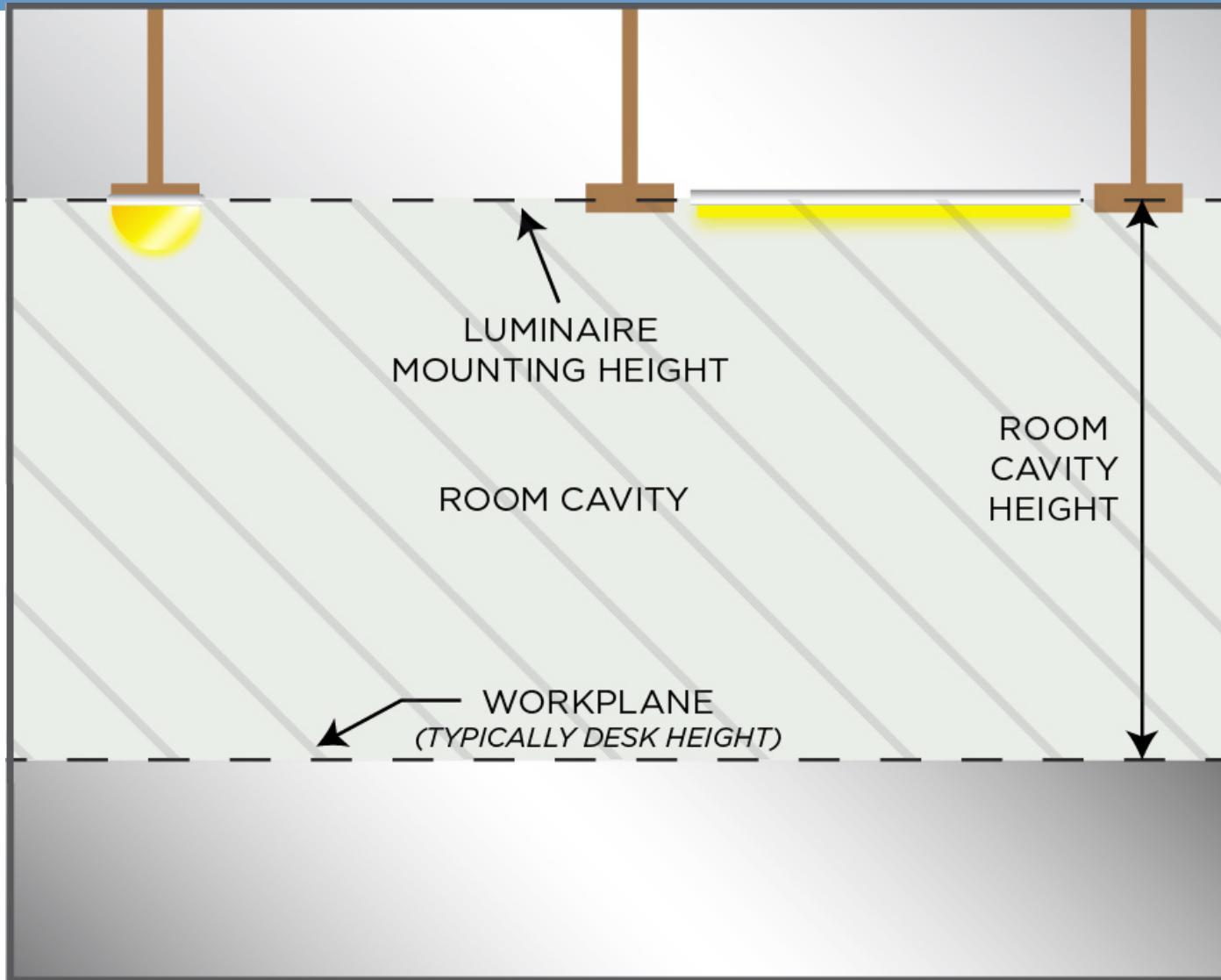
Room Geometry Adjustment – 9.6.4

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

(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

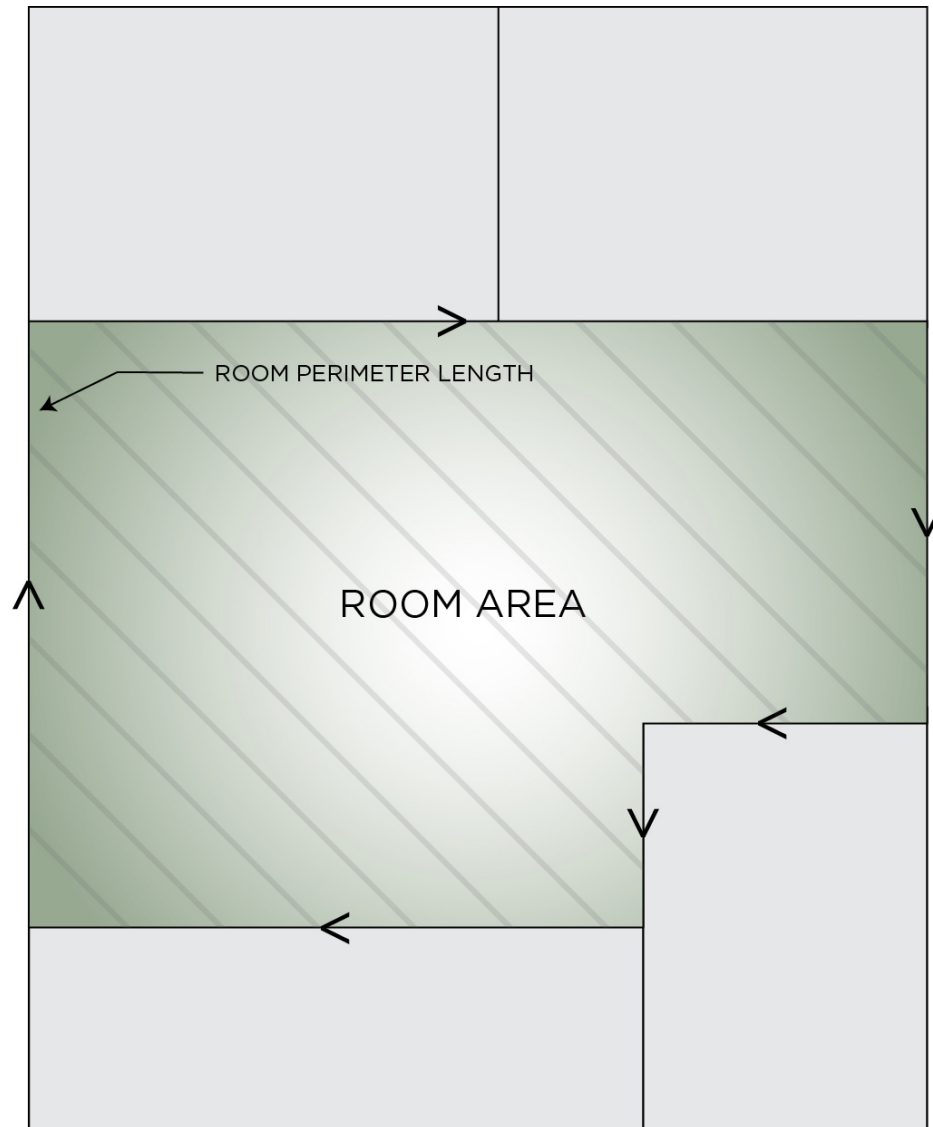
Room Geometry Adjustment (1 of 2)



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June 2014 – PNNL-SA-102812

Room Geometry Adjustment (2 of 2)



Using the Evaluation Checklists

Additional Interior Lighting Power

- Space-by-space increases
 - Specific lighting function
 - Only if specific lighting is installed
 - Only for specified luminaires
 - 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.

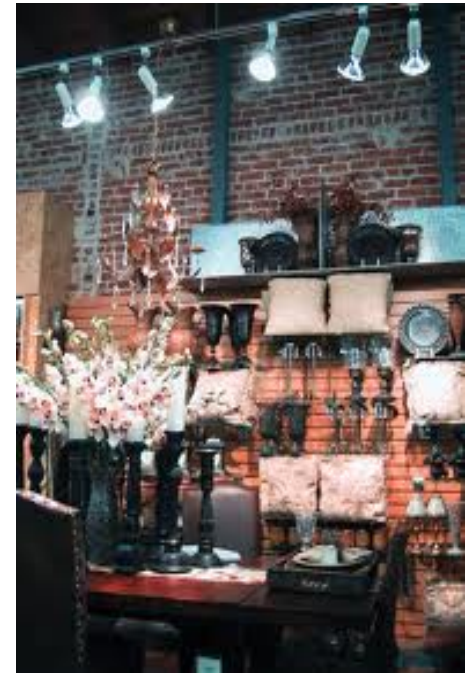
Section 9 – 9.6.2 – 9.6.3 Additional Interior Lighting Power

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.

Applications 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/ft²
- ✓ 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

Section 9 – 9.6.2 Additional Retail Display Lighting Allowance

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

Where:

Retail Area 1 = the floor area for all products not listed in Retail Area 2, 3 or 4

Retail Area 2 = the floor area used for the sale of vehicles, sporting goods and small electronics

Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics and artwork

Retail Area 4 = the floor area used for the sale of jewelry, crystal, and china.

Other merchandise categories not listed may be included in Retail Areas 2 through 4, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.

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June 2014 – PNNL-SA-102812

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

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

| 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 |

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

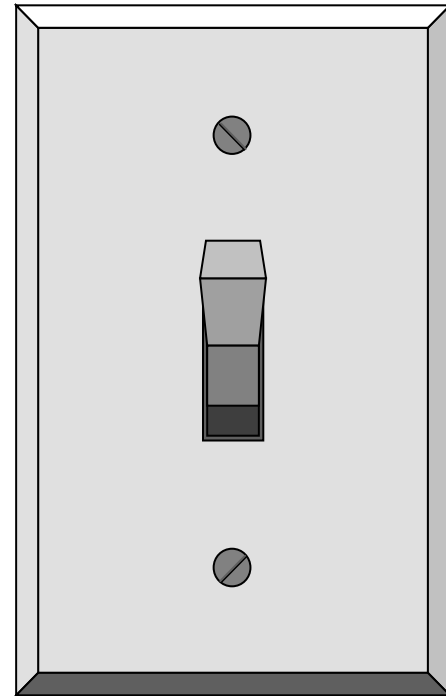
Section 9 – 9.4.1.1 (a) Local Control

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

- In spaces $\leq 10,000$ ft², each control serves 2,500 ft² maximum and in spaces $> 10,000$ ft², serves 10,000 ft² maximum

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



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.

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

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.

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.

| Common Space Types ¹ | LPD, W/ft ² | RCR Threshold | Local Control (See Section 9.4.1.1[a]) | Restricted to Manual ON (See Section 9.4.1.1[b]) | Restricted to Partial Automatic ON (See Section 9.4.1.1[c]) | Bilevel Lighting Control (See Section 9.4.1.1[d]) | Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e]) | Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f]) | Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies]) | Automatic Full OFF (See Section 9.4.1.1[h]) | Scheduled Shutoff (See Section 9.4.1.1[i]) |
|---|-----------------------------|------------------|---|--|--|--|---|--|--|---|--|
| | | | a | b | c | d | e | f | g | h | 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 |

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

Section 9 – 9.4.1.1 (b) Restricted to Manual ON

No lighting automatically turned on

Exception

- Where manual ON would endanger safety or security

Typically, users are allowed to choose to implement this control or Partial On

Section 9 – 9.4.1.1 (c) Restricted to Partial ON

< 50% of general lighting power allowed to be automatically turned on, and none of remaining lighting automatically turned on

Typically, users are allowed to choose to implement this control or Manual On

Section 9 – 9.4.1.1 (d) Bilevel Lighting Control

- General lighting to provide at least one intermediate step in lighting power or continuous dimming in addition to full ON and full OFF
- To have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off

Section 9 – 9.4.1.1 (e) Automatic Daylight Responsive Controls for Sidelighting

- Apply photocontrols *if the combined input power of all general lighting completely or partially within:*
 - *primary sidelighted areas is $\geq 150 W$*
 - *primary and secondary sidelighted areas is $\geq 300 W$*
- Control system must have
 - Calibration adjustments readily accessible
 - *Separate control of general lighting in both primary and secondary sidelighted areas*
 - Photocontrol to reduce electric lighting in response to available daylight using
 - Continuous dimming or
 - At least one control point between 50% and 70% of design light power
 - *Second control point between 20% and 40% of design light power or*
 - *Lowest dimming level technology allows*
 - *Third control point that turns off all controlled lighting*

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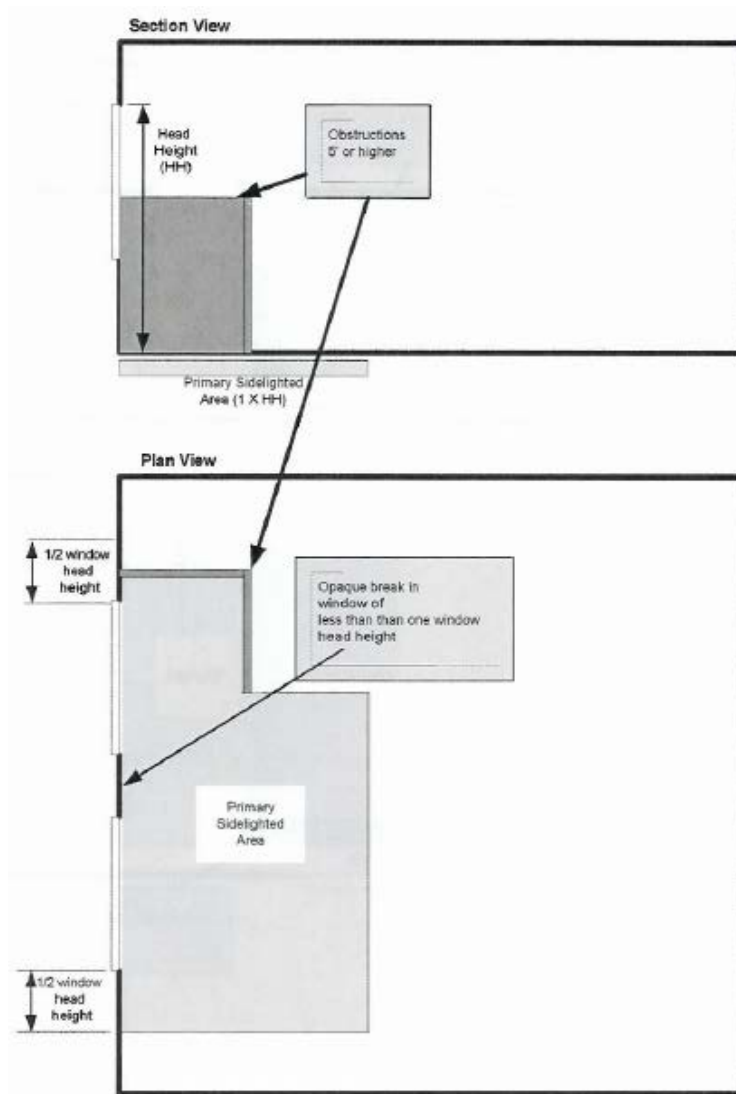
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Section 9 – 9.4.1.1 (e) Automatic Daylight Responsive Controls for Sidelighting *(cont'd)*

Exceptions

- Primary sidelighted areas where top of any existing adjacent structure is twice as high above the windows as its distance away from the windows
- *Sidelighted areas where total glazing area is < 20 ft²*
- Retail spaces

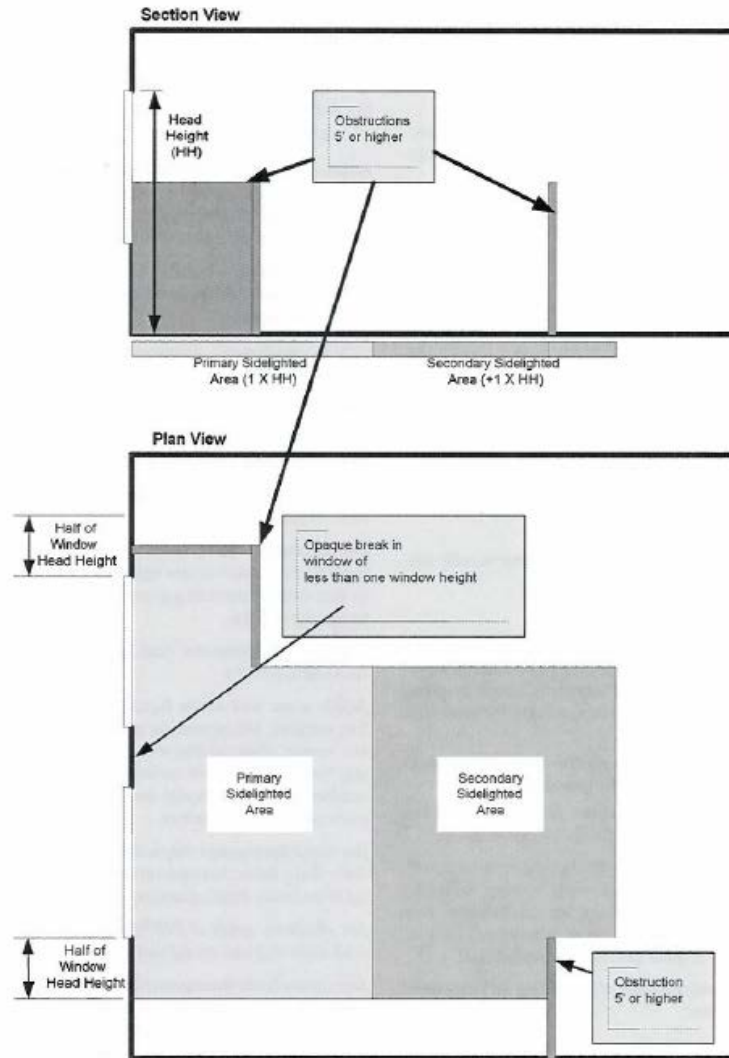
Section 9 – 9.4.1.4 Daylight Zone Definition – Primary Sidelighted Area



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Section 9 – 9.4.1.4

Daylight Zone Definition – Secondary Sidelighted Area



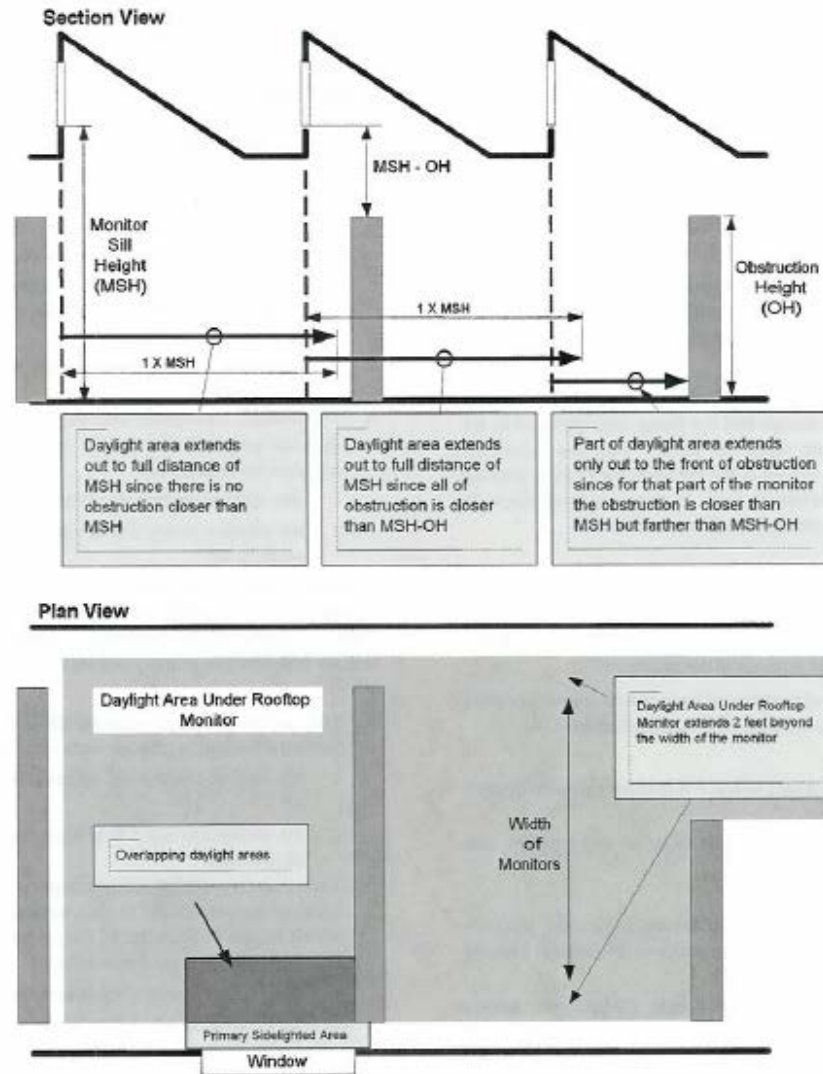
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Section 9 – 9.4.1.1 (f) Automatic Daylight Responsive Controls for Toplighting

- Apply photocontrols *if the combined input power of all general lighting completely or partially under daylight areas under skylights and daylight areas under roof monitors is ≥ 150 W.* Photocontrols must:
 - Have calibration adjustments readily available
 - Reduce electric lighting in response to available daylight using
 - Continuous dimming or
 - At least one control point between 50% and 70% of design light power
 - *Second control point between 20% and 40% of design light power or*
 - *Lowest dimming level technology allows*
 - *Third control point that turns off all controlled lighting*
 - *Control overlapping toplighted and sidelighted daylight areas together with general lighting in the daylight area under skylights or daylight areas under roof monitors*

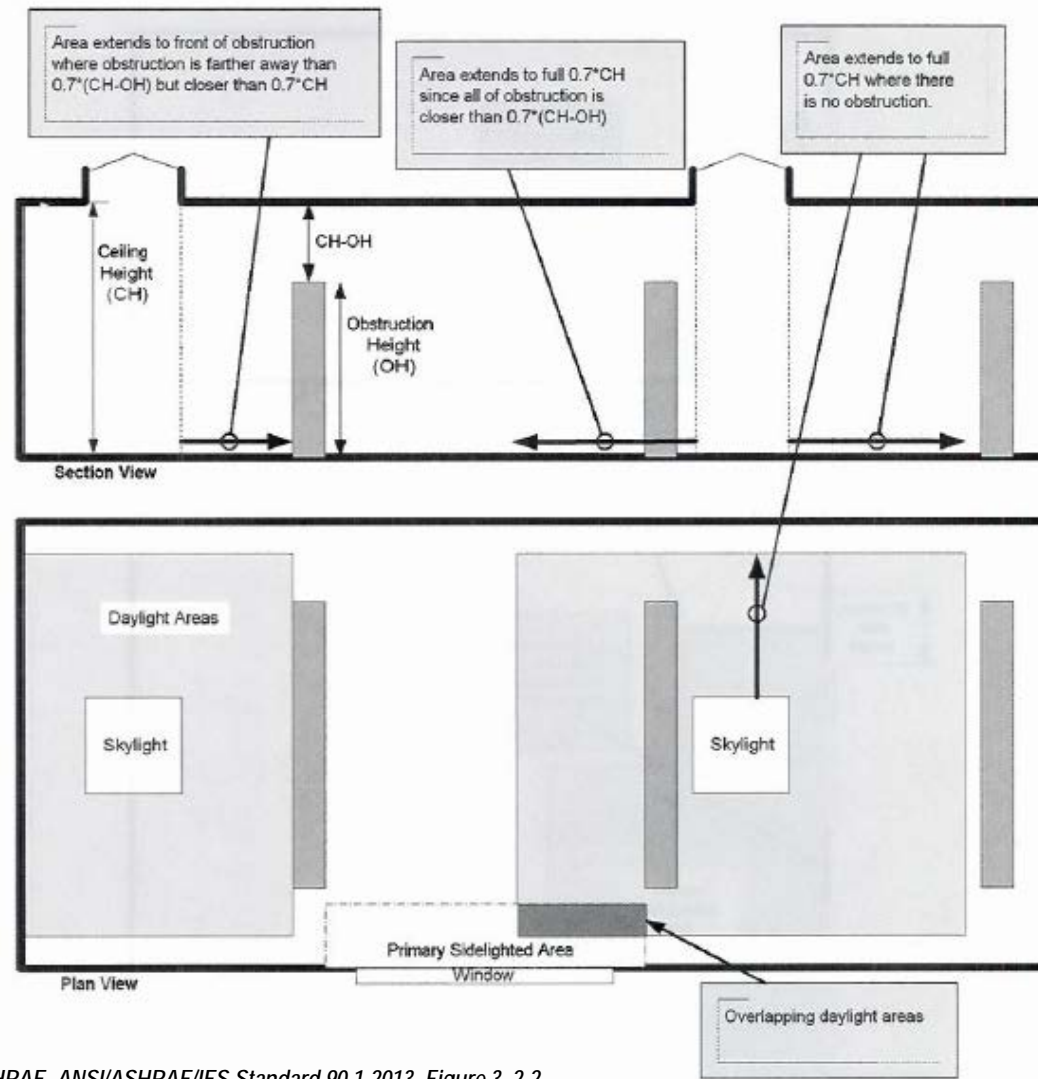
Section 9 – 9.4.1.4

Daylight Zone Definition – Under Rooftop Monitors



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Section 9 – 9.4.1.4 Daylight Zone Definition – Under Skylights



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Section 9 – 9.4.1.1 (g) **Automatic Partial OFF (Full OFF Complies)**

- *Automatically reduce general lighting power by at least 50% within 20 minutes of all occupants leaving the space*

Exceptions

- *Space has LPD < 0.80 W/ft²*
- *Space is lighted by High Intensity Discharge technology*
- *General lighting power in space is automatically reduced by $\geq 30\%$ within 20 minutes of all occupants leaving the space*

Section 9 – 9.4.1.1 (h) **Automatic Full OFF**

- *All lighting automatically shut off within 20 minutes of all occupants leaving the space*
- *Control device to control < 5,000 ft²*

Exceptions

- *Shop and lab classrooms*
- *Areas where auto shutoff causes safety or security concerns*
- *Lighting for 24/7 operation*

Typically, users are allowed to choose to implement this control or Scheduled Shutoff

Section 9 – 9.4.1.1 (i) Scheduled Shutoff

Control lights on a scheduled basis (automatic time switch)

- Time-of-day controller or
- Signal from another control or alarm

Controller or system provide independent control sequences that

- Controls $\leq 25,000$ ft²
- Not more than one floor
- *Accounts for weekend and holidays*

Manual override control

- *< 2 hours during scheduled off*
- *Control $\leq 5,000$ ft²*

Typically, users are allowed to choose to implement this control or Automatic Full Off

Exceptions

- Lighting for 24/7 operation
- Patient care spaces
- Areas where auto shutoff causes safety or security concerns

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.*

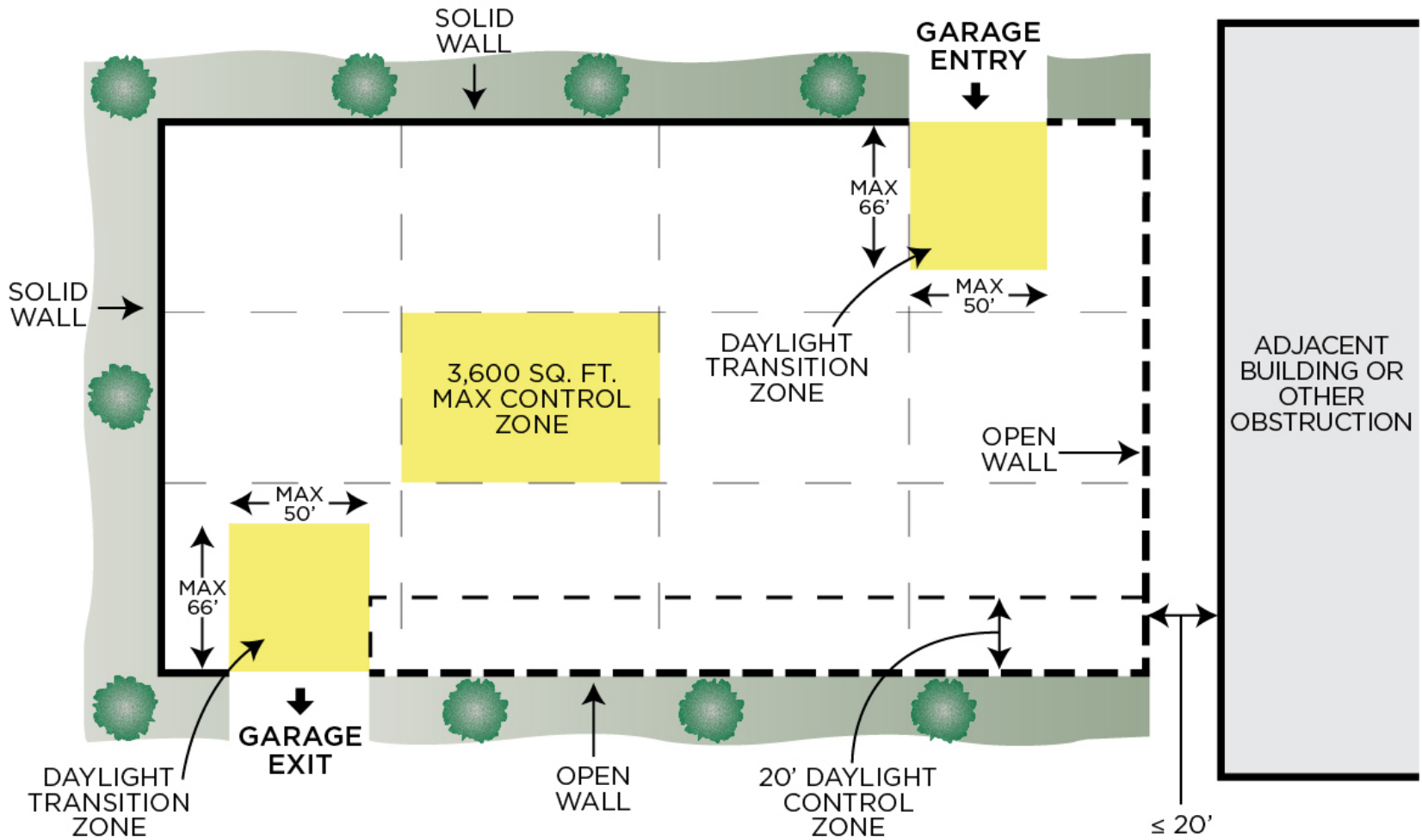
Section 9 – 9.4.1.2 Parking Garage Lighting Control (1 of 2)

- 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 $\leq 3,600 \text{ ft}^2$
- 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 $\geq 40\%$ and
 - no exterior obstructions within 20 ft

Exception

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

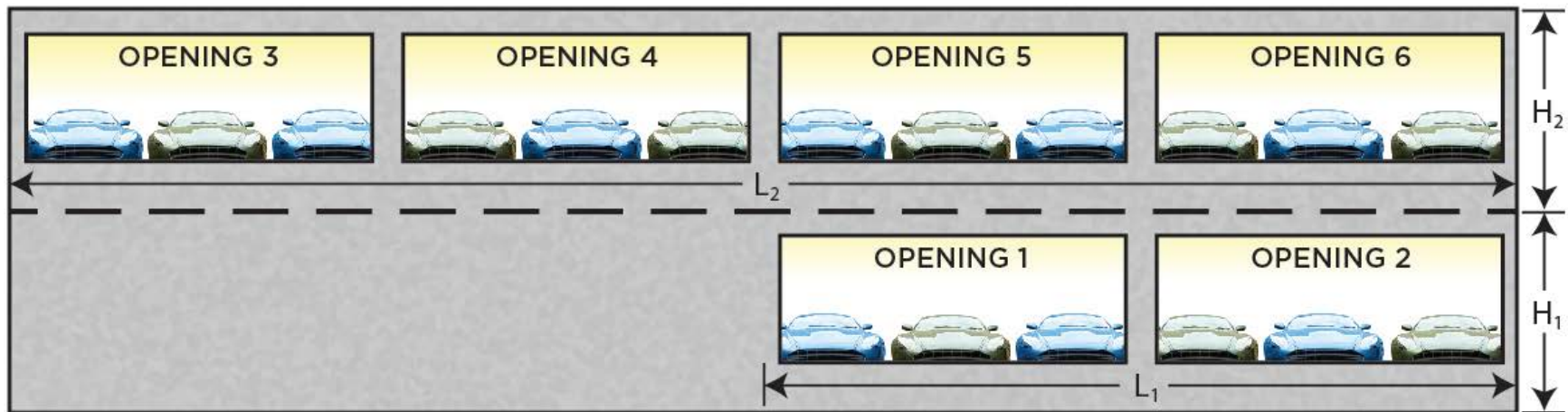
Section 9 – 9.4.1.2 Parking Garage Lighting Control (2 of 2)



Section 9 – 9.4.1.2

Parking Garage Lighting Control – Opening to Wall Ratio

PARKING GARAGE SIDE VIEW (ELEVATION)



Daylighting control required if the total area of all openings in a wall section (i.e. openings 1-2) are greater than or equal to 40% of the total wall area ($H \times L$).

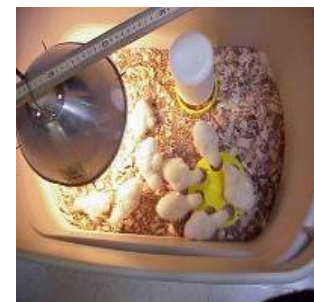
Example: $\frac{\text{Opening 1} + \text{Opening 2}}{H_1 \times L_1}$

Example: $\frac{\text{Opening 3} + \text{Opening 4} + \text{Opening 5} + \text{Opening 6}}{H_2 \times L_2}$

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



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

- 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



Section 9 – Lighting

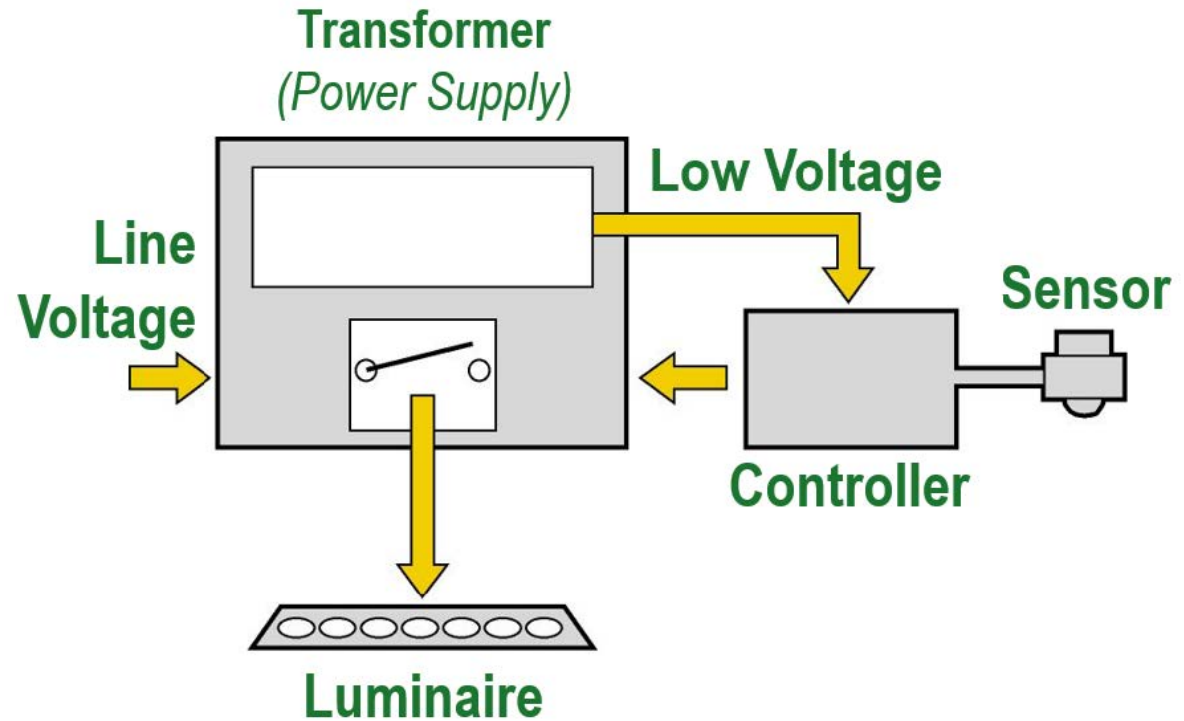
9.4.1.4 Exterior Lighting Control-sets requirements for exterior lighting.

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

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 for 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*

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 Tradable Exterior LPDs

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*

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



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.

Section 9

Tradable Exterior LPDs

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

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 be traded.) | | | | | |
| Uncovered parking areas | | | | | |
| Parking areas and drives | No allowance | 0.04 W/ft ² | 0.06 W/ft ² | 0.10 W/ft ² | 0.13 W/ft ² |
| 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 | No allowance | 0.14 W/ft ² | 0.14 W/ft ² | 0.16 W/ft ² | 0.2 W/ft ² |
| Plaza areas | No allowance | | | | |
| Special feature areas | No allowance | | | | |
| Stairways | No allowance | 0.75 W/ft ² | 1.0 W/ft ² | 1.0 W/ft ² | 1.0 W/ft ² |
| Pedestrian tunnels | No allowance | 0.15 W/ft ² | 0.15 W/ft ² | 0.2 W/ft ² | 0.3 W/ft ² |
| Landscaping | No allowance | 0.04 W/ft ² | 0.05 W/ft ² | 0.05 W/ft ² | 0.05 W/ft ² |
| Building entrances and exits | | | | | |

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.

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.

Section 9 – 9.4.3 Functional Testing

- Functional testing (calibrated/adjusted/programmed) of lighting control devices and systems required within 90 days of occupancy
 - Must be performed by individuals NOT involved in design, manufacture, or installation
 - *For occupant sensors:*
 - *Certify location and aiming per manufacturer recommendation*
 - *Test all sensors if project ≤ 7*
 - *If > 7 sensors, test for each unique combination of sensor type and space geometry and verify*
 - *Status indicator*
 - *Lights turn off or down to permitted level within required time*
 - *Auto-on – lights turn on to permitted level when someone enters the space*
 - *Manual on – lights turn on only when manually activated*
 - *Lights aren't incorrectly turned on by movement in nearby areas or by HVAC operation*

Section 9 – 9.4.3

Functional Testing *(cont'd)*

- *For automatic time switches:*
 - *Confirm programmed schedules*
 - *Document schedules for owner*
 - *Verify correct time and date are set*
 - *Verify any battery backup is installed and energized*
 - *Verify override time limit set to ≤ 2 hours*
 - *Simulate occupied condition and verify and document:*
 - *Lights turn on and off with respective switches*
 - *Switch only operates lights in enclosed space where switch is located*
 - *Simulate unoccupied condition and verify and document:*
 - *All nonexempt lights turn off*
 - *Manual override only operates lighting where it is located*
- *For daylighting controls*
 - *Properly located, field-calibrated, and set to have appropriate setpoints and threshold light levels*
 - *Daylight controlled lighting loads adjust to correct levels with available daylight*
 - *Location where calibration adjustments are made is readily accessible only to authorized personnel*

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.

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.

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.

Section 9 – 9.7 Submittals

- ✓ Record drawings, to include for each piece of lighting equipment:
 - Location
 - Luminaire identifier
 - Control
 - Circuiting
- ✓ Operation and maintenance manuals
- ✓ *Daylighting documentation*
 - *Identify all general lighting located within daylight areas under skylights, daylight areas under roof monitors as well as primary sidelighted areas and secondary sidelighted areas*

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.

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

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

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*

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

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

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



COMcheck-Web simplifies commercial and high-rise residential energy code compliance.

It performs just like [COMcheck](#), the desktop version, but you don't need to download or install any software on your computer.

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COMcheck-Web has been updated!

[Learn what's new.](#) (January 2011)

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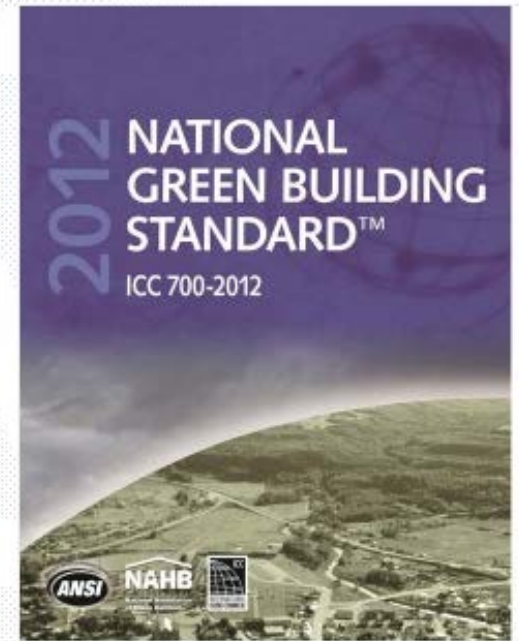
Michigan Energy Code-Commercial

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,

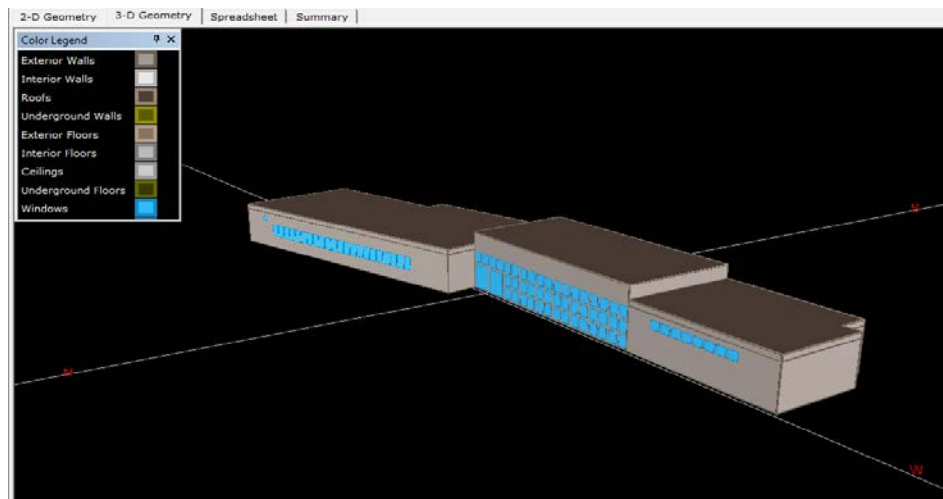
***Still requires mandatory provisions of Chapter 4 of IECC 2015 to be met*

(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



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Energy Codes-Resources (2 of 2)



The screenshot shows the website for the U.S. Department of Energy's Building Energy Codes Program. The header includes the U.S. Department of Energy logo and the text "Energy Efficiency & Renewable Energy". Below the header is a green navigation bar with the title "Building Energy Codes Program" and links for "HOME", "NEWS", "EVENTS", and "ABOUT". A breadcrumb trail reads "DOE » EERE » BTO » BECP ». On the left side, there is a vertical menu with categories: "DEVELOPMENT", "ADOPTION", "COMPLIANCE", and "RESOURCE CENTER". The main content area, titled "Training Materials In-person", is highlighted with a red box and contains a list of training resources, each with a document icon and a red checkmark:

- [Highlights of 90.1-2013 Changes from 90.1-2010](#)
- [Presentation Slides -- Chapter 11 and Appendix G](#)
- [Presentation Slides -- Envelope](#)
- [Presentation Slides -- HVAC](#)
- [Presentation Slides -- Power and Lighting](#)

Energy Codes online training courses

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

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