Resource Inventory and Lessons Learned for the Commercial Portion of the 2009 IECC and 90.1-2007 Workshop 1
Introductions

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Code officials
Name
Municipality
Status of Commercial Codes
Overview

Project funded by the Missouri Department of Natural Resources (MDNR) with American Recovery and Reinvestment Act of 2009 (ARRA) funding.

2 Locations:

1. St. Louis
2. Springfield

Objective of the Workshop: Work with municipalities and counties across the state to identify opportunities to adopt or enhance compliance with the 2009 International Energy Conservation Code (IECC) at a local level.
Overview

- BCAP (Building Codes Assistants Program)
- BECP (Building Energy Codes Program)
What are the topics for today?

1. Overview of best practices and lessons learned in Missouri.
2. Commercial compliance approaches and their corresponding tools.
3. Commercial Resources - building data collection checklist and COMcheck.
## Agenda

<table>
<thead>
<tr>
<th>Topic</th>
<th>Approx. Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction, Project Background, Workshop Overview</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Overview of best practices and lessons learned in Missouri.</td>
<td>20 minutes</td>
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<tr>
<td>Commercial compliance approaches and their corresponding tools</td>
<td>25 minutes</td>
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<tr>
<td>Break</td>
<td>10 minutes</td>
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<tr>
<td>Overview of the commercial envelope requirements</td>
<td>35 minutes</td>
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<tr>
<td>Summary/Questions</td>
<td>15 minutes</td>
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<tr>
<td><strong>Total Time</strong></td>
<td><strong>2 Hrs</strong></td>
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</table>
Some Important Points

Overall
• Focused on commercial
• Discussion-based
• Forum for ideas and practices

What can you expect?
• Code citations in [ ]
• Printed slides

Before we get started...
• Cell phones
Building Energy Codes

ASHRAE Standard 90.1

International Energy Conservation Code

State and Locally Adopted Codes
Comparison of 2009 IECC and ASHRAE 90.1-2007

**2009 IECC**
- 2009 IECC developed by the *International Code Council (ICC)*
- New version every three years with more stringent requirements

**ASHRAE**
- ASHRAE 90.1-2007 developed by *American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)*
- ASHRAE 90.1 is the referenced standard in IECC
- Compliance with ASHRAE 90.1-2007 results in 4% more energy savings than ASHRAE 90.1-2004
Typical Adoption Process, State, and Local

State Appointed Council or Committee

Local Building Officials

Mayor

State Energy Office

Proposal Undergoes Public Review Process

Results Are Incorporated into the Proposal

Approving Authority Reviews Legislation or Regulation

After Filed or Approved, Code Becomes Law

City Council
ASHRAE 90.1 Process

Committee Proposes Standard Changes → Public Review and Comment → Comment Accepted → Committee Approval → ASHRAE Board of Directors Approval → ANSI Approval → New Standards or Addenda Published

Substantive Changes

Appeal of Committee Approval: upheld or denied
## Model Codes & Standards

<table>
<thead>
<tr>
<th>Title</th>
<th>Type</th>
<th>Applicability</th>
<th>Common Versions</th>
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</thead>
</table>
2009 IECC Compliance

Must the Project Comply with the IECC?

- Comply with the Envelope Requirements
  - Section 502
  - 90.1 Section 5

- Comply with the Mechanical/SWH Requirements
  - Sections 503 and 504
  - 90.1 Section 6

- Comply with the Power & Lighting Requirements
  - Section 505
  - 90.1 Section 9

Document Compliance with the IECC

Plan Review

Inspection
Commercial Provisions Contained in Chapter 5

- Chapter 5 is dedicated to Commercial buildings in IECC
- ASHRAE 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical).

**The Code does not allow for mixing and matching of IECC and ASHRAE**
IECC or ASHRAE 90.1

Both IECC & ASHRAE 90.1 apply, either used to comply

Both IECC & ASHRAE 90.1 apply, ASHRAE 90.1 likely used
Climate Zones – 2009 IECC

[Map of climate zones in the United States]
Climate Zones – 2009 IECC
Missouri: A Patchwork of Codes

Due to its history of strong local government, Missouri does not have a mandatory statewide energy code, however all local jurisdictions except class III counties have the right to adopt an energy code. As expected, this system creates a sometimes confusing patchwork of different codes throughout the state.

Regardless of the system in place, the bottom line is that many jurisdictions in Missouri still don’t have an energy code—meaning that many residents do not receive the benefits of energy-efficient construction.
## Missouri Facts

<table>
<thead>
<tr>
<th>Energy Costs</th>
<th>Amount spent annually on energy in Missouri.</th>
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<tbody>
<tr>
<td>$20 billion</td>
<td>Percentage of primary energy imported from other states.</td>
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<td>95%</td>
<td>The rise in the cost of residential electricity, 2004 to 2009.</td>
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<td>22%</td>
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</tbody>
</table>

Missouri residents spend billions every year importing energy from other states and abroad. Energy codes can help the state retain some of these dollars and improve Missouri’s economy.
## Missouri Facts

<table>
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<tr>
<th>Statewide Savings</th>
<th>$318 million</th>
<th>Annual energy savings by 2030.</th>
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<td>26 trillion</td>
<td>Btu of energy avoided annually by 2030.</td>
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<td>1.4 million</td>
<td>Metric tons of CO₂ prevented annually by 2030.³</td>
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By adopting and enforcing the 2009 IECC starting in 2011, Missouri municipalities and counties would significantly improve the state’s economy and environment now and into the future.
Topic 1

Overview of Best Practices and Lessons Learned in Missouri
Commercial State Energy Code Status (*)

(*) as of November 1, 2011, DOE – Building Energy Codes Program
Commercial Energy Code - Midwest
Missouri: No statewide code adoption

- **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code.

- **Many jurisdictions in Missouri also still don’t have an energy code** – meaning that many residents do not receive the benefits of energy-efficient construction.

- Various codes are currently used throughout the state.
Best Practices Missouri

• Jackson County, Lake St. Louis, Marshall, O’Fallon, and the City of St. Louis (St. Louis County Public Works) have adopted the 2009 IECC.

• Creve Coeur and Independence are currently in the adoption process.

• St. Charles County and St. Louis County have adopted the 2009 IRC with amendments.
Best Practices Missouri

Kansas City incorporates energy codes into its broader sustainability effort:

1) The Environmental Management Commission advises the city on energy/environmental issues.

2) The Chamber of Commerce’s Climate Protection Partnership brings together 180 businesses and institutions that support energy efficiency implementation.

3) The Sustainability Coordinator works regionally to promote efforts.

4) The Climate Protection Plan includes energy codes as a policy tool.

5) Kansas City joined with ten municipalities and the Mid-America Regional Council to create a regional energy strategy and promote the adoption of the 2012 IECC.
Best Practices Missouri

Columbia created commissions to advise the city council on energy code issues:

• The Building Construction Codes Commission (BCCC) reviews codes and provides a construction industry perspective.
• The Environment and Energy Commission adds input on the benefits of energy codes, stimulates public interest, and engages public/private agencies.

University City
• The University City Green Practices Committee provides input into energy code adoption efforts.
Local Jurisdiction – Adoption Status

Arnold
Ballwin
Belton
Bethany
Boonville
Branson
Camdenton
Cape Girardeau
Carthage
Chillicothe
Clayton
Columbia
Eldon
El Dorado Springs
Farmington
Florissant
Fulton
Gladstone
Hannibal
Harrisonville
Hazelwood
Higginsville
Highlandville
Joplin
Kansas City
Kirksville
Kirkwood
Knob Noster
Lake St. Louis
Loch Lloyd
Lebanon
Lee’s Summit
Macon
Marshall
Maryville
Mexico
Mountain Grove
Neosho
Nixa
O’Fallon
Osage Beach
Ozark
Pacific
Park Hills
Pineville
Platte City
Raytown
Republic
Riverside
Rolla
Sedalia
Sikeston
Sni Valley
Springfield
St. Charles
St. Joseph
St. Louis
St. Peters
Sugar Creek
Troy
Warrensburg
Wentzville
West Plains
Topic 2

Commercial Compliance Approaches and their Corresponding Tools
Different compliance paths

- Prescriptive compliance
- Trade-off*
- Total building performance

*The 2009 International Energy Conservation Code (IECC) contains a U-factor alternative (Section 502.1.2).
Prescriptive compliance - Based on the code being used

If documentation supporting a trade-off or performance approach is not available, the evaluation of the building is based on the prescriptive compliance path.
Trade-off or Performance Approach

If there is documentation supporting a trade-off or performance approach, the evaluator is instructed to evaluate the building construction based on the documentation provided with the plans and specifications for that non-prescriptive compliance approach.
Trade-off

• For example, a building may have windows more efficient than the prescriptive requirements in the code. These windows may offset a ceiling design that does not satisfy the minimum thermal requirements of the code. If compliance documentation demonstrating this trade-off was submitted and approved, the evaluator will need to verify that the window U-factors and areas, and installed ceiling construction type and R-values match the trade-off documentation.

• If no documentation was submitted, the building will fail the ceiling prescriptive R-value requirement, even if it can be shown that it meets the code requirements based on a trade-off approach.
Trade-off

While this approach might penalize buildings that do comply but haven’t documented that compliance, it is a justified penalty in that the code requires such documentation be submitted. There are two different scenarios that could apply to this example:

- The ceiling insulation R-value(s) are marked on the plans and match those installed in the field, but no trade-off documentation is submitted. Under this scenario, the building fails one code requirement for not meeting the prescriptive ceiling R-value requirements.

- The ceiling insulation R-value(s) are not marked on any submitted plans or other documentation, nor is trade-off documentation submitted. Under this scenario, the building will fail two code requirements.
Total Building Performance Approach

Greater Flexibility
• Detailed Picture of overall building
• Baseline Analysis and Comparison

Obtain Credit for Special Features
• Solar PV / Solar Thermal
• Heat Pump System
Total Building Performance Approach

Samples of performance software available are listed in the


and on the


eQust is a software that can do an energy analysis.
- http://doe2.com/equest/
More Resources

- http://www.ashrae.org/technology/page/121
- http://www.iccsafe.org/cs/Pages/opinions.aspx
- http://www.energycodes.gov/help/
Compliance for additions or alterations

One of the keys to showing compliance for additions and alterations is to remember you are only considering the new space, or the new walls, etc.

You have the option of showing compliance for the entire space, but this is not necessary or typical.
Compliance for additions or alterations

Using COMcheck™, you will indicate "addition" or "alteration" on the project information tab, and need to enter the following information, as it applies to your project:

- Ceiling – gross area (ft\(^2\)) and insulation R-value of new ceiling
- Exterior walls – gross area (ft\(^2\)) of new exterior walls and insulation R-value (any existing exterior wall(s) that will become interior wall(s) once the addition is built are not be entered as part of the addition wall area)
- Windows/Doors – gross area (ft\(^2\)) of windows and/or doors with U-factor from NFRC label or default table in the help section of COMcheck™
- Floor – gross area (ft\(^2\)) of addition and insulation R-value. If the floor is a slab, the length of the exterior slab edge should be entered in linear feet
Compliance for Remodels and Alterations

COMcheck will calculate compliance for your project as you define it. For example, if your project is a tenant improvement with new interior lighting, new exterior lighting and mechanical, you would not need to fill in the envelope tab.

Conversely, if your project is new construction of an unoccupied commercial shell and there is no interior lighting or mechanical system, you would not fill out those tabs.
Please explain how to use different wattage luminaire and comply with the code.

For example, does my lighting comply, if my building that is using a Halo H71CT 6" ceiling insulated Recessed Housing which accepts a R-30 type bulb, the bulb specified is a "15 Watt CFL, Light Bulb - 65 W Equal-Warm White 27000K - R30 Reflector - Energy Miser FE-R30-15W-27k", can this information be input into the COMcheck Compliance Software as 15 Watt CFL, instead of a 65 Watt incandescent to show that it is compliance?
How do I create an energy code compliance report to get my building permit?

If your building official is asking to see a compliance report when you apply for a building permit, you can download software at no charge. You will fill out forms with information about your project, such as square footage of the floors, walls, and ceilings, insulation levels, information about your windows and heating and cooling system. The menu driven software will show you when the building has complied with the energy code, and then you can print out the reports to submit for the building permit.
Where can I get a copy of the energy code?

We suggest checking with your local jurisdiction to verify which code version (year) they are enforcing before purchasing the code book. Copies of the International Energy Conservation Code can be purchased from the ICC website.

Copies of ASHRAE 90.1 can be purchased on the ASHRAE website.
What are the minimum insulation and window requirements for my building?

• Minimum insulation levels and window requirements depend on your climate zone, whether you are complying with the IECC or ASHRAE 90.1. In the IECC you will need the information from Table 502.2 (1) and 502.3.

• In ASHRAE 90.1 the information is found in Table 5.5-1-8, insulation levels for high albedo roofs can be found in Table 5.5.3.1, and SHGC multipliers for permanent projections is in Table 5.5.4.4.1

• There are several ways to get this information: Call, or stop by, your local building department and ask them. Obtain a copy of the code book if you will be needing other information for ongoing projects.

• Submit your question to BECP Technical Support. Please include your state and local jurisdiction so we can determine your climate zone.
My project has both businesses and homes, is it residential or commercial?

For mixed use buildings that are three stories or less and have residential and commercial, the way to determine if the entire building can shown to meet code under residential or commercial is the percentage of the space types. If the residential is 10% or less of the overall building then the entire building can fall under commercial. It is always easier to show compliance for the entire exterior thermal building envelope instead of breaking the building apart.

If using COMcheck, the apartments would be multi-family under the space types option and the other areas should also be designated according to their activities. Remember, if the building is four stories or greater, it is commercial.
Do the last IECC versions reference the ASHRAE Standard in such a way as to require the commissioning work described in them?

- ASHRAE Standards 90.1-2004 and 90.1-2007 require plans and specs to include detail descriptions for Commissioning of HVAC systems and their controls in buildings with conditioned space greater than 50,000 square feet.

- The 2009 IECC allows a code user to use either 90.1-2007 in its entirety (including the HVAC requirements) or to use the requirements in Chapter 5 of the 2009 IECC. Chapter 5 of the 2009 IECC does not have any specific commissioning requirements. There are air system and hydronic system balancing requirements, but nothing specifically labeled "commissioning" or "functional testing".

- Commissioning requirements have been included in the 2012 IECC.
Promoting Awareness of 2009 IECC

General Resources

*Top 10 Reasons for Building Energy Codes*, U.S. Dept. of Energy

*Frequently-Asked Questions*, U.S. Dept. of Energy
State-Level Technical Assistance

Over the years, DOE's Building Energy Codes Program has provided the following types of assistance to state energy organizations:

**Technical analysis of residential and commercial codes**, including:

- Analysis of energy savings associated with adoption of new codes
- Analysis of first cost impacts and cost-effectiveness associated with adoption of new codes
- Comparative analysis of future code options
- Suggested language for modification of national model codes for state-specific issues
State-Level Technical Assistance

**Training on residential and commercial codes**
Development of customized training materials for state codes
Web-based or in-person training on the national model codes and state codes

**Software in support of residential and commercial codes**
State-specific energy codes in [REScheck](#)
State-specific energy codes in [COMcheck](#)

In addition, DOE's BECP has acquired databases of residential and commercial construction volume by state and county. BECP can prepare a number of summary products from these databases for state use related to energy codes.
State-Level Technical Assistance

Funding to provide no-cost technical assistance is limited. In assessing each request, the following issues will be taken into consideration:

Potential overall impact of the proposed assistance, based on current codes and building practices, population and construction starts
Groups of states and individual states take priority over localities
Consistency with DOE's goal of nationwide 70% adoption of the 2009 IECC/ASHRAE 90.1-2007 or the 2012 IECC/ASHRAE 90.1-2010
Consistency with DOE's goal of state wide 90% compliance rates
Requests will be acknowledged upon receipt. Notification of request status will be sent within two weeks. Activity and progress will be monitored continuously.
State-Level Technical Assistance

Status of State-Level Technical Assistance Requests
http://www.energycodes.gov/states/open_requests.stm

Missouri
(City of Kansas City) 08/10 Analyze savings between the 2006 IECC and 2009 IECC and the 2006 IECC and 2012 IECC. - In Progress
Adopt, Implement, Enforce – Resources

www.energycodes.gov
BECP is developing guidelines and tools to use in measuring compliance with building energy codes, which:

- Foster uniformity and objectivity in measuring compliance rates
- Eliminate need for each state to develop its own procedures and tools
- Provide tools that states can adapt for their own preferred use
- Collect additional data and support related activities.
<table>
<thead>
<tr>
<th>Building Energy Codes Assistance for States</th>
<th>Status of State Energy Codes</th>
<th>Check on the current code status of any U.S. state or territory using BECP’s interactive map tool. Also find links to state specific portions of BECP’s recent nationwide analysis reports, state-level energy official contact information, and many other details.</th>
<th><a href="http://www.energycodes.gov/states">www.energycodes.gov/states</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Assistance to States</td>
<td>BECP provides specialized technical assistance to the states in the form of economic analysis, code comparisons, webcast training, and compliance material development requested by states to help them adopt, upgrade, implement, and enforce their building energy codes.</td>
<td><a href="http://www.energycodes.gov/states/techAssist.stm">http://www.energycodes.gov/states/techAssist.stm</a></td>
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<tr>
<td>State Compliance Assistance</td>
<td>BECP has developed an approach states can use for measuring compliance with building energy codes.</td>
<td><a href="http://www.energycodes.gov/arra/compliance_evaluation.stm">http://www.energycodes.gov/arra/compliance_evaluation.stm</a></td>
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<tr>
<td>No-cost Compliance Tools</td>
<td>Residential Code Compliance Software</td>
<td>REScheck™ and REScheck-Web™</td>
<td><a href="http://www.energycodes.gov/software.stm">http://www.energycodes.gov/software.stm</a></td>
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<td></td>
<td>Commercial Code Compliance Software</td>
<td>COMcheck™ and COMcheck-Web™</td>
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<tr>
<td>Training</td>
<td>Building Energy Codes University (BECU)</td>
<td>To help stakeholders broaden and deepen their knowledge of building energy codes, BECP is collecting its diverse training resources in an extensive Building Energy Codes University (BECU) that features webcasts, training videos, self-paced online courses, presentations, and other BECP materials and tools.</td>
<td><a href="http://www.energycodes.gov/training">www.energycodes.gov/training</a></td>
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<tr>
<td>Resource Center</td>
<td>Building Energy Codes Knowledge Base</td>
<td>This knowledge base provides a variety of different media types, including articles, graphics, online tools, presentations, and videos that anyone can use to create their own training and presentations.</td>
<td><a href="http://resourcecenter.pnl.gov/">http://resourcecenter.pnl.gov/</a></td>
</tr>
<tr>
<td>Advocacy</td>
<td>The Building Codes Assistance Project (BCAP)</td>
<td>BCAP is an initiative of the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, and the Natural Resource Defense Council that provides states with code advocacy assistance on behalf of DOE.</td>
<td><a href="http://www.bcap-energy.org">www.bcap-energy.org</a></td>
</tr>
</tbody>
</table>
Break

10 minutes
We’re going to start topic 2 again at ____
Topic 3

Overview of the requirements of Commercial **envelope**, lighting and mechanical provisions of the 2009 IECC
2009 IECC Compliance

Must the Project Comply with the IECC?

- **Comply with the Envelope Requirements**
  - Section 502
  - 90.1 Section 5

- **Comply with the Mechanical/SWH Requirements**
  - Sections 503 and 504
  - 90.1 Section 6

- **Comply with the Power & Lighting Requirements**
  - Section 505
  - 90.1 Section 9

Document Compliance with the IECC

Plan Review

Inspection
Major Changes to the Envelope Requirements

- Commercial Provisions Contained in Chapter 5 IECC

- ASHRAE 90.1-2007 Tables 502.2(1) and Table 502.2(2) Building Envelope Requirements – Opaque Assemblies
What is the Building Thermal Envelope?

• Roof/Ceiling Assembly
• Wall Assembly
• Vertical Fenestration and Skylights
• Floor Assembly
• Slab Edge
• Below Grade Wall Assembly

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space.
What are My Options for Complying with the IECC?

- Chapter 5 of the IECC General Prescriptive Approach
- Use for ≤ 40% of gross wall area in vertical fenestration
- Use for ≤ 3% of gross roof area in skylights
- Section 506 Total Building Performance Approach
- ASHRAE/IESNA Standard 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path.
Climate Zones – 2009 IECC

- Marine (C)
- Dry (B)
- Moist (A)

All of Alaska in Zone 7 except for the following Boroughs in Zone 8:
- Bethel
- Dillingham
- Fairbanks North Star
- Nome
- North Slope

Northwest Arctic

Southeast Fairbanks

Wrangell

Yukon-Koyukuk

Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands.
Climate Zones – 2009 IECC
### Compliance with Chapter 5 Prescriptive Approach

**Table 502(3)(T) Building Envelope Requirements - Opaque Assemblies**

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<tr>
<th>Climate Zone</th>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
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<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
<td>NR NR</td>
</tr>
<tr>
<td>Foam/(Spray) filled with steel wood, (b)</td>
<td>NR NR</td>
<td>NR NR</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
<td>R-0.16</td>
</tr>
</tbody>
</table>

### Footnotes:
- \(a\): Continuous insulation, NR = No requirement.
- \(b\): When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2.2].
- \(c\): Assembly descriptions can be found in Table 502.2.2.
- \(d\): When metal buildings are properly insulated, NR = No requirement.
- \(e\): When heated slabs are placed below grade, below-grade mass must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
- \(f\): Steel floor joist systems shall be R-0.06.
Changes to Tables 502.1.2 and 502.2(1)

- Table now separated by occupancy type
- Group R occupancies use “Group R” column
- Non-Group R occupancies use “All other” column
### Compliance with Chapter 5 Prescriptive Approach

<table>
<thead>
<tr>
<th>ROOFS</th>
<th>DESCRIPTION</th>
<th>REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-19</td>
<td>Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/butt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
<tr>
<td>R-13 + R-13</td>
<td>Standing seam roof with two fiberglass insulation layers. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/butt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
<tr>
<td>R-13 + R-19</td>
<td>Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/butt, and the roof deck is secured to the purlins.</td>
<td>ASHRAE/IESNA 90.1 Table A2.3 including Addendum “G”</td>
</tr>
<tr>
<td>R-16, R-19</td>
<td>Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.</td>
<td>ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”</td>
</tr>
<tr>
<td>R-13 + R-5.6 ci</td>
<td>The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.</td>
<td>ASHRAE/IESNA 90.1 Table A3.2 including Addendum “G”</td>
</tr>
</tbody>
</table>
Roof R-Value (502.2.1) / U-Factor (502.1.2)

Roof R-values and U-factor requirements are based on assembly type / insulation placement

• Insulation entirely above deck
• Metal buildings
• Attic and other
Roof R-Value – Insulation Completely Above Deck

• Insulation considered continuous (CI)
• Insulation thickness can vary ≤ 1” and area weighted U-factor meets the requirements of Table 502.2(1)
Roof R-Value – Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles

- Will not count for code compliance
- Will not comply with Section 502.4.3 – “Sealing of the building envelope”
Roof R-Value – Metal Buildings

- R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method
- Climate Zones 2-8 require two layers of insulation
- CZ 2-5 and marine R: R-13+R-13
- Example (R-13+R-19):
  - R-13 draped perpendicularly to the purlins
  - R-19 running parallel to the purlins supported by the R-13
Roof R-Value – Ceilings with Attic Spaces

- Install insulation between framing
- R-38 in most Climate Zones
- R-30 in Climate Zones 1 and R-49 in Climate Zone 8
Wall R-Value – Mass Walls

- Walls weighing at least 35 lbs/ft$^2$ of wall surface area, or
- 25 lbs/ft$^2$ of wall surface area if material weight is \( \leq 120 \text{ lb/ft}^3 \)
Mass Walls – Concrete Masonry Units

- Climate Zone 4 except marine – Can use integral insulation instead of R-5.7 ci
- Concrete block walls must comply with ASTM C 90, and
- Ungrouted or partially grouted @ 32 inch. o.c. or less vertically or 48 inch. o.c. or less horizontally, and
- Ungrouted cells must be filled with insulation material ≤ of 0.44 Btu-in./h-ft² F
Wall R-Value – Wood, Metal Frame, and Other

- Cavity insulation or cavity plus continuous (ci)
- Continuous insulation not broken up by framing members e.g. rigid board insulation
Metal Building Walls [Table 502.2(2)]

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>R-16</td>
</tr>
<tr>
<td>3-4 except Marine</td>
<td>R-19</td>
</tr>
<tr>
<td>Marine 4 – 6</td>
<td>R-13+R-5.6ci</td>
</tr>
<tr>
<td>7-8</td>
<td>R-19+R-5.6ci</td>
</tr>
</tbody>
</table>

Picture from NAIMA
Below Grade Walls (502.2.4)

- What is a below grade wall?
- Basement or first-story walls ≥ 85% below grade
- Insulation must extend down 10 ft from the outside finished grade level or to the level of the floor, whichever is less
Floors Over Outdoor Air or Unconditioned Space (502.2.5)

- Joist/Framing (Steel/Wood)
- Insulation installed between framing
- Mass Floors
- Materials weighing 35 lbs/ft$^2$, or
- 25 lbs/ft$^2$ if material weight is $\leq 120$ lbs/ft$^3$
Slab-on-Grade Floors (502.2.6)

- Unheated slab – insulation required in Climate Zones 4-8
- Heated slabs – insulation required in all Climate Zones
Opaque Doors (502.2.7)

- Doors having < 50% glass area
- Swinging doors
- Meet U-factor requirement
- Roll-up or sliding doors
- Climate zones 1 - 3: U-1.45
- Climate zones 4 including Marine - 8: U-0.50
## Compliance with Chapter 5 Prescriptive Approach

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vertical fenestration (40% maximum of above-grade wall)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U-factor</strong></td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.40</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Framing materials other than metal with or without metal reinforcement or cladding</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U-factor</strong></td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.40</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Metal framing with or without thermal break</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtain wall/storefront <strong>U-factor</strong></td>
<td>1.0</td>
<td>0.70</td>
<td>0.60</td>
<td>0.50</td>
<td>0.45</td>
<td>0.45</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>Entrance door <strong>U-factor</strong></td>
<td>1.20</td>
<td>1.10</td>
<td>0.90</td>
<td>0.85</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>All other <strong>U-factor</strong></td>
<td>1.20</td>
<td>0.75</td>
<td>0.65</td>
<td>0.55</td>
<td>0.55</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td><strong>SHGC-all frame types</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHGC: <strong>PF &lt; 0.25</strong></td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>SHGC: <strong>0.25 ≤ PF &lt; 0.5</strong></td>
<td>0.33</td>
<td>0.33</td>
<td>0.33</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>SHGC: <strong>PF ≥ 0.5</strong></td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td><strong>Skylights (3% maximum)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>U-factor</strong></td>
<td>0.75</td>
<td>0.75</td>
<td>0.65</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>SHGC</strong></td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

**NR** = No requirement.
**PF** = Projection factor (see Section 502.3.2).

- All others includes operable windows, fixed windows and nonentrance doors.
Vertical Fenestration Requirement (502.3.1)

- Based on above-grade wall area (gross)
- Includes walls between conditioned space and unconditioned space or the great outdoors
- Total fenestration area (includes frame and glazing)
Fenestration U-Factor (502.3.2)

Framing Materials Other Than Metal w/ or w/o metal reinforcement or cladding
• Includes vinyl and wood frame products or other non-metal frames
• Typically manufactured fenestration products
Fenestration U-Factor – Curtain Wall

By definition: Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.
Fenestration U-Factor – Storefront

- By definition: A nonresidential system of doors and windows mulled as a composite fenestration structure that has been designed to resist heavy use.
- Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.
Fenestration U-Factor (303.1.3)

**How Do You Meet the Requirement?**
- Fenestration product rating in accordance to NFRC 100
- Labeled and certified by the manufacturer
- Non-NFRC 100 rated fenestration
- Default Glazed Fenestration U-factor Table 102.1.3(1)
Default U-Factors from Tables 303.1.3(1) and (2)

### TABLE 102.1.3(1)
DEFAULT GLAZED FENESTRATION U-FACTOR

<table>
<thead>
<tr>
<th>FRAME TYPE</th>
<th>SINGLE PANE</th>
<th>DOUBLE PANE</th>
<th>SKYLIGHT Single</th>
<th>SKYLIGHT Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
<td>2.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
<td>0.65</td>
<td>1.90</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
<td>0.55</td>
<td>1.75</td>
<td>1.05</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
<td></td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 102.1.3(2)
DEFAULT DOOR U-FACTORS

<table>
<thead>
<tr>
<th>DOOR TYPE</th>
<th>U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninsulated Metal</td>
<td>1.20</td>
</tr>
<tr>
<td>Insulated Metal</td>
<td>0.60</td>
</tr>
<tr>
<td>Wood</td>
<td>0.50</td>
</tr>
<tr>
<td>Insulated, nonmetal edge, max 45% glazing, any glazing double pane</td>
<td>0.35</td>
</tr>
</tbody>
</table>
Glazed Fenestration SHGC (502.3.2)

What is Solar Heat Gain Coefficient?

“The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.”
Fenestration SHGC Requirements – Table 303.1.3(3)

Two Options for Meeting the SHGC Requirements
• Fenestration product rated and labeled to NFRC 200, or
• Select default from Table 303.1.3(3)

<table>
<thead>
<tr>
<th>TABLE 102.1.3(3)</th>
<th>DEFAULT GLAZED FENESTRATION SHGC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SINGLE GLAZED</strong></td>
<td><strong>DOUBLE GLAZED</strong></td>
</tr>
<tr>
<td>Clear</td>
<td>Clear</td>
</tr>
<tr>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Tinted</td>
<td>Tinted</td>
</tr>
<tr>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>GLAZED BLOCK</strong></td>
<td></td>
</tr>
<tr>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>
Fenestration SHGC Requirements

The Effect of Overhangs on Fenestration SHGC

• Overhangs allow a higher SHGC product to be installed
• Projection factor must be calculated
Skylight U-Factor / SHGC

- Limited to ≤ 3% of Roof Area
- U-factor and SHGC Based
- NFRC 100 Rating for U-factor or Default Table
TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION
U-FACTOR

<table>
<thead>
<tr>
<th>FRAME TYPE</th>
<th>SINGLE PANE</th>
<th>DOUBLE PANE</th>
<th>SKYLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single</td>
<td>Double</td>
<td>Single</td>
</tr>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
<td>2.00</td>
</tr>
<tr>
<td>Metal with Thermal Break</td>
<td>1.10</td>
<td>0.65</td>
<td>1.90</td>
</tr>
<tr>
<td>Nonmetal or Metal Clad</td>
<td>0.95</td>
<td>0.55</td>
<td>1.75</td>
</tr>
<tr>
<td>Glazed Block</td>
<td></td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>
Mandatory Requirements – Sealing of the Building Envelope (502.4.3)

- All penetrations, openings, joints and seams in the building envelope must be sealed. Materials that can be used include:
  - Moisture vapor-permeable wrapping material
  - Sealing materials spanning joints between dissimilar materials must allow for expansion and contraction
Hot Gas Bypass (502.4.4)

- Cooling systems can’t use unless system designed with
  - Multiple steps of unloading OR
  - Continuous capacity modulation
- Capacity limited per Table 502.4.4
- Exception
  - Unitary packaged systems with cooling capacities < 90,000 Btu/h

<table>
<thead>
<tr>
<th>Rated Capacity</th>
<th>Maximum Hot Gas Bypass Capacity (% of total capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 240,000 Btu/h</td>
<td>50%</td>
</tr>
<tr>
<td>&gt; 240,000 Btu/h</td>
<td>25%</td>
</tr>
</tbody>
</table>
Mandatory Requirements – Outdoor Air Intakes and Exhaust Openings (502.4.5)

- Buildings ≥ 3 stories in height above grade
- Class 1 motorized leakage-rated damper
- Maximum leakage rate ≤ 4cfm /ft$^2$ @ 1.0 inch w.g.
Mandatory Requirements – Loading Dock Weatherseals (502.4.6)

- Equip cargo doors and loading dock doors with weather seals
- Goal is to restrict infiltration
Mandatory Requirements – Vestibules (502.4.7)

- Required to reduce infiltration into spaces
- Required on entrance doors leading into spaces ≥ 3,000 ft²
- Doors must have self-closing devices
Mandatory Requirements – Recessed Lighting (502.4.8)

All recessed luminaries installed in the building envelope

- Type IC rated and sealed with gasket or caulk between housing and interior wall or ceiling covering
- Type IC rated and labeled in accordance with ASTM E 283 to allow ≤ 2.0 cfm of air movement from conditioned space to ceiling cavity
Thank You!
Comment card