Michigan Energy Code Training and Implementation Program

1.0 Hour Commercial Program Course Number 16139
2009 Michigan Uniform Energy Code

School of Planning, Design & Construction

Michigan State University
East Lansing, Michigan
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: **16139**

1 Hour Technical:
BI, MI, or registrants with only BO/PR but no inspector registration
Project Support

Prepared by the **School of Planning, Design and Construction at Michigan State University**. Oversight provided by MSU faculty and the **Center for Construction Project Performance Assessment and Improvement (C2P2ai)**.

What Do Building Energy Codes and Standards Cover?

For both residential and commercial:

- Building Envelope
- Mechanical
- Service Water Heating
- Lighting
- Electrical Power

Project Objectives

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

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

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2009 Michigan Uniform Energy Code (MUEC)
2009 Michigan Uniform Energy Code (MUEC)

DEPARTMENT OF ENERGY, LABOR, AND ECONOMIC GROWTH

DIRECTOR'S OFFICE

CONSTRUCTION CODE

Filed with the Secretary of State on November 8, 2010
These rules take effect March 9, 2011

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

R 408.31087, R 408.31088, R 408.31089, and R 408.31090 of the Michigan Administrative Code are amended and R 408.31087a is 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 edition, section 501.1 and the ASHRAE energy standard for buildings except low-rise residential buildings. ANSI/ASHRAE/IESNA standard 90.1-2007 (hereafter the standard), including appendices A, B, C, and D. 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 office of the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes, 2501 Woodlake Circle, Okemos, Michigan 48864, at a cost as of the time of adoption of these rules of $38.00 or may be purchased from the International Code Council, 500 New Jersey Avenue, N.W., 6th Floor, Washington, D.C. 20001. The ASHRAE 90.1-2007 standard is available for inspection at the Okemos office of the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes. The standard may be purchased from the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, Georgia 30329, at a cost as of the time of adoption of these rules of $119.95 each. Copies may be obtained from the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes, 2501 Woodlake Circle, Okemos, Michigan 48864, at a cost as of the time of adoption of these rules of $119.95 each plus the department's cost for shipping and handling.


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Presenters Note: Part 10a dependent on Part 10
AShRAE 90.1—2007 available for download at a discounted rate made possible by the U.S. Dept. of Energy:

http://www.ashrae.org/publications/page/2728

Date visited: 3/23/2011
Code Compliance Software Tools

Prescriptive
None Needed

Total Building “UA” Trade Off
COMcheck Software
(Web-based & Desktop)

Energy Analysis
Software
*For example:*
DOE-2 Software
Carrier H.A.P.
eQuest

Standard 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

http://www.energycodes.gov/becu/trainers.stm

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Standard 90.1-2007 Appendices

- **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
- **F** Addenda Description Information (Informative)
- **G** Performance Rating Method (Informative, LEED®)

Presenters Note:
Appendices E,F, and G have not been adopted by Michigan.

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Date visited: 2/11/2011
Purpose *(Section 1)*

- To provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings
- MUEC residential provisions cover all low-rise (1-3 stories) houses, condos, townhouses, and apartments [R-2, R-3, R-4], but not hotels/motels [R-1]
Scope (Section 2)

(Section 2.1.a)

• New buildings and their systems
• New portions of buildings and their systems (additions)
• New systems and equipment in existing buildings (alterations)

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Scope (Section 2)

• Envelope (Section 2.2.a)
  - if heated by a heating system with an output capacity
    \( \geq 3.4 \text{ Btu/h-ft}^2 \) \((\text{1 watt/ft}^2)\) OR
  - if cooled by a cooling system with a sensible output capacity \( \geq 5 \text{ Btu/h-ft}^2 \)

• Virtually all mechanical, power, and lighting systems are covered (Section 2.2.b)
Scope Exceptions (Section 2.3)

- Too little heating or cooling
- Single-family, multifamily of three stories or less, manufactured or modular homes
- Buildings that don’t use electricity or fossil fuel
- Equipment and portions of building systems that use energy primarily for industrial, manufacturing, or commercial processes

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Date visited: 2/11/2011
Definitions, Abbreviations, and Acronyms (Section 3)

• 10 pages of definitions
  – some added, some deleted, some revised from 90.1-1999
• 1 page of abbreviations and acronyms
• Defined terms are italicized in text of standard
Administration and Enforcement *(Section 4)*

- New buildings *(Section 4.1.1.1)*, additions to existing buildings *(Section 4.1.1.2)*, and alterations to existing buildings *(Section 4.1.1.3)*
- Replacement of portions of existing buildings *(Section 4.1.1.4)*
- Changes in space conditioning *(Section 4.1.1.5)*

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*Date visited: 2/11/2011*
Administration and Enforcement *(Section 4)*

- Compliance documentation *(Section 4.2.2.1)*
  - all the pertinent data of the building, systems, and equipment
- Labeling of materials and equipment *(Section 4.2.3)*
  - Fenestration, doors, insulation, mechanical equipment, and packaged terminal air conditioners
- Alternative materials and methods of construction *(Section 4.1.3)*
- Inspections *(Section 4.2.4)*
Compliance Approaches

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

Compliance Options

- Mandatory Provisions (required for most compliance options)
- Prescriptive Option
- Trade Off Option
- Energy Cost Budget
- Simplified

Energy Code Compliance

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Date visited: 2/11/2011
Building Envelope *(Section 5)*

- **General (Section 5.1)**
  - Scope
  - Space-Conditioning Categories
  - Envelope Alterations
  - Climate

- **Compliance Methods (Section 5.2)**

- **Simplified Building (Section 5.3) Not Used**

- **Mandatory Provisions (Section 5.4)**
  - Insulation
  - Fenestration and Doors
  - Air Leakage

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*Date visited: 2/11/2011*
Building Envelope *(Section 5)*

- Prescriptive Building Envelope Option *(Section 5.5)*
  - Opaque Areas
  - Fenestration
- Building Envelope Trade-Off Option *(Section 5.6)*
- Submittals *(Section 5.7)*
- Product Information and Installation Requirements *(Section 5.8)*

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Scope

• Envelope components that enclose *(Section 5.1.2.1)*
  - Conditioned space
  - Semi-heated space
    - Has a heating system with a capacity > 3.4 Btu/h·ft² of floor area but is not conditioned space

• Requirements apply to three types of spaces *(Section 5.1.2.1)*
  - Nonresidential
  - Residential
  - Semi-heated

• *Exceptions*

*Date visited: 2/11/2011*
Building Envelope

(Figure 5.5)

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Envelope Alterations

- Alterations to the building envelope shall comply with the requirements of Section 5 (Section 5.1.3)
  - *Exceptions* are allowed if they don’t increase energy usage of building
    - Installation of storm windows
    - Replacement of glazing in existing sash and frame
    - Alterations to envelope cavities provided they are insulated to full depth with a nominal R-3.0 per in.
    - Roof and floor alterations where no new cavities are created
  - Replacement of roof membranes
  - Replacement of existing doors
  - Replacement of existing fenestration, provided area of replacement is no more than 25% of total fenestration area

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Date visited: 2/11/2011
Climate Zones—ASHRAE 90.1—2007

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
The State of Michigan is divided into 3 climate zones:

Table 301.3(2)  
Climate Zone Definitions

<table>
<thead>
<tr>
<th>Zone Number</th>
<th>Thermal Criteria</th>
<th>SI Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>5A</td>
<td>5400 &lt; HDD 65°F ≤ 7200</td>
<td>3000 &lt; HDD 18°C ≤ 4000</td>
</tr>
<tr>
<td>6A</td>
<td>7200 &lt; HDD 65°F ≤ 9000</td>
<td>4000 &lt; HDD 18°C ≤ 5000</td>
</tr>
<tr>
<td>7</td>
<td>9000 &lt; HDD 65°F ≤ 12600</td>
<td>5000 &lt; HDD 18°C ≤ 7000</td>
</tr>
</tbody>
</table>

For SI: °C = [(°F)-32]/1.8

Date Visited: 2/11/2011
Figure 301.1A: Climate Zones

2009 Michigan Uniform Energy Code
Figure 301.1a

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Envelope Compliance Paths (Section 5.2.1)

• You have to follow Sections
  – 5.1 (General),
  – 5.4 (Mandatory Provisions),
  – 5.7 (Submittals), and
  – 5.8 (Product Information and Installation Requirements),

• and THEN you can either follow
  – Section 5.5 (Prescriptive) or Section 5.6 (Trade-off)

• If you use the Energy Cost Budget method in Section 11, Section 5.4 is mandatory (Section 5.2.2)
  – However, Section 5.4 merely refers to Section 5.8
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)

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Air Leakage

- Seal, caulk, gasket, or weather-strip (Section 5.4.3.1)
  - Openings and joints in building envelope
  - Fenestration and doors per NFRC 400 (Section 5.4.3.2)
  - Loading docks in climate zones 4-8 (Section 5.4.3.3)
  - Vestibules and doors separating conditioned space from exterior (Section 5.4.3.4)

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Air Leakage - Building Envelope Sealing (Section 5.4.3.1)

- Joints around fenestration and door frames \((a)\)
- Junctions between walls \((b)\)
  - and foundations
  - at building corners
  - and structural floors or roofs
  - and roof or wall panels
- Openings for utility services through roofs, walls, and floors \((c)\)
- Site-built fenestration and doors \((d)\)
- Building assemblies used as ducts or plenums \((e)\)
- Joints, seams, and penetrations of vapor retarders \((f)\)
- All other openings in the building envelope \((g)\)
Air Leakage - Fenestration and Doors (Section 5.4.3.2)

- NFRC 400
- Labeled and certified by manufacturer
- Glazed swinging entrance doors and revolving doors – not to exceed 1.0 cfm/ft²
- All other products – not to exceed 0.4 cfm/ft²
- Exceptions
  - Field-fabricated fenestration and doors
  - Garage doors – ANSI/DASMA 105

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Air Leakage - Loading Dock Weather Seals (Section 5.4.3.3)

In climate zones 4-8:

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


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Air Leakage – Vestibules (Section 5.4.3.4)

- **Required in**
  - **Climate Zones 5-8** for entrances in buildings > 1000 ft²

- **Vestibules must have:**
  - Self-closing doors
  - Interior and exterior doors not open at the same time
  - Distance between interior and exterior doors not < 7 ft when in closed position (remember ADA!) (>10 ft for LEED IEQ 5.3 entrance mat)


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Air Leakage - Vestibule Exceptions (Section 5.4.3.4)

- Non-entrance doors
- Building entrances with revolving doors
- Buildings < 1000 ft$^2$ in climate zones 5-8
- All doors that open from spaces < 3000 ft$^2$ (separate from building entrance) OR from dwelling units

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Prescriptive Building Envelope Option (Section 5.5)

WWR ≤ 40% of gross wall area
Skylight-roof ratio ≤ 5% of roof area
Each envelope component must separately meet requirements

8 criteria sets for different climate types
• Set = single page that summarizes all prescriptive requirements
  – Insulation levels for roofs, walls, floors
  – Fenestration criteria

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Building Envelope Requirements
(Tables 5.5-1 through 5.5-8)

Requirements for Nonresidential, Residential, and Semiheated spaces

• Opaque Elements
  – Roofs, Walls, Floors, and Doors
  – Assembly maximum values or insulation minimum R-values

• Fenestration
  – Vertical Glazing and Skylights
  – Assembly maximum U-values or assembly maximum SHGC
Building Envelope Requirements
(Table 5.5-5)

Climate Zone 5

• Nonresidential Examples
  - Roofs: insulation entirely above deck = R-20.0 c.i. (R-15.0 c.i.)
  - Roofs: Attic and other = R-38.0 (R-30.0)
  - Above-Grade Walls: mass = R-11.4 c.i. (R-7.6 c.i.)
  - Above-Grade Walls: steel-framed = R-13.0 + R-7.5 c.i. (R-13.0 + R-3.8 c.i.)
  - Above-Grade Walls: wood-framed = R-13.0 + R-3.8 c.i. (R-13.0)
  - Below-Grade Walls: below-grade wall = R-7.5 c.i. (No Requirement)
  - Floors: mass = R-10.4 c.i. (R-8.3 c.i.)
  - Floors: steel joist = R-30.0 (R-19.0)
  - Slab-On-Grade Floors: heated = R-15 for 24 in. (R-10 for 36 in.)
  - Doors: nonswinging = U-0.500 (U-1.450)

Presenter’s note: ( ) = 1999 ASHRAE 90.1 values
Designers

• Specify:
  − R-values for walls, floors, and roofs
  − U-factors for opaque doors
  − U-factor and SHGC for fenestration, OR

• Use:
  − Pre-calculated assemblies from Appendix A

Opaque Areas (Section 5.5.3)

Compliance:

• Meet or exceed minimum R-values in table
  – Only R-value of insulation, not to include air films, etc

OR

• Meet maximum U-factor, C-factor, or F-factor for the entire assembly

OR

• Perform area-weighted average U-factor, C-factor, or F-factor
  – Only if there are multiple assemblies within a single class of construction for a single space-conditioning category

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Slab Edge Insulation (Section 5.5.3.5)

Slab-on-Grade Floors

Can use R factor or F factor from 5.5-5 thru 7

When using the F factor must refer to Table A6.3

- Downward from top of slab a minimum of 24"
- R-10 for unheated floors, R-15 for heated floors
- No requirement for insulation in CZ5 for unheated floors
- Insulation can be vertical or extend horizontally under the slab or out from the building (must be under 10 inches of soil) But only with computer based methods and not with prescriptive

Opaque Doors (Section 5.5.3.6)

• Meet or exceed maximum U-factors in appropriate table for climate zone

• Example: Climate Zone 5
  - Nonresidential
    • Swinging = U-0.700 (U-0.700)
    • Non-swinging = U-0.500 (U-1.450)
  - Residential
    • Swinging = U-0.500 (U-0.700)
    • Non-swinging = U-0.500 (U-0.500)
  - Semiheated
    • Swinging = U-0.700 (U-0.700)
    • Non-swinging = U-1.450 (U-1.450)

Presenter’s note: ( ) = 1999 ASHRAE 90.1 values
Fenestration (*Section 5.5.4*)

- Criteria apply to fenestration, including windows, glass doors, glass block, plastic panels, and skylights
- Compliance
  - Meet or exceed maximum U-factors in table
  - Meet or exceed minimum SHGC in table
  - Use NFRC ratings or default values in Appendix A


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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 < 5% of gross roof area (Section 5.5.4.2.2)
  – Including glass skylights, plastic skylights with a curb, and all skylights without a curb


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Fenestration U-Factor (Section 5.5.4.3)

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

Zone 5 and 6 vertical glazing metal framing
U=0.45 and SHGC 0.40

Zone 7 vertical glazing metal framing
U=0.40 and SHGC 0.45

Unit U value rather than glass only (must include frame)
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

http://www.energycodes.gov/becu/trainers.stm

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Overhangs

- Standard credits permanent overhangs by adjustment to SHGC
- Size of overhang is determined by projection factor


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Building Envelope Trade-Off Option

Building complies if:
• It satisfies the provisions of 5.1, 5.4, 5.7, and 5.8 (Section 5.6.1a)
• Envelope performance factor (EPF) of proposed building is ≤ EPF of budget building (Section 5.6.1b)
  – EPF considers only the building envelope components (Section 5.6.1.1) and is calculated using procedures in Normative Appendix C (Section 5.6.1.3)
  – Schedules of operation, lighting power, equipment power, occupant density, and mechanical systems to be the same for both the proposed building and the budget building (Section 5.6.1.2)

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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 \((Section 5.8.1.9)\)
Insulation Installation

- Per manufacturer’s instructions *(Section 5.8.1.2)*
- Achieve rated R-value *(Section 5.8.1.2)*
- No open-blown or poured loose-fill insulation when ceiling slope is > 3/12 *(Section 5.8.1.3)*
- If eave vents installed *(Section 5.8.1.4)*
  - Provide baffling of air vents to deflect incoming air above the surface of the insulation
- Exception *(Section 5.8.1.2)*
  - Metal buildings – if roof and wall insulation is compressed between roof or wall skin and the structure

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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.)

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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

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Insulation Protection:

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

- 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)

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Suspended Ceilings

Roof Insulation:

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

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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

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*U.S. Department of Energy (2010)*

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U-Factor *(Section 5.8.2.4)*

- Skylights – Manufacturer to determine at a slope of 20° above the horizontal
- Labeled and certified by manufacturer *(Sections 5.8.2.1 and 5.8.2.2)*
- Limited to max 5% of roof for prescriptive applied to each space categories *(Tables 5.5-1 through 5.5-8)*
- U Factor depends on skylight class i.e. glass with curb, plastic with curb and without curb
- Exceptions
  - Glazed wall systems in vertical fenestration and skylights – may use U-factors in A.8.1
  - A8.2 acceptable for other vertical fenestration
  - A7 acceptable for opaque doors
  - ANSI/DASMA 105 acceptable for garage doors

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Lighting Compliance

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting

Compliance Options

- Mandatory Provisions (required for most compliance options)
- Prescriptive Option
- Trade Off Option
- Energy Cost Budget
- Simplified

Energy Code Compliance

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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*)**

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Lighting General *(Section 9.1)*

- **Scope (Section 9.1.1):**
  - Interior spaces of buildings *(a)*
  - Exterior building features *(b)*
  - Exterior grounds lighting powered through building *(c)*
  - Exceptions
    - Emergency lighting
    - Lighting required by life safety statute
    - Lighting within dwelling units of buildings
    - Decorative gas lighting

- **Lighting Alterations (Section 9.1.2):**
  - New lighting and lighting controls must comply with this section, unless an alteration replaces less than 50% of luminaires in a space and that alteration does not increase the installed lighting power
Lighting General

(Section 9.1.3)

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

  - Exception: in the case where there are two independently operated lighting systems that are controlled to prevent simultaneous operation
    • Include only the higher wattage system

(Section 9.1.4)

• Luminaire Wattage for various systems shall be determined in accordance with details in this section

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Basic Lighting Requirements

Mandatory Requirements (Interior and Exterior)

- Controls
- Switching
- Efficiency

Interior Lighting Power Limits

- Total Connected Power
- Interior Lighting Power Allowance

Exemptions

Whole Building

OR

Space-by-Space

Additional Allowances

Exterior Lighting Power Limits

- Tradable
- Exemptions
- Non-Tradable

- Total Connected Power
- Exterior Lighting Power Allowance


http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Luminaire Wattage *(Section 9.1.4)*

- Standard incandescent = max. labeled wattage of the luminaire *(a)*
- Luminaires with ballasts or transformers = wattage of the maximum lamp/ballast combination OR max. labeled wattage of the luminaire *(b)*
- 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 *(c)*
- Low voltage track = transformer wattage *(d)*
- All others as specified on equipment *(e)*
Mandatory: Individual Space Control (Section 9.4.1.2)

- At least one for each room or space enclosed by ceiling-height partitions
  - in spaces $\leq 10,000$ ft$^2$, each control serves 2500 ft$^2$ maximum and in spaces $> 10,000$ ft$^2$, serves 10,000 ft$^2$ maximum
- Readily accessible to occupants
- Remote location is allowed to accommodate areas where safety or security is a concern


http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Mandatory: Additional Space Controls (Section 9.4.1.4)

Hotel/motel guest room lighting must be controlled at room entry (c)

Occupancy sensors are required in:
- Classrooms (except shop, lab, K-12)
- Conference/meeting rooms
- Employee lunch/break rooms

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Mandatory: Individual Space Control (Section 9.4.1.4)

Additional control required for:
- Display/accent lighting (a)
- Case lighting (b)
- Task lighting (d)
- Non-visual lighting (e)
- Demonstration lighting (f)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

U.S. Department of Energy (2010) (all)
Mandatory: Automatic Shutoff (Section 9.4.1.1)

- Automatic lighting shutoff control device required in all buildings larger than 5,000 ft²

- Override of automatic shutoff required for not more than 4 hours (Section 9.4.1.2)

- Exceptions to automatic shutoff:
  - Lighting for 24-hour operation
  - Patient care spaces
  - Areas with safety or security concerns

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Automatic Shutoff (Section 9.4.1.1)

- Compliance options:
- Control lights on a scheduled basis (automatic time switch) (a)
  - Time-of-day controller
  - Controls ≤ 25,000 ft² and not more than one floor
- Occupant sensor (b)
  - Turn lights off within 30 minutes of occupant leaving the space
- Signal from another control or alarm that indicates the area is unoccupied (c)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exterior Lighting Control (Section 9.4.1.3)

- For dusk-to-dawn lighting: astronomical time switch or photosensor
- For all other: astronomical time switch OR photosensor + time switch [REVISED!]
- All time switches must have 10 hour battery backup
- Exceptions:
  - Covered vehicle entrances
  - Exits from buildings or parking structures
  - (where required for safety, security, or eye adaptation)

Date visited: 2/11/2011
Additional Control *(Section 9.4.1.4)*

Many special lighting applications must be controlled separately

- Display/accent lighting *(a)*
- Case lighting *(b)*
- Hotel/motel guest room lighting *(c)*
- Task lighting *(d)*
- Non-visual lighting *(e)*
- Demonstration lighting *(f)*
Exit Signs *(Section 9.4.3)*

Limited to 5 watts per face

[Image of exit signs]


http://www.energycodes.gov/becu/trainers.stm

*Date visited: 2/11/2011*
Exterior Lighting Power

- Building grounds lighting luminaires over 100 watts must have lamp efficacy of at least 60 lumen/Watt. **Exception**: motion sensor controls. *(Section 9.4.4)*
- Exterior Building Lighting Power must meet prescribed wattage limits. Exterior applications divided into 2 categories *(Section 9.4.5)*:
  
  ** Tradable**: allowed wattage may be traded among these applications
  
  **Non-Tradable**: allowed wattage cannot be traded between surfaces or with other exterior lighting

http://www.energycodes.gov/becu/trainers.htm

Date visited: 2/11/2011
Exterior Building Lighting Power (Section 9.4.5)

• The total exterior lighting power allowance is the sum of the individual lighting power densities [LPD].....

• ….plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among “Tradable Surfaces” applications.

• Some exemptions apply

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Exterior Building Lighting Power
(Section 9.4.5)

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

- specialized signal, directional, and marker lighting associated with transportation;
- lighting that is integral to advertising signage or directional signage;
- 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;
- lighting for athletic playing areas;
- temporary lighting;
- 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
# Exterior LPDs: 90.1-2007 *(Table 9.4.5)*

**Example:**

<table>
<thead>
<tr>
<th>Applications</th>
<th>Lighting Power Densities</th>
</tr>
</thead>
<tbody>
<tr>
<td>** Tradable Surfaces:**</td>
<td></td>
</tr>
<tr>
<td><strong>Uncovered Parking Areas</strong></td>
<td></td>
</tr>
<tr>
<td>Parking lots and drives</td>
<td>0.15 W/ft² (12 fc @ 80 L/W)</td>
</tr>
<tr>
<td><strong>Building Grounds</strong></td>
<td></td>
</tr>
<tr>
<td>Walkways less than 10 feet wide</td>
<td>1.0 W/linear foot</td>
</tr>
<tr>
<td>Walkways 10 feet wide or greater, Plaza areas and Special feature areas</td>
<td>0.2 W/ft² (16 fc @ 80 L/W)</td>
</tr>
<tr>
<td>Stairways</td>
<td>1.0 W/ft²</td>
</tr>
</tbody>
</table>


Date visited: 2/11/2011
Interior Lighting Power (Section 9.2.2.3)

- Lots of exemptions
- Calculation methods
  - Building area (Section 9.5)
  - Space-by-space (Section 9.6)
  - Trade-offs of interior lighting power allowance among portions of the building for which a different calculation method has been used is not permitted

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Lighting Power Allowance Exemptions (Section 9.2.2.3)

- Theatrical, stage, film, and video production
- Medical and dental procedures
- Exhibit displays for museums, monuments, and galleries
- Plant growth or maintenance
- 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 occupants with special needs

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Building Area Method of Calculating Interior Lighting Power Allowance (*Section 9.5.1*)

- Used for projects involving
  - An entire building
  - A single, independent, and separate occupancy in a multi-occupancy building

- Gross lighted area is multiplied by allowance from Table 9.5.1

- **Limitations:**
  - Insensitive to specific space functions and room configurations
  - Generally is more restrictive
  - Does not apply to all building types - but “selection of a reasonably equivalent type” is permitted


*Date visited: 2/11/2011*
Gross Lighted Area (Section 3 definition)

• Sum of total lighted area of a building
  - Measured from the exterior faces of the exterior walls or from the centerline of walls separating buildings, but excluding a long list of areas. (See Standard).

• Used in the building area method of determining interior lighting power allowance

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
# Building Area Allowances

## Table 9.5.1

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Lighting Power Density (W/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Court House</td>
<td>1.2 (1.4)</td>
</tr>
<tr>
<td>Dining: Bar Lounge/Leisure</td>
<td>1.3 (1.5)</td>
</tr>
<tr>
<td>Dining: Cafeteria/Fast Food</td>
<td>1.4 (1.8)</td>
</tr>
<tr>
<td>Dining: Family</td>
<td>1.6 (1.9)</td>
</tr>
<tr>
<td>Dormitory</td>
<td>1.0 (1.5)</td>
</tr>
<tr>
<td>Exercise Center</td>
<td>1.0 (1.4)</td>
</tr>
<tr>
<td>Office</td>
<td>1.0 (1.3)</td>
</tr>
</tbody>
</table>

*Presenter’s note: ( ) = 1999 ASHRAE 90.1 values*

Space-by-Space Method of Calculating Interior Lighting Power Allowance (Section 9.6.1)

- Identify different building types in your project
- Divide gross lighted area of the building into each of the space types
- Calculate lighting power allowance by multiplying area of space type by lighting power density for that specific space type
- Sum all the allowances
- Advantages:
  - More flexible
  - Applicable to all building types
  - Accounts for room geometry (e.g., lighting needs of enclosed office vs. open office)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
## Space-by-Space LPD

### Table 9.6.1

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Lighting Power Density (W/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Court House</td>
<td>1.9 (1.5)</td>
</tr>
<tr>
<td>Dining: Bar Lounge/Leisure</td>
<td>1.4 (1.5)</td>
</tr>
<tr>
<td>Dining: Cafeteria/Fast Food</td>
<td>2.1 (1.5)</td>
</tr>
<tr>
<td>Dining: Family</td>
<td>2.1 (1.5)</td>
</tr>
<tr>
<td>Dormitory</td>
<td>1.1 (1.5)</td>
</tr>
<tr>
<td>Exercise Center</td>
<td>0.9 (1.3)</td>
</tr>
<tr>
<td>Office, Enclosed</td>
<td>1.1 (1.5)</td>
</tr>
</tbody>
</table>

*Presenter’s note:* ( ) = 1999 ASHRAE 90.1 values


http://www.energycodes.gov/becu/trainers.stm

*Date visited: 2/11/2011*
Retail Display Lighting *(Section 9.6.2)*

Additional Interior Lighting Power Allowance = 1000 watts +
(Retail Area 1 x 1.0 W/ft2) +
(Retail Area 2 x 1.7 W/ft2) +
(Retail Area 3 x 2.6 W/ft2) +
(Retail Area 4 x 4.2 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

*Exception:* Other merchandise categories may be included in Retail Areas 2 through 4 above, 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.

http://www.energycodes.gov/becu/trainers.stm

*Date visited: 2/11/2011*
Energy Cost Budget Method (Section 11)

• The ultimate trade-off method allowing you to trade-off across building systems through the use of annual, hourly simulation tools and a baseline building
• The only real way to deal with unique designs, renewables, high-efficiency equipment, etc.
• The basis of the energy portion of the LEED rating
• Limits allowable energy costs of the design to those of a building meeting the Standard
• Buildings must still meet all mandatory requirements (Section X.4)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011
Energy Cost Budget Method

- Use a good and approved simulation program (Section 11.2.1)
- Use appropriate and approved climate data (Section 11.2.2)
- Use appropriate and approved purchased energy rates (Section 11.2.3)
- Use the same simulation program, climate data, and purchased energy rates for both the design energy cost and energy cost budget (Section 11.2.4)
- Get approval to deal with exceptional calculations that aren’t covered in the simulation program (Section 11.2.5)
Compliance and Implementation Tools
Training Module

School of Planning, Design & Construction
Michigan State University
East Lansing, Michigan
What Does This Mean to Me?


Target Codes:

• Residential: 2009 IECC
• Commercial: ASHRAE 90.1-2007

90% compliance within 8 years

One time demonstration of 90% compliance required

Code Officials Companion Guide

Building Energy Codes Resource Guide: 

*Code Officials Edition*

View or download: 

- Plan review and inspection resources
- REScheck and COMcheck reference guides
- Case studies
- Sample checklists

- Download the PDF or flip through the online version
- Register for automatic updates
COMcheck Compliance Software
Training Module

School of Planning, Design & Construction
Michigan State University
East Lansing, Michigan
Demonstrate Compliance

Prescriptive

―Prescriptive Packages Approach‖

Trade-off

―Trade-off Approach‖

Performance

―Performance Approach‖

COMcheck Introduction

• Based on UA tradeoff
• **COMcheck Software Options**
  - Web-based Version
    • Automatically updates
    • Save files online or download
  - Desktop Version
    • No internet connection required
    • Must check for updates
  - COMcheck package generator
    • Design your own code-compliant insulation and window packages based on regional requirements

COMcheck Online Tool

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.

Contact: Technical Support
Security & Privacy

https://energycode.pnl.gov/COMcheckWeb/
Identifies assembly type and insulation R-value

Wall Assembly:
• Steel Frame
• 16” oc
• R21 Cavity Insulation

Roof Assembly:
• Single membrane
• R30 Continuous Insulation
Define Assembly, Construction Details, Gross Area and insulation R-value

<table>
<thead>
<tr>
<th>Component</th>
<th>Assembly</th>
<th>Construction Details</th>
<th>Gross Area</th>
<th>Cavity Insulation R-Value</th>
<th>Continuous Insulation R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof 1</td>
<td>Insulation Entirely Above</td>
<td></td>
<td>11570</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front Exterior Wall</td>
<td>Steel-Framed, 16&quot; o.c.</td>
<td></td>
<td>6075</td>
<td>21.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Window 1</td>
<td>Metal Frame with Therma</td>
<td></td>
<td>2185</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storefront Window</td>
<td>Metal Frame:Double Pan</td>
<td></td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrance Door</td>
<td>Glass (&gt; 50% glazing):M</td>
<td></td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Exterior Wall</td>
<td>Steel-Framed, 16&quot; o.c.</td>
<td></td>
<td>6075</td>
<td>21.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Window 1</td>
<td>Metal Frame with Therma</td>
<td></td>
<td>2183</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storefront Window</td>
<td>Metal Frame:Double Pan</td>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrance Door</td>
<td>Glass (&gt; 50% glazing):M</td>
<td></td>
<td>47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Plan review for energy code compliance can be conducted quickly and efficiently. The U.S. Department of Energy’s COMcheck™ Compliance Software is designed to create simplified compliance certificates that can be easily reviewed by enforcement personnel. The Quick Reference Guide identifies the objectives of plan review and code compliance responsibilities, and will take you step-by-step through a typical plan review of a COMcheck™ submittal.

Plan Review Objectives: There are three objectives in conducting a building energy code plan review; verify:

A. the documentation has been correctly prepared
B. the levels of efficiency shown on the plans meet or exceed that shown in the documentation
C. all information needed to conduct a field inspection is included in the plans or documentation for the inspector to use on site

Code Compliance Responsibilities: Successful compliance requires the cooperation of many individuals involved in a building project: designers, engineers, architects, building owners, etc. Compliance also requires the efforts of certain individuals to whom the code gives specific responsibilities:

- Applicant
- Building Official
- Plans Examiner or Special Plans Examiner
- Inspector or Special Inspector
Commercial Plan Review

COMcheck Software Version 3.8.0

Envelope Compliance Certificate

2009 IECC

Section 1: Project Information

Project Type: New Construction
Project Title: Sample Office Building

Construction Site:
2222 Redwood Road
Salt Lake City, UT 22262
Permit No. 10-463
Permit Date: August 19, 2010

Owner/Agent:
ABC Property Company
1677 2nd Street
Salt Lake City, UT 22311

Designer/Contractor:
Designs Are Us
1453 McMinion Street
Park City, UT 98422

Step 1: Verify the Project Information matches the information on the building plans. The code, location, and project type will impact compliance.
Additional Information Resources

Training Module

School of Planning, Design & Construction
Michigan State University
East Lansing, Michigan
U.S. Department of Energy

DOE Homepage: [www.energy.gov](http://www.energy.gov)

- National Security
- Energy Sources
- Energy Efficiency
- Environment
- Energy Prices and Trends
- Science and Technology
- Health
- Safety and Security
- Program Offices
- Staff Offices
- Energy Information Administration
- National Laboratories and Technology Centers
- Operations Offices and Field Organizations
