Michigan Energy Code Training and Implementation Program

3.0 Hour Residential & Commercial Program Course Number 17577 2009 Michigan Uniform Energy Code





UNIVERSITY

School of Planning, Design & Construction

Michigan State University East Lansing, Michigan

Presenters

MICHIGAN STATE

3 Hour Combined Residential and Commercial Michigan Energy Code Training and Implementation Program: Course Number: 17577 3 Hours Technical: BI, MI, EI or registrants with only BO/PR but no inspector registration Tim Mrozowski, A.I.A., #1455 William Bezdek, P.E. #1616

Marcus Metoyer #1540

Objectives of this session include:

- Understand the structure of the Michigan Uniform Energy Code (MUEC) which is based on the 2009 International Energy Conservation Code (IECC)
- 2. Understand the structure and recent code changes from the adoption of ASHRAE 90.7-2007 for Michigan
- 3. Understand the prescriptive requirements of the codes and the alternative compliance paths
- 4. Present introduction to REScheck and COMcheck compliance software

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).

Funding provided by Michigan Department of Energy, Labor & Economic Growth, U.S. Department of Energy and the American Recovery and Reinvestment Act of 2009 with assistance from the Michigan Bureau of Energy Systems (BES) and Bureau of Construction Codes (BCC)



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Project Objectives

To train building officials, inspectors, 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

 $\frac{\text{MICHIGAN STATE}}{\text{U N I V E R S I T Y}}$

Visit MSU's Energy Codes Website

www.energycodes.spdc.msu.edu



Weekly Featured Website

For more than 30 years, <u>Michigan Energy Options</u> (formerly Urban and Northern Options) has helped more than a million people in Michigan conserve energy, save money, adopt renewable energy, reduce greenhouse gases and lead more sustainable lives.

The Need For Energy Codes



U.S. Energy Use



What Do Building Energy Codes and Standards Cover? For both residential and commercial:

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

U.S. DOE: Code Official's Resource Guide (2010)





www.energycodes.gov

Date visited: 4/22/2012

Contacts Web Site Policies U.S. Department of Energy USA.gov



Michigan Code Status



Michigan Residential Code Status

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	Michigan		Popular Links	
ADOPTION PROCESS STATE TECHNICAL ASSISTANCE	Commercial Residential	Code Change	STATE RELATED RESOURCES	
	Current Code	2009 IECC with Amendments		
STATUS OF STATE ENERGY CODE	Amondmonts /	2009 Residential MI Uniform	PROGRAM AND INCENTIVES	
COMPLIANCE	Additional State Code Information	Energy Code Rules	Financial Incentives P	
REGULATIONS RESOURCE CENTER	Approved	Can use REScheck	STATE CONTACTS	
	State Specific Research	Impacts of the 2009 IECC for Residential Buildings in the State of Michigan (BECP Report, Sept. 2009)	Primary Contact for State Adoption Irvin J. Poke Director Bureau of Construction Codes Department of Labor and Economic Growth P.O. Box 30254	
	Approximate Energy Efficiency	Equivalent to 2009 IECC	(517) 241-9302 pokei@michigan.gov	
	Effective Date	03/09/2011	State Agency Office Head	
	Adoption Date	11/08/2010	John Sarver Department of Energy Labor and Economic Growth	
	Code Enforcement	Mandatory	ihsarve@michigan.gov	
	DOE Determination	2009 IECC: No 2012 IECC: No		

http://www.energycodes.gov/adoption/states/michigan Date visited: 4/22/2013

All state-funded new construction and major renovation

Code Status: Residential



Residential State Energy Code Status AS OF JANUARY 1, 2013



Date visited: 4/22/2013

Michigan Commercial Code Status

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ADOPTION PROCESS STATE TECHNICAL ASSISTANCE STATUS OF STATE ENERGY CODE ADOPTION COMPLIANCE	Commercial	Residential	Code Change	STATE RELATED RESOURCES		
	[Energy Office of Michigan 🗗		
	Current Code		ASHRAE Standard 90.1-2007 with	Midwest Energy Efficiency Alliance &		
	Amendments / Additional State		2009 Commercial MI Uniform Energy Code Rules	PROGRAM AND INCENTIVES		
REGULATIONS	Code Inf	ormation		STATE CONTACTS		
Resource Center	Approved Compliance ToolsState Specific ResearchApproximate Energy EfficiencyEffective DateAdoption DateCode EnforcementDOE Determination		Can use COMcheck	Primary Contact for State Adoption		
			Impacts of ASHRAE 90.1-2007 for Commercial Buildings in the State of Michigan (BECP Report, Sept. 2009)	Director Bureau of Construction Codes Department of Labor and Economic Growth P.O. Box 30254 Lansing, Michigan 48909 (517) 241-9302 pokei@michigan.gov		
			Equivalent to ASHRAE 90.1-2007			
			03/09/2011	State Agency Office Head John Sarver		
			11/08/2010	(517) 241-6280		
			Mandatory	ine an age internation of the		
			ASHRAE 90.1-2007: No ASHRAE 90.1-2010: No			

State Owned / Funded Buildings

Code Status: Commercial



Commercial State Energy Code Status AS OF JANUARY 1, 2013



<u> http://energycodesocean.org/code-status-commercia</u>

Date visited: 2/11/2011

Michigan Code Status



BRARY TOPICS	CODE STATUS COMMUNITY TOOLS BLOG Search GO						
User Login	Home > 2009 Michigan Uniform Energy Code Effective March 9, 2011						
Username: *	2009 Michigan Uniform Energy Code Effective March 9, 2011						
Password: *	Posted in Adoption, Implementation, Michigan Uniform Energy Code, MUEC, Residential, Commercial, Michigan on November 15, 2010 by Paul Karrer						
LOGIN	Rules to update the 2009 Michigan Uniform Energy Code (MUEC), Part 10 (Residential) and Part 10a (Commercial) wer						
	tiled with the Secretary of State on November 8 and will be effective March 9, 2011. The rules will adopt the 2009 IECC with the secret and ASHRAE Standard 00 1, 2007 (the MI IEC is currently based on the 2002 IEC and ASHRAE						
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Create new account	90.1-1999). The new codes were originally approved on July 20 by the Department of Energy, Labor & Economic Growth (DELEG) Bureau of Construction Codes. A web link will be added to the Bureau's web site at www.michigan.gov/bcc, via the Codes and Standards Order Form to allow customers to purchase the code book directly from the International Code Council (ICC) for \$38.00. Books are nov available. <u>More Information</u> : MUEC: Residential & Commercial Bureau of Construction Codes						
Create new account Request new password	90.1-1999). The new codes were originally approved on July 20 by the Department of Energy, Labor & Economic Growth (DELEG) Bureau of Construction Codes. A web link will be added to the Bureau's web site at www.michigan.gov/bcc, via the Codes and Standards Order Form to allow customers to purchase the code book directly from the International Code Council (ICC) for \$38.00. Books are nov available. <u>More Information</u> : MUEC: Residential & Commercial Bureau of Construction Codes **** BCAP Michigan Code Status						

http://energycodesocean.org/news/2010/november/15/2009-michigan-uniform-energy-code-effective-march-9-2011 Date visited: 4/22/2013

2009 Michigan Uniform Energy Code (MUEC)



Providing for Michigan's Safety in the Built Environment



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 408.31059, R 408.31060, R 408.31061, R 408.31062, R 408.31063, R 408.31064, R 408.31065, R 408.31066, R 408.31069, and R 408.31070, of the Michigan Administrative Code are amended, and R 408.31060a, R 408.31060b, R 408.31060c, R 408.31060d, R 408.31060e, and R 408.31063a are added to the Code as follows:

PART 10 MICHIGAN UNIFORM ENERGY CODE

R 408.31059 Applicable code.

Rule 1059. The provisions of the international energy conservation code, 2009 edition, except for sections 102.1.1, 107.2 to 107.5, 301.2, 301.3, 402.3.2, 501.1, to 506.6.2 and Tables 303.1.3(3), 502.1.2, 502.2(1), 502.2(2), 502.3, 502.4.4, 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6), 503.2.3(7), 503.2.8, 503.2.10.1(1), 503.2.10.1(2), 503.3.1(1), 503.3.1(2), 504.2, 505.5.2, 505.6.2(1), 505.6.2, 505.6.2(2), 506.5.1(1), 506.5.1(2), 506.5.1(3), 506.5.1(4), and 506.6.1(5) govern the energy efficiency for the design and construction of residential buildings and, with exceptions noted, the international energy conservation code is adopted by reference in these rules. All references to the international building code. international residential code, international energy conservation code, international electrical code, international existing building code, international mechanical code, and international plumbing code mean the Michigan building code, Michigan residential code, Michigan uniform energy code, Michigan electrical code, Michigan rehabilitation code for existing buildings, Michigan mechanical code, and Michigan plumbing code respectively. -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.

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

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.

Presenters Note: Part 10a dependent on Part 10

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_053lg_muec_commercial_337937_7.pdf

2009 MUEC Residential Program Prescriptive Approach

Training Module

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Micl

School of Planning, Design & Construction

Michigan State University East Lansing, Michigan

Residential Section Overview

- 2009 IECC and MUEC¹
- Compliance Tools¹
- REScheck Software²

¹As adapted from U.S. DOE provided instructional resources on the 2009 IECC with MI amendments

²Based on U.S. DOE RES*check* training case study applied to Michigan climate zone 5





New for the 2009 MUEC

- No longer allows for mechanical system trade-offs
- Drops the Abbreviated Report Form N1107.1
- Requires 50% of the lighting to be high efficacy (refer to definition section)
- Slight modifications to R-values for walls and ceilings
- Adds rigor to air barrier and air sealing requirements
- Adds rigor to inspection criteria
- Above-code programs, such as HERS and Energy Star, not clear

New for the 2009 MUEC

- Michigan amendments are primarily administrative in nature changing the title of the code from the International Energy Conservation Code (IECC) to the Michigan Uniform Energy Code (MUEC)
- Eliminated references to requirements which do not apply to Michigan, such as:
 - Climate zones 1-4
 - SHGC references
- There are some minor technical amendments, such as:
 - Recessed light fixtures installed in insulated ceilings
 - Reductions in R-value for full insulation over wall double-top plate
 - Reroofing under certain limited circumstances

Demonstrate Compliance



Code Compliance Software Tools



Residential Data Collection Checklist 2009/namesoral Cargo Consulton Collection									
TMC.									
Turing New & Advent Continues Rise Arts T									
Barm (Canan Marre P			Phore	Phone Entra-					
Citylane	Nervard Chesamory 14215	1442.5	a El us has	OTING 1AL DISTANCE PROVINCE AREA					
2341	2eMRd.cm								
survive for	Anthe Tone I was Differen Diagnet Digen Fanne Chinasten Chinasten								
statues: DA		Item Number	Foundation Inspection	Code Value	Verified	Y	ompli	N/A	
tarn Narrhar	Pa-Inspectice/Nam Rovies	Ci	FO1 [402.2.8, 303.2] ⁷	Stab edge insutation R-value. Installed per manufacturer's instructions.	Unheated: R-0 Heated: R-5	R-			
[100.8] ¹	Ornetuction dowings and documentation (and/or and available: Doornersation		FO2 [402.2.8]	Stab edge insulation depth/length	Heated: 2 ft.	n.			
190 A)	sufficiently temportrains areing a code contraining a INVAC such calculations INVAC such calculations		FO3 [402.1.1, 303.2]	Basement wall exterior insulation R-value. Installed per manufacturer's instructions	R-5	R			
Cooky system served FO4 Astrony Conversion (402.2		FO4 [402.2.7] ¹	Basement wall exterior insulation depth	10 ft. or to basement floor	n				
-			F05 [402.2.9, 303.21	Crawl space wall insulation R-value, installed per manufacturer's instructions.	R-5 (cont.) R-13 (cavity)	R R			
			FO6 [403 8] ²	Snow melt controls					
			F07	insulation protection					





Structure of the 2009 MUEC Residential

Based on IECC 2009 with Michigan Amendments

- Chapter 1: Administration, Scope, and Application
 - Some MI amendments

• Chapter 2: Definitions

- Mostly untouched, but with amendments to the definition of 'building' and 'code/building officials'
- Chapter 3: Climate Zones
 - Largely replaced by MI amendments adjusting climate zones
- Chapter 4: Residential Energy Efficiency
 - Some detailed MI amendments
- Chapter 5: Commercial Energy Efficiency
 - Replaced by ASHRAE 90.1—2007
- Chapter 6: Reference Standards

Overview of Residential Code Requirements

- Focus is on building envelope
 - Ceilings, walls, windows, floors, foundations
 - Sets insulation levels and window U-factors
 - Infiltration control—caulk and seal to prevent air leaks
- Ducts—seal and insulate
- Limited space heating, air conditioning, and water heating requirements
 - Federal law sets most equipment efficiency requirements, not the I-codes
- No appliance requirements
- Lighting equipment—50% of lamps to be highefficacy lamps

Any non-conditioned space that is altered to become conditioned space shall be required to be brought into full compliance with this code



Part 1: Scope and Application

Section 101: Scope and General Requirements

- Defines scope of the energy code
- Application:
 - New buildings
 - 101.4.1: Existing Buildings
 - 101.4.2: Historic Buildings
 - 101.4.3: Additions, Alterations, Renovations, and Repairs
 - 101.4.4: Changes in Use/occupancy
 - 101.4.5: Changes in Space conditioning
 - 101.4.6: Mixed Occupancies

101.4.3: Additions, Alterations, Renovations, Repairs:

- Conform as relates to new construction
- Unaltered portions do not need to comply
- Additions can comply alone or in combination with existing building

Exceptions:

- -Storm windows over existing fenestration
- -Glass only replacements
- -Exposed, existing ceiling, wall or floor cavities if already filled with insulation
- -Where existing roof, wall or floor cavity isn't exposed
- -Reroofing for roofs where neither sheathing nor insulation exposed
 - -Insulate above or below the sheathing
 - -Roofs without insulation in the cavity
 - -Sheathing or insulation is exposed



- 101.4.3: Exceptions to Meeting Thermal Building Envelope Provisions:
- Very low energy use buildings (<3.4 Btu/h-ft² or 1 watt/ft²)
- Buildings (or portions of) that are neither heated nor cooled
- Existing buildings (Section 101.4.1)
 - Electrical power, lighting, and mechanical systems still apply
- Buildings designated as historic (Section 101.4.2)



101.4.6: Mixed-use Occupancies:

- Treat the residential occupancy under the applicable residential code
- Treat the commercial occupancy under the commercial code





101.5: compliance

Meet the provisions of chapter 4

- 101.5.1: Computer Simulations
- 101.5.2: Low Energy Buildings
 - Exempted if less than 3.4 BTH/hr sf² and buildings without conditioned spaced

Section 102: Alternate Materials—Method of Construction, Design, or Insulating Systems

Not intended to prevent materials, methods, design, or insulating systems not specifically prescribed provided the method has been improved by the code official as meeting the intent

Section 103: Construction Documents

Construction documents, special inspections, structural programs, other data shall meet:

- Submitted in one or more sets with each application for permit
- Prepared by or under direct supervision of a registered design professional when required by 1980 PA 299
- Building official authorized to require additional construction documents for special conditions

103.2: Information on Construction Documents:

Beyond standard plan and detail information for the energy code, documents must show insulation materials, R-values, fenestration U factors, area-weighted U factors, mechanical system design criteria, mechanical and service water heating system and equipment types, sizes and efficiency, duct sealing, duct and pipe insulation, lighting fixture schedule with wattage and controls, air sealing details (see 103.2 for comprehensive list)

Sec103: Construction Documents

- 103.3 through 103.5: Discussion of approvals
Chapter 1: Administration

Section 104: Inspections

Language similar to IRC provisions

Section 105: Validity
Section 106: Reference Standards

Refers reader to Chapter 6

Section 107: Fees (amended by MI)
Section 108: Stop Work Order

Similar to IRC

Section 109: Board of Appeals

- Similar to IRC (amended by MI)

Chapter 2: Definitions

- Largely untouched, but with amendments to definition of 'building' and 'code/building officials'
- Michigan definition of 'Building' excludes agricultural structures not used for retail business
- 'Building Official' references R408.30499

Section 301: Climate Zones

- Replaced by MI amendments adjusting climate zones
- Climate zones taken from figures 301.1, 301.1A and Table 301.1

Presenter's Note: Some counties are now in new climate zones— Upper Peninsula now includes 6A and 7 and some counties have moved to (6A) from former Zone 2

Presenter's Note: The 2003 MUEC is based upon climate zones 1, 2 and 3. The new MUEC re-labels these as 5A, 6A and 7.

U.S. Climate Zones—2009 IECC



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

The State of Michigan is divided into <u>3</u> climate zones:

Zone	Thermal Criteria				
Number	IP Units	SI Units			
5A	$5400 < HDD65^{\circ}F \le 7200$	3000 < HDD18°C≤4000			
<u>6</u> A	$7200 < HDD65^{\circ}F \le 9000$	4000 < HDD18°C≤5000			
7	$9000 < HDD65^{\circ}F \le 12600$	5000 < HDD18°C≤7000			
$E_{ort} C \downarrow 0 C = I/0 E \downarrow 201/4 0$					

Climate Zone Definitions

For SI: °C = [(°F)-32]/1.8

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

Figure 301.1A: Climate Zones



2009 Michigan Uniform Energy Code Figure 301.1a

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf Date Visited: 4/22/2013

Table 301.1: Climate Zones by County

Climate Zones by Co	untv.		
Zones	anty		
64	7		
Alcona	Raraga		
Algor	Chippowe		
Alger	Conobio		
Aperia	Gogebic		
Anum	Houghion		
Arenac	Iron		
Benzie	Keweenaw		
Charlevolx	Luce		
Cheboygan	Mackinac		
Clare	Ontonagon		
Crawford	Schoolcraft		
Delta			
Dickinson			
Emmet			
Gladwin			
Grand Traverse			
Huron			
losco			
Isabella			
Kalkaska			
Lake			
Leelanau			
Manistee			
Marquette			
Mason			
Mecosta			
Menominee			
Missaukee			
Montmorency			
Newaygo			
Oceana			
Ogemaw			
Osceola			
Oscoda			
Otsego			
Presque Isle			
Roscommon			
Sanilac			
Wexford			
	Climate Zones by Cou Zones 6A Alcona Alger Alpena Antrim Arenac Benzie Charlevoix Cheboygan Clare Crawford Delta Dickinson Emmet Gladwin Grand Traverse Huron Iosco Isabella Kalkaska Lake Leelanau Manistee Marquette Mason Mecosta Menominee Missaukee Montmorency Newaygo Oceana Ogemaw Osceola Oscoda Otsego Presque Isle Roscommon Sanilac		

Key: A - Moist. Absence of moisture designation indicates moisture regime is irrelevant.

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

Section 302: Design Conditions

Maximum 72°F heating Minimum 75°F cooling

Section 303: Material Systems and Equipment

303.1: Identification

 Material systems and equipment must be identified in a manner that will allow determination of compliance

303.1.1: Building Thermal Envelope and Insulation

- Identification mark must be applied by the manufacturer to each piece of thermal envelope insulation 12" or greater in width
- Alternatively, the insulation installer shall provide a certification listing the type, manufacturer, and R-value of insulation
- For blown or sprayed insulation, the initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags shall be listed on the certification
- For sprayed polyurethane foam insulation, installed thickness of areas covered, and R-values of installed thickness shall be listed on the certification. Installer must sign, date and post the certification in a conspicuous location

303.1.1: Blow or sprayed roof ceiling insulation

- Thickness of blown and/or sprayed insulation shall be written in inches on markers that are installed at least one for every 300 sf throughout the attic space
- Marker shall be affixed to trusses or joists and marked with a minimum initial installed thickness with numbers a minimum of 1 inch in height



Section 303: Material Systems and Equipment

303.1.2: Insulation Mark Installation

 Insulating material shall be installed such that manufacturer's R-value mark is readily observable upon inspection

Presenter's Note: Because of increased emphasis on compliance, many jurisdictions will go to insulation inspections

303.1.4: Insulation Product Rating

 R-value must be determined in accordance with CFR Title 16 Part 460, May 31st, 2005 at mean temperature 75°F

303.1.4: Insulation Product Rating

- New labeling requirements for fixed wall insulation
 - Compressing cotton, polyester, fiberglass, or mineral wool batts
 - Must have labeling on batt for compressed R-value
- Currently information is on packaging material per FTC requirements





303.1.3: Fenestration Product Rating

- U factors of fenestration products (windows, doors, and skylights) shall be determined in accordance with NFRC 100, labeled and certified
- Product lacking such certification must use default values from Table 303.1.3 (1), 303.1.3 (2)
- For example: a vinyl clad wood double-glazed window without certification would have to use the default U value of 0.55 from Table 303.1.3 (1)

303.1.3: Fenestration Product Rating

 Michigan has added an exception for computer simulations by independent NFRC certified laboratories as an alternative for use of the default values from Tables 303.1.1(1) and 303.1.3(2)

303.2: Installation

- Must be installed in accordance with manufacturer's instructions
- Must be installed in accordance with International Building Code (IBC)

Presenter's Note: MBC and MRC

Chapter 4: Residential Energy Efficiency

401.1: Scope

- Applies to residential buildings
- Commercial buildings covered under the commercial code based on ASHRAE 90.1— 2007 (excludes low-rise residential up to 3 stories)

Section 401: General

401.1: Scope:

- IRC only for single-family, duplex, and townhouses
- IECC has all low-rise (1-3 stories) houses, condos, and apartments [R-2, R-3, R-4], but not hotels/motels [R-1]
- All buildings that are not "residential" by definition are "commercial"

Includes repairs, alterations, and additions

e.g., window replacements





401.2: Compliance

Projects must comply with certain mandatory provisions

- 401.2.4: Air Leakage
- 402.5: Maximum U values: Fenestration
- 403.1: Controls
- 403.2.2: Duct Sealing
- 403.2.3: Building Cavities
- 403.3 through 403.9: referred to as mandatory
- Must comply with either:
 - Prescriptive (402.1 402.3, 403.2.1 and 404.1)
 - Performance (Section 405)

Section 401: General

401.3: Certificate

- Permanently posted on the electrical distribution panel
- Don't cover or obstruct the visibility of other required labels
- Includes the following:
 - R-values of insulation installed for the thermal building envelope including ducts outside conditioned spaces
 - U-factors for fenestration
 - HVAC efficiencies and types
 - SWH equipment

401.3: Certificate (continued)

- If a gas-fired unvented room heater, electric furnace, or baseboard electric heater is installed
 - Certificate lists gas-fired unvented room heater, electric furnace or baseboard electric heater
- No efficiency listed for the above systems

402.1: General Prescriptive

- 402.1.1: Insulation and Fenestration Criteria
- Additions

TABLE 402.1.1 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

				WOOD				SLAB °	CRAWL
				FRAME	MASS			<i>R</i> -	SPACE°
				WALL	WALL	FLOOR	BASEMENT ^b	VALUE	WALL
CLIMATE	FENESTRATION	SKYLIGHT ^a	CEILING	<i>R</i> -	R-	R-	WALL	AND	R-
ZONE	U-FACTOR	U-FACTOR	R-Value	VALUE	VALUE	VALUE	R-VALUE	DEPTH	VALUE
				20 or					
5A	0.35	0.60	38	13 + 5 ^e	13/17	30 ^d	10/13	10, 2ft	10/13
				20 or					
6A	0.35	0.60	49	13 + 5°	15/19	30 ^d	15/19	10, 4ft	10/13
7	0.35	0.60	49	21	19/21	38 ^d	15/19	10, 4ft	10/13

a. The fenestration U-factor column excludes skylights.

b. The first *R*-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
 c. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less, in zones 1-3 for heated slabs.

d. Or insulation sufficient to fill the framing cavity, R-19 minimum.

e. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

f. The second *R*-value applies when more than half the insulation is on the interior.

From DELEG Construction Code Part 10 Michigan Uniform Energy Code

Additions:

- Treat as a stand-alone building
- Additions must meet the prescriptive requirements in Table 402.1.1



402.1.2: R-value Computation

- Insulation components only
- Do not include other building materials or air films

402.1.3: U-Factor Alternative

Maximum U-factors from Table 402.1.3

Climate	Fenestration	Skylight	Ceiling	Frame	Mass wall	Floor	Basement	Crawl
Zone	U -Factor	U-Factor	U-Factor	Wall	U -Factor ^b	U -Factor	Wall	Space
				U -Factor			U -Factor d	Ŵall
								U -Factor ^c
5A	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6A	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065
7	0.35	0.60	0.026	0.057	0.057	0.026	0.050	0.065

Table 402.1.3 Equivalent U-Factors^a

a. Nonfenestration U-factors shall be obtained from measurement, calculation, or an approved source.

b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be the same as the frame wall *U*-factor in Zones 5 to 7.

c. Basement wall U-factor requirements shown in Table 402.1.3 include wall construction and interior air films, but exclude soil conductivity and exterior air films.

d. Foundation *U*-factor requirements shown in Table 402.1.3 include wall construction and interior air films, but exclude soil conductivity and exterior air films. *U*-factors for determining code compliance in accordance with section 402.1.4 (total UA alternative) of section 405 (simulated performance alternative) shall be modified to include soil conductivity and exterior air films.

From DELEG Construction Code Part 10 Michigan Uniform Energy Code

402.1.4: Total UA Alternative

- Use ASHRAE calculation methods
- Includes all building construction, including air films

Demonstrate Compliance: 3 Options



402.2.1: Ceilings with Attic Spaces

- Raised-heel trusses (energy trusses) are allowed to reduce insulation values in climate zones 6 and 7, not in CZ 5
- R-38 is now required in CZ 5

Presenter's note: the code is silent on whether raised-heel trusses would be required in CZ 5, however it is a 'best practice' (BCC will have to determine)

Ceilings:

- Requirements based on:
 - Assembly type
 - Continuous insulation
 - Insulation between framing
- Meet or exceed R-values

Standard Roof Truss



Ceiling insulation code requirements assume standard truss systems

Cold corners contribute to condensation and mold growth

Raised Heel Truss (Energy Truss)



Raised Heel/Energy Truss credit if insulation is full height over exterior wall (*Prescriptive*) – R-38 instead of R-49



402.2.2: Ceilings without Attic Spaces

- Examples:
 - Raftered
 - Some cathedrals without attics, etc.
- Minimum R-30 (maximum 500 sf or 20% of total insulated ceiling, whichever is less)
- Shall not apply to U-factor alternative approach

402.2.3: Access Hatches and Doors

- Full ceiling insulation thickness
- Weather-stripped

Presenter's note: May require special product or rigid board insulation—new thinking on details





402.2.4: Mass Walls

- Defines mass walls as concrete, concrete block, ICF, masonry cavity, brick (other than brick veneer), earth, solid timber/logs
- This definition applies when using Table 402.1.1



Mass Walls:

- Type:
 - Concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth, and solid timber/logs
- Provisions:
 - At least 50% of the required R-value must be on the exterior or integral to the wall
 - When more than half the insulation is on the interior, climate zones 5-7 require the same insulation values as above-grade walls

402.2.5: Steel-frame Ceilings, Walls and Floors

- Steel-frame buildings must meet insulation requirements of Table 402.2.5 <u>or</u> must meet assembly U-factor requirements of Table 402.1.3
- Must use continuous insulation over the framing members
Steel-frame

- Table 402.2.5
 - Addresses steel-frame ceiling, wall, and floor insulation required R-values

402.2.6: Floors

 Floor insulation, when required, must be in permanent contact with the underside of the subfloor decking

Floors over unconditioned space—unheated basement, crawlspace or

OCIMATE ZODES 1-2	R-Value 13
Climateatones	R-Malue
4c-26	30
3 748 b	39
4c-6	30



Insulation must maintain permanent contact with underside of subfloor

Exception: Climate Zones 4c-8 R-19 permitted if cavity completely filled

402.2.7: Basement Walls

- Insulate basements from the top of the wall from 10 ft. below grade or to the basement floor, whichever is less
- Unconditioned basements shall also meet this requirement, unless the floor overhead is insulated

303.2.1: Protection of Exposed Foundation Insulation

- Requires exterior foundation insulation to have a rigid, opaque, weather-resistant protective covering
- Must extend 6" below grade

Bectimatezpaese	Wa R :Va⊉e50%	below grade
1-2	0	
Climate Zones	R-\$VåBue	
4-5	10/13	
6-8	15/19	
4-5	10/13	
6-8	15/19	



Insulated from top of basement wall down to 10 ft below grade or basement floor, whichever is less

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Defining Below-Grade Walls



402.2.8: Slab-on-grade Floors

- Insulate in accordance with Table 402.1.1
- Insulation shall extend from top of slab on outside or inside of foundation wall
- R-5 shall be added when slabs are heated, such as radiant floor slabs

Presenter's note: May be a typographical error in footnote C—BCC needs to clarify

Slab Edge Insulation:

Slabs with a floor surface < 12 inches below grade

- R-10 (typically 2 inches) insulation in Zones 5 and above
- Downward from top of slab a minimum of 24" (Zones 5) and 48" (Zones 6 and 7)
- Insulation can be vertical or extend horizontally under the slab or out from the building (must be under 10 inches of soil)



Slab Edge Insulation



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402.2.9: Crawl Space Walls

- As an alternative to insulating the floor above, crawl space walls may be insulated
- See Table 402.1.1
- Exposed earth floors must have a vapor retarder

Crawlspace Wall Insulation

Unvented Crawlspaces

- Space should be mechanically vented or conditioned (See Section R408 of the IRC)
- Cover exposed earth with a continuous Class I vapor retarder





Vapor Retarders

- Vapor Retarder Class: A measure of the ability of a material or assembly to limit the amount of moisture that passes through that material or assembly.
 - Vapor retarder class shall be defined using the desiccant method with Procedure A of ASTM E-96 as follows:
 - Class I: 0.1 perm or less
 - Class II: 0.1 < perm < 1.0 perm
 - Class III: 1.0 < perm < 10 perm
- **Material vapor retarder class:** The vapor retarder class shall be based on the manufacturers certified testing or a tested assembly.
 - The following shall be deemed to meet the class specified:
 - Class I: Sheet polyethylene, non-perforated aluminum foil
 - Class II: Kraft faced fiberglass batts or low perm paint (paint with 0.1<perm<1.0)
 - Class III: Latex or enamel paint
- **Class III vapor retarders:** Class III vapor retarder shall be permitted where any one of the conditions in Table 402.5.1 are met.

Vented & Unvented Crawlspaces

Vented Crawlspace Requirements:

- The raised floor over the crawlspace must be insulated.
- A vapor retarder may be required as part of the floor assembly.
- Ventilation openings must exist that are equal to at least 1 square foot for each 150 square feet of crawlspace area and be placed to provide cross-flow (*IRC 408.1*, may be less if ground vapor retarder is installed).
- Ducts in crawlspace must be sealed and have R-8 insulation.

Unvented Crawlspace Requirements:

- The crawlspace ground surface must be covered with an approved vapor retarder (e.g., plastic sheeting).
- Crawlspace walls must be insulated to the R-value requirements specific for crawlspace walls (*IECC Table 402.1.1*).
- Crawlspace wall insulation must extend from the top of the wall to the inside finished grade and then 24" vertically or horizontally.
- Crawlspaces must be mechanically vented (1 cfm exhaust per 50 square feet) or conditioned (heated and cooled as part of the building envelope).

402.2.10: Masonry Veneer

Insulation not required on the brick ledge



402.2.11: Sunrooms

Less stringent insulation R-value and glazing U-factor requirements

Sunroom definition:

- Glazing area >40% glazing of gross exterior wall and roof area
- Separate heating or cooling system or zone
- Must be thermally isolated (closeable doors or windows to the rest of the house)



Thermal Barrier

402.2.11: Thermally Isolated Sunroom Insulation

- Minimum ceiling insulation value shall be R-25 for climate zones 5-7
- Minimum wall value shall be R-13 (all zones)
- New or existing walls, windows, and doors separating sunroom from conditioned space shall meet the building thermal envelope requirements

402.3.5: Thermally Isolated Sunroom U-factor

- Windows and door maximum U-factor of 0.5
- Skylight maximum U-factor of 0.75

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Section 402: Building Thermal Envelope

402.3: Fenestration (Prescriptive)

402.3.1: U-factor

 Can use area-weighted averages to satisfy U-factor requirements

402.3.2: SHGC Requirements Deleted by Michigan Presenter's note: SHGC still required for commercial



402.5: Maximum Fenestration U-factor (Mandatory)

- Maximum U-factors for fenestration is 0.48 in CZ 5 and 0.40 in CZ 6 and 7
- Maximum values when using any of the tradeoff approaches 402.1.4 total UA alternative or computer simulations 405

Presenter's Note: Input from later section

Exemption for up to 15 square feet from Table 402.1.1 (does not apply if

Section 402: Building Thermal Envelope

U-factor alternative approach or total UA alternative are used)

402.3.3: Glazed Fenestration Exemption

402.3.4: Opaque Door Exemption

 One side-hinged opaque door assembly up to 24 square feet is exempt from Table 402.1.1 (does not apply if U-factor alternative approach or total UA alternative are used)



Fenestration

An area weighted average of fenestration can be used to satisfy U-factor & SHGC requirements

- Area-weighted average U-factor is subject to hard limits, even in trade-offs
- NFRC rated and certified

Exceptions:

 SHGC does not apply to residential in Michigan



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402.3.6: Replacement Fenestration

• When replacing total windows, must meet U-factor requirements of Table 402.1.1



Presenter's Note: Air leakage requirements are much more elaborate and specific than under previous code

402.4: Air Leakage (Mandatory)

402.4.1: Building Thermal Envelope

- Twelve specific locations:
 - Typical areas, such as doors, windows, utility penetrations
 - Some special areas, such as: common walls between dwelling units, behind tubs and showers on exterior walls, attic access openings
 - See Section 402.4.1 for specific list

Typical air infiltration locations:

- Windows and doors
- Between sole plates
- Floors and exterior wall panels
- Plumbing
- Electrical
- Service access doors or hatches
- Recessed light fixtures
- Rim joist junction



Air Leakage:

- Sealed with caulking materials or
- Closed with gasketing systems
- Joints and seams sealed or taped or covered with a moisture vapor-permeable wrapping material





402.4.2: Air Sealing and Insulation

- Must be demonstrated by one of the following:
 - Testing option (blower door)
 - Visual inspection option

402.4.2.1: Testing option (blower door):

- Maximum 7 ACH at 50 Pa (1 psf)
- Refer to 402.2.1 for specific testing requirements

Presenter's Note: Earlier versions of IECC 2009 listed 33.5 psf—corrected to 1 psf in later versions



402.4.2.2: Visual Inspection Option

- Requires compliance with Table 402.4.2 and verification
- Building Official may require independent third party inspection

Visual inspection component criteria

- Table 402.4.2
 - Air barrier and insulation inspection checklist
 - Provides criteria for components
 - Air barrier and thermal barrier
 - Ceiling/attic
 - Walls
 - Windows and doors
 - Rim joists
 - Floors
 - Etc.

402.4.3: Fireplaces

 New wood-burning fireplaces shall have gasketed doors and outdoor combustion air



402.4.4: Fenestration Air Leakage

- Maximum infiltration rate of 0.3 cfm/sf for sliding doors
- Maximum rate of 0.5 cfm/sf for swinging doors
- NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440
- Must be listed and labeled
- Site-built windows, skylights and doors are *exempt* from the leakage test

Recessed Lighting Fixtures:

- Type IC rated and labeled in a sealed or gasketed enclosure
- Type IC rated and labeled as meeting ASTM E 283
- Sealed with a gasket or caulk between the housing and interior wall or ceiling covering
- Michigan provides for installation of a non-IC-rated fixture in a fire-rated box with insulation over



402.5: Maximum Fenestration U-factor (Mandatory)

Presenter's Note: Covered under earlier fenestration discussion

Equipment *efficiency* set by Federal law, *not* the energy code



Mandatory Requirements:

- Controls
- Heat pump supplementary heat
- Ducts
 - Sealing
 - Insulation (Prescriptive)
- HVAC piping insulation
- Circulating hot water systems
- Ventilation
- Equipment sizing
- Systems serving multiple dwelling units
- Snow melt controls
- Pools

403.1: Controls (Mandatory)

 At least one thermostat for each separate heating and cooling system

403.1.1: Programmable Thermostat

- For forced-air furnaces, at least one programmable thermostat
 - Daily schedule
 - Different temperature set points
 - Temperature setback
 - Initial settings of 70°F heating and 78°F cooling





403.1.2: Heat Pump Supplementary Heat (Mandatory)

 If heat pump is capable of meeting the load, supplementary electric resistance heat is prohibited, *except* during defrost



http://www.sprinterheating.com/how-heat-pump-works.php Date visited: 12/15/2010 107

403.2: Ducts

403.2.1: Insulation (Prescriptive)

- Supply ducts in attics must have R-8 insulation
- All other ducts must have R-6 insulation
- Exception: ducts located completely inside building thermal envelope

Presenter's Note: Highly recommend full envelope insulation over attic ductwork


403.2.2: Sealing (Mandatory)

- All ducts, air handlers, filter boxes and building cavities used as ducts must be sealed in accordance with the Michigan Residential Code (M1604.1)
- Joints of ducts shall be sealed with tapes, mastics, liquid sealants, gasketing, or other approved closure systems

Presenter's Note: BCC will need to confirm based on MRC 2009 (IRC 2009). No duct tape.



Duct Insulation and Sealing :

403.2.1: Insulation (Prescriptive)

- Ducts outside the building envelope: R-8
- All other ducts: R-6

403.2.2: Sealing (Mandatory)

- Joints and seams shall comply with IRC, Section M1601.4.1
- Building framing cavities shall not be used as supply ducts



Residential HVAC: Duct Location

• Ducts in *un-conditioned* space:



Ducts in conditioned space:



 For piping carrying fluids above 105°F or below 55°F, must be insulated to minimum of R-3

403.3: Mechanical System Piping Insulation (Mandatory)

- R-3 required on HVAC systems
 - <u>Exception</u>: Piping that conveys fluids between 55 and 105°F
- R-2 required on
 - All circulating domestic hot water systems
 - Systems also require a readily accessible manual switch

Michigan exceptions:

- Factory-installed piping within HVAC equipment
- Run-out piping 4 ft or less



403.5: Mechanical Ventilation (Mandatory)

 Outdoor intakes and exhaust must have automatic or gravity dampers



403.6: Equipment Sizing (Mandatory)

- Heating and cooling equipment must be *sized* in accordance with the International Residential Code
- Load calculations determine the proper capacity (size) of equipment
 - Goal is big enough to ensure comfort but no bigger
- Calculations shall be performed in accordance with ACCA Manual J or other approved methods

Presenter's Note: Should refer to MRC, not IRC



403.7: Systems Serving Multiple Dwelling Units (Mandatory)

Presenter's Note: Michigan has deleted sections 503 and 504—BCC to verify

403.8: Snow Melt Systems (Mandatory) Snow- and ice-melting system controls

 pavement temperature > 50°F and no precipitation is falling and when the outdoor temperature is > 40°F



403.9: Pools (Mandatory)

- Pools shall be provided with energy conserving features
 - Pool heater requirements
 - Time switch requirements
 - Pool cover requirements



404.1: Lighting Equipment

Minimum of 50% of lamps shall be high efficacy

T8 or smaller diameter

- > 40 watts: 60 lumens per watt
- 15-40 watts: 50 lumens per watt
- < 15 watts: 40 lumens per watt

Section 405: Simulated Performance Alternative (Performance)

- Provides for computer simulation as an alternative to the prescriptive approach
- Requires computer software with specified capabilities (local official may approve other tools)
- Includes both envelope and equipment
- Allows greatest flexibility—credits features such as:
 - High efficiency furnaces, air-conditioners, etc.
 - Tight ducts (must be leak tested) or hydronic systems
 - Exterior shading, favorable orientation, thermal mass, SHGC, etc.
- Section 405 specifies "ground rules"
 - These will generally be "hidden" in compliance software calculation algorithms
 - Very similar ground rules are used in home federal tax credits and ENERGY STAR Home guidelines

Simulated Performance Alternative

Software Options:

http://www.nrel.gov/analysis/models_tools.html







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Residential Energy Code Compliance and Implementation Tools *Training Module*





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ARRA 2009 = American Recovery and Reinvestment Act of 2009 (The Recovery Act)

Target Codes:

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

90% compliance within 8 years One time demonstration of 90% compliance required

Measuring State Energy Code Compliance Report. PNNL for U.S. DOE. (2010)

Compliance Evaluation



http://www.energycodes.gov/compliance/evaluation/checklists

Ĉ	Score	+Sto	ore	2009 Interna	Residential Da tional Energy Conse	ta Coll	lection Checklist Code Climate Zone 5
Building ID:		Date:I	Name of Evaluato	r(s):			
Building Cont	tact (optional): Name:	P	hone:		Email:	_	
Building Nam	ie:	Address:			Conditioned Flo	or Area:	ft ²
Subdivision:			Lot #:			IECC Section #	Pre-Inspection/Plan Review
State:	County:		Jurisdiction	n:		103.2	Documentation. Determine if a complete set of plans/construction drawings, specifications,
Compliance A Compliance S	Approach (check all that apply): [Software Used:	Prescriptive	Trade-C)ff le Program:	Performan	[ber].	and energy code compliance documentation is available in the building department and sufficiently documents envelope compliance. If there is no building department or the locality does not conduct plan review, this information should be obtained from the registered design professional or builder having responsibility for the project. If
Building Type	e: 1-and 2-Family, Detached: [Multifamily: []1-and 2-Family Dwe]Apartment	ellings 🗌 Modular 🗌 Condon	ninium	Townhous		documentation indicating a trade-off or performance approach is not provided, a prescriptive approach must be assumed for verifying compliance. Construction documents should sufficiently demonstrate energy code compliance with the building envelope, including but not limited to the following information: • The location and R-values of insulation materials
Foundation T Project Type:	ype: Basement [New Building]]Slab]Existing Building Ac	Condition	oned Crawl Space Building Renovatio	Floor Over		U-factors and SHGC values for windows, doors, skylights, and other fenestration products Under the assumption that only state or local government with a responsible enforcement
2009 IECC Section #	Pre-Inspection/Plan Review	Prescriptive Code Value	Plans Verified Value	Field Verified Value	Complies?		and/or permitting agency are included in compliance evaluations, plans and documentation are expected to be held by the responsible agency. If this is not the case, mark all Plan Review code requirements as non-compliant, unless there is another entity responsible for enforcement identified (e.g. utility, contractor licensing board, etc.) in which case they
103.2 [PR1] ¹	Construction drawings and documentation sufficiently demonstrates energy code compliance for the building envelope.				Complies Does Not Comply Not Observable Not Applicable	103.2, 403.7 [PR3] ¹	should be contacted to review this information. In rare cases where there is no jurisdictional oversight and builders self-certify, this requirement can be marked N/A. Documentation . Determine if a complete set of plans/construction drawings, specifications, and energy code compliance documentation is available in the building department for determining lighting and mechanical system compliance. Construction documents should demonstrate energy code compliance with the building lighting and mechanical systems.
103.2, 403.7 [PR3] ¹	Construction drawings and documentation sufficiently demonstrates energy code compliance for lighting and mechanical systems. Systems serving multiple dwelling units must demonstrate compliance with the commercial code.				Complies Does Not Comply Not Observable Not Applicable		including but not limited to: Information related to duct and piping location, insulation type and R-value, and means of sealing Mechanical systems serving multiple dwelling units must demonstrate compliance with the commercial provisions in Sections 503 and 504 of the 2009 IECC instead of Section 403. If there is no building department or the locality does not conduct plan review, this information should be obtained from the registered design professional or builder having responsibility for the project. Documents should sufficiently demonstrate energy code
403.6 [PR2] ²	Heating and cooling equipment is sized per ACCA Manual S based on loads per ACCA Manual J or		Heating: Btu/hr	Heating: Btu/hr	Complies	402.5	compliance for lighting and mechanical systems, including but not limited to information related to duct and piping location, duct and pipe insulation type and R-value, and means of sealing.
	other approved methods.	-	Cooling: Btu/hr	Cooling: Btu/hr	Not Applicable	403.6 [PR2] ²	HVAC Equipment Correctly Sized. Verify that HVAC equipment is correctly sized according to ACCA Manual 5 based on building loads calculated according to Manual J or other approved methods. Verify the methodology used in the load calculations. List the resultant heating and/or cooling acuitment capacities as anonicable in the Black Verified Value
Additional Co	omments/Assumptions:						column



Building Energy Codes Resource Guide: *Code Officials Edition*

View or download: <u>http://www.energycodes.gov/resource-</u> center/resource-guides

- 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

Residential Evaluator Training. Building Energy Codes University. (2010)

BUILDING ENERGY CODES

PNNL Survey:

U.S. DEPARTMENT OF

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- Better understand compliance rates
- Jurisdictional practices

Energy Efficiency &

Renewable Energy

- Identify training needs
- Attempt to coordinate best practices with measured compliance rates
- Confidential results



Taking a Pulse of Building Efficiency Evaluating compliance will help identify energysaving code provisions that aren't being successfully implemented in buildings. This will allow less energy to "slip through the cracks"—lowering both costs to building owners and greenhouse gas emissions.



Please review the survey and gather the needed information before continuing.

Questions About Your Jurisdiction

Jurisdictional information		
Agency name:		
Jurisdiction served:	(Click here for choices)	•
Other jurisdiction not listed above (please s	pecify):	
Estimate of the population served:	1	

https://survey.pnl.gov/se.ashx?s=4D1929A5207AB413 Date visited: 4/22/2013

REScheck Compliance Software *Training Module*





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Demonstrate Compliance



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00000	Energy 2030 Report Calls for Stricter Energy Building Codes © Source: Energy Menager Todey, posted: 02.12.2013 2013 California Building Standards Code Adopted © Source: Business Wire, posted: 01.29.2013
FEATURED RESOURCES	 Model Progressive Building Energy Codes Policy P Source: Northeast Energy Efficiency Partnerships, posted: 12.13.2012
Advanced Energy Design Guides	A CALIFORNIA AND AND A CALIFORNIA

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www.energycodes.gov Date visited: 4/22/2013

Compliance Report





Inspection Checklist

Ceilings'



Generated by REScheck-Web Software

Checklist Allows Code Official to Verify Individual Building Components

cennigs.	
Celling: Raised or Energy Truss, R-38.0 cavity insulation Comments:	
Insulation must achieve full height over the plate lines of exterior walls.	
Above-Grade Walls:	
Exterior Wail 1: Wood Frame, 16in. o.c., R-19.0 cavity insulation Comments:	
Ext. Wall 2 South: Wood Frame, 16In. o.c., R-19.0 cavity insulation Comments:	
Ext. Wall 3 East: Wood Frame, 16in. o.c., R-19.0 cavity insulation Comments:	
Ext. Wall 4 West: Wood Frame, 16in. o.c., R-19.0 cavity insulation Comments:	
Knee Wall West: Wood Frame, 16in. o.c., R-19.0 cavity insulation Comments:	
Knee Wall East: Wood Frame, 16in. o.c., R-19.0 cavity insulation Comments:	

Energy Features Certificate



2009 IECC Energy Efficiency Certificate

Insulation Rating	R-Value	
Ceiling / Roof	38.00	
Wall	19.00	
Floor / Foundation	30.00	
Ductwork (unconditioned spaces):		
Glass & Door Rating	U-Factor	SHGC
Window	0.35	0.15
Door	0.50	NA
Heating & Cooling Equipment	Efficiency	
Heating System:		
Cooling System:		
Water Heater:		
Name:	Date:	

Certificate Posted at Electrical Panel to Identify Primary Building Components

Name of Building Inspector and Date of Final Inspection

Comments:

Bob White

FI12 [401.3]² Certificate posted

COM*check* Software



COMcheck software also available for commercial projects:

http://www.energycodes.gov/comcheck/

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uilding	Energy Codes Program	Building Energy Codes
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	COMcheck	
LIANCE	Commercial Compliance Using COMcheck™	SUBSCRIBE TO UPDATES
lics	The COMcheck product group makes it easy for architects, builders, designers, and contractors to determine whether new commercial or high-rise residential buildings,	To receive updates about compliance tools
IPLIANCE LUATION	additions, and alterations meet the requirements of the IECC and ASHRAE Standard 90.1 as well as several state-specific codes. COMcheck also simplifies compliance for	Superior to the DEEP maning List E1.
TWARE & WEB	building officials, plan checkers, and inspectors by allowing them to quickly determine if a building project meets the code.	a
LATIONS	COMcheck Desktop can be downloaded and installed directly to your desktop, while COI website without baying to download and install	Mcheck-Web [™] is accessible directly from the
URCE CENTER	See if your state or county can use COMcheck to show compliance.	
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2009 MUEC Prescriptive Approach *Envelope Training Module*





UNIVERSITY

School of Planning, Design & Construction

Michigan State University East Lansing, Michigan

ASHRAE 90.1—2007 Download





ASHRAE 90.1—2007 available for download at a discounted rate made possible by the U.S. Dept. of Energy: American Society of Heating, Refrigerating

and Air-Conditioning Engineers. Inc. 791 Tutle Circle NE, Americ, GA 30729

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

Code Compliance Software Tools



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

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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

Purpose (Section 1)

- To provide minimum requirements for the energyefficient 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 Btu/h-ft² (1 watt/ft²) OR
 - if cooled by a cooling system with a sensible output capacity $\geq 5~Btu/h\text{-}ft^2$
- 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

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)

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 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

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

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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)

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

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Building Envelope



(Figure 5.5)

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

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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

Climate Zones—ASHRAE 90.1—2007



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2009 MUEC Climate Zones

The State of Michigan is divided into <u>3</u> climate zones:

Table 301.3(2) Climate Zone Definitions

Zone	Thermal Criteria	
Number	IP Units	SI Units
5A	$5400 < HDD65^{\circ}F \le 7200$	3000 < HDD18°C≤4000
6A	$7200 < HDD65^{\circ}F \le 9000$	4000 < HDD18°C≤5000
7	9000 < HDD65°F≤12600	5000 < HDD18°C≤7000
For SI: °C = [(°F)-32]/1.8		

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

Figure 301.1A: Climate Zones



2009 Michigan Uniform Energy Code Figure 301.1a

http://www.michigan.gov/documents/dleg/dleg bcc 2007 052lg muec residential 337936 7.pdf

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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)

	4-Story Building
7 foot Minimum	Self-Closing Doors

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Air Leakage - Vestibule Exceptions (Section 5.4.3.4)

- Non-entrance doors
- Building entrances with revolving doors
- Buildings < 1000 ft² in climate zones 5-8
- All doors that open from spaces < 3000 ft² (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

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 <u>or</u> insulation minimum R-values
- Fenestration
 - Vertical Glazing and Skylights
 - Assembly maximum U-values <u>or</u> 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



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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 <u>single</u> class of construction for a <u>single</u> space-conditioning category

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



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no longer allowed

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 Ufactors 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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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 semiheated 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



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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.)





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



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

Suspended Ceilings

Roof Insulation:

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



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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-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

Lighting Compliance



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: Spaceby-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

Basic Lighting Requirements



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 ≤ 10,000 ft², each control serves 2500 ft² maximum and in spaces > 10,000 ft², serves 10,000 ft² maximum
- Readily accessible to occupants
- Remote location is allowed to accommodate areas where safety or security is a concern



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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



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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)







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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

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)



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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)

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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



EXTERNATION OF THE SAME AND THE

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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



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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

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:		
Applications	Lighting Power Densities	
Tradable Surfaces:		
Uncovered Parking Areas		
Parking lots and drives	0.15 W/ft ² (12 fc @ 80 L/W)	
Building Grounds		
Walkways less than 10 feet wide	1.0 W/linear foot	
Walkways 10 feet wide or greater, Plaza areas and Special feature areas	0.2 W/ft ² (16 fc @ 80 L/W)	
Stairways	1.0 W/ft ²	

U.S. Department of Energy (2010)

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

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

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 glassenclosed refrigerator and freezer cases
- Retail display windows, provided the display is enclosed by ceilingheight partitions
- Food warming and food preparation equipment
- http://www.energycodes.gov/becu/trainers.stm

- 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

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 multioccupancy 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

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



U.S. Department of Energy (2010)

Building Area Allowances

Table 9.5.1

Presenter's note: () = 1999 ASHRAE 90.1 values

Building Type	Lighting Power Density (W/ft ²)
Court House	1.2 (1.4)
Dining: Bar Lounge/Leisure	1.3 (1.5)
Dining: Cafeteria/Fast Food	1.4 (1.8)
Dining: Family	1.6 (1.9)
Dormitory	1.0 (1.5)
Exercise Center	1.0 (1.4)
Office	1.0 (1.3)

U.S. Department of Energy (2010)

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)

Space-by-Space LPD

Table 9.6.1

Presenter's note: () = 1999 ASHRAE 90.1 values

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

U.S. Department of Energy (2010)

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.





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Code/Location	Building Use			
Code: 90.1 (2007) Standard	Building Area Method I Area Category (Space-By-Space) Method			
State: Michigan 👻	Add Area Category			
City: EastLansing -				
If your location is not included here, choose a nearby location with similar weather conditions	Area Category Area Descriptic			
	1 Unknown Category			
Project Type				
New Construction Addition Alterations				
Semiheated Building (all spaces are semiheated with no cooling)	۰ m ب			
Project Details (optional)	Total Area: 0			
This information will appear on the compliance report.	Exterior Lighting Areas			
Notes:	Add Exterior Area			
	Exterior Lighting Area Area Description Quantity			

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Envelope - Typical Wall Section

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Identifies assembly type and insulation R-value

Wall Assembly:

- Steel Frame
- 16" oc
- R21 Cavity Insulation

Roof Assembly:

- Single membrane
- R30 Continuous Insulation

Envelope – COMcheckTM Exterior Wall Component Inputs

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efi	ine Assembly, Co	onstruction Detai	ls, Gross	Area ar	id i	nsulati	on R-va
File	Case Study eck - COM her Edit View Options Code	ek 3.8.0 Cadae i Help	2009 1866				
C				1		1	
Pr	roject Envelope Inter	ior ighting Exterior Lig	ting Mecha	nical Floor		1	
	Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value
	Building				-		-
-	Roof 1	Insulation Entirely Above 💌		11570	ft2		30.0
2	🖨 Front Exterior Wall	Steel-Framed, 16" o.c. 🔄		6075	ft2	21.0	0.0
3	Window 1	Metal Frame with Therma 💌	Glazing: Ti 💌	2185	ft2		
4	Storefront Window	Metal Frame:Double Pan 💌	Glazing: Ti 💌	46	ft2	-	
5	Entrance Door	Slags (> ER% glazing) M	Type: Ent	77	ft2		
6	Back Exterior Wall	Steel-Framed, 16" o.c.		6075	ft2	21.0	0.0
7	- Window 1	Metal Frame with Therma 💌	Glazing: TI 💌	2183	ft2		
8	Storefront Window	Metal Frame:Double Pan 💌	Glazing: Ti 💌	27	ft2		
9	Entrance Door	Glass (> 50% glazing):M 💌	Type: Entr 💌	47	ft2		

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- 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

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- Building Official
- Plans Examiner or Special Plans Examiner
- Inspector or Special Inspector

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

Designer/Contractor: Designs Are Us 1453 McMinnion Street Park City, UT 99422

HVAC Compliance



HVAC Alterations (Section 6.1.1.3)

- Equipment New equipment shall meet the minimum efficiency requirements (Section 6.1.1.3.1)
- Cooling Systems
 - New cooling systems installed to serve previously uncooled spaces shall comply with this section (Section 6.1.1.3.2)
 - Alterations to existing cooling systems shall not decrease economizer capacity (unless economizer tradeoff is used) (Section 6.1.1.3.3)
 - **Ductwork** New and replacement ductwork shall comply with applicable requirements (Section 6.1.1.3.4)
- **Piping** New and replacement piping shall comply with applicable requirements (Section 6.1.1.3.5)

HVAC Alterations (Section 6.1.1.3)

- Alterations to the building HVAC system shall comply with the requirements of Section 6
- Exceptions that are allowed:
 - Equipment being modified or repaired (not replaced)
 - Provided such modifications will not result in an increase in the annual energy consumption
 - Equipment being replaced or altered which requires extensive revisions to other systems and such replaced or altered equipment is a like-for-like replacement
 - Refrigerant change of existing equipment
 - Relocation of existing equipment
 - Ducts and pipes where there is insufficient space or access to meet these requirements

HVAC Compliance Paths

(Section 6.2.1)

You have to follow Sections

- 6.1 General,
- 6.7 Submittals, and
- 6.8 Minimum Equipment Efficiency,
- And then you can follow either
 - Section 6.3 Simplified Approach OR
 - Sections 6.4 Mandatory Provisions and 6.5 Prescriptive Path

Alternatively, you can follow Section 11 (ECB), in which case Section 6.4 is mandatory (Section 6.2.2)

Completion Requirements (Section 6.4.5)

- Refers to Section 6.7 for Submittal and Completion Requirements including
 - Record drawings (Section 6.7.2.1)
 - Operating and maintenance manuals (Section 6.7.2.2)
 - System balancing (Section 6.7.2.3)
 - System commissioning (Section 6.7.2.4)



U.S. Department of Energy (2010)

Prescriptive Requirements



U.S. Department of Energy (2010)

SWH Compliance



Service Water Heating (Section 7)

- General (Section 7.1)
- Compliance Path(s) (Section 7.2)
- Mandatory Provisions (Section 7.4)
 - Load calculations
 - Equipment efficiency
 - Service hot water piping insulation
 - System controls
 - Pools
 - Heat traps
- Prescriptive Path (Section 7.5)
 - Space heating and water heating
 - Service water heating equipment
- Submittals (Section 7.7)



U.S. Department of Energy (2010)





Power (Section 8)

- Voltage drop (Section 8.4.1)
- Submittals (Section 8.7)





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)



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 - No internet connection required
 - Must check for updates
 - COMcheck package generator
 - Design your own code-compliant insulation and window packages based on regional requirements





Before Using COM*check*, You Will Need:

- Basic understanding of Windows-based programs
- Basic information about the builder and building to be constructed
- Plans including:
 - Areas of exterior walls, glazing, roof/ceiling, basement walls, doors, crawl walls and floors
 - R-values, U-values, wall heights and insulation depths
 - Heating and cooling system efficiencies

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It performs just like <u>COM*check*</u>, the desktop version, but you don't need to download or install any software on your computer.

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Code/Location	Building Use	
Code: 90.1 (2007) Standard 🔹	Building Area Method Area Category (Space-By-Space) Method	
State: Michigan 👻	Add Area Category Sedit Delete	
City: East Lansing	Area Category Area Description Area W/tt ²	
If your location is not included here, choose a nearby location with similar weather conditions.		
Project Type		
New Construction Addition Alterations		
Space Conditioning Type(s)		
🗵 Nonresidential 🔲 Residential 🔲 Semiheated 🎯	Total Area: 0	
Project Details (optional)	Exterior Lighting Areas	
This information will appear on the Edit Project Details		
compliance report.	Add Exterior Area	
Notes:	Exterior Lighting Area Area Description Quantity W/Unit Tradable	
	Select Area Type	-

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Designer/Contractor: Designs Are Us 1453 McMinnion Street Park City, UT 99422



Step 2: Verify the Building Type or Activity Type(s) and Floor Area match the project type. Verify the floor area does not exceed the project floor area shown on the building plans. Single occupancy buildings should always use Whole Building Method unless each Activity Type within the building is identified separately.



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Step 3: Verify the exterior building thermal envelope complies with the code by +0% or greater. Step 4: Verify the construction assemblies listed under Component Name/Description match the construction assemblies shown on the plans. Step 5: Verify the Gross Area or Perimeter values represent the proposed project. Verify the fenestration is calculated correctly (rough opening).

Section 3: Requirements Checklist

			•		
nvelope PASSES: Design 0.4% better than code.					
Climate-Specific Requirements:					
Component Name/Description	Gross A or Perin	rea Cavity eterR-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof 1: Insulation Entirely Above Deck	11570		30.0	0.032	0.048
Front Exterior Wall: Steel-Framed, 16" o.c.	6075	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	2185	-		0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	46	-		0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47			0.800	0.800
Back Exterior Wall: Steel-Framed, 16" o.c.	6075	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	2183	-		0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	27	-		0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	-		0.800	0.800

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0.800
6 0.064
0 0.550
0 0.550
0.800
8 0.064
0 0.550
0 0.550
0.800

Step 6: Verify the insulation R-values shown on the building plans meet or exceed the values in the Cavity R-Value and Continuous R-Value section. Verify the insulation will fit uncompressed in the framing cavity. Continuous R-values are for insulation installed over the face of framing; insulation installed with no thermal breaks.

Step 7: Verify the fenestration and door U-Factors shown meet or exceed what is provided on the building plans. If shown, SHGC and Projection Factor (PF) should also be verified.



Air Leakage, Component Certification, and Vapor Retarder Requirements:

1. All joints and penetrations are caulked, gasketed or covered with a moisture vapor-permeable wrapping material installed in accordance with the manufacturer's installation instructions.

2. Windows, doors, and skylights certified as meeting leakage requirements.

3. Component R-values & U-factors labeled as certified.

4. No roof insulation is installed on a suspended ceiling with removable ceiling panels.

5. 'Other' components have supporting documentation for proposed U-Factors.

6. Insulation installed according to manufacturer's instructions, in substantial contact with the surface being insulated, and in a manner that achieves the rated R-value without compressing the insulation.

7. Stair, elevator shaft vents, and other outdoor air intake and exhaust openings in the building envelope are equipped with motorized dampers.

8. Cargo doors and loading dock doors are weather sealed.

9. Recessed lighting fixtures installed in the building envelope are Type IC rated as meeting ASTM E283, are sealed with gasket or caulk.

10. Building entrance doors have a vestibule equipped with closing devices.

Exceptions:

Building entrances with revolving doors.

Doors that open directly from a space less than 3000 sq. ft. in area.

Section 4: Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2009 IECC requirements in COMcheck Version 3.8.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title	Signature	Date
Project Notes:		
Core and Shell Example. Energy Co core area.	de Compliance is for the building envelope, mechani	ical system and lighting for the Floor 1 finished out
Step 8: 0 Doors, an should be will be me	Checklist items: Insulation, Fenestration ad Air Leakage and Component Certifica reviewed to ensure these mandatory requ t or are exempt (not applicable). For exam- currentation as to what has a martificity is re-	and ation irements mple,

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Target Audience: State Officia

Code Version: ASHRAE Standard 90.1, International Energy Conservation Code (IECC)

This webcast targets state energy organizations interested in implementing an energy code compliance study in their state, provides guidance for partnering with local jurisdictions, describes the BECP procedures, and demonstrates the tools available...

International Energy Conservation Code (IECC) (14) ASHRAE Standard 90:1 (11) Model Energy Code (MEC) (1)

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Energy Codes YouTube Channel



Energy Efficiency & Renewable Energy



http://www.youtube.com/user/EnergyCodes Date visited: 4/23/2013



Energy Efficiency & Renewable Energy

Building Energy Codes 101 Training Manual



http://www.energycodes.gov/sites/default/files/becu/BECU_Codes_101_Training_Manual.pdf Date visited: 4/30/2013

ASHRAE 90.1—2007 Download





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

Date visited: 4/22/2013

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00000	Energy 2030 Report Calls for Stricter Energy Building Codes & Source: Energy Manager Today, posted: 02.12.2013 2013 California Building Standards Code Adopted & Source: Energy Manager Today, posted: 01.2013
FEATURED RESOURCES	 Model Progressive Building Energy Codes Policy P Source: Northeast Energy Efficiency Partnerships, posted: 12.13.2012
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Contacts Web Site Policies U.S. Department of Energy USA.gov

www.energycodes.gov Date visited: 4/22/2013

Building Codes Assistance Project











http://energycodesocean.org/ Date visited: 4/30/2013

BCAP: OCEAN





http://energycodesocean.org/code-status Date visited: 4/30/2013

BCAP: OCEAN





http://energycodesocean.org/why-energy-codes-matter Date visited: 4/30/2013

BCAP: OCEAN





Energy efficiency is in! But as demand for more stringent energy codes grows, so does the complexity of the codes process, and the need for a broad coalition of stakeholders. For anyone new to codes, simply identifying the many actors involved can be a daunting task, much less finding opportunities for involvement. Even veteran code experts must stay up-to-date with the changing landscape.

To help make sense of it all, BCAP is proud to introduce the Energy Codes Universe!

Disclaimer: The intent of this resource is to include all participants in the energy codes process. However, BCAP acknowledges the possibility of excluding deserving organizations. All omissions are inadvertent. If you believe that your organization merits recognition in the Energy Codes Universe, please contact us at bcap-ocean@ase.org.



ASHRAE Training Resources



About ASHRAE + Contact Us + News Join or Login 🤝 ASHRAE Shaping Tomorrow's Built Environment Today Search on Ashrae Need technical info? Search ASHRAE's Bookstore > Standards, Research Education & Membership Resources & Government Society Publications & Technology Certification Affairs Groups & Conferences Education & Certification Share this page 😽 💟 🖂 🚍 Home | Education & Certification CERTIFICATION ASHRAE ELEARNING SELF-STUDY Certification Available individually or **Don't Let Your Certification** ASHRAE's Self-Directed Online Learning Expire. Renew CPMP, OPMP. through a subscription-based Learning provides two ways to library learn ASHRAE's certification programs 2013 Denver Annual Web-based ASHRAE eLearning Individuals can learn at their own are developed by industry Conference Courses practitioners who understand the courses are on-demand and ideal pace from the comfort of home. knowledge and experience that for individual and corporate Groups such as companies or Course Schedule are expected for superior building training. Learn key skills and ASHRAE Chapters can schedule design and system operation. practical applications to earn training to suit their needs. Self-Directed or Group Learning PDHs/CEUs. Instructor-Led Courses 2013 Courses Catalog - Dates, Times, and Course Descriptions for 2013 ASHRAE Courses at Industry Events Workshops ASHRAE Learning Institute ASHRAE Chapter Courses The ASHRAE Learning Institute (ALI) offers a wide range of professional development seminars and short ASHRAE In-Company courses. ALI seminars and courses provide high-quality, authoritative and credible technical information, with all Courses content developed through ALI's peer-review process.ALI instructors are ASHRAE Members, college or university faculty, and/or full-time professional engineers. Learn More >

https://www.ashrae.org/education--certification/ Date visited: 4/30/2013

ICC Training Resources



ICC's education and certification offerings are a valuable resource for construction-related professionals. Code officials, building inspectors, design professionals, and more, look to ICC to provide the critical skills and knowledge necessary to excel in today's challenging construction world. ICC's education programs cover a broad spectrum of code and construction related topics. ICC can provide seminars nationwide and also has a growing online offering. ICC's certification and testing programs offer Internationally recognized credentials as well as regional and speciality testing programs that validate knowledge and skills across a variety of professions, job roles and disciplines.

Education

Whether you want to build your skills and knowledge, stay on the leading edge of code development, or prepare for your next certification exam, ICC's training programs are designed for maximum impact and results. Explore your training options below.

- Course information
- Online Training
- Webinars

Certification & Testing

ICC develops and administers certifications and testing programs for code and construction professionals at the national. state, and municipality levels. Explore your certification options below

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Online Training

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News and Information

Exam Information and Registration

Forms and Applications

Feedback and Appeals Certification Renewal

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- Government Relations
- Chapter Information
- Scholarships
- ICC Evaluation Convinc
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- Contractor/Trades Testing
- Specialty Programs
- UST/AST Certification
- Certification Renewal





pecial Inspector Certification **Renewal Seminars** Discover what's new in the 2012 IBC and earn CEUs in a unique

Training Workshops



BEST3 Conference 2012

http://www.nibs.org/?page=best3

Efficiency Vermont 2011 Conference Presentations

http://www.efficiencyvermont.com/for_our_partners/bbd/conference_schedule/ schedule.aspx

Greenbuild International Conference and Expo

http://www.greenbuildexpo.org/Home.aspx



For a list of upcoming energy related conferences, workshops and events:

U.S. DOE: Energy Information Administration: http://www.eia.gov/calendar/meetings.cfm





Michigan Bureau of Construction Codes (BCC):

http://www.michigan.gov/lara/0,4601,7-154-35299 10575---,00.html

Michigan Energy Office (MEO):

http://www.michigan.gov/mdcd/0,1607,7-122-25676---,00.html

Energy Efficiency for Small Businesses:

http://www.michigan.gov/documents/CIS EO Small Businesses Guide 94204 7.pdf

Energy Star Homes Brochure:

http://www.michigan.gov/documents/cis/CIS_EO_EnergyStarHome_Brochure_193355_7.pdf

Home Maintenance and Operations:

http://www.michigan.gov/documents/CIS_EO_Home_Maintenance_Tips_94189_7.pdf



Energy Star is a governmentbacked program helping businesses and individuals protect the environment through superior energy efficiency



For more information: <u>http://www.energystar.gov/</u>

Energy Star Program





www.energystar.gov Date visited: 4/30/2013

Video Resource: Weatherization TV



http://wxtvonline.org/ Date visited: 4/30/2013

U.S. Green Building Council (USGBC)



State of California: Title 24 Code Training



Home · title24

Building Energy Efficiency Program

The Energy Commission's energy efficiency standards have saved Californians more than \$74 billion in reduced electricity bills since 1975, <u>Read more ...</u>

2008 Standards

- » Standards (PDF file)
- » Residential Compliance Manual
- » Nonresidential Compliance Manual
- » California Climate Zone Map
- >> HVAC Changeout

2013 Standards Effective January 1, 2014

» Rulemaking

» Pre-Rulemaking

Past Standards

Blueprint Newsletter

Educational Resources

Financing Opportunities

Enforcement



Go To

- » Energy Efficiency in Existing Buildings (AB 758)
- » Commercial Building Energy Use Disclosure (AB 1103)
- » Solar Reflectance Index (SRI) Calculator
- » Outdoor Lighting Zones
- » Computer Compliance Programs
- » Local Ordinances
- » Special Cases and Compliance Options
- » Subscribe to Listserv
- » Get Additional Help

http://www.energy.ca.gov/title24/ Date visited: 4/30/2013

City of Seattle: DIY Energy Audit



http://www.seattle.gov/dpd/static/DIYweb_LatestReleased_DPDP016083.pdf Date visited: 4/30/2013

Code college network





CLICK ON ANY OF THE HIGHLIGHTED STATES

The Code College Initiative is designed to address the building and energy code and building science training needs of the building industry, including code officials, state agencies, builders, and trade groups across the nation. Code College presents objective, industry-sponsored online training from national experts that brings the audience to the field with our "online jobsite" approach available 24/7 for the ultimate convenience of the building professional.



Learn more about....

Advertising on the Code College Network

Want to reach 1000's of people in the construction industry with information about your product? BCAP's Cosimina Panetti explains the concept behind the code college network and highlights the many reasons why product manufacturers and industry professionals should take advantage of this exceptional marketing venue. Double click on the video for a full scene version of this 3 minute video.

http://www.codecollegenetwork.com/ Date visited: 4/30/2013

CCN: Video Training Series



Code College On-line Training



Code College Online Video Training Offerings

To watch a video, click on thumbnails.

RESIDENTIAL VIDEOS

BUILDING ENVELOPE > Insulation: Rigid Foam Insulation

Overview of Rigid Feam Insulation



Doug Bibee, Residential Technical Specialist, Dow Building Materials, explains the benefits of using insulated foam sheathing in to increase energy efficiency and help prevent moisture/mold problems.

Exterior Wall Sheathing



Wood framing typically represents 25% of the surface area of walls, so the proper installation of insulated foam sheathing can prevent thermal bridging and increase energy efficiency in a house.

Exterior Basements and Slabs



Insulating the exterior foundation walls helps the concrete stay warm and uses thermal mass properties to help keep the basement warmer. Find out how to install exterior insulated foam sheathing.

Welcome

To view multimedia materials on this site, latest Windows Media player & Quick Time player is required.

Click on **"Heip**" for more information.

http://www.codecollegenetwork.com/video_center/ Date visited: 4/30/2013

Alliance to Save Energy (ASE)





http://www.ase.org/ Date visited: 4/30/2013

ASE: Building Energy Efficient Codes Network



http://ase.org/programs/building-energy-efficient-codes-network Date visited: 4/30/2013

ALLIANCE TO SAVE ENERGY Creating an Energy-Efficient World

Michigan Code Watch



Michigan CodeWatch Online Code Training

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SELECT MODULE

MODULES

- 🗄 Sill Seal Tape
- 🗄 Egress
- 🗄 Rigid Foam Insulation
- Wrapping the House
- Building with SIPS
- E Fireplace Installation
- Proper Ventilation
- Insulated Vinyl Siding
- Engineered Wood
 Siding
- Brick Veneer Installation
- Feeney Cable Railings
- 🗄 Plenum Cable
- 🗉 Sealed Attic Systems

Michigan Bureau of Construction Codes Online Code Training Series

As our statewide construction codes are revised and updated we are providing this e-learning programming to educate the industry on building product information, installation details and performance standards guidance to meet the revised codes. Through the kind support of our industry sponsors, Building Media, Inc., (www.buildingmedia.com) is working in partnership with the Bureau of Construction Codes to develop and provide this unique Internet-based training approach for building and design communities to disseminate and communicate these new and revised construction codes.

The purpose of this online building academy is to provide readily accessible training to building department personnel, builders and architects. The goal of this training program is to:



Assist builders to construct better buildings that are in compliance with the new state building codes

Instruct architects and engineers on understanding the new codes that will be reflected in their designs and engineering.

Click on the buttons on the left to enter the learning modules.





GO

National Association of State Energy Officials (NASEO)



NASEO Joins Coalition in Support of Efficiency Programs through the FY'14 Energy and Water Development Appropriations Bill

NASEO, as part of a broad coalition of efficiency organizations, businesses, and public interest groups signed House and Senate versions of a letter in support of funding levels at or above the President's FY14 budget proposal for activities funded through the Energy and Water Development Appropriations bill...

NASEO Kicks Off 2013 Regional Meetings



Call

» NASEO Government Affairs Conference Call

May 23, 2013, 2:30pm-3:30pm ET

» NASEO Transportation Committee

www.naseo.org Date visited: 4/30/2013



For More Information:

- Residential Energy Services Network
 <u>http://resnet.us</u>
 - Mission: establish and maintain the standards of quality for evaluating building energy performance and increase the opportunity for ownership of high performance buildings
- Energy Efficient Homes Midwest

http://www.eehmidwest.com/

- Midwest agency
- Certifies most raters in Michigan



U. S. Department of Energy Building Energy Codes Program

Additional Training Resources:

http://www.energycodes.gov/events/other_resources.stm

- Several additional training resources
- ICC and ASHRAE links
- Professional and trade organizations
- State-specific resources

Interesting Web Links

ASHRAE Building Science Article

http://bookstore.ashrae.biz/journal/journalarticle.php?filename=building_sciences120108.pdf (requires member login)

California Title 24: Online Learning

http://www.energy.ca.gov/title24/

City of Seattle, WA: DIY Home Energy Audit

http://www.seattle.gov/dpd/static/DIYweb_LatestReleased_DPDP016083.pdf

Efficient Windows Collaborative

http://www.efficientwindows.org/

EPA Energy Star Program

http://www.energystar.gov/

Michigan Code Watch: Online Code Training

http://www.michigancodes.com/

MIT Open Courseware

http://ocw.mit.edu/index.htm

Montana Weatherization Training Center

http://weatherization.org/

Interesting Web Links

Oak Ridge National Laboratory: Building Envelope Research

http://www.ornl.gov/sci/roofs+walls/insulation/ins_01.html

Southface Learning Center

www.southface.org/learning-center/trainings/

Southface Online Training

www.southfaceonlinetraining.org/

U. S. Energy Information Administration: Key Terms Glossary

http://www.eia.doe.gov/a-z_index/Energya-z_a.html

U. S. Green Building Council (LEED Rating System)

www.usgbc.org

USGBC: Education

http://www.usgbc.org/education

U.S. DOE: Building Energy Codes Program

http://www.energycodes.gov

U.S. DOE: Energy Savers Blog

http://www.eereblogs.energy.gov/energysavers/post/What-Energy-Saving-Gifts-Are-You-Giving-this-Year.aspx



Appendix

MICHIGAN STATE UNIVERSITY
Heat Flow Terms:

- R-value
- U-value
- C-factor
- F-factor





A measure of thermal resistance, or how well a material or series of materials resist the flow of heat. R-value is the reciprocal of U-value. Materials with higher R-values resist better than those with lower R-values.

Unit of measure: hr ft² °F / BTU R = 1 / U-value



A measure of how well a material or series of materials conduct heat. U-values for window and door assemblies are the reciprocal of the assembly R-value. Materials with lower Uvalues resist heat better than those with higher U-values.

Unit of measure: BTU / hr ft² °F U = 1 / R-value



C-factor is also a rate of heat flow through a homogenous material, but could be for any given thickness.

Unit: BTU / hr ft² °F

C-factor does not include soil or air films



Glossary

The perimeter heat loss factor for slab-on-grade floors, expressed in **BTU / hr ft. °F**

Glazing/Fenestration

- Fenestration
- Solar Heat Gain Coefficient
- Shading Coefficient

Fenestration

The terms "fenestration", "window", and "glazing" are often used interchangeably. However, fenestration refers to the design and position of windows, doors and other structural openings in a building (including frames).



- U-values for windows can be measured at the center of the glass or can be expressed as a whole unit U-value
- National codes such as IECC and IRC require a unit U-value
- Codes have specific requirements for testing and labeling of window U-values

http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/dbimages/full/891.jpg Date Visited: 3/15/2011

Solar Heat Gain Coefficient (SHGC)

SHGC is the glazing's effectiveness in rejecting solar heat gain. It is a part of a system for rating window performance used by the **National Fenestration Rating Council (NFRC).**

It is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed, then subsequently released inward. It is expressed as a number between 0 and 1. The lower a window's SHGC, the less solar heat it transmits.

SHGC is gradually replacing the older index, Shading Coefficient (SC), in design standards.



Glossarv

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The ratio of solar heat gain through fenestration, with or without integral shading devices, to that occurring through un-shaded 1/8-in thick double-strength glass.

If you are using glass whose performance is listed in terms of SC, you may convert to SHGC by multiplying the SC value by 0.87

Climate Zone / Degree Days

Glossary

- Climate Zone
- Heating Degree Days
- Cooling Degree Days

Heating Degree Days

Glossary

A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one-day, when the mean temperature is less than 65°F (18.3°C), there exists as many degree-days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F (18.3°C).

Example for any given day: High Temp = 50° F Low Temp = 20° F Average Temperature = $50^{\circ} + 20^{\circ}$ F = $70/2 = 35^{\circ}$ F Degree Day = 65° F - 35° F = 30° F Therefore, the day was a 30° HDD

Totaling the degree-days generated each day for the entire year represents the annual Heating Degree Days which is abbreviated as HDD

Cooling Degree Days

For any one-day when the mean temperature is more than 50°F (10°C), there are as many degree-days as degrees Fahrenheit temperature difference between the mean temperature for the day and 50°F (10°C).

Glossarv

Example for any given day: High Temp = 80° F Low Temp = 40° F Average Temperature = 80° + 40° F = $120/2 = 60^{\circ}$ F Degree Day = 60° F - 50° F = 10° F Therefore, the day was a 10° CDD

Totaling the degree-days generated each day for the entire year represents the annual Cooling Degree Days which is abbreviated as CDD





- Air Barrier
- Mass Wall
- Semi-heated Space

The principal function of the air barrier is to prevent both the infiltration of outdoor air into a building and the exfiltration of indoor air to the outside.

Air leakage can cause problems such as loss of energy and deposition of moisture in the walls. Wall with thermal heat sinking capacity exceeding 7 BTU/ft²°F or 5 BTU/ft²°F provided that the wall has material unit weight not greater than 120 lb/ft³.

It is generally constructed of masonry or heavy wood and serves as a heat sink. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 BTU/hr.ft² of floor area, but is not a conditioned space.

Equipment Efficiency Terms

- Energy Efficiency
- Coefficient of Performance (COP)
- Energy Efficiency Ratio (EER)
- Seasonal Energy Efficiency Ratio (SEER)
- Annual Fuel Utilization Efficiency (AFUE)

Glossary

Energy Efficiency = Useful Energy OUTPUT / energy INPUT

Example: The IRC requires the heating appliances to be 78% energy efficient or 0.78.

Practically, efficiency cannot be 100% or 1 because energy is always lost in appliances in the form of sound or light energy.

Coefficient of Performance (COP)

The ratio of the rate of heat exchange to the rate of energy input in consistent units for a complete cooling/heating system as tested under a nationally recognized standard or designated operating conditions.



Glossary

The ratio of net cooling capacity of an equipment item in Watts (1 BTU / hr = 0.29 Watts) to the total rate of power input (in Watts) under designed operating conditions.

EER = Net cooling capacity (in Watts) / Power input (Watts)

Seasonal Energy Efficiency Ratio (SEER) Glossary

The ratio of the total cooling output of an air conditioner during its annual usage period of cooling to the energy input during the same period.

SEER = Cooling output / Energy input

- New equipment ranges from about 10 to 16 SEER
- Higher SEER ratings indicate more efficient equipment

Annual fuel utilization efficiency is the combustion heating equipment efficiency and is abbreviated as AFUE. AFUE typically ranges from about 78 to 96% AFUE.

Higher AFUE ratings indicate more efficient equipment

Basic Energy Units

• British Thermal Unit (BTU):

- 1 BTU is the amount of heat energy required to raise the temperature of one pound of water by 1°F, at sea level (It takes about 2,000 BTUs to make a pot of coffee).
- Joules:

1,000 joules = 1 Kilojoules = 1 BTU So, 2 million joules to make a pot of coffee!!

Other measures such as CALORIES

Heat Energy and Heat Flow

Energy Processes

- Heat is a form of energy
- Flows in 3 ways:
 - CONDUCTION
 - CONVECTION
 - RADIATION





http://www.savenrg.com/norbs.jpg

https://www.cresis.ku.edu/iceicebaby/?m=201010

Date visited: 4/30/2013

CONDUCTION

- Higher to lower temperature (higher \rightarrow lower *energy*)
- Transfer of heat through a substance, resulting from a difference in temperature between different parts
- Rate of heat flow between 2 regions is directly proportional to:
 - The temperature difference between them and
 - Conductivity of the substance
 - Contact area
- *Example*: Heat flowing from inside conditioned space to outside unconditioned space through walls

CONVECTION

- Warmer air rises
- Convection is the mode of heat transfer in fluids (air and liquids)
 - Air expands when heated—density decreases
 - Warmer air rises through the surrounding cooler air
 - Cooler air that flows in to replace the rising warmer air gets heated and also rises
 - Thus, a current called a convection current, becomes established in the air
 - The same principle causes land and sea breezes

RADIATION

Radiant energy is energy that comes from a source and travels through space (example: solar radiation)

- The Sun: The most common source of radiant energy
- The Sun's light and heat cannot reach us by conduction or convection because space is almost completely empty (VACUUM)

When sunlight hits the earth, its radiant energy is absorbed or reflected

Energy in Building Science

Energy Processes

- A building's energy performance is closely related to other aspects of building science such as:
 - MOISTURE
 - MOLD
 - VENTILATION
- Changes in construction details for one purpose can have unintended effects
- When designing for energy one should consider moisture and ventilation simultaneously
- In some states successful training programs for builders have been developed, which address these interrelationships

Energy Processes

Excessive moisture in buildings, combined with favorable temperature conditions, can foster:

- Mold growth
- Air quality problems
- Health problems
- Decay of building materials and failure of the envelope

According to EPA: The key to mold control is moisture control

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Envelope Air/Moisture Flows

Energy Processes



Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004 ³¹⁹

Envelope Moisture Formation



Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004 3

Energy Processes

Moisture Control

KEY COMPONENTS OF A COLD CLIMATE HOUSE

Continuous, warm-side air barrier Full-coverage, warm-side vapor retarder Full-coverage, optimal thermal insulation Continuous, exterior-side weather barrier Energy-efficient & condensation-resistant windows Effective ground-moisture/soil gas control Safe, efficient space heating & cooling Managed mechanical ventilation Low-toxicity materials, finishes & furnishings Efficient & safe appliances & lighting



Primary Benefit of Measure

Secondary Benefit

Minor Effect

Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004 ³²¹

Ventilation

- Outdoor air ventilation addresses most indoor air quality issues:
 - Sick Building Syndrome
 - Moisture and Mold Problems
 - Second-hand Tobacco Smoke
 - Material Out-gassing
 - Multiple Chemical Sensitivity
- Good ventilation dilutes pollutants
- Ventilation can increase energy consumption, which can be mitigated by the use of heat exchangers

Source: 'Ventilation Basics and Beyond', Presentation made by Jeff Tiller at 2004 National State Building Energy Codes Conference

Why Ventilate?

Moisture control

- Reduce excessive moisture harmful to the building structure
- Reduce excessive moisture that is a source of mold and mildew growth
- Eliminate odors and pollutants that are harmful to human health

Source: 'Ventilation Basics and Beyond', Presentation made by Jeff Tiller at 2004 National State Building Energy Codes Conference