

CSI - Ohio

The Common Sense Initiative

Business Impact Analysis

Agency Name: Ohio Board of Building Standards

Regulation/Package Title: Ohio Building Code Amendments

Rule Number(s): 4101:1-1-01, 4101: 1-13-01, 4101:1-35-01

Date: June 15, 2016

Rule Type:

New

5-Year Review

Amended

Rescinded

The Common Sense Initiative was established by Executive Order 2011-01K and placed within the Office of the Lieutenant Governor. Under the CSI Initiative, agencies should balance the critical objectives of all regulations with the costs of compliance by the regulated parties. Agencies should promote transparency, consistency, predictability, and flexibility in regulatory activities. Agencies should prioritize compliance over punishment, and to that end, should utilize plain language in the development of regulations.

Regulatory Intent

1. Please briefly describe the draft regulation in plain language.

Please include the key provisions of the regulation as well as any proposed amendments.

The Ohio Board of Building Standards (Board) proposes to amend Ohio Administrative Code (OAC) Rules as follows:

4101:1-1-01 to revise modify the fees for services provided by the Division of Industrial Compliance;

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4101:1-13-01 (rescind and adopt new) to adopt ASHRAE 90.1-10 and the 2012 IECC with selected amendments; and

4101:1-35-01 to update the references to the ASHRAE 90.1 to the 2010 edition and the IECC to the 2012 edition in the list of referenced standards.

2. Please list the Ohio statute authorizing the Agency to adopt this regulation.

Revised Code § 3781.10: <http://codes.ohio.gov/orc/3781.10>

Revised Code § 3781.11: <http://codes.ohio.gov/orc/3781.11>

Revised Code § 3791.07: <http://codes.ohio.gov/orc/3791.07>

3. Does the regulation implement a federal requirement? Is the proposed regulation being adopted or amended to enable the state to obtain or maintain approval to administer and enforce a federal law or to participate in a federal program?

If yes, please briefly explain the source and substance of the federal requirement.

Yes. The Energy Conservation and Production Act (ECPA) requires the Secretary of Energy to review new editions of the model energy codes or successor codes and determine whether the codes will improve energy efficiency. If so, the results of the review are published in the *Federal Register* and each state is required to submit a certification to the Secretary of Energy that it has reviewed the most recent code and made a determination of whether to adopt the code or request an extension within two years of the *Federal Register* notice. On October 19, 2011, Department of Energy determined that the 2010 ASHRAE 90.1 standards achieves greater energy efficiency for commercial buildings over the 2007 edition. In October 2013, the Board, jointly with Office of Energy in the Development Services Agency, requested a 2 year extension to review the 2010 ASHRAE 90.1 standard. The Board's review the energy standards included in this rule package, which began in the fall of 2015, and its decision to update to the newer editions that have been determined to achieve greater energy efficiency is in compliance with its request for extension and its ECPA obligations.

4. If the regulation includes provisions not specifically required by the federal government, please explain the rationale for exceeding the federal requirement.

NA

5. What is the public purpose for this regulation (i.e., why does the Agency feel that there needs to be any regulation in this area at all)?

Revised Code § 3781.10 directs the Board to “formulate and adopt rules governing the erection, construction, repair, alteration and maintenance of all buildings specified in section

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3781.06 of the Revised Code...” It further requires that the Board’s rules also “relate to the conservation of energy and the safety and sanitation of those buildings.”

6. How will the Agency measure the success of this regulation in terms of outputs and/or outcomes?

The enforcement of these rules will be implemented by certified township, city, and county building departments. Rule 4101:1-1-01 lays out the administrative procedures certified building departments must follow to implement the substantive requirements of these rules to determine compliance. These provisions require a builder or owner to make application to a building department to obtain an approval to build (permit). As part of this application the owner must submit sufficient information and/or construction documents for the building official/plans examiner to determine whether the proposed work complies with the code. After the builder or owner obtains the approval (permit), construction may commence and the building department inspectors will inspect the construction to ensure that the work conforms with the original approval. Rule 4101:1-1-01 § 105.2 provides that in the absence of fraud or a serious safety or sanitation hazard, any non-residential structure built in accordance with approved plans shall be conclusively presumed to comply with these rules. The Board requires that certified nonresidential building departments submit an annual yearly operational report which lists the following information: current employees and their certifications, total number of permits issued during the year for each type of occupancy, total number of inspections made, the total value of construction, and the total number of appeals of the code requested by a builder or owner during the year.

Development of the Regulation

7. Please list the stakeholders included by the Agency in the development or initial review of the draft regulation.

If applicable, please include the date and medium by which the stakeholders were initially contacted.

Continuing law in Rules 4101:1-1-01, 4101:1-13-01 and 4101:1-35-01 were previously reviewed by the Common Sense Initiative (CSI) Office. On March 22, 2012, October 31, 2012, January 9, 2014 and September 11, 2015, the CSI Office issued memorandums making no recommendations regarding Rule 4101:1-1-01 and concluded that the Board should proceed with formal rule filing with the Joint Committee on Agency Rule Review. On January 9, 2015, the CSI Office issued a memorandum making no recommendation regarding Rule 4101:1-13-01 and concluded that the Board should proceed with formal rule filing with the Joint Committee on Agency Rule Review. On October 31, 2014, January 9, 2014, and September 11, 2015, the CSI Office issued a memorandum making no recommendation regarding Rule

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4101:1-35-01 and concluded that the Board should proceed with formal rule filing with the Joint Committee on Agency Rule Review.

On December 11, 2015, the Board sent an email to all agency stakeholders informing them of a scheduled stakeholder meeting on January 12, 2016 to hear comments and respond to questions on these rules. The email and stakeholder distribution list are attached as Exhibit A. The notice summarized the proposed amendments and also informed stakeholders that they if they could not attend the stakeholder meeting, they could submit questions or comments via email or regular mail January 12, 2016. On January 12, the Board conducted a stakeholder meeting on the proposed rules at 10:00 AM and the following individuals attended: Bill Kaufholz, Fischer Homes, Jason Finch, Fischer Homes, Eric Lacey, RECA, Jeff Mang, PIMA, John Stahl, Preferred Solutions, Inc, Janis Stahl, Preferred Solutions Inc, Bert Thomson, Mid Ohio Development, Don Phillips, COCOA, Marty Burns, Therm-All, Vince Squillace, OHBA, Ric Johnson, OHBA and Alec Carnes, Heapy Engineering. The stakeholder meeting agenda and materials distributed at the meeting are attached as Exhibit B.

8. What input was provided by the stakeholders, and how did that input affect the draft regulation being proposed by the Agency?

A copy of the correspondence the Board received in response to December 11, 2015 email and a summary of the January 12, 2016 stakeholder meeting are attached as Exhibit C. The initial comments received were reviewed by the Board's Code Committee at its January 14, 2016 and March 3, 2016 meetings.

At the January 12th stakeholder meeting, Alec Carnes requested that instead of deleting Section 8.4.2 from ASHRAE 90.1 for Automatic Receptacle Controls, that the Board delete the requirement based on occupancy. The Board's Code Committee reviewed the request and determined not to make a change as a result of the comment.

At the January 12th stakeholder meeting and in written comments, Jeff Mang requested that the Board incorporate language from the 13 ASHRAE 90.1 and 15 IECC for roof recovery and provides clarification. Upon review of these comments, the Board's Code Committee agreed the rules required additional clarification. The revised language as a result of these comments is included in this rule package.

At the January 12th stakeholder meeting, Bill Kaufholz, Fischer Homes, asked the Board to consider referring to the RCO for energy code requirements for R-2, R-3 and R-4 so that the energy requirements and associated costs would not be different between these occupancies and 1-, 2- 3- family homes. Mr. Kaufholz explained that in Kentucky the state had adopted the 12 IECC in 2014, but then rescinded the action due to the cost impact. He stated that the

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same demographic are shopping for multi-family that are shopping for 1- 2- & 3- family and the increase in cost for compliance with 12 IECC vs the RCO would put the multi-family builders at a disadvantage. The Board's Code Committee and Board Staff worked with Mr. Kaufholz to develop language to allow certain residential occupancies to continue to use the energy code requirements referenced in the RCO. The revised language as a result of these comments is included in this rule package.

At the January 12, 2016 stakeholder meeting, Bert Thompson requested amendment to 12 IECC to all for sampling to comply with blower door testing requirements for multi-family homes when multiple identical units are constructed. Staff responded that currently similar language is included the RCO for 1- 2- 3- family homes under the Ohio Home Builders alternative compliance path and invited Mr. Thompson to submit suggested language. Mr. Thompson did not submit language for consideration.

Daniel Lea submitted written comments requesting modifications to Section 1301.2 of the IECC for calculating ACH rated. Upon review of these comments, the Board's Code Committee agreed the rules required additional clarification. The revised language as a result of these comments is included in this rule package.

9. What scientific data was used to develop the rule or the measurable outcomes of the rule? How does this data support the regulation being proposed?

The proposed changes include updates to the 2012 edition of the International Energy Conservation Code (IECC) and the 2010 edition of ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1).

The IECC is promulgated and amended by the International Code Council (ICC). The model codes developed by ICC are updated every three years through a process that incorporates petitioning, public hearings and voting by ICC members. When a petition to amend the model code is submitted, the proponent of the change must submit the proposed language of the amendment, the reason for the amendment including scientific data when applicable, and the cost impact of the amendment. All submitted petitions are then published prior to initial code development hearings on the petitions. Interested persons may review the proposed changes and attend the code development hearing and provide comments. A report then is published on the public hearings for review and then final action is taken on the proposed changes at final action hearings. All successful changes are incorporated into the next edition of the model code.

The ASHRAE 90.1 standards is promulgated and amended by American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The ASHRAE 90.1 standard is updated

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every three years through a consensus similar to the ICC code development process. Merle McBride, a member of the ASHRAE 90.1 Committee, attended the Board's Code Committee meetings during its review of the standard to provide information to the Committee and answer questions.

10. What alternative regulations (or specific provisions within the regulation) did the Agency consider, and why did it determine that these alternatives were not appropriate? If none, why didn't the Agency consider regulatory alternatives?

During its review of IECC and ASHRAE 90.1 standards, the Board's Code Committee reviewed both the 2012 and 2015 editions of the IECC and the 2010 and 2013 editions of ASHRAE 90.1. The Board determined to not adopt these newer editions of the standards as incremental changes in energy code requirements are preferable.

11. Did the Agency specifically consider a performance-based regulation? Please explain.

Performance-based regulations define the required outcome, but don't dictate the process the regulated stakeholders must use to achieve compliance.

Yes, the energy standards proposed to be updated in this package include performance-based compliance paths including an option to use free trade-off software available from the US Department of Energy to demonstrate compliance.

Additionally, continuing law permits a registered design professional's alternative engineered design to be a compliance alternative method to the prescriptive requirements of the code. Section 106.5 of the OBC permits a registered design professional to submit sufficient technical data to substantiate that performance of the proposed alternative engineered design meets the intent of the code. Additionally, section 107.4.3 provides that when construction documents have been prepared by an Ohio registered design professional conforming to the requirements of the rules of the Board pertaining to design loads, stresses, strength, and stability and other requirements involving technical analysis, the documents need only be examined to the extent necessary to determine conformity with other requirements of the rules of the Board.

12. What measures did the Agency take to ensure that this regulation does not duplicate an existing Ohio regulation?

Editorial changes are routinely made to the rules to provide consistency with the Ohio Revised Code and other Board and agencies' rules. Additionally, RC § 3781.10 gives the Board sole authority to adopt rules which regulate the erection, construction, repair, alteration, and maintenance of all buildings or classes of buildings specified RC 3781.06 including residential and non-residential buildings.

13. Please describe the Agency’s plan for implementation of the regulation, including any measures to ensure that the regulation is applied consistently and predictably for the regulated community.

For these rules to be enforced by a local government, its building department must be certified by the Board. The Board also certifies the personnel who work within these departments to ensure only qualified personnel are enforcing the Board’s rules. Certified personnel must complete continuing education to maintain their certifications and continue to be authorized to enforce these rules. The Board has authority to suspend or revoke certifications for failure to properly enforce the rules. Also, the Board has a staff member dedicated to responding to complaints by persons affected by the Board rules. This program helps promote consistent and predictable application of the Board rules.

Adverse Impact to Business

14. Provide a summary of the estimated cost of compliance with the rule. Specifically, please do the following:

a. Identify the scope of the impacted business community;

- Corrected Division of Industrial Compliance fee for new construction
- Updated energy standards with increased cost of construction
- Cost to purchase updated energy standards

b. Identify the nature of the adverse impact (e.g., license fees, fines, employer time for compliance); and

- Corrected Division of Industrial Compliance fee for new construction – Application fees
- Updated energy standards with increased cost of construction – Equipment/material costs; labor costs
- Cost to purchase updated energy standards – Publication cost

c. Quantify the expected adverse impact from the regulation.

The adverse impact can be quantified in terms of dollars, hours to comply, or other factors; and may be estimated for the entire regulated population or for a “representative business.” Please include the source for your information/estimated impact.

Corrected Division Industrial Compliance Certificate of Occupancy fee for new construction -- Amendments Group 90 reviewed by CSI Office and adopted by the Board effective January 1, 2016 included fee increases for the Division of Industrial

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Compliance which were projected to increase fees for 10,000 sq. ft. F-1 building would be approximately \$360. Included in the changes were an inadvertent removal of \$65 Certificate of Occupancy fee for new construction which was included in the overall projected fee increase analysis above.

Updated energy standards with increased cost of construction – Due to the variance in allowed building designs, particularly commercial buildings, it is difficult to ascertain in dollars, a cost increase or decrease in the design/construction cost of building as a result of proposed rules changes. However, the US Department of Energy (DOE) has evaluated the cost/savings associated with updating ASHRAE 90.1 standard from the 2007 to 2010 edition and the IECC from the 2009 to 2012 edition based on representative building prototypes. For example, DOE estimates that for a 5500 sq ft small office building, the construction cost increase in the climate zone that covers most of Ohio would be \$8622 which includes changes in the requirements for building envelope, power, HVAC & lighting from the 2007 to 2010 ASHRE 90.1 standard. The cost impact of the update to the IECC would be similar.

The DOE studies can be found at the following links in their entirety:

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22972.pdf

<https://www.energycodes.gov/sites/default/files/documents/PNNL-22760.pdf>

Cost to purchase updated energy standards – A combined volume that includes both the 2012 IECC and AHSRAE 90.1-2010 standards are available for purchase for \$128 from the International Code Council

15. Why did the Agency determine that the regulatory intent justifies the adverse impact to the regulated business community?

Corrected Division Industrial Compliance Certificate of Occupancy fee for new construction - Based on fee comparison study performed by the Division, even with the fee increase the Division's fees are still lower for comparable projects than several of the larger municipal building departments around the state. Finally, the increases are also offset by proposed fee reductions, including the elimination of \$65 fee for certificates of occupancy and development of special fee schedule for temporary structures.

Updated energy standards with increased cost of construction – While there is cost increase in the first cost of construction associated with these standards update as discussed above, DOE also estimates cost savings over time due to lower energy costs. For the 5500 sq ft small

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office building, the simple payback in energy savings would occur after 8.7 years and life cycle cost net savings is estimate to be \$14,300. More detailed cost/benefit discussion can be found in the DOE studies listed above. Additionally, the Board is directed in RC 3781.10 to adopt standards that relate to the conservation of energy. See Question 5 above. Finally, the proposed adoption of the energy standards fulfills the commitment by the Board to review the 2010 ASHRAE 90.1 standard that has been determined to achieve greater energy efficiency is in compliance with its request for extension and its ECPA obligations. See Question 3 above.

Regulatory Flexibility

16. Does the regulation provide any exemptions or alternative means of compliance for small businesses? Please explain.

The rules do not have special exemptions or alternative means of compliance specifically for small business. The OBC requires a building official to issue an adjudication order to an owner when the design or construction of a building does not comply with the OBC. The adjudication order must comply with Revised Code Chapter 119 and give the owner an opportunity to appeal. This mechanism is often utilized by an owner voluntarily to obtain a variance from the requirements. Variance requests are heard by either the Ohio Board of Building Appeals or a certified local board of building appeals.

Also, the OBC permits alternative engineered designs prepared by a registered design professional to not strictly comply with the prescriptive requirements of the rules. To obtain approvals based on alternative engineered designs, the design professional must submit sufficient technical information to demonstrate that the performance meets the intent of the rules.

17. How will the agency apply Ohio Revised Code section 119.14 (waiver of fines and penalties for paperwork violations and first-time offenders) into implementation of the regulation?

Revised Code § 3781.102 does not authorize the Board to set the fees and/or penalties assessed by local certified building departments in connection with the enforcement of these rules. Compliance with the rules is accomplished through construction conforming to the certificate of plan approval (permit). Therefore, there are no potential paperwork violations of these rules.

18. What resources are available to assist small businesses with compliance of the regulation?

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The Board's technical staff spends approximately 25% of their time responding to questions on the building codes and educating design professionals, contractors, the public, and code officials of the intent of the Board's rules assisting all parties in compliance.

Exhibit A

Hanshaw, Regina

From: Lane, Michael
Sent: Friday, December 11, 2015 3:36 PM
To: Hanshaw, Regina; Regoli, Steve; Ohler, Debbie; Johnson, Robert
Subject: FW: Board of Building Standards Proposed Rules/Stakeholder Meeting Notification (Commercial Energy Codes)
Attachments: Stakeholder Meeting Notification.pdf

From: Lane, Michael
Sent: Friday, December 11, 2015 3:34 PM
To: Lane, Michael <Michael.Lane@com.state.oh.us>
Subject: Board of Building Standards Proposed Rules/Stakeholder Meeting Notification (Commercial Energy Codes)

Board of Building Standards Stakeholder:

You are receiving this message pursuant to the requirements of Executive Order 2011-01K and Senate Bill 2 of the 129th General Assembly, which require state agencies, including the Ohio Board of Building Standards (Board), to draft rules in collaboration with stakeholders, assess and justify any adverse impact on the business community, and provide opportunity for the affected public to provide input on the rules.

Stakeholder Meeting

The Board will conduct a Stakeholder Meeting to hear comments and respond to questions on the proposed amendments summarized below on January 12, 2016 at 10:00 AM in Training Room 1, 6606 Tussing Road, Reynoldsburg, Ohio 43068. All interested stakeholders are invited to attend.

Overview of Proposed Rules

Proposed Ohio Building Code Rules

These proposed rules can be viewed here: <http://www.com.ohio.gov/dico/bbs/ProposedRules.aspx>
4101:1-13-01 to adopt ASHRAE 90.1-10 and the 2012 IECC with selected amendments; and **4101:1-35-01** to update the references to the ASHRAE 90.1 to the 2010 edition and the IECC to the 2012 edition in the list of referenced standards.

Contact Information for Comments or Questions

If you cannot attend the above Stakeholder Meeting, you can submit written comments or questions on the proposed amendments to the Board. You may submit your comments via email at BBS@com.state.oh.us or U.S. Mail at Ohio Board of Building Standards, 6606 Tussing Rd, Reynoldsburg, Ohio 43068, Attn: Regina Hanshaw by January 12, 2016.

Sincerely,

Regina S. Hanshaw
Executive Secretary
Ohio Board of Building Standards

*

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Sincerely,

Regina S. Hanshaw
Executive Secretary
Ohio Board of Building Standards

Stakeholder List

10/21/15

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Exhibit B

Stakeholder Meeting
Proposed Ohio Building Code Rule Changes
January 12, 2016
10:00 AM

The Board is conducting this stakeholder meeting as part of the Common Sense Initiative (CSI) Business Regulation Impact process to provide information on proposed rules and respond to questions from interested persons prior to formal rule-filing. After review of all comments submitted in writing and at today's meeting, the Board will incorporate any approved changes as a result of the comments and document the reasons for the changes in a Business Regulatory Impact Analysis. The revised rules and the Business Regulatory Impact Analysis will then be filed with the CSI Office for review and recommendation and resent to stakeholders via e-notification. After receipt of the CSI Office recommendations, the Board will determine whether to move forward with formal rule-filing. If the Board does determine to formally file these rules, as revised, the Board will also conduct a regular public hearing prior to their adoption as required by Revised Code Chapter 119.

Proposed Ohio Building Code Rule Changes

The Board proposes to amend the Ohio Administrative Code as follows: **4101:1-13-01** to adopt ASHRAE 90.1-10 and the 2012 IECC with selected amendments; and **4101:1-35-01** to update the references to the ASHRAE 90.1 to the 2010 edition and the IECC to the 2012 edition in the list of referenced standards.



Department of Commerce

Division of Industrial Compliance

John R. Kasich, Governor

Jacqueline T. Williams, Director

JANUARY 2016 STAKEHOLDER MEETING 2011 OHIO BUILDING CODE PROPOSED CHANGES – COMMERCIAL ENERGY CODE

Ohio Administrative Code Rule Number	OBC Section	Reason for Proposed Change
4101:1-13-01	1301.2	To add and identify modifications to the 2012 IECC
	1301.3	To add and identify modifications to the 2010 ASHRAE 90.1
4101:1-35-01	ASHRAE	To update from the 2007 to the 2010 standard 90.1
	ICC	To update from the 2009 to the 2012 IECC

4101:1-13-01 Energy efficiency.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1301 GENERAL

1301.1 Scope. This chapter governs the design and construction of buildings for energy efficiency.

1301.1.1 Criteria. Buildings shall be designed and constructed in accordance with the *applicable provisions of the "International Energy Conservation Code" or the requirements of "ASHRAE 90.1" listed in Chapter 35 of this code except as modified in Sections 1301.2 and 1301.3.*

1301.2 Modification to International Energy Conservation Code. *The following changes shall be made to the International Energy Conservation Code:*

~~1. Table 402.4.2—~~

~~a. In the first row, second column, delete the last item titled "Air permeable insulation is inside of an air barrier".~~

~~b. Delete the last row.~~

Section R402.4.1.2, the first sentence shall be modified to read as follows: The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding 4 air changes per hour.

2. ~~Section 402.4.3~~ R402.4.2 shall read "Fireplaces. New wood-burning fireplaces shall have doors or tight-fitting flue dampers and outdoor combustion air. If using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace."

3. Section R403.2.3 shall read "Building cavities (Mandatory). Building framing cavities shall not be used as supply ducts."

4. Section 403.9 – Delete section and all subsections.

1301.3 Modifications to ASHRAE 90.1. The following changes shall be made to the ASHRAE 90.1:

1. Addenda ap, ci, and de included in the ASHRAE "Standard 90.1-2010 Addenda 2013 Supplement Package" as found on the ASHRAE website <https://www.ashrae.org/standards-research--technology/standards-addenda> are also adopted and intended to be applicable to computer rooms and data centers.
2. Section 8.4.2 Automatic Receptacle Control; Delete section.

4101:1-35-01 Referenced standards.

3501.1 General. *This chapter lists the standards that are referenced in various sections of the building code. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title. The application of the referenced standards shall be as specified in Section 102.5.*

3501.2 Referenced codes. *When indicated in this code, the following codes refer to provisions in the listed chapters of the administrative code:*

<i>Referenced Code</i>	<i>Ohio Administrative Code Chapters</i>
<i>Building Code</i>	<i>4101:1-1 to 4101:1-35</i>
<i>Energy Code</i>	<i>4101:1-13</i>
<i>Fire Code</i>	<i>1301:7-1 to 1301:7-7</i>
<i>Mechanical Code</i>	<i>4101:2-1 to 4101:2-15</i>
<i>Ohio Boiler and Pressure Vessel Rules</i>	<i>4101:4-1 to 4101:4-10</i>
<i>Ohio Elevator Code</i>	<i>4101:5-1 to 4101:5-3</i>
<i>Residential Code of Ohio for One, Two and Three Family Dwellings</i>	<i>4101:8-1 to 4101:8-44</i>
<i>Plumbing Code</i>	<i>4101:3-1 to 4101:3-13</i>

3501.3 Building Code Referenced Standards.

Aluminum Association
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209

AA

**Standard
reference
number**

ADM1—10

Title

Aluminum Design Manual: Part 1-A Specification for Aluminum Structures, Allowable Stress Design; and Part 1-B—Aluminum Structures, Load and Resistance Factor Design

ASM 35—00 Aluminum Sheet Metal Work in Building Construction
(Fourth Edition)

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Schaumburg, IL 60173

**AAMA
Standard
reference
number**

1402—09

Title

Standard Specifications for Aluminum Siding, Soffit
and Fascia

AAMA/WDMA/CSA
101/I.S.2/A440—08

North American Fenestration
Standard/Specifications for Windows, Doors and
Skylights

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331

**ACI
Standard
reference
number**

216.1—07

Title

Standard Method for Determining Fire Resistance of
Concrete and Masonry Construction Assemblies

318—08

Building Code Requirements for Structural Concrete

530—08

Building Code Requirements for Masonry Structures

530.1—08

Specifications for Masonry Structures

American Forest & Paper Association
1111 19th St, NW Suite 800
Washington, DC 20036

**AF&PA
Standard
reference
number**

Title

WCD No. 4—03	Wood Construction Data—Plank and Beam Framing for Residential
NDS—05	National Design Specification (NDS) for Wood Construction with 2005 Supplement
AF&PA—93	Span Tables for Joists and Rafters
ANSI/AF&PA PWF—07	Permanent Wood Foundation Design Specification
ANSI/AF&PA SDPWS—08	Special Design Provisions for Wind and Seismic

American Institute of Steel Construction
One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001

AISC
Standard
reference
number

	Title
341—05	Seismic Provisions for Structural Steel Buildings, including Supplement No. 1 dated 2005
360—05	Specification for Structural Steel Buildings

American Iron and Steel Institute
1140 Connecticut Avenue
Suite 705
Washington, DC 20036

AISI
Standard
reference
number

	Title
S100—07	North American Specification for the Design of Cold-formed Steel Structural Members
S200—08	North American Standard for Cold-formed Steel Framing—General
S210—08	North American Standard for Cold-formed Steel Framing—Floor and Roof System Design
S211—08	North American Standard for Cold-formed Steel Framing—Wall Stud
S212—08	North American Standard for Cold-formed Steel Framing—Header Design

S213—08	North American Standard for Cold-formed Steel Framing— Lateral Design
S214—08	North American Standard for Cold-formed Steel Framing— Truss Design, with Supplement 2, dated 2008

American Institute of Timber Construction
Suite 140
7012 S. Revere Parkway
Englewood, CO 80112

**AITC
Standard
reference
number**

Title

AITC Technical Note 7—96	Calculation of Fire Resistance of Glued Laminated Timbers
AITC 104—03	Typical Construction Details
AITC 110—01	Standard Appearance Grades for Structural Glued Laminated
AITC 113—01	Standard for Dimensions of Structural Glued Laminated Timber
AITC 117—04	Standard Specifications for Structural Glued Laminated Timber of Softwood Species
AITC 119—96	Standard Specifications for Structural Glued Laminated Timber of Hardwood
AITC200—09	Manufacturing Quality Control Systems Manual for Structural Glued Laminated Timber
ANSI/AITCA 190.1—07	Structural Glued Laminated Timber

Automotive Lift Institute
P.O. Box 85
Courtland, NY 13045

**ALI
Standard
reference
number**

Title

ALI ALCTV—2007	Standard for Automobile Lifts—Safety Requirements for Construction, Testing and Validation (ANSI)
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American National Standards Institute
 25 West 43rd Street, Fourth Floor
 New York, NY 10036

ANSI Standard reference number	Title
A13.1—07	Scheme for the Identification of Piping Systems
A108.1A—09	Installation of Ceramic Tile in the Wet-set Method, with Portland Cement
A108.1B—09	Installation of Ceramic Tile, quarry Tile on a Cured Portland Cement Mortar Setting Bed with Dry-set or Latex-
A108.4—09	Installation of Ceramic Tile with Organic Adhesives or Water-cleanable Tile-setting Epoxy Adhesive
A108.5—09	Installation of Ceramic Tile with Dry-set Portland Cement Mortar or Latex-portland Cement Mortar
A108.6—09	Installation of Ceramic Tile with Chemical-resistant, Water Cleanable Tile-setting and -grouting Epoxy
A108.8—09	Installation of Ceramic Tile with Chemical-resistant Furan Resin Mortar and Grout
A108.9—09	Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout
A108.10—09	Installation of Grout in Tilework
A118.1—10.1	American National Standard Specifications for Dry-set Portland Cement
A118.3—10.1	American National Standard Specifications for Chemical-resistant, Water-cleanable Tile-setting and -grouting Epoxy and Water Cleanable Tile-setting Epoxy
A118.4—10.1	American National Standard Specifications for Latex-portland Cement
A118.5—10.1	American National Standard Specifications for Chemical Resistant Furan Mortar and Grouts for Tile
A118.8—10.1	American National Standard Specifications for Modified Epoxy Emulsion Mortar/Grout
A136.1—10.1	American National Standard Specifications for Organic Adhesives for Installation of Ceramic
137.1—08	American National Standard Specifications for Ceramic Tile
A208.1—09	Particleboard

Z 97.1—09 Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test

APA - Engineered Wood Association
7011 South 19th
Tacoma, WA 98466

**APA
Standard
reference
number**

Title

APA PDS—08	Panel Design Specification
APA PDS Supplement 1—90	Design and Fabrication of Plywood Curved Panels (revised 1995)
APA PDS Supplement 2—92	Design and Fabrication of Plywood-lumber Beams (revised 1998)
APA PDS Supplement 3—96	Design and Fabrication of Plywood Stressed-skin Panels (revised 1996)
APA PDS Supplement 4—93	Design and Fabrication of Plywood Sandwich Panels (revised 1993)
APA PDS Supplement 5—95	Design and Fabrication of All-plywood Beams (revised 1995)
EWS R540—07	Builders Tips: Proper Storage and Handling of Glulam Beams
EWS S475—07	Glued Laminated Beam Design Tables
EWS S560—10	Field Notching and Drilling of Glued Laminated Timber Beams
EWS T300—07	Glulam Connection
EWS X440—08	Product Guide— Glulam
EWS X450—01	Glulam in Residential Construction—Western Edition

The Association of Pool & Spa Professionals
2111 Eisenhower Avenue
Alexandria, VA 22314

APSP

**Standard
reference
number**

Title

ANSI/APSP 7—06 Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs and Catch Basins

American Society of Agricultural and Biological Engineers
2950 Niles Road
St. Joseph, MI 49085

**ASABE
Standard
reference
number**

Title

EP 484.2 -98 Diaphragm Design of Metal-clad, Post-frame Rectangular Buildings
EP 486.1 -99 Shallow-post Foundation Design
EP 559 -03 Design Requirements and Bending Properties for Mechanically Laminated Columns

American Society of Civil Engineers
Structural Engineering Institute
1801 Alexander Bell Drive
Reston, VA 20191-4400

**ASCE/SEI
Standard
reference
number**

Title

3—91 Structural Design of Composite Slabs
5—08 Building Code Requirements for Masonry
6—08 Specification for Masonry Structures
7—05 Minimum Design Loads for Buildings and Other Structures including Supplements No. 1 and 2, excluding Chapter 14 and Appendix 11A
8—02 Standard Specification for the Design of Cold-formed Stainless Steel Structural Members
19—10 Structural Applications of Steel Cables for Buildings
24—05 Flood Resistant Design and Construction
29—05 Standard Calculation Methods for Structural Fire Protection

32—01 Design and Construction of Frost Protected Shallow Foundations

*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329-2305*

ASHRAE
Standard
Reference
Number

ASHRAE 90.1-~~2007~~2010

Title

Energy Standard for Buildings Except Low-Rise Residential Buildings (as modified in chapter 13 of this code including Addenda ap, cj, and de applicable to computer rooms and data centers)

American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

ASME
Standard
reference
number

A17.1/CSA B44—2010
A18.1—2008

Safety Code for Elevators and Escalators
Safety Standard for Platform Lifts and Stairway Chairlifts

A90.1—2009

Safety Standard for Belt Manlifts

B16.18—2001

(Reaffirmed 2005)

Cast Copper Alloy Solder Joint Pressure Fittings

B16.22—2001

(Reaffirmed 2005)

Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

B20.1—2009

Safety Standard for Conveyors and Related Equipment

B31.3—2008

Process Piping

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

ASTM Standard reference number	Title
A 36/A 36M—08	Specification for Carbon Structural Steel
A 153/A 153M—09	Specification for Zinc Coating (Hot-dip) on Iron and Steel Hardware
A 240/A 240M—10a	Standard Specification for Chromium and Chromium-nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
A 252—10	Specification for Welded and Seamless Steel Pipe Piles
A 283/A 283M—03(2007)	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
A 307—07b	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A 416/A 416M—10	Specification for Steel Strand, Uncoated Seven-wire for Prestressed Concrete
A 463/A 463M—09a	Standard Specification for Steel Sheet, Aluminum-coated, by the Hot-dip Process
A 572/A 572M—07	Specification for High-strength Low-alloy Columbium-vanadium Structural Steel
A 588/A 588M—10	Specification for High-strength Low-alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inches (100 mm) Thick
A 615/A 615M—09b	Specification for Deformed and Plain Billet-steel Bars for Concrete Reinforcement
A 653/A 653M—09a	Specification for Steel Sheet, Zinc-coated Galvanized or Zinc-iron Alloy-coated Galvannealed by the Hot-dip Process
A 690/A 690M—07	Standard Specification for High-strength Low-alloy Nickel, Copper, Phosphorus Steel H-piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments
A 706/A 706M—09b	Specification for Low-alloy Steel Deformed and Plain Bars for Concrete Reinforcement
A 722/A 722M—07	Specification for Uncoated High-strength Steel Bar for Prestressing

A 755/A 755M—03(2008)	Specification for Steel Sheet, Metallic-coated by the Hot-dip Process and Prepainted by the Coil-coating Process for Exterior Exposed Building Products
A 792/A 792M—09a	Specification for Steel Sheet, 55% Aluminum-zinc Alloy-coated by the Hot-dip Process
A 875/A 875M—09a	Standard Specification for Steel Sheet Zinc-5 percent, Aluminum Alloy-coated by the Hot-dip Process
A 913/A 913M—07	Specification for High-strength Low-alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-tempering Process (QST)
A 924/A 924M—10	Standard Specification for General Requirements for Steel Sheet, Metallic-coated by the Hot-dip Process
A 992/A 992M—06a	Standard Specification for Structural Shapes
B 42—10	Specification for Seamless Copper Pipe, Standard
B 43—09	Specification for Seamless Red Brass Pipe, Standard Sizes
B 68—02	Specification for Seamless Copper Tube, Bright Annealed (Metric)
B 88—09	Specification for Seamless Copper Water Tube
B 101—07	Specification for Lead-coated Copper Sheet and Strip for Building Construction
B 209—07	Specification for Aluminum and Aluminum Alloy Steel and Plate
B 251—10	Specification for General Requirements for Wrought Seamless Copper and Copper-alloy Tube
B 280—08	Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
B 370—09	Specification for Cold-rolled Copper Sheet and Strip for Building Construction
B 695—04(2009)	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
C 5—10	Specification for Quicklime for Structural
C 22/C 22M—00 (2005)e01	Specification for Gypsum
C 27—98 (2008)	Specification for Standard Classification of Fireclay and High-alumina Refractory Brick
C 28/C 28M—10	Specification for Gypsum
C 31/C 31M—10	Practice for Making and Curing Concrete Test Specimens in the Field
C 33—08	Specification for Concrete Aggregates

C 34—10	Specification for Structural Clay Load-bearing Wall Tile
C 35—01(2009)	Specification for Inorganic Aggregates for Use in Gypsum Plaster
C 36/C 36M—03	Specification for Gypsum Wallboard
C 37/C 37M—01	Specification for Gypsum Lath
C 55—09	Specification for Concrete Building Brick
C 56—10	Specification for Structural Clay Nonload Bearing Tile
C 59/C 59M—00 (2006)	Specification for Gypsum Casting and Molding Plaster
C 61/C 61M—00 (2006)	Specification for Gypsum Keene's
C 62—10	Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
C 67—09	Test Methods of Sampling and Testing Brick and Structural Clay
C 73—05	Specification for Calcium Silicate Face Brick (Sand-lime Brick)
C 79—04a	Specification for Treated Core and Nontreated Core Gypsum Sheathing Board
C 90—09	Specification for Loadbearing Concrete Masonry Units
C 91—05	Specification for Masonry Cement
C 94/C 94M—10	Specification for Ready-mixed
C 126—10	Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units
C 140—10	Test Method Sampling and Testing Concrete Masonry Units and Related Units
C 150—09	Specification for Portland Cement
C 172—10	Practice for Sampling Freshly Mixed
C 199—84 (2005)	Test Method for Pier Test for Refractory Mortars
C 206—03 (2009)	Specification for Finishing Hydrated Lime
C 208—08a	Specification for Cellulosic Fiber Insulating Board
C 212—10	Specification for Structural Clay Facing Tile
C 216—10	Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
C 270—10	Specification for Mortar for Unit Masonry
C 315—07	Specification for Clay Flue Liners and Chimney Pots
C 317/C 317M—00 (2005)	Specification for Gypsum Concrete
C 330—09	Specification for Lightweight Aggregates for Structural Concrete

C 331—05	Specification for Lightweight Aggregates for Concrete Masonry Units
C 406—10	Specification for Roofing Slate
C 442/C 442M—04	Specification for Gypsum Backing Board and Coreboard and Gypsum Shaftliner Board
C 472—99 (2009)	Specification for Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
C 473—10	Test Method for Physical Testing of Gypsum Panel Products
C 474—05	Test Methods for Joint Treatment Materials for Gypsum Board Construction
C 475—02 (2007)	Specification for Joint Compound and Joint Tape for Finishing Gypsum Wallboard
C 503—10	Specification for Marble Dimension Stone (Exterior
C 514—04 (2009)e1	Specification for Nails for the Application of Gypsum
C 516—08	Specifications for Vermiculite Loose Fill Thermal
C 547—07e1	Specification for Mineral Fiber Pipe Insulation
C 549—06	Specification for Perlite Loose Fill
C 552—07	Standard Specification for Cellular Glass Thermal Insulation
C 557—03(2009)e01	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
C 568—10	Specification for Limestone Dimension Stone
C 578—10	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
C 587—04 (2009)	Specification for Gypsum Veneer Plaster
C 588/C 588M—01	Specification for Gypsum Base for Veneer Plasters
C 595—10	Specification for Blended Hydraulic Cements
C 615—10	Specification for Granite Dimension
C 616—10	Specification for Quartz Dimension Stone
C 629—10	Specification for Slate Dimension
C 630/C 630M—03	Specification for Water-resistant Gypsum Backing Board
C 631—09	Specification for Bonding Compounds for Interior Gypsum Plastering
C 635/C 635M-07	Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel

C 636/C 636M—08	Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
C 645—09a	Specification for Nonstructural Steel Framing Members
C 652—10	Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
C 728—05 (2010)	Standard Specification for Perlite Thermal Insulation Board
C 744—10	Specification for Prefaced Concrete and Calcium Silicate Masonry
C 754—09a	Specification for Installation of Steel Framing Members to Receive Screw-attached Gypsum Panel Products
C 836/C 836M-10	Specification for High-solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
C 840—08	Specification for Application and Finishing of Gypsum Board
C 841—03 (2008)e1	Specification for Installation of Interior Lathing and Furring
C 842—05	Specification for Application of Interior Gypsum Plaster
C 843—99 (2006)	Specification for Application of Gypsum Veneer Plaster
C 844—10	Specification for Application of Gypsum Base to Receive Gypsum Veneer Plaster
C 847—10a	Specification for Metal Lath
C 887—05 (2010)	Specification for Packaged, Dry Combined Materials for Surface Bonding Mortar
C 897—05 (2009)	Specification for Aggregate for Job-mixed Portland Cement-based Plaster
C 920—10	Standard for Specification for Elastomeric Joint Sealants
C 926—06	Specification for Application of Portland Cement-based Plaster
C 931/C 931M—04	Specification for Exterior Gypsum Soffit Board
C 932—06	Specification for Surface-applied Bonding Compounds Agents for Exterior Plastering
C 933—09	Specification for Welded Wire Lath
C 946—10	Specification for Practice for Construction of Dry-stacked, Surface-bonded Walls

C 954—10	Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch (0.84 mm) to 0.112 inch (2.84 mm) in Thickness
C 955—09a	Standard Specification for Load-bearing Transverse and Axial Steel Studs, Runners Tracks, and Bracing or Bridging, for Screw Application of Gypsum Panel Products and Metal Plaster Bases
C 956—04 (2010)	Specification for Installation of Cast-in-place Reinforced Gypsum
C 957—10	Specification for High-solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
C 960—04	Specification for Predecorated Gypsum Board
C 1002—07	Specification for Steel Self-piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
C 1007—08a	Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
C 1019—09	Test Method of Sampling and Testing Grout
C 1029—10	Specification for Spray-applied Rigid Cellular Polyurethane Thermal Insulation
C 1032—06	Specification for Woven Wire Plaster Base
C 1047—10a	Specification for Accessories for Gypsum Wallboard and Gypsum Veneer
C 1063—08	Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-based Plaster
C 1088—10	Specification for Thin Veneer Brick Units Made from Clay or Shale
C 1167—03 (2009)	Specification for Clay Roof Tiles
C 1177/C 1177M—08	Specification for Glass Mat Gypsum Substrate for Use as Sheathing
C 1178/C 1178M—08	Specification for Coated Glass Mat Water-resistant Gypsum Backing Panel
C 1186—08	Specification for Flat-Fiber Cement Sheets
C 1261—10	Specification for Firebox Brick for Residential Fireplaces
C 1278/C 1278M—07a	Specification for Fiber-reinforced Gypsum Panels
C 1280—09	Specification for Application of Gypsum Sheathing

C 1283—07a	Practice for Installing Clay Flue Lining.
C 1288—99 (2010)	Standard Specification for Discrete Nonasbestos Fiber-cement Interior Substrate Sheets
C 1289—10	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
C 1314—10	Test Method for Compressive Strength of Masonry Prisms
C 1325—08b	Standard Specification for Nonasbestos Fiber-mat Reinforced Cement Interior Substrate Sheets
C 1328—05	Specification for Plastic (Stucco Cement
C 1386—07	Specification for Precast Autoclaved Aerated Concrete (AAC) Wall Construction
C 1395/C 1395M—06a	Specification for Gypsum Ceiling Board
C 1396M—09a	Specification for Gypsum Board
C 1405—10	Standard Specification for Glazed Brick (Single Fired, Solid Brick Units
C 1492—03 (2009)	Standard Specification for Concrete Roof
C 1629/C 1629M—06	Standard Classification for Abuse-resistant Nondecorated Interior Gypsum Panel Products and Fiber-reinforced Cement Panels
C 1658/C 1658M—06	Standard Specification for Glass Mat Gypsum Panels
D 25—99 (2005)	Specification for Round Timber Piles
D 41—05 (2010)	Specification for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
D 43—00 (2006)	Specification for Coal Tar Primer Used in Roofing, Dampproofing and Waterproofing
D 56—05	Test Method for Flash Point By Tag Closed Tester
D 86—10a	Test Method for Distillation of Petroleum Products at Atmospheric Pressure
D 93—10	Test Method for Flash Point By Pensky-Martens Closed Cup Tester
D 225—07	Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules
D 226/D 226M-09	Specification for Asphalt-saturated Organic Felt Used in Roofing and Waterproofing
D 227—03	Specification for Coal-tar-saturated Organic Felt Used in Roofing and Waterproofing
D 312—00 (2006)	Specification for Asphalt Used in
D 422—63 (2007)	Test Method for Particle-size Analysis of Soils
D 448—08	Standard Classification for Sizes of Aggregate for Road and Bridge

D 450—07	Specification for Coal-tar Pitch Used in Roofing, Dampproofing and Waterproofing
D 635—10	Test Method for Rate of Burning and/or Extent and Time of Burning of Self-supporting Plastics in a Horizontal Position
D 1143/D 1143M—07 <i>el</i>	Test Method for Piles Under Static Axial Compressive Load
D 1227—95 (2007)	Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
D 1557—09	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft-lb/ft ³ (2,700 KN m/m ³)]
D 1586—08 <i>a</i>	Specification for Penetration Test and Split-barrel Sampling of Soils
D 1761—06	Test Method for Mechanical Fasteners in Wood
D 1863—05	Specification for Mineral Aggregate Used on Built-up Roofs
D 1929—96 (2001) <i>e01</i>	Test Method for Determining Ignition Properties of Plastics
D 1970—09	Specification for Self-adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roof Underlayment for Ice Dam Protection
D 2166—06	Test Method for Unconfined Compressive Strength of Cohesive Soil
D 2178—04	Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
D 2216—10	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D 2487—10	Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
D 2626—04	Specification for Asphalt Saturated and Coated Organic Felt Base Sheet Used in Roofing
D 2822—05	Specification for Asphalt Roof Cement
D 2823—05	Specification for Asphalt Roof Coatings
D 2843—10	Test for Density of Smoke from the Burning or Decomposition of Plastics
D 2850—03 <i>a</i> (2007)	Test Method for Unconsolidated, Undrained Triaxial Compression Test on Cohesive Soils
D 2898—10	Test Methods for Accelerated Weathering of Fire-retardant-treated Wood for Fire Testing

D 3019—08	Specification for Lap Cement Used with Asphalt Roll Roofing, Nonfibered, Asbestos Fibered and NonasbestosFibered
D 3161—09	Test Method for a Wind Resistance of Asphalt Shingles (Fan Induced Method)
D 3200—74 (2005)	Standard Specification and Test Method for Establishing Recommended Design Stresses for Round Timber Construction Poles
D 3201—08 <i>ae1</i>	Test Method for Hygroscopic Properties of Fire-retardant-treated Wood and Wood-based Products
D 3278—96(2004)e01	Test Methods for Flash Point of Liquids by Small Scale Closed-cup Apparatus
D 3462/ D3462M-10a	Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
D 3468—99 (2006)e1	Specification for Liquid-applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing
D 3679—09a	Specification for Rigid Poly [Vinyl Chloride (PVC) Siding]
D 3689—07	Method for Testing Individual Piles Under Static Axial Tensile Load
D 3737—09	Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)
D 3746—85 (2008)	Test Method for Impact Resistance of Bituminous Roofing Systems
D 3747—79 (2007)	Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation
D 3909—97b (2004)e01	Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
D 3957—09	Standard Practices for Establishing Stress Grades for Structural Members Used in Log Buildings
D 4022—07	Specification for Coal Tar Roof Cement, Asbestos Containing
D 4272—09	Test Method for Total Energy Impact of Plastic Films by Dart Drop
D 4318—10	Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
D 4434/D 4434M-09	Specification for Poly (Vinyl Chloride) Sheet Roofing
D 4479—07	Specification for Asphalt Roof Coatings—Asbestos-free

D 4586—07	Specification for Asphalt Roof Cement—Asbestos-free
D 4601—04	Specification for Asphalt-coated Glass Fiber Base Sheet Used in Roofing
D 4637/D 4637M-10	Specification for EPDM Sheet Used in Single-ply Roof Membrane
D 4829—08a	Test Method for Expansion Index of Soils
D 4869—05e01	Specification for Asphalt-saturated (Organic Felt) Underlayment Used in Steep Slope Roofing
D 4897/D 4897M-01(2009)	Specification for Asphalt-coated Glass Fiber Venting Base Sheet Used in Roofing
D 4945—08	Test Method for High-strain Dynamic Testing of Piles
D 4990—97a (2005)e1	Specification for Coal Tar Glass Felt Used in Roofing and Waterproofing.
D 5019—07a	Specification for Reinforced Nonvulcanized Polymeric Sheet Used in Roofing Membrane
D 5055—10	Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-joists
D 5456—10	Specification for Evaluation of Structural Composite Lumber Products
D 5516—09	Test Method of Evaluating the Flexural Properties of Fire-retardant-treated Softwood Plywood Exposed to the Elevated Temperatures
D 5643—06	Specification for Coal Tar Roof Cement, Asbestos-free
D 5664—10	Test Methods for Evaluating the Effects of Fire-retardant Treatment and Elevated Temperatures on Strength Properties of Fire-retardant-treated Lumber
D 5665—99a (2006)	Specification for Thermoplastic Fabrics Used in Cold-applied Roofing and Waterproofing
D 5726—98 (2005)	Specification for Thermoplastic Fabrics Used in Hot-applied Roofing and Waterproofing .
D 6083—05e01	Specification for Liquid Applied Acrylic Coating Used in Roofing
D 6162—00a (2008)	Specification for Styrene-butadiene-styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

D 6163—00 (2008)	Specification for Styrene-butadiene-styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
D 6164—05 e1	Specification for Styrene-butadiene-styrene (SBS) Modified Bituminous Sheet Metal Materials Using Polyester Reinforcements
D 6222—08	Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcements
D 6223/D6223M-02(2009)e1	Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
D 6298—05e1	Specification for Fiberglass Reinforced Styrene-butadiene-styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface
D 6305—08	Practice for Calculating Bending Strength Design Adjustment Factors for Fire-retardant-treated Plywood Roof Sheathing
D 6380—03 (2009)	Standard Specification for Asphalt Roll Roofing (Organic) Felt
D 6509/D6509M-09	Standard Specification for Atactic Polypropylene (APP) Modified Bituminous base Sheet Materials Using Glass Fiber Reinforcements
D 6694—08	Standard Specification for Liquid-applied Silicone Coating Used in Spray Polyurethane Foam Roofing
D 6754/D6754M-10	Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
D 6757—07	Standard Specification for Inorganic Underlayment for Use with Steep Slope Roofing Products
D 6841—08	Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-retardant-treated Lumber
D 6878—08e1	Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
D 6947—07	Standard Specification for Liquid Applied Moisture Cured Polyurethane Coating Used in Spray Polyurethane Foam Roofing System
D 7158—08d	Standard Test Method for Wind Resistance of Sealed Asphalt Shingles (Uplift Force/Uplift Resistance Method)

E 84—10b	Test Methods for Surface Burning Characteristics of Building Materials
E 90—09	Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E 96/E 96M—05	Test Method for Water Vapor Transmission of Materials
E 108—10a	Test Methods for Fire Tests of Roof Coverings
E 119—10b	Test Methods for Fire Tests of Building Construction and Materials
E 136—09b	Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
E 330—02 (2010)	Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
E 331—00 (2009)	Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
E 492—09	Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-ceiling Assemblies Using the Tapping Machine
E 605—93 (2006)	Test Method for Thickness and Density of Sprayed Fire-resistive Material (SFRM) Applied to Structural Members.
E 681—09	Test Methods for Concentration Limits of Flammability of Chemical Vapors and Gases
E 736—00 (2006)	Test Method for Cohesion/Adhesion of Sprayed Fire-resistive Materials Applied to Structural Members
E 814—10	Test Method of Fire Tests of Through-penetration Firestops
E 970—10	Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source
E 1300—09a	Practice for Determining Load Resistance of Glass in Buildings.
E 1354—10a	Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

E 1592—05	Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
E 1602—03 (2010) <i>e1</i>	Guide for Construction of Solid Fuel-burning Masonry Heaters
E 1886—05	Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials
E 1966—07	Test Method for Fire-resistant Joint Systems.
E 1996—09	Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
E 2072—10	Standard Specification for Photoluminescent (Phosphorescent) Safety Markings
E 2273—03	Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
E 2307—10	Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-scale, Multistory Test Apparatus
E 2404—10	Standard Practice for Specimen Preparation and Mounting of Textile, Paper or Vinyl Wall or Ceiling Coverings to Assess Surface Burning Characteristics
E 2568—09 <i>e1</i>	Standard Specification for PB Exterior Insulation and Finish Systems (EIFS)
E 2570—07	Standard Test Method for Evaluating Water-resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) for EIFS with Drainage
E 2573—07 <i>a</i>	Standard Practice for Specimen Preparation and Mounting of Site-fabricated Stretch Systems to Assess Surface Burning Characteristics
F 547—06	Terminology of Nails for Use with Wood and Wood-based Materials
F 1346—91 (2003)	Performance Specification for Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas and Hot Tubs
F 1667—10	Specification for Driven Fasteners: Nails, Spikes and Staples

F 2006—10	Standard/Safety Specification for Window Fall Prevention Devices for Nonemergency Escape (Egress) and Rescue (Ingress) Windows
F 2090—10	Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms
F 2200—05	Standard Specification for Automated Vehicular Gate Construction
G 152—06	Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
G 154—06	Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
G 155—05a	Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

The Association of the Wall and Ceiling Industries International
 513 West Broad Street, Suite 210
 Falls Church, VA 22046

AWCI
Standard
reference
number

	Title
12-B—05	Technical Manual 12-B Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-resistive Materials; an Annotated Guide, <i>Second</i> Edition

American Wood Protection Association
 P.O. Box 361784
 Birmingham, AL 35236-1784

AWPA
Standard
reference
number

	Title
C1—03	All Timber Products—Preservative Treatment by Pressure Processes
M4—06	Standard for the Care of Preservative-treated Wood Products
U1—10	USE CATEGORY SYSTEM: User Specification for Treated Wood Except Section 6, Commodity Specification H

American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

AWS

**Standard
reference
number**

Title

D1.1—10	Structural Welding Code—Steel
D1.3—08	Structural Welding Code—Sheet Steel
D1.4—05	Structural Welding Code—Reinforcing Steel

Builders Hardware Manufacturers' Association
355 Lexington Avenue, 17th Floor
New York, NY 10017-6603

BHMA

**Standard
reference
number**

Title

A 156.10—05	Power Operated Pedestrian Doors
A 156.19—07	Standard for Power Assist and Low Energy Operated Doors

Canadian General Standards Board
Place du Portage 111, 6B1
11 Laurier Street
Gatineau, Quebec, Canada KIA 1G6

CGSB

**Standard
Reference
Number**

Title

37-GP-52M (1984)	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric
37-GP-56M (1985)	Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing—with December 1985 Amendment
CAN/CGSB 37.54—95	Polyvinyl Chloride Roofing and Waterproofing Membrane

Composite Panel Association

19465 Deerfield Avenue, Suite 306
Leesburg, VA 20176

CPA
Standard
reference
number

	Title
ANSI A135.4—2004	Basic Hardboard
ANSI A135.5—2004	Prefinished Hardboard Paneling
ANSI A135.6—2006	Hardboard Siding

Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814-4408

CPSC
Standard
reference
number

	Title
16 CFR Part 1201(1977)	Safety Standard for Architectural Glazing Material
16 CFR Part 1209 (1979)	Interim Safety Standard for Cellulose Insulation
<i>16 CFR Part 1301(1977)</i>	<i>Ban of Unstable Refuse Bins</i>
16 CFR Part 1404 (1979)	Cellulose Insulation
16 CFR Part 1500 (1991)	Hazardous Substances and Articles; Administration and Enforcement Regulations
16 CFR Part 1500.44 (2001)	Method for Determining Extremely Flammable and Flammable Solids
16 CFR Part 1507 (2001)	Fireworks Devices
16 CFR Part 1630 (2000)	Standard for the Surface Flammability of Carpets and Rugs

Canadian Standards Association
5060 Spectrum Way, Suite 100
Mississauga, Ontario, L4W 5N6 Canada

CSA
Standard
reference

number	Title
101/I.S.2/A440—08	Specifications for Windows, Doors and Unit Skylights

Cedar Shake and Shingle Bureau
P.O. Box 1178
Sumas, WA 98295-1178

CSSB
Standard
reference

number	Title
CSSB—97	Grading and Packing Rules for Western Red Cedar Shakes and Western Red Shingles of the Cedar Shake and Shingle Bureau

Door and Access Systems Manufacturers Association International
1300 Summer Avenue
Cleveland, OH 44115-2851

DASMA
Standard
reference

number	Title
ANSI/DASMA 107—1997 (R2004)	Room Fire Test Standard for Garage Doors Using Foam Plastic Insulation
108—05	Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference
115—05	Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure

U.S. Department of Commerce
National Institute of Standards and Technology
1401 Constitution Avenue, NW
Washington, DC 20230

DOC**Standard
reference
number****Title**

PS-1—07	Structural Plywood
PS-2—04	Performance Standard for Wood-based Structural-use Panels
PS 20—05	American Softwood Lumber Standard

U.S. Department of Labor
c/o Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402-9325

DOL**Standard
reference
number****Title**

29 CFR Part 1910.1000 (1974)	Air Contaminants
---------------------------------	------------------

U.S. Department of Transportation
c/o Superintendent of Documents
1200 New Jersey Avenue, SE
Washington, DC 20402-9325

DOTn**Standard
reference
number****Title**

49CFRParts 100-185-2005	Hazardous Materials Regulations
49 CFR Parts 173.137 (2005)	Shippers—General Requirements for Shipments and Packaging—Class 8—Assignment of Packing Group
49 CFR—1998	Specification of Transportation of Explosive and Other Dangerous Articles, UN 0335, UN 0336 Shipping Containers

European Committee for Standardization (EN)

Central Secretariat
Rue de Stassart 36
B-10 50 Brussels

EN
Standard
reference
number

EN 1081-98
Resistance

Title

Resilient Floor Coverings—Determination of the Electrical

Federal Emergency Management Agency
Federal Center Plaza
500 C Street S.W.
Washington, DC 20472

FEMA
Standard
reference
number

FIA-TB11—01

Title

Crawlspace Construction for Buildings Located in
Special Flood Hazard Areas

Factory Mutual Global Research
Standards Laboratories Department
1301 Atwood Avenue, P.O. Box 7500
Johnson, RI 02919

FM
Standard
reference
number

4450 (1989)

Title

Approval Standard for Class 1 Insulated Steel Deck Roofs—
with Supplements through July 1992

4470 (2010)

Approval Standard for Class 1 Roof Covers

4474 (04)

Evaluating the Simulated Wind Uplift Resistance of Roof
Assemblies Using Static Positive and/or Negative
Differential Pressures

4880 (2010)

American National Standard for Evaluating Insulated Wall
or Wall and Roof/ Ceiling Assemblies, Plastic Interior Finish

Materials, Plastic Exterior Building Panels, Wall/Ceiling
Coating Systems, Interior and Exterior Finish Systems

Gypsum Association
810 First Street N.E. #510
Washington, DC 20002-4268

GA

**Standard
reference**

number

Title

GA 216—10

Application and Finishing of Gypsum Panel Products

GA 600—09

Fire-resistance Design Manual, 18th Edition

Hardwood Plywood Veneer Association
1825 Michael Faraday Drive
Reston, VA 20190-5350

HPVA

**Standard
reference**

number

Title

HP-1—2009

Standard for Hardwood and Decorative Plywood

U.S. Department of Housing and Urban Development
451 7th Street, SW,
Washington, DC 20410

HUD

**Standard
reference**

number

Title

HUD 24 CFR Part 3280 (1994)
Standards

Manufactured Home Construction and Safety

International Code Council, Inc.
500 New Jersey Ave, NW 6th Floor
Washington, DC 20001

ICC

Standard

reference number	Title
ICC/ANSI A117.1—09	Accessible and Usable Buildings and Facilities
ICC 300—07	ICC Standard on Bleachers, Folding and Telescopic Seating and
ICC 400—07	Standard on Design and Construction of Log Structures
ICC 500—08	ICC/NSSA Standard on the Design and Construction of Storm
ICC 600—08	Standard for Residential Construction in High Wind Regions
IEBC – 09	International Existing Buildings Code
IECC— 09 <u>12</u>	International Energy Conservation Code (<i>adoption includes both the commercial provisions and the residential provisions found in chapters 2 through 5, but only section 101 of chapter 1 and chapters 2 through 6 and as further modified in chapter 13 of this code</i>)
IFGC—09	International Fuel Gas Code (<i>including ICC Emergency Amendment changing IFGC Sections 406.7</i>)
SBCCI SSTD 11—99	Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles

International Organization for Standardization
 ISO Central Secretariat,
 1 ch, de la Voie-Creuse,
 Case Postale 56
 CH-1211 Geneva 20, Switzerland

ISO

Standard

reference

number

Title

ISO 8115—86 Cotton Bales—Dimensions and Density

National Association of Architectural Metal Manufacturers,
 800 Roosevelt Road,
 Bldg. C, Suite 312
 Glen Ellyn, IL 60137

**NAAMM
Standard
reference
number**

FP 1001—07

Title

Guide Specifications for Design of Metal Flag Poles

National Concrete Masonry Association,
13750 Sunrise Valley,
Herndon, VA 22071-4662

**NCMA
Standard
reference
number**

TEK5-08

Title

Details for Concrete Masonry Fire Walls

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269-9101

**NFPA
Standard
reference
number**

10—10

Title

Portable Fire Extinguishers

11—10

Low Expansion Foam

12—08

Carbon Dioxide Extinguishing Systems

12A—04

Halon 1301 Fire Extinguishing Systems

13—10

Installation of Sprinkler Systems (*including TIA 10-2*)

13D—10

Installation of Sprinkler Systems in One- and Two-family Dwellings and Manufactured Homes (*including TIA 10-2*)

13R—10

Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height (*including TIA 10-2*)

14—10

Installation of Standpipe and Hose System

16—07

Installation of Foam-water Sprinkler and Foam-water Spray Systems

17—09

Dry Chemical Extinguishing Systems

17A—09

Wet Chemical Extinguishing

20—10	Installation of Stationary Pumps for Fire Protection
30—15	Flammable and Combustible Liquids Code
31—11	Installation of Oil-burning Equipment
32—07	Dry Cleaning Plants
37-10	<i>Installation and Use of Stationary Combustion Engines and Gas Turbines</i>
40—11	Storage and Handling of Cellulose Nitrate Film
58—11	Liquefied Petroleum Gas Code
61—08	Prevention of Fires and Dust Explosions in Agricultural and Food Product Facilities
70—14	National Electrical Code
72—10	National Fire Alarm and Signaling Code (<i>including TIA 10-4 and TIA 10-5</i>)
80—10	Fire Doors and Other Opening Protectives
85—07	Boiler and Combustion System Hazards Code (Note: NFPA 8503 has been incorporated into NFPA 85)
92B—09	Smoke Management Systems in Malls, Atria and Large Spaces
99—05	Standard for Health Care Facilities
105—10	Standard for the Installation of Smoke Door Assemblies
110—10	Emergency and Standby Power Systems
111—10	Stored Electrical Energy Emergency and Standby Power Systems
120—10	Coal Preparation Plants
170—09	Standard for Fire Safety and Emergency Symbols
211—10	Chimneys, Fireplaces, Vents and Solid Fuel-burning
221-09	<i>Standard for High challenge Fire Walls, Fire Walls, and Fire Barrier Walls</i>
252—08	Standard Methods of Fire Tests of Door Assemblies
253—06	Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
257—07	Standard for Fire Test for Window and Glass Block Assemblies
259—08	Test Method for Potential Heat of Building Materials
265—07	Method of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings on Full Height Panels and Walls

268—07	Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source
285—06	Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components
286—06	Standard Method of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
288—07	Standard Method of Fire Tests of Floor Fire Door Assemblies Installed Horizontally in Fire-resistance-rated Floor Systems
409—11	Aircraft Hangars
418—06	Standard for Heliports
484—09	Combustible Metals
654—06	Prevention of Fire & Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids
655—07	Prevention of Sulfur Fires and Explosions
664—07	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
701—10	Standard Methods of Fire Tests for Flame-propagation of Textiles and Films
704—07	Standard System for the Identification of the Hazards of Materials for Emergency Response
1124—06	Manufacture, Transportation and Storage of Fireworks and Pyrotechnic Articles
2001—08	Clean Agent Fire Extinguishing Systems

Precast Prestressed Concrete Institute
 175 W. Jackson Boulevard, Suite 500
 Chicago, IL 60604-6938

PCI
Standard
reference
number
 MNL 124—89

Title
 Design for Fire Resistance of Precast Prestressed
 Concrete

MNL 128—01 Recommended Practice for Glass Fiber Reinforced
Concrete Panels

Post-Tensioning Institute
8601 North Black Canyon Highway, Suite 103
Phoenix, AZ 85021

PTI

**Standard
reference
number**

Title

PTI—2008	Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils, Third Edition
PTI—2008	Standard Requirements for Design of Shallow Post-tensioned Concrete Foundation on Expansive Soils, Second Edition

Rack Manufacturers Institute
8720 Red Oak Boulevard, Suite 201
Charlotte, NC 28217

RMI

**Standard
reference
number**

Title

ANSI/MHI6.1—08	Specification for Design, Testing and Utilization of Industrial Steel Storage Racks
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Steel Deck Institute,
P. O. Box 25
Fox River Grove, IL 60021

SDI

**Standard
reference
number**

Title

ANSI/NC1.0—06	Standard for Noncomposite Steel Floor Deck
ANSI/RD1.0—06	Standard for Steel Roof Deck

Steel Joist Institute,
1173B London Links Drive

Forest, VA 24551

SJI

**Standard
reference
number**

Title

CJ-1.0—06

Standard Specification for Composite Steel Joists,
CJ-series

JG-1.1—05

Standard Specification for Joist Girders

K-1.1—05

Standard Specification for Open Web Steel Joists, K-
series

LH/DLH-1.1—05

Standard Specification for Longspan Steel Joists,
LH-series and Deep Longspan Steel Joists, DLH-
series

Single-Ply Roofing Institute,
411 Waverly Oaks Road, Suite 331B,
Waltham, MA 02452

SPRI

**Standard
reference
number**

Title

SPRI/ANSI/ES-1—03

Wind Design Standard for Edge Systems Used with
Low Slope Roofing Systems

RP-4—02

Wind Design Guide for Ballasted Single-ply Roofing
Systems

Telecommunications Industry Association
2500 Wilson Boulevard
Arlington, VA 22201-3834

TIA

**Standard
reference
number**

Title

TIA-222-G—09

Structural Standards for Steel Antenna Towers and Antenna
Supporting Structures including-Addendum 1, 222-G-1,
Dated 2007

The Masonry Society,

3970 Broadway, Unit 201-D,
Boulder, CO 80304-1135

TMS

**Standard
reference
number**

Title

0216—07	Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
0302—07	Standard Method for Determining the Sound Transmission Class Rating for Masonry Walls
402—08	Building Code Requirements for Masonry Structures
602—08	Specification for Masonry Structures

Truss Plate Institute,
218 N. Lee Street, Suite 312
Alexandria, VA 22314

TPI

**Standard
reference
number**

Title

TPI 1—2007	National Design Standards for Metal-plate-connected Wood Truss Construction
------------	---

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096

UL

**Standard
reference
number**

Title

9—09	Fire Tests of Window Assemblies
10A—09	Tin Clad Fire Doors
10B—08	Fire Tests of Door Assemblies
10C—09	Positive Pressure Fire Tests of Door Assemblies
14B—08	Sliding Hardware for Standard Horizontally-mounted Tin Clad Fire Doors
14C—06	Swinging Hardware for Standard Tin Clad Fire Doors Mounted Singly and in Pairs

103—10	Factory-built Chimneys, for Residential Type and Building Heating Appliances
127—08	Factory-built Fireplaces
199E—04	Outline of Investigation for Fire Testing of Sprinklers and Water Spray Nozzles for Protection of Deep Fat Fryers.
217—06	Single and Multiple Station Smoke Alarms
263—03	Standard for Fire Test of Building Construction and Materials
268—09	Smoke Detectors for Fire Protective Signaling Systems
300—05	Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
300A-06	<i>Extinguishing system units for residential range top cooking surfaces</i>
305—97	Panic Hardware
325—02	Door, Drapery, Gate, Louver and Window Operations and Systems—with Revisions through February 2006
555—2006	Fire Dampers
555C—2006	Ceiling Dampers
555S—99	Smoke Dampers—with Revisions through July 2006
580—2006	Test for Uplift Resistance of Roof Assemblies
641—95	Type L Low-temperature Venting Systems
710B—04	Recirculating Systems—with Revisions through April 2006
723—08	Standard for Test for Surface Burning Characteristics of Building Materials
790—04	Standard Test Methods for Fire Tests of Roof Coverings
793—08	Standards for Automatically Operated Roof Vents for Smoke and Heat
864—03	Standards for Control Units and Accessories for Fire Alarm Systems—with Revisions through March 2006
924—06	Standard for Safety Emergency Lighting and Power Equipment
1040—96	Fire Test of Insulated Wall Construction—with Revisions through June 2001
1256—02	Fire Test of Roof Deck Construction—with Revisions through January 2007
1479—03	Fire Tests of Through-penetration Firestops—with Revisions through April 2007
1482—10	Solid-fuel-type Room Heater
1715—97	Fire Test of Interior Finish Material—with Revisions through March 2004
1777—07	Chimney Liners

1784—01	Air Leakage Tests of Door Assemblies—with Revisions through December 2004
1897—04	Uplift Tests for Roof Covering Systems
1975—06	Fire Test of Foamed Plastics Used for Decorative Purposes
1994—04	Standard for Luminous Egress Path Marking Systems—with Revisions through February 2005
2017—08	Standards for General-purpose Signaling Devices and Systems
2079—04	Tests for Fire Resistance of Building Joint Systems—with Revisions through March 2006
2200—12	Stationary Engine Generator Assemblies

Underwriters Laboratories of Canada,
7 Underwriters Road,
Toronto, Ontario, Canada M1R3B4

ULC
Standard
reference
number

	Title
CAN/ULC S102.2—2010	Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies—with 2000 Revisions

United States Code,
c/o Superintendent of Documents
U.S. Government Printing Office,
Washington, DC 20402-9325

USC
Standard
reference
number

	Title
10 U.S.C. Sections 18233(A)(1) and 18237-1994	
18 USC Part 1, Ch.40	Importation, Manufacture, Distribution and Storage of Explosive Materials

Window and Door Manufacturers Association
1400 East Touhy Avenue #470
Des Plaines, IL 60018

**WDMA
Standard
reference
number**

AAMA/WDMA/CSA
101/I.S.2/A440—08

Title

Specifications for Windows, Doors and Unit
Skylights

Wire Reinforcement Institute, Inc.
942 Main Street, Suite 300
Hartford, CT 06103

**WRI
Standard
reference
number**

WRI/CRSI—81

Title

Design of Slab-on-ground Foundations—with 1996 Update

1301.3 Modifications to ASHRAE 90.1. The following changes shall be made to the ASHRAE 90.1:

1. [Addendum ap] Section 3.2; Add the following new definitions:

Computer room energy: annual energy use of the data center, including all IT equipment energy, plus energy that supports the IT equipment and computer room space, calculated in accordance with industry-accepted standards defined as Total Annual Energy (see Informative Appendix E).

IT equipment energy: annual energy used for computer storage and network equipment along with supplemental equipment represented by the uninterruptible power supply (UPS) output calculated in accordance with industry-accepted standards (see Informative Appendix E).

Power usage effectiveness (PUE): computer room energy divided by IT equipment energy calculated in accordance with industry-accepted standards (see Informative Appendix E).

Power usage effectiveness – category 0 (PUE₀): peak electric demand (kW) for the entire computer room, including IT equipment and supporting infrastructure, divided by peak electric demand (kW) of the IT equipment.

Power usage effectiveness – category 1 (PUE₁): annual energy consumption (kWh) for the entire computer room, including IT equipment and supporting infrastructure, divided by annual energy consumption (kWh) of the IT equipment.

2. [Addendum ap] Section 6.2.1; Modify to read as follows:

6.2.1 Compliance. Compliance with Section 6 shall be achieved by meeting all requirements for Sections 6.1, “General”; Section 6.7, “Submittals”; Section 6.8, “Minimum Equipment Efficiency Tables”; and one of the following:

a. Section 6.3, “Simplified Approach Option for HVAC Systems”

b. Sections 6.4, “Mandatory Provisions” and 6.5, “Prescriptive Path”

c. Sections 6.4, “Mandatory Provisions” and 6.6, “Alternative Compliance Path”

3. [Addendum de] Section 6.5.1.2.1, Exception b; Modify to read as follows:

b. Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100% of the expected system cooling load at 25°F dry bulb for climate zone 4A and 20°F dry bulb for climate zone 5A.

4. [Addendum ap] Section 6.6; Add new sections to read as follows:

6.6 Alternative Compliance Path

6.6.1 Computer Rooms Systems. HVAC systems serving the heating, cooling, or ventilating needs of a computer room shall comply with Section 6.1, 6.4, 6.6.1.1 or 6.6.1.2, 6.6.1.3, 6.7, and 6.8.

6.6.1.1 The computer room PUE₁ shall be less than or equal to 1.36 and shall not include energy for battery charging. Hourly simulation of the proposed design, for purposes of

calculating PUE₁, shall be based on the ASHRAE Standard 90.1 Appendix G simulation methodology.

Exception: This compliance path is not allowed for a proposed computer room design utilizing a combined heat and power system.

6.6.1.2 The computer room PUE₀ shall be less than or equal to 1.36, shall not include energy for battery charging, shall be the highest value determined at outdoor cooling design temperatures, and shall be limited to systems only utilizing electricity for an energy source. PUE₀ shall be calculated for two conditions: 100% design IT equipment energy and 50% design IT equipment energy.

6.6.1.3 Documentation shall be provided, including a breakdown of energy consumption or demand by at least the following components: IT equipment, power distribution losses external to the IT equipment, HVAC systems, and lighting.

5. Section 8.4.2 Automatic Receptacle Control; Delete section.

6. [Addendum ap] Informative Appendix E; Add the following references:

The Green Grid Administration

3855 SW 153rd Drive

Beaverton, Oregon 97006 USA

(T) 503-619-0653

(F) 503-644-6708

<u>Subsection No.</u>	<u>Reference/Source</u>
<u>3.2 Computer Room Energy</u>	<u>Recommendations for Measuring and Reporting Overall Data Center Efficiency v2 17 May 2011 - The Green Grid</u>
<u>3.2 IT Equipment Energy</u>	<u>Recommendations for Measuring and Reporting Overall Data Center Efficiency v2 17 May 2011 - The Green Grid</u>
<u>3.2 Power Usage Effectiveness</u>	<u>Recommendations for Measuring and Reporting Overall Data Center Efficiency v2 17 May 2011 - The Green Grid</u>

7. [Addendum cj] Normative Appendix G, Table G3.1, No. 4 Schedules, Proposed Building Performance Column, HVAC Fan Schedules; Add the following exception:

c. HVAC fans shall remain on during occupied and unoccupied hours in systems primarily serving computer rooms.

8. [Addendum cj] Normative Appendix G, Table G3.1, No. 10 HVAC Systems, Baseline Building Performance column; Add the following:

If the proposed design includes computer room humidification then the computer room humidification system, schedules, and setpoints in the baseline building design shall be the same as in the proposed design.

For systems serving computer rooms, the baseline shall not have reheat for the purpose of dehumidification.

9. [Addendum cj] Normative Appendix G, Section G3.1.1 Baseline HVAC System Type and Description, second sentence; Modify to read as follows:

For systems 1, 2, 3, 4, and 11, each thermal block shall be modeled with its own HVAC system.

10. [Addendum cj] Normative Appendix G, Section G3.1.1 Baseline HVAC System Type and Description, Exception "b"; Delete "computer server rooms" from the last sentence and add the following sentence to the end of the exception:

This exception does not apply to computer rooms.

11. [Addendum cj] Normative Appendix G, Section G3.1.1 Baseline HVAC System Type and Description; Add the following exception:

g. Computer rooms in buildings with a total computer room peak cooling load >3,000,000 Btu/h kW or a total computer room peak cooling load >600,000 Btu/h where the baseline HVAC system type is 7 or 8 shall use System 11. All other computer rooms shall use System 3 or 4.

12. [Addendum cj] Normative Appendix G, Table G3.1.1B; Add System No. 11 and note as follows:

11. SZ-VAV, Single -zone VAV, VAV, Chilled water, See note.

Note: Where the proposed design heating source is electric or other, the heating type shall be electric resistance. Where the proposed design heating source is fossil fuel, fossil/electric hybrid, or purchased heat, the heating type shall be hot-water fossil fuel boiler.

13. [Addendum cj] Normative Appendix G, Section G3.1.2.7 Economizers; Modify the second sentence to read as follows:

Outdoor air economizers shall be included in baseline HVAC Systems 3 through 8 and 11 based on climate as specified in Table G3.1.2.6A.

14. [Addendum cj] Normative Appendix G, Section G3.1.2.7 Economizers; Add the following exception:

c. Systems that serve computer rooms complying with Section G3.1.2.7.1.

15. [Addendum cj] Normative Appendix G; Add new section as follows:

G3.1.2.7.1 Computer Room Economizers. Systems that serve computer rooms that are HVAC System 3 or 4 shall not have an economizer. Systems that serve computer rooms that are HVAC System 11 shall include an integrated water-side economizer meeting the requirements of Section 6.5.1.2 in the baseline building design. If the simulation software cannot model an integrated water-side economizer, then an air-side economizer shall be modeled.

16. [Addendum cj] Normative Appendix G, Table G3.1.2.9; Add a new column as follows:

Variable Volume System 11
 $CFM_s \cdot 0.00062 + A (L_s \cdot 0.001 + A)$

17. [Addendum cj] Normative Appendix G, Section G3.1.3.4; Modify the title of the section to read as follows:

G3.1.3.4 Hot –Water Supply Temperature Reset (Systems 1, 5, 7, and 11).

18. [Addendum cj] Normative Appendix G, Section G3.1.3.6; Modify the title of the section to read as follows:

G3.1.3.6 Piping Losses (Systems 1, 5, 7, and 11).

19. [Addendum cj] Normative Appendix G, Section G3.1.3.7; Modify the title of the section to read as follows:

G3.1.3.7 Type and Number of Chillers (Systems 7, 8, and 11).

20. [Addendum cj] Normative Appendix G, Section G3.1.3.8; Modify the title of the section to read as follows:

G3.1.3.8 Chilled-Water Design Supply Temperature (Systems 7, 8, and 11).

21. [Addendum cj] Normative Appendix G, Section G3.1.3.9; Modify the title of the section and add new exception to read as follows:

G3.1.3.9 Chilled-Water Supply Temperature Reset (Systems 7, 8, and 11).

Exception: If the baseline chilled-water system serves a computer room HVAC system, the supply chilled-water temperature shall be reset higher based on the HVAC system requiring the most cooling; i.e., the chilled-water setpoint is reset higher until one cooling-coil valve is nearly wide open. The maximum reset chilled-water supply temperature shall be 54°F.

22. [Addendum cj] Normative Appendix G, Section G3.1.3.10; Modify the title of the section and add a new last sentence to the main paragraph which reads as follows:

G3.1.3.10 Chilled-Water Pumps (Systems 7, 8, and 11).

For computer room systems using System 11 with an integrated water-side economizer, the baseline building design primary chilled-water pump power shall be increased 5 W/gpm (80 kW/1000 L/s) for flow associated with the water-side economizer.

23. [Addendum cj] Normative Appendix G, Section G3.1.3.11; Modify the title of the section and add a new fifth sentence to the main paragraph which reads as follows:

G3.1.3.11 Heat Rejection (Systems 7, 8, and 11).

For computer room systems using System 11 with an integrated water-side economizer, the baseline building design condenser water-pump power shall be increased 5 W/gpm (80 kW/1000 L/s) for flow associated with the water-side economizer.

24. [Addendum cj] Normative Appendix G, Section G3.1.3.15; Modify the title of the section to read as follows:

G3.1.3.15 VAV Fan Part-Load Performance (Systems 5 through 8 and 11).

25. [Addendum cj] Normative Appendix G; Add new section as follows:

G3.1.3.16 Computer Room Equipment Schedules. Computer room equipment schedules shall be modeled as a constant fraction of the peak design load per the following monthly schedule:

Month 1, 5, 9 – 25%

Month 2, 6, 10 – 50%

Month 3, 7, 11 – 75%

Month 4, 8, 12 – 100%

26. [Addendum cj] Normative Appendix G; Add new section as follows:

G3.1.3.17 System 11 Supply Air Temperature and Fan Control. Minimum volume setpoint shall be 50% of the maximum design airflow rate, the minimum ventilation outdoor air flow rate, or the air flow rate required to comply with applicable codes or accreditation standard, whichever is larger.

Fan volume shall be reset from 100% airflow at 100% cooling load to minimum airflow at 50% cooling load. Supply air temperature setpoint shall be reset from minimum supply air temperature at 50% cooling load and above to space temperature at 0% cooling load. In heating mode supply air temperature shall be modulated to maintain space temperature, and fan volume shall be fixed at the minimum airflow.

Significant changes 2007-2010 ASHRAE 90.1 Commercial Provisions

(Sources: ASHRAE 90.1-2010 Foreword, PNNL-20883, and the Weidt Group twgi.com)

- Expands scope to cover receptacles and process loads for computer rooms
- More stringent building envelope insulation values, especially for metal buildings
- Expands vestibule requirements into Climate Zone 4
- Adds new requirement for air barriers
- Requires skylights and daylighting in some building types
- Adds plug receptacle controls for private offices, open offices, and computer classrooms
- Adds elevator lighting and ventilation power limitations
- Increases HVAC efficiencies for Packaged Terminal AC and Packaged Terminal HP
- Adds Water- to- Water HP, Variable Refrigerant Flow AC, and computer room cooling efficiencies
- Updates air and water cooled chiller and open circuit cooling tower efficiencies
- Single Zone VAV systems are required to comply with constant volume fan power limitation
- Expands energy recovery requirements to more applications
- Expands economizers requirements in more climate zones
- Expands damper requirements
- Expands control requirements
- Expands requirements for kitchen exhaust systems
- Provides pressure credits for laboratory exhaust
- Updates requirements for piping insulation
- Reduces Lighting Power Density allowances
- Expands occupancy sensor control requirements to more spaces
- Adds parking garage lighting controls
- Adds automatic daylighting controls
- Adds new 5-zone exterior lighting power density table and controls

C.2 Energy and Energy Cost Savings Summary Without Plug and Process Loads, 90.1-2007 and 90.1-2010

Prototype Name	%weight adjusted	90.1-2007		90.1-2010		Site Energy Savings	Energy Cost Savings
		Site Energy (Kbtu/ft ²)	Site Energy Cost (\$/ft ²)	Site Energy (Kbtu/ft ²)	Site Energy Cost (\$/ft ²)		
Small Office	5.61%	30.2	\$0.84	24.4	\$0.66	19.21%	22.18%
Medium Office	6.05%	33.3	\$0.89	23.9	\$0.56	28.44%	36.81%
Large Office	3.33%	27.6	\$0.81	19.2	\$0.56	30.15%	30.80%
Standalone Retail	15.25%	57.6	\$1.47	42.1	\$1.10	27.03%	25.20%
Stripmall	5.67%	62.9	\$1.59	51.5	\$1.26	18.18%	21.11%
Primary School	4.99%	43.8	\$1.16	29.3	\$0.83	33.08%	28.09%
Secondary School	10.36%	41.7	\$1.11	27.1	\$0.78	34.90%	30.15%
Outpatient Healthcare	4.37%	106.2	\$2.63	77.2	\$1.86	27.32%	29.15%
Hospital	3.45%	110.2	\$2.71	69.4	\$1.96	36.98%	27.85%
Small Hotel	1.72%	48.4	\$1.22	44.4	\$1.07	8.18%	11.54%
Large Hotel	4.95%	118.9	\$2.43	90.9	\$2.01	23.57%	17.22%
Warehouse	16.72%	21.5	\$0.47	16.5	\$0.34	23.01%	28.10%
Quick Service Restaurant	0.59%	279.0	\$7.34	250.6	\$6.46	10.16%	12.09%
Full Service Restaurant	0.66%	229.7	\$5.43	178.1	\$3.94	22.49%	27.50%
Mid-rise Apartment	7.32%	29.8	\$0.73	26.8	\$0.67	9.95%	7.72%
High-rise Apartment	8.97%	34.5	\$0.92	31.0	\$0.86	10.02%	6.99%
Totals	100.0%						
National Weighted Average		50.7	\$1.26	38.2	\$0.96	24.51%	23.43%

Significant changes 2009→2012 IECC Commercial Provisions

(Source: PNNL-21435)

- The table covering fenestration in commercial buildings has been simplified to define all fenestration as being fixed, operable, or an entrance door. The distinction between framing materials, thermal breaks, and curtain walls/storefronts with respect to thermal requirements has been removed. In some cases only residential criteria were modified. For example, solar heat gain coefficients (SHGC) were raised moderately for residential buildings but were not raised for commercial buildings. In addition, many of the U-factors applicable to skylights have been reduced.
- The allowable percentage of skylight area as a function of roof area has been increased from 3% to 5% of total roof area. Additionally, in certain building types (e.g., offices, convention centers over 10,000 ft² with ceilings more than 15 ft high), at least half of the floor area must be in a daylighting zone under skylights (with several exceptions allowed).
- Vertical fenestration area is now limited to 30% of above-grade wall area. The previous maximum of 40% is still allowed in Climate Zones 1-6, provided half of the conditioned floor is in a daylight zone, controls are installed, and the VT/SHGC ratio is at least 1.1.
- Visible transmittance is now used in several provisions for both vertical fenestration and skylights. In particular, a VT/SHGC ratio is one of three conditions used to increase the fenestration area maximum from 30% to 40%.
- Air barrier requirements have been added such that a continuous barrier is now needed throughout the building envelope in other than Climate Zones 1-3. The barrier must be sealed at all seams and joints, and lighting fixtures and other recesses must be treated to maintain that barrier.
- HVAC system piping insulation requirements have become more stringent. These requirements now also rely on pipe diameter and fluid temperature.
- Air system economizers are required in more climate zones and at a lower threshold (33K Btu/h instead of 54K Btu/h).
- A space-by-space method for determining allowable lighting power limits based on ASHRAE 90.1-10 was added.
- A new section on building commissioning has been added. It is now necessary for a *registered design professional* (or agency) to develop a mechanical system commissioning plan, and provide evidence of commissioning prior to the final mechanical inspection. HVAC air and water flow rates now must be balanced, and equipment, controls, and lighting must be performance tested.

Table ES-1 Summary of Cost-effectiveness Analysis

Prototype		Climate Zone				
		2A Houston	3A Memphis	3B El Paso	4A Baltimore	5A Chicago
Life Cycle Cost Net Savings						
Small Office	Total	\$9,500	\$12,700	\$10,400	\$6,100	\$14,300
	\$/ft ²	\$1.73	\$2.31	\$1.89	\$1.11	\$2.60
Large Office	Total	\$1,810,000	\$1,560,000	\$990,000	\$1,500,000	\$1,730,000
	\$/ft ²	\$3.63	\$3.13	\$1.99	\$3.01	\$3.47
Standalone Retail	Total	\$110,000	\$95,600	\$99,200	\$74,000	\$121,000
	\$/ft ²	\$4.46	\$3.87	\$4.02	\$3.00	\$4.90
Primary School	Total	\$205,000	\$195,000	\$354,000	\$197,000	\$307,000
	\$/ft ²	\$2.77	\$2.64	\$4.79	\$2.66	\$4.15
Small Hotel	Total	\$304,450	\$328,000	\$316,000	\$284,700	\$325,000
	\$/ft ²	\$7.05	\$7.59	\$7.31	\$6.59	\$7.52
Mid-rise Apartment	Total	\$20,400	\$25,500	\$18,300	\$30,800	\$41,800
	\$/ft ²	\$0.60	\$0.76	\$0.54	\$0.91	\$1.24
Simple Payback (years)						
Small Office		11.6	9.5	10.7	15.5	8.7
Large Office		3.3	4.1	4.7	4.1	2.2
Standalone Retail		5.8	7.0	5.4	8.8	5.7
Primary School		6.1	6.7	0.8	6.7	4.5
Small Hotel		0.9	immediate	immediate	1.4	immediate
Mid-rise Apartment		13.0	11.3	13.9	10.1	8.0
Scalar Ratio (Limit 20.2)						
Small Office		9.7	6.5	8.7	14.1	5.9
Large Office		4.8	5.8	7.2	5.9	3.1
Standalone Retail		6.6	8.2	5.2	10.1	6.0
Primary School		8.9	9.6	0.7	9.8	6.4
Small Hotel		-23.4	-24.8	-24.8	-27.3	-27.9
Mid-rise Apartment		9.0	7.8	9.6	7.0	5.6

4.0 IECC Energy Savings and Energy Cost Savings Results

This section provides the results of the quantitative savings analysis—the estimated site energy and energy cost savings for the 2009 and 2012 IECC compared to the 2006 IECC. Table 4.1 shows the national aggregated results using the construction weighting factors (see Table 2.3 in this report). Site energy is utility electricity and natural gas delivered and used at the building site. Energy cost savings were based on the site energy usage results and national average costs of electricity and natural gas (see Section 2.5 in this report).

As shown in Table 4.1, the Energy Use Intensity (EUI) and Energy Cost Index (ECI) are reduced with each subsequent edition of the IECC. For example, the 2009 IECC results in savings as high as 11.4% when compared to the 2006 IECC. Results are shown both with and without including loads not regulated by the IECC (i.e., plug-and-process loads).

Table 4.1. Site Energy Savings and Site Energy Cost Savings for the 2009 and 2012 IECC Compared to the 2006 IECC

	2006 IECC	2009 IECC	2012 IECC
With Plug-and-Process Loads (All Loads)			
EUI (kBtu/ft ² /year)	76.3	69.7	62.1
EUI savings compared to 2006 IECC	N/A	8.7%	18.6%
ECI (\$/ft ² /year)	1.87	1.72	1.54
ECI savings compared to 2006 IECC	N/A	7.7%	17.4%
Without Plug-and-Process Loads (Regulated Loads)			
EUI (kBtu/ft ² /year)	57.9	51.3	43.8
EUI savings compared to 2006 IECC	N/A	11.4%	24.3%
ECI (\$/ft ² /year)	1.45	1.30	1.13
ECI savings compared to 2006 IECC	N/A	9.9%	22.4%
EUI = Energy use intensity			
ECI = Energy cost index			
Data in this table are based on a national weighted average			

4.1 Result Comparison between 2006, 2009, and 2012 IECC

Figure 4.1 and Figure 4.2 show the EUI and EUI savings by prototype for the 2009 and 2012 IECC respectively as compared with the 2006 IECC (with plug-and-process loads). For each prototype, Table 4.2 lists the site EUI and energy savings (with plug-and-process loads) for the 2009 IECC and the 2012 IECC as compared to the 2006 IECC. Table 4.3 lists the site energy costs and energy cost savings, (with plug-and-process loads) for the 2009 IECC and the 2012 IECC as compared to the 2006 IECC. On a weighted national basis, the 2009 IECC results in 8.7% energy savings over the 2006 IECC, and the 2012 IECC results in 18.6% energy savings over the 2006 IECC.

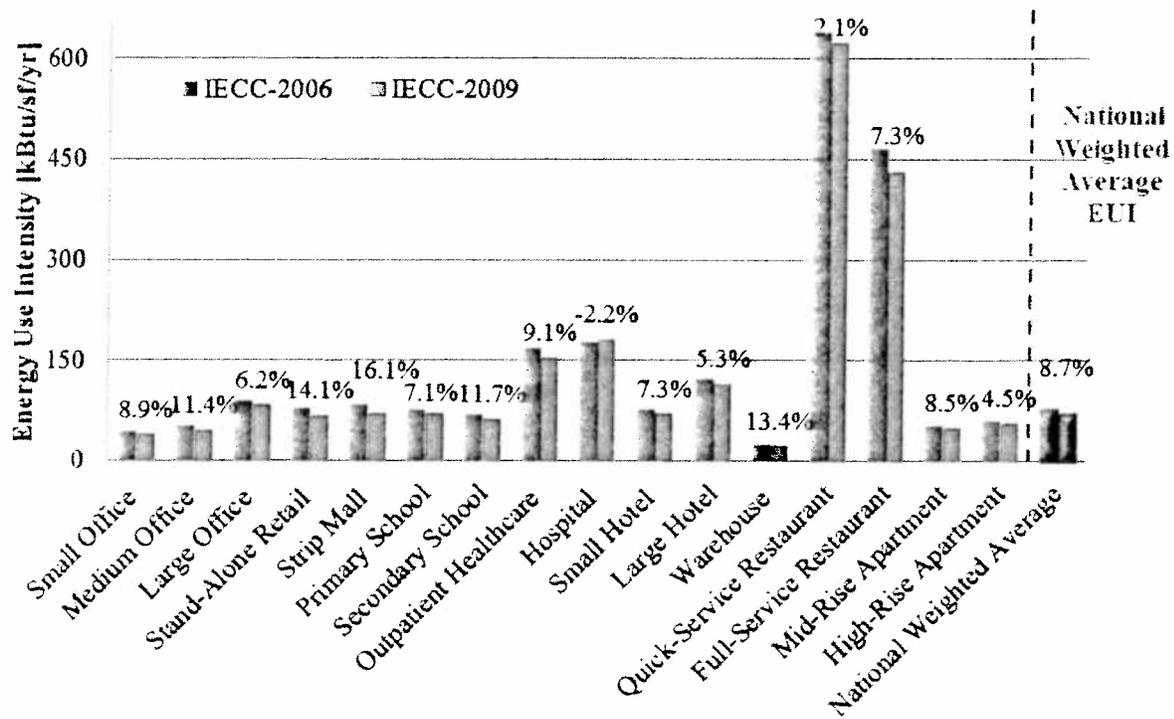


Figure 4.1. 2009 IECC Site Energy Savings Compared to 2006 IECC with Plug-and-Process Loads

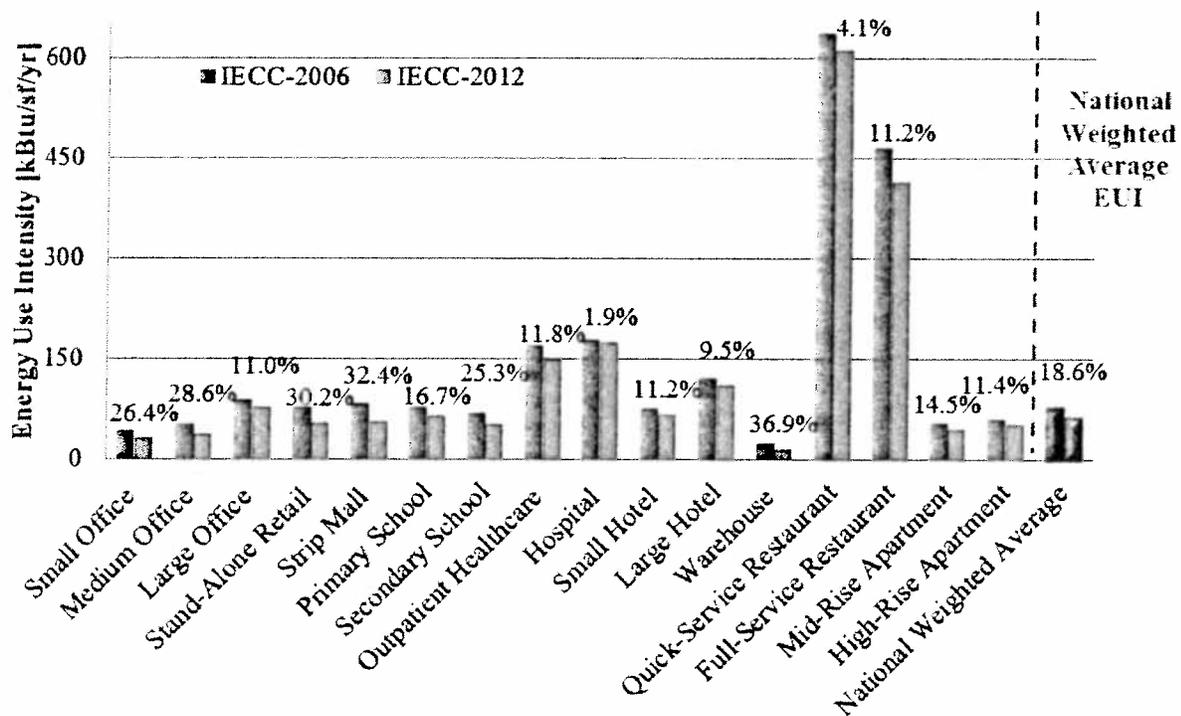


Figure 4.2. 2012 IECC Site Energy Savings Compared to 2006 IECC with Plug-and-Process Loads

Table 4.2. Site Energy Use Intensity and Savings with Plug-and-Process Loads

Prototype Name	2006 IECC (kBtu/ft ² /year)	2009 IECC (kBtu/ft ² /year)	2009 IECC Compared to 2006 IECC (%)	2012 IECC (kBtu/ft ² /year)	2012 IECC Compared to 2006 IECC (%)
Small Office	41.5	37.8	8.9	30.5	26.4
Medium Office	50.8	45.0	11.4	36.2	28.6
Large Office	87.4	81.9	6.2	77.7	11.0
Stand-Alone Retail	77.2	66.3	14.1	53.9	30.2
Strip Mall	82.6	69.3	16.1	55.8	32.4
Primary School	76.0	70.6	7.1	63.3	16.7
Secondary School	68.6	60.5	11.7	51.2	25.3
Outpatient Healthcare	167.6	152.3	9.1	147.9	11.8
Hospital	176.8	180.8	-2.2	173.4	1.9
Small Hotel	74.6	69.1	7.3	66.2	11.2
Large Hotel	120.7	114.3	5.3	109.3	9.5
Warehouse	24.7	21.4	13.4	15.6	36.9
Quick-Service Restaurant	635.5	622.3	2.1	609.5	4.1
Full-Service Restaurant	464.4	430.5	7.3	412.2	11.3
Mid-Rise Apartment	52.2	47.8	8.5	44.7	14.5
High-Rise Apartment	58.1	55.5	4.5	51.5	11.4
National Weighted Average	76.3	69.7	8.7	62.1	18.6

Table 4.3. Site Energy Cost Index and Energy Cost Savings with Plug-and-Process Loads

Prototype Name	2006 IECC (\$/ft ² /year)	2009 IECC (\$/ft ² /year)	2009 IECC Compared to 2006 IECC (%)	2012 IECC (\$/ft ² /year)	2012 IECC Compared to 2006 IECC (%)
Small Office	1.23	1.13	8.7	0.91	26.1
Medium Office	1.41	1.25	11.2	1.02	27.9
Large Office	2.43	2.34	3.6	2.24	8.0
Stand-Alone Retail	1.89	1.69	10.3	1.47	22.0
Strip Mall	2.12	1.83	13.8	1.46	31.1
Primary School	1.91	1.79	6.0	1.57	17.7
Secondary School	1.84	1.65	10.3	1.40	23.9
Outpatient Healthcare	4.31	3.82	11.3	3.74	13.2
Hospital	3.99	4.09	-2.5	3.92	1.9
Small Hotel	1.74	1.62	6.7	1.54	11.8
Large Hotel	2.68	2.57	4.4	2.46	8.3
Warehouse	0.56	0.52	8.1	0.36	35.5
Quick-Service Restaurant	11.44	11.19	2.1	10.73	6.1
Full-Service Restaurant	9.18	8.55	6.8	7.93	13.6
Mid-Rise Apartment	1.39	1.28	7.8	1.22	11.9
High-Rise Apartment	1.39	1.32	4.7	1.25	10.2
National Weighted Average	1.87	1.72	7.7	1.54	17.4

The 2012 IECC results in the highest energy savings for the Warehouse prototype, primarily due to the large increase in envelope insulation requirements. Negative energy savings were observed for the Hospital prototype, due to higher outside air ventilation rates in the 2009 and 2012 IECC models than in the 2006 IECC models. As discussed in Section 3.2.5 of this report, zone ventilation rates in some healthcare spaces in the Outpatient Healthcare and Hospital prototypes were based on outside air requirements in the 2001 edition of *Guidelines for Design and Construction of Hospitals and Health Care Facilities* (AIA 2001) for the 2006 IECC models. Those for the 2009 and 2012 IECC models were based on the 2006 edition of the Guideline (AIA 2006). For many space types, the 2006 edition has higher zone ventilation requirements than the 2001 edition.

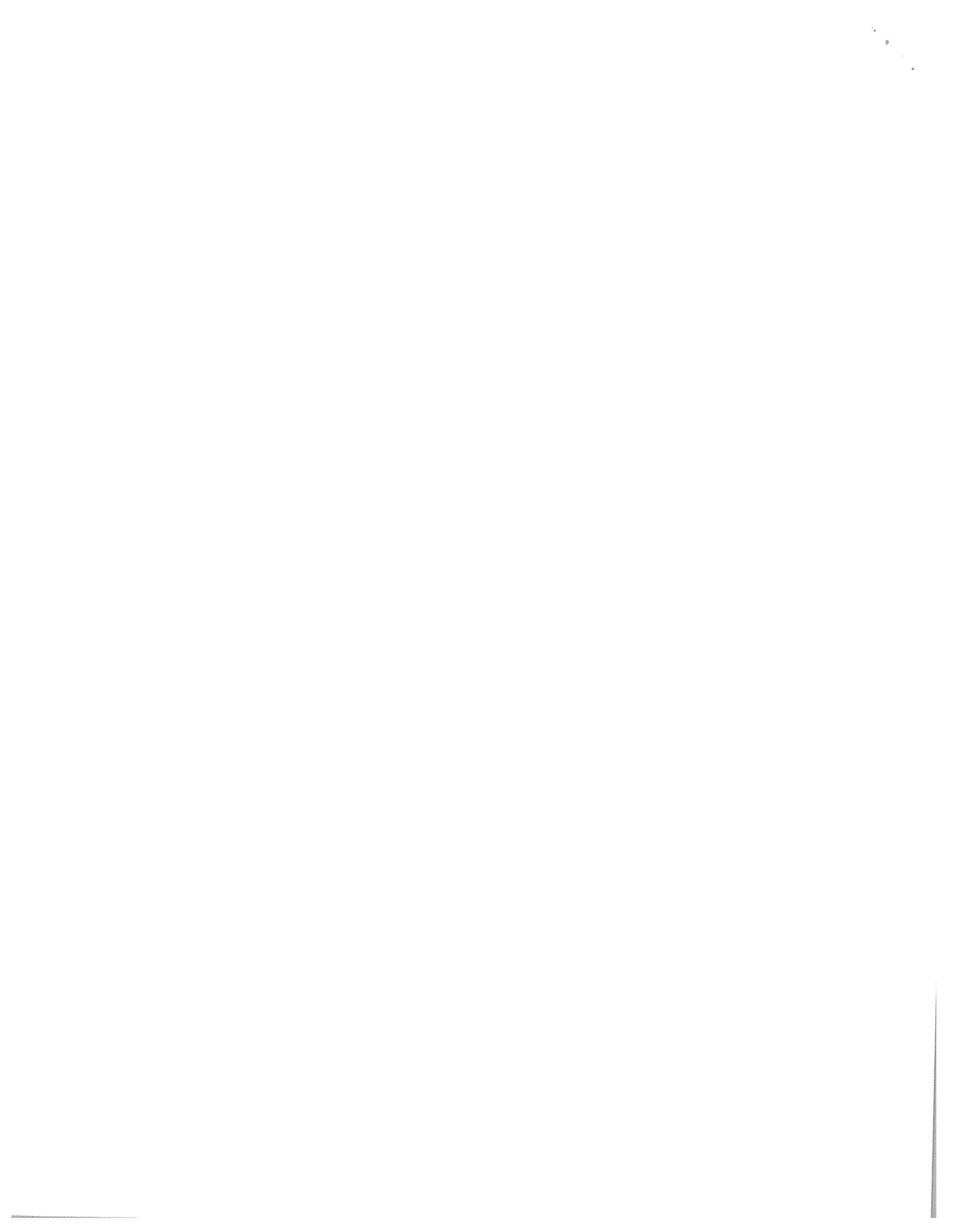
To eliminate the impact of plug-and-process loads end use on the energy savings analysis, Table 4.4 lists the site EUI and energy savings, without plug-and-process loads, for the 2009 IECC and the 2012 IECC as compared to the 2006 IECC. Table 4.5 lists the site energy cost and energy cost savings, without plug-and-process loads, for the 2009 IECC and the 2012 IECC as compared to the 2006 IECC. The 2009 IECC results in 11.2% energy savings over the 2006 IECC and the 2012 IECC results in 24.3% energy savings over the 2006 IECC.

Table 4.4. Site Energy Use Intensity and Savings without Plug-and-Process Loads

Prototype Name	2006 IECC (kBtu/ft ² /year)	2009 IECC (kBtu/ft ² /year)	2009 IECC Compared to 2006 IECC (%)	2012 IECC (kBtu/ft ² /year)	2012 IECC Compared to 2006 IECC (%)
Small Office	32.4	28.7	11.4	21.4	33.8
Medium Office	35.8	30.0	16.2	21.5	39.9
Large Office	43.9	38.4	12.4	34.3	21.7
Stand-Alone Retail	69.7	58.8	15.6	46.4	33.5
Strip Mall	77.2	63.9	17.3	50.4	34.7
Primary School	53.8	48.4	10.1	41.4	23.1
Secondary School	53.9	45.9	14.9	36.7	31.9
Outpatient Healthcare	120.4	105.1	12.7	100.6	16.4
Hospital	127.0	131.0	-3.1	123.9	2.5
Small Hotel	52.1	46.6	10.5	43.7	16.0
Large Hotel	84.9	78.6	7.5	73.7	13.2
Warehouse	22.2	18.9	14.9	13.1	41.1
Quick-Service Restaurant	344.0	330.8	3.8	318.0	7.6
Full-Service Restaurant	298.4	264.5	11.4	246.1	17.5
Mid-Rise Apartment	37.7	33.2	11.8	30.1	20.1
High-Rise Apartment	44.9	42.3	5.9	38.4	14.4
National Weighted Average	57.9	51.3	11.4	43.8	24.3

Table 4.5. Site Energy Cost Index and Energy Cost Savings without Plug-and-Process Loads

Prototype Name	2006 IECC (\$/ft ² /year)	2009 IECC (\$/ft ² /year)	2009 IECC Compared to 2006 IECC (%)	2012 IECC (\$/ft ² /year)	2012 IECC Compared to 2006 IECC (%)
Small Office	0.96	0.85	11.2	0.66	31.5
Medium Office	0.98	0.82	16.3	0.62	36.5
Large Office	1.23	1.15	7.1	1.08	12.7
Stand-Alone Retail	1.66	1.47	11.7	1.25	25.0
Strip Mall	1.96	1.66	15.0	1.30	33.7
Primary School	1.39	1.28	8.2	1.06	23.9
Secondary School	1.48	1.29	12.8	1.05	29.3
Outpatient Healthcare	3.01	2.52	16.2	2.46	18.1
Hospital	3.14	3.24	-3.2	3.07	2.3
Small Hotel	1.34	1.22	8.8	1.14	14.7
Large Hotel	2.27	2.15	5.2	2.04	9.8
Warehouse	0.48	0.44	9.4	0.29	40.5
Quick-Service Restaurant	8.09	7.85	3.0	7.39	8.6
Full-Service Restaurant	6.61	5.98	9.5	5.39	18.4
Mid-Rise Apartment	0.95	0.84	11.5	0.79	16.8
High-Rise Apartment	1.00	0.94	6.4	0.86	13.9
National Weighted Average	1.45	1.30	9.9	1.13	21.8



Highlights

Cost-effectiveness against a 2009 IECC baseline:

- Life-cycle cost savings, averaged across climate zones and building types, are \$5,151 for the 2012 IECC
- Simple payback period is 4.5 years for the 2012 IECC

Consumer savings compared to a 2009 IECC baseline:

- Households save an average of \$330 per year on energy costs with the 2012 IECC
- Net annual consumer savings, including energy savings, mortgage cost increases, and other associated costs in the first year of ownership, average \$242 for the 2012 IECC
- Energy costs, on average, are 24.6% lower for the 2012 IECC

Cost-Effectiveness

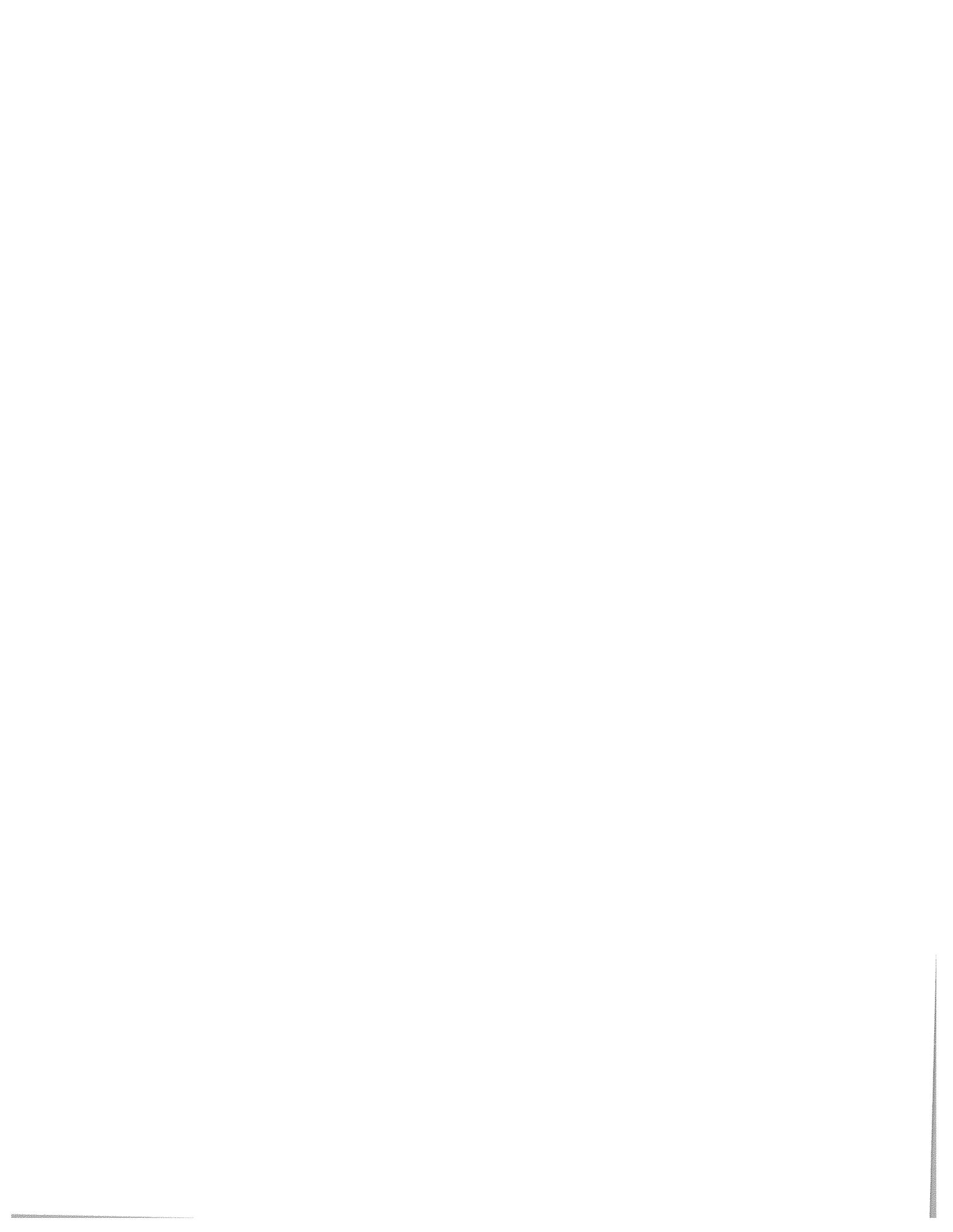
The U.S. Department of Energy (DOE) evaluates the energy codes based on three measures of cost-effectiveness:

- **Life-Cycle Cost:** Full accounting over a 30-year period of the cost savings, considering energy savings, the initial investment financed through increased mortgage costs, tax impacts, and residual values of energy efficiency measures
- **Cash Flow:** Net annual cost outlay (i.e., difference between annual energy cost savings and increased annual costs for mortgage payments, etc.)
- **Simple Payback:** Number of years required for energy cost savings to exceed the incremental first costs of a new code

Life-cycle cost is the primary measure by which DOE assesses the cost-effectiveness of the IECC. These savings assume that initial costs are mortgaged, that homeowners take advantage of the mortgage interest deductions, and that long-lived efficiency measures retain a residual value after the 30-year analysis period. As shown in Table 1, life-cycle cost savings averaged across climate zones are \$5,151 for the 2012 IECC.

Table 1. Average Life-Cycle Cost Savings from Compliance with the 2012 IECC, Relative to the 2009 IECC

	Life-Cycle Cost Savings (\$)	Net Positive Cash Flow (Years)	Simple Payback (Years)
2012 IECC	\$5,151	1	4.5





MEEA
Midwest Energy Efficiency Alliance

20 N. Wacker Drive
Suite 1301
Chicago, Illinois 60606
312.587.8390 main line
312.587.8391 fax
www.mwalliance.org

Comparison Between Residential 2009 IECC and 2012 IECC: Climate Zones 4 and 5

Note: This document does not contain all provisions of each code;
Only the major portions of the code are listed below:

Indicates Change

Insulation and Fenestration Requirements by Component	2009 IECC		2012 IECC	
	CZ 4	CZ 5	CZ 4	CZ 5
Fenestration U-factor	0.35	0.35	0.35	0.32
Skylight U-factor	0.60	0.60	0.55	0.55
Glazed fenestration SHGC	NR	NR	0.40	NR
Ceiling R-value	R-38	R-38	R-49	R-49
Wood frame wall R-value	R-13	R-20 or R-13 + 5	R-20 or R-13 + 5	R-20 or R-13+5
Mass wall R-value	5/10	13/17	8/13	13/17
Floor R-value	R-19	R-30	R-19	R-30
Basement wall R-value	10/13	10/13	10/13	15/19
Slab R-value and depth	10, 2 ft	10, 2 ft	10, 2 ft	10, 2 ft
Crawl space wall R-value	10/13	10/13	10/13	15/19



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Comparison Between Residential 2009 IECC and 2012 IECC: Climate Zone 4

Note: This document does not contain all provisions of each code;
Only the major portions of the code are listed below:

Insulation and Fenestration Requirements by Component	2009 IECC	2012 IECC
Fenestration U-factor	0.35	0.32
Skylight U-factor	0.60	0.55
Glazed fenestration SHGC	NR	0.40
Ceiling R-value	R-38	R-49
Wood frame wall R-value	R-13	R-20 or R-13+5
Mass wall R-value	5/10	8/13
Floor R-value	R-19	R-19
Basement wall R-value	10/13	10/13
Slab R-value and depth	10, 2 ft	10, 2 ft
Crawl space wall R-value	10/13	10/13



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Comparison Between Residential 2009 IECC and 2012 IECC: Climate Zone 5

Note: This document does not contain all provisions of each code;
Only the major portions of the code are listed below:

Insulation and Fenestration Requirements by Component	2009 IECC	2012 IECC
Fenestration U-factor	0.35	0.32
Skylight U-factor	0.60	0.55
Glazed fenestration SHGC	NR	NR
Ceiling R-value	R-38	R-49
Wood frame wall R-value	R-20 or R-13 + 5	R-20 or 13 + 5
Mass wall R-value	13/17	13/17
Floor R-value	R-30	R-30
Basement wall R-value	10/13	15/19
Slab R-value and depth	10, 2 ft	10, 2 ft
Crawl space wall R-value	10/13	15/19

	2009 IECC	2012 IECC
Eave Baffle	<u>NO REQUIREMENT</u>	For air permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater size than the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. (R402.2.3)
Access Hatch	Access hatches (from conditioned to unconditioned spaces, like attics and crawl spaces) shall be weatherstripped and insulated to level equivalent to insulation on surrounding surfaces (R402.2.3)	SAME (402.2.4)
Conditioned Basement walls	Must be insulated from top of basement wall down to 10 ft below grade or to basement floor, whichever is less. Unconditioned basement walls must meet same requirement, unless floor overhead is insulated (402.2.7)	SAME (402.2.8)
Crawl Space walls	Crawl space walls may be insulated when the space is not vented to the outside, as an alternative to insulating floors above crawl spaces. (402.2.9)	SAME, except requires "Class I vapor retarder in accordance with the IBC or IRC, as applicable." (R402.2.10)
Glazed Fenestration Exemption	Up to 15 square feet of total glazing area shall be permitted to be exempt from U-factor and SHGC requirements (402.3.3)	SAME (402.3.3)
Opaque Door Exemption	One side-hinged opaque door assembly up to 24 square feet exempted from U-factor requirement. (402.3.4)	SAME (R402.3.4)
Thermally Isolated sunroom U-factor	Maximum fenestration U-factor shall be 0.50 and maximum skylight U-factor shall be 0.75. (402.3.5)	Maximum fenestration U-factor shall be 0.45 and maximum skylight U-factor shall be 0.70. (R402.3.5)
Replacement Fenestration	Where some or all of an existing fenestration unit is replaced, including sash and glazing, the replacement fenestration unit shall meet the applicable U-factor and SHGC requirements. (402.3.6)	SAME (402.3.6)
Building Thermal Envelope Sealing	List of measures that must be caulked, gasketed, weatherstripped, or otherwise sealed at (402.4.1)	Components of building thermal envelope (listed in Table 402.4.1.1) shall be installed in accordance with the manufacturer's instructions. Where required by the code official, an approved third party shall inspect all components and verify compliance. (R402.4.1.1)

	2009 IECC	2012 IECC
Thermal envelope testing	Must either perform visual inspection (402.4.2.2) OR a blower door test to confirm air leakage of less than 7 ACH50 (402.4.2.1)	Must follow Table R402.4.1.1 and ALSO use blower door test to confirm air leakage of 3 ACH50 or less. Where required by the code official, testing shall be conducted by approved third party. (R402.4.1.2)
Fireplaces	New wood-burning fireplaces shall have gasketed doors and outdoor combustion air. (402.4.3)	New wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air. (R402.4.2)
Maximum fenestration U-factor and SHGC	Area-weighted average maximum fenestration U-factor permitted using tradeoffs from section 402.1.4 or 404 shall be 0.40 for vertical fenestration, and 0.75 for skylights. (402.6)	Area-weighted average maximum fenestration U-factor permitted using tradeoffs from section R402.1.4 or R405 shall be 0.48 in CZ 4 and 5 for vertical fenestration, and 0.75 in CZ 4 - 8 for skylights. (R402.5)
Duct Insulation	Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6. <u>Exception:</u> Ducts or portions thereof located completely inside the building thermal envelope (403.2.1)	Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6. <u>Exception:</u> Ducts or portions thereof located completely inside the building thermal envelope (403.2.1)
Duct Sealing	Specific requirements for duct sealing at (403.2.2)	Ducts, air handlers, and filter boxes shall be sealed. Joints and seams shall comply with either IMC or IRC; Duct tightness test required to meet 4 CFM per 100 sq.ft. if not located entirely within building envelope. (R403.2.2)
Building Cavities	Building framing cavities shall not be used as supply ducts. (403.2.3)	Building framing cavities shall not be used as ducts or plenums. (R403.2.3)
Mechanical system piping insulation	Mechanical system piping shall be insulated to minimum of R-2. (403.3)	Mechanical system piping shall be insulated to minimum of R-3. (R403.3)
Protection of piping insulation	<u>NO REQUIREMENT</u>	Piping insulation exposed to weather shall be protected from damage; Adhesive tape not permitted. (R403.3.1)
Circulating hot water systems	Piping insulated to at least R-2. (403.4)	No insulation requirement (R403.4.1)
Hot water pipe insulation	<u>NO REQUIREMENT</u>	Insulated to R-3, with exceptions (R403.4.2)

	2009 IECC	2012 IECC
Mechanical Ventilation	No whole-house continuous ventilation requirement	Requirement for mechanical ventilation that meets requirements of IRC or IMC. (R403.5)
Equipment sizing	Heating and cooling equipment shall be sized in accordance with ASHRAE Fundamentals. (403.6)	Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. (R403.6)
Systems serving multiple dwelling units	<u>NO REQUIREMENT</u>	Systems serving multiple dwelling units shall comply with Sections C403 and C404 of the IECC- Commercial provisions in lieu of Section R403. (R403.7)
Lighting Equipment	Minimum 50 percent high-efficacy lamps (404.1)	Minimum 75 percent high-efficacy lamps (R404.1)
Snow melt system controls	<u>NO REQUIREMENT</u>	Requirement at (R403.8)
Pools and in-ground spas	<u>NO REQUIREMENT</u>	Requirement at (R403.9.1-3)

Exhibit C

January 12, 2016 Stakeholder Meeting Ohio Building Code Rules – Commercial Energy Codes

Attendees:

Bill Kaufholz, Fischer Homes
Jason Finch, Fischer Homes
Eric Lacey, RECA
Jeff Mang, PIMA
John Stahl, Preferred Solutions, Inc
Janis Stahl, Preferred Solutions, Inc
Bert Thomson, Mid Ohio Development
Don Phillips, COCOA
Marty Burns, Therm-All
Vince Squillace, OHBA
Ric Johnson, OHBA
Alec Carnes, Heapy Engineering

Staff Present:

Regina Hanshaw
Steve Regoli
Debbie Ohler

Comments Submitted:

Alec Carnes, Heapy, requested that instead of deleting Section 8.4.2 from ASHRAE 90.1 for Automatic Receptacle Controls, that the Board delete the requirement based on occupancy.

Bill Kaufholz, Fischer Homes, asked the Board to consider referring to the RCO for energy code requirements for R-2, R-3 and R-4 so that the energy requirements and associated costs would not be different between these occupancies and 1-, 2- 3- family homes. Mr. Kaufholz explained that in Kentucky the state had adopted the 12 IECC in 2014, but then rescinded the action due to the cost impact. He stated that the same demographic are shopping for multi-family that are shopping for 1- 2- & 3- family and the increase in cost for compliance with 12 IECC vs the RCO would put the multi-family builders at a disadvantage. Mr. Kaufholz submitted proposed language and cost data in writing to the Board and is incorporated as Attachment A.

Jeff Mang, PIMA, requested that the Board incorporate language from the 13 ASHRAE 90.1 and 15 IECC for roof recovery and replacement. He stated that the new editions have improved language that provides clarification. Mr. Mang submitted proposed language in writing to the Board and is incorporated as Attachment B.

Eric Lacey, RECA, stated that he supports Mr. Mang's request and at the code hearings the changes for roofs that were approved in the 13 ASHRAE 90.1 and 15 IECC received both industry and code official support.

Bert Thompson, Mid Ohio Development, requested amendment to the 12 IECC to allow for sampling to comply with blower door testing requirements for multi-family homes when multiple identical units are constructed. Staff responded that currently similar language is included the RCO for 1- 2- 3- family homes under the Ohio Home Builders alternative compliance path.

General Comments

Eric Lacey, RECA, stated support for the adoption of the proposed energy codes but asked the Board to also consider adoption of the newer editions – 15 IECC and 13 ASHRAE 90.1. Mr. Lacey stated that not only does adoption of newer energy codes improve energy efficiency standards but also supports the economy by creating jobs for highly skilled labor.

John Stahl, Preferred Solutions Inc, asked about any federal obligations the state has when considering changes to the standards. Staff responded that the Board did consider the changes included in the package would not affect the overall energy efficiency achieved.

Eric Lacey, RECA, explained federal requirements for states to consider and adopt either commercial or residential energy codes after DOE makes a determination that a newly issued model energy code achieves greater energy efficiency.

Vince Squillace, OHBA, commented on Ohio's unique rule adoption process and thanked the Board for conducting meeting and considering comments.



2013 KENTUCKY BUILDING CODE (KBC)

SUGGESTED CODE CHANGE NO. KBC

(815 KAR 7:120)

PROPOSED CHANGE:

Amend Chapters 13 Section 1301.1.1 of the 2013 Kentucky Building Code (KBC) to read as follows:

1301.1.1 Criteria. Buildings shall be designed and constructed in accordance with the *International Energy Conservation Code*.

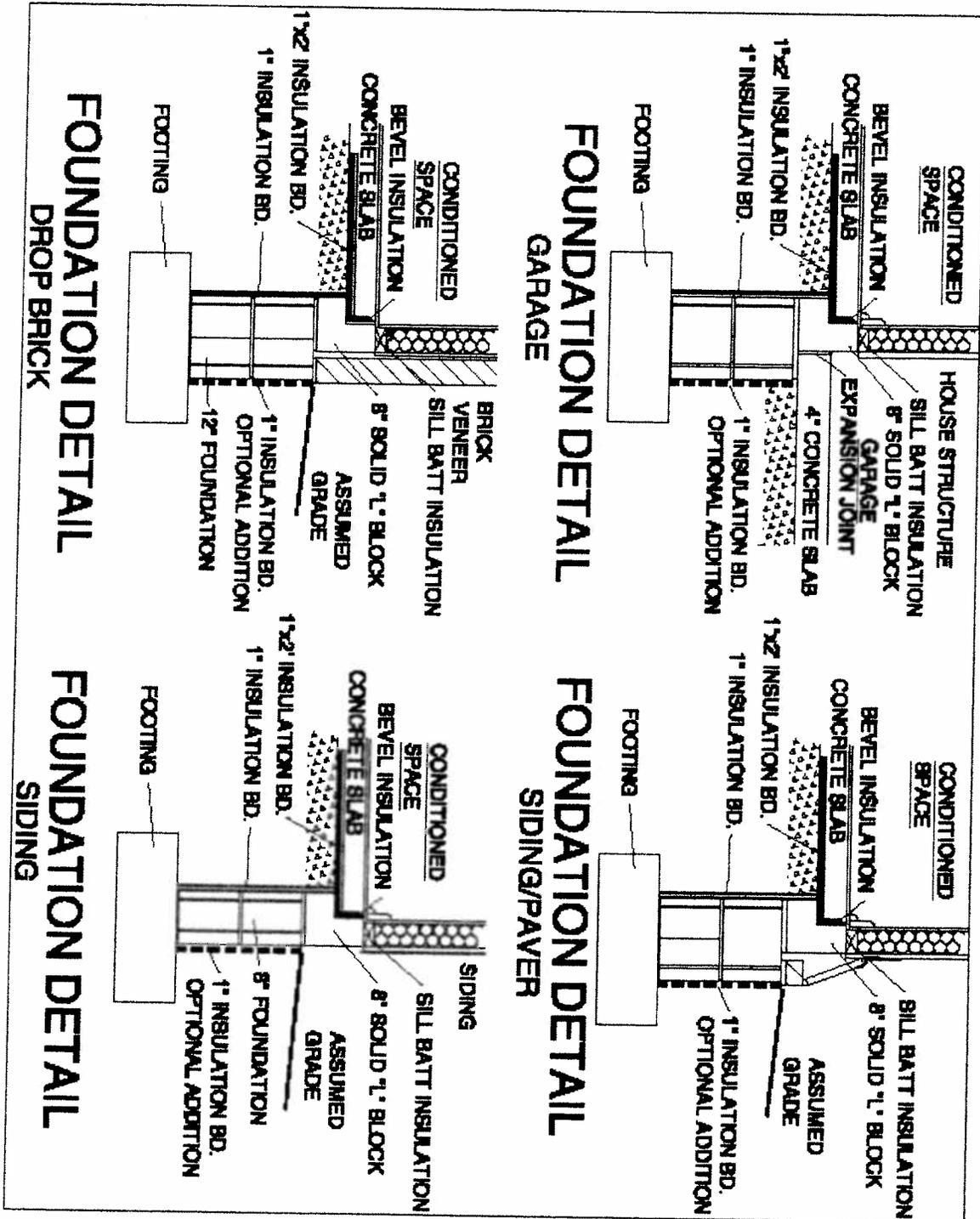
Exception: Group R-2, R-3 and R-4 buildings three stories or less in height above grade shall be designed and constructed to comply with chapter 4 of the 2009 *International Energy Conservation Code*.

1301.2 Basement walls and slab-on grade floor for Group R-2, R-3 and R-4 regulated by the 2009 International Energy Conservation Code shall comply with section 1301.2.1 and 1301.2.2.

1301.2.1 Basement walls. Walls associated with basements and that make up the building thermal envelope shall be insulated from the inside or outside of the *basement* wall from the top of the basement wall down below grade to the design frost depth in accordance with Table 1809.5. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections 402.1.1 and 402.2.6 of the 2009 *International Energy Conservation Code*.

1301.2.2 Slab on grade floors. Slab on grade floors constructed in accordance with Figure 1301.2.2 shall be permitted as an alternative insulation method.

Figure 1301.2.2 Alternative insulation method for slab on grade floors



Chapter 35 add the reference to the 2009 IECC edition for low rise residential facilities

ICC

International Code Council, Inc.
 500 New Jersey Ave, NW
 6th Floor
 Washington, DC 20001

CHANGE REQUESTED BY:

NECESSITY/FUNCTION OF CHANGE: To put all Group R-2, R-3 and R-4 buildings three stories or less in height on the same playing field. Currently, the residential groups identified are not treated equal in the application of the energy code. The KRC allows residential construction to comply with the 2009 IECC while the KBC requires residential construction to comply with the 2012 IECC. With the exception of Group R-1 (Hotel/Motel) this code change will bring consistent design and code enforcement of the energy code to all other residential construction. Group R-1 is excluded because the IECC defines "Residential Building" as a Group R-2, R-3 and R-4 buildings three stories or less in height above grade. Therefore, the code is not intended to apply Chapter 4 of the IECC to Group R-1.

Section 1301.2 is language in the KRC applicable to residential construction. This language needs to be added to the KBC to fully treat all R-2, R-3 and R-4 projects equally under the KBC and KRC.

ECONOMIC IMPACT/ COST ANALYSIS: Will reduce construction costs by eliminating some of the more costly methods of construction associated with testing building envelope tightness such as.

1. Under the 2013 KBC with the referenced 2012 IECC, building envelope tightness for residential construction is 3 air changes per hour. Building envelope tightness for residential construction under the 2013 KRC with the referenced 2009 IECC is 7 air changes per hour.
2. The 2009 IECC provides two options to verify building envelope tightness and insulation installation. Those two options are the blower door test (402.4.2.1) and visual inspection (402.4.2.2). The 2012 IECC eliminated the visual inspection option thereby requiring blower door testing on all residential construction to verify compliance.
3. Duct tightness is to be verified by one of two tests, post construction test and rough-in test. The test criteria for both tests is more restrictive in the 2012 IECC. The air leakage requirement went from 8 cfm or less per 100 ft² in the 2009 IECC to 4 cfm or less per 100 ft² in the 2012 IECC in post construction test and from 6 cfm or less in the 2009 IECC to 4 cfm or less in the 2012 IECC for the rough-in test. If the air handler is not installed at the time of the rough-in test, total leakage shall be less than or equal to 3 cfm (85 L/min) per 100 square feet in the 2012 IECC opposed to 4 cfm in the 2009 IECC

BENEFITS EXPECTED FROM CHANGE: Reduced construction costs. Reduced cost to future home buyers.

REGULATION TO BE IMPLEMENTED BY: Kentucky Code Officials responsible for regulation of residential occupancies under the KBC

DEPARTMENT RECOMMENDATION: _____

REVIEWED BY BOARD OF HOUSING: _____

ACTION: _____

REGULATION SUBMITTED TO LRC: _____

EFFECTIVE DATE: _____

2012 IECC - 14 Home Gallery

Code Section #	Location	Code Change Description	Qty.	Unit	Unit Cost	Estimate Cost	Cost per Home	Notes
R402.1.1	Ceiling	(Zone 4) Change from R38 to R44	7,802	SF	\$0.12	\$936.24	\$66.87	to meet prescriptive
R402.1.1	Ceiling	Change from R38 to R49	7,802	SF	\$0.15	\$1,170.30	\$83.59	to meet prescriptive
R402.1.1	Frame Walls	(Zones 4&5) Change Insulation from R-13to R-20 (requiring 2x6 walls)	9,447	SF	\$0.15	\$1,417.05	\$101.22	to meet prescriptive
R402.1.1	Frame Walls	Exterior walls to 2x6 vs. 2x4 to accomidate R-20 Insulation	1,387	LNFT	\$2.98	\$4,133.26	\$295.23	to meet prescriptive
	Frame Walls	R-15 insulation on unfinished wall	269	LNFT	\$0.33	\$88.77	\$6.34	to meet prescriptive
	Subfloor	R-20 in subfloor handboards	958	LNFT	\$0.15	\$143.70	\$10.26	to meet prescriptive
R402.1.1	Subfloor	(Zone 5) - R-30 in subfloor handboard to meet RESCHECK	958	SF	\$0.33	\$316.14	\$22.58	Butler / Warren Co
rescheck	Exterior walls	(Zone 5) R-15 exterior walls to meet RESCHECK	9,447	SF	\$0.16	\$1,511.52	\$107.97	Butler / Warren Co
rescheck	Ceiling	(Zone 5) Change from R-38 to R-60 to meet RESCHECK	7,802	SF	\$0.30	\$2,340.60	\$167.19	Butler / Warren Co
R403.2	Ductwork	300 Level - Duct Tightness (Duct Blaster) test	6	EA	up to date	up to date	\$0.00	
R402.4.4	Recess Lighting	All recess lights 1C rated, air leakage <= 2.0 cfm	N/A	N/A	up to date	up to date	\$0.00	
R402.4.1.2	Whole home	(Zones 3-8) Blower door test 3 air changes per hour	14	EA	\$185.72	\$2,600.08	\$185.72	have to do 7 homes at a time at a h
R403.2.2.1	Air Handlers / Ductwork	Postconstruction air leakage to be less than 4cfm per 100 sf of floor	n/a	EA	up to date	up to date	\$0.00	
R403.2.3	Building Cavities	Ducted Returns	14	EA				Galleries have to be redesigned airhandler can't be ducted and d ASHRAE req. for air leak
R403.4.2	Hot water pipe	R-3 insulation on hot water lines	14	EA	\$50.00	\$700.00	\$50.00	
R403.5	Whole house	Whole house ventilation system	14	EA	\$200.00	\$2,800.00	\$200.00	
R404.1	Lighting	75% of lamps require to be high efficiency	N/A	N/A	up to date	up to date	\$0.00	
R402.4.1.2	Frame Walls	Seal top and bottom plates to prevent air leakage for Blower Door Test	14	EA	\$150.00	\$2,100.00	\$150.00	
R403.4.1	Building	Loop System	1	EA	\$750.00	\$750.00	\$53.57	

2012 IECC Zone 4 =	\$9,886.32	\$706.17	
2012 IECC Zone 5 =	\$15,903.16	\$1,135.94	prescriptive
2012 IECC Zone 5 =	\$13,118.34	\$937.02	Rescheck
Product Redesign =			SoftCost for Architecture / E

January 11, 2016

Regina S. Hanshaw
Executive Secretary
Ohio Board of Building Standards
6606 Tussing Road
Reynoldsburg, Ohio 43068



Re: 2011 Ohio Building Code Proposed Changes—Commercial Energy Code

Dear Ms. Hanshaw,

The Polyisocyanurate Insulation Manufacturers Association (PIMA) supports Ohio's efforts to update its energy code for commercial buildings. Significant progress has occurred in the evolution of the model building energy codes and standards since Ohio last updated its building code in 2011 to the 2009 IECC and ASHRAE Standard 90.1-2007. Updating Ohio's commercial building energy code to the 2012 IECC and ASHRAE Standard 90.1-2010 is certainly a positive step and would result in significant energy savings; approximately 18.5%.¹

However, by not adopting the most current code and standard (*i.e.*, the 2015 IECC and Standard 90.1-2013), Ohio would be forgoing additional energy savings that would further benefit the State's economy, energy reliability, and air quality. According to the U.S. Department of Energy (DOE), adoption of the 2015 IECC for commercial buildings would result in additional savings of approximately 11.5% compared to the 2012 IECC.² DOE also reports that these additional savings can be obtained by Ohio at a very reasonable cost. The average simple pay back that would result from adopting the 2015 IECC/Standard 90.1-2013 as compared to the 2012 IECC/Standard 90.1-2010 would range from 0 to 7 years depending on the specific Ohio climate zone.³ For many of the dominant commercial building categories in Ohio (*e.g.*, large office and stand-alone retail) there would be a negative incremental construction cost associated with the updated code!

In addition to these energy savings, the newer versions of the IECC and Standard 90.1 incorporate many administrative and clarifying improvements that make them easier to understand and use. For example, when the covering on an older low-slope roof (with

¹ Department of Energy, [Building Energy Standards Program: Final Determination Regarding Energy Efficiency Improvements in the Energy Standard for Buildings, Except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1-2010](#); October 19, 2011; 76 FR 64904.

² Department of Energy, [Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings](#), August 2015, page 4.1.

³ Department of Energy, [Cost-Effectiveness of ASHRAE Standard 90.1-2013 for the State of Ohio, December 2015](#), page 5.

insulation above the deck) is removed on a commercial building and replaced with a new membrane, the insulation underneath that membrane should be brought up to current standards, or even replaced if it is wet or otherwise damaged (see 2015 IECC sections C501.1, C503.1 exception 5, C503.3.1 and 2015 IBC section 1511.3.1.1). Important clarifying language on this issue was added to the 2015 IECC and Standard 90.1-2013 that improved the usability of building energy codes as they apply to roof alterations.⁴

Adoption of specific provisions from the 2015 IECC and ASHRAE Standard 90.1-2013

If the Board decides to adopt the 2012 IECC and Standard 90.1-2010 instead of the 2015 IECC and Standard 90.1-2013, I would urge you to incorporate the improvements related to commercial building re-roofing that were adopted during the last ICC and ASHRAE code adoption cycles. These changes do not affect the stringency of the code, but instead clarify the original intent of the code with unambiguous language making it easier to understand and more effective. Also, these changes would only apply to commercial buildings with low-slope roofs where the insulation is located above the roof deck.

Under both the 2012 IECC and Standard 90.1-2010, the language related to compliance requirements for “re-roofing” projects is set forth as an exception to the provisions related to building alterations and renovations. The confusing language and inappropriate terminology used has led to widespread non-compliance and difficulty in enforcing the intent of the provisions.

Re-roofing is one of the more important opportunities for improving the energy efficiency of existing commercial buildings. A report prepared in 2009 by Bayer MaterialScience (now Covestro), found that improving the roof insulation in an existing building from a level of R-12.4 (*i.e.*, the average R-value of roofs on older buildings⁵) to R-30 when the roof membrane is replaced, achieves an average reduction in building energy use of 6.5%.⁶ The modeling and analysis for this report was very thorough: using DOE’s EnergyPlus software and cost inputs are from RS Means construction cost data.

Please refer the attached documents in considering this proposal: (1) proposed amendment to the 2012 IECC related to re-roofing along with the “reason statements” that were provided at the time this language was adopted by the ICC; and (2) the final language of Addendum dd to the 90.1-2010 standard related to this issue.

⁴ The new language clarified roof insulation requirements, differentiating between roof recovering (on top of existing roof coverings) and replacement of roof coverings.

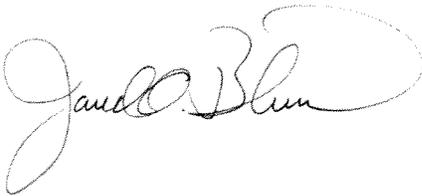
⁵ Joe Huang and Ellen Franconi, Commercial Heating and Cooling Loads Component Analysis. LBL-37208. Berkeley, CA: Lawrence Berkeley National Laboratory, November 1999. Huang reported that for post-1980 buildings the low-slope roof R-values ranged from R-10.1 to R-14.

⁶ Jerry Phelan, George Pavlovich, and Eric Ma, Energy and Environmental Impact Reduction Opportunities for Existing Buildings with Low-Slope Roofs. Bayer MaterialScience, April 2009

**Information about the Polyisocyanurate Insulation Manufacturers Association
(PIMA)**

PIMA is the trade association for manufacturers of rigid polyiso foam insulation, a product that is used in most low-slope commercial roofs as well as in commercial and residential walls. PIMA members have a nationwide presence with manufacturing facilities located across the United States, including: 30 polyiso plants, several chemical plants and research centers responsible for the supply of raw materials used in the manufacture of polyiso, and numerous plants that produce roof membranes, metal flashings and other products essential to building construction.

Sincerely,

A handwritten signature in black ink that reads "Jared O. Blum". The signature is written in a cursive style with a large, looping flourish at the end.

Jared O. Blum
President

Attachment #1

PROPOSED AMENDMENT TO THE 2012 IECC RELATED TO COMMERCIAL BUILDING RE-ROOFING

Revise as follows:

C101.4.3 Additions, alterations, renovations or repairs. Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations or repairs shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building.

Exception: The following need not comply provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Glass only replacements in an existing sash and frame.
3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. ~~Reroofing for roofs where neither the sheathing nor the insulation is exposed.~~ Roof recover or roof repair.
6. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
67. Replacement of existing doors that separate conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a conditioned space from the exterior shall not be removed.
78. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.
89. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the alteration does not increase the installed interior lighting power.

Add new text as follows:

C402.2.1.1 Roof replacement. For roof replacements, where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above deck, roof replacement shall include compliance with the requirements of Table C402.1.2 or Table C402.2.

Add new definitions as follows:

SECTION C202 GENERAL DEFINITIONS

[B] REROOFING. The process of recovering or replacing an existing roof covering. See "Roof recover" and "Roof replacement."

[B] ROOF RECOVER. The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

[B] ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

[B] ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

For background purposes, the people and organizations that sponsored this amendment during the ICC Code Development Proceedings for the 2015 IECC and their reason statements are listed below.

Michael D. Fischer, Kellen Company, representing Center for the Polyurethanes Industry; Michael D. Fischer, Kellen Company, representing Polyisocyanurate Insulation Manufacturers Association; Brian Dean, ICF International, representing Energy Efficient Codes Coalition; Garrett Stone, Brickfield Burchette Ritts & Stone, PC; Jeff Harris, Alliance to Save Energy; Harry Misuriello, American Council for an Energy-Efficient Economy; and Bill Prindle, Energy Efficient Codes Coalition.

Reason Statements

Fischer (Part I): The current requirements that govern envelope performance requirements during reroofing do not utilize definitions contained in the building codes. The use of the term reroofing in and of itself is overly broad and subject to confusion. Roof replacement, which is the specific condition intended for envelope compliance, provides an important opportunity to decrease building energy use in US buildings. This proposal provides needed clarity to ensure that buildings are evaluated for compliance to current energy code requirements when the roof is replaced. The proposal also improves the exception to ensure that roof repair and recover projects are clearly not intended to bear additional expense that could be burdensome.

Fischer (Part II): The exceptions to applicability of the IECC for reroofing are unclear, and include confusing language. This proposal includes definitions used in the roofing chapter of the IBC in order to better scope the appropriate exceptions to the envelope requirements in the IECC.

The proposed language clarifies that roof replacement triggers the envelope requirements, but only when the roof assembly is part of the thermal envelope and the insulation is entirely above the roof deck. If the insulation is located within an attic cavity, roof replacement itself does not trigger insulation upgrades. The proposal also makes it clear that recover and repairs are not intended to trigger energy upgrades, while ensuring that the opportunity to add roof insulation when the roof is replaced is not missed.

Dean, Harris, Misuriello, Prindle, Stone: The purpose of this code change is to clarify code requirements related to roofs on existing buildings by distinguishing between roof repairs, roof recovering, and roof replacement. The proposal creates new definitions for each of these actions (Chapter 2), clarifies that repair and recover are exceptions to the code (section C101.4.3), and clarifies that when certain roof replacements occur (new section C402.2.1.1), that the roof must meet the roof insulation requirements in Table C402.1.2 or C402.2.

While the code generally requires additions, alterations, renovations or repairs to comply with the code, the specific application in many instances may not be entirely clear or consistently interpreted and enforced. Roof replacements are a good example of this issue. This code proposal is intended to resolve any interpretation issues related to roof replacement and ensure that proper insulation is installed when the opportunity is presented. It is important that opportunities to improve the efficiency of existing buildings are seized when presented and the replacement of roofs is one such important opportunity.

Cost Impact: The code change proposal will not increase the cost of construction.

Note: The four proposed definitions are terms defined in the IBC, the term 'roof replacement' is also found in the IgCC. The definitions found in the other codes are the same as proposed here.

Attachment #2

ASHRAE STANDARD 90.1-2010 ADDENDUM dd RELATED TO COMMERCIAL RE-ROOFING

ADDENDA

2013 Supplement

ANSI/ASHRAE/IES Addenda e, f, i, l, m, n, q, r, u, w, aa, ad, ae, af, ag, ah, ai, aj, al, am, an, ap, aq, ar, as, at, au, av, aw, ax, ay, az, ba, bb, bc, bd, be, bf, bg, bh, bi, bj, bk, bl, bn, bo, bp, bq, br, bs, bt, bv, bw, bx, by, ca, cb, cc, cd, ce, cf, ch, cj, ck, cl, cm, cn, co, cp, cr, ct, cv, cy, cz, da, db, dc, dd, de, dg, di, dj, dk, dl, dm, dn, do, dp, dq, dr, dt, dv, and dw
to ANSI/ASHRAE/IES Standard 90.1-2010

Energy Standard for Buildings Except Low-Rise Residential Buildings

See Appendix for approval dates.

These addenda were approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards.

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(This foreword is not part of this addendum. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This revision clarifies the exception to reroofing and roof recovering.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum dd to Standard 90.1-2010

Add the following definitions to Section 3.2 (I-P and SI units).

roof covering: the topmost component of the roof assembly intended for weather resistance, fire classification, or appearance.

roof recovering: the process of installing an additional roof covering over an existing roof covering without removing the existing roof covering.

Revise exceptions to Section 5.1.3 (I-P and SI units).

5.1.3 Envelope Alterations

[...]

- e. Roof recovering
- f. Removal and replacement of a roof covering membrane where either the roof sheathing or roof insulation is not exposed or, if there is existing roof insulation, integral to or below the roof deck.

f.g. [...]

g.h. [...]

Hanshaw, Regina

From: Daniel Lea <dlea@woh.rr.com>
Sent: Monday, January 11, 2016 4:01 PM
To: BBS, BBSOfficAsst3
Subject: January 12 Stakeholder Meeting

It appears travel to Columbus for the subject meeting on Tuesday may be affected by weather. In the event I am unable to attend the meeting I would like to suggest the following modification of a proposed change

1301.2 Modification to International Energy Conservation Code. *The following changes shall be made to the International Energy Conservation Code:*

1. Table 402.4.2-

a. *In the first row, second column, delete the last item titled "Air-permeable insulation is inside of an air barrier".*

b. *Delete the last row.*

*Section R402.4.1.2, the first sentence shall be modified to read as follows:
The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding 4 air changes per hour at 50 Pascals.*

While there are various ways of calculating an ACH rate the assumption here would be that it is to be determined by a blower door test. A pressure differential of 50 Pascals is the standard metric in blower door testing, but other pressure differentials can be used. When blower door tests are cited in technical reports and research papers it is customary to specify that the test was at 50 Pascals. It would seem appropriate to eliminate any possible misunderstanding by specifying the pressure differential in the code.

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